Measurement & Monitoring:
15th Quarterly Literature Update

3D Electrical Imaging of Contaminated Soil Near a Gas Station at Brugelette, Belgium
Kaufmann, Olivier and John Deceuster, Faculty of Engineering Mons, Belgium.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 330-341, 2004

A field experiment was conducted over a contaminated site located near a gas station where the fuel tanks had leaked. A dolomitic bedrock lies beneath 5 to 8 meters of clayey sands. Ten boreholes were drilled and four cone penetrometer tests were conducted, with less than conclusive results. To assess the contribution of geophysical investigations in delineating contaminated areas, a 3-D cross-diagonal resistivity survey was performed using roll-along technique, and a seismic refraction profile was conducted. The electrical data set was inverted with Res3DInv to build a resistivity-depth model of the ground. High resistivities suggest a bedrock geometry consistent with the drilling results, but a finer analysis reveals that the resistivities at the top of the bedrock tend to be significantly higher in areas where gas is detected than in uncontaminated areas. This increase in resistivities is interpreted as an effect of the presence of fresh hydrocarbons.

3D Electrical Imaging of Known Targets at a Controlled Environmental Test Site
Chambers, J.E., R.D. Ogilvy, O. Kuras, J.C. Cripps, and P.I. Meldrum.
Environmental Geology, Vol 41 No 6, p 690-704, Feb 2002

A 3D electrical tomography (ET) method has been used to investigate two known targets at an abandoned commerical site. Resistivity and chargeability data were collected using a network of linear survey lines. The influence of array type and orientation was evaluated, and 2D and 3D inversion results were compared. Superior geometric and electrical property resolution of 3D models was achieved using dipole-dipole as compared to Wenner array data. Subject to suitable survey design, 3D ET can provide spatial images that could significantly improve the detectability of buried man-made targets.

3D Mapping of Geology and Arsenic Using Integrated Geophysical and Geochemical Studies in Bangladesh
Versteeg, R. (INEEL, Idaho Falls, ID); L. van Geen and M. Steckler; Martin Stute; Y. Zheng; S. Goodbred; G. Heath; K.M. Ahmed.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 253-270, 2003

Twenty 2D resistivity lines and data on the arsenic content in 5000 wells were collected to determine the geological controls on the distribution of groundwater arsenic within a 25 square km area of Bangladesh. Coupling dense geophysical data with geochemical well data, and visualizing the results in 3D provided for a clear understanding of the relation between geology and arsenic distribution. The work showed that there were different types of geological controls on arsenic within the study area.

2002 Hyperspectral Analysis of Hazardous Waste Sites on the Savannah River Site
Jensen, J,R., B.C. Hadley, & J.A. Tullis (Univ. of South Carolina, Columbia); J. Gladden, E. Nelson, & S. Riley (Westinghouse Savannah River Company, Aiken, SC); T. Filippi (Texas A&M Univ., College Station); M. Pendergast (SMP Enterprises, Augusta, GA).
Report No: WSRC-TR-2003-00275, 57 pp, Aug 2003

At DOE's Savannah River Site, researchers are investigating hyperspectral remote sensing technology to determine if it can be used to measure accurately and monitor possible indicators of change on vegetated hazardous waste sites. Specifically, they are evaluating the usefulness of hyperspectral remote sensing to assess the condition of vegetation on clay caps on the Mixed Waste Management Facility. This report first describes the principles of hyperspectral remote sensing and then discusses the in situ measurement and hyperspectral remote sensing methods used to analyze hazardous waste areas on the Savannah River Site.
http://sti.srs.gov/fulltext/tr2003275/tr2003275.pdf

Accelerated Solvent Extraction (ASE) as a Sample Extraction Technique for Perchlorate in Solid Matrices
Richter, Bruce, Sheldon Henderson, Doug Later, and Rosanne Slingsby, Dionex, Salt Lake City, UT.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 30.

Accelerated solvent extraction (ASE) is an extraction technique that uses organic or aqueous-based solvent for fast and efficient extractions. The use of elevated temperatures and pressures allow extractions to be done quickly and with little solvent. ASE with chelating agents has been used for the extraction of metals from soils, and the method also has been used for ionic materials like chloride, sulfate, phosphate, bromate, and perchlorate. This presentation addresses the use of ASE as an extraction method prior to perchlorate determination using ion chromatography (IC) with suppressed conductivity or mass spectrometry for detection in soils and vegetation samples.

Adaptations of the Purge Water Management System for Long-Term Groundwater Monitoring at Savannah River Site, South Carolina
Schiefer, Eric, Westinghouse Savannah River Company, Aiken, SC.
World Water and Environmental Resources Congress 2004, American Society of Civil Engineers.
Paper No: ERD-EN-2004-0002, 24 pp, 2004

To support long-term ground-water monitoring requirements, the Savannah River Site has implemented the Purge Water Management System (PWMS). The key attribute of this system lies in its ability to reduce or eliminate the generation of purged ground water, which is costly in terms of the time and management. The PWMS was developed and implemented at SRS to create a system that is user-friendly and similar in operation to traditional sampling methods, yet it eliminates the need to collect, transport, and treat purged ground water. This closed-loop aqueous system extracts, temporarily stores, and returns ground water to a well without significantly altering water quality. Because the purge water is returned to the well, no hazardous waste is generated. The PWMS is used in conjunction with current traditional sampling methods.
http://sti.srs.gov/fulltext/erden200402/erden200402.pdf

Age Dating Groundwater Plumes Based on the Ratio of 1,1-Dichloroethylene to 1,1,1-Trichloroethane: An Uncertainty Analysis
Gauthier, Thomas D. and Brian L. Murphy, Exponent, Tampa, FL.
Environmental Forensics, Vol 4 No 3, p 205-213, Sep 2003

This article focuses on the uncertainties and biases involved in estimating the age of a 1,1,1-trichloroethane (TCA) release from 1,1-dichloroethene (DCE)/TCA ratios. The authors examined two methods: (1) the use of one-time ratio measurements together with a laboratory-derived hydrolysis rate constant and (2) the use of time-series data collected over several years. They determined that the principal source of uncertainty is due to uncertainty in concentration measurements. In interpreting field data, the age obtained should be recognized as an average based on when contact between water and TCA began, which may be different than the spill date for pure-phase spills of TCA. Under some circumstances, time estimates can be made when biodegradation of TCA, as well as hydrolysis, occurs.

Air Quality Monitoring Report: A Review of Responses to the NASA Request for Information on Trace Contaminant Monitoring
[Meeting of Air Quality Monitoring Review Panel and Vendors at] South Shore Harbour Resort and Conference Center, Houston, Texas, October 21-22, 2003. Sponsored by NASA through joint support from the International Space Station Program Office (Code M), Advanced Human Support Technology (Code U), and the JSC Toxicology Group.
NASA/TM-2004-213144, 54 pp, July 2004

In August 2003, NASA issued a Request for Information (RFI) for the International Space Station (ISS) On-Board Environmental Monitoring Systems. The purpose of the RFI was to identify next-generation environmental monitoring systems with demonstrated ability or potential to meet defined requirements for systems to evaluate air and water quality on board the ISS. This report summarizes the submission and analysis of proposed solutions designed to improve on the functionality of the existing volatile organic analyzer (VOA). The VOA is responsible for analysis of a wide range of volatile organic compounds that may be present in atmosphere. NASA is using the RFI process to investigate new technologies that may improve on existing capabilities. A wide variety of detectors and technologies was proposed in response to the RFI. While some analytical techniques had critical weaknesses that might limit their ability to provide a comprehensive solution, no specific technology was identified as clearly superior for ISS purposes. In fact, the two highest scoring systems used very different analytical technologies, with the European Space Research and Technology Center Fourier trans form infrared technology and the gas chromatography/ion mobility spectrometry system proposed by Smiths Detection offering specific advantages and disadvantages. This observation is positive in that it does not appear that a "single path" exists that might limit technologies that can be used in designing the next generation of ISS air monitoring. Given uncertainties and limitations, it may be prudent for NASA to pursue at least two different technologies in the first phase of testing for any VOA replacement. This report contains the scoring and evaluations for the 10 submittals received in response to the air portion of the RFI.
http://ston.jsc.nasa.gov/collections/TRS/_techrep/TM-2004-213144.pdf

Airborne and Ground Geophysical Surveys for Locating and Mapping Underground Storage Tanks at Bellows Air Force Station, Hawaii: an Integrated Approach
Takata, Sandra A. and Jeffery B. Hackworth (IT Corporation, Knoxville, TN); Doug McConnell (Fugro Airborne Surveys Corp., Mississauga, ON, Canada).
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, CHP-1, 12 pp, 2001

Airborne and ground-based geophysical surveys of 3,000 acres of land and shallow offshore areas were conducted at Bellows Air Force Station (BAFS), Oahu, HI, to locate buried metal potentially representing underground storage tanks (USTs) and similar debris. Over 650 geophysical anomalies were identified in the airborne survey based on both electromagnetic and magnetic data. Most of the anomalies were attributed to surface cultural features or geology and were eliminated from further investigation. Visual field reconnaissance eliminated some of the remaining 73 anomalies located on the ground, but 18 anomalies were selected for detailed ground surveys conducted using frequency- and time-domain EM, magnetics, and ground-penetrating radar. Select anomalies identified in the ground geophysical data were trenched and the sources excavated.

Amplitude Variation with Offset (AVO) Analysis of Ground Penetrating Radar Data for Direct Detection and Delineation of NAPL Contamination
Jordan, T.E. and G.S. Baker, Univ. at Buffalo, Buffalo, NY.
Eos, Transactions of the American Geophysical Union, Vol 84 No 46, Fall Meeting Suppl., Abstract H21A-07, 2003

Amplitude variation with offset analysis of ground penetrating radar data (AVO/GPR) can improve the differentiation of nonaqueous phase liquid (NAPL) from stratigraphic changes. Common offset GPR methods can detect the presence of NAPL in soil by examining amplitude and travel time (velocity) anomalies; however, stratigraphic changes such as the presence of a silt or clay lens or perched water table may produce similar amplitude and velocity anomalies, which makes it difficult to delineate NAPL in a terrain with unknown stratigraphy using common offset data collection methods exclusively. Modeling indicates that analyzing the difference in amplitude responses from linearly polarized electric field vertically oriented (EV) to the horizontally oriented (EH) signals at various incidence angles improves target discrimination. A case history illustrates that collecting common midpoint GPR data using EH and EV polarized signals at anomalous common offset amplitude responses and analyzing the data using AVO and normalized residual polarization methods may improve the detection and differentiation of NAPL from stratigraphic changes in the subsurface. The results were corroborated with a capacitively coupled resistivity instrument and subsequent intrusive sampling.

The Analysis of 1,4-Dioxane by GC/MS with Large Volume Injection
Grindstaff, J., J. Peterson, and R. Holden, Columbia Analytical Services, Inc., Kelso, WA.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon.
Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PM052, 2004

A method for the detection of 1,4-dioxane has been developed using a modified separatory funnel extraction technique designed to overcome both the water solubility and volatility issues associated with extraction of the chemical. The extracts are subsequently analyzed using a large volume injector in conjunction with gas chromatography and mass spectroscopy (GC/MS) running in the selected ion monitoring mode (SIM). Using the modified extraction procedure combined with large volume injection GC/MS SIM, method detection levels in the parts per trillion (ppt) quantification range can be readily achieved.

Analysis of Benzylsuccinates in Groundwater by Liquid Chromatography/Tandem Mass Spectrometry and Its Use for Monitoring In Situ BTEX Biodegradation
Beller, Harry R., Lawrence Livermore National Laboratory, Livermore, CA.
Environmental Science & Technology, Vol 36 No 12, p 2724-2728, 2002

Benzylsuccinic acid (BS) and methylbenzylsuccinic acid (MeBS) isomers have been proposed as distinctive indicators of anaerobic toluene and xylene metabolism in fuel-contaminated aquifers, but labor-intensive analytical procedures have limited their analysis at field sites. A rapid electrospray liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS) method for benzylsuccinates is available that involves selected reaction monitoring, internal standard quantification with BS, small sample size (<1 mL), and no extraction or concentration steps. Tests have shown the highly selective LC/MS/MS method to be sensitive (detection limits ca. 0.3 g/L), accurate, and precise. This paper describes an application of the method to characterize geographic and temporal distributions of BS and MeBS isomers in an anaerobic, hydrocarbon-contaminated aquifer. The method shows promise for rapid and reliable monitoring of in situ bioremediation of gasoline-contaminated groundwater.

Analysis of Perchlorate in Drinking Water, Groundwater, Saline Water, Soil, and Biota by LC/MS
Di Rienzo, Robert P. (DataChem Laboratories, Inc., Salt Lake City, UT); Kham Lin; Thomas T. McKay; Richard W. Wade.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 31.

A method has been developed and validated for the determination of perchlorate in drinking water, groundwater, saline water, soil, and biota using liquid chromatography/mass spectrometry (LC/MS) without sample pretreatment. This new method uses a newly developed commercially available peptides-impregnated reverse-phase liquid chromatography column (KP-RPPX series columns) developed by K'(Prime) Technologies, Inc. By using this column in an Agilent 1100 LC/MSD system, the technique separates perchlorate from known interferences in difficult matrices and can detect the chemical in matrices that are unacceptable for analysis by method 314.0. Mass spectrometry is used to monitor perchlorate at mass 83. An 83/85 isotopic ratio is used for additional identification of perchlorate, with statistical process control limits to assess the validity of the detection. An Internal Standard of Oxygen-18-labeled perchlorate is used to enhance the analysis. The method can achieve a method detection limit in aqueous samples of 0.05 ppb and can easily quantify perchlorate at 0.2 ppb in environmental sample matrices. Analysis is accomplished in less than 13 minutes and up to 20 samples can be processed in an eight-hour sequence with appropriate QC. The method eliminates matrix interference, high dissolved solids, and conductivity.

Analysis of the Geoelectrical Stratigraphy of a Controlled LNAPL Release
Mickle, R.J. and A.L. Endres, Univ. of Waterloo, Waterloo, ON, Canada.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, 85(17), Jt. Assem. Suppl., Abstract NS23A-01, 2004

A numerical model for the geoelectrical stratigraphy of an LNAPL impacted site was constructed and compared with geoelectrical data collected during a controlled LNAPL release in a large test cell (3 meters across, 1.7 meters deep) containing repacked Borden sand. Significant differences were noted between the predicted and actual electrical conductivity profiles for both the clean and contaminated cases. The predicted and actual dielectric permittivity profiles showed some differences for the clean case; better agreement was obtained for the contaminated case.

Analysis of the Physical Behavior of Viruses Using the Integrated Virus Detection System (IVDS)
Wick, Charles H., U.S. Army Edgewood Chemical and Biological Center, Aberdeen Proving Ground, MD.
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 2 pp, 2004

The Integrated Virus Detection System (IVDS), a new method that is essentially a virus particle counter, has been invented, patented, and demonstrated for a wide range of both enveloped and non-enveloped viruses. This paper describes and illustrates the invention with examples. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionM/MS-07.pdf

Analysis of Uncertainty in Estimating Dioxin Bioaccumulation Potential in Sediment-Exposed Benthos
Clarke, J.U.; V.A. Lutz; C.H. Jones; E.P. Jones; S.W. Pickard.
Report No: ERDC-TN-DOER-R5, NTIS: ADA427545, 18 pp, Sep 2004

This technical note demonstrates two methods for analyzing uncertainty in estimating theoretical bioaccumulation potential (TBP) in benthic organisms residing in or on sediments contaminated with polychlorinated dibenzo-p-dioxins/dibenzofurans (PCDD/F). An additional question addressed is whether congener-specific biota/sediment accumulation factors (BSAFs) in the TBP calculation provide a more certain estimate than simply using a generalized BSAF representing all congeners. TBP is a simple equilibrium partitioning-based model recommended for estimating levels of neutral organic chemicals that could result in the tissues of organisms exposed to sediments. The model is used in a screening mode to indicate whether the sediments in question are either so clean or so contaminated that a decision regarding disposal can be made at that point, or to indicate the necessity of definitive (and more costly) bioaccumulation testing. The model delivers a point estimate, expressed as a probable organism tissue concentration of a chemical of interest, given a known concentration of the chemical in sediment and the organic carbon content of the sediment. TBP incorporates a partition coefficient, BSAF, which is the ratio of lipid- normalized concentration of a chemical in an organism to organic carbon-normalized concentration of the chemical in sediment to which the organism is exposed. BSAFs for a given chemical can vary over orders of magnitude in different species and sediments.
http://handle.dtic.mil/100.2/ADA427545

Application of 1D Reactive Transport Modelling to Evaluate Remediation Measures at Abandoned Uranium Mines
Merkel, B.J., Technische Univ. Bergakademie Freiberg, Freiberg, Germany.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-IV, p 466-467, 2003

The author discusses the prospects of reactive transport modeling in risk assessment studies and rehabilitation measures, using in situ leaching at the Konigstein mine as an example. From 1984 to 1991 (when mining stopped there), sulfuric acid was applied as a leaching agent with subsequent significant impact on the groundwater. The multilayer aquifer consists of four interlayered double porosity aquifers and siltstones units. Distinct potential reactions were modeled with PHREEQC using its 1-D reactive transport tool.

Application of a Rapid Sediment Characterization Tool for Polychlorinated Biphenyls (PCBs) to Expedite Site Assessment Processes at a Navy Shipyard BRAC Site
Guerrero, J., J. Leather, M. Pound, and M. Offenhauer (U.S. Navy, San Diego, CA); P. White (Battelle, Columbus, OH); J. Baker (Tetra Tech EMI Inc., Pasadena, CA).
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. SETAC, Poster PW207, 2003

The Marine Environmental Quality Branch at the Space and Naval Warfare Systems Center, San Diego (SPAWARSYSCEN San Diego) has modified, developed, tested, and implemented a rapid sediment characterization tool for polychlorinated biphenyls (PCBs) in marine and freshwater sediments utilizing principles of enzyme-linked immunosorbent assay (ELISA). This rapid screening technique was employed at a Navy shipyard BRAC site in the San Francisco Bay area where PCBs were the major contaminant of interest. Due to the rapid, near real-time data the immunoassay method provided, co-exisiting risk assessment studies on both off-shore and on-shore sediment sites were expedited, and direct analytical costs were reduced. Direct comparison of screening data with lab data (immunoassay vs. GC-ECD) consistently demonstrated good correlations for total PCB concentrations. The screening survey data are presented and discussed.

Application of an Ion Chromatography Method for Perchlorate Determination in Difficult Matrices
Canas, J., K. Tian, and T. Anderson, Texas Tech Univ., Lubbock.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. Abstract 247, 2003

Due to matrix interferences, little progress has been made in the analysis of perchlorate in non-water samples, but recently an online preconcentration and pre-elution (PC/PE) ion chromatography method has been developed to remove matrix interferences in these difficult samples. Detection limits with this method are comparable to if not lower than those achieved using EPA Method 314.0. The PC/PE method has been applied to the analysis of perchlorate in fertilizers with detection limits ranging from 420 to 870 g/kg (ppb) and also can be applied to other sample matrices, such as plant tissues, urine, and citrus fruits and juices.

Application of Cross-Borehole Radar to Monitor Fieldscale Vegetable Oil Injection Experiments for Biostimulation
Lane, J.W. Jr. (U.S. Geological Survey, Storrs, CT); F.D. Day-Lewis; R.J. Versteeg; C.C. Casey; P.K. Joesten.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 429-448, 2004

Cross-borehole radar methods were used to monitor a field-scale biostimulation pilot project at the Anoka County Riverfront Park downgradient of the Naval Industrial Reserve Ordnance Plant in Fridley, MN. Emulsified vegetable oil is being injected to treat ground water contaminated with chlorinated hydrocarbons (TCE and DCE). Vegetable oil can serve as substrate to stimulate naturally occurring microbes, which ultimately break down chlorinated hydrocarbons into chloride, carbon dioxide, and water through oxidation-reduction reactions. Cross-borehole radar data were acquired by the U.S Geological Survey in five site visits over 1.5 years. This paper presents level-run (zero-offset profile) and time-lapse radar tomography data collected in multiple planes. Comparison of pre- and post-injection data sets provides valuable insights into the spatial and temporal distribution of both emulsified vegetable oil and also the extent of ground water chemistry alterations resulting from injections. Three injection mixtures with different radar signatures were used: (1) vegetable oil emulsion, (2) vegetable oil emulsion with a colloidal iron tracer, and (3) vegetable oil emulsion with a magnetite tracer. Despite the expected signatures of different tracers, increases in attenuation were observed downgradient of all three injections, so the researchers were able to infer that the attenuation changes did not result from the iron tracers. This application of radar methods demonstrates the utility of radar for monitoring biostimulation.

Application of Method 4025 to Bring Dioxin Sites Into EPA's Triad Approach to Site Assessment and Remediation
Harrison, Robert O., CAPE Technologies, South Portland ME.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 68.

The three components of EPA's Triad approach to site assessment and remediation are systematic planning, dynamic work strategies, and real-time measurement technologies, which include analytical methods. EPA Method 8290 (dioxin/furan analysis by high resolution gas chromatography-high resolution mass spectrometry) is not capable of the turnaround time and sample throughput rates demanded by Triad, but the addition in 2001 of Method 4025 (Dioxin Screening in Soil by Immunoassay) to the SW-846 Compendium makes it possible to implement the Triad approach for dioxin sites via on-site dioxin analysis in a mobile lab. Method 4025 provides the third leg of the Triad, but it has implementation issues, such as the need for analyst training, QA requirements, integration of screening methods into a project, and education of consumers of field-generated data, as well as issues unique to kit-based dioxin analysis, such as sample preparation and safety requirements, flexibility of cleanup protocols, effect of varying congener profiles on TEQ correlation, and test calibration for quantitative results. Lessons learned are presented to demonstrate right and wrong approaches to implementation.

The Application of X-Ray Fluorescence Technology for Field Screening of Metal Contamination in Soils
Jones, Glyn, Golder Associates.
Remediation Technologies Symposium 2003, 15-17 October 2003, Banff, Alberta.
Environmental Services Association of Alberta. Book of Abstracts, No 34, 2003

X-ray fluorescence (XRF) technology can be used to screen for metal contamination in soils in the field, minimizing the need for laboratory analysis of samples. The principle behind this process is simple: when an X-ray emission from a radioactive source strikes a sample, the x-ray can either be absorbed by the atoms or scattered through the material. The atoms will then give off a characteristic X-ray whose energy level is unique to the elements present. Specific methodology has been developed to ensure that the results of XRF field sampling are comparable to those from laboratory analysis. In general, more sample preparation (drying, milling, and sieving) will result in greater accuracy. Better measurements can be collected with drier, finer, and more homogeneous particles. U.S. EPA has developed method 6200, Field Screening using a Field-Portable XRF, and several approved instruments are available for in situ screening using this method. The author discusses and illustrates with examples the field analysis of samples using XRF.

Application of Remote Sensing and Airborne Geophysics to Mine Tailings Monitoring, Copper Cliff, Ontario
Morris, Bill (McMaster Univ., Hamilton, ON, Canada); Jiali Shang; Philip Howarth; Ken Witherly.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 12MMM1, 14 pp, 2002

Waste from nickel mining contains a mixture of fine silicates with a variable amount of sulfides and iron oxides. Oxidation of the sulfides results in the formation of environmentally hazardous acid-rich leachate, i.e., acid mine drainage (AMD). Identification of the distribution of regions of higher sulphide concentration and resulting leachate ponding can be derived from combining hyperspectral imagery and topographic data with airborne geophysical surveys. The hyperspectral imagery and topographic data identify near-surface variations and the airborne geophysical surveys identify shallow subsurface variations. Preliminary investigations over the Copper Cliff tailings site, Sudbury, ON, show that these parameters can be used to separate tailings with varying compositional and alteration levels, and water bodies of varying acidic levels. Increased vegetation coverage identified by hyperspectral data indicates ongoing oxidation of older tailings and soil development. This paper details the other findings of the investigation.

AquaSentinel: A Continuous Monitoring Biosensor System for Primary-Source Drinking Water Protection
Greenbaum, Elias and Miguel Rodriguez, Jr., Oak Ridge National Laboratory, Oak Ridge, TN.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 50.

AquaSentinel is a revolutionary biosensor system for primary-source drinking water protection that uses naturally-occurring microscopic algae as fluorometric biosensors. Optoelectronic instrumentation measures fluorescence induction curves, which indicate the physiological state of the algae. This technology has been successfully demonstrated for the detection of chemical warfare agents in primary-source drinking water. The blood agent potassium cyanide, the acetylcholine esterase inhibitor methyl parathion, and the herbicides Diuron and Paraquat were the model toxic agents selected for the demonstration. Experiments were performed with samples drawn from the Clinch River. The proof-of-principal of this technology has been demonstrated: chemical toxins that are known to harm humans also harm the free-living algae that are present in all surfaces waters, such as streams, rivers, lakes, reservoirs, and ponds. United Defense, LP, has acquired an exclusive commercial license from Oak Ridge National Laboratory for this technology in the United States.

Arsenic Biomonitoring Using a Hyperaccumulator Fern (Pteris vittata)
Minganti, Vincenzo, Laura Cornara, Massimo Piana, Antonio Corallo, and Mauro Giorgio Mariotti.
Journal of Environmental Monitoring, Vol 6 No 1, p 23-25, 2004

Pteris vittata L. (brake fern or ladder brake) is being studied to assess whether its ability to hyperaccumulate arsenic makes it suitable for monitoring purposes. P. vittata hyperaccumulation was evaluated by analyzing specimens grown in hydroponic media spiked with As(V). Arsenic concentrations ranging from 2 to 310 ug/g dry weight have been measured in samples collected at different sites. Arsenic concentrations in fern fronds correlate with the estimated arsenic emission in the area, verifying the applicability of the fern as an arsenic biomonitor.

Assessing in Situ Mineralization of Recalcitrant Organic Compounds in Vadose Zone Sediments Using DELTA13C and 14C measurements
Kirtland, Brian C. and C. Marjorie Aeliona (Univ. of South Carolina, Columbia); Peter A. Stone (SC Department of Health and Environmental Control, Columbia).
Journal of Contaminant Hydrology, Vol 76 Nos 1-2, p 1-18, Jan 2005

Predictions of biodegradation rates are needed for measuring the biodegradation of recalcitrant organic compounds in situ and thereby assessing intrinsic biodegradation, or natural attenuation. Traditional techniques measuring O2, CO2, or chemical concentrations (in situ respiration, metabolite and soil air monitoring) may not be sufficiently sensitive to estimate biodegradation rates for chlorinated hydrocarbons (CHC). Researchers combined isotopic measurements (14C and DELTA13C of CO2 and DELTA13C of CHCs) with traditional methods to assess in situ biodegradation of perchloroethene (PCE) and its metabolites in PCE-contaminated vadose zone sediments. This paper describes the conduct of the study over a period of 56 days. The researchers found 14C-CO2 analyses to be a sensitive measurement for quantifying in situ recalcitrant organic compound mineralization in vadose zone sediments.

Bioelectrochemical Process Development, Final Report
Ekechukwu, A.A. & C.E. Turick.
WSRC-RP-2004-00535, 13 pp, July 2004

Work performed under the independent research and development project, "Bioelectrochemical Process Development," involved Shewanella Oneidensis MR-1, a model dissimilitory metal-reducing bacterium (DMRB). The work successfully demonstrates the following: MR-1 transfers electrons by hydrogen oxidation to solid phase electrodes; MR-1 can act as an electron transfer agent when attached to a solid metal electrode surface (a modified electrode has been developed and tested); and MR-1 transfers electrons from solution to a solid electrode. DMRB grow by transferring electrons to insoluble metals. Bacterial oxidation of organic compounds or hydrogen results in electron flow from the bacterial cell for the purpose of cellular energy production. Extracellular electron transfer to solid

terminal electron acceptors permits coupling this oxidation process to electrodes. As a result, detection of organic compounds and hydrogen can be accomplished by bacterial contact to an electrode. The authors have designed a process that incorporates bacterial cells onto electrodes for hydrogen detection. This type of biosensor also responds to the presence of Fe(III), thereby providing potential utility as a Fe(III) sensor. Immediate uses of this technology include in situ detection and quantification of organic compounds and hydrogen in the subsurface that provide energy for growth of indigenous bacteria.
http://sti.srs.gov/fulltext/rp2004535/rp2004535.pdf

Bioluminescence Biosensor for the Detection of Organomercury Contamination
Endo, G., T. Yamagata, and M. Narita (Tohoku Gakuin Univ., Miyagi, Japan); C.-C. Huang (National Chung-Hsing Univ., Taiwan, ROC).
Acta Biotechnologica, Vol 23 No 2-3, p 123-129, Aug 2003

A bioluminescence biosensor for organomercurials was developed using a bacterial gene expression system for the mercury-resistance determinant. merB3-Luciferase (mer-lux) transcriptional fusion plasmids pHYDELTA3Lux and pHY.DELTA3Lux were constructed to evaluate the gene expression system with a new organomercury lyase gene merB3 from Bacillus megaterium strain MB1, which is resistant to a broad spectrum of mercury compounds. Transformants carrying a set of two plasmids, MB1 and pGR1A, were used as biological sensors for the detection of organomercurials. An Escherichia coli transformant is available to distinguish the organomercury from inorganic mercury; inorganic mercurials can induce the bioluminescence of both the bacterial strain lines, whereas organomercurials can only induce the bioluminescence of the lines with pHYB3Lux. The transformant with a merB3-defective fusion plasmid and the gene expression vector responded only to chloride; however, the transformant with an intact merB3 fusion plasmid and the gene expression vector responded to mercury chloride and all organomercurials tested in the study. The biosensor was able to detect bio-affecting inorganic mercury from several hundred nanomolar to several ten micromolar.

Bio-Molecule Embedded Conducting Polymer Nanowire Sensor
Ramanathan, Kumaran, Nosang V. Myung, Wildred Chen, and Ashok Mulchandani, Univ. of California, Riverside.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 583a, 2004

A novel electrochemical process has been developed to grow bio-molecule-embedded conducting-polymer nanowire across microfabricated electrodes. Unlike a nanosensor array based on carbon nanotube (CNT) and silicon nanowires, the new process provides a revolutionary route to create a truly high-density and individually addressable nanosensor array. The technique enables fabrication of nanowire sensors with controlled dimensions, positions, alignments, and chemical composition. The conducting polymer nanowire was deposited under galvanostatic conditions from an aqueous monomeric solution containing electrolytes, with the diameter and length of nanowires precisely controlled from 100 nm to 500 nm and 3 to 13 micron, respectively. The concentration of the electrolyte, monomer, and current density are critical. Biomolecule entrapment occurs during electropolymerization, and is determined using electrochemical and optical techniques. The fabrication technique accommodates a variety of polymers and biomolecules for designing specific biosensor platforms. Because the nanowires are individually addressable, a mixture of analytes can be simultaneously detected.

Bioremediation of Oil-Contaminated Soil by Landfarming: Assessment of Soil Quality Using a Field Test Kit
Edenborn, H., K. Watson, and M. Delmastro (U.S. DOE, National Energy Technology Laboratory, Pittsburgh, PA); R. Garvin; F. Mulcahy; V. Zenone.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. SETAC, Abstract PT003, 2003

Though successful remediation of oil-contaminated soil is often measured by the attainment of a baseline concentration of total petroleum hydrocarbons (TPH) of about 10,000 mg/kg (1%) to minimize toxicity to humans and reduce the substantial threat of discharge to waterways, it does not address toxicity to other organisms or impacts on overall soil quality. In northwestern Pennsylvania, the plugging of leaking abandoned oil wells near waterways generates oil-contaminated soils that U.S. EPA remediates in small landfarm plots. A soil quality test kit developed by the U.S. Department of Agriculture was used to assess soil health at ongoing and completed landfarm plots. The kit, which can be assembled from readily available materials, measures numerous physical, chemical, and biological components in soil, such as water infiltration, bulk density, aggregate stability, soil slaking, pH, soil respiration, earthworm abundance, soil water repellency, volatile ammonia and TPH, and methanol-extractable TPH. Results showed that residual crude oil components in remediated soil continued to adversely affect the water-holding capacity of soil in landfarm plots. Certain soil quality measurements for oiled soils, such as soil aggregate stability, could not be directly compared to unaffected soils, but were useful in identifying the spatial distribution of contaminated soils.

Biosensor-Based Diagnostics of Contaminated Groundwater: Assessment and Remediation Strategy
Bhattacharyya, Jessica (Univ. of Aberdeen, Aberdeen, UK); D. Read; S. Amos; S. Dooley; K. Killham; G.I. Patona.
Environmental Pollution, Vol 134 No 3, p 485-492, Apr 2005

Investigators assessed the feasibility of using bacterial biosensors to complement chemical analysis and enable cost-effective, focused sampling as part of groundwater characterization activies at a former airfield contaminated with a wide range of chlorinated solvents. Three metabolic biosensors (Vibrio fischeri, Pseudomonas fluorescens 10568, and Escherichia coli HB101) and two catabolic (Pseudomonas putida TVA8 and E. coliDH5a) were used to identify areas where the availability and toxicity of pollutants is of most immediate environmental concern. The biosensors generally agreed with chemical analyses. The biosensors used showed different sensitivities to each other and to the groundwater samples tested. The potential efficacy of remediation strategies was explored by coupling the biosensor tests to sample manipulation involving sparging and charcoal treatment tests.

A Biosensor for Sensitive and Direct Determination of V Type Nerve Agent Analog and Degradation Products Based on Carbon Nanotubes
Joshi, Kanchan A., Ashok Mulchandani, and Wilfred Chen, Univ. of California, Riverside.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 456e, 2004

Food and water supplies are likely to be contaminated by organophosphate (OP) compounds due to their widespread application as pesticides and insecticides. Also found in the OP-thiol ester family are chemicals such as VX, a highly toxic nerve agent. The degradation products of these compounds can serve as proof of their use (as in terrorist activity) and help in monitoring their destruction. Nanotechnology combined with protein engineering can be used to detect the degradation products of these compounds, as well as the parent agent in environmental samples. This paper describes an investigation of the sensitive electrochemical detection of VX degradation products at a low applied potential based on the use of carbon nanotubes (CNT). Operation at a low potential may eliminate interferences from some of the other compounds likely to be present in real environmental samples.

A Biosensor for Sensitive and Direct Determination of VX Analog and Degradation Products Based on Carbon Nanotubes
Joshi, Kanchan A., Ashok Mulchandani, and Wilfred Chen, Univ. of California, Riverside.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 36f, 2004

Sarin, soman, and VX are highly toxic nerve agents. The degradation products of these compounds, which are more stable in the environment than the parent nerve agents, can serve as proof of their use and help the destruction of these compounds to be monitored. The authors discuss sensitive electrochemical detection of VX degradation products at a low applied potential based on the use of carbon nanotubes (CNTs) combined with a variant of the enzyme organophosphorus hydrolase (OPH). The sensitive detection of the VX analogue, Demton-S, is illustrated. The important V-type nerve agents VX and R-VX produce different thiol moieties after hydrolysis, depending on the reaction pathway, and CNT-modified electrodes can be used to detect these thiol-containing species at a low applied potential. A variant of the bacterial enzyme OPH that showed better catalytic activity for demeton-S than the wild-type enzyme was generated by site-directed mutagenesis and immobilized on the CNT-modified electrode, producing sensitive and direct detection of demeton-S.

Borehole Radar Attenuation-Difference Tomography During the Tracer/Time-Lapse Test at the Boise Hydrogeophysical Research Site
Goldstein, Sarah E., Tim C. Johnson, Michael D. Knoll, Warren Barrash, and William P. Clement, Boise State Univ., Boise, ID.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 147-162, 2003

A tracer test and time-lapse radar imaging experiment was conducted at the Boise Hydrogeophysical Research Site to investigate the utility of crosswell radar in imaging an electrically conductive tracer plume. A multilevel water sampling system downgradient from the tracer injection well and in the radar imaging plane collected detailed, 1-D electrical conductivity data during the tracer test. The researchers compared the spatial and temporal position and concentration variations of the plume as indicated by the fluid conductivity data to those suggested by radar-level run-attenuation differences, shot-receiver attenuation difference crossplots, and an attenuation-difference tomogram. The results indicate that crosswell radar imaging coupled with hydrologic tracer testing can provide useful information about subsurface fluid flow and mass transport in complex fluvial aquifers.

Calibration of Semipermeable Membrane Devices (SPMDs) for Vapor Phase Airborne Contaminants
Cranor, W., D. Alvarez, J. Huckins, and J. Petty (USGS-CERC, Columbia, MO); G. Robertson (US EPA NERL, Las Vegas, NV).
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Platform Presentation IP045, 2004

Buildings may contain complex mixtures of airborne chemicals of unknown toxicity, and building inhabitants may unknowingly be exposed to them. Exposure to contaminants in indoor air can result in detrimental effects known as "sick building syndrome." Scientists at the USGS's Columbia Environmental Research Center are conducting joint research with EPA scientists to calibrate the semipermeable membrane device (SPMD) as an air sampler for monitoring atmospheric and indoor air quality. Sampling rate data has been collected to generate algorithms necessary to employ this passive integrative sampling device as a quantitative air sampler. A vapor-phase chemical production and delivery system capable of generating and maintaining constant concentrations of vapor-phase chemical mixtures has been developed for the calibration of the SPMDs (patent pending). The system was operated for 60 days to assess monitoring data for 26 chemicals selected from current-use pesticides, historic-use organochlorine pesticides, and polynuclear aromatic hydrocarbons. This presentation describes the results.

Carbon Isotopic Fractionation During Anaerobic Biotransformation of Methyl tert-Butyl Ether and tert-Amyl Methyl Ether
Somsamak, Piyapawn (Rutgers, State Univ. of New Jersey, New Brunswick); H.H. Richnow; M.M. Haggblom.
Environmental Science & Technology, Vol 39 No 1, p 103-109, 1 Jan 2005

Innovative approaches are needed to demonstrate active in situ biodegradation of MTBE. A study was conducted to gather information at the laboratory level to evaluate the potential of applying carbon isotope fractionation as an indicator for in situ biodegradation of the fuel oxygenates MTBE and tert-amyl methyl ether (TAME). MTBE utilization was observed in a methanogenic sediment microcosm after a lengthy lag period of about 400 days. MTBE utilization was sustained upon refeeding and subculturing. tert-Butyl alcohol (TBA) was found to accumulate after propagation of cultures. The MTBE-grown cultures also utilized TAME and produced tert-amyl alcohol (TAA). The detection of TBA and TAA indicated that ether bond cleavage was the initial step in degradation for both compounds. Carbon isotope fractionation during anaerobic MTBE and TAME degradation was studied, and isotopic enrichment factors were estimated for anaerobic MTBE and TAME degradation. The experiment provided strong evidence of significant carbon isotope fractionation during anaerobic MTBE and TAME degradation, demonstrating that this technique can be used as an indicator for in situ MTBE and TAME degradation.

Carbon Paste Electrode Modified with Carbamoylphosphonic Acid Functionalized Mesoporous Silica: A New Mercury-Free Sensor for Uranium(VI) Detection
Yantasee, W., Y. Lin, G.E. Fryxell, and Z. Wang, Pacific Northwest National Lab, Richland, WA.
Electroanalysis, Vol 16 No 10, p 870-873, 2004

This paper reports a new approach for developing a mercury-free, solid-state uranium electrochemical sensor that has less chance for ligand depletion than existing sensors. A carbon-paste electrode modified with carbamoylphosphonic acid self-assembled monolayer on mesoporous silica has bben developed for uranium detection based on an adsorptive square-wave stripping votammetry technique. The uranium detection limit is 25 ppb after 5 minutes preconcentration and improves to 1 ppb after 20 minutes preconcentration. The relative standard deviations are normally less than 5%.

Case History: A 3-D Resistivity Investigation of a Contaminated Site at Lernacken, Sweden
Dahlin, T., C. Bernstone, and M.H. Loke.
Geophysics, Vol 67 No 6, p 1692-1700, 2002

A contaminated site formerly used for the disposal of sludge and industrial waste liquids was investigated using a 3-D resistivity imaging technique. A roll-along technique for 3-D data acquisition allowed the use of standard multielectrode equipment designed for engineering and environmental applications. Data were measured using two perpendicular electrode-orientation directions with only one layout of the cables. The data were plotted as two sets of pseudo depth slices using the two electrode orientation directions, which resulted in markedly different plots. The results obtained were compared to other geophysical and background data, with good agreement. Multichannel measurement equipment is necessary to speed up the data acquisition process for routine application of the 3-D roll-along technique in combination with 3-D inversion.
http://www.tg.lth.se/resist/Geophysics2002.pdf

Case Studies of Two Innovative Field Technologies using GC and GC/MS
Carol Thielen, INFICON, E. Syracuse, NY.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 47.

This paper presents case studies of two field technologies. In the first case, a man-portable GC/MS was used to expedite site investigation of a contaminated airfield. The GC/MS was used to characterize both the vertical and horizontal extent of the contamination, and these data helped determine the appropriate placement of monitoring wells. The on-site GCMS method identified an unexpected contaminant in addition the expected ones. This on-site technique saved the project about 36% of the expended cost. In the second case, an unattended in situ purge-and-trap GC was used to monitor VOCs in the influent water to a municipal drinking water treatment system. The system took measurements every 30 minutes and produced detection limits in the parts per trillion range. This system provided the city with a means of early notification when a surge of MTBE and other unknown contaminants were detected in the influent water. The system was initially installed for water security purposes and demonstrated its efficacy within the first year.

Case Study: Environmental Monitoring Using Remote Optical Sensing (OP-FTIR) Technology at the Oklahoma City Air Logistics Center Industrial Wastewater Treatment Facility
Hall, Freddie E. Jr., Tinker Air Force Base, OK, Environmental Management Directorate.
Federal Facilities Environmental Journal, Vol 15 No 1, p 21-37, 2004

Production and maintenance operations at Tinker Air Force Base in Oklahoma City, OK, generate industrial wastewater streams that contain organic and heavy metal compounds. Processes discharging wastewater are treated at the on-site industrial wastewater treatment facility. Regulatory reporting mandates require identifying volatile organic compound emission sources, estimating emissions from the wastewater treatment facility, quantifying ambient air concentrations surrounding the facility via air dispersion modeling, and evaluating computer-generated numerical concentration estimates with respect to discontinuous field data and an open-path optical remote monitoring system. This article compares three strategies for meeting air-quality management requirements: (1) a coupled model (air emission and air dispersion); (2) air-quality monitoring data collected via discontinuous air sampling and analysis (i.e., periodic canister monitoring); and (3) air-quality data generated by optical remote monitoring using open-path Fourier transform infrared spectroscopy (OP-FTIR). The author discusses the validation of the predictive accuracy of the three strategies.

A Case Study for Demonstrating the Application of U.S. EPA's Monitored Natural Attenuation Screening Protocol at a Hazardous Waste Site
Clement, T. Prabhakar (Univ. of Western Australia, Nedlands, WA, Australia), Michael J. Truex (Battelle Pacific Northwest Div., Richland, WA), Peter Lee (NPC Services Inc., Baton Rouge, LA).
Journal of Contaminant Hydrology, Vol59 Nos 1-2 , p 133-162, Nov 2002

This paper presents natural attenuation assessment data collected at a Louisiana Superfund site contaminated with large quantities of DNAPL waste products. Chlorinated ethene and ethane compounds are the major contaminants of concern. This case study illustrates the steps involved in implementing U.S. EPA's 1998 technical protocol for monitored natural attenuation (MNA) screening [Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA 600-R-98-128] at this chlorinated solvent site. In the first stage of the MNA assessment process, the field data collected from four monitoring wells located in different parts of the plume were used to complete a biodegradation scoring analysis, which indicated that the site has the potential for natural attenuation. In the second stage, a detailed conceptual model was developed to identify various contaminant transport pathways and exposure points. The EPA model and BIOCHLOR was used to assess whether the contaminants are attenuating at a rate along these transport paths sufficient for MNA to be considered a feasible remedial option. The site data and modeling results indicate that the chlorinated ethene and chlorinated ethane plumes are degrading and will attenuate within 1000 feet downgradient from the source, well before reaching the identified exposure point. The investigators conclude that MNA can be considered a feasible remediation option for this site.

CB Nanosensors
Jarvis, N.L. (Edgewood Chemical Biological Center, U.S. Army SBCCOM, Aberdeen Proving Ground, MD); A.W. Snow; H.Wohltjen; & R.R. Smardzewski.
Nanotech 2003: Technical Proceedings of the 2003 Nanotechnology Conference and Trade Show, Volume 3, p 337-338, 2003

A new class of nanoscale, low-power, solid-state devices is being investigated for the detection of hazardous vapors. These chemical vapor sensors comprise nanometer-sized gold particles encapsulated by monomolecular layers of alkanethiol surfactant deposited as thin films on interdigitated microelectrodes. These new, alkylthiol-stabilized, gold nanocluster materials are known as metal-insulator-metal-ensembles (MIMEs). When chemical (agent or hazmat) vapors reversibly absorb into these thin MIME films, a large modulation of the electrical conductivity of the film is observed. The measured tunneling current between gold clusters is extremely sensitive to very small amounts of monolayer swelling or dielectric alteration caused by absorption of vapor molecules. Response times are controlled by vapor diffusion and are extremely fast for monolayers. Selectivity depends on chemical functionalization of the alkanethiol. For chemical agent simulants, sensitivities extend well below sub-ppm vapor concentrations.

Changes in Geoelectrical Properties Accompanying Microbial Degradation of LNAPL
Atekwana, E.A. and D.P. Cassidy (Western Michigan Univ., Kalamazoo); C. Magnuson and A.L. Endres (Univ. of Waterloo, Waterloo, ON, Canada); D.D. Werkema Jr. and W.A. Sauck (Western Michigan Univ., Kalamazoo).
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, OCS-1, 10 pp, 2001

Anomalously high conductivities within and below the free product zone in soils at sites with "aged" contamination by light nonaqueous phase liquids (LNAPLs) have been identified in field geophysical studies. Lab experiments and simple numerical modeling studies have tested the hypothesis that these anomalously high conductivities result from products of LNAPL biodegradation. From this study, two important observations are made that have significant ramifications on the measured geoelectrical properties at aged LNAPL sites. First, microbial degradation of LNAPLs produces a variety of acids that enhance chemical weathering of the aquifer materials, resulting in high TDS content and thereby increasing the conductivities of the pore waters. Second, emulsification of the LNAPL by surfactant production has the potential to change the wetting phase from LNAPL wetted to water wetted, providing electrically conductive paths within LNAPL saturated zones. Both of these observations are consistent with field investigations with reported conductivity values 2 to 5 times background values from contaminated zones. The field studies have also shown that the LNAPL saturated zone is conductive and not resistive. Thus, the results from laboratory work and numerical modeling indicate that LNAPL biodegradation readily explains the temporal changes in conductivity observed in geophysical investigations of contaminated aquifers.

Characterisation of Hazardous Waste Sites Using the BGR Helicopter Geophysical System
Siemon, B. (Inst. for Joint Geoscientific Research, Hannover, Germany); C. Stuntebeck; K.P. Sengpiel; B. Roettger; H.J. Rehli; D.G. Eberle.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, LWS-5, 12 pp, 2001

The Federal Institute for Geosciences and Natural Resources of Germany (BGR) completed a research and development project to optimize its helicopter-borne geophysical system for high-resolution site characterization. Previously used for groundwater and mineral exploration, BGR sought to adapt the existing helicopter-borne geophysical system to surveying anomalies much smaller in shape and size. The helicopter-borne system permits simultaneous electromagnetic (AEM), magnetic, and natural gamma-ray surveying. BGR suggested several improvements to Geoterrex-Dighem of Toronto, manufacturer of the AEM system. (1) Increased dipole moment. (2) Only horizontal coplanar coils and minimum interference by overlapping coils. (3) Operation at five frequencies. (4) A new calibration concept: amplitude and phase calibration during flight. These instrumental modifications were tested in surveys over two former military training areas south of Berlin. Special detection surveys to locate typical waste, such as individual steel drums, scrap metal, steel pipes, petrol tanks, and ordnance, buried at depths varying from 0.3 to 1.5 m, were carried out with a nominal flight line spacing of 50 m. Suitable detection algorithms were developed and tested using an airborne data set collected over an area where thousands of individual anomalies were identified and subsequently verified on the ground. More than 95% of the anomalies selected for verification could be confirmed either by visual inspection of the ground surface or ground geophysical surveying or excavation. The GPS/GLONASS positioning error was less than 10 m in most cases.

Characterization and Comparison of Three Passive Air Samplers for Persistent Organic Pollutants
Shoeib, Mahiba and Tom Harner, Meteorological Service of Canada, Environment Canada, Toronto, ON, Canada.
Environmental Science & Technology, Vol 36 No 19, p 4142-4151, 2002

In an investigation of the accumulation of persistent organic pollutants by three passive sampling media--semipermeable membrane devices (SPMDs), polyurethane foam (PUF) disks, and an organic-rich soil--the media were exposed to contaminated indoor air over a period of 450 days. Concentrations of individual PCB congeners and polychlorinated naphthalene homologs were monitored in the air and other media. Uptake was initially linear and governed by the surface area of the sampler and the boundary layer air-side mass transfer coefficient. As the study progressed, equilibrium was established between ambient air and the passive sampling media for the lower molecular weight PCB congeners. This information was used to calculate passive sampler/air partition coefficients, KPSM-A. These were correlated to the octanol/air partition coefficient, and the resulting regressions were used to predict KPSM-A for the full suite of PCBs.

Characterization of Perchlorate Exposure Using a Preconcentration Ion Chromatography Method Developed for Complex Matrices
Canas, J., K. Tian, T. Anderson, Texas Tech Univ., Lubbock
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Abstract 163, 2004

Due to matrix interferences, little progress has been made in the analysis of perchlorate in non-water matrices. An online preconcentration and preelution (PC/PE) ion chromatography method has been developed to remove matrix interferences in these complex samples. This new method has been used to characterize exposure in organisms by analyzing for perchlorate in fish, amphibians, avian eggs, biological tissues, vegetation, and hydroponic fertilizers. Preliminary work also indicates the effectiveness of the new method to deal with matrix interferences commonly found in citrus fruits and juices. PC/PE perchlorate detection limits in fertilizers range from 130 to 190 g/kg (ppb) depending on fertilizer type, compared to a Method 314.0 detection limit of approximately 30 mg/kg (ppm).

Characterization of Polymer-Coated Glass as a Passive Air Sampler for Persistent Organic Pollutants
Harner, Tom (Meteorological Service of Canada, Environment Canada, Toronto, ON); Nick J. Farrar, Mahiba Shoeib, Kevin C. Jones, and Frank A.P.C. Gobas.
Environmental Science & Technology, Vol 37 No 11, p 2486-2493, 2003

Thin-film polymer-coated glass surfaces (POGs) were investigated as passive air samplers during an uptake experiment in an indoor environment with high levels of gas-phase PCBs. The POGs consisted of a micron thick layer of ethylene vinyl acetate (EVA) coated on glass cylinders. The uptake was initially linear with time and governed by the air-side mass transfer coefficient and surface area of the sampler. This was followed by a curvilinear region and finally a constant phase when equilibrium was established between air and EVA. The high surface area-to-volume ratio of the POGs allowed rapid equilibrium with gas-phase PCBs; equilibration times were on the order of hours for the low molecular weight congeners. When POGs of varying thickness were equilibrated with air, the amount of PCB accumulated increased with increasing thickness of the EVA, indicating that uptake was by absorption into the entire polymer matrix. Relationships based on the air-side mass transfer coefficient and KEVA-A were developed for PCBs that describe the entire uptake profile and allow air concentrations to be determined from the amount of chemical accumulated in the POG.

Characterization of the Ability of Polymeric Chemiresistor Arrays to Quantitate Trichloroethylene Using Partial Least Squares (PLS): Effects of Experimental Design, Humidity, and Temperature
Rivera, D., M.K. Alam, C.E. Davis, and C.K. Ho, Sandia National Labs, Albuquerque, NM.
Sensors and Actuators B: Chemical, Vol 92, p 110-120, 2003

Partial least squares (PLS) can provide quantitative predictions of trichloroethene (TCE) using an array of chemiresistors through appropriate experimental design. The authors discuss the effects of humidity and temperature on the response of chemiresistor arrays and the predictive ability of PLS. To truly assess the quality of a calibration model, it must be tested through prediction of a test set at a time separated from the acquisition of the calibration data to be sure that the model is stable with respect to changing environmental conditions and device drift.
http://www.sandia.gov/sensor/PLS_Rivera_et_al.pdf

Characterizing the Hydraulic Components of a Contaminated Basalt Aquifer using Borehole Geophysical and Hydrologic Methods
Bishop, C.W. (Idaho National Engineering and Environmental Lab, Bechtel BWXT Idaho, LLC, Idaho Falls, ID); M.D. Knoll; R.C. Hertzog.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS23A-03, 2004

Groundwater flow and contaminant transport in basalt aquifers occurs primarily through high permeable interflow rubble zones and interconnected fracture zones. These zones are difficult to identify and characterize because they occupy a small percentage of the aquifer volume and exhibit complex patterns of spatial connectivity. Researchers at DOE's Idaho National Lab have demonstrated the effectiveness of characterize these preferential flow zones by integrating information from borehole geophysical logs, optical televiewer (OTV) images, crosswell radar and seismic tomography, hydraulic tests, flowmeter logs, and chemical analysis of water samples. Their work uses data collected in two wells located at the site that penetrate a saturated 60 m thick sequence of interlayered and fractured basalt within the Snake River Plane Aquifer and also intersect a trichloroethelene (TCE) plume undergoing bioremediation.

Chemicapacitive Microsensors for Volatile Organic Compound Detection
Patel, S.V. (Graviton Inc., La Jolla, CA/Seacoast Science Inc., Carlsbad, CA), T.E. Mlsna, B. Fruhberger, E. Klaassen, S. Cemalovic, and D.R. Baselt.
Sensors and Actuators B, Vol 96, p 541-553, 2003

A low-cost, low-power volatile organic compound (VOC) sensor has been constructed from an array of micromachined parallel-plate capacitors. In place of a standard dielectric, the individual capacitors were filled with selectively absorbing polymers. Absorption of a target vapor alters the permittivity of the polymers and thereby changes the capacitance of the elements in the array. A variety of polymers have been used, including polyethylene-co-vinylacetate, which is sensitive to nonpolar hydrocarbons and siloxanefluoro alcohol and highly sensitive to polar VOCs and chemical warfare agent simulants. The measured sensitivity of the sensor to most VOCs was found to be in the low parts per million (ppm) range. The sensor typically responded within a second but frequently required 5 to 10 minutes to reach equilibrium. The sensor has demonstrated detection of many VOCs well below the lower explosive limits and could be used in industrial leak monitoring applications or for homeland defense. http://www.seacoastscience.com/SAb%20galley%20proof.pdf

Chemiresistor Microsensors for In-Situ Monitoring of Volatile Organic Compounds: Final LDRD Report
Ho, Clifford K., Lucas K. McGrath, Chad E. Davis, Michael L. Thomas, Jerome L. Wright,
Ara S. Kooser, and Robert C. Hughes, Sandia National Laboratories, Albuquerque, NM.
SAND2003-3410, 137 pp, Sep 2003

This report summarizes a 3-year LDRD (Laboratory Directed Research and Development) project aimed at developing microchemical sensors for continuous, in situ monitoring of volatile organic compounds. A chemiresistor sensor array was integrated with a waterproof housing that allows the sensors to be operated in air, soil, or water. The chemiresistor itself consists of a conductive polymer deposited onto a microfabricated circuit. The polymer swells reversibly in the presence of VOCs as vapor-phase molecules absorb into the polymer, causing a change in the electrical resistance of the circuit that can be calibrated to known concentrations of analytes. An array of four chemiresistors has been fabricated on a single chip to aid in discrimination, and many polymers were tested and evaluated to yield an optimized array of chemiresistors to detect the contaminants of interest. Data analysis methods employing pattern recognition techniques (e.g., VERI) and statistical methods (e.g., partial-least squares) were investigated and evaluated using data obtained from the chemiresistor array when exposed to a variety of environmental conditions and analytes. Preconcentrators were also investigated as a means of increasing the sensitivity of the chemiresistor sensors, and automated on-chip temperature control methods were developed to produce more stable responses. A complete chemiresistor monitoring system has been developed for field applications. A rugged, waterproof housing allows the chemiresistor to be emplaced in monitoring wells or immersed in water. A cable connects the sensor to a surface-based solar-powered data logger employing wireless telemetry. Data can be collected automatically and uploaded to a web site (examples at www.sandia.gov/sensor/cwl). Field tests of the sensor system have yielded promising results. New and alternative designs and applications for the sensor (e.g., concentric spiral configuration, Chemicouples(TM), ChemSticks(TM), Bioresistors(TM), automated monitoring and remediation systems) have been developed as part of this project. These new concepts and applications have led to seven patent applications and generation of nearly $700K of external revenue.
http://www.sandia.gov/sensor/SAND2003-3410.pdf

Chlorophenols Identification in Water Using an Electronic Nose and ANNs (artificial neural networks) Classification.
Vazquez, M.J., R.A. Lorenzo, and R. Cela, Aquagest, Santiago de Compostela, Spain.
Water Science and Technology, Vol 49 No 9, p 99-105, 2004

An electronic nose (EN) generally comprises a chemical sensing system and a pattern recognition system (e.g., an artificial neural network). An EN based on a non-specific conducting polymer array was used to monitor chlorophenols in water samples. The experimental parameters studied were sample volume, platen temperature, sample equilibration time, loop fill time, sample pressurization time, and injection time. The results showed that it was possible to differentiate the five chlorophenol groups: monochlorophenol, dichlorophenol, trichlorophenol, tetrachlorophenol, and pentachlorophenol, with good differentiation between the clusters.

Chromium Stable Isotope Fractionation During Bacterial Reduction of Hexavalent Chromium
Sikora, E.R. and T.M. Johnson (Univ. of Illinois at Urbana-Champaign); T.D. Bullen (USGS, Menlo Park, CA).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract H43E-05, 2004

Chromium (Cr) is a common contaminant in surface water and ground water. It occurs as Cr(VI), which is soluble and toxic, and Cr(III), which is insoluble and less toxic. Reduction of Cr(VI) to Cr(III) is often the most important reaction controlling attenuation of Cr plumes, and Cr stable isotope measurements show great promise as indicators of this reaction. The determination of Cr fractionation factors for anaerobic reduction by Shewanella Oneidensis MR-1 involved the suspension of MR-1 cells in buffer solutions with small concentrations of lactate or formate and Cr(VI). Reduction occurred slowly, over days or weeks. Under the lean conditions found in most aquifers, the kinetic isotope effect induced by bacterial reduction is roughly equal to that induced by abiotic reduction, and the Cr isotope method should be useful for estimating Cr(VI) reduction, regardless of the exact mechanism involved.

Commercial Application of the CALUX Bioassay for Use in Detecting Dioxin and Related Chemicals
Denison, Michael S., Univ. of California, Davis.
A Legacy in Multidisciplinary Research, Vol I. National Institute of Environmental Health Sciences, Superfund Basic Research Program, p 23-24, 2003

SBRP-funded researchers have developed, validated, and patented a cell bioassay system known as CALUX that is sensitive, specific, quick, and inexpensive. This recombinant cell bioassay has been engineered to respond to dioxin-like HAHs and PAHs, with the activation of gene expression, specifically that of firefly luciferase. Xenobiotic Detection Systems (XDS), Inc., a biotech company in North Carolina, has combined the CALUX bioassay system with a rapid chemical extraction procedure to develop a sensitive combination system for the detection of dioxins and dioxin-like chemicals in extracts of biological, environmental, and food and feed samples. After reviewing the validation results, the U.S. Food and Drug Administration (FDA) licensed the CALUX screening technology from XDS for critical evaluation as a rapid screening method for dioxins and related chemicals in food and feed. The FDA is in the initial phase of incorporating the bioassay into their food/feed screening program and introducing the innovative techniques into FDA-sponsored laboratories. The technology has been licensed to companies in Japan and Belgium, and XDS is using it extensively to screen dioxins in a wide variety of matrices sent to them by governmental, commercial, academic, and public organizations. The U.S. EPA has also expressed interest in licensing the CALUX screening technology, and an application for EPA approval of the assay will be submitted. With EPA approval, the bioassay should realize significantly greater commercial and regulatory use. One patent has been granted as a result of this SBRP-funded research.

Comparison of 1,4-Dioxane as a Volatile and Semivolatile Analyte in Single and Multi-Laboratory Studies
Strout, Keith, Michael Zimmerman, and Clyde Hedin (Shaw Environmental, Las Vegas, NV); Terry Smith (U.S. EPA, Washington, DC). NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 29.

This paper presents the results of single and multi-laboratory studies for the analysis of 1,4-dioxane in water as a volatile and semivolatile analyte. 1,4-Dioxane is targeted as a volatile in EPA Method 8260B and the upcoming EPA CLP SOW, SOM01. Due to the difficulties in reliably detecting 1,4-dioxane in the regulatory range of 1-10 ug/L using purge and trap, a growing number of labs are targeting this compound as an extractable semivolatile. Comparisons are presented for volatile analyses, such as several purge-and-trap GC/MS calibration and samples sets under varying conditions and including 5 and 25 mL purge volumes, ambient and heated purge temperatures, increased purge flow rate, and full-scan and selected ion monitoring (SIM) mass spectrometry. The authors provide a comparison of the accuracy and precision for 1,4-dioxane analysis made using optimized purge-and-trap GC/MS and extraction semivolatile GC/MS analysis.

A Comparison of Commonly Used Cyanide Analytical Methodologies for Manufactured Gas Plant (MGP) Applications
Occhialini, J.F., J.C. Todaro, J. Clements, J. Roth, and E. Dayn (Alpha Analytical Labs, Westborough, MA); T.B. Devine; W.R. Swanson; M. Rostkowski.
Environmental Forensics, Vol 5 No 2, p 71-78, June 2004

The authors report on the analysis of a groundwater sample from an area affected by cyanide-containing residuals. Several common analytical procedures were used to illustrate and compare the concentrations of cyanide that the various methodologies were able to detect. Filtered and unfiltered sample aliquots were analyzed to evaluate whether significant differences could be observed with any of the analytical methods that could be attributed to relative solubility differences among the cyanide species present. Further studies of environmental forensic applications of cyanide source identification based on the comparison of the differing analytical methodologies will be useful for the characterization and remediation of MGP sites.

Comparison of NOAA and USEPA Analytical Methods for Metals
Bernhardt, A. (Tetra Tech NUS, Inc., Pittsburgh, PA); F. Evans; M. Raymond; J. Speicher; R. Haynie; D. Cohen.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PM117, 2004

Sediment samples from Portsmouth Naval Shipyard, Kittery, ME, were analyzed for metals and organic chemicals using analytical methods developed for the National Oceanic and Atmospheric Administration (NOAA) Status and Trends Program. These methods are limited to a few laboratories and are typically more expensive than standard EPA analytical methods. A study was conducted to determine the differences in metals concentrations by having split samples analyzed using the NOAA digestion method and EPA Method 6020. For the metals of primary concern for the monitoring program, there was good correlation for chemical concentrations between the two methods, but the concentrations of the metals using the NOAA method were slightly greater than the concentrations using the EPA method.

Comparison of Sampling Techniques and Evaluation of Semipermeable Membrane Devices (SPMDs) for Monitoring Polynuclear Aromatic Hydrocarbons (PAHs) in Groundwater
Gustavson, Karl E. and John M. Harkin, Univ. of Wisconsin-Madison.
Environmental Science & Technology, Vol 34 No 20, p 4445-4451, 2000

Groundwater was sampled at the site of a former manufactured gas plant using three conventional methods (bailing, low-flow, and bailing with filtering) and long-term in situ samplers (semipermeable membrane devices, or SPMDs). Samples from each technique were analyzed for polynuclear aromatic hydrocarbons (PAHs) and total suspended solids (conventional methods only) to determine the effect of sampling procedure on PAH concentrations. Among the conventional techniques, bailing indicated the highest PAH concentrations, and bailing/filtering the lowest. High molecular-weight PAHs were most prevalent in bailed samples and most affected by filtering, suggesting these species are particle-associated. SPMD results corroborated this finding. SPMDs performed well in this study, showing values similar to values obtained by the conventional techniques, as well as detecting some low-concentration PAHs not detected by conventional methods.

A Compendium of Chemical, Physical and Biological Methods for Assessing and Monitoring the Remediation of Contaminated Sediment Sites
U.S. EPA, Office of Research and Development. EPA 600-R-04-108, 289 pp, Apr 2004

This document summarizes chemical, physical, and biological (toxicity and bioassessment) testing methodologies for monitoring and assessing the remediation of contaminated sediment sites. Methods are presented as fact sheets with hypertext links to access reference documents that often include the complete method description. The document primarily focuses on methods from the published literature or other sources that can be used at sites to determine the effects of chemical contaminants on aquatic life and human health.
http://www.epa.gov/nerleerd/108Complete.pdf

Conductive Copolymer-Modified Carbon Fibre Microelectrodes: Electrode Characterisation and Electrochemical Detection of p-Aminophenol
Jamal, Mamun, A. Sezai Sarac, and Edmond Magner, Univ. of Limerick, Limerick, Ireland.
Sensors and Actuators B, Vol 97, p 59-66, 2004

A series of conductive polymer-modified carbon fibre electrodes was prepared, characterized by scanning electron microscopy and FTIR, and examined for their ability to detect para-aminophenol (p-AP). Poly[N-vinylcarbazole-co-vinylbenzene sulfonic acid], poly[carbazole-co-methylthiophene], and polycarbazole were coated electrochemically on carbon fiber microelectrodes. The monomers employed have an effect on the homogeneity of the resultant films in that very homogenous copolymers can be synthesised with p[NVCzVBSA].
http://www.ul.ie/~ces/MagnerGroupSite/publications/sens_act_b_jan_2004.pdf

Contaminant Leakage Detection System Using a Grid-Net Electrical Conductivity Measurement Method
Oh, M.H., Y.S. Kim, & J. Park, Seoul National Univ., Korea.
Brownfields II -- Second International Conference on Brownfield Sites: Assessment, Rehabilitation and Development, 14-16 June 2004, Siena, Italy. Wit Press, Wessex Inst. of Technology, UK. Transactions on Ecology and the Environment, vol 70, ISBN: 1-85312-719-1, 10 pp, 2004

Leak detection systems that use electrical conductivity measurement are advantageous since they are fast and efficient methods that require little data processing to obtain accurate and repeatable results. A grid-net electrical conductivity measuring method had been developed for 2-D monitoring of leaking contaminants in a target area. The optimum electrode spacings of a 2-electrode sensor were found for leachate and diesel fuel, and then laboratory model tests were performed to evaluate the direct application of a grid-net electrical conductivity measurement system for the detection of these contaminants. In the laboratory model test results, landfill leachate and diesel fuel leakage were accurately identified by the grid-net electrical conductivity measurement system.

Continuous Real-Time Monitoring of Phosphine Concentrations in Air Using Electrochemical Detectors Interfaced by Radio Telemetry
Thorn, Tommy G. Jr. (Lorillard Tobacco Co., Danville, VA), E.M. Chodyniecki, K.W. Ingold, G.A. Long, C.D. Miller, E.A. Robinson, F.S. Cowan, and R.L. Thomas.
Environmental Science & Technology, Vol 36 No 9, p 2048-2053, 2002

The authors identify a radio telemetry-based system that continuously monitors phosphine using two different types of electrochemical detectors as an ECD/RT. EDC/RT units were used to monitor phosphine inside and at varying distances from large tobacco storage warehouses. Data from the master controller unit were transferred to a personal computer that received and displayed the data. Supervisory control and data acquisition software assimilated the data from each ECD/RT unit, displayed and updated it as new transmissions were received, and stored the data in secure databases. A comparison of data from an ECD/RT from a unit approximately 4 m downwind of a sealed warehouse and a colorimetric tube at the same location showed an average over the 20-minute collection period for the ECD/RT of 0.13 ppm and a final phosphine concentration from the colorimetric method of 0.05 ppm. The ECD/RT system allows for continuous, remote monitoring around warehouses under fumigation and superior time response to fugitive emissions of phosphine.

Controlled Release, Blind Test of DNAPL Remediation by Ethanol Flushing
Brooks, Michael C. (U.S. Army Corps of Engineers, Jacksonville, FL); Michael D. Annable; P. Suresh C. Rao; Kirk Hatfield; James W. Jawitz; William R. Wise; A. Lynn Wood; Carl G. Enfield.
Journal of Contaminant Hydrology, Vol 69 Nos 3-4, p 281-297, Apr 2004

A DNAPL source zone was established within a test cell through a controlled release of perchloroethene (PCE) to evaluate DNAPL remediation by in situ cosolvent flushing. Ethanol was used as the cosolvent, and the main remedial mechanism was enhanced dissolution based on the phase behavior of the water/ethanol/PCE system. Over a 40-day period, 64% of the estimated 83 L of PCE present at the start of the test was removed by flushing the cell with an alcohol solution of 70% ethanol and 30% water. The test showed high removal efficiencies, but the demonstration ended before complete cleanup was effected. The ethanol solution extracted from the cell was recycled during the test using activated carbon and air stripping. These treatments successfully removed PCE for recycling with minimal impact on the ethanol content in the treated fluids. Results from pre- and post-flushing partitioning tracer tests overestimated the treatment performance; both of the tracer tests missed significant amounts of the PCE present, which suggests that some PCE was inaccessible to the ethanol solution, leading to inefficient PCE removal rates. The flux-averaged aqueous PCE concentrations measured in the post-flushing tracer test were reduced by a factor of 3 to 4 in the extraction wells that showed the highest PCE removal compared to concentrations in the pre-flushing tracer test.

Cost Effective Long-Term Groundwater Monitoring Design Using a Genetic Algorithm and Global Mass Interpolation
Reed, Patrick Michael, Master's thesis, Univ. of Illinois at Urbana-Champaign, 54 pp, 1999

Long-term monitoring at many sites can require decades of expensive sampling at tens or even hundreds of existing monitoring wells, resulting in hundreds of thousands or millions of dollars of costs for sampling and data management per year. This paper presents a new methodology for identifying cost-effective sampling plans to reduce costs at sites with numerous existing monitoring wells. This study assumes that once sites enter the long-term monitoring phase of remediation, site characterization will be essentially complete and monitoring networks will already exist that can sufficiently capture future plume migration. The method uses a numerical simulation model to predict future plume location. A genetic algorithm then searches for sampling plans using kriging and inverse-distance weighting interpolation to calculate global mass estimates for candidate subsets of wells within the existing monitoring network.
http://cee.uiuc.edu/emsa/documents/preed-1999-01.pdf

Cost Effective Long-Term Groundwater Monitoring Design Using a Genetic Algorithm and Global Mass Interpolation
Reed, P. M., B. S. Minsker, and A. J. Valocchi.
Water Resources Research, Vol 36 No 12, p 3731-3741, 2000

A new methodology for sampling plan design has been developed to reduce the costs associated with long-term monitoring of sites with groundwater contamination. The method combines a fate-and-transport model, plume interpolation (inverse-distance weighting, ordinary kriging, and a hybrid combination of both), and a genetic algorithm to identify cost-effective sampling plans that accurately quantify the total mass of dissolved contaminant. Application of the methodology to Hill Air Force Base indicated that sampling costs could be reduced by as much as 60% without significant loss in accuracy of the global mass estimates. Inverse-distance weighting was effective as a screening tool for evaluating whether more comprehensive geostatistical modeling is warranted, while the hybrid method was useful for implementing a tiered approach, reducing computational time by more than 60% relative to kriging alone.

Cost-Effective Sampling Network Design for Contaminant Plume Monitoring under General Hydrogeological Conditions
Wu, Jianfeng (Univ. of Alabama, Tuscaloosa/Nanjing Univ., Nanjing, China), Chunmiao Zheng, and Calvin C. Chien.
Journal of Contaminant Hydrology, Vol 77 Nos 1-2, p 41-65, Mar 2005

A new simulation/optimization methodology has been developed for cost-effective sampling network design associated with long-term monitoring of large contaminant plumes. An earlier optimization model based on a genetic algorithm was coupled with a flow and transport simulator and a

global mass estimator to search for optimal sampling strategies. This study introduces the first and second moments of a three-dimensional contaminant plume as new constraints in the optimization formulation, and demonstrates the proposed methodology through a real-world application to the monitoring of plume evolution during a pump-and-treat operation at a large field site. The new moment constraints significantly increase the accuracy of the plume interpolated from the sampled data relative to the plume simulated by the transport model. The plume interpolation approaches employed in this study are ordinary kriging and inverse distance weighting. Potential cost savings up to 65.6% may be achieved without any significant loss of accuracy in mass and moment estimations. The inverse distance weighting interpolation method is computationally more efficient than the kriging-based method and results in more potential cost savings, but ordinary kriging leads to more accurate mass and moment estimations.
http://hydro.geo.ua.edu/hydro/wu_zheng_chien.pdf

Critical Evaluation of Factors Required to Terminate the Postclosure Monitoring Period at Solid Waste Landfills
Barlaz, Morton A. (North Carolina State Univ., Raleigh, NC), Alix P. Rooker, Peter Kjeldsen, Mohammed A. Gabr, and Robert C. Borden.
Environmental Science & Technology, Vol 36 No 16, p 3457-3464, 2002

Regulations governing the disposal of solid waste in landfills specify that the landfills must be monitored for 30 years after closure, unless this period is extended by the regulatory authority. The objectives of this paper are to identify and evaluate parameters that can be used to define the end of the post-closure monitoring period and to present a conceptual framework for an investigation of whether post-closure monitoring can be terminated at a landfill. Parameters evaluated include leachate composition and leachate and gas production. The approach must be tested on a site-specific basis to identify additional data requirements and regulatory activity that might be required to prepare regulators for the large number of requests to terminate post-closure monitoring that can be expected over the next 20 years.

Cross-Well Radar Detection of Pollution Pools: Modeling, Inversion and Experimentation
Zhan, H., M. Farid, C. Rappaport, A. Alshawabkeh, E. Miller, & H. Raemer, Northeastern Univ.
Center for Subsurface Sensing & Imaging Systems (CenSSIS), Research and Industrial Collaboration Conference, 7-8 October 2004, Northeastern University, Poster Presentation.

Remediation of DNAPL source zone requires efficient, nonintrusive, cost-effective and reliable methods for DNAPL delineation and characterization. Such methods will assist in monitoring DNAPLs in the subsurface and also assessment of remediation technologies and transient change in mass/volume of the DNAPL source zone. The reconstruction approaches require sensor transfer function, which is based on the physics of the problem, involving dyadic Green's function calculation. Different detection techniques are implemented in the field, e.g., direct push-probe technologies (DPT), in situ tracers (IST), and geophysical methods (GM). GM methods are the most non-invasive methods for locating subsurface DNAPLs, thus avoiding the risk of additional vertical migration of pooled DNAPL. GPR is the least non-invasive, but has depth limitation. Cross-well radar (CWR) has been chosen for this research. The prospective algorithms in solving the pool characterization problem are based on multi-scale image formation and shape-based inversion methods for localizing parameterized pollution pools. (Conference proceedings at http://www.censsis.neu.edu/RICC/2004/)
http://www.censsis.neu.edu/RICC/2004/students/posters/EnviroCivilp4.pdf

Crosswell Seismic Imaging in a Contaminated Basalt Aquifer
Daley, T.M., E.L. Majer, and J.E. Peterson, Lawrence Berkeley National Lab, Berkeley, CA.
Geophysics, Vol 69 No 1, p 16-24, Jan/Feb 2004

The authors describe work that demonstrates the application of crosswell seismic tomography to a fractured basalt aquifer to aid hydrologic characterization. Two seismic sources of different frequency were used to provide imaging at spatial scales and to demonstrate that low-velocity zones are co-located with contaminant transport (assumably because of fracture flow). Most of the surveys of the fractured basalt aquifer at Idaho National Engineering and Environmental Laboratory used a high-frequency (1000-10,000 Hz) piezoelectric seismic source to obtain P-wave velocity tomograms. The P-wave velocities range from less than 3200 m/s to more than 5000 m/s. Also, a new type of borehole seismic source, an orbital vibrator, was deployed as part of the subsurface characterization program at this contaminated groundwater site. The combination of piezoelectric data for closer well spacing and orbital vibrator data for larger well spacings has provided optimal imaging capability and added to an understanding of the site aquifer's hydrologic properties and its scale of heterogeneity.

Delineating the Subsurface: Using Surface Geophysics to Identify Groundwater Flow Paths in a Carbonate Aquifer
Grgich, Paula; Hammack, Richard; Harbert, Williams; Sams, James; Veloski, Garret; Ackman, Terry;
Journal of Environmental Hydrology, Vol 12 No 12, July 2004

Researchers examined stream loss in Hoyes Run, a small tributary of the Youghiogheny River in Garrett County, MD. The stream bounds the pit of the Deep Creek limestone quarry. During low flow, the stream abruptly terminates in a swallet, leaving approximately 100 m of dry streambed. Multiple resistivity profiles using the SuperSting(TM) Resistivity System were generated along the zone of stream loss and compared with results of ground penetrating radar (GPR) and electromagnetic conductivity (EM) profiles in the same location. Dye trace using Fluorescein(TM) confirmed the flow path of water from the stream into the quarry. In addition to geophysically investigating the swallet, the study located two other zones of loss active during periods of higher flow. Geologic examination of the area reveals several sizable known caves developed in the same limestone sequence; however, there are no known cave entrances in the immediate vicinity. The study shows that surface geophysics coupled with hydrologic and geologic analysis can locate possible flow paths for groundwater in a karst aquifer, even in the absence of obvious karst surface expression. Borehole confirmation is slated before remediation measures are executed.
http://www.netl.doe.gov/products/r&d/techpapers/2004-163.pdf

Design and Installation of a Remotely Controllable Autonomous Resistivity Monitoring System at the Gilt Edge Mine Superfund Site, South Dakota
Versteeg, Roelof, Gail Heath, & Clark Scott (INEEL, Idaho Falls, ID); Ken Wangerud (U.S. EPA, Denver, CO); Dave Paul (Bureau of Reclamation, Denver, CO).
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 753-758, 2004

A constructed cover system is one approach to controlling acid mine drainage (AMD) from mine tailings. Detailed monitoring information on cap and rock behavior allows for rapid and cost-effective intervention in case of cap failure. At the Gilt Edge Mine Superfund site, a remotely controllable autonomous resistivity monitoring system was integrated in the repository below the geomembrane cap. The structure of this system allows user access to raw and processed data in real time.

Design and Laboratory Testing of a Chamber Device to Measure Total Flux of Volatile Organic Compounds from the Unsaturated Zone under Natural Conditions
Tillman, Fred D. Jr. (U.S. EPA, Athens, GA); James A. Smith (Univ. of Virginia, Charlottesville).
Journal of Contaminant Hydrology, Vol 75 Nos 1-2, p 71-90, Nov 2004

Investigators studied the quantification of air-phase volatile organic compounds (VOCs) leaving the unsaturated zone soil gas and entering the atmosphere, including the additional flux provided by advective soil-gas movement induced by barometric pumping. The vertical flux chamber (VFC), a simple and easy-to-use device for measuring VOC flux under natural conditions, was designed using numerical simulations and evaluated in the laboratory. Under both diffusion-only and advection-plus-diffusion transport conditions in the laboratory, the flux chamber measured an average of 82% of 15 diffusion-only fluxes and an average of 95% of 15 additional advection-plus-diffusion flux experiments. The vertical flux chamber has the capability of providing reliable measurement of VOC flux from the unsaturated zone under both diffusion and advection transport conditions.

Detection of DNAPLs using Ultra High-Resolution Seismic Data and AVO Analysis at Charleston Naval Weapons Station, South Carolina
Waddell, M.G., W.J. Domoracki, and T.J. Temples, Univ. of South Carolina, Columbia.
Society of Exploration Geophysicists (SEG) 72nd Annual Meeting, Salt Lake City, Utah, Technical Program Expanded Abstracts, p 1583-1586, 2002

At the Charleston Naval Weapons Station, Charleston, SC, three high resolution P-wave reflection profiles were collected with two objectives: (1) image a target depth of 20 feet below land surface to assist in determining the geologic controls on the DNAPL plume geometry, and (2) apply Amplitude Variation with Offset (AVO) analysis to the seismic data to locate the zone of high concentration of DNAPL. Contaminant flow was controlled by the presence of a high permeability channel. The flow direction was in a different direction than was predicted by the potentiometric surface for the aquifer. Standard cross-section interpretation did not detect the presence of a channel. Seismic stratigraphic methods readily identified the channel and correlated well to hydraulic conductivity data derived from slug tests.

Detection of Organic Pollutants in Sandy Soils via TDR and Eigendecomposition
Mohamed, A.M.O. and R.A. Said, United Arab Emirates Univ., Al Ain, United Arab Emirates.
Journal of Contaminant Hydrology, Vol 76 Nos 3-4, p 235-249, Feb 2005

The authors conducted a study in which organic pollutants in sandy soils were detected using a time domain relectrometry (TDR) probe system and eigendecomposition technique. Four types of organic fluids (motor oil, diesel oil, methanol and ethanol) were examined in samples prepared with different combinations of deionized water and organic fluid contents. Reflected signals were captured by an oscilloscope for each experiment, and their characteristics were identified using eigendecomposition technique. The most significant eigenvalues were identified by their relative magnitude. The system was sensitive to both water and pore fluid organic contents. For saturated conditions, signature curves were determined for identification of organic and/or water contents in soil pore fluids.

Detection of Sub-Toxic Concentrations of Metals by Sensor Bacteria

Ivask, A. (National Inst. of Chemical Physics and Biophysics, Tallinn, Estonia); M. Francois; A. Kahru; H.-C. Dubourguier; F. Douay; K. Hakkila; M. Virta.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-I, p 164-165, 2003

A study was designed to develop and characterize sensor bacteria for the detection of subtoxic bioavailable concentrations of metals in the environmental samples. The bacterial strains were constructed using recombinant-DNA technology. The sensors are based on controlled expression of a reporter gene (firefly luciferase) by a genetic regulatory unit that gives a specific response (increased bacterial luminescence) for a certain metal. Strains have been developed for the detection of inorganic mercury, organomercurials, zinc, chromate, lead, copper, cadmium, and arsenite.

Determination of Atrazine Using Square Wave Voltammetry with the Hanging Mercury Drop Electrode (HMDE)

dos Santos, Luciana B.O., Gilberto Abate, and Jorge C. Masini, Univ. de Sao Paulo, Sao Paulo, SP, Brazil.
Talanta, Vol 62 No 4, p 667-674, 10 March 2004

This paper presents the optimization of instrumental and solution parameters for determination of atrazine in river waters and formulation by square wave voltammetry (SWV) using a hanging mercury drop electrode. Good agreement was observed between results obtained by the proposed method and by HPLC for river water samples spiked with 25 g/L of atrazine. The determination was not affected by the presence of humic acid at concentration of 5 mg/L, indicating that interactions of the herbicide with this class of compounds are fully labile. The test results indicated that the stability of the voltammetric signal was affected by the nature of the sample.

Determination of Hg On-Line and In-Field by Continuous Unmanned US EPA 1631 and 245.7 Methods

Hensman, C. and P. Kilner, Frontier Geosciences Inc., Seattle, WA.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PH235, 2004

In conjunction with DOE, a continuous mercury monitoring system has been developed to better understand and monitor the variability of mercury in complex matrices. The system involves online sample preparation with chemical, thermal, and UV digestion, followed by cooling and gas liquid separation. Detection is achieved by cold vapor atomic fluorescence spectrophotometry. Using either EPA Method 1631 or 245.7, the system achieves a detection range of 100 ppb to sub-ppt levels with measurement of mercury concentrations at intervals of 5 minutes or longer. Modifications to the physical instrument, to the analyzer chemistry, and to the analytical method can be made to optimize the system for matrices ranging from drinking water to petroleum hydrocarbon to organic-rich industrial wastewater. This presentation details the method and presents field study results.

The Determination of Perchlorate Anion in High Total Dissolved Solids Water Using LC/MS/MS
Krol, Jim, Waters Corp., Milford, MA.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, P3.

Using the EPA Information Collection Rule as a data base, drinking water facilities have reported higher than anticipated concentrations of perchlorate in environmental waters in 22 states. DoD and DoE are also interested in perchlorate, an ingredient in many munitions, from a soil contamination perspective. EPA method 314.0 (Determination of Perchlorate Using Ion Chromatography…) uses anion exchange chromatography with suppressed conductivity detection. This method works well but becomes limiting as the total dissolved solids concentration increases, especially sulfate. Sample preparation to remove chloride and sulfate is necessary and requires the use of a O18 perchlorate internal standard to account for recovery. This presentation describes an LC/MS/MS method for perchlorate with no requirement for sample preparation; instead, it looks at the chromatography of perchlorate relative to sulfate. As organic modifier concentration increases, perchlorate elutes faster than sulfate, allowing the chromatographer to place perchlorate baseline separated between high chloride and high sulfate. With the direct injection of 100 uL of a solution containing 1000 ppm each of bicarbonate, chloride, and sulfate, MS/MS detection can obtain a perchlorate detection limit (3:1 S/N) of 0.2 ppb.

Determination of Perchlorate in High Salinity Water: Preconcentration/Preelution IC
Tian, K., P. Dasgupta, R. Patel, and T. Anderson, Texas Tech Univ., Lubbock.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas.

An automated system has been developed for the determination of trace perchlorate by ion chromatography (IC) with an online preconcentration and preelution technique. The sample is preconcentrated and less strongly held ions preeluted before the analyte is transferred to the principal separation system. This approach provides low limits of detection (LOD) and is particularly robust toward the effect of high concentrations of common anions, such as those present in groundwater samples. It compares favorably with EPA Method 314.0. Experimental results with synthetic water samples, groundwater samples, and some retail hydroponic nitrate fertilizer samples show that this approach is particularly robust toward the effect of complex matrix in various samples due to its high efficiency to remove the background matrix of samples.

Determination of Pollution Trends in Abandoned Mining Site by Application of a Multivariate Statistical Analysis to Heavy Metals Fractionation Using SM&T-SES
Perez, G. and M. Valiente.
Journal of Environmental Monitoring, Vol 7 No 1, p 29-36, 2005

The toxicity of heavy metals in the environment depends in part on their mobility and availability. Accurately determining the true potential of metals in the environment can be difficult, particularly when inferring laboratory results to the field. Sequential extraction schemes (SES), whereby a sequential series of extractants are deployed onto an environmental sample, are capable of characterizing the partitioning of heavy metals through various geochemical phases. At an abandoned mining site in Southern France, the authors used SES combined with statistical analysis to examine the chemical partitioning of six metals (As, Cd, Cu, Ni, Pb, and Zn) and identify pollution trends around the site. Chemical partitioning of metals in each sample was determined in four fractions (acid-soluble, reducible, oxidable, and residual) following Standard Measurements and Testing (SM&T) SES. Statistical evaluation of results by pattern recognition techniques identified groups of samples with similar characteristics and observed correlations between variables, determining the pollution trends and distribution of heavy metals within the study area.

Developing Nanoparticle-Based Hollow Microspheres as a Platform for a Fluorescence-Based Sensor
Yoo, Regina M. (Rice Univ., Houston, TX); Paul E. Laibinis; Michael S. Wong.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 583g, 2004

The authors present evidence that demonstrates the potential use of nanoparticle-based hollow microspheres for optical sensing applications. To establish the feasibility of these microspheres as sensing elements, they evaluated the pH-dependent fluorescence response of hollow microspheres that contained a pH-sensitive fluorescein probe.

Development and Calibration of a Resin-Based Passive Sampling System for Monitoring Persistent Organic Pollutants in the Atmosphere
Wania, Frank (Univ. of Toronto at Scarborough, Toronto, ON, Canada); Li Shen; Ying Duan Lei; Camilla Teixeira; Derek C.G. Muir.
Environmental Science & Technology, Vol 37 No 7, p 1352-1359, 2003

A passive air sampling technique has been developed based on the sorption of gaseous pollutants to the sampling resin XAD-2, a styrene-divinylbenzene copolymer. This paper describes the conduct and results of a field study undertaken to gain a quantitative understanding of the uptake kinetics of the passive air samplers. The study was made at sites in Canada alongside ongoing conventional air sampling of organochlorine pesticides. The uptake of contaminants by the sampler is controlled by molecular diffusion and is independent of wind velocity. The XAD-2 resin-based sampler can be used to derive semiquantitative information on the vapor-phase concentrations of organochlorines in the atmosphere and is suitable for the measurements of long-term average concentrations at the levels occurring in remote regions.

Development and Evaluation of Stable Isotope and Fluorescent Labeling and Detection Methodologies for Tracking Injected Bacteria During In Situ Bioremediation
Fuller, M. E. (Shaw Environmental Inc., Lawrenceville, NJ); T.C. Onstott (Princeton Univ., NJ).
Report No: DOE/ER/62712-1, 11 pp, Nov 2003

This report summarizes the results of a research project conducted to develop new methods to label bacterial cells so that they could be tracked and enumerated as they move in the subsurface after they are introduced into the groundwater (i.e., during bioaugmentation). Labeling methods based on stable isotopes of carbon (13C) and vital fluorescent stains were developed. Both approaches proved successful for effectively labeling bacterial cells. Several methods for enumeration of fluorescently-labeled cells were developed and validated, including near-real time microplate spectrofluorometry that could be performed in the field; however, the development of a novel enumeration method for the 13C-enriched cells, chemical reaction interface/mass spectrometry (CRIMS), was not successful due to difficulties with the proposed instrumentation. Both labeling methodologies were successfully evaluated and validated during laboratory- and field-scale bacterial transport experiments. The methods developed during this research should be useful for future bacterial transport work, as well as other microbial ecology research in a variety of environments.
http://www.osti.gov/dublincore/gpo/servlets/purl/820180-DgF6xs/native/820180.pdf

Development of an On-Line Biological Early Warning System Using Japanese Medaka (Oryzias Latipes) for Monitoring a Mixture of Toxic Chemicals in Water Supplies
Kang, I.J. (SEIKO Electric Co., Ltd., Fukuoka, Japan); Y. Oshima; H. Kunimaru; M. Yamasuga; F. Okamoto; T. Honjo.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Abstract 729, 2004

For real-time monitoring of unexpected toxicants and chemical mixtures released into water supplies, researchers have developed an on-line fish-sensor system using Japanese medaka (medaka-sensor, Seiko Electric Co., Ltd, Japan) and tested the detection ability of the medaka-sensor for mixed toxic, complex chemicals in an aquarium flow system. Two cameras tracked the behavior of medaka, and images from the cameras were used to calculate the behavior of fish in three dimensions. These data were analyzed on a computer in real time to detect abnormal or deviant behaviors. In a previous study, this system could quickly detect toxicity of individual chemicals (e.g., 10 ppm of potassium cyanide in 10 min). For chemical mixture testing, medaka were exposed to a mixture of phenol (12.5 and 50 ppm) and potassium cyanide (1 and 10 ppm) for 1 hour. In another test, medaka were exposed to a mixture of several pesticides (fenitrothion, diazinon, benthiocarb and atrazine). The medaka-sensor system was able to detect abnormal behaviors. The authors discuss these tests and compare the mixed toxicity test results with the results of the individual chemical toxicity tests.

Development of an On-Line Biological Early Warning System Using Light Emitting Bacteria: the End of Analytical-chemical Techniques?
Appels, Joep, microLAN B.V., Waalwijk, The Netherlands.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Abstract 733, 2004

The use of a biomonitor in drinking water production as part of an early warning system has become widespread and accepted all over the world. These biological protection systems closely and continuously follow the continuous effect of toxicants on producers (algae), consumers (daphnia, fish, mussels) and destruents (light-emitting bacteria), 365 days per year. The University of Regensburg developed a completely automated system using freshly cultivated light-emitting bacteria (Vibrio fischeri) as a biological sensor, but the early version of the system did not meet all requirements for an ideal early warning system. With input from potential users of the system, the monitor was changed to meet their specific needs. This presentation details the latest version of a biological early warning system (BEWS) that provides a useful screening tool for toxicity problems and combines well with analytical chemical techniques.

Development of Gene Expression Fingerprints for Identification of Environmental Contaminants Using cDNA Arrays
Inouye, L.S.; C.Y. Ang; V.A. McFarland.
Report No: ERDC-TN-DOER-R4, NTIS: ADA427522, 16 pp, Sep 2004

This technical note reports the current status of work being done at the U.S. Army Engineer Research and Development Center (ERDC) to develop cDNA array-based assays that map gene expression from contaminant exposures. Results substantiate that distinct gene expression profiles exist for major contaminant classes, such as PARs, PCBs, and PCDD/Fs. Results also indicate that identification of these contaminant mixtures in environmental media is possible by examining their effects on gene expression in mammalian cells. Research at ERDC directed at developing screening assays for contaminated sediments has been applied to extracts of both sediments and the organisms living in them. Several microbial and cell-based in vitro methods are now routinely used for this purpose. These were described, and the possibilities of using cDNA arrays in a screening assay were explored, in a technical note (Inouye and McFarland, TN-DOER-C19, 2001). Briefly, cDNA arrays allow quantification of gene expression profiles (genes that are "turned on or off" at a selected time) providing a "fingerprint" of the sub-cellular responses of the test subject, e.g., cultured human liver cells, to a chemical challenge. While current in vitro tests such as the 101L cell-based assay for dioxin equivalents (see Ang et al., TN-DOER-C10, 2000) offer inexpensive and rapid screening of one endpoint, cDNA arrays offer the potential for simultaneous screening of multiple endpoints and mixtures of contaminants. The activation of multiple genes related to disruption of normal cell functions, such as apoptosis, tumor suppression, cell proliferation, cell cycles, cytokines, oxidative stress, and more, can be measured in a single exposure using eDNA arrays. The resulting information can provide valuable insights into the toxic modes of action of mixtures of contaminants present in sediments. http://handle.dtic.mil/100.2/ADA427522

Developments in a Normal Mode Helical Electrical Antennae Crosshole Instrumentation and Integrated Interpretation System
Ross Groom, PetRos EiKon Inc, Milton, ON and Cliff Candy, Frontier Geosciences, Vancouver, BC
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, SPT-4, 10 pp, 2001

Modeling studies have indicated the usefulness of lower frequency antennae in a wide range of applications, but antennae lengths and efficiencies under conventional design have prohibited application at this lower range. The use of normal mode helical antennae (NMHA) provides the opportunity to exploit a range of frequencies lower than those employed with conventional antennae design, while retaining the resolution and sensitivity advantages of these techniques. The lower frequencies are accessible using a NMHA system, with the antennae providing acceptable efficiencies from a compact downhole device both in length and thickness. In conjunction with instrument development, researchers have developed simulation capabilities both for the antennae radiation pattern and electromagnetic wave scattering in a 3-D environment, allowing for contrasts in resistivity, electrical permittivity and magnetic permeability. Data representation techniques have been developed to display data effectively in one, two and three dimensions. Useful tomographic techniques have been developed for the system to accommodate near-field scattering and curved boreholes. Survey techniques and data are presented for several different types of applications: a landfill site with leachate contamination, an industrial site with industrial cleaning solution contamination, a calibration site with detailed logs, and a survey to study groundwater geometry in a glacial till environment.

Diagnostic Tools For Performance Evaluation of Innovative In Situ Remediation Technologies at Chlorinated Solvent Contaminated Sites

Deeb, R.A. (Malcolm Pirnie, Inc., Emeryville, CA); M. Kavanaugh; K. Goldstein; B. Parker; J. Cherry; K. Sorenson; L. Alvarez-Cohen; D. Mackay; M. Einarson; M. Goltz; M. Annable; K. Hatfield.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 160, 2003

The performance of groundwater remediation systems at chlorinated solvent contaminated sites generally has been evaluated using point measurements of dissolved contaminant concentrations in aquifers (e.g., changes in maximum concentrations, plume extent, etc.). Such an approach has significant limitations that may greatly affect the evaluation of technology effectiveness at contaminated sites. First, detailed monitoring of contaminant plumes in granular geologic media conducted by other researchers has shown that the distribution of dissolved contaminants is often spatially complex due to factors such as spatial variability of contaminant distribution in the subsurface source zone, variability of groundwater flow rate and direction, and variation in water level. It may often be difficult to impossible for typical groundwater monitoring efforts, especially those relying on sparse networks of long-screened wells, to determine where the majority of the contaminant mass is migrating and thus whether or not remediation systems are effectively reducing that migration. Second, at sites with complex geologies (e.g., fractured rock), the evaluation of in situ technology performance is complicated further by contaminant migration through discrete fractures. To better evaluate the success of in situ remedial systems at chlorinated solvent contaminated sites, a set of diagnostic tools is being applied at three hydrogeologically distinct sites employing a range of innovative in situ chemical, biological, and physical treatment technologies. The proposed diagnostic procedures include technology- and geology-specific tools, as well as those that can be used widely, irrespective of the type of technology or site conditions. Mass flux measurement provides a technology-wide metric of overall system performance because it can clearly demonstrate a reduction in the rate of contaminant mass release from the treated zone. Innovative technology-specific tools (e.g., molecular tools for in situ bioremediation) and geology-specific tools (e.g., rock crushing at fractured bedrock sites) are also being tested for a real-time diagnosis of performance. This presentation describes technical accomplishments to date related to the project.

Diamond Paste Based Electrodes for the Determination of Pb(II) at Trace Concentration Levels

Stefan, Raluca-Ioana and Semere Ghebru Bairu, Univ. of Pretoria, Pretoria, South Africa.
Talanta, Vol 63 No 3, p 605-608, 17 June 2004

Three types of monocrystalline diamond--natural diamond 1 m, synthetic diamond 50 m (synthetic-1), and synthetic diamond 1 m (synthetic-2)--were used for electrode construction. Low detection limits between 10 and 100 pmol/L prove the sensitivity of the electrodes. Lead was determined with high reliability from water and tea samples at trace concentration levels using the diamond paste-based electrodes.

Differential Mobility Spectrometry of Chlorocarbons with a Micro-Fabricated Drift Tube

Eiceman, G.A. (New Mexico State Univ., Las Cruces); E.V. Krylov; B. Tadjikov; R.G. Ewing; E.G. Nazarov; R.A. Miller.
Analyst, Vol 129 No 4, p 297-304, Apr 2004

Chlorocarbons were ionized through gas phase chemistry at ambient pressure in air and resultant ions were characterized using a micro-fabricated drift tube with differential mobility spectrometry (DMS). Positive and negative product ions were characterized simultaneously in a single drift tube equipped with a 3 mCi 63Ni ion source at 50 degrees C and drift gas of air with 1 ppm moisture. A DMS analyzer with a membrane inlet continuously monitored effluent from columns of bentonite or synthetic silica beads to determine breakthrough volumes of individual chlorocarbons. These results suggest the potential of DMS for monitoring subsurface environments either on site or (perhaps) in situ.

Diffusive Gradients in Thin Films (DGT) for Monitoring Bioavailable Contaminant Stripping (BCS) by the As Hyperaccumulator Pteris vittata L.
Fitz, W.J. and W.W. Wenzel (Univ. of Agricultural Sciences, Vienna, Austria); H. Zhang; J. Nurmi and G. Kollensperger; K tipek and Z. Fischerova; G.J. Stingeder.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-III, p 144-145, 2003

In phytoremediation studies, researchers have learned that total concentrations are not a good measure of pollutant bioavailability. The concept of bioavailable contaminant stripping (BCS) aims at removing only the bioavailable (or phytoavailable) metal/metalloid fraction. Phytoextraction remedies may require measurements other than total elemental concentrations to monitor efficiency and longevity of the remedial action with respect to pollutant bioavailability. The diffusive gradients in thin films (DGT) technique is a promising alternative for risk assessment of metal-polluted soils in order to predict element concentrations in plants. Unlike commonly used chemical extractants, DGT is founded on kinetic rather than equilibrium principles, allowing the measurement of elemental fluxes. The method interposes a well-defined diffusive layer between the soil and the fixing agent. The authors describe the results of a rhizobox experiment conducted to assess DGT-induced fluxes in bulk and rhizosphere soil of the arsenic hyperaccumulator Pteris vittata L.

Direct-Push Geochemical Profiling for Assessment of Inorganic Chemical Heterogeneity in Aquifers
Schulmeister, M.K., J.M. Healey, and J.J. Butler Jr (Kansas Geological Survey, Univ. of Kansas, Lawrence); G.W. McCall (Geoprobe Systems Inc., Salina, KS).
Journal of Contaminant Hydrology, Vol 69 No 3-4, p 215-232, Apr 2004

A direct-push based approach for high-resolution inorganic chemical profiling was developed at a site where sharp chemical contrasts and iron-reducing conditions had been observed. The direct-push profiling results were compared with results from existing multilevel samplers (MLSs). Chemical profiles obtained with a conventional direct-push exposed-screen sampler differed from those obtained with an adjacent MLS because of sampler reactivity and mixing with water from previous sampling levels. The sampler was modified by replacing steel sampling components with stainless steel and heat-treated parts and the addition of an adapter to prevent mixing. Profiles obtained with the modified approach were in excellent agreement with those obtained from an adjacent MLS for all constituents and parameters monitored (Cl, NO3, Fe, Mn, DO, ORP, specific conductance and pH). The discrete-depth capability of this approach allows inorganic chemical variations to be described at a level of detail that has rarely been possible.

Discriminating between Copper and Silver Mill Tailings in Silver Bow Creek Overbank Deposits, Butte, Montana, U.S.A.
Davis, A. and S.O. Helgen (Geomega, Boulder, CO); T. McNulty (T.P. McNulty and Associates, Tucson, AZ).
Environmental Forensics, Vol 2 No 3, p 249-259, Sep 2001

Approximately 2.9 m tons of overbank deposits comprising sediment intermixed with tailings (largely from silver and copper mining) lie along Silver Bow Creek between Butte, MT, and the Warm

Springs Ponds. To apportion the associated costs, investigators had to discriminate between ownership liability for the silver and copper tailings. Samples were collected from mine tailing end-members and Silver Bow Creek deposits, and their characteristic mineralogy (e.g., galena for silver tailings and enargite for copper tailings) was used to ascertain mixing of the tailings along the creek. The analysis identified Pb as a signature element for silver tailings and Cu for copper tailings. Over 200 Cu and Pb chemical analyses representing 43 transects through the overbank deposits along the creek allowed calculation of the proportional contribution of the end members for each integrated transect, producing an apportionment of 53% copper and 47% silver tailings in the overbank deposits.

A Disposable Amperometric Biosensor for Rapid Screening of Anticholinesterase Activity in Soil Extracts
Guerrieri, A.; L. Monaci; M. Quinto; F. Palmisano.
Analyst, Vol 127 No 1, 5-7, Jan 2002

A disposable amperometric biosensor for the determination of anticholinesterase activity in soil extracts was obtained by co-crosslinking acetylcholinesterase and choline oxidase with bovine serum albumin using glutaraldehyde. An inhibition percentage of 38 plus or minus 4% was recorded for soil extracts spiked with 10 ppb of ethyl parathion. The device has the potential to be used as a gross sensor for assessing anticholinesterase activity in soil extracts.

Economic and Performance Based Design of Monitoring Systems for PRBs
Elder, C., C. Benson, G. Eykholt.
Proceedings of the 2001 International Containment and Remediation Conference, Inst. for International Cooperative Environmental Research, Florida State Univ., Tallahassee, FL. 5 pp, 2001

Monitoring well configurations were evaluated for horizontal permeable reactive barriers (HPRBs) and funnel and gate PRBs (FGPRBs) on their ability to detect the median (C50), 75th percentile (C75), and 90th percentile (C90) of effluent concentration. Using a second-order stochastic model and input into MODFLOW, an HPRB or FGPRB was simulated within a heterogeneous aquifer by replacing appropriate finite difference cells of the model with hydraulic conductivities representative of the barrier. The most economical lateral and vertical well spacing was determined to be about 5 and 3 m, respectively for the HPRB, and 2 and 4 m, respectively for the FGPRB.
http://www.uwgeotech.org/Old%20Website%20Files/pubs/gwmr_elder_economic.pdf

Effect of Different Phases of Diesel Biodegradation on Low Frequency Electrical Properties of Unconsolidated Sediments
Abdel Aal, Gamal Z. (Univ. of Missouri-Rolla); E.A. Atekwana; L.D. Slater; E.A. Atekwana.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 386-395, 2004

Low frequency electrical measurements were made in laboratory sand columns contaminated with different phases of hydrocarbon and undergoing biodegradation to investigate the effect of microbial processes on the low-frequency electrical properties and to determine if the phase of hydrocarbon (dissolved or residual) contamination showed measurable differences in the electrical properties of the sediments during biodegradation. The results were consistent with models that suggest that residual hydrocarbons trapped in the pore sediments are more freely available for degradation by bacteria than in the dissolved phase, resulting in a relatively higher rate of biodegradation and accompanying biogeochemical alterations as reflected in the electrical measurements. The authors conclude from the study results that microbial processes can affect electrical properties and the accompanying physicochemical alterations at the mineral-fluid interface are readily detectable using low-frequency electrical measurements.

Electrical Imaging of Permeable Reactive Barrier (PRB) Integrity
Slater, Lee (UMKC, Kansas City, MO); Joe Baker (Honeywell FM & T, Kansas City, MO); Andrew Binley (Lancaster Univ., Lancaster, UK); Danney Glaser and Isaiah Utne (UMKC, Kansas City).
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC3, 2002

A permeable reactive barrier (PRB) typically contains a reactive medium of granular iron, which degrades chlorinated organics into potentially nontoxic dehalogenated organic compounds and inorganic chloride. Geophysical methods may assist assessment of in situ barrier integrity and evaluate long term barrier performance. The highly conductive granular iron makes a PRB an excellent target for electrical imaging methods. Surface and cross-borehole electrical imaging were conducted at the PRB installed at DOE's Kansas City plant. Poor signal strength and insensitivity at depth resulting from current channeling in the highly conductive iron limited surface imaging. Cross-borehole electrical measurements were highly effective at defining an accurate cross-sectional image of the barrier in situ. Cross-borehole images obtained for seven panels along the barrier showed significant variability in barrier integrity along the installation and suggested variability in the integrity of the contact between PRB and bedrock. This non-invasive in situ evaluation of barrier geometry has broad implications for the evaluation of PRB performance as a passive hydrocarbon treatment approach.

Electrical Imaging of Tracer Migration at the Massachusetts Military Reservation, Cape Cod
Singha, K. (Stanford Univ., Stanford, CA); A.M. Binley (Lancaster Univ., Lancaster, UK); J.W. Lane Jr. (U.S. Geological Survey, Storrs, CT); S.M. Gorelick (Stanford Univ., Stanford CA).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 464-474, 2003

Electrical resistivity tomography (ERT) was investigated as a method to provide spatially continuous information about aquifer properties through imaging of tracer flow and transport in an unconfined aquifer at the Massachusetts Military Reservation, Cape Cod, MA. During the summer of 2002, high-resolution 3-D images of the movement of an electrically conductive sodium-chloride tracer were captured in both space and time to help delineate aquifer heterogeneity. Sixty 3-D data sets were collected between four corner-point wells for 20 days following the 9-hour tracer injection. Concentrations were measured at a 15-point multilevel sampler centrally located within the ERT array, at the production well, and at two wells external to the central array. The tomograms indicate movement of the saline tracer consistent with measured concentration data.

Electrochemiluminescence Enzyme Immunoassay for TNT
Wilson, Robert, Charles Clavering, and Alistair Hutchinson.
Analyst, Vol 128 No 5, p 480-485, 2003

An electrochemiluminescence (ECL) enzyme immunoassay for TNT is carried out in a computer-controlled flow injection electrochemiluminometer. This system is used to select and pump solutions through a flow cell, which contains a gold working electrode as part of a three-electrode arrangement. Antibodies are labeled with the enzyme glucose oxidase and used in competitive immunoassays in which the separation step is carried out by concentrating unbound antibodies on the immunosorbent surface. Hydrogen peroxide generated by the enzyme label when glucose is pumped through the flow cell is detected using luminol ECL. Light intensity was inversely proportional to the concentration of TNT in the sample in the range 0 to 100 ppb. The details of the immunoassay and computer-controlled flow injection electrochemiluminometer are discussed, as well as the potential for developing a portable instrument for field use.

Electromagnetic Mapping (EM MAP) of Perched Water to Improve Remedial Activities at Hill Air Force Base
Phillips, T. (HGT, Inc.); M. Cox (CH2MHill, Inc.).
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, GW1-5, 9 pp, 2001

This report contains a description of how a proprietary geophysical technique was used to define the sources of a groundwater plume contaminated with light nonaqueous phase liquids (LNAPLs) in and around Operable Unit 1 (OU1) on the eastern side of Hill Air Force Base, UT. The investigators also sought to locate subsurface channels for the plume that extended into off-base areas. Results of the geophysical surveys defined water channels feeding seeps along the east and north sides of two landfills within OU1. An additional survey defined sources for groundwater recharge. Channels contributing to the off-Base groundwater were mapped separately. When coupled with the other investigative tools used at OU--monitoring well/piezometer installations, cone penetrometer tests, and soil borings--the technique improves the overall understanding of groundwater flows at the site and provides a higher degree of confidence in the siting of other investigative tools. The technique also provided essential data for the design of a groundwater interception trench to connect contaminated groundwater and LNAPLs. This proprietary geophysical technique is based on U.S. Patent 5,825,188.

Elemental Speciation: An Environmental and Forensic Challenge and an Approach to the Analysis Uncertainty
Kingston, H.M. Skip, Mizanur Rahman, John Kern, Matt Pamuku, Karin Rosen, Ye Han, Dingwei Huo, and Theo Towns, Duquesne Univ., Pittsburgh PA.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 10.

Some elemental species undergo conversion or degradation of the species of interest during sampling, storage, sample preparation and the measurement steps. Two elements that are well known to exhibit this behavior are the many species of mercury and chromium. There have been no diagnostic tools to trace the fate of species until recently because conventional speciation methods can only measure species concentrations in the final solutions at the time of measurement. Knowing the transformation of the species is critical in the development and validation of methods and for the certification of standard reference materials. Speciated isotope dilution mass spectrometry (SIDMS), which addresses the correction for such degradation or conversions, has been developed (U.S. Patent 5,414,259) and successfully addresses these difficult measurement needs. It has been demonstrated to accurately determine the species concentrations at both the time of spiking and of measurement. SIDMS has the potential to be used as a diagnostic tool to validate other methods and to certify speciated standards. By spiking the sample at each step with enriched stable isotopes of the same species, SIDMS can be used as a diagnostic tool to identify the steps at which the species are altered. EPA Method 6800, 'Elemental and Speciated Isotope Dilution Mass Spectrometry,' (SW-846) has been evaluated and validated or is under validation for different species. One limitation that has retarded the use of SIDMS is the lack of standards that are isotopically enriched for use in this method, but they are now being made. Mathematical support is being prepared at Duquesne University in conjunction with U.S. EPA to enable the solving of one-, two-, and three-species transformational problems.

An Empirical Analysis of the Groundwater-to-Indoor-Air Exposure Pathway: The Role of Background Concentrations in Indoor Air
McHugh, Thomas, John Connor, and Farrukh Ahmad, Groundwater Services, Inc., Houston, TX.
Environmental Forensics, Vol 5 No 2, p 33-44, Mar 2005

A database of 270 paired groundwater and indoor air measurements of volatile organic compounds (VOCs) from 31 sites has been compiled and analyzed to further scientific understanding of the groundwater-to-indoor-air exposure pathway. Using regression analyses, these data have been analyzed to detect evidence of indoor air impacts from dissolved petroleum hydrocarbons or chlorinated solvents in underlying groundwater, estimate the true attenuation factor for volatilization from groundwater to indoor air, and assess the utility of popular groundwater-to-indoor-air transport models for evaluating this exposure pathway. The database reveals that more than 95% of the indoor air concentrations fall within or below the range of national background indoor air values, with no correlation between petroleum constituent concentrations measured in groundwater and the concentrations of these VOCs in indoor air of overlying structures. A correlation between groundwater and overlying indoor air is seen for chlorinated solvent cases; however, the average true attenuation factor, after correcting for background, is approximately 6.9x10(-5), well below the default 1x10(-3) value used by EPA's Draft Vapor Intrusion Guidance to determine groundwater screening levels.

Environmental Applications of Geophysical Surveying Techniques
Gibson, Paul and Dorothy M. George, National Univ. of Ireland, Republic of Ireland.
Nova Publishers, Hauppauge NY. ISBN:1-59033-782-4, 2003

The nature of the subsurface is important to humans for reasons ranging from ascertaining the stability of structures to locating minerals, oil, or hazardous contaminants underground. A substantial percentage of our drinking water comes from groundwater aquifers, and contamination of these aquifers by effluent or leachate from landfill sites is a major concern. Geophysical techniques provide the tools required to obtain useful information about the subsurface. Geophysics is a science that transcends the usual disciplinary boundaries and thus this book will benefit engineers, planners, archaeologists, hydrologists, geographers, and environmental scientists. The authors aim to explain the theoretical basis behind the main geophysical techniques used in environmental investigations, discuss the equipment used in such investigations, and provide case studies of the use of the techniques.

Environmental Instrumentation and Analysis Handbook
Down, Randy D. and Jay H. Lehr (eds.).
Wiley, New York. ISBN: 0-471-46354-X, 1102 pages, 2004

A myriad of regulations exist through which the government sets and maintains standards for dealings with the natural world. Keeping on top of this vast array of information is crucial to engineers and scientists across several disciplines and industries. This handbook presents a compilation of technical information on the design and application of instrumentation used specifically to measure and analyze contaminants in air, water, and soil.

Estimating the Minimum Age of a Chlorinated Solvent Plume in Ground Water with Chlorofluorocarbon (CFC) and Tritium Methodologies: A Case Study
Oudijk, Gil, Triassic Technology, Inc., Princeton, NJ.
Environmental Forensics, Volume 4 No 1, p 81-88, Mar 2003

A method that has historically been used in the hydrology field to determine recharge ages of groundwater can be applied to estimating the minimum age of contaminant discharges. Chlorofluorocarbons (CFCs) and tritium are anthropogenic substances present in the atmosphere over the past half century. These constituents recharge the groundwater through precipitation and can be used as an age marker. In cases where the recharge water is in contact with contaminants, the CFCs and tritium may be used to estimate the minimum age of the contaminant release.

Evaluation of a New Purge and Trap On-Line Interface for the Real Time Analysis of VOCs in Aqueous Streams
Krigbaum, Mark, Teledyne Tekmar, Mason, OH.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, P6.

The new On-line Purge and Trap Interface eliminates the need for grab sampling and provides a solution for Homeland Defense drinking water protection and spill detection via sampling water intakes on public water sources, such as rivers, lakes, and reservoirs. Water treatment facilities also can monitor automatically various stages of the water treatment process for the generation of disinfection byproducts (e.g., trihalomethanes). The interface delivers water samples from up to six separate streams to the Velocity XPT(TM) Purge and Trap Concentrator for volatile organic compound (VOC) analysis. Standard solutions are automatically added to the 5 or 25 mL sample aliquot. The interface can be configured with a vial autosampler to run continuing calibration checks from vials intermixed with stream samples. The entire system is controlled using a special PC software allowing for unattended sampling and analysis at pre-arranged times. The presentation discusses setup and sequencing requirements and provides calibration, control sample, and results data from a large water treatment utility.

Evaluation of Airborne Thermal Infrared Imagery for Locating Mine Drainage Sites in the Lower Kettle Creek and Cooks Run Basins, Pennsylvania, USA
Sams, James I. III and Garret A. Veloski.
Mine Water and the Environment, Vol 22 No 2, p 85-93, 2003

High-resolution airborne thermal infrared (TIR) imagery data were collected over 90.6 square km of remote and rugged terrain in the Kettle Creek and Cooks Run Basins in north-central

Pennsylvania to evaluate the effectiveness of TIR for identifying sources of acid mine drainage (AMD). Many old abandoned mines are scattered throughout the area, but little detailed mine information was available, particularly for the source locations of AMD sites. Potential AMD sources were extracted from airborne TIR data employing custom image processing algorithms and GIS data analysis. Field reconnaissance of 103 TIR anomalies resulted in the classification of 53 sites (51%) as AMD sources. These sources had low pH (<4) and elevated concentrations of iron and aluminum. Twenty-six of the sites had been previously documented as AMD, while the other 27 were undocumented. This paper summarizes the procedures used to process the TIR data and identify potential mine drainage sites and methods used for field reconnaissance and verification of TIR data.
http://www.netl.doe.gov/products/r&d/techpapers/2003-144.pdf

Evaluation of Airborne Thermal Infrared Imagery for Locating Mine Drainage Sites in the Lower Youghiogheny River Basin, Pennsylvania, USA
Sams, James I., III; G.A. Veloski, and T.E. Ackman, USGS, Pittsburgh, PA.
Mine Water and the Environment, Vol 22 No 2, p 94-103, 2003

In 1999, nighttime high-resolution airborne thermal infrared imagery (TIR) data were collected from a helicopter platform over the Youghiogheny River, from Connellsville to McKeesport, in southwestern Pennsylvania. The TIR data were used to identify sources of acid mine drainage (AMD) from abandoned mines that discharge directly into the Youghiogheny River. Image processing and geographic information systems (GIS) techniques identified 70 sites within the study area as possible sources. The combination of GIS datasets and the airborne TIR data provided a fast and accurate targeting method. Field reconnaissance determined that 24 of the 70 sites were mine drainage sources. This paper summarizes the procedures used to process the TIR data and extract potential AMD sites, methods used to verify the TIR data, factors that affected the TIR data, and a brief summary of the area's water quality.
http://www.netl.doe.gov/products/r&d/techpapers/2003-143.pdf

Evaluation of Permeable Reactive Barrier (PRB) Integrity Using Electrical Imaging Methods
Slater, Lee and Andrew Binley, Rutgers Univ., Newark, NJ.
Geophysics, Vol 68 No 3, p 911-921, 2003

A permeable reactive barrier (PRB) most commonly contains granular iron as the reactive medium that degrades chlorinated organics into potentially nontoxic dehalogenated organic compounds and inorganic chloride. The highly conductive granular iron makes the PRB an excellent target for conductivity imaging methods. Electrochemical storage of charge at the iron/solution interface generates an impedance that decreases with frequency, and the PRB is thus a potential induced polarization (IP) target. Surface and cross-borehole electrical imaging (conductivity and IP) was conducted at a PRB installed at DOE's Kansas City plant. Cross-hole 2-D and 3-D electrical measurements were highly effective at defining an accurate cross-sectional image of the barrier in situ. Both the conductivity and IP images reveal the barrier geometry. Cross-hole images of seven panels along the barrier suggest variability in iron emplacement along the installation. On five panels, the PRB structure is imaged as a conductive feature exceeding 1 S/m, but on two panels the conductivity in the assumed vicinity of the PRB is less than 1 S/m. The images also suggest variability in the integrity of the contact between the PRB and bedrock. Noninvasive geophysical methods may assist assessment of in situ barrier integrity and evaluation of long-term barrier performance.

An Evaluation of Tracers for Use in Vadose Zone Investigations at the Idaho National Engineering and Environmental Laboratory
Wright, Karen E. and Laurence C. Hull, Idaho Completion Project, Idaho Falls, ID.
ICP/EXT-04-00334, 52 pp, July 2004

Four naphthalene sulfonate compounds were tested for use as conservative vadose-zone tracers. A well-studied and conservative tracer, 2,4,5 trifluorobenzoic acid, was carried through the experimental procedure for comparison. The experimental design adopted was a four-way classification with three replicates for each treatment. Factors tested were tracer, vadose zone material, tracer concentration, and time. Using a batch method, we exposed aliquots of vadose zone materials to low (10 ppb) or high (1 ppm) concentrations of the tracers. Materials chosen for study consisted of a surface playa sediment, two composite interbed sediments, and a composite crushed basalt sample. The effect of time on sorption was tested by contacting the materials for 1, 3, 10, and 14 days. Trifluorobenzoic acid concentrations used were 500 ppb and 10 ppm because of less sensitive detection limits. Naphthalene sulfonates were measured using high-performance liquid chromatography, and trifluorobenzoic acid was measured using ion chromatography. We found 2,4,5 trifluorobenzoic acid and 1,5 naphthalene disulfonate to be conservative with no statistically significant sorption to any of the four materials, for either concentration, for up to 14 days. For the first 10 days of contact, 1,3,6 naphthalene trisulfonate trisodium showed no statistically significant sorption, but showed significant sorption at 14 days. 2 Naphthalene sulfonate is removed from the aqueous phase within one day, with nearly 40% removed for low concentrations after 14 days. Analytical interferences prevented the quantification of 2,7 naphthalene disulfonate disodium. Two tracers tested, 2,4,5 trifluorobenzoic acid, and 1,5 naphthalene disulfonate, were conservative and are useful as vadose zone tracers. For tracer tests of less than 14 days, 1,3,6 naphthalene trisulfonate trisodium could be useful.
http://ar.inel.gov/images/pdf/200407/2004072800793GSJ.pdf

Experimental and Theoretical Assessment of Cross-Well Radar for DNAPL Imaging
Farid, M., A.N. Alshawabkeh, and C.M. Rappaport, Northeastern Univ., Boston, MA.
PowerPoint presentation, 14 pp, 2004

PowerPoint presentation; no abstract.
http://www.censsis.neu.edu/RICC/2004/presentations/mfarid.pdf

Experimentally Determined Holding Times for Environmental Samples Containing Low Levels of Perchlorate
Stetson, S. and R. Wanty (USGS, Denver, CO); D. Macalady (Colorado School of Mines, Golden).
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PH010, 2004

The stability of perchlorate in water samples has not been thoroughly examined, which means that scientifically defensible holding times of perchlorate-bearing samples and standards have yet to be determined. This paper details a study to determine the long-term stability of perchlorate standards in deionized water and in a common water matrix. Sets of samples containing 1000, 100, 10, and 0 g/L perchlorate in deionized water and in local tap water were formulated. These samples were analyzed for perchlorate concentration against freshly prepared standards every 24 hours for the first seven days, biweekly for the next four weeks, and weekly after that for a total of 25 weeks. The results from this 6-month study are presented with a recommendation for maximum holding times of perchlorate samples after collection.

Eye on Organics: Fluorescence Method Allows Imaging and Tracking of Chemicals in Plant Cells
Ritter, Stephen K.
Chemical & Engineering News, 20 July 2004

Two-photon excitation microscopy (TPEM), a fluorescence technique commonly used to image cell and tissue samples of plants and animals, has been used for the first time to visualize how organic compounds from pesticides or air pollution migrate through the cellular structure of living plants. Potential uses of the novel application include improving the design and use of pesticides, tracking the migration of chemicals from packaging into food, and designing new strategies for bioremediation of contaminated soil. In TPEM, a laser is used to excite a biological sample with two low-energy photons, which combine at a focal point with sufficient energy to induce fluorescence without damaging the prepared sample. Fluorescent dyes, green fluorescent protein tags, or other markers typically are needed to highlight specific cell structures. The detected fluorescence in turn can be used to generate an image for further study. Researchers at the University of Lancaster, UK, came to realize that the natural fluorescence of some cell structures and aromatic organic compounds could be visualized without the need for fluorescence markers, making it possible to nonintrusively analyze plants at the cellular level and track where the compound of interest might degrade or disperse over time. Using anthracene as a model compound, they developed images that show the chemical as it migrates from the waxy outer surface of corn leaves into the aqueous cytoplasm of epidermal leaf cells.

Fast Sampling and Analysis of Offgas Dioxins/Furans Using a Thermal Desorption-Gas Chromatography-High Resolution Mass Spectrometry Method
Whitworth, C.G. (MSE Technology Applications, Inc., Butte, MT); R.T. Rees; K.G. Reick; J.L. Montgomery; D.M. Battleson; J. LeFever; L.J. Sears.
Waste Management 2002 Symposium, 24-28 Feb 2002, Tucson, Arizona.

DOE is using or evaluating several alternatives to incineration (ATI) technologies for treating hazardous wastes and low-level mixed wastes. ATI treatment technologies may have the potential for generating gaseous or other emissions of polychlorinated dioxins/furans, a class of highly toxic compounds that are regulated to very low levels. Researchers are evaluating gas chromatography/high resolution mass spectrometry (GC/HRMS) as a means to analyze highly contaminated samples. They have found that GC/HRMS provides much improved identification and quantitation of dioxins/furans in the presence of background interfering compounds, and also allows identification of many of the interfering compounds. Identification of the interfering compounds will allow improvements in staged thermal desorption and in other techniques for the purpose of reducing interfering compounds presented to a GC/MS.
http://www.wmsym.org/Abstracts/2002/Proceedings/28b/445.pdf

Feasibility Study of Leak Detection and Emissions Monitoring via Earth Observation Data: Phases I and II
McHugh, Sherry; Ian McDermott; Des Power; Charles Randell, C-CORE, St. John's, Newfoundland.
Gas Research Institute, Des Plaines, IL. Report No: GRI-03/0175, 174 pp, Dec 2003

This report covers Phases I and II of a feasibility study on leak detection and emissions monitoring of natural gas pipelines. In Phase I, issues associated with gas leaks and detection techniques were investigated, and a complete assessment was conducted of the current technologies used in leak detection and the feasibility of using satellite remote sensing to detect underground natural gas leaks. An examination of capabilities of current and future remote sensing satellites determined that there are currently no satellites that can detect methane directly. Future hyperspectral satellites cover the weak overtone bands of methane, but satellites such as MOPPIT or SCIAMACHY have spatial resolutions that are too coarse for use in leak detection. Detecting gas leaks via identification of stressed vegetation was identified as the most likely method of detecting leaks via satellite surveillance, with IKONOS potentially the most successful at detecting stressed vegetation caused by underground leaks. In Phase II, this technology was tested on a simulated pipeline leak in the field. While indication of vegetation stress was observed at one of the two sites monitored, the interpretation was complicated by the recovery of the vegetation following the remediation of the leak simulators. Other approaches to detecting natural gas leaks, such as temperature differences measured with the Landsat 7 sensor or through the Probe-1 hyperspectral sensor, were unsuccessful given the current technical limitations of the resolution and the spectral range, respectively.

Field Analysis of Chromium VI During and After Remediation of a Former Chrome Plating Facility.
Pearson, Thomas W., TechLaw, Inc., Port Orchard, WA.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 34.

To show whether remediation efforts at the Frontier Hard Chrome superfund site were effective, push-probe soil and water samples were taken from various areas within the site after a treatment chemical and cement slurry had been injected. There were about 40 sampling points on the site, based on one per 500 cubic yards of treated soil. The soil and water samples were analyzed at the site for hexavalent chromium (chromate), pH, and oxidation-reduction potential (ORP). Chromate (Cr(VI)) analysis was complicated by reaction of the chromium reagents with the residual treatment chemical in the samples, which necessitated dilution and filtration in most cases. Normal QC procedures such as matrix spikes were not feasible, as the presence of the remediation chemical reduced any chromate added to the samples. The pH and ORP determinations were used to further demonstrate whether chromate could be present in the samples. Further information on remedy performance monitoring at the site is available at http://yosemite.epa.gov/r10/cleanup.nsf/sites/fhc

Field Detector Evaluation of Organic Clay Soils Contaminated with Diesel Fuel
Clark, Clayton J. II, Univ. of Florida, Gainesville.
Environmental Forensics, Vol 4 No 3, p 167-173, Sep 2003

Researchers explored the relationship between two portable field detectors, the flame ionization detector (FID) and the photoionization detector (PID), in analysis of two clay soil sites contaminated with diesel fuel. As in previous research, a log-log linear correlation was found between the PID and FID instruments for diesel fuel-contaminated soil at each site, and the correlation factors between the field instruments at each site were similar. Either field instrument could be used to delineate the diesel fuel contamination at a site based upon a previously calculated correlation between the two instruments, and an overall numerical correlation between the field instruments can be used at various sites of similar soil and contamination characteristics.

Field Evidence for Plant-Enhanced PAH Degradation and Implications for Monitoring Phytoremediation of Petroleum Hydrocarbon Contaminated Soil: Results from RTDF Cooperative Field Tests

Kulakow, Peter A. and Xiujuan Feng, Kansas State Univ., Manhattan.

The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, University of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Participants in the Remediation Technologies Development Forum have been conducting cooperative field trials since 1998 to test phytoremediation of weathered petroleum hydrocarbon contaminated soils. The 13 test locations include refineries, former manufactured gas plants, spill sites, motor vehicle waste areas, and oil production sites. The trials are being conducted to determine if planted vegetation can enhance progress toward meeting practical environmental management objectives for petroleum sites within a three-year period. To monitor the effect of phytoremediation, laboratory analyses were used to determine total petroleum hydrocarbons, polycyclic aromatic hydrocarbons, a hopane biomarker, and petroleum hydrocarbon fractions by the TPH criteria working group method. Eleven locations have completed the planned three-year trial period. Statistical analyses of the lab data show that observable effects of vegetation treatments on hydrocarbon concentrations varied among locations, with some locations showing strong positive effects of vegetation treatments while others show no evidence of treatment effect. High variability, especially at refinery sites, decreased the ability to detect treatment differences. This paper discusses the conclusions and lessons learned in the project.

Field Measurements of Atrazine in Groundwater using Fiber Optic Enzymatic Biosensors

Acha, Victor, Cory D Jensen, Jonathan Jaeger, David S. Dandy, Kevin L. Lear, and Kenneth F. Reardon, Colorado State Univ., Fort Collins.

AIChE 2004 Annual Meeting, November 7-12, Austin, TX.

American Inst. of Chemical Engineers, New York, NY. Presentation 41d, 2004

Herbicides and pesticides such as atrazine are persistent and can remain active for years in the environment, causing ecological damage and risks to human health. There is an urgent need for analytical techniques capable of readily and accurately measuring atrazine at low concentrations, preferably on site and in situ instead of in off-site laboratories, which are expensive and slow. The authors have developed inexpensive, very sensitive fiber optic biosensors (patent pending) for atrazine that are capable of rapid measurements in the field. These sensors consist of a two-layer detection element--a layer of cells containing the detection enzyme affixed to a pH-sensitive fluorophor--immobilized on the distal end of an optical fiber, which is connected to a light source/detection unit. The change in fluorescence depends on the contaminant concentration, and these sensors provide quantitative output over a range of analyte concentration. As characterized in the laboratory, these sensors have sub-ppb limits of quantification and active lifetimes of more than 10 days. Atrazine measurements with the biosensor at an agricultural chemical field site and the results from the laboratory experiments are presented.

Field Portable Microchip Analyzer for Airborne and Surface Toxic Metal Contamination
Collins, Greg E., Naval Research Laboratory, Washington, DC.
Report No: DOE/ER/62711, 13 pp, Sep 2004

The primary research objective of this effort was to develop a portable capillary electrophoresis (CE) microchip capable of sensitively and rapidly monitoring hazardous metal ions (e.g., U, Be, Cr(VI), Hg, Pb, Co, Ni, Cs, Sr) for deactivation and decommissioning efforts at various DOE sites. Inexpensive, compact light sources were utilized as excitation sources, and detection was achieved using compact, inexpensive, photodiode array detectors. Particular emphasis was placed on developing viable new extraction methods for metal ion sampling from both the air via a microimpinger, which was integrated onto the microchip itself, and from contaminated surfaces, both techniques being amenable to on-line introduction onto the microchip. Two different detection methods for monitoring the electrophoretic separations taking place down the microchannel were exploited in this research: indirect and direct detection. Special emphasis was placed on maintaining the ultimate portability of the final microchip device through the careful selection of metallochromic dyes and fluorophores, which were amenable with small, inexpensive light sources (e.g., LEDs) and photodetectors. This report summarizes work from 1998 through 2004.

http://www.osti.gov/dublincore/gpo/servlets/purl/833462-E30cMk/native/833462.pdf

Field-Portable X-Ray Fluorescence (FP-XRF) Determinations of Metals in Post-Blast Ordnance Residues
Walsh, Marianne E., Engineer Research and Development Center, Hanover, NH.
Report No: ERDC/CRREL-TR-04-5, NTIS: ADA422727, 33 pp, Mar 2004

Field-portable X-ray fluorescence (FP-XRF) analyzers, such as the Niton 700, provide rapid, on-site analyses for a variety of elements. FP-XRF was used to determine metals in post-blast ordnance residue that was deposited on snow, which provided large collection surfaces that were free of soil particles. The ordnance items included M67 hand grenades, 40-mm grenades, 60-mm and 81-mm mortar projectiles, 105-mm howitzer projectiles, claymore mines, and C4 demo blocks with M6 blasting caps. For most of these items, the post-blast residue contained lead, iron, copper, and zinc. FP-XRF also was used to determine these elements in soils from training ranges where these ordnance items were used. When present above the FP-XRF limits of detection, the FP-XRF determinations of lead, zinc, and copper did not differ significantly from determinations by laboratory analyses.

http://handle.dtic.mil/100.2/ADA422727
or
http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-5.pdf

Field Screening Method for Perchlorate in Water and Soil
Thorne, Philip G., Applied Research Associates, South Royalton, VT.
Report No: ERDC/CRREL Technical Report 04-8, 36 pp, Apr 2004

Federal and state regulatory agencies are concerned about the possible adverse effects of perchlorate (ClO4-) contamination in drinking water, as the anion is known to target the human thyroid gland and its metabolic hormone-producing function. A reliable and inexpensive colorimetric method for perchlorate in water and soil extracts has been developed and tested with surface water, well water, bioreactor effluent, and soil extracts. The detection limit for water is 1 mg/L and 0.3 mg/g for spiked soils. A 0.5-L sample of water or a 1-mL sample of aqueous soil extract is passed through a solid-phase extraction cartridge that has been conditioned with a perchlorate-specific ion-pair reagent. Perchlorate, as well as small quantities of chlorate and major ions, is retained. A rinse step removes the interferences

and the perchlorate is eluted into an ion-pairing dye in a 13 x 100-mm test tube. A 1-mL aliquot of xylene is added, the tube is shaken, and the dye pair extracts into the xylene that separates into a layer lying in the light path of a standard portable spectrophotometer. Results from nearly 100 well-water and bioreactor samples show excellent agreement with EPA Method 314 over the range of 1 to 225 mg/L (slope = 1.11, R2 = 0.913). Some false positives were encountered in some wells. A cleanup method was developed that can eliminate false positives due to humic substances. The colorimetric method is being adapted to an automated on-line monitor.
Available at http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-8.pdf

Field Test of an Ultraviolet Differential Optical Absorption Spectrometer for Remote Air Toxics Sensing
Scheff, Peter A., Richard A. Wadden, and Lorraine Lardizabal (Univ. of Illinois, Chicago); Donna Kenski (U.S. EPA, Region 5).
U.S. EPA, Technology Innovation Office, Washington, DC. 98 pp, 2001

Researchers evaluates the use of UV-DOAS during and after capping and slope stabilization activities at the Paxton landfill in southeast Chicago. Due to the temporary nature of this project, the projector was bolted onto a wooden pallet, which was secured to the roof of one trailer located on the north end of the landfill, and the receiver was placed near an open window inside another trailer situated at the south end of the landfill. With a monitoring path length of 232 meters and located along the fence line of the landfill, the UV-DOAS reported concentrations of benzene, toluene, m-xylene, styrene, ozone, and nitrogen dioxide every three minutes. The UV-DOAS concentrations for the organic compounds were compared with the data obtained from VOC canister samples placed along the beam path. When detecting benzene, toluene, m-xylene, and styrene, our results show no association between the UV-DOAS and the VOC canister samples; however, when detecting nitrogen dioxide and ozone, a strong association was seen between the UV-DOAS and the direct reading monitors. Even though a strong association was demonstrated between the NO2 and O3 detected by UV-DOAS and the direct reading monitors, the UV-DOAS did not detect organic compound concentrations comparable to those detected by the canister samples. Therefore, the data suggest that the UV-DOAS may not be suitable for organic compound measurements.
http://clu-in.org/programs/21m2/projects/6.pdf

A Field Test of New Tools to Evaluate Management Options for Contaminated Sediments
Schubauer-Berigan, J., R. Brenner, J. Lazorchak, and T. Lyons (U.S. EPA, Cincinnati, OH); E. Foote, V. Magar, J. Abbott, and J. Eastep (Battelle Memorial Inst., Columbus, OH).
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. SETAC, Abstract 410, 2003

Understanding how well different contaminated sediment management approaches work (e.g., dredging, in-place treatment, capping, and monitored natural recovery) in different environments is critical for choosing an appropriate approach to reduce human and ecological risks. The authors present the results of a field test at Lake Hartwell, SC, of some new sampling devices developed to evaluate the effectiveness of strategies for managing PCB-contaminated sediments. Lake Hartwell, a reservoir contaminated with PCBs, is currently being monitored for natural recovery. The field test combined commercial semipermeable membrane devices (SPMDs) with new in situ sampling devices developed for this study to evaluate and quantify PCB movement between sediments and overlying water. Caged fish and clams were also deployed. Congener-specific PCB analysis was performed via mass spectrometry. This paper reports the results.

Fingerprinting of Gasoline and Coal Tar NAPL Volatile Hydrocarbons Dissolved in Groundwater
Sauer, Ted C. and Helder J. Costa, Blasland, Bouck & Lee, Inc., New Bedford, MA.
Environmental Forensics, Vol 4 No 4, p 319-329, Dec 2003

A solubility-based approach to matching dissolved hydrocarbons in groundwater to their source NAPL has been developed and validated for two sites with commonly encountered types of NAPL contamination. A gasoline LNAPL and a coal tar DNAPL from two separate sites (West Virginia and California) and groundwater interfaced with these NAPLs were analyzed for about 50 gasoline-range hydrocarbons consisting of paraffin, isoparaffin, (mono-) aromatic, naphthene, and olefin compounds (PIANO). Solubility characteristics of selected alkyl aromatic hydrocarbons from the PIANO analysis were used to identify a set of diagnostic hydrocarbons, expressed as hydrocarbon ratios, which were found to be useful in distinguishing the source(s) of hydrocarbons in groundwater. Environmental factors such as selective degradation of specific isomers and various geological conditions (e.g., soil mineralogy and organic content) may confound the application of this solubility-based fingerprinting approach, hence it is recommended that multiple diagnostic pairs be simultaneously evaluated when considering this fingerprinting approach for specific sites and product types.

Fingerprinting of Hydrocarbon Fuel Contaminants: Literature Review
Alimi, Hossein (Global Petroleum and Environmental Geochemistry, Woodland Hills, CA); Thomas Ertel and Bettina Schug (UW-Umweltwirtschaft GmbH, Stuttgart, Germany).
Environmental Forensics, Vol 4 No 1, p 25-38, Mar 2003

Environmental fingerprinting is used in the assessment of fuel pollutants to characterize the type of the fuel contaminants, determine their source, and understand their fate in the environment. The authors evaluated the published literature in this area, especially those articles describing new laboratory fingerprinting techniques and new developments in the application of these results to real case studies. This report also focuses on new combinations of analytical techniques for detailed characterization of analytes.

Forensic Analysis of Chlorinated Hydrocarbon Plumes in Groundwater: a Multi-Site Perspective
McNab, Walt W., Exponent-Failure Analysis Associates, Oakland, CA.
Environmental Forensics, Vol 2 No 4, p 313-320, 2001

Forensic analyses of chlorinated hydrocarbon plumes typically entail reviews of site records, flow and transport modeling, and analysis of indicator compounds to gain insights into the behavior of a contaminant plume in the subsurface. Hypotheses pertaining to plume behavior can be tested against a knowledge base of what is typical behavior and what is not. Three example applications of statistical techniques to a multi-site data set are presented to provide background for problems pertinent to forensic analyses. These examples include measuring the frequency of association between selected chlorinated hydrocarbon compounds, assessing the effects of transformation processes on temporal concentration trends in populations of groundwater monitoring wells, and dating plumes, in a relative sense, by concentration correlation analyses.

Gasoline Detection Using GPR in an Urban Area
Dehaini, J., F. Taioli, and W.F. Aquino.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 12GPR11, 7 pp, 2002

This paper presents a case study where GPR was successfully applied to map a contamination plume generated by leaking underground tanks at a gas station in Sao Paulo, Brazil. The contamination was characterized by a 'shadow zone' in the GPR sections that was mapped after appropriate processing, despite the noise common to densely occupied urban areas. The processing was mainly based on the rate of energy content of portions of the signal. After the delineation of the plume, boreholes were drilled in both contaminated and non-contaminated areas. Analysis of the water present in the boreholes confirmed the interpretation of the GPR sections and the precise extent of the contaminant plume, which was larger than previously estimated by a direct investigation.

Geochemical Characterization of Acid Mine Drainage from a Waste Rock Pile, Mine Doyon, Quebec, Canada
Sracek, O. (Laval Univ., Quebec City, Quebec, Canada); M. Choquette; P. Gelinas; R. Lefebvre; R.V. Nicholson.
Journal of Contaminant Hydrology, Vol 69 No 1-2, p 45-71, Mar 2004

Water quality in the unsaturated and saturated zones of a waste rock pile containing sulfides was investigated (1) to evaluate geochemical trends, including the acid mine drainage (AMD) buffering mechanism and the role of secondary minerals, and (2) to investigate the use of stable isotopes for the interpretation of physical and geochemical processes in waste rock. Pore water in unsaturated zone was sampled from suction lysimeters and with piezometers in underlying saturated rocks. The investigation revealed strong temporal (dry period vs. recharge period), and spatial (slope vs. central region of pile) variability in the formation of acid mine drainage. The results indicate that physical and chemical processes within the pile are strongly coupled and cannot be considered separately when oxidation rates are high and influence gas transport as a result of heat generation.

Geophysical and Geochemical Characterization of Groundwater Contamination Surrounding an Oil Shale Tailings Landfill, Maoming, China
Carpenter, Philip J. (Northern Illinois Univ.); Aizhong Ding; Lirong Cheng; Puxin Liu; Fulu Chu.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 938-948, 2003

Oil shale mining and retorting northwest of Maoming City, southern China, produced 50 million tons of waste that were dumped in two landfills. Rainfall and surface water percolation through the waste has led to the pollution of adjacent shallow drinking water aquifers by heavy metals and organic compounds in the landfill leachate. Sampling indicated elevated lead and chloride concentrations, reduced pH, and high electrical conductivity immediately east, west, and south of the north landfill. Inverted resistivity soundings and profiles in these areas suggest conductive zones due to groundwater contamination between the surface and 30 m bgs. The electrical properties of this leachate were further examined by making a sounding over the north landfill. Unsaturated tailings near the top of the landfill exhibit a resistivity of several hundred ohm-m, whereas leachate-saturated tailings and sediments deeper within the landfill have resistivities below 80 ohm-m. The next step is integration of geo-referenced hydrogeologic maps, geochemical data, and geophysical models using a geographic information system to formulate a conceptual hydrogeological model of the site.

Geophysical Characterization of an Abandoned Gold Mine
Kong, Andrew, Forpu Njikam, Clifton Townes, G. Van Ness Burbach, and Guoqing Tang, North Carolina A&T State Univ., Greensboro, NC.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 917-929, 2003

The primary purpose of geophysical surveys conducted on the North State Goldmine site in High Point, NC, was to identify voids and other features that might present geotechnical hazards during redevelopment. This paper describes and contrasts the effectiveness of three geophysical methods employed at the site: 2-D electrical resistivity profiling using a dipole-dipole array with 28 electrodes at 2-meter spacing and GPR data gathered using both 200 MHz and 400 MHz antennae. The investigators attempted unsuccessfully to augment these data with seismic refraction data. The resistivity profiles proved the most effective for identifying potential voids on this site. GPR identified some apparent fill areas possibly related to old mine workings.

Geophysical Investigation of Groundwater Contamination: Case Study of the Laurel Valley Landfill, Culpeper, Virginia
Brooks, J.A., K.C. Hardcastle, R.P. Allen, and P.J. Foster (Emery & Garrett Groundwater, Inc., Meredith, NH); P.E. Howard Jr. (County of Culpeper, Culpeper, VA).
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, poster P21, 6 pp, 2002

A geophysical program conducted at the Laurel Valley Landfill in Culpeper, VA, was designed to delineate the extent of groundwater contamination in the soil and bedrock underlying the site. The contaminants comprise various organic compounds, including chlorinated hydrocarbons and aromatics. Automated resistivity profiling was supplemented by electromagnetic, magnetometer, and VLF surveys. Approximately 8000 meters of resistivity lines were conducted along a series of parallel surveys surrounding and through the landfill. Modeling of the resistivity data using the RES2DINV program provided 2-D models of subsurface resistivity to depths of up to 70 meters. The EM and VLF survey data provided insights into near-surface resistivity changes and the magnetometer data helped map the underlying bedrock geology. Interpretation of the geophysical data highlighted bedrock fracture zones where groundwater contamination may not be currently present, but present potential pathways for contaminant migration in the future.

Geophysical Investigation of the Effect of Acid Mine Drainage on the Soil and Groundwater near a Mine Dump, Selebi-Phikwe Cu-Ni Mine, NE Botswana
Shemang, Elisha M., Kebabonye Laletsang, and Thebeyame R. Chaoka, Univ. of Botswana, Gaborone, Botswana.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 930-937, 2003

Geophysical investigations of the effect of mine waste on subsurface conditions were carried out using 2-D resistivity and electromagnetic techniques. The results of the 2-D DC resistivity survey showed portions of the top layer of low to moderate resistivity, suggesting that the low resistivities in this layer might be the result of interaction of mine waste with the soil. The EM profiles show that around a stream channel, conductivities are higher than outside the stream. The stream originates near the dump, and leachates (acid mine drainage, or AMD) from the mine waste are transported by water and deposited along the stream, with some of the leachates filtering into the ground.

Geophysical Investigation of the Sulphur Bank Mercury Mine Superfund Site, Lake County, California
Hammack, R.W.; J.I. Sams III; G.A. Veloski; and J.S. Mabie.
Mine Water and the Environment, Vol 22 No 2, p 69-70, 2003

Airborne geophysical reconnaissance was used to identify potential flow paths for mercury-rich, acidic water entering Clear Lake near the Sulphur Bank Mercury Mine. Airborne magnetic and electromagnetic conductivity surveys were conducted over a 4.75-square-mile area that included the Oaks Arm of Clear Lake and the old mine. These surveys identified four magnetic and/or conductive anomalies that may represent groundwater conduits toward or away from the Herman Impoundment. An anomaly that extended from Herman Impoundment through a waste rock dam and into Clear Lake was selected for a more detailed ground electromagnetic conductivity survey. The combined results of the airborne and ground surveys provided a detailed, lateral depiction of conductive zones, the most probable pathways for groundwater flow. These surveys also identified near-surface areas that may contain elevated concentrations of sulfide minerals that weather to produce acid groundwater.
http://www.netl.doe.gov/products/r&d/techpapers/2003-171.pdf

Geophysical Investigations at the T&T Mine Complex, Preston County, West Virginia
Mabie, J.S. and T. Wilson (West Virginia Univ., Morgantown); R.W. Hammack (U.S. DOE, National Energy Technology Laboratory, Pittsburgh, PA).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 898-916, 2003

Airborne frequency domain electromagnetic surveys were flown over the abandoned T&T Mine Complex in Preston County, WV, to determine if airborne electromagnetic surveys can detect pools of conductive water in underground mines. Surface geophysical soundings and borehole logs were used to validate airborne data. Forward models of the electromagnetic response for the different techniques used at this site suggested that a known mine pool at 90-m depth would not be detected. The study results validate the forward models; the mine pool was not detected by either the airborne or ground-based techniques; however, the airborne survey was not executed under optimal conditions, and properly conducted surveys may be more successful.

Geophysical Profiling in Support of a Nitrate and Uranium Groundwater Remediation Study
Doll, W.E., T.J. Gamey, D.B. Watson, and P.M. Jardine, Oak Ridge National Lab., Oak Ridge, TN.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC7, 10 pp, 2002

Multielectrode resistivity methods and pseudo-tomographic seismic refraction techniques were used to image to a depth of approximately 30 m at the Field Research Center at DOE's Oak Ridge National Laboratory in Tennessee, a research site for the study of bioremediation methods. The site is known to contain nitrates, uranium, and other contaminants. The geophysical methods were effective in defining the plume and in defining geologic units that appear to influence contaminant transport. Extensive drilling and groundwater sampling verified the geophysical data.

Geophysics Applied to a Bioreactor During Leachate Recirculation and to Leachate Samples
Grellier, Solenne (CReeD, Limay/Univ. Pierre et Marie Curie, Paris, France); Roger Guerin; Christophe Aran; Henri Robain; Gerard Bellier.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 725-732, 2004

A bioreactor landfill is designed to use leachate recirculation and controlled biodegradation to stabilize the waste mass. Researchers at CreeD, Paris 6 University, and IRD are investigating the use of geophysical measurement methods to examine water content variations in the waste mass. The study involves in situ and laboratory measurements at an ONYX site where leachate recirculation is performed by vertical wells. Electrical 4-D imaging is carried out with a fast resistivity meter to follow the leachate flow in the cell. Results during leachate injection trials have been encouraging. Recirculation study began in 2003 and should continue for several years. The investigation of electrical properties of leachate is being conducted to characterize the evolution of electrical resistivity versus temperature before studying this evolution in waste.

GPR Offset Dependent Reflectivity Analysis for Characterization of a High-Conductivity LNAPL Plume
Bradford, John H., Boise State Univ., Boise, ID.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 238-252, 2003

In July 2002, a field team collected a 10,000 sq ft 3-D ground-penetrating radar (GPR) survey consisting of over 4,000 linear ft of dense, multi-fold data. The field site is located over a known LNAPL plume associated with a former fire-training facility. Previous work has shown that hydrocarbon contamination within the saturated zone is associated with anomalously high electric conductivity at this site. Regions of high conductivity result in zones of increased GPR signal attenuation. These high conductivity areas manifest as 'shadow zones' below the water table reflection (10 to 15 ft bgs) and are readily identified on GPR profiles. A team is evaluating the efficacy of GPR amplitude vs. offset (AVO) analysis in the characterization of conductive contaminant plumes. Amplitude analysis shows that a clear AVO gradient anomaly is associated with the LNAPL plume, and the lateral extent of the anomaly roughly coincides with the shadow zone.

Granite Fracturing and Incipient Pollution Beneath a Recent Landfill Facility as Detected by Geoelectrical Surveys
Mota, R., F.A. Monteiro Santos, A. Mateus, F.O. Marques, M.A. Goncalves, and J. Figueiras (Univ. de Lisboa, Lisboa, Portugal); H. Amaral (Research Project DIWASTE, Fundacao da FCUL, Lisboa, Portugal).
Journal of Applied Geophysics, Vol 57 No 1, p 11-22, Dec 2004

A resistivity survey using Wenner array was carried out in June 2000 on an active landfill in a granite region of Northern Portugal to detect the possible spread of contamination. This survey was complemented with a self-potential (SP) survey, a dipole-dipole (DD) array profile and azimuthal Vertical Electrical Sounding arrays (VES). The location of these profiles was constrained by the available space in the landfill facility and by the available geological data, mainly fracturing. Significant groundwater circulation was characterized by a low resistivity zone with a fairly well defined configuration. Chemical analysis of water samples collected in boreholes inside the landfill facility and in springs around it confirmed the presence of water contamination. The presence of a well-delimited anomaly with low resistivity just beneath the leachate collector system strongly suggests that the groundwater contamination is due to a landfill leak.

Guidance for Environmental Background Analysis, Volume I: Soil
Battelle Memorial Inst., Earth Tech, Inc., and NewFields, Inc.
Naval Facilities Engineering Command, NFESC UG-2049-ENV, 188 pp, Apr 2002

This volume focuses on analytical methods and procedures that can be used to identify background chemicals in the soil medium (whether from anthropogenic or natural sources), and estimate the background chemical concentration ranges that represent soil background conditions at the site. These soil background analysis techniques focus primarily on naturally occurring metals. Methods and procedures designed specifically for background analysis of naturally occurring metals in soil are presented in Section 3 (Geochemical Method), and Section 5 (Case Studies). Appendix A (Geochemistry for Background Analysis) provides a summary of the geochemical principles that form the basis of the Geochemical Method.
http://enviro.nfesc.navy.mil/erb/erb_a/restoration/methodologies/bg_soil_guide.pdf

Guidance for Environmental Background Analysis, Volume II: Sediment
Battelle Memorial Inst., Earth Tech, Inc., and NewFields, Inc.
Naval Facilities Engineering Command, NFESC UG-2054-ENV, 241 pp, Apr 2003

This guidance document supports and implements the September 2000 Navy background policy document, 'Navy Interim Final Policy on the Use of Background Chemicals.' It is part of a series devoted to background analysis that provides instructions for characterizing background conditions at sites where past property uses have resulted in actual or suspected chemical releases. Though soil and sediment background analyses have many similarities, for sediment background analyses require special consideration of unique features of the aquatic and terrestrial environment that affect the distribution of sediment chemicals: the hydrodynamic, ecological, and biological characteristics of the sediment basin; potential sources of contamination within the sediment basin and the upstream watershed; and the lateral, vertical, and temporal distribution of the investigated sediments. The background analysis techniques presented in this volume focus primarily on evaluation of sediment metal concentration data; however, these techniques can be applied to any location-specific quantitative data, including organic chemical concentration data, and the ecological and biological measurements gathered during a typical sediment investigation.
http://enviro.nfesc.navy.mil/erb/erb_a/restoration/fcs_area/con_sed/ug-2054-sed-guide.pdf

Handheld Apparatus for Multipurpose Sample Collection & Registration
Office of Technology Transfer and Commercialization (OTTC), California State Univ., San Bernardino, 22 July 2004

A new technology has been invented to address many of the current problems in the sampling and registration of solid, liquid, and/or gaseous contaminants in buildings. The project leader and inventor of this patent-pending technology is Torsten Staab, a member of the Automation & Robotics team at Los Alamos National Laboratory, Los Alamos, NM. The technology is a handheld, multipurpose sample collection and registration device that can be used for rapid, automated, cross contamination-free, indoor and outdoor sample collection, and registration of solid, liquid, and gas samples. Besides supporting a wide variety of commonly used sample-collection media, such as filter papers or contact plates, the device also automatically records and tracks sampling-related data, such as time and date, operator identification, sample type, and sampling location. The handheld device provides the following features and benefits: (1) a universal sample media adapter and sample media loading/unloading mechanism suitable for any type of sample collection media (e.g., swabs, vials, contact plates, filters, ghost swipes, etc.); (2) a hands-off sample loading/unloading mechanism that eliminates direct contact between the sample collector and the sample, thus preventing cross-contamination; (3) built-in electronic data acquisition capabilities that eliminate the need for manual record-keeping in the field (The device automatically records 3D coordinates of the sampling location, voice-based sample annotations by the user, sample storage container ID, information about the sampling protocol, and video images of sampling location and objects); (4) automated data tracking capabilities that simplify sample chain-of-custody. The device generates one unified, multimedia (voice, video, text), electronic data record for each sample it collects. These sample records can be easily uploaded into a Laboratory Information Management System (LIMS) for subsequent sample processing and analysis; (5) potential savings in labor costs. OTTC funding will be used for prototype development, field testing, and a market assessment. For more information: Torsten Staab (technical information), tstaab@lanl.gov; Veronique Longmire (business information), vero@lanl.gov; 505-665-7345, Fax: 505-665-3911.

Helicopter Electromagnetic and Magnetic Survey of the Upper Animas River Watershed: Application to Abandoned Mine Land Studies

Bruce D. Smith, Robert R. McDougal, Anne E. McCafferty, Maryla Deszcz-Pan, Douglas B. Yager
U.S. Geological Survey, Denver, CO.

SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. p 140-155, 2004

A helicopter electromagnetic and magnetic (HEM) survey has been taken to estimate groundwater flow paths in the surface and subsurface (bedrock) as part of an abandoned mine land study. The apparent conductivity and total field magnetic maps from the HEM survey are used to identify geologic features that can influence groundwater flow. The most easily understood studied groundwater flow paths are near surface streams and flow through alluvial or colluvial deposits. The HEM data indicates parts of the upper Animas River where bedrock groundwater flow may be important. High apparent conductivities near one mine waste pile suggest near surface flow paths and a source for high dissolved solids where high sulfide mill tailings have been removed after the HEM survey. The youngest dacite-rhyolite intrusives show different types of magnetic and electrical properties that may have implications for the occurrence of acid generating lithologies.

High Resistivities Associated with DNAPL Plume Images by RIP Technique

Yang, Chieh-Hou (Ching Yun Inst. of Technology, Taiwan); Jiunn-I You (National Central Univ., Taiwan); Ming-Chung Tao (3JTech. Co. Ltd., Taiwan).

Society of Exploration Geophysicists (SEG) 72nd Annual Meeting, Salt Lake City, Utah, Technical Program Expanded Abstracts, p 1587-1590, 2002

Abstract not available.

High Resolution Seismic Reflection Survey for Groundwater Contaminant Studies, CFB Borden, Ontario, Canada
Hunter, J.A. (Geological Survey of Canada, Ottawa, ON, Canada); M. Tetreault; A. Pugin; S.E. Pullan.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 662-275, 2003

A high-resolution CMP P-wave reflection seismic survey was conducted over a 1 square km area (in an urban setting) of Canadian Forces Base Borden in central Ontario to detect and map a shallow aquitard. This impermeable clayey silt unit blocks known surface groundwater contamination from reaching permeable units at depth; structural variation of this surface is a factor in groundwater flow. With borehole geophysical log control (including P-wave velocities), stacked, migrated, and filtered sections were produced for five seismic lines. Reflections were observed from the upper aquitard, a lower dense till, and the top of bedrock. Topographic relief of the upper aquitard correlated well with stratigraphic profiles obtained from continuous coring and measured groundwater flow directions obtained from observation wells. The seismic results served to confirm the subsurface hydrogeological model, including the viability of the aquitard throughout the area. The work provided additional assurance that existing contaminant management measures are adequate.

Highly Stable Voltammetric Detection of Nitroaromatic Explosives in the Presence of Organic Surfactants at a Polyphenol-Coated Carbon Electrode
Wang, Joseph (New Mexico State Univ., Las Cruces); Sompong Thongngamdee; Arun Kumar.
Electroanalysis, Vol 16 No 15, p 1191-1192, 2004

A polyphenol-coated screen-printed carbon electrode was used to make highly sensitive voltammetric measurements of TNT in the presence of surface-active substances (e.g., gelatin, humic acid, and sodium dodecyl sulfate). The permselective/protective polyphenol coating offers excellent resistance to surfactant fouling, while allowing facile transport of the target TNT. The TNT peak current and potential remain nearly the same in the presence of organic macromolecules, as compared to substantial peak suppressions and shifts at the bare electrode. Control of the electropolymerization time achieved the desired exclusion of interfering surface-active macromolecules while allowing transport of the target TNT. The response for ppm levels of TNT is highly linear and stable for prolonged operations in the presence of surface-active substances. The device holds great promise for field-based voltammetric monitoring of nitroaromatic explosive compounds.

Homeland Security, Olfactory Images, and Virtual Chemical Sensors
Viswanathan, Shekar (National Univ., La Jolla, CA); Edward J. Staples (Electronic Sensor Technology, Newbury Park, CA).
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 41a, 2004

This paper describes an electronic nose that uses a single solid-state sensor to create an unlimited number of specific virtual chemical sensors for chemically profiling odors and chemical vapors. The portable chemical profiling system incorporates an ultra-high speed chromatography column, a solid-state sensor, a programmable gate array microprocessor, and an integrated vapor preconcentrator. Using ultra-high speed chromatography, chemical vapors can be speciated and their concentration measured in less than 10 seconds with picogram sensitivity using a solid-state SAW sensor with electronically variable sensitivity. The sensor produces high resolution 2-D olfactory images unique to many complex odors. This paper presents examples involving odors from explosives, contraband drugs of abuse, hazardous chemicals, and biological life forms.

Improving the Reliability of Contaminated Land Assessment Using Statistical Methods, Part 1: Basic Principles and Concepts
CL:AIRE (Contaminated Land: Applications in Real Environments), London, UK. TB7, 4 pp, Mar 2004

This bulletin is designed to introduce some basic statistical methods that can be used to help quantify uncertainties, allow for heterogeneity, and provide confidence in making decisions when managing contaminated land. There are two ways of approaching contaminated land assessment. One approach avoids statistical methods to make life apparently 'simple.' The other approach uses statistics to allow more reliable conclusions to be made by taking into account the imperfections of the real world. The first approach is initially very appealing. It is possible to apply a standard sampling protocol to a site and to assume that all samples taken are representative of the site. The samples can be sent to a laboratory for chemical analysis, and then an assumption made that all of the measurements of contaminant concentration in the soil are 'true.' A simple comparison between the measurements and the regulatory limit is then made to decide whether the site is 'contaminated' or needs further investigation. This first approach is potentially very unreliable and can lead to serious decision errors. Both of the assumptions made in the first approach concerning 'representative' samples, and 'true' chemical analysis are usually unjustified in most contaminated land investigations; however, it is possible to recognize these limitations and make reliable decisions, using a few basic statistical methods. The methods can not only improve the reliability of the decisions, but can also often reduce the cost of the investigation and site development. The objectives of this bulletin are therefore to show that the reliability of decisions made on contaminated land can be improved by application of basic statistical techniques, explain how a number of basic statistical techniques can be applied and discuss their strengths and their weaknesses, and provide the basis for a second bulletin that will describe more advanced methods for contaminated land assessment, using statistics. The statistical approach is illustrated in a case study of an investigation of lead contamination in topsoil at a site in West London to demonstrate many of the common characteristics of site assessment.
http://www.claire.co.uk/html/TB7web.pdf

In Search of a Biosensing Biocide: Simple Compound Is Eyed as a Lead to a Chemical/Biological Counteragent
Dagani, Ron.
Chemical & Engineering News, Vol 82 No 40, p 8, 4 Oct 2004

A team at the University of Pittsburgh led by Professor Alan J. Russell has synthesized a simple lipid molecule forms a bilayer, the bilayers curl up to form nanotubes, and bunches of nanotubes assemble into a "nanocarpet." The team has been working to develop materials that both sense and decontaminate chemical or biological weapons, and their nanotubes respond to different substances by changing color, and also kill bacteria. Russell's coworker, Sang Beom Lee, synthesized a secondary amine salt that formed remarkably uniform nanotubes in a single step in 100% yield. The nanotubes are always 89 nm across, and the walls, which consist of five lipid bilayers, are 27 nm thick. The tube length varies, but typically is around 1 um. Exposing the nanotubes to ultraviolet light induces them to polymerize through the triple bonds of the diacetylene groups on adjacent molecules. When these polymerized nanotubes are exposed to detergents or strong acids (stand-ins for chemical weapons), they change color from blue to red or yellow. Solutions of the polymerized nanotubes respond to high levels of Escherichia coli by changing from dark blue to reddish hues. The nanotubes also reduce the concentration of the bacteria. The project is funded by the U.S. Army Research Office, which seeks a coating that can simultaneously detect and destroy biological or chemical agents.

In Situ Biodegradation Determined by Carbon Isotope Fractionation of Aromatic Hydrocarbons in an Anaerobic Landfill Leachate Plume (Vejen, Denmark)
Richnow, Hans H. (UFZ Centre for Environmental Research Leipzig-Halle GmbH, Leipzig, Germany); R.U. Meckenstock; L. Ask Reitzel; A. Baun; A. Ledin; T.H. Christensen.
Journal of Contaminant Hydrology, Vol 64 Nos 1-2, p 59-72, June 2003

Concentrations and isotopic compositions (13C/12C) of aromatic hydrocarbons were determined in eight samples obtained from the strongly anoxic part of the leachate plume downgradient from the Vejen Landfill in Denmark, where methanogenic, sulfate-reducing, and iron-reducing conditions were observed. The isotope fractionation factors for the degradation of the m/p-xylene and ethylbenzene obtained from the field observations were similar to factors previously determined for the anaerobic degradation of toluene and o-xylene in lab experiments, and suggest that in situ biodegradation is a major process controlling the fate of these contaminants in this aquifer. In addition to demonstrating the potential of assessing isotopic fractionation as a means for documenting the in situ biodegradation of complex mixtures of aromatic hydrocarbons in leachate plumes, this study illustrated the difficulties of data interpretation in complex plumes and high analytical uncertainties for isotope analysis of organic compounds in low concentration ranges.

In-Situ Chemiresistor Sensor Package for Real-Time Detection of Volatile Organic Compounds in Soil and Groundwater
Ho, Clifford K. and Robert C. Hughes, Sandia National Laboratories, Albuquerque, NM.
Sensors, Vol 2, p 23-34, 2002

This paper presents the development of a real-time microsensor-based monitoring system that can be used to detect and characterize volatile organic compounds in soil and groundwater. The system employs an array of polymer-based microsensors (chemiresistors) packaged in a waterproof housing that is designed to protect the sensor from harsh subsurface environments, including completely water-saturated conditions. The sensors and packaging have been tested in field and laboratory environments, and characterization methods are being developed that utilize contaminant-transport models and time-dependent, in situ sensor data to identify the location of the contaminant source.
http://www.sandia.gov/sensor/soil_groundwater_chemiresistor.pdf

In Situ Freeze-Capturing of Fracture Water using Cryogenic Coring
Su, Grace W. & Joseph S.Y. Wang (Lawrence Berkeley National Lab.); Kris Zacny (Univ. of California, Berkeley).
Vadose Zone Journal, Vol 3 No 4, p 1479-1482, 2004

Investigators lack techniques for sampling in situ water from unsaturated fractures in low-moisture environments. Laboratory experiments demonstrate that cryogenic coring is a promising technique for freezing and collecting water in unsaturated fractures. The method is applicable to sampling for nonaqueous phase liquids (NAPLs).

Induced Polarization (IP) Measurements of Soils from an Aged Hydrocarbon Contaminated Site
Abdel Aal, Gamal Z. (Univ. of Missouri-Rolla); Estella A. Atekwana, Lee D. Slater, and Craig Ulrich (Rutgers Univ., Newark, NJ).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 190-201, 2003

Organic acids, CO2, and water are products of hydrocarbon biodegradation. Biodegradation enriches ions, increasing electrolyte concentration and changing fluid chemistry, and dissolution is expected to induce physical changes in the surface area of soil particles, potentially impacting their electrical response. To test this hypothesis, induced polarization (IP) measurements in the frequency range 0.1 to 1000 Hz were made on samples from an aged hydrocarbon contaminated site where intrinsic bioremediation occurs. Results from the saturated zone indicate that real conductivity is unable to distinguish contaminated from uncontaminated samples; however, using imaginary conductivity, contaminated samples are distinguished from uncontaminated samples by their higher magnitudes. The results suggest that IP is potentially a better indicator of contamination and biodegradation than DC resistivity, but more investigation is required to better understand the effect of biodegradation processes on the measured SIP response and the surface conduction mechanism.

INEEL Teams Win Two R&D 100 Awards
Idaho National Engineering and Environmental Laboratory News Release, 11 Aug 2004

For the 8th consecutive year, teams at DOE's Idaho National Engineering and Environmental Laboratory (INEEL) have earned selection among the top 100 new technologies in the world by R&D Magazine. An award for environmental monitoring technology went to the INEEL Geologic and Environmental Probe System (GEOPS). GEOPS is a new multifunction probe system that safely characterizes and monitors conditions within or below suspected contaminated sites. Project team leader Richard L. Jones, along with team members Tom Clark, Joel Hubbell, Buck Sisson, Jason Casper, Terry Turner, Louis Valenti, and Andrew Baumer, worked on the technology. GEOPS is a breakthrough technology that for the first time allows direct characterization and monitoring within or below hazardous waste sites. Instead of drilling or coring, a GEOPS probe is pushed into the ground like a needle into a pincushion. The probe's robust, sleek steel design easily penetrates compacted soil, metal drums, and other debris to depths of up to 100 meters without producing surface contamination or changing the characteristics of the waste to be sampled. The unique design assures a complete seal from any subsurface contamination during placement and operation. GEOPS can accommodate multiple measurements, including a suction lysimeter or vapor port for use if soil moisture or vapor collection data is desired; a tensiometer to determine how tightly water is held by unsaturated soils; a soil sample retriever; and a geophone to measure ground motion velocities. This versatility offers significant cost reductions and installation advantages over current technologies, resulting in low continual operating costs because GEOPS avoids waste disposal, reduces handling costs, and eliminates repetitive drilling. GEOPS offers improved safety, because it avoids the spread of hazardous or radioactive contaminants to the environment. GEOPS is valuable in monitoring and sampling any targeted subsurface area, especially abandoned and active landfills, mining areas, farms, and airports.

Influence of Residual Surfactants on DNAPL Characterization Using Partitioning Tracers
Cho, Jaehyun and Michael D. Annable (Univ. of Florida, Gainesville); P. Suresh C. Rao (Purdue Univ., West Lafayette, IN).
Journal of Contaminant Hydrology, Vol 72 Nos 1-4, p 67-83, Aug 2004

Via the partitioning tracer technique, researchers examined in batch and column experiments the magnitude of artifacts introduced in estimating DNAPL content when residual surfactants used for in situ flushing are present. Batch equilibrium tests using residual surfactants ranging from 0.05 to 0.5 wt.% showed that as the surfactant concentrations increased, the tracer partition coefficients decreased linearly for sodium hexadecyl diphenyl oxide disulfonate (DowFax 8390), increased linearly for polyoxyethylene (10) oleyl ether (Brij 97), and decreased slightly or exhibited no observable trend for sodium dihexyl sulfosuccinate (AMA 80). Results from column tests using clean sand with residual DowFax 8390 and tetrachloroethene (PCE) were consistent with those of batch tests. In the presence of DowFax 8390 (less than 0.5 wt.%), the PCE saturations were underestimated by up to 20%. Adsorbed surfactants on a loamy sand with positively charged oxides showed false indications of PCE saturation based on partitioning tracers in the absence of PCE. Soil without surfactant (background soil) gave a false PCE saturation of 0.0004, while soil contacted by AMA 80, Brij 97, and DowFax 8390 presented false PCE saturations of 0.0024, 0.043, and 0.23, respectively.

Initial Site Characterization Enhanced with Geophysics: a Multi-Benefit Case History at a Petroleum UST Site
Byer, Gregory B., James A. Berndt, and Jason Armour, Mundell & Associates, Inc., Indianapolis, IN.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC13, 12 pp, 2002

A truck stop located near Clayton, IN, has been the focus of an initial site characterization (ISC) required by the state of Indiana for leaking petroleum underground storage tank (LUST) sites. Conventional drilling-only assessments by previous investigators were found to be inadequate at this site for developing an understanding of contaminant movement and distribution. The contaminants, principally gasoline and diesel fuel products, had been found widespread across much of the 9-acre site, unexpectedly distant from known UST locations, in apparent conflict with the geologic setting.
The investigators suspected that anthropomorphic features such as utility trenches were tied to contaminant movement. Electromagnetic conductivity (EM-31 and EM-39), 2-D electrical resistivity, and ground penetrating radar were used to reveal the sources of contaminant movement and to map out a contaminant transport network consisting of narrow, interconnected pea gravel-filled drainage trenches crosscut by utility trenches. After initial discovery of the trenches with terrain conductivity mapping (EM-31), they were better defined by mapping the ratio of the EM-31 vertical dipole conductivity to horizontal dipole conductivity. Pinpointing the trench locations and routes was accomplished by an unconventional use of the Geonics EM-39 downhole conductivity probe as a surface-mapping tool and by using a Sensors and Software Noggin 250 ground penetrating radar system. The surveyors also noted a possible correlation of electrical conductivity with the degradation of petroleum hydrocarbons, consistent with similar recent findings by others.

Initial Studies of an Immobilised, Regenerable Chemiluminescent Sensor
Lowry, Roy B., Claire E. Williams, and Jim Braven, Univ. of Plymouth, Plymouth, UK.
Talanta, Vol 63 No 4, p 961-966, 8 July 2004

Ruthenium tris(4-methyl-4'-vinyl-2,2'-bipyridine) was electropolymerized onto the surface of a Pt electrode to form a regenerable chemiluminescent polymer for chemical analysis. This system was optimised for detection of oxalate by investigating the effect of both scan rate and the pH of the analyte solution. A chemically modified electrode successfully completed over 200 regeneration cycles over a 6-month period, demonstrating the stability of the system. The system functions in a similar way to traditional homogeneous chemiluminescent methods, but the active compound is retained and re-used rather than discarded, which results in both environmental and cost savings.

An Innovative Approach for Visualization of Subsurface Soil Properties
Hu, Z. (Univ. of Regina, Regina, Sask., Canada); B. Bass; C.W. Chan; G.H. Huang.
Canadian Journal of Soil Science, Vol 84 No 1, 63-70, 2004

Subsurface characterization is an important requirement in the decision-making process of selecting a remediation technique for petroleum-contaminated sites. The soil type distribution is important because it affects selection of the site remediation technique. The authors describe the software Soil-Visual (1.0, 1.1), which is used for visualizing the soil sampling data, the soil type distribution, and contaminant concentration distribution of a contaminated site. This software can be used to determine the soil particle size distribution and contaminant concentration distribution of the entire site from limited soil sampling data and to visualize the multi-dimensional soil type distribution and contaminant concentration distribution data of each soil layer on a two-dimensional map.

Innovative Fluorescence Methods for MGP Site Characterization.
St. Germain, Randy, New York State Electric and Gas Corp., Ithaca/Dakota Technologies, Inc., Fargo, ND.
Gas Research Inst., Des Plaines, IL. Report No: GRI-04/0029, 60 pp, May 2004

Determining the distribution and extent of byproduct contamination at former manufactured gas plant (MGP) sites is difficult and expensive. Investigators undertook an examination of the spectroscopic properties of coal tars as part an effort to develop the optimal system for subsurface laser-induced fluorescence (LIF) screening of coal tar-contaminated soils. Results indicate that the absorbance spectra of thin films and m-xylene solutions lacked any significant structure and did not point to any "key" wavelengths that would improve fluorescence linearity behavior. Water left in contact with the MGP products contained aqueous phase PAH concentrations whose fluorescence intensity rivals the tars, leading to false positives if spectroscopic discrimination is not applied. Aqueous phase emission falls off sharply with excitation wavelengths above 400 nm. Excitation/emission matrices of thin films show that MGP product fluorescence behavior varies, but some general trends are seen, e.g., fluorescence emission spectra and calibration curves for a variety of laser wavelengths on several tars indicate that linearity improves with increasing wavelength at the cost of lower limits of detection. One tar would respond linearly with concentration under visible wavelength excitation, but a second tar did not. A laser excitation and fluorescence emission wavelength pairing that consistently predicted coal tar concentration based solely on fluorescence intensity was not identified.

Innovative Methods for Investigating the Fate of Chemical Warfare Agents in Soil
Checkai, R.T., M.V. Haley, M. Simini, and C.T. Phillips (U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD); C.L. Crouse and K.L. Matson (Geo-Centers, Inc., Aberdeen Proving Ground, MD).
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 5 pp, 2004

Surface-controlled reactions affecting hydrolysis of organic compounds in the environment can predominate over bulk solution hydrolysis, especially in soil environments. Unpredicted residual levels of chemical warfare agents (CWA) at threat levels in the field necessitated the development of new methods for investigating the fate of CWA delivered onto soil. Design and fabrication of Soil System Units now allows determination of the fate of CWA in soil, as well as investigation of the soil chemical and physical characteristics affecting the persistence of threat from continuing presence of CWA in soil, under conditions that represent those in the field. Initial results show that the Soil System Unit approach is highly effective for investigating the fate of CWA in the soil environment. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionO/OP-10.pdf

An Innovative Monitoring System to Manage the Risk of Release to the Subsurface Associated with Industrial and Commercial Uses of Volatile Organic Compounds
Schmitt, Clifford T. and Richard W. McManus, Farallon Consulting, LLC, Issaquah, WA.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 3.

When volatile organic compounds (VOCs) are released to the subsurface, a portion of the VOCs released into soil volatilizes and disperses as a vapor into the pore space within the soil matrix. Analytical results for samples of the soil gas present in soil pore space that has been affected by the release will indicate detectable concentrations of VOCs. Farallon Consulting, LLC, has developed a system to monitor for releases of VOCs to the subsurface that involves specially designed monitoring ports installed in facility floor slabs near areas where VOCs historically were or currently are used and/or stored. The monitoring ports are designed to be installed quickly and easily, to be relatively unobtrusive, and to provide access through a concrete floor slab to collect soil gas samples that are representative of subsurface conditions. The monitoring ports are specifically designed to prevent the potential migration of liquid or vapor-phase VOCs from inside the facility through the monitoring port to subsurface soil. Soil gas samples are collected periodically from the monitoring ports using standard protocols. The samples can be analyzed either at a laboratory with a gas chromatograph/mass spectrometer or in the field with a Gastec or equivalent colorimetric tube.

Innovative Technologies for In Situ Detection, Speciation, and Quantification of Radionuclide and Heavy Metal Contamination
Ballard, J.H. (ERDC, Vicksburg, MS); J.C.Morgan (IITRI, Vicksburg, MS); M.J. Cullinane (ERDC).
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, SPT-3, 7 pp, 2001

While conducting the Site Characterization and Analysis Penetrometer System (SCAPS) Research and Development Program, the U.S. Army Engineer Research and Development Center (ERDC) developed a suite of direct-push sensor technologies with the capability to interrogate subsurface soil and/or groundwater in situ. The sensor systems provide cost-effective speciation and quantification of contaminants in near-real time. Direct-push multisensor configurations have been developed with the capacity to provide simultaneous interrogation of subsurface media for multiple contaminants, soil geophysical properties, and layering classifications in situ. These configurations have helped optimize the placement of conventional monitoring wells. This paper addresses new innovative radionuclide and heavy metal detection technologies and multisensor configurations applicable to well logging and direct push subsurface and surface site characterization for the in situ detection and quantification of depleted uranium, gamma-emitting radionuclides, and heavy metal contaminates in near-real time.

Innovative Technology Verification Report: Field Measurement Technology for Mercury in Soil and Sediment -- MTI Inc.'s PDV 6000 Anodic Stripping Voltammetry
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 600-R-04-028, 94 pp, May 2004

MTI's PDV 6000 was demonstrated under EPA's Superfund Innovative Technology Evaluation Program in June 2003 in Las Vegas, NV. The sensitivity, accuracy, and precision measurements were successfully completed. Results of these measurement evaluations suggest that the MTI field instrument does not perform as well as the laboratory analytical method but does provide a rough estimate of mercury concentrations in soils and sediments often suitable for field analysis. During the demonstration, MTI required 38 hours for analysis of 197 samples. The cost per analysis, based on measurement of 197 samples, when incurring a minimum 1-month rental fee for the PDV 6000, was determined to be $43.74 per sample. Excluding the instrument rental cost, the cost for analyzing the 197 samples was $32.57 per sample. Based on the 3-day field demonstration, the total cost for equipment rental and necessary supplies was estimated at $8,600. The PDV 6000 exhibited good ease of use and durability, and no major health and safety concerns; however, there is potential for gas-producing reactions to occur during the digestion procedure used to prepare the samples. MTI sells kits containing extraction reagents and disposable supplies for the analyses of samples. When conducting a large number of analyses, purchase of bulk reagents and disposable supplies should be considered to reduce costs.
http://www.epa.gov/ORD/SITE/reports/600r04028/600r04028.htm

Innovative Technology Verification Report: Field Measurement Technology for Mercury in Soil and Sediment -- Milestone Inc.'s Direct Mercury Analyzer (DMA)-80
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 600-R-04-012, 89 pp, May 2004

Milestone's Direct Mercury Analyzer (DMA-80) was demonstrated under the EPA's Superfund Innovative Technology Evaluation Program in May 2003 at Oak Ridge National Laboratory in Oak Ridge, TN. The sensitivity, accuracy, and precision measurements were successfully completed. The DMA-80 performed well in all these categories. During the demonstration, Milestone required 22 hours and 10 m inutes for the analysis of 173 samples. The measurement costs were estimated to be $6,210 for Milestone's DMA-80 rental option or $35.90 per sample; $18.55 per sample excluding rental fees. The DMA-80 exhibited good ease of use and durability, as well as no major health and safety concerns; however, the device portability is somewhat limited by its size. Despite this limitation, the demonstration findings collectively indicated that the DMA-80 is a reliable field mobile measurement device for mercury in soil.
http://www.epa.gov/ORD/SITE/reports/600r04012/600r04012.htm

Innovative Technology Verification Report: Field Measurement Technology for Mercury in Soil and Sediment -- Metorex's X-MET(R) 2000 X-Ray Fluorescence Technology
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 600-R-03-149, 86 pp, May 2004

Metorex's X-MET 2000 X-ray fluorescence analyzer was demonstrated under EPA's Superfund Innovative Technology Evaluation Program in May 2003, at Oak Ridge National Laboratory in Oak Ridge, TN. The sensitivity, accuracy, and precision measurements were successfully evaluated. The X-MET 2000 was found to have an MDL of between 16.5 and 26.9 mg/kg and a PQL of approximately 64 mg/kg; however, this PQL was difficult to estimate due to poor instrument accuracy. The instrument was found to be very precise (Metorex had an average relative standard deviation on sample replicates of 9.34% compared to the referee lab's 20.6%), but to have poor accuracy (22 of 32 samples had a percent difference of greater than 50%). During the demonstration, Metorex required 18 hours (36 man hours) for analysis of 197 samples. The measurement costs were estimated to be $6,556 for Metorex's X-MET 2000 rental option or $33.28 per sample; $16.02 per sample excluding rental costs. The X-MET 2000 exhibited good ease of use and durability, as well as no major health and safety concerns. The analyzer is lightweight and extremely portable. The demonstration findings collectively indicated that the X-MET 2000 is a rapid and portable field measurement device for mercury in soil.
http://www.epa.gov/ORD/SITE/reports/600r03149/600r03149.htm

Innovative Technology Verification Report: Field Measurement Technology for Mercury in Soil and Sediment -- NITON's XLi/XLt 700 Series X-Ray Fluorescence Analyzers
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 600-R-03-148, 94 pp, May 2004

NITON's XLi/XLt 700 Series X-ray fluorescence analyzers were demonstrated under EPA's Superfund Innovative Technology Evaluation Program in May 2003, at Oak Ridge National Laboratory in Oak Ridge, TN. The sensitivity, accuracy, and precision measurements were successfully completed for both instruments. Results with the XLi 702 were found to be very precise and accurate when compared to standard reference materials. During the demonstration, NITON required 17.5 hours (assumes one technician) for analysis of 197 samples. The measurement costs were estimated to be $7,786 for NITON's XLi 702 rental option, or $39.52 per sample; $13.18 per sample excluding rental costs. Results for the XLt 792 was found to be very precise and accurate when compared to standard reference materials. During the demonstration, NITON required 17.5 hours (assumes one technician) for analysis of 197 samples. The measurement costs were estimated to be $9,396 for NITON's XLi 792 rental option, or $47.69 per sample; $13.18 per sample excluding rental costs. The XLi/XLt 700 Series Analyzers exhibited good ease of use and durability, as well as no major health and safety concerns. The analyzers are hand-held single units and extremely portable. The demonstration findings collectively indicated that the XLi/XLt 700 Series Analyzers are rapid, lightweight, hand-held portable field measurement devices for mercury in soil.
http://www.epa.gov/ORD/SITE/reports/600r03148/600r03148.htm

Innovative Technology Verification Report: Field Measurement Technology for Mercury in Soil and Sediment -- Ohio Lumex's RA-915+/RP-91C Mercury Analyzer
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 600-R-03-147, 86 pp, May 2004

Ohio Lumex's RA915+/91C mercury analyzer was demonstrated under EPA's Superfund Innovative Technology Evaluation Program in May 2003, at Oak Ridge National Laboratory in Oak Ridge, TN. The sensitivity, accuracy, and precision measurements were successfully completed. Results of these measurement evaluations suggest that the Ohio Lumex field instrument can perform as well as the laboratory analytical method. Accuracy comparisons to standard reference materials showed statistical equivalence but field sample analysis suggested possible matrix interferences. Field instrument precision was better than laboratory precision as determined by relative standard deviation calculations. During the demonstration, Ohio Lumex required 21.25 hours (1,275 minutes) for analysis of 197 samples. The cost per analysis, based on measurement of 197 samples, when incurring a minimum 1-month rental fee for the RA-915+/RP-91C, was determined to be $23.44 per sample. Excluding the instrument rental cost, the cost for analyzing the 197 samples was determined to be $15.82 per sample. Based on the 3-day field demonstration, the total cost for equipment rental and necessary supplies was estimated at $4,617. The RA915+/RP-91C exhibited good ease of use and durability, as well as no major health and safety concerns; however, the device portability is somewhat limited by its size. The demonstration findings collectively indicated that the RA915+/RP-91C is a reliable field mobile measurement device for mercury in soil. The device is readily available for purchase or lease.
http://www.epa.gov/ORD/SITE/reports/600r03147/600r03147.htm

An Integrated Application of Field Screening Tools for Rapid Sediment Characterization at a Former Navy Site: A Case Study.
Guerrero, J. (US Navy, San Diego, CA); J. Leather; V. Kirtay; J. Speicher.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PT252, 2004

Because environmental sites undergoing assessment are more likely to contain multiple classes of contaminants than only one, the integration of a broad range of screening tools is required to provide a more accurate picture of the contaminant distribution as opposed to a single method. An integrated screening approach was utilized to support a remedial investigation of an offshore sediment site (Allen Harbor) adjacent to the Naval Construction Battalion Center Davisville, a Navy BRAC site located in Rhode Island. The Marine Environmental Quality Branch in San Diego has modified, tested and implemented a suite of rapid screening tools for sediments that can provide near real-time data to streamline site characterization, focus resources on regions of concern and provide insight into contaminant locations, sources, and interactions. Screening data from X-ray fluorescence (XRF) for metals showed good correlation to laboratory data for major and minor elements, such as Fe, Cu, Zn, and Pb. Direct comparison between immunoassay screening for PAHs and confirmatory laboratory data also demonstrated good correlations for total PAH concentrations.

Integrated Geophysical Characterization of the Winthrop Landfill Southern Flow Path, Winthrop, Maine
Dawson, C.B., J.W. Lane, Jr., Eric A. White, and Marcel Belaval, U.S. Geological Survey, Storrs, CT.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC6, 2002

Near the site of the former Winthrop Landfill, Winthrop, ME, the U.S. Geological Survey, in cooperation with United Technologies Corporation, used an integrated suite of borehole, surface, and water-borne geophysical methods to investigate the hydrogeology controlling the transport of leachate from the landfill to nearby Annabessacook Lake. USGS conducted borehole electromagnetic (EM) induction and gamma logging and inductive terrain-conductivity, 2D resistivity, continuous seismic reflection, and magnetic surveys. The objectives of this integrated geophysical study were to provide constraints on the location and extent of the southern flow path(s) of contamination from the landfill to the lake; identify shoreline seep geophysical signatures; identify potentially hidden seeps in the lake; and determine depth to bedrock below Annabessacook Lake in the study area. This paper reports the results of the geophysical investigations.

Integration of Geophysics, Geologic Mapping and Water-Level Monitoring to Characterize the Hydrogeology of a Fractured Bedrock Site in Berlin, New Hampshire
Degnan, James R. (U.S. Geological Survey, Pembroke, NH); Stewart F. Clark Jr.; Philip T. Harte.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 759-770, 2004

At the site of a former chlor-alkali plant along the bank of the Androscoggin River in Berlin, NH, elemental mercury is found in fractured depressions and potholes on the bedrock surface, in the overburden, and dissolved in ground water. Although an upgradient slurry wall to contain the groundwater has been installed and the former cell house area capped with an impermeable geomembrane, mercury has been removed from fractures at the surface on the riverbank five times and more continues to be found. The integrated use geophysical surveys, geologic mapping, and water-level monitoring revealed potential pathways for movement of mercury and groundwater. This paper reports the results of the geohydrological study.

Interactive Genetic Algorithm Framework for Long Term Groundwater Monitoring Design
Babbar, Meghna, Barbara Minsker, and Hideyuki Takagi.
Critical Transitions In Water And Environmental Resources Management (Proceedings of the 2004 World Water and Environmental Resources Congress, 27 June-1 July 2004, Salt Lake City, UT). ASCE Press, Reston, VA, ISBN: 0-7844-0737-1, p 1-10, 2004

The authors demonstrate the use of interactive genetic algorithms for long-term groundwater monitoring problems having multiple numerical and subjective objectives. They also analyze the effects of using an interactive optimization approach (as opposed to more traditional numerical optimization approaches) on the optimal monitoring designs.
http://cee.uiuc.edu/emsa/conference/mbabbar-2004-02.pdf

An Introduction to the Use of Airborne Technologies for Watershed Characterization in Mined Areas
Ackman, Terry E., U.S. Dept of Energy, National Energy Technology Laboratory, Pittsburgh, PA.
Mine Water and the Environment, Vol 22 No 2, p 62-68, 2003

This paper introduces airborne geophysical and imagery technologies that can be used to rapidly characterize watersheds. Frequency domain electromagnetics (FDEM) and thermal infrared (TIR) imagery are being used to map surface and subsurface hydrologic features. FDEM is being used to map water-filled fractures and voids that serve as groundwater conduits; TIR is being used to identify locations where groundwater discharges to the surface. Airborne reconnaissance can provide significant cost savings through large-scale data collection, reduced landowner-access issues, improved watershed management practices, superior techniques for locating drilling sites, and efficient targeting of costly, high-resolution ground investigations.
http://www.netl.doe.gov/products/r&d/techpapers/2003-172.pdf

Investigation of Groundwater Contamination Using Electric and Electromagnetic Methods at an Open Waste-disposal Site: a Case Study from Isparta, Turkey
Karlik, G. (Istanbul Technical Univ., Istanbul, Turkey); M.A. Kaya (Suleyman Demirel Univ., Isparta, Turkey).
Environmental Geology, Vol 40 No 6, p 725-731, Mar 2001

Direct current (DC) resistivity geoelectrical sounding and very low frequency electromagnetic (VLF-EM) data were collected at an open waste site in Turkey to look for contamination in the groundwater at shallow depths in alluvium composed of gravel, sand, and clay. The investigators mapped the spread of groundwater contamination using a VLF-EM method, which allows fast and inexpensive data collection and complements the results of geoelectrical sounding. There was good correlation between the results of the VLF-EM and the DC-resistivity methods for the investigation of subsurface structure of the site, in which conventional sampling and previous hydrogeological surveys have indicated high levels of chemical concentrations.

Investigations into Contaminant Plumes: Using AEM Profiling For Groundwater Modeling Input
van den Berg, Harald, EIT, Utrecht, The Netherlands.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 175-179, 2003

Contaminant pollution plumes due to acid mine drainage from tailings storage facilities were defined with high resolution airborne electromagnetic (AEM) profiling and traced out by digitizing subsurface contact zones from conductivity depth imagery in a 3D visualization environment. In combination with various spatial data sets, derived plume characteristics were used as input in creating 3D groundwater models.

Ion Composition Elucidation (ICE): an Investigative Tool for Characterization and Identification of Compounds of Regulatory Importance
Grange, A.H., L.I. Osemwengie, G.M. Brilis, and G.W. Sovocool, U.S. EPA, Las Vegas, NV.
Environmental Forensics, Vol 2 No 1, p 61-74, 2001

Ion composition elucidation (ICE) often leads to identification of compounds and provides high-quality evidence for tracking compounds to their sources because it provides the numbers of atoms of each element in the ions in the mass spectrum, greatly limiting the number of possible compounds that could produce the mass spectrum. A review of chemical and commercial literature can then limit the number of possible compounds to one or a few that can be purchased to confirm tentative compound identifications by comparison of mass spectra and chromatographic retention times. This paper reviews applications of ICE for ultra-trace-level compounds in an extract of the effluent from a tertiary sewage treatment plant. Ion composition elucidation is conceptually simple relative to other analytical techniques and thus more easily explained to a judge or jury.

IP Response of Bacterially-Induced Sulfide Mineral Precipitation
Ntarlagiannis, D. (Rutgers Univ., Newark, NJ); K.H. Williams (Lawrence Berkeley National Lab, Berkeley, CA); K.H. Williams (Univ. of California at Berkeley, Berkeley, CA); L.D. Slater (Rutgers Univ., Newark, NJ); S.S. Hubbard (Lawrence Berkeley National Lab, Berkeley, CA).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS13A-02, 2004

Researchers are investigating the potential of high-resolution geophysical methods for non-invasive monitoring of the coupled biogeochemical processes associated with bioremediation. Although geophysical methods cannot detect these processes directly, they may be able to detect changes in chemical and physical parameters associated with them. This presentation focuses on the analysis of low-frequency electrical responses to laboratory biostimulation experiments performed using multiple and identical flow-through measurement columns to investigate the effect of biologically induced sulfide precipitation (Zn and Fe) on electrical, seismic, and radar responses.

Iron(III) tetra-(N-methyl-4-pyridyl)-Porphyrin as a Biomimetic Catalyst of Horseradish Peroxidase on the Electrode Surface: an Amperometric Sensor for Phenolic Compound Determinations
Santos Damos, F.; M. d. P. Taboada Sotomayor; L.T. Kubota; S.M.C.N. Tanaka; A.A. Tanaka.
Analyst, Vol 128 No 3, p 255-259, 2003

An amperometric sensor for phenolic compound determinations is based on horseradish peroxidase chemistry, using iron(III) tetra-(N-methyl-4-pyridyl) porphyrin (FeIIIT4MpyP) and histidine (His) in its construction. The detection limit for catechol determination was 0.35 umol/L in a response time of less than 0.5 s. The proposed sensor presented stable responses for 100 successive determinations and showed satisfactory responses even after 200 measurements.

Isotopic and Geochemical Assessment of in Situ Biodegradation of Chlorinated Hydrocarbons
Kirtland, Brian C.; C.M. Aelion; P.A. Stone; D. Hunkeler, Univ. of South Carolina, Columbia, SC.
Environmental Science & Technology, Vol 37 No 18, p 4205-4212, 15 Sep 2003

Lacking an in situ method to detect and quantify complete mineralization of chlorinated hydrocarbons (CHCs) to carbon dioxide, researchers combined isotopic measurements with traditional chemical techniques to assess in situ biodegradation of trichloroethene (TCE) and carbon tetrachloride (CT) at the Savannah River site near Aiken, SC. Tracking the parent compounds and breakdown products with C-14 tracers provided a direct in situ measure of complete CHC mineralization in the vadose zone and ground water. Further use of this method may improve remediation strategies.

Laboratory and Field Results Linking High Bulk Conductivities to the Microbial Degradation of Petroleum Hydrocarbons
Werkema Jr., D.D. (U.S. EPA, Las Vegas, NV); E.A. Atekwana and E.A. Atekwana (Univ. of Missouri, Rolla); J. Duris, S. Rossbach, J. Allen, L. Smart, and W.A. Sauck (Western Michigan Univ., Kalamazoo).
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 363-373, 2004

This paper presents the results of a field and laboratory investigation of how microbial degradation processes in unconsolidated hydrocarbon-contaminated sediments influence the geoelectrical response of this impacted zone. The field and laboratory tests showed higher bulk conductivity in sediments containing petroleum hydrocarbons. The sediments also showed increased populations of alkane-degrading microbes and elevated dissolved cations, which suggests enhanced mineral dissolution related to the microbial degradation of the hydrocarbon. Both lab and field data showed the highest bulk conductivities occurring within zones affected by the free-phase and residual phase hydrocarbon and not within the water saturated zone. The similar results for hydrocarbon-contaminated sediments in lab and field settings suggest that the mechanism for the high bulk conductivity in the contaminated zone is related to the microbial metabolism of the hydrocarbon and the resulting geochemical alterations within the contaminated zone.

Lake-Based Magnetic Mapping of Contaminated Sediment Distribution, Hamilton Harbour, Lake Ontario, Canada
Pozza, M.R., J.I. Boyce, and W.A. Morris, McMaster Univ., Hamilton, Ontario, Canada.
Journal of Applied Geophysics, Vol 57 No 1, p 23-41, Dec 2004

The remediation of toxic sediment in harbors and urban waterways requires detailed mapping of contaminated sediment distribution and thickness. Recent work in Hamilton Harbour in Lake Ontario demonstrated a new approach by estimating pollutant levels from proxy measurements of sediment magnetic properties. Measurements from 40 core samples collected within the harbor show that the magnetic susceptibility of a contaminated upper layer of sediment is one to two orders of magnitude greater than in the underlying uncontaminated 'pre-colonial' sediments. Elevated levels of urban-source magnetic oxides provide susceptibility contrast results sufficient to generate a total field anomaly that can be measured with a towed magnetometer. Systematic lake-based magnetic surveying of the harbor using an Overhauser marine magnetometer identified well-defined positive magnetic anomalies that coincide with mapped accumulations of contaminated sediments on the harbor bottom. Detection of shallow magnetic anomalies is dependent upon a closely spaced survey grid and careful post-cruise processing to remove diurnal, regional, and water-depth related variations in the magnetic field intensity.

A LC/MS Multi-Analyte Screening Method for Deleterious Organics in Drinking Water.
Krol, Jim Sr. and Joe Romano (Waters Corporation, Milford, MA); Lawrence Zintek (EPA Region 5, Chicago, IL).
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 5.

The determination of hazardous organics in drinking water is an area of the Homeland Security Presidential Directive (HSPD-9) that will affect the EPA. It mandates that EPA's Office of Water expand monitoring and surveillance systems for recognizing a terrorist attack or a significant change in water quality. The ability to perform multi-analyte screening for numerous organics simultaneously would help maximize efforts to note the presence and significance of toxic agents. Universal detection with high sensitivity is the key, i.e., a universal reversed-phase gradient providing a degree of analyte separation coupled with the specificity of mass spectrometry allows for screening for multi-analytes simultaneously. This presentation discusses the development of a single multi-analyte screening strategy for several deleterious pesticides and herbicides in drinking water using HPLC/ Electrospray Mass Spectrometry.

Lidar: Range-Resolved Optical Remote Sensing of the Atmosphere
Weitkamp, Claus (ed.).
Springer, Springer Series in Optical Sciences, Vol 102, ISBN: 0-387-40075-3, 2005

Written by leading experts in the field of lidar, this book brings all the recent applications and practices up to date, with a forward by one of the founding fathers in the field. Its broad cross-disciplinary scope should appeal to scientists ranging from specialists in optical sciences to environmental engineers.

Light Sources Reveal Signatures of Contaminants in Trees
U.S. Department of Energy FY 2006 Budget Request to Congress, p 246.

X-ray spectroscopy via a beam line at the National Synchrotron Light Source at Brookhaven National Laboratory is being used to determine metal speciation and contaminant distributions in soils, sediments, plants, and animals. Synchrotron x-ray fluorescence mapping of tree rings from a Savannah River Site with high soil concentrations of contaminants shows that trees collected from contaminated areas contain a "signature" of the metals within their annual rings. The study also revealed an important caveat: a tree growing in the middle of a contaminated settling pond with very high levels of nickel showed a dramatic peak in metal concentration in only one year, suggesting that the tree had been able to avoid taking up excess nickel for most of its life. The sudden increase in nickel uptake observed in this study suggests that a branch of the tree's root system may have grown into a grossly contaminated hot spot, taking up a potentially toxic level of nickel that would almost certainly have killed the root system with which it was in contact.

Long-Term Groundwater Monitoring: The State of the Art
The Task Committee on the State of the Art in Long-Term Groundwater Monitoring Design of the Environmental and Water Resources Institute.
American Society of Civil Engineers, Reston, VA. ASCE/EWRI, ISBN: 0-7844-0678-2, 103 pp, 2003

This report summarizes state-of-the-art groundwater monitoring network design for analysis and for practitioners. The methods for the design of groundwater monitoring networks consist of groundwater and quantitative procedures that identify optimal sampling locations and time to obtain representative groundwater quality data essential in the development of groundwater management strategies. Included are chapters that address the objectives of long-term groundwater monitoring, data requirements in groundwater monitoring network design, case studies, and future research and technology transfer needs in groundwater hydrology and hydrogeology.

Long Term Monitoring of Hydrocarbon Contamination Using Multi-Level Vapor Phase Piezometers
Pearce, P., W. Parker, and P. Van Geel, Carleton Univ., Ottawa, ON, Canada.
Environmental Forensics, Vol 3 No 2, p 163-177, 2002

A field study conducted at a former gasoline station evaluated the feasibility of supplementing groundwater monitoring protocols by assessing the vadose zone for the extent of residual subsurface contamination. The researchers also characterized the response of the soil-gas signatures with respect to different soil types and degrees of contamination. Analysis of soil samples taken from boreholes to locate areas of contamination was followed by the installation of a series of 10 nested soil-gas wells with monitoring depths of 0.75, 1.5, 2.25 and 3.0 m from which soil-gas surveys were performed at regular intervals over an extended period to quantify gaseous TPH (TPHg), oxygen, and carbon dioxide concentrations. Soil-gas wells located near the source term exhibited characteristic soil gas signatures and significant fluctuations in TPHg, oxygen, and carbon dioxide concentrations with time, whereas the wells located beyond the soil contamination showed limited correlation between TPHg, oxygen, and carbon dioxide concentrations and decreased seasonal variability.

Long-Term Monitoring Sensor Network
Farrington, Stephen P. (Applied Research Associates, Inc); John W. Haas; Neal Van Wyck.
OSTI: DE00822906, 27 pp, Oct 2003

Long-term monitoring (LTM) associated with subsurface contamination sites is a key element of Long Term Stewardship and Legacy Management across the DOE complex; however, LTM is an expensive endeavor, often exceeding the costs of the remediation phase of a cleanup project. The primary contributors to LTM costs are associated with labor. Sample collection, storage, preparation, analysis, and reporting can add a significant financial burden to project expense when extended over many years. Development of unattended in situ monitoring networks capable of providing quantitative data satisfactory to regulatory concerns has the potential to significantly reduce LTM costs. But survival and dependable operation in a difficult environment is a common obstacle because deploying almost any sensor in the subsurface for extended periods of time will expose it to chemical and microbial degradation. Frequent replacement or servicing (cleaning) of sensors is expensive and labor-intensive, offsetting most, if not all, of the cost savings realized with unattended in situ sensors. To enable facile, remote monitoring of contaminants and other subsurface parameters over prolonged periods, Applied Research Associates, Inc has been working to develop an advanced LTM sensor network consisting of three key elements: (1) an anti-fouling sensor chamber that can accommodate a variety of chemical and physical measurement devices based on electrochemical, optical and other techniques; (2) two rapid, cost-effective, and gentle means of emplacing sensor packages either at precise locations directly in the subsurface or in pre-existing monitoring wells; and (3) a web browser-based data acquisition and control system (WebDACS) utilizing field-networked microprocessor-controlled smart sensors housed in anti-fouling sensor chambers. The monitoring network is highly versatile and can be applied to a variety of subsurface sensing scenarios in different media. The project is initially focused on monitoring water quality parameters of pH, conductivity, oxidation-reduction potential, and temperature in groundwater.
http://www.osti.gov/bridge/servlets/purl/822906-qNYWmr/native/822906.pdf

Low-Level Perchlorate Detection Method Shows Promise
Los Alamos National Laboratories News Release, 18 July 2003

A Los Alamos National Laboratory evaluation of a relatively new method to detect minuscule amounts of perchlorate in water indicates that the detection method holds promise in detecting perchlorate at concentrations of less than one part per billion, which could further strengthen and improve the Laboratory's environmental surveillance capabilities. The study--done in conjunction with personnel from the New Mexico Environment Department and DOE--also indicates that Northern New Mexico waters may have trace concentrations of perchlorate that are well below any proposed safe drinking water standard. EPA currently has one approved method (EPA Method 314) for perchlorate detection, but the method is reliable only for concentrations of four parts per billion (ppb) or greater. In 2003, Los Alamos researchers began a rigorous scientific evaluation of Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/M) to detect ultra-low concentrations of perchlorate. In tests, the LC/MS/MS method seemed to be able to reliably detect perchlorate in the pure water samples that had been spiked with a known concentration of the chemical, but when used to test drinking water and groundwater samples, the LC/MS/MS method seemed less reliable--perhaps due to the presence of salts and minerals commonly found in groundwater. The study suggested the presence of minuscule traces of perchlorate in all drinking water samples tested with the LC/MS/MS method; concentrations potentially ranged from 0.1 to 0.3 ppb. The results of this study suggest that trace levels of perchlorate may be widespread in the environment, but this hypothesis must be further tested. Greater quality control and calibration procedures are necessary at laboratories that use the LC/MS/MS method to test water before the method can be deemed reliable and accurate.

Magnetic Mapping and Classification of Contaminant Impact Levels in Lake Sediments
Boyce, J.I. and W.A. Morris (McMaster Univ., Hamilton, ON, Canada); M.R. Pozza (Marine Magnetics Corp., Richmond Hill, ON, Canada).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS13A-06, 2004

Magnetic property measurements of sediment cores from Hamilton Harbour show that concentrations of PAHs and some heavy metals (Pb, Zn, Fe) in an upper contaminated sediment layer are strongly correlated with magnetic susceptibility. The magnetic contrast between contaminated and clean pre-colonial sediments is sufficient to generate a total field anomaly that can be measured with a magnetometer towed above the lake bottom. This endeavor clearly identified localized magnetic anomalies that coincided with known accumulations of contaminated sediments on the harbor bottom. Lake-based magnetic surveying provides a rapid reconnaissance method for mapping large areas of bottom contamination prior to detailed coring work.

Mapping a Paleochannel System Controlling Contaminant Migration at a Wood-Treating Facility Using Electromagnetics
Sandberg, Stewart K. (Univ. of Southern Maine, Gorham, ME); William Corso; Jessica R. Levine; Gary Newhart; Greg Powell.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, ASP-2, 12 pp, 2001

During the investigation of groundwater contamination at a wood-treating facility near Sheridan, OR, a geophysical survey was conducted in April 2000 to detect and delineate coarse-grained channel-type deposits in the unconsolidated section above bedrock. These deposits constitute preferential pathways for groundwater flow and contaminant migration through the subsurface. Delineation of the extent of dissolved phases of petroleum-based creosote and pentachlorophenol (PCP) solutions was the overall objective of the investigation. Due to the possibility that dense nonaqueous phase liquid (DNAPL) contamination might have accumulated in topographic lows of the bedrock surface near the source area, the geophysical survey also investigated the topography on the bedrock surface. Transient electromagnetic (TEM) soundings, a resistivity sounding, and an extensive terrain conductivity (EM-31) survey were taken, but extensive sources of cultural interference at the site (buildings, fences, railroad tracks, etc.) limited the geophysical survey. This paper describes the results of the survey.

Mapping an Industrial Landfill Area from Penetration of GPR Data
Calabrese, Marica, Luigi Zanzi, and Maurizio Lualdi, Politecnico di Milano, Milano, Italy.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 695-708, 2004

An investigation of a closed landfill involved the performance of an electrical survey. The GPR survey carried out in July 2003 using 250 MHz and 50 MHz antennas. Analysis of the profiles shows a strong difference in the penetration between the landfill and the surrounding fields. Due to the high conductivity of industrial waste within the landfill, the penetration is very low, whereas the penetration outside the landfill can reach a depth of several meters. As a result, GPR was extensively applied for accurately mapping the lateral extent of the landfill and for estimating possible variations of the contamination level. The DC method is the most appropriate technique for an approximate estimate of the landfill depth.

Mapping of Leachate Plumes at Two Landfill Sites in South Africa Using Geoelectrical Imaging Techniques
Rosqvist, H., T. Dahlin, A. Fourie, L. Rohrs, A. Bengtsson, and M. Larsson.
Proceedings of the Ninth International Waste Management and Landfill Symposium, S. Margherita di Pula (Cagliari), Sardinia, Italy, 6-10 October 2003, 10 pp.

The authors present a methodology for mapping leachate contamination close to a landfill using geoelectrical techniques. A comparison of the geoelectrical measurements to field sampling and monitoring results indicated that the geoelectrical technique has been successful.
http://www.tg.lth.se/resist/Sardinia_2003.pdf

Material Property Estimation for Direct Detection of DNAPL using Integrated Ground-Penetrating Radar Velocity, Imaging and Attribute Analysis
Bradford, John H. (Univ. of Wyoming); Stephen Holbrook; Scott B. Smithson.
Report No: DOE/ER/15008, 265 pp, Dec 2004

The focus of this project is direct detection of DNAPLs, specifically chlorinated solvents, via material property estimation from multi-fold surface ground-penetrating radar (GPR) data. GPR processing methodology is combined with quantitative attribute analysis and material property estimation to determine the location and extent of residual and/or pooled DNAPL in both the vadose and saturated zones. An important byproduct of the research is state-of-the-art imaging that allows an investigator to pinpoint and attribute anomalies, characterize stratigraphy, identify fracture zones, and

locate buried objects. Chlorinated solvents have much lower electric permittivity and conductivity than water. An electrical property contrast is induced when solvents displace water in the sediment column resulting in an anomalous GPR signature. Three aspects of reflected wave behavior -- propagation velocity, frequency dependent attenuation, and amplitude variation with offset (AVO) -- can help to identify zones of DNAPL contamination directly. Velocity analysis provides a direct estimate of electric permittivity, attenuation analysis provides a measure of effective conductivity, and AVO behavior is used to estimate the permittivity ratio at a reflecting boundary, or to measure sub-wavelength permittivity anomalies. Areas of anomalously low electric permittivity and conductivity may be identified as potential DNAPL-rich zones. The work has included characterization of both LNAPL and DNAPL contamination because LNAPLs have similar electrical properties to DNAPL and therefore detection methodologies are complementary. The GPR NAPL signature is non-unique, and in most cases it is possible that an uncontaminated earth model could produce a similar result. The key to successful application of these methodologies is in identifying significant departures from the background GPR response that are consistent with the expected NAPL anomaly.
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=835736&query_id=1

Measurement and Estimation of the Root Uptake of Organic Chemical by Plants
Doucette, W., J. Chard, B. Bugbee, R. Dupont, Utah State Univ., Logan.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Abstract 19, 2004

Understanding plant uptake is critical in assessing the effectiveness of phytoremediation. Although the specific mechanisms and factors affecting the translocation of organic chemicals from roots to shoots are poorly understood, translocation is believed to be related, at least in part, to the lipophilicity of the contaminant. Current expressions for predicting translocation are based on bell-shaped curves relating the log Kow of the chemical taken up to the transpiration stream concentration factor (TSCF) and a ratio of the concentration of compound in the plant shoots relative to root-zone solution concentrations. The shape of the curve implies that there is an optimal lipophilicity for translocation, and compounds that are either highly polar or are very lipophilic are not expected to be significantly translocated; however, recent experimental data suggest that these relationships need to be re-examined, especially for neutral, highly water-soluble industrial organics (i.e., 1,4-dioxane, MTBE, sulfolane). TSCF values were experimentally determined for a series of compounds having widely different hydrophobicities using both intact plant and pressure chamber techniques. The authors discuss the relationship between chemical structure and plant uptake, as well as the impact of the experimental methods used to generate the plant uptake data.

Metabolic Primers for the Detection of (Per)chlorate-Reducing Bacteria in the Environment and Phylogenetic Analysis of cld Gene Sequences
Bender, K.S., M.R. Rice, & W.H. Fugate (Southern Illinois Univ., Carbondale); J.D. Coates (Univ. of California, Berkeley); L.A. Achenbach (Southern Illinois Univ., Carbondale).
Applied & Environmental Microbiology, Vol 70 No 9, p 5651-5658, Sep 2004

Natural attenuation of perchlorate is dependent on the presence and activity of dissimilatory (per)chlorate-reducing bacteria (DPRB) within a target site. Researchers have developed and optimized two degenerate primer sets targeting the chlorite dismutase (cld) gene to detect DPRB in the environment. A nested PCR approach increases the sensitivity of the molecular detection method.

Screening of environmental samples indicated that all products amplified by this method were cld gene sequences. The use of these primer sets represents a direct and sensitive molecular method for the qualitative detection of (per)chlorate-reducing bacteria in the environment, thus offering another tool for monitoring natural attenuation.
http://www.science.siu.edu/microbiology/achenbach/CDprimers.pdf

Methods Information Communications Exchange (MICE) Service Website
Sturgeon, Shannon (U.S. EPA, Washington, DC); Ray Anderson (SAIC, Reston, VA).
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, P15.

EPA's Methods Information Communication Exchange (MICE) service provides timely answers to method-related questions and takes comments on technical issues regarding the EPA Office of Solid Waste methods manual known as SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. MICE is designed to directly educate the public regarding inherent SW-846 method flexibility and to clarify whether a method is required by a RCRA regulation. It also documents existing issues or misconceptions regarding SW-846 methods, and thus serves as a first step in resolution of some problems. The MICE service can be reached in 3 ways: by telephone (703-676-4690), by fax (703-318-4646), or by e-mail (mice@cpmx.saic.com). The voice-mail answering service is available 24/7. A caller can listen to several recorded messages on common SW-846 topics and leave a message containing a question or comment. Some of the more commonly asked questions: (1) where to order copies of SW-846, (2) the status of SW-846 Updates I, II, IIA, IIB, III, and IVA, (3) where to find information on sample holding times, preservation, and storage in SW-846, (4) the availability of SW-846 methods under development and other EPA methods, and (5) information on RCRA characteristics testing. The website itself contains answers to some frequently asked questions. MICE address: http://www.epa.gov/epaoswer/hazwaste/test/mice.htm

Micro-Machined Planar Field Asymmetric Ion Mobility Spectrometer as a Gas Chromatographic Detector
Eiceman, G.A. (New Mexico State Univ., Las Cruces); E.G. Nazarov; R.A. Miller; E.V. Krylov; A.M. Zapata.
Analyst, Vol 127 No 4, p 466-471, Apr 2002

A planar high field asymmetric waveform ion mobility spectrometer (PFAIMS) with a micro-machined drift tube was characterized as a detector for capillary gas chromatography. The performance of the PFAIMS was compared directly to that of a flame ionization detector (FID) for the separation of a ketone mixture from butanone to decanone. This paper describes the results of the performance testing.

Microbial In Situ Degradation of Aromatic Hydrocarbons in a Contaminated Aquifer Monitored by Carbon Isotope Fractionation
Richnow, Hans H. (UFZ-Centre for Environmental Research Leipzig-Halle GmbH, Leipzig, Germany); E. Annweiler; W. Michaelis; R.U. Meckenstock.
Journal of Contaminant Hydrology, Vol 65 No 1-2, p 101-120, Aug 2003

The authors present an approach for characterizing in situ microbial degradation using the 13C/12C isotope fractionation of contaminants as an indicator of biodegradation. The 13C/12C isotope fractionation of aromatic hydrocarbons studied in anoxic laboratory soil percolation columns with toluene or o-xylene as the sole carbon and electron source and sulfate as electron acceptor indicated that a calculation of biodegradation based on isotope fractionation could work in systems like soil columns. In a field study, a polluted, anoxic aquifer was analyzed for BTEX and PAH contaminants. Based on the isotope values and the laboratory-derived isotope fractionation factors for toluene and o-xylene, the extent to which the residual substrate fraction in the monitoring wells had been degraded by microorganisms was calculated. The results revealed significant biodegradation along the groundwater flow path. In the wells at the end of the plume, the bioavailable toluene and o-xylene fractions had been almost completely reduced by in situ microbial degradation; however, the constant isotope values of indane and indene in the study indicated that microbial degradation did not lead to isotope fractionation of all aromatic hydrocarbons.

Microbial Mats and Trace Metals Interaction in Surface Sediments Uncovered by DGT Micro-Scale Measurements
Motelica-Heino, M. (BRGM, Orleans, France); W. Davison (Lancaster Univ., Lancaster, UK).
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-I, p 66-67, 2003

Diffusive gradient in thin-films (DGT) uses a probe the size of credit card inserted into the sediment. Metal ions bind to a chelating resin after diffusion through a layer of polyacrylamide hydrogel. This device allows minimum disturbance of the sediment and induces a flux from the pore water that can be related to the elemental concentration in the sampled medium. DGT can provide a snapshot of the metal distribution in the sediment that can be defined by spectrochemical analytical techniques in the laboratory.

Microfabricated Optical Biosensors for In Situ Bioreactor Monitoring
Pishko, Michael V. and Jeanna C. Zguris, Pennsylvania State Univ., Univ. Park.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 37a, 2004

Multi-analyte optical sensing technology has been developed to continuously and noninvasively monitor key cell culture media components in the bulk (using glucose, oxygen, lactate, pH, NO, and interleukin-2 as model analytes) within bioreactors. Researchers are immobilizing analyte-sensitive fluorophores and fluorophore-labeled biorecognition molecules (antibodies, lectins) within novel poly(ethylene) glycol-based gel materials that are analyte-permeable and non-fouling, and maintain protein conformation and thus biological function. These gels can be micro-patterned in a sensor array via photolithography or photoreaction injection molding. The gels are designed to allow rapid mass transfer of the analyte from the surrounding media into the gel interior where it can interact with an analyte-sensitive fluorophore or bind to biorecognition molecules specific for that analyte.

Mineral Grain Surface Observations at a Hydrocarbon-Contaminated Aquifer: Implications for the Geoelectrical Properties of Soils
Burton, Mark E. (Univ. of Missouri-Rolla); Eliot A. Atekwana (Indiana Univ./Purdue Univ., Indianapolis); Estella A. Atekwana (Univ. of Missouri-Rolla).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 271-280, 2003

Though a recent geoelectrical model suggests that the high electrical conductivities measured for soils contaminated by hydrocarbons result from enhanced mineral weathering accompanying microbial degradation of hydrocarbons, a preliminary study shows that the relationship between pore water electrical conductivity and the electrical conductivity of soils contaminated with hydrocarbons is poor. The researchers used scanning electron microscopy (SEM) to examine the morphology of the surfaces of quartz and feldspars from discrete depth intervals associated with vertical electrical conductivity zonation at a hydrocarbon-contaminated site. The composition of precipitates on the mineral surfaces was determined using electron dispersion spectroscopy (EDS). The goal of the study was to determine if vertical electrical conductivity anomalies observed in soils were related to changes in the soil matrix resulting indirectly from biodegradation of hydrocarbons. SEM analyses showed minimal pitting on mineral grains in the upper vadose zone relative to deeper intervals. Mineral grains at depths <50 cm had precipitates on their surfaces attributed to precipitation related to soil-forming processes. At locations where soils were contaminated with residual-phase hydrocarbons, the surfaces of mineral grains were heavily etched and pitted compared to similar depths for uncontaminated soils. In the saturated zone, limited etching/pitting and moderate amounts of precipitates were noted on mineral surfaces. Iron oxide precipitation was greater than 30% in uncontaminated soils, but less than 10% in the contaminated soils. The results show that microbial degradation of hydrocarbon in soils causes changes in the surface grain morphology of minerals that can potentially affect the electrical properties of hydrocarbon-contaminated soils.

Monitoring a Field-Scale Biostimulation Pilot Project Using Cross-Hole Radar and Borehole Geophysical Methods
Lane, Jr., J.W. and F.D. Day-Lewis, U.S. Geological Survey, Storrs, CT.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., AbstractH13G-03

The U.S. Geological Survey (USGS) conducted geophysical investigations in support of a field-scale biostimulation pilot project at the Anoka County Riverfront Park in Fridley, MN. The pilot project was undertaken to assess the applicability of subsurface injection of vegetable-oil emulsion (VOE) to promote microbial degradation of chlorinated hydrocarbons in groundwater. Naturally occurring microbes, which use the VOE as substrate, ultimately break down chlorinated hydrocarbons into chloride, carbon dioxide, and water through oxidation-reduction reactions. To monitor movement of the VOE and changes in water chemistry resulting from VOE advection, dissolution, and/or enhanced biological activity, USGS acquired cross-hole zero-offset radar profiles, radar travel-time tomography data, and a suite of borehole geophysical logs, including electromagnetic (EM) induction conductivity. Data were collected during 5 site visits over 1.5 years. This paper reports on the final analysis and combined interpretation of multiple data types, including application of petrophysical models to radar zero-offset profiles and tomograms to yield estimates of VOE saturation and changes in total dissolved solids downgradient of the VOE injection zones. Comparison of pre- and post-injection datasets provides insight into the spatial and temporal distributions of both VOE and groundwater with altered chemistry--information critical to understanding and verifying biodegradation of chlorinated hydrocarbons at the site. The field data indicate that the plume of ground water with altered chemistry would not be detected in several of the monitoring wells by direct sampling, given the locations of monitoring-well screens. The study results demonstrate the utility of geophysical monitoring for engineered remediation operations.

Monitoring Air Pollution in and Around the Premises of Industrial Parks Using Two Types of Electronic Nose and Gas Chromatography-Ion Trap Mass Spectrometry
Liu, Jen Yu and Yong Chien Ling, Sr. National Tsing Hua Univ., Taiwan.
227th American Chemical Society Meeting, Anaheim, CA, 28 March - 1 April 2004, p 552 [abstract only]

GC-MS and two types of portable electronic nose were used to monitor air pollution in seven industrial parks. The electronic noses provided real-time analysis of air at the sites. The advantage of multisensors in spatially resolved sensing for direct multicomponent analysis was explored to minimize tedious sample preparation procedures. The electronic noses provided characteristic odor fingerprints, which were correlated with the GC-MS analysis. The GC-MS provided a more detailed diagnosis, indicating the presence of hydrocarbons, halocarbons, phenols, nitrogenous benzenes, sulfur compounds, lipid-derived compounds, and polysiloxanes. Subsequent principal component analysis helped in identifying the pollutants' source. The electronic nose was shown to be a simple and rapid screening method for identifying a pollutant source.

Monitoring Bioaugmenation with Single Well Push-Pull Tests in Sediment Systems Contaminated with Trichloroethene
Lee, Jae Hyuk, Mark Dolan, Jonathan Istok, & Jennifer Field, Oregon State Univ., Corvallis.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PH255, 2004

Bioaugmentation can be defined as the introduction of microorganisms to degrade a target compound in a contaminated medium. Despite successful bioaugmentation in bench- and field-scale studies, it still is not clear whether dechlorinating activity is due to indigenous or bioaugmented strains and whether the injected cultures have lesser or greater distribution around the injection wells. Microcosm studies conducted to compare the reductive dechlorination rates of trichloroethene (TCE) and trichlorofluoroethene (TCFE) in control sediments and sediments bioaugmented with a dechlorinating culture produced data that were then used to design intermediate-scale (125 cm) push-pull laboratory tests conducted in physical aquifer models (PAMs). Push-pull test methodology, TCFE, and the PAMs were used to monitor the progress of bioaugmentation in PAMs containing TCE-contaminated sediment. The rate and products of TCFE transformation were determined by conducting push-pull tests in the PAM. The spatial distribution of the dechlorinating culture within the PAM correlated with concentrations of TCFE and TCE dechlorination products. No transformation products of TCFE and TCE were observed for sediment controls that did not receive the dechlorinating culture.

Monitoring Biodegradation of VOCs Using High-Speed Gas Chromatography with a Dual-Point Sampling System
Current, Robert W., Evguenii I. Kozliak, and Anthony J. Borgerding, Univ. of North Dakota, Grand Forks.
Environmental Science & Technology, Vol 35 No 7, p 1452-1457, 2001

A new sampling system has been designed and interfaced with high-speed gas chromatography (HSGC) to monitor and assess the performance of a trickle-bed bioreactor designed for the removal of volatile organic compounds from air. A portion of a gas stream containing styrene and toluene was sampled both before and after passing through the bioreactor by means of a dual-loop sampling system.

With a frequency of as high as 2 per minute, treated and untreated samples were alternately transferred on-line to the cryofocusing injection system of a HSGC and analyzed. This analytical system generated data with less than 2% relative standard deviations for standard samples, and residual contamination of subsequent analyses from a highly concentrated sample (2000 g/L) was not observed. Rapid monitoring of the system detected subtle changes in the concentration of analytes with 30 s temporal resolution.

Monitoring Microbe-Induced Sulfide Precipitation Under Dynamic Flow Conditions Using Multiple Geophysical Techniques
Williams, K.H. (UC Berkeley & LBNL, Berkeley, CA) & S. Hubbard; D. Ntarlagiannis (Rutgers Univ., Newark, NJ); J. Banfield (UC Berkeley).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS13A-01, 2004

A laboratory study investigated the feasibility of using minimally invasive geophysical techniques to monitor microbe-induced sulfide precipitation in saturated sand-packed columns under dynamic flow conditions. The effect of zinc and iron sulfide precipitation on geophysical signatures was evaluated during stimulated sulfate-reduction by Desulfovibrio vulgaris. Over a period of seven weeks, the areas where sulfide precipitation and accumulation occurred resulted in significant changes in two of the three geophysical measurements. High frequency (400-600kHz) acoustic wave amplitudes were reduced by nearly an order of magnitude over the course of the experiment with no significant accompanying change in wave velocity. Saturated hydraulic conductivity measurements showed a final decrease of nearly two orders of magnitude from those recorded initially. The results were compared to a substrate- and metals-amended but non-inoculated control column. Geophysical measurements in the control column showed no change in acoustic wave amplitudes, induced polarization, or hydraulic conductivity over the same time period. Final destructive analysis of the columns was performed to assess the sediment-affixed cell densities, evaluate the nature of the microbe-sulfide associations, and elucidate the spatial arrangement of the sulfides within the sedimentary pore space. Evaluation of the multiple data sets suggests that microbe-induced sulfide precipitation is both directly detectable using geophysical techniques and capable of altering saturated flow conditions. The geophysical monitoring approach may prove useful at the field scale for time-course monitoring of metals remediation during engineered bioremediation.

Monitoring of an In-situ Air Sparging Experiment Using Electrical Resistivity Tomography
Yang, Xianjin (SteamTech Environmental Services, Bakersfield, CA); Douglas J. LaBrecque; Illa Amerson-Treat; Richard L. Johnson; Paul Lundegard; Gianfranco Morelli.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, EEM-2, 15 pp, 2001

Electrical resistivity tomography (ERT) was used successfully for monitoring the air distribution in an in situ air sparging experiment. The experiment evaluated the removal of residual gasoline from the source zone of a simulated gasoline spill in a tank filled with water-saturated sands The percent difference in resistivity provided a quantitative view of air saturation in the sand tank. The initial background resistivity image suggests that the tank filled with water-saturated sands is geoelectrically non-homogenous, though the sands in tank are homogeneous in the sense of grain size. The background resistivity images also showed evidence of trapped residual gasoline around the water table. Air sparging was carried out in different modes. Air sparging at a flow rate of 20 cubic feet per minute (cfm) resulted in a larger radius of influence than at 5 cfm. At the same air flow rate, sparging in the pulse mode created a larger affected zone than in the continuous mode. Pulse operation produced a more complex air distribution in the tank. Skewed airflow at both 5 cfm and 20 cfm flow rates indicated the presence of preferential pathways in the tank.

Monitoring of Leachate Recirculation in a Bioreactor Using Electrical Resistivity
Grellier, S. (CReeD, Limay, France & UMR 7619 Sisyphe, Univ., Paris, France) & N. Bureau; H. Robain (UR R027 GEOVAST, Inst. of Research for the Development, Bondy, France); A. Tabbagh, C. Camerlynck, & R. Guerin (UMR 7619 Sisyphe, Universit, Paris, France).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS23A-05, 2004

Bioreactor landfills speed up waste biodegradation by optimizing the moisture content through leachate recirculation. Electrical resistivity tomography (ERT) can be carried out with a fast resistivity method to monitor leachate recirculation. During a recirculation period waste moisture increases, so that electrical resistivity may decrease, but at the same time temperature and mineralization of both waste and leachate become intermixed. If waste temperature is much higher than leachate temperature, electrical resistivity will not decrease as much as it would if the temperature difference was smaller. If leachate mineralization (i.e., leachate conductivity) is higher than that of wet waste in the landfill, electrical resistivity will tend to decrease. The authors describe an injection experiment in which leachate temperature was relatively cold (between 5 and 10 degrees C), leachate conductivity was about 9200 uS/cm, and waste resistivity in the borehole region was about 80 Omega m. This is a situation where the temperature difference between waste and leachate is large and the resistivity difference between waste and leachate is high. The resistivity variation is essentially due to waste moisture increase. The ERT method allows leachate diffusion to be seen through the waste mass and the influence zone of the leachate recirculation system to be determined.

Multi-Ion Imaging Using Fluorescent Sensors in a Microtiterplate Array Format
Mayr, Torsten; Gregor Liebsch; Ingo Klimant; Otto S. Wolfbeis.
Analyst, Vol 127 No 2, p 201-203, 2002

This paper describes a novel type of sensor array for water analyses that delivers simple on/off patterns of complex ion mixtures. Fluorescent indicators for Ca, Na, Mg, sulfate, Cl, and Hg were arranged in microtiterplates and the analytical information was imaged with a CCD camera within microseconds using an intrinsic referencing method.

Monitoring Oxidation of Chlorinated Ethenes by Permanganate in Groundwater Using Stable Isotopes: Laboratory and Field Studies
Hunkeler, D. (Univ. of Waterloo, Waterloo, ON, Canada), R. Aravena, B. L. Parker, J. A. Cherry, and X. Diao.
Environmental Science & Technology, Vol 37 No 4, p 798-804, 2003

In situ permanganate injection is increasingly applied for destruction of chlorinated ethenes in groundwater. This paper describes an examination of the roles that carbon isotope analysis can play in the assessment of trichloroethene (TCE) oxidation by permanganate. In laboratory experiments, a strong carbon isotope fractionation was observed during oxidation of TCE with similar isotopic enrichment factors for initial KMnO4 concentrations between 67 and 1250 mg/L. In the field, a single permanganate injection episode into a sandy TCE-contaminated aquifer enriched C-13 values up to +204%. Elevated Cl- concentrations were observed at distances of up to 4 m from the injection point. Farther away, the Cl- increased without any change in C-13 of TCE, which suggests that Cl- was not produced locally but migrated to the sampling point. Isotope mass balance calculations made it possible to identify zones where TCE oxidation continued to occur during the rebound phase. The C-13 values proved useful in assessing the dynamics between TCE oxidation and dissolution, as well as in locating oxidation zones of chlorinated ethenes not identified from Cl- distribution alone.

Multi-Method Geophysical Examination of a Hydrocarbon Contaminated Site
Mwanda, K. (Western Michigan Univ., Kalamazoo); E.A. Atekwana; W.A. Sauck.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC14, 10 pp, 2002

A former refinery site in Carson City, MI, with a 50-year history of hydrocarbon contamination was investigated with electromagnetic (EM-31), magnetic, dc resistivity, and ground-penetrating radar (GPR) methods. The site geology consists of glacial drift sediments of fine to medium sands (1-4 m thick) underlain by a clay aquitard unit. Water table depths range from 1.2 m in the west to 4 m in the east of the surveyed area. Although not readily evident on the magnetic anomaly maps, the EM-31 surveys clearly showed remnants of buried pipes of various lengths at various orientations. The EM maps also showed extensive near-surface conductivity anomalies. Soil borings of anomalous conductivities to the west suggest the presence of shallow clays with pooled hydrocarbons at depths less than 20 cm beneath the surface. The highest conductivities at the site are associated with a region of significant hydrocarbon contamination in both the unsaturated and saturated zones. Soil borings confirmed the sizes of the pipes and the shallow subsurface stratigraphy. Vertical electrical soundings were consistent with the subsurface stratigraphy and complemented the EM and GPR results. The boring results indicate that areas where free product is present are more conductive than areas with only residual product contamination. Other recent studies also suggest that in situ apparent resistivity is lowest (highest conductivity) at the hydrocarbon free-product locations, higher for the dissolved-phase location and highest in the non-contaminated location. The authors conclude that the conductivity anomalies may be related to the occurrence of intrinsic biodegradation.

A Multiobjective Approach to Cost Effective Long-Term Groundwater Monitoring Using an Elitist Nondominated Sorted Genetic Algorithm with Historical Data
Reed, P. M., B. S. Minsker, and D. E. Goldberg.
Journal of Hydroinformatics, Vol 3 No 2, p 71-89, 2001

The authors present a methodology for quantifying the tradeoffs between sampling costs and local concentration estimation errors in an existing groundwater monitoring network. The method utilizes historical data at a single snapshot in time to identify potential spatial redundancies within a monitoring network. The study combines nonlinear spatial interpolation with the Non-dominated Sorted Genetic Algorithm (NSGA) to identify the tradeoff curve (or Pareto frontier) between sampling costs and local concentration estimation errors. Guidelines are given for using theoretical relationships from the field of genetic and evolutionary computation for population sizing and niching. The paper also identifies a selection pressure analysis and a niching-based elitist enhancement of the NSGA, which are integral to the algorithm's efficiency in quantifying the Pareto frontier for costs and estimation errors.

Nanoelectronic Chemical Sensors for Chemical Agent and Explosives Detection
Smardzewski, R.R. (Geo-Centers, Inc., Aberdeen Proving Ground, MD); N.L. Jarvis (U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD); A.W. Snow (Naval Research Laboratory, Washington, DC); H.Wohltjen (Microsensor Systems, Inc., Bowling Green, KY).
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 7 pp, 2004

The authors report on nanoelectronic chemical vapor sensors (chemiresistors) consisting of nanometer-sized gold particles (1.2-2.4nm) encapsulated by monomolecular layers of functionalized alkanethiols deposited as thin films on interdigitated microelectrodes. When chemical vapors reversibly absorb into these thin films, the electrical conductivity of the film is modulated. The measured current between gold clusters is extremely sensitive to very small amounts of monolayer swelling or dielectric alteration caused by absorption of vapor molecules. For chemical agent simulants, a large dynamic range of sensitivities extends down to parts per billion vapor concentrations. Detection limits in the femtogram range have been observed for explosive vapors of TNT/DNT. Complete reversibility has been observed for all analyte vapors, and the devices exhibit relatively low sensitivity to water vapor, which usually is a major interferent. Tailored selectivities of the sensors are accomplished by incorporation of chemical functionalities at the terminal structure of the alkanethiol or substitution of the entire alkane structure. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionM/MO-01.pdf

Nanoscale Biosensor Arrays for Detection of Chemical and Biological Warfare Agents
Cooke, Joseph, Gary Eagleson, Yushan Yan, Ashok Mulchandani, and Wilfred Chen, Univ. of California, Riverside.
AIChE 2004 Annual Meeting, November 7-12, Austin, TX.
American Inst. of Chemical Engineers, New York, NY. Presentation 583d, 2004

An antibody sensor array platform has been developed that takes advantage of smart biomolecules with thermally tunable hydrophobic properties. These biomolecules can be used for specific and selective adhesion of antibodies onto a target region of an array surface. A DNA microarrayer was used to fabricate arrays of hydrophobic pads of roughly 60 micron diameter by spotting and curing organosilanes onto a glass surface. Elastin-Protein A fusions were created to allow the self-assembly and non-covalent immobilization of antibodies in a functionally active orientation directly onto an array surface using a simple temperature trigger. This platform creates a basis for a self-assembled sensor array that will incorporate sandwich immunoassays to detect and quantify chemical and biological warfare agents.

Nanotubes Detect Nerve Gas
Technology Research News, 21 Nov 2003

Naval Research Laboratory researchers have found that carbon nanotubes are sensitive to extremely small concentrations--less than one part per billion--of chemical nerve agents. Carbon nanotubes are rolled-up sheets of carbon atoms that can be as narrow as one nanometer, which is one millionth of a millimeter. The researchers fabricated nanotube-based sensors from random networks of single-walled carbon nanotubes and used a prototype to detect dimethyl methylphosphonate, which simulates the nerve agent sarin. The networks of nanotubes form transistors, and the presence of a nerve agent increases the nanotubes' resistance to electricity. The sensors are inexpensive, require little power, and could be used to detect sub-parts-per-billion concentrations of nerve agents and other chemical warfare agents and hazardous chemicals. The prototype sensor is contained in a quartz tube one-eighth of an inch wide by two inches long. The nanotube network sensors can be combined with filters coated with polymers that are sensitive to certain chemicals to make sensors that chemical-specific. These separate sensors could be incorporated into handheld or remotely-operated devices in arrays designed to detect a variety of substances. The researchers estimate that these carbon nanotube sensors could become practical within two to five years.

Natural Perchlorate Has a Unique Oxygen Isotope Signature
Bao, Huiming (Louisiana State Univ., Baton Rouge); Baohua Gu (Oak Ridge National Lab, Oak Ridge, TN).
Environmental Science & Technology, Vol 38 No 19, p 5073-5077, 2004

The authors report the first measurement of the triple-oxygen isotope ratios (18O/16O and 17O/16O) for both man-made perchlorate from commercial sources and natural perchlorate extracted from Atacama Desert soils. They found that normalized 18O/16O ratios for natural perchlorate has a far wider range than does man-made perchlorate. The findings from this research provide a tool for the identification and forensics of perchlorate contamination in the environment.

A New Approach to Radionuclide Analysis in Groundwaters
Hochel, R.C., R.A. Sigg, D.P. DiPrete, & A.A. Ekechukwu, Savannah River National Lab., Aiken, SC.
WSRC-MS-2004-00544, 19 pp, 2004

A method using liquid scintillation spectral analysis (LSSA) for analyzing mixtures of radionuclides in groundwater samples, which is fast, simple, and inexpensive, was developed and bench-tested. Samples can be measured in a field laboratory with a new commercial portable liquid scintillation instrument that provides advanced analysis, display, and computational features previously found only in large expensive laboratory models. Results can be available within hours from the time samples are collected. The analysis provides a good measure of total sample activity and a spectral index value that may detect changes in radionuclide distributions from previous analyses when counting statistic are adequate. If a sample shows no change, further analytical costs for it may be avoided. A method that rapidly and quantitatively concentrates very low levels of activity from liter-size samples in minutes was also tested. With some modest improvements in this step, this work offers a completely new methodology and approach to groundwater remediation, which can dramatically reduce analytical costs and speed monitored cleanup and closure in many types of radiological work programs.
http://sti.srs.gov/fulltext/ms2004544/ms2004544.pdf

A New Cation-Exchange Method for Accurate Field Speciation of Hexavalent Chromium
Ball, James W. and R. Blaine McCleskey, U.S. Geological Survey.
U.S. Geological Survey Water-Resources Investigations Report 03-4018, 22 pp, 2003

A new cation-exchange method for field speciation of Cr(VI) has been developed to meet present stringent regulatory standards and to overcome the limitations of existing methods. The new method allows measurement of Cr(VI) concentrations as low as 0.05 micrograms per liter, storage of samples for at least several weeks prior to analysis, and use of readily available analytical instrumentation. The sensitivity, accuracy, and precision of the determination in waters over the pH range of 2 to 11 and Fe concentrations up to 1 milligram per liter are equal to or better than existing methods such as EPA method 218.6. Time stability of preserved samples is a significant advantage over the 24-hour time constraint specified for EPA method 218.6.
http://wwwbrr.cr.usgs.gov/projects/GWC_chemtherm/pubs/WRIR%2003-4018.pdf

New Techniques in Volumetric Imaging and Photographic Documentation of Salt Contaminated Soil
Bauman, Paul, KOMEX International Ltd.
Remediation Technologies Symposium 2003, 15-17 October 2003, Banff, Alberta.
Environmental Services Association of Alberta. Book of Abstracts, No 35, 2003

Because chlorides and sulfates do not sorb or biodegrade, they may have significant negative impact on agricultural land in areas that already suffer from dryland salinity, the corrosive effects of salinized soil, and the high cost of remediating salt-contaminated soil. Intrusive characterization (drilling, soil sampling, analytical chemistry, etc.) and remediation of salty soils, which can be very costly, are directly related to the volume of contaminated soil and the surface area of contamination. Geophysical techniques may be cost-effective for mapping, cross-sectionally slicing, and volumetrically imaging subsurface salt contamination. This paper describes non-intrusive geophysical techniques of 2-D and 3-D electrical resistivity tomography that can rapidly and cost-effectively provide volumetric images of subsurface salt contamination associated with flare pits, drilling sumps, injection wells, pipeline breaks, tank leaks, and tanker spills. Salt-contaminated sites are particularly amenable to low-level, high-resolution aerial photographic techniques due to changes in vegetation color in both the visible light and infrared spectra. This type of survey can produce a 3-D rendering of subsurface salt contamination overlaid by a high resolution, ortho-rectified photographic base map, essentially an easily understood blueprint for followup intrusive investigations or excavations.

NEWMOA Technology Review Committee Advisory Opinion: Passive Diffusion Bag Samplers for VOC Sample Collection from Groundwater Monitoring Wells
Northeast Waste Management Officials' Association, Boston, MA. 15 Feb 2002

The purpose of this Advisory Opinion is to raise awareness of the use of passive diffusion bag (PDB) sampler technology for VOC sample collection from groundwater monitoring wells and its on-site application in the Northeast. The Opinion is intended to educate project managers, consultants, and the state regulators who oversee projects about the factors that can affect the proper use of diffusion samplers. All seven of the Northeast states participated in the development of this Advisory Opinion consensus statement; however, it should be noted that this Opinion does not constitute an "approval" of this technology. The appropriateness of the use of PDB samplers will need to be determined on a site-by-site basis. Potential users should contact officials in the state in which the project is located to determine if there are any state-specific requirements that could apply.
http://www.newmoa.org/Newmoa/htdocs/cleanup/advisory/diffusionsampler.htm

Nondetects and Data Analysis: Statistics for Censored Environmental Data
Helsel, Dennis R., U.S. Geological Survey.
Wiley, New York. ISBN: 0-471-67173-8, 268 pp, 2004

The measurement of trace chemicals in water, air, soil, and biota frequently results in values reported only as less than the detection limit. The standard practice in environmental science for interpreting these data is woefully inadequate, usually consisting of substituting one-half the detection limit and performing traditional statistics tests. Offering a unique approach, this book presents methods that are widely used in medical and industrial settings but have been rarely or never applied to issues of environmental health. The steps necessary to take these existing procedures and apply them to left-censored environmental data are fully illustrated.

Non-Invasive Biomonitoring Approaches to Determine Dosimetry and Risk Following Acute Chemical Exposure: Analysis of Lead or Organophosphate Insecticide in Saliva

Timchalk, C., T.S. Poet, A.A. Kousba, J.A. Campbell, and Y. Lin, Pacific Northwest National Lab., Richland, WA.

Journal of Toxicology and Environmental Health Part A, Vol 67, p 635-650, 2004

Saliva is a useful medium to test for purposes of non-invasive biomonitoring. A microfluidic/electrochemical device using square wave anodic stripping voltammetry has been developed for the analysis of lead (Pb) in saliva. The system demonstrates a linear response over a broad concentration range (1 to 2,000 ppb) and is capable of quantitating saliva Pb in rats. Appropriate pharmacokinetic analyses have been used to quantitate systemic dosimetry based on determination of saliva Pb concentrations, and saliva has recently been used to quantitate dosimetry following exposure to the organophosphate insecticide chlorpyrifos in a rodent model system. It is feasible to rapidly quantitate acute exposure to a broad range of chemical agents by coupling this non-invasive technology with pharmacokinetic modeling.

A Novel Approach for Investigating Foliar Uptake of Organic Pollutants Through the Use of 'Synthetic' Leaves

Gouin, T. (Trent Univ., Peterborough, ON, Canada); T. Harner (Environment Canada).

Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Platform Presentation IP046, 2004

To investigate the possible significance of plant growth relevant to air concentrations of persistent organic pollutants (PBDEs and PCBs), several polymer coated glass samplers were deployed within a deciduous forest coinciding with the emergence of fresh new foliage. These samplers were left fully exposed to simulate exposure of fresh foliage to both wet and dry deposition. These 'synthetic' leaves were coated with three thicknesses of ethylene vinyl acetate (50, 20, and 2 m), and collected on a regular schedule. Real leaves from sugar maple trees were collected on the same basis, and ambient air concentrations were assessed with passive and active air samplers. Analysis of the synthetic leaves provided information on the kinetics and equilibrium of air/foliage transfer of contaminants.

Numerical and Physical Modeling of the Effects of Temperature Change on Ground Penetrating Radar Signals

Kochiss, C.S. (Univ. of Connecticut, Storrs/U.S. Geological Survey, Storrs); L. Liu (Univ. of Connecticut, Storrs/Cold Regions Research and Engineering Laboratory, Hanover, NH).

2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS22A-05, 2004

Ground-penetrating radar (GPR) can be used to detect the extent of a contaminant plume and to monitor the remediation process as contaminants are removed. When thermal remediation methods (e.g., steam injection) are used to mobilize nonaqueous phase liquids for vapor extraction, these methods cause a temperature change in earth materials, which subsequently causes variations in GPR signal response. When using GPR to monitor a remediation process, all possible factors that affect GPR signatures must be recognized for better definition and delineation of contaminant flow and transport. Numerical models used to quantify the effects of temperature changes and fluid phase changes in a porous medium indicate that when a porous medium is heated, the GPR signal will show a decrease in travel time and an increase in amplitude from a reflector. A simplified numerical model of the GPR signal response to a steam injection was made by comparing GPR signal responses to a water-filled layer and an air-filled (steam) layer within the saturated porous medium. The polarity of the reflected GPR signal is opposite for the water- and air-filled layers. Physical experiments conducted in a laboratory-scale sand tank confirm the results obtained from the numerical models.

Object-Based Inversion of Crosswell Radar Tomography Data to Monitor Vegetable Oil Injection Experiments
Lane, J.W. Jr. (U.S. Geological Survey, Storrs, CT); F.D. Day-Lewis; R.J. Versteeg; C.C. Casey.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 1134-1160, 2003

Crosswell radar tomography methods can be used to dynamically image ground-water flow and mass transport, and dynamic imaging can be used to identify preferential flow paths and help characterize complex aquifer heterogeneity. Because the ray-path coverage of the interwell region is limited by the borehole geometry, the tomographic inverse problem is typically under-determined, and tomograms may contain artifacts such as spurious blurring or streaking that confuse interpretation. Using synthetic and crosswell radar field data acquired during vegetable-oil injection biostimulation experiments at a site in Fridley, MN, the investigators implemented object-based inversion (using a constrained, non-linear, least-squares algorithm) as an alternative to pixel-based inversion approaches that utilize regularization (such as damping or smoothing criteria) with good results. The authors present details of work and results from this project. [Same title/authors published in Journal of Environmental & Engineering Geophysics, Vol 9 No 2, p 63-77, 2004]
http://water.usgs.gov/ogw/bgas/publications/SAGEEP03_Lane/SAGEEP03_Lane.pdf

Odor Sensor Utilizing Surface Plasmon Resonance for Environmental Monitoring
Nanto, H.; Y. Kitade; Y. Sekikawa; Y. Takei; N. Kubota, E. Kusano; A. Kinbara.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 174-181, 2004

An odor sensor based on surface plasmon resonance (SPR) was investigated for detection of ammonia and amine gases. The sensor was prepared by depositing the molecular recognition membrane on substrate coated with Au thin film using plasma chemical vapor deposition (CVD). The acrylic acid membrane SPR sensor exhibited an excellent selectivity and high sensitivity for ammonia and amine gases.

On-Line Coupling of Supercritical Fluid Extraction with Large-Volume Injection Gas Chromatography for the Determination of Explosives and Related Compounds in Vapour Samples
Batlle, R. (Stockholm Univ., Stockholm, Sweden), H. Carlsson, A. Colmsjo, C. Crescenzi, P. Tollback.
The Pittsburgh Conference: PITTCON 2003, Presentation 2090-5.

Mine detection by means of metal detectors has become more difficult because metal content in modern mines can be as low as 0.1 g, leading to a high rate of false alarms. Researchers are examining chemical detection of the vapor that evolves from explosives and is transported to the surrounding air or soil in the immediate vicinity. This multi-analyte method is less prone to interferences than metal detection, but has high sensitivity demands, whereas the concentration of explosives or related compounds expected to reach gas phase in real field conditions is extremely low. A complete analytical procedure to detect trace explosives and related chemicals in the atmosphere is described. In the proposed systems, separation and quantitation of 8 nitroaromatic compounds related to mine detection was achieved, showing promise not just for demining, but for fingerprinting mines according to both amount and type of explosive criteria.

On-Site Comprehensive Analysis of Explosives Using HPLC-UV-PAED
Marple, Ronita L. and William R. LaCourse.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 161-173, 2004

High-performance liquid chromatography with ultra violet and photo-assisted electrochemical detection (HPLC-UV-PAED) has been developed for the sensitive and selective detection of explosives in ground water and soil extracts. Use of on-line solid-phase extraction (SPE) minimizes sample pretreatment and enables faster and more accurate on-site assessment of a contaminated area. Detection limits are equivalent or superior to those achieved with EPA Method 8330, as this automatable, field-compatible, and environmentally friendly approach is capable of determining a wider range of organic nitro compounds.

Optical Chloride Sensor Based on [9]Mercuracarborand-3 with Massively Expanded Measuring Range
Xu, Chao, Yu Qin, and Eric Bakker, Auburn Univ., Auburn, AL.
Talanta, Vol 63 No 1, p 180-184, 10 May 2004

By optimizing a fluorescent chloride optical sensing film based on a plasticized poly(vinyl chloride) film incorporating the halide-selective ionophore [9]mercuracarborand-3 and the H+-chromoionophore ETH 5418, researchers expanded the sensor measuring range for monovalent ions by about 6 orders of magnitude. This optimization was achieved with a recently established two-step ionophore binding mechanism. The optode shows very good selectivity, with an excellent discrimination of thiocyanate and lipophilic anions such as salicylate, nitrate, and perchlorate. The main interferences are the other halides, bromide and iodide.

Optical Fiber Sensor for Photosynthetic Herbicides Detection by Time-Resolved Absorption
Andreu, Y., F. Baldini, C. Domenici, A. Giannetti, D. Masci, A.A. Mencaglia.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 31-37, Mar 2004

A new sensing system for the detection of photosynthetic herbicides in water is based on the use of the reaction center (RC) isolated from Rhodobacter sphaeroides, a purple bacterium. RC is a trans-membrane protein complex with one characteristic: stationary and excited states have different absorption properties. The presence of herbicides affects the path followed by the protein to return to the stationary state, which allows the herbicides to be detected by monitoring the temporal changes of absorption following optical excitation. An optoelectronic system has been developed that combines a diode at 860 nm and a hybrid photodetector as excitation source and detector, respectively. Optical fibers couple the optoelectronic system to a 5 cm-long cell containing the RC solution. The system has been used for the detection of the herbicides diuron, atrazine, terbutryn, terbuthylazine, and simazine.

Optical Sensor a Simple Warning System
Instrument Society of America, 2 Feb 2005

Sending weak beams of light through glass tubes that resemble soda straws can inexpensively solve problems ranging from the migration of waste through a landfill to detecting when an automobile battery will soon be too weak to start a car. The interface sensor is the subject of a pending Sandia National Laboratories patent application and a research agreement with Custom Electronics, an electronics company in upstate New York. The company is partnering with Sandia to develop a prototype device from the current bench-top demonstration. Researcher Jonathan Weiss is the inventor.

The device can work in a landfill that holds chemicals that may leach into groundwater. How can an observer tell what the chemicals in a landfill are doing? For leaching to occur, liquid must be present. Arrange two fiber-optic cables like snakes, one above the other, in the landfill. Shine a light through the fibers. Because the temperatures of the fibers change the amount of light scattered by them, the emissions can indicate the temperature at any point along the fiber. That temperature comes in part by how much water is in the surrounding soil. Thus, fluid flowing down through the landfill would produce a clear signal from the wetted, cooled fiber.

Optimization of a Resonance Enhanced Multiphoton Ionization (REMPI) Probe for Detection of Selected Volatile Organic Compounds (VOCS)

Chen, K. (Univ. of South Carolina, Columbia), S.B. Brown, B.W. Colston, M.S. Angel.

The Pittsburgh Conference: PITTCON 2003, Presentation 1030-1.

Resonance-enhanced multiphoton ionization (REMPI) is a spectroscopic technique that can be used to selectively detect and identify VOCs, such as the high-priority groundwater and vadoze zone contaminants TCE and PCE. A prototype REMPI probe uses an electrode to collect electrons generated during the REMPI process, and the current provides a measure of VOC concentration. A (2+1) REMPI scheme is used for these ultraviolet (UV) and vacuum ultraviolet (VUV) absorbing molecules. In current studies, a tunable dye laser is scanned over the range of interest to identify the wavelengths that will selectively excite and ionize the target molecule in the presence of other species in the sample. REMPI dependence on laser wavelength, laser power, and other experimental parameters is being systematically examined for selected VOC contaminants.

Optimized Procedure by Experimental Designs for the Extraction and Determination of Sb(III) and Sb(V) Species in Soils, Using Oxalic-Ascorbic Acids Medium, by Hydride Generation Atomic Fluorescence Spectrometry

De Gregori, Ida, Univ. Catolica de Valparaiso, Valparaiso, Chile.

The Pittsburgh Conference: PITTCON 2003, Presentation 590-2P.

Environmental concern about antimony (Sb) has grown because anthropogenic emissions from smelters and fossil fuel combustion have increased the presence of the element in the soil. As Sb toxicity is strongly dependent on the chemical form (Sb(III) is more toxic than Sb(V)), speciation data are required. Researchers aim to optimize an analytical procedure to carry out Sb redox speciation in soils, based on a single extraction procedure and selective determination of Sb(III) by hydride generation coupled to atomic fluorescence spectrometry (HG-AFS). The approach uses an oxalic acid/ascorbic acid mixture as extractant solution and detection medium. For detection, the effect on the Sb(III) and Sb(V) fluorescence signals of NaBH4, HCl, and oxalic acid concentrations were investigated. Results show that only the concentration of NaBH4 has a significant effect on the selective determination of Sb(III) by HG-AFS; however, the presence of oxalic acid is essential to suppress the Sb(V) signal and to obtain only the Sb(III) fluorescence signal. The accuracy of the method was assessed by recovery studies of both Sb redox species from a spiked agricultural soil. Result obtained agreed with the spiked concentrations. The methodology also was applied to the Sb redox speciation in agricultural soils impacted by copper smelter activities.

ORNL System Eliminates Perchlorate, Helps Scientists Trace Source
Oak Ridge National Laboratory News Release, 21 Oct 2004

An award-winning system developed at Oak Ridge National Laboratory to clean up perchlorate pollution is helping scientists determine whether the contamination is natural or man-made. The latter application could be instrumental in tracking environmental perchlorate, finding its source, and resolving resulting liability issues. Perchlorate is produced and used to make solid rocket propellant and explosives but also occurs naturally, as in nitrate soils from Chile used to make fertilizers, making the source sometimes difficult to trace. The ORNL treatment system developed under the leadership of ORNL scientist Baohua Gu removes and breaks down perchlorate into harmless chloride and water, then recharges the resin so it can be reused many times. The process costs up to 80% less than conventional methods and is one of R&D Magazine's top 100 inventions for 2004. The developers have found another benefit: the process of removing perchlorate also purifies it, allowing the scientists to isolate trace quantities and examine the compound more closely than ever before. Using isotopic analysis, they compared naturally-occurring perchlorate from Chile's Atacama Desert to synthetic or manufactured samples and found the natural type had a much higher value of the oxygen-17 isotope (an oxygen atom with 8 protons and 9 neutrons in the nucleus) but a lower chlorine-37 value (a chlorine atom with 17 protons and 20 neutrons in the nucleus). The ORNL treatment system provides a tool for the identification and forensics of perchlorate contamination in the environment. ORNL has licensed the resin technology to the Purolite company and the regeneration and recovery technology to Calgon Carbon Corporation. The presence of natural or atmospheric perchlorate in the environment obviously has far-reaching ramifications, ranging from public health issues to liabilities that could be imposed by agricultural and environmental cleanup needs. Perchlorate has been found in lettuce and milk, which begs the questions: How is it getting there and migrating through the environment? Where is the liability? The technology could have a considerable impact on how those questions are answered.
Contact: Mike Bradley, ORNL, 865-576-9553, bradleymk@ornl.gov.

Overview of the AEMS Project
Mouri, M., Y. Ishimori, K. Kawano, H. Uchida, Y. Ishikawa, E. Tamiya, and M. Ishizuka.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 78-85, Mar 2004

The objective of the Advanced Environmental Monitoring System (AEMS) project is to develop a new integrated groundwater monitoring system based on innovative technologies to facilitate effective management of groundwater contamination in and around high-tech industrial facilities. The biosensors developed in this project will be used not only to monitor groundwater and other fresh water for various sources of contamination, but also to assess the toxicity and environmental hazards arising from industrial effluents.

Oxyreactive Thermal Analysis in Control of Oil Decomposition in Soils with Low and Higher Organic Matter Content
Cebulak, S. (Silesian Univ., Sosnowiec, Poland); J. Pacha; Z. Wydmuch; U. Skret; M. Fabianska.
Fresenius Environmental Bulletin, Vol 13 No 3a, p 207-210, 2004

Oxyreactive thermal analysis can be used as a rapid and cheap method for monitoring oil behavior (such as decomposition) in polluted soils. In laboratory investigations carried out over a 6-month period, comparative simultaneous derivative thermogravimetry (DTG) and differential thermal (DTA) analyses clearly showed oil transformation during bioremediation and enabled researchers to identify the fragmentation of hydrocarbons and their condensation. The samples also were analyzed with gas chromatography/mass spectrometry. The researchers noted differences in transformation processes related both to the passage of time and to organic matter content.

Partitioning and Interfacial Tracers for Differentiating NAPL Entrapment Configuration: Column-Scale Investigation
Dai, D., F.T. Barranco Jr., and T.H. Illangasekare.
Environmental Science & Technology, Vol 35 No 24, p 4894-4899, 2001

Current application of partitioning and interfacial tracers for estimating subsurface NAPL amount and NAPL-water interfacial area is limited largely to NAPL at residual saturation, such as in post-remediation settings where mobile NAPL has been removed through product recovery. Scientists investigated partitioning and interfacial tracer behavior in controlled column-scale test cells for a range of entrapment configurations varying in NAPL saturation, with the results serving as a determinant of technique efficacy (and design protocol) for use with complexly distributed NAPLs, possibly at high saturation, in heterogeneous aquifers. Representative end members ranging from residual NAPL saturation (discontinuous blobs) to high NAPL saturation (continuous free-phase LNAPL lens) were evaluated. For the high-saturation LNAPL lens, results indicated that NAPL-water interfacial area, but not NAPL amount (under-predicted by 35%), can be reasonably determined using conventional computation techniques. Under-prediction of NAPL amount led to an erroneous prediction of NAPL distribution. The study results indicate that careful consideration should be given to technique design and critical assumptions before applying equilibrium-based partitioning tracer methodology to settings where NAPLs are complexly entrapped.

Partitioning Tracer Tests as a Remediation Metric: Case Study at Naval Amphibious Base Little Creek, Virginia Beach, Virginia
Divine, Craig E. (Colorado School of Mines, Golden); John E. McCray; Leah M. Wolf Martin; William J. Blanford; David J. Blitzer; Mark L. Brusseau; Thomas B. Boving.
Remediation Journal, Vol 14 No 2, p 7-31, 2004

The partitioning tracer test (PTT) is a characterization tool that can be used to quantify the pore-space saturation (SN) and spatial distribution of dense nonaqueous phase liquids (DNAPLs) in the subsurface. Because the method essentially eliminates data interpolation errors by directly measuring a relatively large subsurface volume, it offers significant promise as a remediation metric for DNAPL-zone remediation efforts. This paper provides the details of field PTTS conducted before and after a DNAPL-zone treatment at the Naval Amphibious Base Little Creek, Virginia Beach, VA. The results of this case study indicate that methods for estimating lower quantification limits for field PTTs require further development.

Partitioning Tracer Tests for Characterizing Immiscible-Fluid Saturations and Interfacial Areas in the Vadose Zone
Brusseau, Mark L., Nicole T. Nelson, and Molly S. Costanza-Robinson, Univ. of Arizona, Tucson.
Vadose Zone Journal, Vol 2, p 138-147, 2003

Most current subsurface characterization methods provide measurements for very small spatial domains, such that they are essentially point values. These methods can provide accurate and precise data for small scales, but their use for characterizing larger domains generally is constrained by sample-size limitations. Approaches that provide measurements at larger scales are being developed to complement the point-sampling methods, such as methods based on the use of tracer tests. This paper reviews "partitioning" tracer tests, which can be used to measure immiscible-liquid saturation of organic contaminants, soil water content, and fluid/fluid interfacial areas in subsurface systems.

Passive Sampling Devices as Potential Indicators of Contaminant Uptake in Plants
Yu, L. and T. Anderson, Texas Tech Univ., Lubbock.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. Poster PH135, 2003

As the significance of bioavailability in ecotoxicological studies has increased, the use of surrogates to monitor contaminant exposure and uptake into biological systems has gained attention among scientists. Based on the results of previous work, perchlorate is readily accumulated into plant tissue, especially in plant tissues above ground, thus serving as a potential pathway of exposure from soil/sediment to higher-level organisms. Strong anion/cation exchange cartridges (SAX/SCX) and Nafion tubing were evaluated as potential passive sampling devices for perchlorate and metal uptake into vegetation during a one-week period. Details and results are presented.

Performance of Anion Exchange Chromatography Method for the Routine Evaluation of Metal Cyanide Complexes in Solid Waste Leachates
Ghosh, Rajat S., Sharon M. Drop, and John R. Smith, The RETEC Group, Inc, Monroeville, PA.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 21.

Cyanide compounds and ionic complexes are numerous and vary markedly in terms of chemical stability and toxicity, hence understanding the chemical speciation of cyanide in the environment is critical for assessing environmental impact and developing appropriate methods for disposal, treatment, and remediation. In 2004, validation study data on an ion chromatography method, capable of determining single-transition metal cyanide complexes at mg/L and g/L concentration levels in waters and solid waste extracts was submitted to EPA by Alcoa and RETEC. The authors describe the detailed performance data of that method when applied to four different solid-phase leachate matrices at high and low concentration level of detection. The ion chromatography method described employs anion exchange separation and UV spectroscopy for differentiating and quantifying metal cyanide complexes. The recoveries of the metal cyanide complexes of iron, cobalt, silver, gold, copper and nickel were determined across multiple laboratories and in a variety of solid waste extracts generated via EPA Method 9013. Following EPA approval, this method could be routinely used for risk assessments, environmental monitoring and site compliance evaluations.

Perchlorate in Various Vegetables by IC/MS
Gandhi, Jay (Metrohm-Peak, Inc., Houston TX); Joe Hedrick (Agilent Technologies).
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 32.

This paper describes successful use of IC-MS for the analysis of perchlorate in vegetable extracts to low parts per billion detection limits. Superior Suppressor technology from Metrohm IC enabled coupling an industry standard Agilent Mass Spectrometer for robust analysis without any matrix diversion or splitting. System configuration and sample results demonstrate method performance.

Perchlorate: Problems, Detection, and Solutions
Motzer, William E., Hydro-Environmental Technologies, Inc., Alameda, CA.
Environmental Forensics, Vol 2 No 4, p 301-311, 2001

Most perchlorate salts have high water solubilities; concentrated solutions have densities greater than water. Once dissolved, perchlorate is extremely mobile, requiring decades to degrade. Contaminated surface and groundwater may require bioremediation and/or phytoremediation technologies. Perchlorate in groundwater is relatively unretarded and probably travels by advection. Therefore, it may be used as a tracer for hydrocarbon and metal contaminants that are significantly more retarded. Possible forensic techniques include chlorine isotopes for defining multiple or commingled perchlorate plumes.

Perchlorate Screening Study: Low Concentration Method for the Determination of Perchlorate in Aqueous Samples Using Ion Selective Electrodes. Letter Report of Findings for Method Development Studies, Interference Studies, and Split Sample Studies, Including Standard Operating Procedure
U.S. Army Corps of Engineers & U.S. EPA Region 9. 172 pp, Oct 2001

The method was found to perform well in matrices with low concentrations of anions, and is expected to be especially useful for matrices with less than 1000 mg/L chloride or 1.5 mg/L NO3-N. Matrices with higher concentrations of these anions must be evaluated to determine if this method meets project objectives.
http://clu-in.org/programs/21m2/letter_of_findings.pdf

Photoacoustic Spectrometry for Trace Gas Analysis and Leak Detection Using Different Cell Geometries
Gondal, M.A., A. Dastageera, and M.H. Shwehdib, King Fahd Univ. of Petroleum & Minerals, Dhahran, Saudi Arabia.
Talanta, Vol 62 No 1, p 131-141, 9 Jan 2004

A photoacoustic (PA) spectrometer with high selectivity and sensitivity has been developed for trace gas analysis and for the detection of leaking gas at the part per trillion by volume (pptV) level. This PA system comprises a resonant photoacoustic cell, a pulsed line tunable CO2 laser as an excitation source, and a sensitive electret microphone as a photoacoustic detector with an option to trigger the safety alarm system for early warning of gas leaks. Three resonant PA cells using a pulsed laser system with various geometries have been developed, tested, and compared for the detection of photoacoustic signals. Detection of sulfur hexafluoride (SF6) gas using these three cells has been carried out to optimize the sensitivity. These PA systems should find application for pollution monitoring and the detection of hazardous gases in a noisy environment.

Photoinduced Nucleation: a New Technology for the Detection of Chemical Contaminants. Final Report
Katz, Joseph L., Johns Hopkins Univ..
Report No: DOE/ER/62004-1, 4 pp, Sep 2003

A DOE research grant supported the creation and initial development of a new kind of chemical detector; one that can detect species at part-per-trillion (ppt) levels because it does not rely on the direct measurement of a species presence; rather, it uses an indirect measurement of the effect of the trace species on the condensation nucleation of a supersaturated vapor. Since this nucleation process is

extremely sensitive to the concentrations of certain types of impurities, this nucleation-based detection can be made more sensitive than any current spectroscopic detector.
http://www.osti.gov/dublincore/gpo/servlets/purl/820828-zvSlwj/native/820828.pdf

Physical Model Experiment to Test the Sensitivity of GPR to the Presence of Gasoline
Pyke, K.A. and J.J. Daniels (Ohio State Univ., Columbus); M. Vendl (U.S. EPA, Region V, Chicago, IL).
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS23A-02, 2004

Ground penetrating radar (GPR) measurements were made on a 3-D grid on the surface of a tank filled with sand to measure changes in the vadose zone at three stages during the introduction of water and gasoline. The fluids were introduced into the bottom of the tank, and water table fluctuations were simulated by adding and removing water. Results from this experiment show the sensitivity of GPR to moisture content and its effectiveness for monitoring small changes in the water table and the capillary fringe.

Polymeric Nanowire Chemical Sensor
Craighead, Harold G., Principal Investigator.
Research Note: CNF Project # 762-99, Cornell NanoScale Facility, 2004

Researchers at Cornell have devised a simple way to position conducting polymer nanowires on an electrode, and have made a prototype high-speed chemical detector that is capable of sensing minuscule amounts of ammonia gas. The method could ultimately be used to make a device that has an array of wires sensitive to different chemicals. Such a device would be able to rapidly detect and analyze the composition of gases in the air.
http://www.nnf.cornell.edu/2004cnfra/2004CNFra66.pdf

Portable Hg Monitor
Karanassios, Vassili (Univ. of Waterloo, Waterloo, Ontario, Canada) and William Vander Wilp.
The Pittsburgh Conference: PITTCON 2003, Presentation 90-8P.

Researchers at the University of Waterloo have developed a portable, battery-operated instrument for the determination of Hg in air. This system is sufficiently sensitive to show Hg signals for amalgam tooth-fillings when used like a breathalizer. This presentation details the development and characterization of the new system.

Portable Sick House Syndrome Gas Monitoring System Based on Novel Colorimetric Reagents for the Highly Selective and Sensitive Detection of Formaldehyde
Suzuki, Yoshio, Nobuo Nakano, and Koji Suzuki, Collaboration of Regional Entities for the Advancement of Technological Excellence (CREATE), Kanagawa Academy of Science and Technology, Kawasaki, Kanagawa, Japan.
Environmental Science & Technology, Vol 37 No 24, p 5695-5700, 2003

When formaldehyde and similar chemicals emit from furniture and textiles in a house, these vapors can irritate the eyes, nose, and respiratory organs and causes allergies. This problem is called 'sick house' syndrome. Inventors designed and synthesized novel colorimetric formaldehyde-sensing molecules (KD-XA01 and KD-XA02) that possess an enaminone structure. With the use of KD-XA01, they have developed a hand-held instrument to monitor indoor formaldehyde (HCHO) gas. The sensing molecules produced speedy color changes from colorless to yellow under mild conditions, due to the fact that the enaminone structure in the reagent reacts with HCHO to form a lutidine derivative. This reaction takes place in both the solution phase and the solid phase. To take advantage of this phenomenon, a rapid monitoring system has been developed for detecting indoor HCHO gas using a highly sensitive and selective detection tablet constructed from the porous cellulose paper that contains silica gel as an adsorbent, KD-XA01, and phosphoric acid under optimum conditions. This highly sensitive HCHO gas monitor is widely applicable and convenient to use for those who are not specialists in this field.

Portable Standoff Raman and Mie-Rayleigh Lidar for Cloud, Aerosol, and Chemical Monitoring
Sharma, S.K.; J.N. Porter; A.K. Misra; H.W. Hubble; P. Menon.
Lidar Remote Sensing for Environmental Monitoring IV. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5154, p 1-14, Dec 2003

Researchers at the University of Hawaii have developed lidar systems based on a 12.7-cm diameter telescope and a 20 Hz frequency-doubled Nd:YAG laser source. A 0.25-m HoloSpec f/2.2 spectrometer equipped with a gated intensified detector (PI Model I-MAX-1024-E) is being used for stand-off Raman detection of organic liquid and vapors and plastic explosives. The samples of interest are excited with 532-nm laser light (35 mJ/pulse). The operational range of the Raman system is in 10s of meters and has been tested at distance of 66 m. This system can also be operated as a Raman lidar by using appropriate filters for atmospheric nitrogen, oxygen, and other gaseous species of interest. The Mie-Rayleigh lidar system uses the same telescope and laser, but has three (1064, 532, and 355-nm) wavelengths available for monitoring clouds and aerosols with a usable range of 60 to 4000 m.

The Potential and Progress of LIBS Sensor Technology for Homeland Defense
Miziolek, A.W. (U.S. Army Research Laboratory, Aberdeen Proving Ground, MD), R.S. Harmon, K. McNesby.
The Pittsburgh Conference: PITTCON 2003, Presentation 2470-1.

Laser Induced Breakdown Spectroscopy (LIBS) detector technology has the following positive attributes: (1) no sample preparation, (2) sensitivity in nanograms, (3) potentially rugged and field-portable, (4) real-time response, and (5) either point sensor or standoff detection. Possible military and homeland defense applications include robotics applications (ground and airborne), RCRA/toxic metal detection and identification, and detection of landmines, UXO, trace explosives, and chemical or biological warfare agents. Increased use of the echelle spectrograph and the development of a compact multispectrometer system (LIBS 2000+ broadband spectrometer from Ocean Optics Inc.), allow for very broad spectral coverage (200-900+ nm) with high resolution (0.1 nm), which enables sensitivity to molecular and biological materials. This presentation covers LIBS research at Aberdeen Proving Ground, including LIBS analyses of bacilli, explosives, and landmine casings.

ppb-Level Organic Gas Detection with a New Low Cost Surface Acoustic Wave Based Sensor System for Ambient Air Monitoring
Rapp, M.W. (Forschungszentrum Karlsruhe Gmbh Inst. For Instrumental Analysis, Karlsruhe, Germany); F. Bender; K. Lubert, A. Voigt.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-8.

Work continues to further miniaturize polymer-coated surface acoustic wave (SAW) sensor arrays with concomitant dramatic reduction of sampling volume and inner surface area. This also minimizes response time remarkably, as well as unwanted adsorption phenomena. Contacts of interchangeable SAW sensors are made by a new capacitive coupling technique using contact pads on the circuit board facing corresponding pads on the SAW sensors. Gas sampling is achieved via two milled channels on the circuit board underneath 4 sensors in line, respectively resulting in a sampling volume of only 50uL Sampling gas come into contact only with inert surfaces or the polymeric sensing layers on the SAW sensors, resulting in very fast response times of 2 to 4 seconds. The sensitivity of this array can be enhanced with a self-developed preconcentration unit (trap). The thermal capacity of the trap is kept very low in order to get short cycle times of a few minutes combined with high pre-concentration factors (up to several thousand) due to large sampling volumes. The devices are exposed to the pre-concentrated sample for only a few seconds, necessitating the rapid sensor response of the SAW sensor micro array. This new sensor concept combines highly reliable analyte identification with the capability to detect unpolar gases in the low ppb-range and polar gases in the ppm range. The behavior can be inverted if polar resins are used. The capabilities of the SAW micro-arrays are illustrated with examples of clean room monitoring, detection of drugs and explosives, a new type of early state fire detection, and indoor air quality monitoring and other typical 'electronic nose' applications.

Predicting Cyanide Bioavailability in Cyanide-Metal Mixtures
Santore, R. and A. Redman (HydroQual, Camillus, NY); Y. Yi and P. Paquin (HydroQual, Mahwah, NJ).
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PW231, 2004

Cyanide speciation should be considered as one of the controlling factors that determine the potential for cyanide effects. Toxicity testing with various cyanide compounds has shown that the chemical form largely determines the bioavailability of cyanide to aquatic organisms, with free cyanide (HCN and CN-) being the most toxic. The authors have conducted a literature review to compile information on the chemical speciation of cyanide and appropriate thermodynamic values, as well as toxicity information on the relative bioavailability of cyanide in different complex mixtures. They note that the presence of metals can radically alter the bioavailability and toxicity of cyanide. Modeling predictions for cyanide bioavailability and toxicity are discussed.

A Procedure for Integrating Monitoring Techniques, in Situ and in Remote Sensing, Aimed to Evaluate Environmental Impact of Industrial Activities: the Case of Melfi Industrial Area (Southern Italy)
Ragosta, M., R. Caggiano, M. D'Emilio, R. Lasaponara, M. Macchiato, T. Simoniello.
Proceedings: International Workshop on Geo-Spatial Knowledge Processing for Natural Resource Management, 28-29 June 2001, Varese, Italy. p 294-297, 2001.

The researchers carried out field surveys to evaluate the bioavailable fraction of heavy metals in superficial soil from 1996 to 2000 in S. Nicola di Melfi around an industrial settlement (FIAT SATA). Analysis of the collected data has given evidence of the different space-time behavior of the contaminating metals. The researchers have compared these field data with information gained through a Geographic Informative System (GIS), a ground pattern with other informative layers. They compared the field data with the output of a transport model and with the degradation data coming from NDVI maps obtained from NOAA-AVHRR satellite data. Preliminary results demonstrate the possibility of using jointly the data collected on different spacial and temporal scales and data from models for the evaluation of the impact of atmospheric metal particulate pollutants.

Proton Transfer Reaction Ion Trap Mass Spectrometry
Alexander, M. and P. Prazeller (Pacific Northwest National Lab.); T. Jobson, and P. Palmer (San Francisco State Univ.).
Environmental Molecular Sciences Laboratory 2003 Annual Report, section 2-5-41, 2004

Proton transfer reaction mass spectrometry (PTR-MS) is a relatively new field that has attracted a great deal of interest in the last few years. This technique uses H3O+ as a chemical ionization agent. The advantages of PTR-MS include high sensitivity, selectivity, and accuracy. The PTR-MS mass spectra are simpler than those obtained by conventional electron-impact spectra because the ionization method--transfer of a proton--is "soft," resulting in little fragmentation. This can cause problems in peak identification, however, due to isobaric interferences. A possible and much-discussed solution to this problem is to couple the PTR drift tube to an ion trap mass spectrometer (ITMS). ITMS is appealing because of the ability to perform MS-MS and possibly distinguish between isomers and other isobars, as well as because the duty cycle is much higher than a linear quadrupole, so faster response time can be obtained for the detection of multiple compounds. In a successful effort to create a PTR-ITMS, the first step was to run the trap at high pressure to compensate for the high ion energies required to make it through the interface. This resulted in a background level at least a factor of 100 higher than is normal for this detector. Simply implementing differential pumping can improve the sensitivity by this factor. Better pumping in the interface can improve the signal by a factor of 10 to 100, so sensitivities of 1 ppb should be possible. When the effectiveness of MS-MS in an ion trap distinguishing isobars (acetone and propanal) was tested, both compounds fragmented into mass 41 and mass 31, but with different fragmentation ratios. These data indicate that MS-MS in the ITMS could distinguish between pure compounds, but mixtures would be hard to resolve. The data to date show great promise for PTR-ITMS. The sensitivity should ultimately be 1 ppb or better which, combined with the higher duty cycle inherent in ITMS, will make the PTR-ITMS a valuable tool for time-dependent studies.

Prototype Sensor for the Detection of a Nerve Agent Analog
Boyd, J. (Texas Tech Univ., Lubbock); G. Southard; G. Murray; G. Cobb.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. SETAC, Abstract 626, 2003

A sensor prototype has been developed for the detection of pinacolyl methylphosphonate, a hydrolysis product of the nerve agent soman. This sensor combines liquid core waveguide and molecularly imprinted polymer (MIP) technologies. The waveguide consists of Teflon AF 2400 filled with dilute basic solution. The MIP incorporates a functionality-imprinted copolymer containing a coordinatively bound luminescent lanthanide ion. The analyte of interest (AOI) hydrolyzes under basic conditions within the waveguide to allow selective and reversible binding to the lanthanide complex of the MIP. The AOI-MIP complex is excited by an inexpensive light source in the 370-nm range and emits a narrow luminescence band in the 610-nm region of the lanthanide spectrum. The teflon waveguide propagates emitted light to a metal package photomultiplier for detection. Reversible binding of the hydrolysis product allows the sensor to be washed, ultimately resetting the sensor. This sensor has the potential to respond within seconds to a chemical release at or below the time-weighted average/airborne exposure limit (TWA/AEL), which is in the low part-per-trillion range for soman. The MIP alone is capable of responding to AOI in less than 10 seconds.

"Push-Pull" Tests for Monitoring Bioaugmention with Reductive Dechlorinating Cultures
Research Brief from the Western Hazardous Research Center, Brief No 5, Sep 2004

Bioaugmentation is a promising remediation approach for remediating contaminated ground water in which the aquifer is injected with a microbial community that can degrade high contaminant concentrations in situ. Successful biaugmentation requires careful monitoring. Practitioners need a way to quantitatively track changes in the microbial community, the extent of bioaugmentation, and the treatment's effectiveness. Researchers from Oregon State University--Jack Istok, Jennifer Field, and Mark Dolan--are developing a single well "push-pull" test to monitor the effectiveness of the treatment in anaerobic source zones. The push-pull test involves injecting a test solution into an aquifer and then withdrawing the test solution and ground-water mixture. Comparisons of the "pushed" and "pulled" solutions provide information about the physical, chemical, and biological conditions within the aquifer. The researchers are focusing on using the method to monitor the cleanup of high concentrations of chlorinated solvents, such as tetrachloroethene and trichloroethene, by anaerobic reductive dechlorination. More information on this project at
http://ccee.oregonstate.edu/research/grl/push-pull/
http://wrhsrc.oregonstate.edu/briefs/brief_5.htm

Quantification of Bacterial Chemotaxis in Porous Media Using Magnetic Resonance Imaging
Olson, M.S., R.M. Ford, J.A. Smith, and E.J. Fernandez, Univ. of Virginia, Charlottesville.
Environmental Science & Technology, Vol 38 No 14, p 3864-3870, 15 July 2004

Bacterial chemotaxis is the phenomenon in which bacteria actively modulate their direction of movement so as to approach chemoattractants (favorable, usually nutritious chemicals) and avoid chemorepellents (unfavorable, usually noxious chemicals). This phenomenon has the potential to enhance biodegradation of organic contaminants in polluted groundwater systems. Investigators used magnetic resonance imaging (MRI) for noninvasive measurement of changes in bacterial-density distributions in a packed column at a spatial resolution of 330 m as a function of time. Both the diffusive and the chemotactic behavior of Pseudomonas putida F1 were measured in the presence of TCE. The presence of TCE required addition of a nonzero chemotactic sensitivity coefficient, indicating a significant response to TCE. The need was justified by a test for statistical significance. This study represents the first quantification of bacterial chemotactic parameters within a packed column. Understanding and promoting the conditions under which chemotaxis occurs in porous media may allow it be exploited to improve rates of in situ pollutant biodegradation.

Quantification of Mass Fluxes and Natural Attenuation Rates at an Industrial Site with a Limited Monitoring Network: a Case Study

Bockelmann, Alexander, Daniela Zamfirescu, Thomas Ptak (Univ. of Tubingen, Tubingen, Germany), Peter Grathwohl, and Georg Teutsch.

Journal of Contaminant Hydrology, Vol 60 Nos 1-2, p 97-121, Jan 2003

The number of available monitoring wells at a contaminated site may be limited by economic or geological considerations, making it more difficult to perform a reliable field investigation and to quantify primary lines of evidence for natural attenuation, like the documentation of a decrease of contaminant mass flux in flow direction. This study reports the results of a groundwater investigation at a former manufactured gas plant in southwest Germany. Due to difficult drilling conditions (coarse glaciofluvial gravel deposits and an anthropogenic fill above the aquifer), only 12 monitoring wells were available for the investigation and localization of the contaminant plume. Based on the sparse set of monitoring wells, field-scale mass fluxes and first-order natural attenuation rate constants of the BTEX constituents and low-molecular-weight PAHs were estimated using a different point scale and a new integral investigation method. Even at a heterogeneous site with a sparse monitoring network, point-scale investigation methods can provide reliable information on field-scale natural attenuation rates, if a dependable flow model or tracer test data is available. Lacking this information, only the integral investigation method presented can yield adequate results for the quantification of contaminant mass fluxes under sparse monitoring conditions.

Quantifying Chlorinated Ethene Degradation During Reductive Dechlorination at Kelly AFB Using Stable Carbon Isotopes

Morrill, P.L. (Univ. of Toronto, Toronto ON, Canada); G. Lacrampe-Couloume; G.F. Slater; B.E. Sleep; E.A. Edwards; M.L. McMaster; D.W. Major; B.S. Lollar.

Journal of Contaminant Hydrology, Vol 76 Nos 3-4, p 279-293, Feb 2005

Stable isotope analysis of chlorinated ethene contaminants, primarily cis-1,2-dichloroethene (cDCE), was carried out during a bioaugmentation pilot test at Kelly Air Force Base, San Antonio, TX. Following bioaugmentation with a mixed microbial enrichment culture, KB-1(TM), perchloroethene (PCE), trichloroethene (TCE) and cDCE concentrations declined, while vinyl chloride (VC) concentrations increased and subsequently decreased as ethene became the dominant transformation product. Shifts in carbon isotopic values up to 2.7, 6.4, 10.9 and 10.6 per thousand were observed for PCE, TCE, cDCE and VC, respectively, after bioaugmentation, consistent with the effects of biodegradation. Seventy-two days post-bioaugmentation, a rising trend of VC concentrations and the first appearance of ethene were indicative of biodegradation, but the most compelling evidence of biodegradation was the substantial carbon isotope enrichment (2.0 to 5.0 per thousand) in 13C-cDCE.

Quantifying Contaminant Mass Flux and the Associated Uncertainty

Li, Ke (Univ. of Michigan, Ann Arbor); P. Goovaerts; L.M. Abriola.

SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 137, 2003

Quantifying dissolved mass flux from DNAPL source zones and assessing the uncertainty associated with these flux estimates, both prior and subsequent to remediation activities, is highly desirable for evaluating the potential benefits of a given treatment technology and predicting the attendant risk reduction at a site. Under SERDP Project CU-1293, sampling protocols are being developed to quantify near source zone contaminant mass flux and assess the reliability of flux estimates through a control plane. The following procedure has been implemented and coded for uncertainty propagation and upscaling. (1) The uncertainty (probability distribution) associated with each parameter of the mass flux equation (hydraulic conductivity, aqueous contaminant concentration) is modeled using indicator kriging at each spatial location within the planar transect. (2) The uncertainty is then propagated through the mass flux equation to derive a probability distribution of mass flux for each cell using stratified random sampling and Monte Carlo simulation or co-simulation, depending on whether or not the hydraulic conductivity and aqueous contaminant concentration are correlated. (3) This location-specific model of uncertainty is then upscaled, through stochastic simulation using the probability field approach, to derive a probability distribution (possible values and corresponding probabilities) for the total mass flux through the plane. This distribution provides a range for mass flux estimates and the corresponding probabilities. It also can be used to identify locations where a second stage of sampling could be performed to lower the uncertainty of the mass flux estimate. The approach has been tested using concentration data generated with a compositional multiphase flow simulator. Preliminary results show that the model captures the "true value" of the mass flux successfully. Future work will involve the use of data from 3-D sandbox experiments and field monitoring to refine and evaluate the uncertainty model.

Quantitative Imaging of 3D Solute Transport Using 2D Time-Lapse ERT: a Synthetic Feasibility Study
Kemna, Andreas (Agrosphere Inst., Julich Research Center, Germany), Jan Vanderborght, Horst Hardelauf, and Harry Vereecken.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 342-353, 2004

Time-lapse electrical resistance tomography (ERT) has shown great potential to monitor solute plumes in the subsurface, but the ultimate value of ERT for quantitative imaging of solute transport (in heterogeneous aquifers, for example) is still under dispute. Difficulties can arise from the fact that ERT data acquisition and interpretation is often limited to 2D image planes, while aquifers are generally characterized by a 3D structure involving considerable variability of flow and transport properties. The potential of time-lapse ERT in such a situation was investigated via a synthetic tracer experiment in which 3D solute transport in a heterogeneous hydraulic conductivity field, characterized by an exponential covariance function, was simulated. The results of the synthetic study demonstrate that quantitative imaging of 3D solute transport by means of time-lapse ERT is feasible.

Radioactive Releases in the Environment: Impact and Assessment
Cooper, John R., Keith Randle, and Ranjeet S. Sokhi.
John Wiley & Sons, New York. ISBN: 0-471-89923-2, 490 pp, 2003

This book brings together the fundamentals of radiological protection, the techniques used for measuring radioactivity and radionuclides, and the methods for modeling the dispersion of radionuclides in the environment. Information on radioactive decay, the interaction of ionizing radiation with matter, and biological effects of radiation is provided in a form that enables the reader to quickly appreciate its importance to the environment and human health. Summaries of the effects of past releases, including the Chernobyl accident, are included, as well as examples of applications of models to calculate and predict concentrations of radionuclides in our environment. This book is aimed at those studying radioactivity in the environment and its impact on man. It will also serve as a handbook for workers in the fields of radiochemical analysis and environmental modeling and for scientists, consultants, and environmental health and pollution officers who have to provide radiological data or information for legislative and related purposes.

A Radiocarbon Method and Multi-Tracer Approach to Quantifying Groundwater Discharge to Coastal Waters
Gramling, Carolyn M., PhD. thesis, Massachusetts Inst. of Technology, Cambridge.
Report No: MIT/WHOI-2003-15, DTIC: ADA417788, 351 pp, Sep 2003

Groundwater discharge into estuaries and the coastal ocean is an important mechanism for the transport of dissolved chemical species to coastal waters. Because many dissolved species are present in groundwater in concentrations that are orders of magnitude higher than typical river concentrations, groundwater-borne nutrients and pollutants can have a substantial impact on the chemistry and biology of estuaries and the coastal ocean. Direct fluxes of groundwater into the coastal ocean (submarine groundwater discharge, or SGD) can be difficult to quantify. Geochemical tracers of groundwater discharge can reflect the cumulative SGD flux from numerous small, widely dispersed, and perhaps ephemeral sources such as springs, seeps, and diffuse discharge. The natural radiocarbon content (DELTA 14C) of dissolved inorganic carbon was developed as a tracer of fresh, terrestrially driven fluxes from confined aquifers. This DELTA 14C method was tested during five sampling periods from November 1999 to April 2002 in two small estuaries in southeastern North Carolina. In coastal North Carolina, fresh-water artesian discharge is characterized by a low DELTA 14C signature acquired from the carbonate aquifer rock. Mixing models were used to evaluate the inputs from potential sources to each estuary, including seawater, springs, fresh water stream inputs, and salt marsh respiration additions. These calculations showed that artesian discharge dominated the total fresh water input to these estuaries during nearly all sampling periods. These new DELTA 14C-based SGD estimates were compared with groundwater flux estimates derived from radium isotopes and from radon-222. It is clear that these tracers reflect different components of the total SGD. This multi-tracer approach provides a comprehensive assessment of the various components contributing to the total SGD.
http://handle.dtic.mil/100.2/ADA417788

Rapid and Sensitive Detection of Perchlorate at Trace Concentrations
Office of Technology Transfer and Commercialization (OTTC), California State Univ., San Bernardino, 22 July 2004

A rapid and real-time detection of perchlorate at low concentrations is being developed using surface-enhanced Raman spectroscopy (SERS) at Oak Ridge National Laboratory (led by Dr. Baohua Gu). The overall goal of this proposed project is to develop a new SERS substrate material for rapid, real-time, specific, and sensitive detection of perchlorate at a range from one part per billion (ppb = microgram per liter) to a few ppb concentrations. Analytical time by SERS is very rapid, on the order of a few seconds to a few minutes. Perchlorate has a very strong, characteristic Raman peak, so that this method is specific for analyzing perchlorate in water. Other common anions, such as chloride, are not Raman-active, whereas nitrate, sulfate, and chlorate have different characteristic Raman peaks The presence of these anions does not interfere with the detection of perchlorate. The preliminary results indicated that the technology can achieve a detection limit of about ten ppb (sensitivity). The presence of high concentrations of other anions and organic materials in natural water may interfere or decrease the sensitivity, but it is believed that the technology will achieve greater sensitivity even in the presence of these interference anions. This new technology is expected to reduce labor hours and chemical handling compared with the ion chromatographic and electron-spray mass spectroscopic techniques. The SERS substrate sensing materials could potentially be reused and may result in significant cost savings in both sample preparation and instrument analytical times.
http://www.esd.ornl.gov/~b26/

Rapid Detection Chemical Agent Instrumentation for Homeland Security
Meyer, Richard T. (CIC Photonics, Inc., Albuquerque, NM), A. John Derrig, Jorge E. Perez.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-2.

The IRGAS(TM) industrial gas analysis system has been retrofitted for adaptation to the detection of chemical weapon agents (CWA), toxic industrial chemicals, and illicit drugs for Homeland Security defense. The IRGAS consists of a ruggedized FTIR spectrometer coupled to a 6.5-meter long path gas cell in a transportable enclosure. The associated SPGAS(TM) Quantification Software provides identification within seconds and high-sensitivity (ppb) detection of dangerous chemical gases and vapors. Alert and warning mechanisms include visual displays, sound and light excitations, and signal transmissions to control centers. The results of tests on CWA simulants are presented.

Rapid Mass Spectrometric DNA Diagnostics for Assessing Microbial Community Activity During Bioremediation
Benner, W.H., J. Hunter-Cevera, J.M. Jaklevic, and T. Torok, Lawrence Berkeley National Lab.
EMSP Completed Project Final Report: No 54698, 15 pp, 2004

Changes in pollutant profiles observed in contaminated soils have been attributed to biological activity, when in actuality abiotic processes caused pollutant removal. This sometimes casual implication of biodegradation is not acceptable, though understandable, because factors that cause the disappearance of pollutants are not always easy to identify. This work focused on the identification and detection of a gene that participates in the degradation of several aromatic hydrocarbons. Biodegradation of pollutants proceeds through various intermediate steps that eventually culminate in an innocuous chemical. The biodegradation pathways of benzene, naphthalene, and toluene pass through catechol, an intermediate destroyed by an enzyme known as catechol dioxygenase. Thus, if DNA for the catechol dioxygenase gene is found in soil samples, it is reasonable to conclude that there are organisms in the soil capable of biodegrading naphthalene. After a bacterium found to utilize naphthalene as its sole carbon source was isolated from soil, sequencing part of the dioxygenase gene from this organism led to the successful development of a PCR assay that could detect the gene. Conditions then were established for detecting the gene with matrix-assisted laser-desorption time-of-flight mass spectrometry.
http://emsp.em.doe.gov/EMSPprojects1996_2003/completed/54698.pdf

Rapid Speciation and Determination of Toxic Metals in Soils and Sediments: Improvement of Actual Extraction Techniques
Asselin, Julie (McGill Univ., Montreal, Quebec, Canada), Jean Bouffard, Laurie Chan, Eric D. Salin.
The Pittsburgh Conference: PITTCON 2003, Presentation 1150-14P.

Work was undertaken to develop and validate an extraction procedure to determine toxic metals (e.g., methylated mercury, or MeHg) in soils and sediments in search of a method that is faster than the commonly used ASTM and EPA methods. Different soil samples were extracted using the traditional EPA 1311 leaching procedure. All the samples were then extracted using a porous capsule and a microwave heating program, and with a flow-through cell with conventional heating. All extracts were analyzed by ICP-AES and/or ICP-MS for toxic and non-toxic elements. Extraction temperature, extraction time, pH, porosity, and diffusion effects were monitored and optimized. Results obtained with the two systems were compared to those obtained with the EPA method. While the results obtained with the porous capsule were not as good as expected, those with the flow-through cell design show promise. This paper discusses the different designs and the results obtained.

Real-Time PCB Monitoring Using Time-of-Flight Mass Spectrometry with Picosecond Laser Ionization

Deguchi, Yoshihiro (Nagasaki Research and Development Center, Mitsubishi Heavy Industries, Ltd., Nagasaki, Japan), Shinsaku Dobashi, Norihiro Fukuda, Katsuhiko Shinoda; Masatoshi Morita.
Environmental Science & Technology, Vol 37 No 20, p 4737-4742, 2003

Laser ionization time-of-flight mass spectrometry was applied for real-time measurement of polychlorinated biphenyls (PCBs). Picosecond 266-nm laser light ionization reduced fragmentation and provided very high PCB detection sensitivity much faster than conventional GC-ECD or GC-MS methods, which require several days for PCB analysis. Detection sensitivity of under 0.01 mg/Nm3 was achieved with a 1-min measuring time. A prototype PCB monitoring device has been developed and tested in a pilot PCB treatment plant.

Real-Time Measurements of Gaseous Pollutants Using Cermet Sensors

Meshkov, Natalia K. (Argonne National Lab, Argonne, IL); L. Skubal; M. Vogt.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 12, 2003

DoD needs to identify and characterize emissions of trace air toxic compounds, especially persistent organic pollutants, from operations or activities at its facilities. The currently available ambient air toxic concentration data are non-temporal and non-spatial and produce low-quality emission factors. Researchers are developing a new characterization technique to produce "instantaneous" pollutant concentration profiles of emissions from both stationary and mobile sources. The pollutants of particular interest are gases from diesel exhaust, i.e., benzene, 1,3-butadiene, acetaldehyde, and acrolein. Newly developed miniature sensors are of two types: titanium dioxide-based photocatalytic sensors, and electrochemical sensors based on voltammetric techniques using solid electrolytes, such as tungsten bismuth oxide and yttrium-stabilized zirconia. Results are presented on using the sensors to detect diesel exhaust gases at several concentrations, singly and in combinations, in air and in the presence of diesel exhaust. This research was supported wholly or in part by SERDP project CP-1243.

A Real-Time Polymerase Chain Reaction Method for Monitoring Anaerobic, Hydrocarbon-Degrading Bacteria Based on a Catabolic Gene

Beller, Harry R. (Lawrence Livermore National Laboratory, Livermore, CA), Staci R. Kane, Tina C. Legler, and Pedro J.J. Alvarez.
Environmental Science & Technology, Vol 36 No 18, p 3977-3984, 2002

A real-time polymerase chain reaction (PCR) method has been developed that can quantify hydrocarbon-degrading bacteria in sediment samples based on a catabolic gene associated with the first step of anaerobic toluene and xylene degradation. The method is sensitive (detection limit ca. 5 gene copies) and has a linear range of better than 7 orders of magnitude. The method was used to investigate how gasohol releases from leaking underground storage tanks could affect indigenous toluene-degrading bacteria. Microcosms inoculated with aquifer sediments from four different sites were incubated anaerobically with BTEX constituents and nitrate in the presence and absence of ethanol. Overall, population trends were consistent with observed toluene degradation activity: the microcosms with the most rapid toluene degradation also had the largest numbers of bssA copies. In the microcosms with the most rapid toluene degradation, numbers of bssA copies increased 100- to 1000-fold over the first 4 days of incubation, during which time most of the toluene had been consumed. The real-time PCR method for bssA could be a powerful tool for monitoring the natural attenuation of BTEX in fuel-contaminated groundwater.

Real Time Site Field Characterization and Monitoring Using an Innovative Gas Chromatograph with a Novel Surface Acoustic Wave Detector
Staples, Edward, Dudley Williams, & George Pappas.
Seventh Annual West Coast Conference on Contaminated Soils and Groundwater, 10-13 March 1997, Oxnard, California. Association for the Environmental Health of Soils, 1997.

This paper describes the development of a new surface acoustic wave/gas chromatograph (SAW/GC) technology for the rapid identification and characterization of compounds in water, soil, and gas matrices. The ability to detect picogram levels of environmentally significant compounds has been demonstrated; however, the capability of characterizing these compounds in 10 seconds or less is novel and unique and permits personnel to use the instrument for field screening and follow-up monitoring. The technology allows for the speciation of semi-volatile and non-volatile compounds, PCBs, dioxins, and explosives in water, soil, and air matrices to the part-per-billion level. The design and theory of operation are presented, as well as test results obtained from field demonstrations conducted at refineries and other contaminated sites. Deployment strategies, cost and benefits, and maintainability issues are noted.

Realtime Monitoring of Pipelines for Third-Party Contact
Burkhardt, Gary L. and Alfred E. Crouch, Southwest Research Inst., San Antonio, TX.
Technology Status Assessment, 7 pp, Dec 2003

Third-party contact with pipelines (typically caused by contact with a digging or drilling device) can result in mechanical damage to the pipe. Because this type of damage often goes unreported and can lead to eventual catastrophic failure of the pipe, a reliable, cost-effective method is needed for monitoring and reporting third-party contact events. Several approaches currently exist, or are being investigated: acoustic monitoring devices, continuous fiber-optic sensors buried alongside the pipe, satellite surveillance, cathodic protection monitoring, and methods that rely on telephone calls prior to digging. Because all of these methods have inherent limitations or are undesirable under certain conditions, a project was initiated to investigate an alternate monitoring method, impressed alternating-cycle current (IACC). IACC is capable of directly and continuously monitoring pipelines for third-party contact. Implementation is relatively straightforward, and it can be retrofitted to existing pipelines without the need for excavating the pipeline. This technology assessment document describes the state of the art of pipeline monitoring, including positive and negative characteristics of existing technologies, and presents a comparison to the IACC technology being developed.
http://www.netl.doe.gov/scng/projects/transmission/ngi/td/pubs/10211TechStatusAssess-Final.pdf

Recent Developments in Ion Mobility Spectrometry as a Chemical Sensor
Hill, Herbert H. (Washington State Univ., Pullman, WA), Wes E. Steiner.
The Pittsburgh Conference: PITTCON 2003, Presentation 1550-5.

This paper addresses problems and solutions for the detection of drugs, explosives, chemical warfare agents, and other chemical and biological compounds by ion mobility spectrometry (IMS) in both aqueous and vapor environments. These compounds have been detected in aqueous samples by interfacing an electrospray ionization source to an ion mobility spectrometer. Electrospray ionization can be used for both direct detection of the compounds in solution and detection of traditional vapor phase components. Secondary electrospray ionization (SESI) provides reactant ions similar to those used in traditional IMS ion sources. Comparative data are presented for the two ionization methods, and advantages and disadvantages of each are discussed.

Receptor-Conjugated Nanoparticles to Detect Biological Warfare Agents
Kumar, A. (U.S. Army ERDC/CERL, Champaign, IL); S. Dwarakanath (Nano Science Diagnostics, Inc., Austin, TX); J.G. Bruno (Operational Technologies Corp., San Antonio, TX); L.D. Stephenson (U.S. Army ERDC/CERL, Champaign, IL).
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 7 pp, 2004

Recent research has examined the feasibility of detecting biological warfare agents by conjugating their antibodies (receptors) with nanoparticle tags (also known as "quantum dots"), which subsequently fluoresce upon excitation when they are bound to a specific biowarfare agent or its simulant. When they react with the target bacteria, optically excited nanoparticle-receptor conjugates generate spectra in which the intensities of primary emission peaks decrease, while the secondary emission peaks increase in intensities, i.e., energy is transferred from major peaks to minor peaks. These optical emission spectral signatures, with emission wavelength shifts of 140 nm in some cases, strongly suggest the possibility of homogeneous (one step) assays, leading to positive detection of bacterial agents, without wash steps using nanoparticle-receptor conjugates. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionM/MO-04.pdf

Relationship Between Biodegradation and Bulk Electrical Conductivity
Atekwana, Estella and Eliot A. Atekwana (Univ. of Missouri-Rolla); Franklyn D. Legall, R.V. Krishnamurthy, and William A. Sauck (Western Michigan Univ., Kalamazoo).
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 354-362, 2004

Geochemical and stable carbon isotope data obtained at closely spaced intervals within a hydrocarbon impacted aquifer were used to assess the relationship between high bulk conductivity zones and biodegradation of hydrocarbon. Biodegradation was verified using terminal electron acceptors (nitrate, sulfate, and iron), dissolved inorganic carbon (DIC), and the isotope ratio of DIC. The bulk conductivity was measured using in situ vertical resistivity probes. Peak values in the bulk conductivity occurred in zones in the aquifer where TPH levels were high and nitrate, sulfate and iron reduction were occurring. In the zones where bulk conductivity was higher, DIC was higher and the isotope ratio of DIC was either more negative or more positive, while the major cations were elevated compared to uncontaminated locations. These results suggest that the higher bulk conductivities were related to microbial redox processes, perhaps by enhanced mineral weathering within zones of higher biological activity stimulated by the presence of hydrocarbon and available terminal electron acceptors. These findings suggest a qualitative interrelationship between redox processes, bio-mineralization of hydrocarbons, and high bulk conductivities, and argue for the need to incorporate geophysical investigations as part of natural attenuation assessment programs.

Relationship Between Magnetic Susceptibility of Soils and Concentrations of Heavy Metals in the Region of Moravosilesian Beskydy Mts., Czech Republic
Matysek, Dalibor, Helena Raclavska, Konstantin Raclavsky, VSB, Technical Univ. of Ostrava, Ostrava, Czech Republic.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 1332-1341, 2004

Dust particles emitted by iron metallurgy, power plants, and other industrial facilities can be transported and deposited at great distances from the sources. A study of forest soils located approximately 35 km from an industrial source area of pollution revealed a close relationship between magnetic susceptibility and concentrations of some elements, especially Cr, Fe, As, Ni, Mo, W, P, Pb, Sb, Ti, Al, Sn, V, Rb, Zn, Cu, Sr and S.

Relationship Between Total Dissolved Solids and Bulk Conductivity at a Hydrocarbon-Contaminated Aquifer
Atekwana, Estella A.(Univ. of Missouri-Rolla); Eliot A. Atekwana and Rebecca S. Rowe (Indiana Univ., Indianapolis).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 228-237, 2003

A recent conceptual model links high conductivities observed in hydrocarbon-contaminated soils to higher total dissolved solids (TDS) resulting from mineral weathering from acids produced during biodegradation. Though not a direct evidence of biodegradation, TDS is a geochemical parameter that closely links groundwater electrical properties to hydrocarbon degradation. Investigators sampled groundwater from discrete depths from several locations within a hydrocarbon-impacted aquifer to investigate the relationship between TDS and electrical conductivity of soils. TDS was measured in the field using a conductivity/TDS meter and by the gravimetric method in the laboratory. The results show similar values of TDS for both techniques in uncontaminated groundwater. In general, both TDS and electrical conductivity of soils increased with depth at contaminated and uncontaminated locations, but TDS was 40% higher in contaminated groundwater relative to uncontaminated groundwater. No clear relationship was evident between groundwater specific conductance and electrical conductivity of soils, suggesting that electrical conductivity of soils cannot be simply related to groundwater ionic concentration or TDS at the contaminated locations.

A Reliable and Predictable Sulfur Chemiluminescence Detector
Yan, Xinwei (Antek Instruments, LP, Houston, TX) and Franek Olstowski.
The Pittsburgh Conference: PITTCON 2003, Presentation 1690-2.

Extensive research has been carried out to further understand the combustion and chemiluminescence detection processes in sulfur chemiluminescence detection (SCD). Significant progress has been made in improving reliability and predictability of the SCD. The authors present a new easy-to-install and easy-to-operate SCD with good detector performance.

Remote Detection of Gas Emissions in Industrial Processes
Harlow, C.A., J.S. Earle, and A.M. Sterling, Louisiana State Univ., Baton Rouge.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 146, 2003

A system is under development that uses an imaging spectrometer to characterize fugitive gas leaks and stack emissions from industrial facilities. The IMSS hyperspectral imaging system used for these measurements produces images with 512 by 512 pixels. Each pixel contains an infrared spectrum. Several data sets were collected for the purpose of the instrument development, one set from a laboratory under controlled conditions and another set consisting of emissions data from a pilot kiln. This experiment allowed hyperspectral imagery of gas emissions to be obtained under controlled conditions. The gas concentrations were controlled in the experiment and independently measured with the pilot kiln instrumentation. This work indicates that the hyperspectral imagery spectra reflect gas concentrations and that the gases can be automatically detected from the hyperspectral imagery. Yet to be determined are the conditions that cause weak signals and atmospheric effects on the signals.
More information at http://dept.lamar.edu/gchsrc/htdocs/newsletters/news04/gchsrc.htm

Remote/Network Controlled Rapid Sampling and Detection of Explosives and Chemical Warfare Agents in the Field
Nam, Paul (Univ. of Missouri-Rolla), V. Flanigan, K. Hambacker, S. Kapila, K. Mitchell, H. Shen, D. Sivils.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-3.

A rapid chemical vapor sampling and detection system with a network arrangement for the remote and real-time monitoring of explosives and chemical warfare agents (CWAs) employs tandem electron attachment detectors and a miniature sulfur/nitrogen/phosphorus detector (SNPD) for the selective detection of nitroaromatic explosives and CWAs, respectively. An automated, rapid-cycling vapor concentrator and sample introduction device is used for the detection of trace level chemical vapors in air samples. Volatile chemicals in sample air are preconcentrated inside an array of fused silica capillary tubes cooled with a thermoelectric cooler. Enriched chemical vapors are quantitatively transferred to the detectors through rapid thermal desorption. An inert sampling train prevents cross-contamination and analyte loss. A solute-modulated detection system consisting of a tandem arrangement of electron capture detectors and an electron attachment reactor permits selective detection of nitroaromatic molecules. The miniature SNPD provides high sensitivity and specificity for sulfur, nitrogen, or phosphorus containing species, including organophosphate nerve agents, yielding clearly discernable signals for contaminants present at part per billion levels in headspace above soil and water. The system has been evaluated at Sandia National Lab in New Mexico.

Remote Sensing and GIS Accuracy Assessment
Lunetta, Ross S. and John G. Lyon.
CRC Press, Boca Raton, FL. ISBN: 156670443X, 320 pp, 2004

The development of robust accuracy assessment methods for the validation of spatial data represents a difficult challenge for the geospatial science community. Obstacles to robust assessments include continuous data characteristics and positional errors. Based upon a special symposium sponsored by the U.S. EPA, this book identifies the important scientific elements related to the performance of accuracy assessments for remotely sensed data, GIS data analysis, and integration products. Scientists from federal, state, and local governments, academia, and nongovernmental organizations authored twenty technical chapters that examine sampling issues, reference data collection, edge and boundary effects, error matrix and fuzzy assessments, error budget analysis, and change detection accuracy assessment. The book includes the keynote presentation by Russell G. Congalton that provides a historical accuracy assessment overview, articulates current technical shortcomings, and identified numerous issues that were debated throughout the symposium.

Remote Sensing of Microbial Volatile Organic Compounds with a Bioluminescent Bioreporter Integrated Circuit
Ripp, S.A.; K.A. Daumer; J.L. Garland; M.L. Simpson; G.S. Sayler.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 208-213, 2004

Scientists have constructed a bioluminescent bioreporter for the detection of the microbial volatile organic compound (MVOC) p-cymene. MVOCs are produced as metabolic byproducts of bacteria and fungi and are detectable before any visible signs of microbial growth appear. These MVOC can serve as very early indicators of potential biocontamination problems. The bioreporter Pseudomonas putida UT93 contains a Vibrio fischeri luxCDABE gene fusion to a p-cymene/p-cumate inducible promoter. Exposure of strain UT93 to p-cymene from approximately 0.02 to 850 ppm produced self-generated bioluminescence in less than 1.5 hours. The bioreporter was also interfaced with an integrated circuit microluminometer to create a miniaturized hybrid sensor for remote monitoring of p-cymene signatures.

Remote Sensing Tools Assist in Environmental Forensics. Part I: Traditional Methods
Brilis, G.M. (U.S. EPA, Las Vegas, NV); C.L. Gerlach (Lockheed Martin Corporation, Las Vegas); R.J. van Waasbergen (Applied Environmental Data Services, Arlington, TX).
Environmental Forensics, Vol 1 No 2, p 63-67, June 2000

The authors provide an overview of the use of aerial photography, topographic mapping, and photogrammetry in environmental enforcement actions. The visualization of spatial relationships of natural and man-made features can focus the scope of environmental investigation, and provide a historical record of changes in site conditions. From aerial photos, precise quantitative information (measurement and positional data) can be collected using photogrammetry and produced in digital format for input into a geographic information system (GIS) for computerized analysis and display. Some information derived from aerial photographs requires specialized photointerpretive skills and experience, e.g., the recognition of vegetation mortality, oil-spill damage, and the ecological quality of water bodies. The major advantage of topographic maps over aerial photos is that maps can show things that are not visible from the air, while omitting unnecessary and distracting information. Because maps are derived products, they may contain bias in content and presentation and must be backed up by careful documentation and quality assurance protocols.

Remote Sensing Tools Assist in Environmental Forensics. Part II: Digital Tools
Brilis, G.M. (U.S. EPA, Las Vegas, NV), R.J. van Waasbergen, P.M. Stokely, C.L. Gerlach.
Environmental Forensics, Vol 2 No 3, p 223-229, 2001

Geographic information systems (GIS) manage, analyze, and display geographic information. Environmental applications include analysis of source, extent and transport of contaminants, nonpoint runoff modeling, flood control, and emergency response support. The ability to examine spatial relationships between environmental observations and other mapped and historical information, and to communicate these relationships to others, makes GIS valuable in environmental forensics. U.S. EPA currently requires the inclusion of locational information with all other environmental data collected. The Global Positioning System (GPS) is a satellite-based system that provides highly accurate, 3-D position information anywhere on the earth's surface. Using portable radio receivers, field analysts can easily record the positions of spill sites, sampling locations, and other environmental features. GPS can be used not only to capture spatial information into a GIS system, but also to evaluate and quantify the spatial accuracy of existing digital map data and to provide control points for existing aerial photographs and other remotely-sensed data.

Representative Sampling for Energetic Compounds at an Antitank Firing Range
Thomas F. Jenkins, Thomas A. Ranney, Alan D. Hewitt, Marianne E. Walsh, and Kevin L. Bjella
ERDC/CRREL Technical Report 04-7, 66 pp, Apr 2004

Field sampling experiments were conducted at the CFB-Valcartier Arnhem antitank rocket range to investigate sampling schemes that would yield representative soil samples at firing points and impact areas of antitank ranges. Three sampling strategies were evaluated. Between the firing point and the target, 10-m x 10-m grids were established and 30-increment composite soil samples were collected. In two of these grids, one near the firing point and one at the target, the grids were divided into 100 1-m x 1-m minigrids. Within each minigrid, a discrete and a 10-increment composite soil sample were collected and analyzed for energetic compounds. In the target area, an alternative strategy was evaluated using concentric halos around the target. Each halo was subdivided into increasing numbers of segments at increasing distances from the targets. Multi-increment composite samples were collected within each halo segment. Behind the firing line, nine line (linear) composites were collected at various distances from 0 to 25 m from the firing line. Results from the 100 1-m x 1-m minigrids near the firing line and the target demonstrated that the distribution of analyte concentrations in the discrete samples was non-Gaussian and the range of concentrations varied over two orders of magnitude. The distributions of data for multi-increment composite samples with various numbers of increments were simulated by averaging the concentration estimates from randomly selected discrete samples. For the firing line area, the distribution of NG-computed composites exhibited increased normality as the number of increments increased, and the resulting tolerance range declined substantially. This also held true for HMX in the target area. Recommendations are made for appropriate sampling strategies to collect representative surface soil samples for antitank rocket ranges.
http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-7.pdf

Research and Development: Measurement of Fugitive Emissions at Region I Landfill
U.S. EPA, Office of Superfund Remediation Technology Innovation, Washington, DC.
EPA 600-R-04-001, 56 pp, 2004

This report discusses a new measurement technology for characterizing emissions from large area sources. This work was funded by EPA's Monitoring and Measurement for the 21st Century Initiative. The site selected for demonstrating this technology is a Superfund landfill being evaluated for recreational use. Data on methane and air toxics are needed to help determine any increased risk to those using the site. Open-path Fourier transform infrared (OPFTIR) spectrometers were used to provide data on both background and surface emissions. The technology provides concentration maps indicating the spatial variability and areas where additional control may be needed. Horizontal scans to identify any hot spots and vertical scans to determine the mass flux using a multiple-beam configuration were conducted. Optical remote sensing/radial plume mapping provided concentration mapping of the site. These data will be used to make decisions about potential recreational use of this site.
http://www.epa.gov/appcdwww/apb/EPA-600-R-04-001.pdf

Rhizosphere Characteristics of the Arsenic Hyperaccumulator Pteris vittata L. and Monitoring of Phytoremoval Efficiency
Fitz, W.J., W.W. Wenzel (BOKU-Univ. of Natural Resources and Applied Life Sciences, Vienna, Austria), H. Zhang, J. Nurmi, K. Tipek, Z. Fischerova, P. Schweiger, G. Kollensperger, L.Q. Ma, and G. Stingeder.
Environmental Science & Technology, Vol 37 No 21, p 5008-5014, 2003

Ferns that hyperaccumulate arsenic show promise for phytoremediation of As-contaminated soils. In a study of changes in the rhizosphere characteristics of Pteris vittata (Chinese Brake fern), As did not decrease significantly in the rhizosphere soil solution after one cropping, despite substantial removal of As by the fern. This was apparently due to the large buffer capacity of the soil and possibly because of ion competition with DOC. Further examination indicated that As was mainly acquired from less available pools. Arsenic depletion in the rhizosphere and limited resupply from less available pools were indicated by a 19.3% decreased As flux, measured using diffusive gradients in thin films (DGT). Modeling indicated that the rate of release from solid phase to solution in the rhizosphere was one-third of that in the bulk soil. The authors conclude that DGT can be used as a monitoring tool to evaluate the efficiency of phytoextraction and to study the potential resupply of bioavailable pools after phytoextraction has ceased.

A Robotic Sampler for Explosive Residuals in Surface Soils
Lever, James, Thomas Nichols, and Daniel Denton, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 122, 2003

Quantifying the concentration of explosive residuals in surface soils is essential for cost-effective remedial operations at contaminated sites and to sustain use of live-fire training ranges. Low-order detonations can scatter millimeter-sized particles of high explosives in heterogeneous distribution across the soil surface. Measuring their concentration demands adherence to a rigorous sampling protocol that is tedious to execute and can expose human samplers to risks from UXO; the presence of sub-munitions excludes manual sampling entirely. Researchers have built a robot, using inexpensive commercial components, to satisfy the sampling protocol for surface explosive residuals and to explore the relationship between sampling protocol and robot mobility requirements. It is a 25-kg, dual-track vehicle. The developers focused on two technical areas: developing a sampling device that can satisfy sampling requirements for a broad range of soil conditions, and demonstrating sufficient autonomous navigation to execute stratified random sampling over a variety of terrain conditions. The rotary-tube sampler takes fairly consistent samples measuring about 3 cm x 3 cm in a variety of soil conditions. Each sample bag can accept about 30 individual samples to form a composite that represents the sampled area. An onboard carousel holds six bags, allowing five areas to be sampled before the robot must return the samples to human operators. The sixth bag is reserved to take samples to clean the tube and thereby minimize cross-contamination between areas. The robot is designed to operate autonomously to collect a composite sample, log the coordinates of the area sampled, complete a composite within about 20 minutes, and operate without intervention for about 2 hours. A person can tele-operate the robot between sampling areas and to and from a base station where batteries and sample bags can be replenished. The presentation describes the robot, shows results of laboratory and field demonstration tests, and compares the robot's performance with the sampling protocol requirements.

The Role of Advanced Monitoring in Steam Stripping for In-Situ Remediation of DNAPL
Dr. Douglas LaBrecque, Multi-Phase Technologies, LLC, Sparks NV
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, OCS-4, 14 pp, 2001

During a 1999 pilot study of Steam Stripping/Hydrous Pyrolysis Oxidation at a trichloroethene (TCE)-contaminated site at the Portsmouth Gaseous Diffusion Plant in Ohio, two complementary systems were used to monitor temperature and steam movement. Point measurements of temperature were made using an array of 314 thermocouples. Measurements between boreholes were made using electrical resistivity tomography (ERT). Without ERT, even the relatively large number of in situ thermocouples gave a sparse and often misleading view of the temperature distribution and steam front location within the aquifer. The use of ERT/thermocouples to provide high resolution, near real-time monitoring of temperature increases upon steam injection showed that portions of the aquifer were not being heated. These areas appeared to correlate with depressions in bedrock elevation, but the bedrock topography is complex and the correlation was not always obvious. The ERT results enabled the targeting of the areas not heated for new injectors. Using this adaptive approach, the aquifer was adequately heated and the bulk of the TCE removed from the study area.

The Role of Ion Mobility Spectrometry in Explosives Detection
Rodacy, Philip J. (Sandia National Labs, Albuquerque, NM); Christopher A. Gresham, David W. Hannum, Kevin L. Linker, John E. Parmeter, Charles L. Rhykerd.
The Pittsburgh Conference: PITTCON 2003, Presentation 150-2.

Many of the current explosives detection techniques, such as canines, x-ray, current ion mobility spectrometry and thermal neutron activation, suffer from poor specificity, lack of sensitivity, high false alarm rates, lack of portability, and high cost of deployment and maintenance. Recent advances in the field of ion mobility spectrometry (IMS) promise to address and overcome many of these shortcomings. This presentation focuses on the use of IMS-based systems that have been developed for use on land and in the marine environment.

The Role of Sensing & Sensors
Sandia Technology, Vol 4 No 3, 2002

This issue of the quarterly Sandia Technology journal focuses on sensor technologies being developed at the facility. The articles cover the Palm-top uChemLab(TM), sensor-MEMS, hazard analysis from a distance, biosensors, and sensor technology transfer.
http://www.sandia.gov/sensor/ST2002v4no3.pdf

Ryegrass Species as Biomonitors of Atmospheric Heavy Metals Emissions: the Integration of Chemical-Physical and Biological Techniques
Caggiano, R., M. D'Emilio, M. Macchiato, and M. Ragosta.
Fresenius Environmental Bulletin, Vol 10, p 31-36, 2001

Scientists equipped an integrated experimental test site for measuring atmospheric concentrations of heavy metals (Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn) through chemical-physical and biological devices. The determination of trace elements was performed by means of atomic absorption spectrophotometry techniques (FAAS and GFAAS). The first step of the work was the characterization of the source profiles in the investigated area. A detailed analysis of daily concentrations of heavy metals in total suspended particulate collected on filters, based on multivariate statistical methods, allowed the identification of three different source profiles. Profile SP1 includes Zn, Cu, Mn, and Ni; SP2 includes Cd, Pb, Ni, and Cr, representing different industrial sources. Profile SP3 includes Fe, Mn, Zn, and Pb and is representative of natural and "other" anthropogenic sources. Contemporaneously, the scientists measured the concentrations of the same metals in biomonitors. The aim was to evaluate the reliability of rye grass species as active biomonitors of metal concentrations. Comparison of the heavy metal concentrations measured in plants and in particulate suggests that rye grass species are good indicators of the presence of heavy metals in the atmosphere. The good reproducibility of the measurements and the high agreement with values obtained with chemical-physical methods indicate that the biomonitoring protocol is particularly suitable to detect concentrations of Cd, Cr, and Ni.

Sampling Strategies Near a Low-Order Detonation and a Target at an Artillery Impact Area
Jenkins, T.F.; A.D. Hewitt; T.A. Ranney; C.A. Ramsey; D.J. Lambert.
Report No: ERDC/CRREL-TR-04-14, NTIS: ADA428488, 45 pp, Nov 2004

Field sampling experiments were conducted at the firing range at Fort Polk, Louisiana. The objectives were to determine the spatial distribution and best approach for collecting representative surface soil samples to estimate mean concentrations of residues of high explosives at two types of potential source zones: (1) an area near a low-order PARTIAL detonation of an 81-mm mortar and (2) an artillery/mortar target. Soil sampling near the low-order detonation revealed the presence of potential "hot spots" and showed that the concentrations of RDX and TNT ranged over five orders of magnitude. The range of concentrations was reduced to a factor of about 60 when randomly collected 25-increment composite samples were collected within this area. The range reduced further to about a factor of three for four simulated (i.e., existing discrete values) 25-increment systematically derived composite samples. A vast improvement in the repeatability of replicate samples can be achieved using composite sampling approaches. Composite samples collected around a target showed that the distribution of energetic residues was random, and overall the concentrations were much lower than around the partially detonated round.
http://handle.dtic.mil/100.2/ADA428488

Scaling DNAPL Migration from the Laboratory to the Field
Imhoff, Paul T. and Amy S. Mann (Univ. of Delaware, Newark); Mark Mercer and Michael Fitzpatrick (U.S. EPA, Washington, DC).
Journal of Contaminant Hydrology, Vol 64 Nos 1-2, p 73-92, June 2003

Modified inspectional analysis is a technique for developing scaling relationships through nondimensionalizing the governing equations. This methodology was applied to scale observations of DNAPL migration in a laboratory model to four hypothetical field scenarios where large volumes of DNAPL were released. One scenario was compared to a large DNAPL spill site. The length and time scales of DNAPL movement predicted from the analysis are consistent with those predicted from a numerical model of this site. This approach may prove useful for scaling results from other laboratory investigations of DNAPL migration to field-scale systems.

Secondary Ion Mass Spectrometry (SIMS) to Mapping Heavy Metal in Plant
Mangabeira, P., A.F. Almeida, and M. Mielke (Univ. Estadual de Santa Cruz, Ilheus, Bahia, Brazil); I. Musrafh; F. Escaig; D. Laffray; M.I.G. Severo; A.H. Oliveira; P. Galle.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-III, p 184-185, 2003

Investigators studied the uptake, transport, and localization of various isotopes of chromium in tomato plants using secondary ion mass spectrometry (SIMS) microscopy. The experiment was carried out in a growth room at 28 degrees C with 12 hours of fluorescent white light and 12 hours of darkness. The four control plants received only the basic nutrient solution, while the rest of the plants were treated additionally with 50mg Cr/L. Image analysis was performed on the CAMECA SMI 300 using O2+ primary beam at a tension of 10kV. The images representing the distribution of a given element can be observed on a fluorescent screen or recorded on a photographic emulsion. This sensitive method permits the detection of elements that are present in very low concentrations or even at trace levels (1ppm). The distribution of sodium and calcium was used to reveal the topography of the tissues examined. The most abundant isotope of chromium, chrome 52, was selected to obtain the images representing its microscopic distribution. The secondary ion images showed high signals of chromium in roots inside and around the secondary xylem, and weak signals in cortex and surface area. Cr was mainly accumulated in roots and transported poorly upward. In leaves, Cr was mainly found in the cell walls of the vascular bundle. The results show that chromium was detected in order of decreasing concentration, in roots, stems, and leaves. No chromium signal was detected in fruits.

Seismoelectric Investigations at Clean and Contaminated Sites
Strachan, Elizabeth and Paul J. Wolfe, Wright State Univ., Dayton, OH.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, SPT-2, 9 pp, 2001

Seismoelectric site investigations can be affected by background electrical noise from power lines. The authors describe studies of the seismoelectric effect conducted at a site with a clean aquifer and a site with fuel leaking from a storage tank farm. They used readings at the clean site to develop appropriate data-acquisition techniques and the resulting data to test data-processing techniques. From the arrival time of the seismoelectric signal, they were able to determine the depth of the water table which was verified by drilling. On the basis of these results, they attempted to determine the extent of the fuel layer on the water table at an inactive military fuel site where monitoring wells indicated a fuel layer up to 50 cm thick. The water table in the contaminated zone is about 15m below the ground surface. The site control showed a clear seismoelectric response, but the contaminated zone did not. The investigators tentatively concluded that fuel suppressed the seismoelectric response and that the extent of the fuel plume was larger than expected. These results suggest the need for further study.

Selective Detection System of BTX Mixture-Gases Using a Microfluidic Device For Field Monitoring
Horiuchi, Tsutomu (NTT Microsystem Integration Laboratori, Atsugi, Kanagawa, Japan), Itaru Honma, Yuzuru Iwasaki, Osamu Niwa, Yuko Ueno, Takeo Yamada, Ha-shen Zhou.
The Pittsburgh Conference: PITTCON 2003, Presentation 1030-4.

A small (37 x 28 x 10 cm) detection system for benzene, toluene, and xylene (BTX) comprises a microfluidic device (concentration and detection cells, both 1 x 3 cm), a small pump, a deuterium lamp, a UV spectrometer, a controller and an SCSI interface. Airborne BTX are aromatic volatile organic compounds (VOCs) that are toxic even at ppb concentrations. Though they are frequently found together, as in vehicle exhaust, their differing levels of toxicity call for a way to identify them quantitatively in the air. concentration cell in our detection system is composed of an adsorbent to concentrate the VOC gases and a thin-film platinum heater to desorb the concentrated gas thermally. The desorbed gas is introduced into the detection cell to measure its UV absorption spectrum. When gas with BTX constituents was introduced into this detector, the component ratios from the mixture-gas were obtained spectrum using least squares to minimizes the error between the mixture gas spectrum and a calculated spectrum of reference spectra of each component gas. An integrated fluidic device in which the concentration and detection cells are put together showed quicker response than a separated-cells configuration. Highly ordered mesoporous silica better improved the separation property than commercially available amorphous silica. The researchers obtained a 10 ppb detection limit for toluene gas and achieved the separate detection of benzene, toluene, and xylene in a mixture gas with a 30 min sampling time using this system.

Semi-Autonomous Robotic Sampler for Explosives Residues in Surface Soils
Lever, J.H.; T. Nichols; D. Denton; R. Meador; A. Morlock; J. Kenyon, K. Palmer; P.G. Thorne, Engineer Research and Development Center Hanover, NH.
Report No: ERDC/CRREL-TR-04-13, NTIS: ADA423935, 24 pp, June 2004

A 25-kg, dual-track robot was built to satisfy the sampling protocol for surface explosives residues in soils. A rotary-tube cutter takes fairly consistent samples in a variety of soil conditions. Each sample bag holds about 30 samples to form a composite that represents the sampled area. An onboard carousel holds six bags: five composite samples and a sixth bag to clean the tube to minimize cross-contamination. The robot was designed to operate autonomously to collect a composite sample, log the coordinates of the area sampled, complete a composite within about 20 minutes, and operate without intervention for about 2 hours. A person can tele-operate the robot between sampling areas and to and from a base station where batteries and sample bags can be replenished.
http://handle.dtic.mil/100.2/ADA423935
and/or
http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-13.pdf

Sensitive Detection of Chemical Agents and Toxic Industrial Chemicals Using Active Open-Path FTIRs
Walter, William T.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 144-150, 2004

Active open-path FTIR sensors provide more sensitive detection of chemical agents than passive FTIRs, and at the same time identify and quantify toxic industrial chemicals. Passive FTIRs are bistatic sensors relying on infrared sources of opportunity. The source temperatures available for passive chemical-agent FTIR sensors are limited to 300 degrees K. Active FTIR chemical-agent sensors utilize silicon carbide sources, which can be operated at 1500 degrees K. Minimum detection limits are better than 5 ug/cubic meter for GA, GB, GD, GF and VX. Active FTIR sensors can assist first responders and emergency response teams in their assessment of and reaction to a terrorist threat by identifying toxic chemicals and their concentrations.

Sensors for Chemical Risk Assessment
Campanella, Luigi.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 50-57, Mar 2004

Scientists are working to develop a new solid-state sensor that is based on the capacity of the sensor element to catalyze the photodegradation of various kinds of organic compounds and to monitor the consequent pH variation so as to measure environmental permanency and consequent risks. The electron holes present in the titanium dioxide structure are able to trigger an oxidative process involving substances that can be adsorbed on it. In another approach, radicals as markers of risk are considered, and sensors proposed for their determination.

Sequential Extraction Versus Comprehensive Characterization of Heavy Metal Species in Brownfield Soils
Dahlin, C.L., C.A. Williamson, W.K. Collins, and D.C. Dahlin, U.S. DOE, Albany, OR.
Environmental Forensics, Vol 3 No 2, p 191-201, 2002

Soils from two Superfund sites were tested to examine the applicability of sequential extraction to determine species of heavy metals. Data from a standard sequential extraction procedure were compared to those from a comprehensive study that combined optical- and scanning-electron microscopy, X-ray diffraction, and chemical analyses. The study shows that larger particles of contaminants, encapsulated contaminants, and/or man-made materials such as slags are subject to incasement, non-selectivity, and redistribution in the sequential extraction process; hence, standard sequential extraction procedures developed for characterizing species of contaminants in river sediments may be unsuitable for stand-alone determinative evaluations of contaminant species in industrial-site materials.

A Simplified Recovery Method Used in the CALUX Bioassay
Earnheart, C., L.M. Pence, M.K. Halbert, G. Hirsch, and J.C. Archer, FDA/ORA/Arkansas Regional Laboratory, Jefferson, AR.
2003 FDA SCIENCE FORUM -- FDA Science: Protecting America's Health. The 9th FDA Science Forum, 24-25 April 2003, Washington, DC

The cellular-dependent bioassay system, Chemically Activated LUminescence eXpression (CALUX(R)), detects compounds that activate the aryl hydrocarbon receptor (AhR). When detecting dioxins, different recovery methods are available for determination. The manufacturer-recommended recovery method uses a surrogate technique in which one of the duplicate extracts is spiked with a 14C12 dioxin. The recovery is then calculated from a scintillation counter response. Another method calculates percent recoveries from a single extract per sample batch, but a batch recovery assumes no matrix affect and thus is not a true recovery. The authors propose adding 12C12 1,2,3,4-TCDD to each sample to quantitatively determine recoveries by GC/Mass Spectrometry because (1) 12C12 1,2,3,4-TCDD will not activate the AhR and is not radioactive, and (2) duplicates are not needed, thus decreasing analysis time and conserving reagents/supplies.

Simultaneous Detection of Cadmium, Copper, and Lead using A Carbon Paste Electrode Modified with Carbamoylphosphonic Acid Self-Assembled Monolayer on Mesoporous Silica (SAMMS)
Yantasee, W. (Pacific Northwest National Lab), Y. Lin, G.E. Fryxell, and B.J. Busche.
Analytica Chimica Acta, Vol 502 No 2, p 207-212, 2004

A new sensor has been developed for simultaneous detection of cadmium, copper, and lead based on the voltammetric response at a carbon paste electrode modified with carbamoylphosphonic acid (acetamide phosphonic acid) self-assembled monolayer on mesoporous silica (Ac-Phos SAMMS). The adsorptive stripping voltammetry technique involves preconcentration of the metal ions onto Ac-Phos SAMMS under an open circuit, then electrolysis of the preconcentrated species, followed by a square wave potential sweep towards positive values. The metal detection limits were 10 ppb after 2 minutes preconcentration and improved to 0.5 ppb after 20 minutes preconcentration.

Simultaneous Measurement of Specific Discharge and Cr(VI) Mass Flux in Porous Media Using Permeable Adsorbent Device
Campbell, Timothy J.; K. Hatfield; M.D. Annable, Florida Univ., Gainesville.
NTIS: ADA423922, 32 pp, Aug 2001

The authors propose a method for simultaneous measurement of local groundwater specific discharge and Cr(VI) mass flux using a permeable adsorbent device. The proposed method allows for determination of both local groundwater specific discharge and Cr(VI) mass flux as two-dimensional vectors, with each vector composed of an angular and a radial component. The device consists of a cylindrical container whose outer shell is constructed of highly permeable mesh material with impermeable end caps. The interior of the device is divided into a center well and three outer sectors, each packed with a granular anion exchange resin having high adsorption capacity for the Cr(VI) oxyanions CrO42- and HCrO4-. The adsorbent in the center well of the device is loaded with berizoate as resident tracer. Experiments were conducted in which these devices were placed in porous packed bed columns through which was passed a measured quantity of simulated groundwater containing chromate. The resin was then removed from the four sectors separately and extracted to determine the masses of Cr(VI) and resident tracer bound in each. The results show that the proposed method represents a promising technique for determination of specific discharge and contaminant mass flux in contaminated aquifers.
http://handle.dtic.mil/100.2/ADA423922

Single-Well "Push-Pull" Partitioning Tracer Test for NAPL Detection in the Subsurface
Istok, J.D. (Oregon State Univ., Corvallis); J.A. Field; M.H. Schroth; B.M. Davis; V. Dwarakanath.
Environmental Science & Technology, Vol 36 No 12, p 2708 -2716, 2002

In single-well injection-extraction ("push-pull") partitioning tracer tests, retardation factors for injected partitioning tracers are estimated from the increase in apparent dispersion observed in extraction-phase breakthrough curves in the presence of nonaqueous phase liquid (NAPL). Laboratory push-pull tests was conducted in physical aquifer models packed with natural aquifer sediment prepared both with and without the presence of trichloroethene (TCE) NAPL, and field tests were conducted in an aquifer contaminated with petroleum hydrocarbon NAPL. Injected test solutions contained a suite of partitioning and non-partitioning alcohol tracers. Laboratory push-pull partitioning tracer tests were able to detect and quantify sorption of partitioning tracers to aquifer sediment (in the absence of NAPL) and to detect NAPL when it was present. NAPL saturations computed from estimated retardation factors bracketed those computed from known volumes of emplaced NAPL in the sediment. Numerical modeling with assumed homogeneous NAPL distribution and linear equilibrium partitioning of tracers between aqueous and NAPL phases was shown to be invalid when subsequent excavation of the sediment pack showed that a portion of the emplaced NAPL had sunk to the bottom of the physical model. Field push-pull partitioning tracer tests were able to detect NAPL in a portion of the aquifer known to contain NAPL; computed NAPL saturations were comparable to those obtained from sediment coring and the results of a partitioning interwell tracer test conducted in the same location. Though the single-well partitioning tracer test can detect NAPL under both laboratory and field conditions, additional research is needed to verify the ability of the test to quantify NAPL saturations.

Site Characterization Technologies for DNAPL Investigations
U.S. EPA, Office of Superfund Remediation and Technology Innovation.
Report No: EPA 542-R-04-017, 165 pp, Aug 2004

Because of their unique way of moving through the subsurface, dense nonaqueous phase liquids (DNAPLs) can become ongoing ground-water contamination sources for many years, if not centuries. Their ability to move as a mass through the vadose zone and penetrate the water table while following the path of least geologic resistance makes them very difficult to characterize and remediate. This report summarizes information on the current state of technologies available for locating and characterizing DNAPL at contaminated sites. The document is intended to help managers at sites with potential or confirmed DNAPL contamination identify suitable characterization technologies, screen the technologies for potential application, learn about applications at similar sites, and locate additional information on these technologies.
http://www.cluin.org/download/char/542r04017.pdf

Soil Resistivity Measurements for Clay Content Estimation and its Application for Petroleum Contamination Study
Shevnin, Vladimir, Omar Delgado Rodriguez, and Aleksandr Mousatov (Mexican Petroleum Inst., Mexico City); Albert Ryjov (Moscow State Geological Prospecting Academy, Moscow, Russia).
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 396-408, 2004

Clay content in soil influences soil permeability and adsorption and hence the position and movements of contaminants. Soil resistivity measurements as a function of water salinity at full saturation of soil samples and data interpretation (or inversion) can be used to find the clay content and porosity of a sample. Together with water resistivity estimation, this information permits the characterization of uncontaminated soil and boundary conditions estimation for separating contaminated from uncontaminated zones. Soil resistivity is determined by pore water resistivity, porosity, clay content, and humidity. Estimating soil parameters from measurements of water and soil resistivity is performed with the help of forward and inverse petrophysical calculation. The authors report on a study of the sensitivity of petrophysical algorithms to principal soil parameters and estimated errors of interpretation depending on input error. Practical examples from the field are presented to illustrate the good correspondence between vertical electrical sounding data, water and soil resistivity measurements, and petrophysical estimations.

Sol-Gel Based Mid-Infrared Evanescent Wave Sensors for Detection of Nitro-Compounds in Aqueous Solution
Janotta, Markus (Georgia Tech, Atlanta, GA) and Boris Mizaikoff.
The Pittsburgh Conference: PITTCON 2003, Presentation 230-3.

Optical sensing devices based on the principle of evanescent field spectroscopy have been designed and tested for continuous perception of nitro-based analytes, such as nitrobenzene, trinitrobenzene, and several organophosphate pesticides. To enhance the performance characteristics of these mid-IR evanescent field (MIR-EFS) sensors, novel recognition layers have been developed and characterized through a sol-gel process. Upon introducing organically modified siloxanes, reactive functional groups have been incorporated into the sol-gel matrix, allowing enhanced control of polarity and porosity. Different organically modified sol-gels have been prepared by acid-catalyzed copolymerization and have been coated onto ZnSe ATR crystals and silver halide fibers. The approach of imprinted sol-gel membranes for MIR-EFS sensors was tested for increased selectivity and sensitivity, and the results indicate that sol-gels offer a promising alternative to conventional polymeric coating materials for MIR-EFS sensors, making them particularly suitable for harsh conditions.

Sorbent Wicking Device for Sampling Hydrophobic Organic Compounds in Unsaturated Soil Pore Water. II: Chemical Capture, Recovery, and Analysis
McNamara, Sean W. and R.G. Luthy, Stanford Univ., Stanford, CA.
Journal of Environmental Engineering, Vol 131 No 1, p 21-28, Jan 2005

A sampling device consisting of an annular porous stainless-steel interface encasing granular-activated carbon and a fiberglass wick is being examined for chemical capture and quantitative recovery of chlorinated hydrophobic organic compounds (HOCs) sampled from the pore-water of unsaturated soils. Laboratory saturated soil column studies showed that the sorbent-wick sampler provided reliable and repeatable estimates of the pore-water concentrations of chlorobenzenes at pore-water concentrations as low as several parts per billion. Field trials in a land biotreatment unit that had undergone 5 years of intrinsic bioremediation assessed the availability of trace levels of aqueous-phase PCBs. The test results indicated that the samplers replicated the aqueous-phase PCB homolog pattern measured in ex situ aqueous extraction tests. Ortho-substituted PCBs, which are relatively recalcitrant in land biotreatment units, were dominant in sorbent-wick samples and aqueous extracts. The sorbent-wicking device allows investigators to obtain time-averaged mass and volumetric flux rates of HOCs in land treatment units.

Spatial Variability of In Situ Microbial Activity: Biotracer Tests
Sandrin, Susannah K., Mark L. Brusseau, Joseph J. Piatt, Adria A. Bodour, William J. Blanford, and Nicole T. Nelson.
Ground Water, Vol 42 No 3, p 374-383, May/June 2004

Field experiments were conducted at two sites to evaluate the utility of the biotracer method for characterizing the spatial variability of microbial activity. Site 1 has mixed waste in a contaminated surficial aquifer, and Site 2 has chlorinated solvents in a regional aquifer. Mass recovery of the biotracer decreased approximately linearly with increasing residence time for Site 2. Similar behavior was observed at Site 1, except in the region adjacent to the injection zone, where percent recoveries were much lower than predicted. Considering the large range over which biodegradation rate coefficients can vary, the rate coefficient exhibited relatively minimal spatial variability (factor of 2.5) for Site 2, whereas the spatial variability of the rate coefficient was an order of magnitude greater for Site 1. These differences in variability are consistent with conditions associated with the respective sites.

Spatial Variations of Residual NAPL Zone Concentration in Subsurface
Sun, D. and J. Zhu, Texas A&M Univ., College Station.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract H21B-13, 2004

Improved models are presented for the prediction of the solute concentration in the zone of residual nonaqueous phase liquid (NAPL) as a result of dissolution. The models enable the pseudo-equilibrium formulation to be used and therefore the numerical simulations for field application problems can be simplified compared to the non-equilibrium counterpart. The models are especially useful for situations of small residual NAPL saturation, which are typical for many field applications. The previous screening models lumped the entire NAPL source zone together without considering the spatial distribution of NAPL source zone concentrations. The new models incorporate the fact that the NAPL mass in the upstream will dissolve first, creating a dissolution zone that will travel downstream at certain velocity and thus demonstrating that the NAPL zone concentration is dependent on both the time and the distance into the NAPL zone.

Specific Tools for Monitoring Perchlorate Bioremediation

Coates, J.D. and S.M. O'Connor (Univ. of California, Berkeley); N.B. Sutton (Claremont McKenna College, Claremont, CA).
The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst.
Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Two taxonomic groups, the Dechloromonas and the Dechlorosoma species, have been identified that represent the dominant (per)chlorate-reducing bacteria (ClRB) in the environment. Chlorite dismutation is a key step in the reductive pathway common to all ClRB and is mediated by the enzyme, chlorite dismutase (CD). Biochemical and genetic analyses suggested that CD is highly conserved amongst the ClRB, which makes this enzyme makes an ideal target for a probe specific for these organisms. This paper describes efforts that have led to the development of a highly specific and sensitive immuno-probe based on the commonality of the CD in ClRB. A rapid (45 min) ELISA microtiter assay has been developed to assess ClRB in environmental samples regardless of their phylogenetic affiliations. This work aims to enable the monitoring of ClRB in an engineered perchlorate bioremediation strategy.

Spectral Induced Polarization Studies of Mine Waste Piles in Colorado and New Mexico

Campbell, David L. and Robert J. Horton, U.S. Geological Survey, Denver, CO.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, AML-1, 13 pp, 2001

The authors describe a laboratory study undertaken to help interpret spectral induced polarization (SIP) data collected in the field on waste piles from sulfide mineral-bearing mines in Colorado and New Mexico. Samples containing unaltered sulfide minerals had strong relaxation features in the frequency range from about 0.01-100 Hz. These relaxation features consist of resistivity values that start out low and that continue to drop with increasing frequency, and phase values that are generally negative and large and whose curves are concave down, over that frequency range. In most western U.S. mine waste piles, however, the original sulfide minerals have been weathered and chemically altered to sulfate and oxide minerals such as jarosite, anglesite, and goethite, which results in the fading and disappearance of the sulfide relaxation features on the corresponding spectra. As water is added to dried samples, they become more conductive and their spectra change markedly, typically changing from spectra like those of weathered mine waste to spectra that superficially resemble those of material containing unaltered sulfide minerals. Unfortunately, laboratory spectra generally failed to resemble spectra measured in the field, possibly because of varying water content or disturbances resulting from the sampling process, but more likely due to inherent scaling factors that are responsible for the differences between spectra measured on cm-size laboratory samples and those measured on m-size field blocks.

Stable Hydrogen, Carbon and Chlorine Isotope Measurements of Selected Chlorinated Organic Solvents
Shouakar-Stash, O., S.K. Frape, and R.J. Drimmie, Univ. of Waterloo, Waterloo, ON, Canada.
Journal of Contaminant Hydrology, Vol 60 Nos 3-4, p 211-228, Feb 2003

Stable hydrogen isotopes of two chlorinated solvents, TCE and TCA, from 5 different manufacturers were determined and compared to their carbon and chlorine isotopic signatures. After a column experiment was carried out to dechlorinate PCE to TCE using iron, a comparison of the dechlorination products showed completely different hydrogen isotope ratios than those shown by the manufactured TCEs. Compared to the positive values of DELTA2H in manufactured TCEs, the dechlorinated products had a very depleted DELTA2H. This finding has strong implications for distinguishing dechlorination products (PCE to TCE) from manufactured TCE. The results of this study indicate the potential of combining 2H/1H analyses with 13C/12C and 37Cl/35Cl for isotopic fingerprinting applications in organic contaminant hydrogeology.

Stable Isotope Fractionation Analysis as a Tool to Monitor Biodegradation in Contaminated Acquifers
Meckenstock, Rainer U. (Inst. of Groundwater Ecology, GSF- National Research Center for Environment and Health, Neuherberg, Germany); Barbara Morasch; Christian Griebler; Hans H. Richnow.
Journal of Contaminant Hydrology, Vol 75 Nos 3-4, p 215-255, Dec 2004

In a review of recent laboratory and field studies in which applied stable isotope analysis (SIFA) was applied to assess biodegradation of contaminants, stable isotope enrichment factors were noted that varied from no fractionation to moderate fractionation to larger fractionations. The different isotope enrichment factors can be related to the respective biochemical reactions. The authors discuss under what circumstances SIFA can be used for a qualitative or even a quantitative assessment of biodegradation in the environment, with a focus on the aerobic and anaerobic degradation of aromatic hydrocarbons and chlorinated solvents as the major contaminants of groundwater.

Static Headspace Analysis of Volatile Organic Compounds in Soil and Vegetation Samples for Site Characterization
Alvarado, Jorge S. and Candace Rose, Argonne National Laboratory, Argonne, IL.
Talanta, Vol 62 No 1, p 17-23, 9 Jan 2004

In the absence of a standard methodology for the determination of volatile organic compounds (VOCs) in vegetation and in view of the high detection limits of the method for soils, scientists at Argonne National Laboratory developed a methodology using headspace gas chromatography with an electron capture detector for the determination of low levels (parts per billion to parts per trillion) of VOCs in soils and vegetation. The technique demonstrates good sensitivity, good recoveries of internal standards and surrogate compounds, good performance, and minimal waste. A case study illustrates the application of this technique as a first-step vadose-zone characterization methodology.

Statistical Method to Evaluate the Occurrence of PCB Transformations in River Sediments
Karcher, S.C., M.J. Small, & J.M. VanBriesen, Carnegie Mellon Univ., Pittsburgh, PA.
Proceedings of the 228th American Chemical Society Meeting, 22-26 August 2004, Philadelphia, Pennsylvania. Annual Fall Meeting, Extended Abstract, 5 pp, 2004

Dechlorination, the process by which one or more of the chlorines on a polychlorinated biphenyl (PCB) molecule are removed, has been the subject of much research over the past few decades. Understanding if, and to what extent dechlorination is occurring in river sediments can have important implications for remedial design strategies. Historical PCB reporting methods have been insufficient to support the development of an in-depth understanding of the dechlorination process in field samples. Much of the confusion stems from not knowing the specific Aroclor (such as A1242) or Aroclors (such as a mixture of A1242 and A1254) that represent the original source contamination at a field location, thus providing no clear starting point for comparison. This study broadens the definition of the starting point from knowing which Aroclors were present, to needing only to know that the source contaminants were Aroclors. The method focuses only on PCB congeners that maintain a constant relative proportion in sequentially more-highly chlorinated commercial Aroclors. Available at http://www.ce.cmu.edu/~jeanne/posters%20for%20web/ExtendedAbstract_Karcher767229_toDD.pdf

Stochastic Modeling of DNAPL Source Reconstruction in a Highly Characterized Glaciofluvial Aquifer.
Maji, R. and E. Sudicky, Univ. of Waterloo, Waterloo, ON, Canada.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract H41D-13

In this paper, a multiphase compositional model is applied in a conditional multi-realization framework to simulate, in detail, the dense nonaqueous phase liquid (DNAPL) saturations and aqueous phase plume migration in a highly-characterized, heterogeneous glaciofluvial aquifer. The DNAPL saturation distribution and mass estimates for each realization of the aquifer are then reconstructed by sampling the saturation data using two alternate approaches, each with different degrees of sampling conditioning. Method 1 reconstructs the DNAPL source and mass estimate by employing the transition probability/Markov chain approach while Method 2 involves a traditional variogram analysis of the sampled saturation data followed by kriging. The reconstructed geometry of the DNAPL source zone and the estimated mass of DNAPL present within the source zone, along with the uncertainty of the estimates, are compared for each source reconstruction using the different geostatistical interpolation methodologies and for the various degrees of saturation and aquifer permeability conditioning.

Strategies For Monitoring The Performance of DNAPL Source Zone Remedies
Interstate Technology and Regulatory Council (ITRC) Dense Nonaqueous-Phase Liquids Team. Report No: DNAPLs-5, 206 pp, Aug 2004

The task of evaluating the efficiency and effectiveness of a remedial action in meeting the remediation and operational objectives established for the project is termed "performance assessment." System effectiveness is the ability of the system to achieve remediation goals at a given site, while "efficiency" refers to the optimization of time, energy, and cost toward the achievement of effectiveness. The EPA defines performance monitoring as "the periodic measurement of physical and/or chemical parameters to evaluate whether a remedy is performing as expected." In terms of dense nonaqueous phase liquid (DNAPL) source-zone treatment, performance assessment involves the collection and evaluation of conditions following treatment and the comparison of that information to pretreatment or baseline conditions. This report is intended for regulators and others interested in learning about approaches to performance monitoring while implementing various in situ technologies for the treatment of DNAPLs. This document presents the various ways in which success or failure in treating a DNAPL source zone have been measured. Because the vast majority of experience in DNAPL source-zone remediation has been in unconsolidated geologies, such as sands and silts, many of the conclusions, recommendations, and lessons learned presented do not necessarily transfer to performance assessment in fractured bedrock, karst, or other consolidated geologies. Available at http://www.itrcweb.org//DNAPLs-5.pdf

Striking the Balance: Long Term Groundwater Monitoring Design for Multiple, Conflicting Objectives
Reed, P. and B.S. Minsker.
Journal of Water Resources and Planning Management, Vol 130 No 2, p 140-149, 2004

In this paper, a full multiscale approach to partial differential equation (PDE)-constrained optimization is developed and used to solve a successive approximation linear quadratic regulator model for optimal control of in situ bioremediation. The method starts the search for optimal designs from the coarsest mesh and solves for the optimal solution at that level, then uses the optimal solution obtained as the initial guess for the finer mesh. While at the finer mesh, the method switches back to the coarser mesh to solve for the derivatives and uses those derivatives to interpolate back to the finer mesh. This procedure continues until convergence is achieved at the finest level. This approach exploits important interactions between PDE discretization and optimization and achieves significant computational saving by using approximations early in the search when a broad search of the decision space is being performed. Application of the method to a bioremediation case study with about 6,500 state variables converges in about 8.8 days, compared to nearly 1 year using the previous model.

Striking the Balance: Long-Term Groundwater Monitoring Design for Multiple Conflicting Objectives
Reed, P., Ph.D. thesis, Univ. of Illinois at Urbana-Champaign, 238 pp, 2002

This research develops a highly adaptable multiobjective long term monitoring (LTM) design methodology that aids the negotiation process by enabling decision makers to directly assess the tradeoffs among a variety of performance objectives. The monitoring methodology combines quantile kriging and the Nondominated Sorted Genetic Algorithm-II (NSGA-II) to successfully balance four objectives: (1) minimizing sampling costs, (2) maximizing the quality of interpolated plume maps, (3) maximizing the relative accuracy of contaminant mass estimates, and (4) minimizing local estimation uncertainty. Visualization is used as an aid in selecting, understanding, and balancing these performance objectives en route to a single compromise solution.
http://cee.uiuc.edu/emsa/reed.html

Stripping Chronopotentiometric Measurements of Lead(II) and Cadmium(II) in Soils Extracts and Wastewaters Using a Bismuth Film Screen-Printed Electrode Assembly
Kadara, Rashid O. and Ibtisam E. Tothill, Cranfield Univ., Silsoe, Bedfordshire, UK.
Analytical and Bioanalytical Chemistry, Vol 378 No 3, p 770-775, Feb 2004 [OSTI: DE20448406]

A three-electrode configuration system has been fabricated using low-cost screen-printing (thick-film) technology. Coupled with a portable electrochemical instrument, this system has provided a relatively inexpensive on-site detector for trace levels of toxic metals. The carbon surface of the screen-printed working electrode is used as a substrate for in situ deposition of a metallic film of bismuth, which allows the electrochemical preconcentration of metal ions. Detection limits of 8 and 10 ppb were obtained for cadmium(II) and lead (II), respectively, for a deposition time of 120 seconds. The new system's results were validated against a mercury film electrode and ICP-MS.

Study of Bioavailability of Heavy Metals in the Baltic Sea Sediments using Sequential Extraction and Specific Bacterial Sensors
Kunttu, Katja (Finnish Inst. of Marine Research, Helsinki, Finland); Angela Ivask; Mirja Leivuori; Anne Kahru; Marko Virta.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-II, p 30-31, 2003

Though the largest part of heavy metal monitoring in marine environments is focused on the total metal concentrations in sediments, total concentrations may not identify the actual toxicity hazard because major parts of the metals are bound to primary and secondary minerals that hold metals within their crystal structure. Heavy metals are not expected to be released from these minerals under the conditions normally encountered in the nature. A study was undertaken to measure easily exchangeable, bioavailable heavy-metal concentrations (cadmium, copper, lead, and zinc) with chemical methods and with bacterial biosensors based on recombinant strains capable of sensing specific heavy metals. The initial goal was to overcome the changes that occur in metal binding sites when the sediment sample is freeze-dried or oven-dried prior to analysis. Future work will investigate the bioavailability of heavy metal in sediment samples using inexpensive bacterial biosensors for quick field analysis.

Study of Explosive Residues Found above Buried Landmines
Grossman, Scott L. and Kira Hutchinson.
Detection and Remediation Technologies for Mines and Minelike Targets VIII. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 718-727, 2003

Techniques under development for locating landmines often detect explosive molecules that have migrated out of the buried landmines and through the soil to the soil's surface. This paper describes an experiment to monitor the explosive signature above 27 landmines of 9 types buried for years in a temperate environment. Soil samples were collected above and around these twenty-seven mines and analyzed using gas chromatography coupled with an electron capture detector (GC-ECD). The results of the GC-ECD analyses are presented.

Study of Oil Pollution in Airports with Resistivity Sounding
Shevnin, V., A. Mousatov, E. Nakamura-Labastida, O. Delgado-Rodriguez, A. Mejia-Aguilar (Mexican Petroleum Inst., Mexico); J.-L. Sanchez-Osio (Ecoexel S.A. de C.V., Mexico); H. Sanchez-Osio (Competitividad Ambiental S.A. de C.V. Mexico).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 180-189, 2003

The resistivity method on tomographic sounding technology was successfully applied mapping pollution zones from aviation fuel at two airports in Mexico.

Study of Oil Pollution in Mexico with Resistivity Sounding
Shevnin, V. (IMP, Mexico), A. Ryjov (MSGPA, Moscow, Russia), E. Nakamura (IMP, Mexico), A. Sanchez (EcoExel, Mexico), V. Korolev (MSU, Moscow, Russia), A. Mousatov (IMP, Mexico).
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC5, 2002

At a contaminated site at which some remediation had already been performed, resistivity soundings (VES) were taken to assess the ecological state of the ground and to provide a basis for planning future remediation work. The area is occupied by buildings and industrial constructs and is covered by concrete 20 cm thick. The VES studies were performed along the internal factory roads. The high level of geologic and electromagnetic noise caused some problems in VES field application and data analysis, and data processing for two-sided pole-dipole array was applied to decrease geological and EM noise. VES profiling allowed investigated objects to be perceived both in layout and in depth. The groundwater conductivity was estimated in several wells to allow the theoretical calculation of the rock (sand and clay) resistivities. In oil-polluted places, bacterial degradation of the oil produced low resistivity anomalies. The comparison of theoretical calculations of rocks resistivities with VES results allowed pollution zone mapping. Oil pollution anomalies were localized in several areas of linear outlines bound with fault zones, as was confirmed by drilling and chemical analysis.

Study Shows Nanoshells Ideal as Chemical Nanosensors: 'Nanoshells' Enhance Sensitivity to Chemical Detection by Factor of 10 Billion
Rice University News Release, 11 Jan 2005

New research published in the Proceedings of the National Academy of Science (Jackson and Halas, 101(52):17930-17935, 12/28/04) finds that tailored nanoparticles known as nanoshells can enhance chemical sensing by as much as 10 billion times, which makes them about 10,000 times more effective at Raman scattering than traditional methods. When molecules and materials scatter light, a small fraction of the light interacts in such a way that it allows scientists to determine their detailed chemical makeup. Nanoshells also can be tuned to interact with specific wavelengths of light by varying the thickness of their shells. This tunability allows for the Raman enhancements to be optimized for specific wavelengths of light. Naomi Halas, Director of Rice's Laboratory of Nanophotonics, and former graduate student Joseph B. Jackson, now with Nanospectra Biosciences, Inc., created thin films of nanoshells deposited atop plates of glass. Films with various densities were studied, as were films containing both silver and gold nanoshells. Through painstaking analysis, Halas and Jackson showed that the nanoshells' 10 billion-fold increase in Raman effect was due entirely to the interactions of light with individual nanoshells. This is markedly different from the pattern exhibited by pure gold or silver nanoparticle films. The finding that individual nanoshells can vastly enhance the Raman effect opens the door for biosensor designs that use a single nanoshell, e.g., for the detection of very small amounts of a material, like a few molecules of a deadly biological or chemical agent. Their research was funded by the Air Force Office of Scientific Research, the National Science Foundation, NASA, the Robert A. Welch Foundation and the Army Research Office.

Surface Decontamination of Simulated Chemical Warfare Agents Using a Nonequilibrium Plasma with Off-Gas Monitoring
Moeller, T.M. (InnovaTek, Inc., Richland, WA); M.L. Alexander (PNNL, Richland, WA); M.H. Engelhard & D.J. Gaspar (EMSL, Richland, WA); M.L. Luna & P.M. Irving.
Environmental Molecular Sciences Laboratory 2003 Annual Report, section 2-5-37, 2004

InnovaTek is developing a surface decontamination technology that uses active species generated in a nonequilibrium corona plasma. This work used a variety of instrumental methods to verify the efficacy of the plasma technology: gas chromatograph-mass spectrometry (GC-MS), X-ray photoelectron spectroscopy (XPS), and secondary ionization mass spectrometry (SIMS). In addition, ion trap mass spectrometry (ITMS) with direct atmospheric sampling with a direct air-sampling interface was used as a real-time monitor of the decontamination process. The plasma technology was tested against dimethyl methylphosphonate (DMMP), a simulant for the chemical agent Sarin. The relative concentration of the DMMP breakdown products from plasma exposure shows a range of approximately two orders of magnitude. These data are consistent with the GC-MS results, though the dynamic range is reduced on the low end by signal-to-noise limitations and on the high end by the time response of the system. The apparent induction time of two minutes is a convolution of the actual induction time for the DMMP on the surface to react with the plasma and the delay and broadening due to the capillary interface. This has the effect of spreading the intensity in time and reducing the maximum observed signal. It is significant that the off-gas mass spectrum differs significantly from the pure DMMP mass spectrum, as this demonstrates unequivocally that the cold plasma decontamination is not simply volatilizing the DMMP, but breaking it down into harmless components. The surface cleaning technology is being further refined to develop a product that will not only decontaminate surfaces, but will also sense when decontamination is complete.

Surface-Enhanced Raman as a Water Monitor for Warfare Agents
Spencer, K.M.; J.M. Sylvia; S.L. Clauson; J.A. Janni.
Vibrational Spectroscopy-Based Sensor Systems. Proceedings of SPIE--The International Society for Optical Engineering, Vol 4577, p 158-165, 2002

Detection of chemical warfare (nerve, blister, and choking) agents generally requires detection down to the low ppb levels. Surface-Enhanced Raman Spectroscopy (SERS) is a spectroscopic technique that can detect trace levels of contaminants directly in the aqueous environment. This paper presents results on the use of SERS to detect chemical and biological agent simulants with an end goal of creating a Joint Service Agent Water Monitor. Detection of cyanide, 2-chloroethyl ethyl sulfide, phosphonates, and Gram-positive and Gram-negative bacteria using SERS has been performed and is discussed.

Surface Plasma Resonance Biosensor Based on Prism Geometry
Zhang, D., X.-C. Yuan, S.C. Tjin, B.K. Ng, C.Y. Fu, R. Irawan.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 69-77, Mar 2004

This paper describes improvements made to an optical biosensor system that uses a long-range surface plasma resonance technique. The prism-based biosensor system has a broader operating range to improve sensitivity, a wider measurable reflective index range, and a narrower absorbing peak. This optical biosensor system could be implemented in a compact immunoassay device.

Surface-Water Quality Assessment Using Hyperspectral Imagery
Blanco, Alfonso; William E. Roper; Richard B. Gomez.
Geo-Spatial and Temporal Image and Data Exploitation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5097, p 178-188, 2003

The authors review water quality parameters--chlorophyll, dissolved organic carbon, and total suspended solids--obtained using the AVIRIS Sensor from the Sakonnet River in Narragansett Bay, RI. The hyperspectral imaging data provided by AVIRIS not only help in the assessment and definition of locations and pollutant concentrations of point and non-point sources, they also support the location and placement of the water and wastewater infrastructure needed to eliminate these point and non-point sources. This hyperspectral application greatly reduces the need for expensive, labor-intensive field sampling.

A Survey of Waste Pits at the Idaho National Engineering and Environmental Laboratory Using the New USGS Prototype ATV Towed VETEM Platform
Abraham, Jared D., David VonG. Smith, and David L. Wright, U.S. Geological Survey, Denver, CO.
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, LWS-3, 8 pp, 2001

The Very Early Time Electromagnetic (VETEM) system is a prototype EM system that can be configured in different ways for different applications. VETEM is designed to improve state-of-the-art shallow subsurface electromagnetic imaging in environments where the electrical conductivity is too high for ground-penetrating radar (GPR) to be effective. The VETEM system is unusual in that it records both the transmitted as well as the transient decay part of the signal, and operates within a much higher frequency spectrum than traditional time-domain electromagnetic (TDEM) systems. The USGS prototype VETEM system was successfully deployed over Pit 4 and Pit 10 in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. This field deployment was the first use of the new VETEM all-terrain vehicle (ATV) towed platform, which has an integrated real-time kinematic global positioning system system that can provide positioning at a decimeter level of accuracy. Coverage of the large surface area would have been impractical without the ATV-towed version of VETEM. The uniformly high quality data obtained over Pit 4 and Pit 10 have yielded high-resolution time-slice images of subsurface conductivity variations that illustrate the high-resolution time-dependent response of the VETEM system to the buried waste.

Technologies Reduce Exposure of Bangladeshis to Groundwater Arsenic
Freeman, Jennifer, Columbia University.
Columbia News, 8 Feb 2005

Well diggers in Araihazar, Bangladesh, will soon be able to take advantage of a cell phone-based data system, developed at the Earth Institute, to target safe groundwater aquifers for installing new wells that are not tainted with arsenic. Using a new needle sampler (also developed at the Earth Institute), they will also be able to test whether the water is safe during drilling and before a well is actually installed. From a 25-square-kilometer study area in the Araihazar upazila, researchers have spent five years studying better ways of providing safe drinking water in rural Bangladesh. The phone-in data system will use new statistical procedures developed by Columbia statistics professor Andrew Gelman and colleagues to estimate the likelihood of a particular location in the Araihazar having low-arsenic water at a given depth. The approach was first tested in Columbia's study area and, after successful results, will now be expanded to an area that is six times larger. Gelman's work was recently published in the journal Risk Analysis (24(6):1597-1612, Dec 2004). After the well diggers select a site, they will be able to sample the water without actually installing a well by using an inexpensive new device called the needle sampler that is made primarily from inexpensive industrial materials readily available in Bangladesh. Use of this tool will avoid the wasted effort and expense of digging a tube well that turns out to contain unsafe water. A paper describing the effectiveness of the needle-sampling technique was recently published in the journal Environmental Science and Technology (38(12):3442-3448(2004)). In the article, Alexander van Geen and his colleagues at the Lamont-Doherty Earth Observatory and the University of Dhaka, who developed the needle sampler, explain that it takes no more than an hour to use and could be deployed by the well-digging teams currently trained to install tube wells in Bangladesh. The research was funded by the National Institute of Environmental Health Sciences Superfund Basic Research Program and the Earth Institute.

Technology Demonstration of Sensor Applications to Direct Push Platforms and Monitoring and Operations
Jarski, Paul & Randy St. Germain, Dakota Technologies Inc., Fargo, ND.
NTIS: ADA424257, 82 pp, Mar 2004

Dakota Technologies, Inc. (DTI) demonstrated a real-time, direct-push, halogen-specific detector (the Haloprobe) with the U.S. Army Corps of Engineers, Kansas City District Site Characterization and Analyses Penetrometer System (SCAPS) crew. The Air Force Center for Environmental Excellence (AFCEE) coordinated the effort to mobilize equipment and personnel to a site on the former Rickenbacker Air Force Base in Columbus, OH, in December 2003. This site provided an excellent opportunity to train the SCAPS crew on the Haloprobe operations and to provide beneficial subsurface information to Shaw Environmental and the Air Force Real Property Agency for delineating trichloroethene (TCE) contamination near site Building 848. The work occurred in two phases, totaling 5 working days. 36 pushes were advanced, including 27 with the Haloprobe, 5 with a laser induced fluorescence (LIF) probe, 3 for collection of soil samples, and 1 to condition a replaceable membrane.
http://handle.dtic.mil/100.2/ADA424257

Temporal and Modal Characterization of DoD Source Air Toxic Emission Factors
Gullett, B.K. (U.S. EPA, NRMRL, Research Triangle Park, NC); A. Touati; L. Oudejans; S. Ryan.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 26, 2003

Jet Resonance Enhanced Multiphoton Ionization (jet-REMPI), combined with a Time-of-Flight Mass Spectrometer (TOFMS), is a sensitive, selective, real-time detection technology being applied to determine organic toxic air emission factors from DoD sources. A rotating filter system was designed and used with the jet-REMPI-TOFMS to avoid adsorption of gaseous organic air toxics onto the soot particles. A 60- kW Tactical Utility (Class 2) diesel generator set was used as the DoD source for these measurements. The jet-REMPI/TOFMS technique has been successfully applied to a diesel generator exhaust to measure, in real time, concentration levels of aromatic air toxics present on the Urban Air Toxic list (http://www.epa.gov/ttn/atw/sab/natareport.pdf). The results were verified with conventional EPA sampling measurement techniques, as well as with an on-line gas chromatograph (GC) technique. Individual BTEX compounds were detected in the concentration range of 30 to 200 ppb, while polycyclic aromatic hydrocarbons were found in the range of 5 to 100 ppb. These individual concentrations were acquired by averaging real-time measurements of each target analyte for 1 minute. The isomer selectivity of the jet-REMPI/ TOFMS instrument provided data for individual xylene isomers that are otherwise co-eluting in traditional GC/MS analysis. Good agreement was also seen between jet-REMPI/TOFMS and the GC measurement technique for volatile organic compounds, such as BTEX. Transient events, such as a cold start-up of the diesel generator, resulted in sharp (less than 15 seconds) peak emissions that were up to a factor of 50 higher for benzene than the predominately constant concentration levels observed during normal operation; warm re-starts resulted in lower peak concentrations. Note that these transient events cannot be captured using conventional measurements or even the on-line GC method, since this latter technique yields an average concentration over a 1 to 2 minute sampling period. Future work will extend to measurements of other sources used in DoD operations. This research is funded wholly or in part by SERDP project CP-1247.

Temporal and Spatial Variability of High Resolution In Situ Vertical Apparent Resistivity Measurements at a LNAPL Impacted Site
Werkema, D.D. Jr. (Western Michigan Univ., Kalamazoo); E.A. Atekwana; A. Endres; W.A. Sauck.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 13ESC4, 2002

Ten high resolution vertical resistivity probes (VRPs) have been installed within plume and off-plume locations at a LNAPL contaminated site adjacent to a former oil refinery in Carson City, MI. The VRPs are sealed PVC wells with stainless steel screws that serve as electrodes spaced every 2 inches (5.08 cm) with depth. Monitoring well measurements of the water table and VRP measurements of apparent resistivity were made monthly during a full calendar year. The investigators discuss the temporal resistivity variation and water table fluctuations and compare the apparent resistivity response from VRPs within the free-product plume (lowest), within the residual plume (higher), and at a clean, non-contaminated location (highest). The VRP results indicate that the natural hydrogeologic regime is not present in LNAPL-contaminated areas because the fluctuating water table is not observed in these VRPs, but it is evident in the non-contaminated VRP. The authors conclude that the results demonstrate the potential for the use of vertical resistivity probes in understanding vadose zone processes and hydrogeologic dynamics at a LNAPL-contaminated site.

Terahertz Imaging and Spectroscopy for Landmine Detection
Fitch, Michael J.; Dunja Schauki; Craig A. Kelly; Robert Osiander.
Terahertz and Gigahertz Electronics and Photonics III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5354, p 45-54, Apr 2004

Pulsed THz (100 GHz to 30 THz) Imaging Spectroscopy combines high resolution radar, depth ranging, and infrared spectroscopy in one mine-detection system. It allows minefield detection, single mine imaging, and near-zero false alarm due to the capabilities of explosives and plastic identification using spectroscopy with working distances to 1000 feet. Imaging capabilities have been demonstrated with 1 mm spatial resolution on a rubber O-ring embedded in sand. The estimated transmission depth in moist sand is 1 to 3 cm. The authors present initial results investigating the feasibility of THz spectroscopy in the frequency range from 1 to 10 THz to detect and identify explosives and related compounds. This effort involves chemical modeling to obtain spectroscopic information on explosives, related compounds, and environmental background. A time-domain THz system using femtosecond laser pulses is also being developed.

To Purge or Not to Purge? VOC Concentration Changes During Line Volume Purging
Zimmerman, John H. and Brian A. Schumacher, U.S. EPA, ORD/NERL/ESDLV, Las Vegas, NV.
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, P4.

Soil vapor surveys are commonly used as a screening technique to delineate volatile organic compound (VOC) contaminant plumes and provide information for soil sampling plans. Traditionally, three purge volumes of vapor are removed before a sample is collected. Researchers evaluated the VOC concentrations lost during purging for micro-volume and macro-volume active sampling. The micro-volume vapor sample had total line purge volume of 1.25 mL and the macro-volume vapor sample had a total line purge volume of 15 mL. Six line purge volumes were collected for each vapor sampling technique, with the fourth purge volume used for site screening data. Each sample was collected by gas-tight syringe and transferred to a thermal desorption tube for sorption, transport, and analysis. The vapor data were compared to co-located soil data to determine if any correlation existed between the VOC concentrations. For both active vapor sampling techniques, the VOC concentrations in the first three purge volumes exceeded the VOC concentrations in the last three purge volumes, which suggests that the general rule of removal of three purge volumes prior to taking a sample for analysis could lead to underestimating the level of VOC contamination present. At one of the sampling locations, the data show a general increase in concentration of VOCs as line volume purges were collected. The data did not show a correlation between the concentration of VOCs determined by either vapor sampling technique when compared to that of the co-located soil sample.

Toshiba to Develop Advanced Groundwater Monitoring System
Water and Wastes Digest, 22 Oct 2003

Toshiba Corporation is providing technical coordination to an international consortium of academic institutions and companies working to develop the Advanced Environmental Monitoring System (AEMS), a total solution for continuous, automated monitoring of groundwater pollutants. Toshiba will support development of the AEMS with its new biosensor, the company's patent-pending technology for detecting hazardous substances such as pesticides and heavy metal ions in the groundwater and subsoil below manufacturing facilities. The project brings together universities, private corporations and government-sponsored research laboratories in Canada, the U.S., Japan and Australia, and aims for commercialization of AEMS in 2007. AEMS is expected to detect and identify leaks of contaminants at source and in real time and thereby support early deployment of measures to clean up polluted groundwater and soil. The present system of laboratory analysis of samples is both costly and time-consuming. AEMS comprises an array of on-site biosensor systems installed near deep wells drilled around a monitored production facility. The wells feed groundwater samples to the sensor systems for continuous monitoring of groundwater contamination around the designated area. The biosensor is bio-mimetic and consists of two layers of artificial lipid membranes used to detect toxic chemicals in the groundwater. The membranes generate specific responses to different types of organic compounds in pollutants, allowing identification of hazardous substances. Toshiba has improved the sensitivity of the biosensor to the point where it is now capable of detecting hazardous substances, such as TCE and nonylphenol in concentrations as low as 1 ppb.

Total Copper Analyzer for Rapid In Situ Characterization of Effluent Discharges
Rivera-Duarte, I. (Space and Naval Warfare Systems Center, San Diego); M. Putnam; E. Arias.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 40, 2003

The Total Copper Analyzer (TCA) is an instrument designed to detect total copper concentration in effluents, in situ and in near-real time. Copper concentrations measured with the TCA are consistent to those measured by EPA's Method 3020A. The TCA is a flow-through system that includes the acidification and digestion of the effluent sample, and the detection of copper concentration with a specialized jalpaite copper ion-selective electrode. This information is provided to an integrated computer system with proprietary software, which calculates and reports the concentration of total copper in the effluent. The measurement is done in situ by the effluent discharge and it takes approximately 10 minutes for completion, thus allowing for the efficient management of effluents as it provides near real-time characterization. The Environmental Security Technology Certification Program (ESTCP) is funding a demonstration of the TCA under project CP-0311. This demonstration includes laboratory testing and long-term (i.e., one month) testing under realistic industrial conditions. The demonstration will provide data on the precision and accuracy of the measurements, the limit of detection, and the minimum maintenance necessary to use the TCA continuously for a whole month. Initial laboratory testing indicates that the TCA is able to perform for up to three consecutive months with minimum maintenance requirements. The estimated working range is from 10 to 50 ppb, with a precision of plus-or-minus 3 ppb at the 30 ppb level. This presentation discusses demonstration results in the laboratory and at Puget Sound Naval Shipyard and Pearl Harbor Naval Shipyard.

Trace Analysis of Perchlorate in Water
Vanderford, B. (Southern Nevada Water Authority, Las Vegas), P. Roefer, K. Zikmund, J. LaBounty, D. Rexing.
24th Annual Meeting of the Society of Environmental Toxicology and Chemistry, 9-13 November 2003, Austin, Texas. Abstract 242, 2003

Perchlorate levels in surface waters and groundwater are often quite low and may not be detectable by traditional analytical methodology. EPA Method 314, which has a reporting limit of 4 ug/L, is most commonly used. A novel analytical method has been developed that utilizes liquid chromatography with tandem mass spectrometry to accurately measure trace (ng/L) levels of the perchlorate anion. The method is robust, rapid, and requires less than one mL of sample volume. The new technique was applied to the analysis of several surface, ground, and bottled waters. In waters previously thought to have no perchlorate contamination, concentrations were discovered at 100 to more than 300 ng/L. Of 15 commercially available bottled waters tested, over 30% contained detectable levels of perchlorate at concentrations ranging from 120 to 170 ng/L.

Trace Analysis of Peroxide-Based Explosives
Karst, Uwe (Univ. of Twente, Ae, The Netherlands), P. Kolla, R. Schulte-Ladbeck.
The Pittsburgh Conference: PITTCON 2003, Presentation 2520-2.

There are currently no trace analytical methods available for peroxide-based explosives--e.g., triacetonetriperoxide (TATP) and hexamethylenetriperoxidediamine (HMTD)--which cannot be detected by standard HPLC or GC detectors. The authors propose a reversed-phase high-performance liquid chromatography method with post-column photochemical treatment and fluorescence detection for the detection of TATP and HMTD. The substances and interferences are separated on a C-18 column and the analytes are subsequently decomposed to hydrogen peroxide by means of UV irradiation. Afterwards, they are detected fluorimetrically based on the horseradish peroxidase (HRP)-catalyzed oxidative coupling of phenols by hydrogen peroxide. As peroxidase substrate, p-hydroxyphenylacetic acid (PHPAA) is used. Limit of detection is 5 umol/L for both analytes, and the linear range of the calibration function comprises more than two decades. The method allows field testing with readily available and portable instrumentation.

Trace Detection of Volatile Organic Compounds by Diode Laser Cavity Ring-Down Spectroscopy
Parkes, A.P., B.L. Fawcett, R.E. Austin, S. Nakamichi, D.E. Shallcross, and A.J. Orr-Ewing.
Analyst, Vol 128 No 7, p 960-965, 2003

This paper describes the use of continuous-wave cavity ring-down spectroscopy (cw CRDS) with near infrared diode lasers for quantitative detection of trace levels of unsaturated volatile organic compounds (VOCs) at wavelengths that avoid overlapping absorptions by atmospheric constituents, such as water and carbon dioxide. The current detection limit is 6 parts per billion by volume (ppbv) for acetylene, which is sufficient for direct atmospheric detection of this molecule in many urban environments. Detection limits for alkenes are inferior at 78 ppbv for ethyne and 900 ppbv for 1,3-butadiene. While CRDS detection offers advantages over established GC techniques for monitoring small VOCs such as ethene, it appears to be less well suited to the study of larger organic compounds. The authors discuss approaches for improving the instrument to reach the sensitivities required to monitor the various alkenes and other C-H-containing molecules in the troposphere.

Tracer Interaction Effects during Partitioning Tracer Tests for NAPL Detection
Imhoff, P.T. (Univ. of Delaware, Newark), K. Pirestani, Y. Jafarpour, and K.M. Spivey.
Environmental Science & Technology, Vol 37 No 7, p 1441-1447, 2003

Partitioning tracer tests have been used in laboratory studies and field investigations to quantify the amount of nonaqueous phase liquid (NAPL) within porous media. Tracer partitioning was examined in static batch systems and dynamic column experiments using 2,3-dimethyl-2-butanol and 1-hexanol as partitioning tracers and trichloroethene as the NAPL. Co-tracer effects resulted in nonlinear partitioning of 2,3-dimethyl-2-butanol in batch tests, and this nonlinearity increased with increasing tracer concentrations. Column experiments were conducted with these same tracers, and nonlinear tracer partitioning associated with co-tracer effects resulted in underestimation of NAPL mass in systems where tracer slugs larger than 0.68 pore volumes were used. The results from the investigation suggest caution when using co-tracers at high concentrations and provide insight into the influence of mass transfer limitations and tracer partitioning on NAPL detection.

Tracer/Time-Lapse Radar Imaging Test at the Boise Hydrogeophysical Research Site
Barrash, Warren (Boise State Univ., Boise, ID); Michael D. Knoll; David W. Hyndman; Tom Clemo; Edward C. Reboulet; Elisabeth M. Hausrath.
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas. Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 163-174, 2003

A tracer/time-lapse (radar imaging) test (TTLT) was conducted in a heterogeneous fluvial aquifer at the Boise Hydrogeophysical Research Site in August 2001 to demonstrate, evaluate, and improve the capability to dynamically image an electrically conductive plume during a tracer test, as well as to provide quantitative results for geophysical, hydrologic, and combined hydrologic and geophysical modeling of plume detection, plume evolution, and permeability heterogeneity. Custom in-well equipment was designed with and manufactured by collaborators at Michigan State University to allow (a) simultaneous logging with radar instruments for cross-hole imaging while collecting water samples and/or head-change measurements from isolated zones in the same wells and (b) collection of high-resolution water chemistry samples and head-change data in the middle region of two tomographic planes for quantitative calibration of attenuation differences detected by radar tomography. Two supposedly conservative tracers were used for the TTLT: (1) bromide, an electrically conductive inorganic salt, and (2) uranine, an organic fluorescent dye. These two tracers were injected into a 4-m-thick interval in well B3 spanning the contact between two hydrostratigraphic units with contrasting porosity and permeability. Chemical results from about 50 locations were available from samples collected about every four hours during the TTLT to provide near real-time feedback on breakthrough behavior. The behavior of the uranine tracer was not conservative and differed greatly from that of bromide. Follow-up investigation suggests that the cause(s) for the non-conservative uranine behavior may be biological and/or microbiological activity associated with cottonwood roots in the aquifer.
http://cgiss.boisestate.edu/~billc/BHRS/Sageep03/con01.pdf

Tracer Techniques for DNAPL Source Delineation and In-Situ Flushing Techniques for Enhanced Source Removal: Pilot Scale Demonstrations at the Dover National Test Site
Brooks, Michael C.; Michael D. Annable; Suresh C. Rao, Florida Univ., Gainesville.
NTIS: ADA410848, 293 pp, Sep 2001

A study was performed to evaluate the performance of innovative tracer techniques for dense nonaqueous phase liquid (DNAPL) characterization and in situ cosolvent and surfactant flushing for DNAPL removal in an isolated test cell (3.0m x 4.5m x 12.3m) located at the Dover National Test Site, Dover AFB, DE. As part of a larger project to assess the performance of several in situ flushing technologies for DNAPL source removal, it involved controlled releases of up to 100L of perchloroethene (PCE) into test cells for each remedial technology. Subsequent to PCE release, two partitioning tracer tests were conducted, one before and another after the remedial test. The University of Florida (UF) conducted the first remedial demonstration, cosolvent flushing, and the second remedial demonstration, surfactant flushing, was conducted jointly by UF and the University of Oklahoma. The focus of this report is the four partitioning tracer tests and the cosolvent flushing demonstration.
http://handle.dtic.mil/100.2/ADA410848

Tracing the Origin of Perchlorate
Erickson, Britt E.
Analytical Chemistry, p 388A-389A, 1 Nov 2004

This article discusses the analytical techniques that researchers are employing to trace the ubiquitous occurrence of perchlorate in the environment and to answer the question: How much of it is man-made and under what circumstances might it occur naturally? Perchlorate has been detected in locales unlikely to have been affected by the modern manufacture or use of materials that contain it. For example, nitrate salt deposits from the Atacama Desert in Chile are known to contain trace levels of naturally occurring perchlorate. Researchers are still trying to determine how the perchlorate got there.
http://www.geol.lsu.edu/DeptNews/FacNewsItems/2004BaoPerchlorate.pdf

Trail Road Landfill, Nepean, Ontario, Canada: Case Study Abstract
U.S. EPA, Technology Innovation Office. Innovations In Site Characterization: Geophysical Investigation at Hazardous Waste Sites. EPA 542-R-00-003, p 159-171, Aug 2000

Leachate has been detected in the groundwater below the Trail Road Landfill. The leachate consists of a complex mixture of organic and inorganic constituents, as well as elevated levels of calcium, magnesium, chloride, sulphate, potassium, ammonia, other nitrogen compounds, other dissolved organic carbons, phenols, and iron. A geophysical investigation was conducted at the landfill to demonstrate an innovative method for monitoring a landfill leachate plume. The information contained in this report was extracted from the interpretive report of the investigation. Six different geophysical methods were combined in borehole applications to collect the geophysical data for this investigation. The six methods were natural gamma, gamma-gamma, total magnetic and magnetic susceptibility, electrical conductivity, and temperature. Geophysical logs were developed in eight existing monitoring wells.
http://www.epa.gov/tio/download/char/geophys_innovate_b.pdf

Tree Bark "Pockets" as Environmental Pollution Archives
Satake, K. and D. Bellis, National Inst. for Environmental Studies, Tsukuba, Ibaraki, Japan.
Proceedings of the 7th International Conference on the Biogeochemistry of Trace Elements (7th ICOBTE), 15-19 June 2003, Uppsala, Sweden. Book of Abstracts. Vol 1-I, p 212-213, 2003

Tree bark is an often-overlooked resource for directly measuring levels of local pollution, because air pollutants accumulate directly onto the surface. During tree growth, bark can be incorporated into the trunk to form a 'bark pocket.' The presence of bark pockets within the trunk make it possible to assess historical trends in air pollutants in past years. The bark pockets are located between annual rings, thus forming an environmental archive that allows accurate retrospective biomonitoring.

Tunable Diode Laser Sensor for Multiple Species Monitoring in Harsh Atmospheres
Von Drasek, William A.; Shawn Wehe; Mark Allen.
Industrial and Highway Sensors Technology. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5272, p 30-40, 2004

Monitoring and control of industrial processes for improved efficiency, pollutant reduction, and product quality requires a sensor adaptable for harsh environments, such as high temperature with high levels of particulate matter. Traditional industrial monitoring relies on extractive sampling that requires frequent maintenance due to probe plugging or corrosion and routine calibration. The ideal sensor would perform in situ process monitoring, require little or no maintenance, and provide real-time process information The use of tunable diode lasers based on absorption monitoring overcomes many of the problems associated with conventional extractive sampling. However, the majority of industrial combustion processes will undergo temperature variations along with changes in the atmosphere oxidation or reducing state during normal operation. These variations call for a diode laser system capable of multiple species monitoring. The authors describe an industrial prototype system operating in the near-infrared for simultaneous monitoring of O2 (.76 um), CO (1.5 um), H2O (1.5 um), and gas temperature. The prototype system uses only two diode lasers and a beam launch and receiver optical design to discriminate the vastly different laser wavelengths while suppressing background radiation noise and beam steering from thermal gradients.

Two New Analytical Methods Tools for Water Protection
Keith, L.H. (Instant Reference Sources, Inc., Monroe, GA); H.J. Brass and S.C. Allgeier (U.S. EPA); D.J. Sullivan (USGS-WRD); J.M. Diamond and C. Barbour (Tetra Tech).
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 73.

One of the new tools being developed in the interest of homeland security is a database of methods to analyze for chemical, biological, and radiological (CBR) agents that could pose a threat to public water supplies. The success of the National Environmental Methods Index (NEMI, a free, searchable database at www.nemi.gov) has led to a companion effort--the NEMI/CBR database. NEMI-CBR presents data on methods that might be applied to identify CBR contaminants emanating from a terrorist attack on water supplies. NEMI-CBR contains types of information that are important for anti-terrorism responses: (1) rapidity of analysis, (2) analyte/organism specificity, and (3) class specificity. A variety of method types are available in the database. Confirmatory methods are those used for monitoring water for analytes and/or organisms of interest and typically have good performance characteristics (e.g., high precision, low bias, good sensitivity, and good analyte selectivity). Conversely, incident response methods must be rapid and preferably suited for use in the field. Field analytical methods typically exhibit lower precision, higher bias, less sensitivity and less analyte selectivity than confirmatory methods. NEMI-CBR also offers a companion expert system, the CBR Methods Advisor, which helps a user to find the best methods for various scenarios. The expert system can be used for an emergency response to an incident or to find methods to confirm a suspected analyte or organism identity. It helps the user to assess which methods may be most applicable to a particular situation and which methods may be inappropriate. The expert system incorporates the logic and advice of EPA's Response Protocol Toolbox. The CBR Methods Advisor can be used for planning and training, as well as in response to an event. The expert system can be placed on a CD-ROM and used with a laptop computer to provide access to advice and methods in the field or in the event of an emergency involving loss of electricity or phone lines. The methods database and expert system are currently restricted to methods and information concerning water analysis, but the frameworks of both products can be expanded to include non-water matrices.

Ultra-High Speed Solid-State FTIR Spectroscopy and Applications for Chemical Defense
Buican, Tudor N. (Semiotic Engineering Associates LLC, Albuquerque, NM); Arthur H. Carrieri (U.S. Army RDECOM Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD).
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 8 pp, 2004

A new class of FTIR spectrometers is capable of acquiring 6x104 - 1.4x105 interferograms (spectra) per second, over the spectral range of 1 um to 12 um, with a resolution of 10 cm-1 or better. The new FTIR technology is based on the use of birefringence interferometers and employs photoelastic modulators (PEMs) as birefringent elements for ultra-high modulation speed. With characteristic data rates of tens of kHz and wide spectral range, these spectrometers are eminently suitable for high-speed, spectrally detailed, chemical-biological (CB) hyperspectral imaging. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionA/AP-05.pdf

Ultra-Sensitive Electrochemical Detection via Electrochemiluminescence (ECL) Photonic Reporting in a Two-Electrode Microfluidic System
Zhan, W. (Texas A&M Univ., College Station, TX); J.C. Alvarez; R.M. Crooks.
The Pittsburgh Conference: PITTCON 2003, Presentation 1710-10.

A new two-electrode redox sensing system operates within microfluidic channels. The sensing mechanism relies on electrochemical detection at one electrode and electrogenerated chemiluminescent (ECL) reporting at the other electrode. Each indium tin oxide electrode is located in separated channels connected downstream to maintain electrochemical contact. Under these conditions, electrochemically generated products at the sensing electrode cannot quench the steady ECL at the reporting electrode. Both electrochemical reactions are coupled electrically and charge balance allows direct correlation of the emitted light to the concentration of the sensed species when the corresponding potential bias is applied between the two electrodes. The device can be configured to indirectly detect anodically responsive redox species such as ferrocyanide and dopamine.

Ultra-Trace Optical Detection of Cu2+ in Aqueous Media Using Photonic Crystal Polymerized Colloidal Array Chemical Sensing Materials
Sharma, A.C. (Univ. of Pittsburgh, Pittsburgh, PA), S.A. Asher, A.V. Goponenko, M.M. Ward.
The Pittsburgh Conference: PITTCON 2003, Presentation 2400-5.

A novel photonic crystal material has been developed to detect Cu2+ levels in aqueous media. The sensor material is about 90% water containing polyacrylamide hydrogel, lightly crosslinked with bisacrylamide, with an embedded photonic crystal, and 8-hydroxyquinoline groups appended to the hydrogel backbone. This sensor motif can sequester Cu2+ ions at ultra-trace levels (sub-ppt or lower) from aqueous solutions to form 2:1 8-hydroxyquinolate:Cu2+ complex sites. These sites act as additional crosslinks over and above the existing bisacrylamide crosslinks, resulting in a decrease in the volume of the hydrogel. The lattice constant of the embedded crystalline colloidal array (CCA) photonic crystal decreases upon Cu2+ binding, to produce blue shifts in the diffracted wavelength from the CCA, and thus a blue shift in the visually perceived color of the sensor. Further shifts result in the decrease of crosslink density and an increase in the volume of the hydrogel, causing an increase in the lattice constant of the embedded CCA photonic crystal, and thus a red shift in the diffracted wavelength from the CCA. The visually perceived color of the sensor red shifts in aqueous solutions with a high Cu2+ content. This inexpensive and elegant development thus offers a means to continuously optically monitor and detect ultra-trace concentrations of heavy metal ions, especially copper, in aqueous solutions.

An Ultrasensitive Explosive Detection System Based on Amplifying Fluorescent Polymer
Cumming, Colin J., Nomadics, Inc., Stillwater, OK.
The Pittsburgh Conference: PITTCON 2003, Presentation 1900-5.

The detection of vapor from explosives such as TNT is challenging because the vapor pressure is extremely low. Though most explosive detection technologies rely on the presence of particulate explosive material, the presence of particulate explosive material cannot be assumed. A molecular wire-based technology employs intrinsic amplification that allows the detection of low vapor pressure explosives, such as TNT. The detection system incorporates a pentiptycene-derived phenyleneethynelene polymer employed as a thin film. The films exhibit high fluorescence quantum yields and sufficient free volume to allow diffusion of small organic molecules into the film. The technology can be used to detect buried landmines, unexploded ordnance, and environmental contamination in the field, as well as TNT vapor detection in containers and vehicles. A variant of the technology has been used for the real-time detection of explosives in water.

Ultraviolet Induced Florescence Cone Penetration Testing for Characterization at Hydrocarbon Contaminated Sites for Natural Attenuation Studies
Murphy, Sean and James Armstrong (Komex International Ltd.); Kevin Biggar (Univ. of Alberta); David Woeller (ConeTec).
Remediation Technologies Symposium 2003, 15-17 October 2003, Banff, Alberta.
Environmental Services Association of Alberta. Book of Abstracts, No 22, 2003

Delineating the lateral and vertical extent of subsurface hydrocarbon contamination is a routine component of environmental site characterization required for cost-effective remediation. This paper describes application of the ultraviolet-induced fluorescence (UVIF) cone-penetration testing (CPT) tool, which consists of a full piezocone penetrometer that can record tip resistance, sleeve friction, pore pressure and UV-induced fluorescence. The CPT components provide a means of determining soil type, changes in soil stratigraphy, and the location of the groundwater table, along with various soil design parameters. The UVIF system operates on the principal that petroleum hydrocarbons contain aromatic hydrocarbons (one or more benzene rings) that fluoresce when irradiated by UV light. By measuring the UVIF intensity in the subsurface, an investigator can determine both the lateral and vertical extent of hydrocarbon contamination. The magnitude of the fluorescence relates to the relative concentration of the aromatic hydrocarbons present in the soil. Presented data illustrate appropriate use of UVIF-CPT for delineating subsurface contamination extent at upstream oil and gas facilities.

Undetected Groundwater Contamination at Underground Storage Tank Sites by the Gasoline Lead Scavengers Ethylene Dibromide and 1,2-Dichloroethane
Falta, R.W., Clemson Univ., Clemson, SC.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract H44A-02, 2004

Ethylene dibromide (EDB, a synthetic organic chemical) and 1,2-dichlorethane (1,2-DCA, chlorinated solvent) were once used as gasoline additives. EDB and 1,2-DCA are classified as probable human carcinogens by U.S. EPA. The current EPA maximum contaminant level (MCL) for EDB in drinking water is 0.05 ug/L, and the MCL for 1,2-DCA is 5 ug/L. Both contaminants are mobile and persistent in groundwater. Past site investigations and remediation efforts at underground storage tank sites contaminated by leaded gasoline have rarely addressed the potential for EDB or 1,2-DCA contamination, though the concentrations of EDB and 1,2-DCA in leaded gasoline were high enough to produce groundwater concentrations of thousands of ug/L. There is a substantial likelihood that undetected EDB and 1,2-DCA plumes above the MCL may exist at many sites where leaded gasoline leaked or spilled. An initial review of field data from underground storage tank sites in two states suggests that this problem is widespread.

US EPA SITE Program Performance Verification Testing of Monitoring and Measurement Technologies for Dioxin and Dioxin-like Compounds in Soil and Sediment
Amy Dindal (Battelle Memorial Inst.) and Stephen Billets (US Environmental Protection Agency)
Battelle Memorial Inst., 505 King Avenue, Columbus, OH
NEMC 2004: The 20th Annual National Environmental Monitoring Conference, 19-23 July 2004, Washington, DC. Book of Abstracts, No. 38.

U.S. EPA's Superfund Innovative Technology Evaluation (SITE) Program is designed to meet three primary objectives: (1) identify and remove obstacles to the development and commercial use of innovative technologies, (2) demonstrate promising innovative technologies and gather reliable performance and cost information to support site characterization and cleanup activities, and (3) encourage the use of innovative technologies at Superfund sites, as well as other waste sites or commercial facilities. SITE demonstrations are conducted to obtain representative, high-quality performance and cost data on innovative technologies so that potential users can assess a given technology's suitability for a specific application. A field demonstration of six technologies developed to measure dioxin and dioxin-like compounds in soil and sediment was conducted in Saginaw, MI, in April 2004 to evaluate and compare the performance and cost of each technology to that of conventional, laboratory-based EPA analytical methods for dioxin that use high resolution mass spectrometry (Methods 1613B and 1668A). Over 200 samples with a variety of distinguishing matrix characteristics, such as high levels of PCBs and PAHs, were analyzed by each participant. The samples comprised environmentally-contaminated matrices collected from ten sites in the eastern United States and standard reference materials obtained from commercial providers. Evaluation reports of technology performance are being prepared. This presentation describes the participating technologies, experimental design, and data evaluation process.

The Use of Airborne EM Conductivity to Locate Contaminant Flow Paths at the Sulphur Bank Mercury Mine Superfund Site
Hammack, R.W. (U.S. DOE, National Energy Technology Laboratory, Pittsburgh, PA), G.A. Veloski, J.I. Sams III, and J.S. Shogren.
SAGEEP 2002: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 10-14 February 2002, Las Vegas, Nevada.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, 12MMM2, 13 pp, 2002

The abandoned Sulphur Bank Mercury Mine on the eastern shore of Clearlake is the suspected source of mercury levels that have led to the posting of a fish advisory for the lake. Herman Impoundment, the now flooded open pit of the Sulphur Bank Mercury Mine, is separated from Clearlake by a dam composed of waste rock removed from the open pit. Results from an airborne EM conductivity survey flown over the mine site and adjacent areas suggest the probable flow paths taken by the highly conductive Herman Impoundment water through the waste rock dam. The airborne data were used to target areas for ground-based EM conductivity surveys. The higher-resolution results of the ground-based survey corroborated the findings of the airborne survey, allowing groundwater-flow intervention efforts to be concentrated within small areas of the waste rock dam.

The Use of Anthropogenic Tracers to Determine Groundwater Age and Resolve Contaminate Sources
Reimer, Janet J. and Henry Bokuniewicz, Stony Brook Univ., Stony Brook, NY.
Eleventh Conference on Geology of Long Island and Metropolitan New York, 17 April 2004, Stony Brook University.

The determination of groundwater age can be used to ascertain the rate of degradation of contaminants, to verify mathematical models of groundwater flow that predict travel-time of source water to wells, and to determine the probable sources of contaminants whose initial applications occurred during a specific time period. The main objective of the research described in this paper is to determine the age of groundwater at two particular well fields in which perchlorate and nitrate have been detected at levels of concern. Three dating methods using carbon-14, the ratio of Freon-11(CFC-11) to Freon-12 (CFC-12) (chlorofluorocarbons), and the ratio of tritium (3H) to helium (He), will be applied to determine the age of the groundwater collected from wells which deliver water from Long Island's sole-source aquifer. The age of a parcel of water implies the length of time since the water was last in contact with the atmosphere. The age of the groundwater, SWAP data, and the known hydraulic conductivities of the sole-source aquifer will then be used to determine if the sources of contamination can be traced to recent events, or if unknown sources of contamination exist that would warrant further investigation. Thus far, it appears there is another unknown source of perchlorate contamination at this public supply well field other than the application of Chilean Saltpeter in the late 1950s.
http://pbisotopes.ess.sunysb.edu/lig/Conferences/abstracts-04/reimer.htm

The Use of Cone-Based Electrical Resistivity Tomography to Image Conductive Contaminants
Pidlisecky, A. and K.R. Knight, Stanford Univ., Stanford, CA.
2004 Joint Assembly of the Canadian Geophysical Union, American Geophysical Union, Society of Exploration Geophysicists, and Environmental and Engineering Geophysical Society, 17-21 May 2004, Montreal, Canada. Eos Trans. AGU, Vol 85 No 17, Jt. Assem. Suppl., Abstract NS23A-06, 2004

A new technique, cone-based electrical resistivity tomography (C-bert), is being tested for determination of the 3D spatial distribution of subsurface contaminants. C-bert involves placing several permanent current electrodes in the subsurface and using electrodes mounted on a cone penetrometer to measure the resultant potential field while advancing the cone into the subsurface. This approach obtains both potential field measurements and the standard suite of cone-penetration measurements, including high-resolution resistivity logs. These data can be used to constrain the inversion of the potential field data. The authors describe a C-bert experiment performed to image salt water intrusion in a fresh water aquifer in Vancouver, BC. The results of this first field test indicate that C-bert is a promising new way to image the subsurface.

Use of GIS and Geostatistics to Delineate DNAPL in Groundwater
Rosen, J. (GeoSyntec Consultants, Guelph, ON, Canada); K.B. Spark; S. O'Hara; P. Wood.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 164, 2003

An understanding of the volume and extent of dense non-aqueous phase liquid (DNAPL) in groundwater is crucial to its successful cleanup, but direct mapping of DNAPL is often difficult and costly. A simple 3-step system using 2-D geographical information systems (GIS) and 3-D geostatistics is presented to classify (step one), visualize (step two), and quantify (step three) evidence of DNAPL and estimate its volume and extent. This method may provide enough information on the volume and extent of DNAPL to focus remedial efforts using only historical data, and preclude the need for additional costly field activities. In step one, direct visual observations of free-phase product or staining and indirect evidence (i.e., soil organic vapor analysis, soil contaminant concentrations compared to saturation limit, or groundwater contaminant concentrations compared to solubility) of DNAPL associated with 3-D coordinates are assigned values of 0 (DNAPL absent), 1 (DNAPL presence possible), 2 (DNAPL presence probable), or 3 (DNAPL present), according to a parameter-specific classification scheme. In step two, these classified data are mapped in cross-section or 3-space using 2- or 3-D GIS. By assigning different colors to the various classifications and different symbol shapes to the various types of evidence, areas with probable DNAPL presence are easy to identify. In step three, these classified data are kriged in three dimensions. By using an indicator kriging algorithm on the values 0 to 3, regions of probable DNAPL presence are delineated and locations with direct DNAPL evidence are given preferential weighting. The kriged shape can then be visualized at any location (i.e., cross-sections can 'slice' through the geostatistically probable regions of DNAPL presence), and a volume can be estimated at various confidence intervals.

The Use of HEM to Delimit the Areal Extent of Contaminated Aquifers at Surface And Underground Coal Mines
Hammack, R.W., G.A. Veloski, and T.E. Ackman (U.S. DOE, National Energy Technology Laboratory, Pittsburgh, PA); E.I. Love and W. Harbert (Univ. of Pittsburgh, Pittsburgh, PA).
SAGEEP 2003: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 6-10 April 2003, San Antonio, Texas.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 887-897, 2003

Helicopter-mounted electromagnetic (HEM) surveys have been used to delimit conductive mine pools and groundwater features at abandoned surface and underground coal mines in the eastern United States. The surveyors delineated the source areas and flow paths for acidic, metal-containing groundwater to aid future aid remediation efforts. This paper reports on a HEM survey of Kettle Creek Watershed, Clinton County, PA, taken with a 6-frequency electromagnetic data acquisition system. The survey accurately located conductive pools within underground mines, acid-generating mine spoil at surface mines, and areas of groundwater recharge and discharge.

The Use of Laser-Induced Breakdown Spectroscopy to Discriminate Between Landmines and Other Objects
Harmon, Russell. S. (U.S. Army Research Laboratory, Research Triangle Park, NC); Frank C. De Lucia; Andrzej W. Miziolek; Aaron LaPointe; Raymond J. Winkel, Jr.; Roy A. Walters.
24th Army Science Conference Proceedings, 29 November - 2 December 2004, 2 pp, 2004

Laser Induced Breakdown Spectroscopy (LIBS) is an emerging, minimally-destructive sensor technology for in situ, real-time chemical species identification and analysis. The Army Research Laboratory has been engaged in LIBS analysis for over a decade and recently has been investigating the potential to apply broadband LIBS analysis to specific military problems, such as the need for a handheld, confirmatory sensor for landmine detection. [Note: pdf file available only for a limited time.]
http://www.asc2004.com/Manuscripts/sessionA/AS-15.pdf

Use of Neural Networks for Assessment of Adverse Impact Duration of Solid Waste Disposal Facilities on the Aquatic Environment
Kmiecik, E.; I. Twardowska; J. Szczepanska.
Environmental Monitoring and Remediation III. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 111-118, 2004

Models incorporating supervised neural networks were developed to simulate time-dependent changes of acid mine drainage (AMD) generation expressed as sulfate formation due to oxidation of ferrous sulfides occurring in mining waste. The model allows for practical evaluation of the time span in which the concentration of a contaminant will reach the permissible level or the process of contaminant release will terminate, with a relative error of no more than 1%. The simulation results of temporal and spatial contaminant concentration changes will be used for the Upper Silesia Coal Basin in Poland as a basis to assess the extent of environmental deterioration dependent on the duration of waste disposal to the site. These analyses enable reliable models describing time-dependent changes of water quality in the vicinity of long-term contamination sources. The models also allow evaluation of the duration of the adverse impact of a facility on the aquatic environment and should reduce the expenses of monitoring by the reduction of the amount of sampling and analysis required.

Use of Respirometry to Determine Metal Toxicity Through Measurement of Hydrogen Consumption by Sulfate Reducing Bacteria in the Presence of Heavy Metals.
Tabak, H., E. Holder, M. Kupferle, and J. Haines, U.S. EPA.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Abstract 306, 2004

A unique method was developed for the biotreatment of acid mine water present in the Berkeley Pit near Butte, MT, as well as for resource recovery of metals (arsenic, cadmium, aluminum, manganese, iron, lead, zinc, and copper) from acid mine drainage (AMD). The biotreatment process is based on complete separation of the biological sulfate reduction step due to the activity of hydrogen consuming sulfate reducing bacteria (SRB) and the metal precipitation step. Hydrogen sulfide produced in the SRB membrane bioreactor systems is used in the metal sequential separation and precipitation step to form insoluble metal sulfides and hydroxides. EPA studies have shown that the heavy metals as ions or metal sulfides in the acidic wastes are toxic and inhibitory to SRB, hence the need for methods to determine metal concentrations that are toxic and/or inhibitory to SRB. A respirometric procedure has been developed to determine the toxic and inhibitory effects of the heavy metals on the hydrogen-consuming SRB by quantitatively measuring SRB hydrogen utilization in the presence of AMD heavy metals. Respirometers (NCON Systems, Inc.) were adapted to measure H2 uptake by SRB in presence of various concentrations of the metals. This presentation details the research and development of the procedure and its use in SRB studies.

Use of Tracer Tests to Evaluate the Impact of Enhanced-Solubilization Flushing on In-Situ Biodegradation
Alter, S.R. and M.L. Brusseau (Univ. of Arizona, Tucson); Piatt, J.J.; Ray-Maitra, A.; Wang, J.-M.; Cain, R.B.
Journal of Contaminant Hydrology, Vol 64 Nos 3-4, p 191-202, July 2003

Tracer tests were conducted to evaluate the effect of a complexing sugar flush (CSF) on in situ biodegradation potential at a site contaminated by jet fuel, solvents, and other organic compounds.

Technical-grade hydroxypropyl-B-cyclodextrin was used during the CSF study, which was conducted in a hydraulically isolated cell emplaced in a surficial aquifer. In situ biodegradation potential was assessed with the use of tracer tests conducted before and immediately after the CSF study. Ethanol, hexanol, and benzoate were used as the biodegradable tracers, and bromide as a nonreactive tracer. While the biodegradation of benzoate was similar for both tracer tests, the biodegradation of ethanol (23% increase) and hexanol (41% increase) was greater for the post-CSF tracer test. Analysis of core samples collected from within the test cell indicates that the population density of aerobic jet-fuel degraders increased in the vicinity of the injection wells during the CSF. These results indicate that the cyclodextrin flush had no noticeably negative effect on the indigenous microbial community.

User Friendly Kit for Monitoring Arsenic Levels in Drinking Water
Nambiar, OGB (National Chemical Laboratory, Pune, Maharashtra, India), Aditi V. Kulkarni.
The Pittsburgh Conference: PITTCON 2003, Presentation 1970-9.

A user-friendly arsenic monitoring kit has been developed for the trace analysis and spot detection of the toxic element. This highly sensitive and portable kit can measure quantitatively the arsenic levels from 5 ppb to 100 ppb or higher. The calibrated detector tube provides the arsenic concentration directly from the pink colored band developed in the tube. The kit was used to test for arsenic in large numbers of tube wells in West Bengal compared with analysis by atomic absorption spectrometer. This presentation describes the results.

Using a Whole-Cell Biosensor to Correlate Metal Speciation with Bioavailability
Dahl, Amy L., Polina Liberman, and Jean-Francois Gaillard, Northwestern Univ., Evanston, IL.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 84, 2003

In this Investigators correlated the response of a biosensor to the determination of the electrochemically labile (bioavailable) fraction (species) of mercury. An E. coli biosensor with merR-luxcdabe transposon was exposed to mercury concentrations in the 0-4mM range in the presence of a minimally complexing medium. Cathodic square wave voltammetry using an Ir microarray plated with Au was used to measure Hg speciation. The luminescense response of the biosensor was linear within the 0 to 280nM range after an exposure time of 4 hours. A drop-off in luminescence occurred at higher concentrations. The experiment was repeated in the presence of EDTA with virtually identical response. In contrast, the voltammetric signal illustrated that the electrochemically labile metal fraction was reduced due to metal complexation with EDTA. Toxicity was not reduced when bacteria were grown in the presence of EDTA, proving that the Hg-EDTA complex is labile. Future experiments will look at Cd and Zn toxicity and will attempt to ameliorate the toxic effect through addition of other ligands.

Using Amplitude Variation with Offset and Normalized Residual Polarization Analysis of Ground Penetrating Radar Data to Differentiate an NAPL Release from Stratigraphic Changes
Jordan, T.E. and G.S. Baker (Univ. at Buffalo, Buffalo, NY); K. Henn (Tetra Tech NUS, Pittsburgh, PA); and J.-P. Messier (U.S. Coast Guard Support Center, Elizabeth City, NC).
Journal of Applied Geophysics, Vol 56 No 1, 41-58, 2004

Amplitude and phase variation with offset analysis of ground penetrating radar data (APVO/GPR) can improve the differentiation of nonaqueous phase liquid (NAPL) from stratigraphic changes--such as the presence of a silt or clay lens or perched water table--which can render it difficult to delineate NAPL in a terrain with unknown stratigraphy using common offset (CO) GPR data collection methods exclusively. A case history demonstrates that collecting common-midpoint GPR data using EH and EV polarized signals at anomalous CO amplitude responses and analyzing the data using APVO and normalized residual polarization (NRP) methods can improve the detection and differentiation of NAPL from stratigraphic changes in the subsurface. These results were corroborated using a capacitively coupled resisitivity instrument and subsequent intrusive sampling.

Using Chromium Stable Isotope Ratios to Quantify Cr(VI) Reduction: Lack of Sorption Effects
Ellis, Andre S. and Thomas M. Johnson (Univ. of Illinois at Urbana-Champaign); Thomas D. Bullen (U.S. Geological Survey, Menlo Park, CA).
Environmental Science & Technology, Vol 38 No 13, p 3604-3607, 2004

Chromium stable isotope values can be used to monitor reduction of Cr(VI) in natural waters. A study shows that Cr stable isotope fractionation caused by sorption is negligible. Batch experiments at pH 4.0 and pH 6.0 were conducted in series to sequentially magnify small isotope fractionations. A simple transport model suggests that adsorption may cause amplification of a small isotope fractionation along extreme fringes of a plume, leading to shifts in 53Cr/52Cr values, which suggests that isotope values at extreme fringes of Cr plumes be critically evaluated for sorption effects. In the absence of isotope fractionation caused by equilibrium speciation and sorption, most of the variation in 53Cr values can be attributed to reduction, and reliable estimates of Cr reduction can be made.

Using Electromagnetic Induction to Trace Soil Nitrogen
Agricultural Research Service News Release, 16 Sep 2004

Nitrogen, a chemical nutrient needed by many growing crops, can accidentally end up in surface or subsurface water. An Agricultural Research Service scientist is using electromagnetic induction (EI) to measure changes in the soil's electrical conductivity, a quality that can provide important clues to the amount of nutrients present in the soil. Roger A. Eigenberg is an agricultural engineer at the ARS Roman L. Hruska U.S. Meat Animal Research Center in Clay Center, NE. He has used EI to study several fields and create a map with light-shaded areas representing high electrical conductivity--or areas of high nitrate concentration--and dark areas that indicate low conductivity, or low nitrate concentration. Eigenberg has compared fields with and without a winter cover crop and fields with added manure or compost. He discovered that EI could be used to monitor the effects of winter cover crops, because EI changes corresponded to soil nutrient changes as the cover crop took up nutrients in the fall and released them back to the soil in the spring. Another Clay Center research location was a former manure compost site. In the past, scientists had to take numerous soil samples to determine where manure rows had been located. Using commercially available EI equipment, Eigenberg was able to locate them in a fraction of the time. He tracked nutrient movement over a four-year period and found that using equipment such as the EI meter can determine nutrient buildup and movement to help prevent nitrate leaching into groundwater. More details about this research were published in the September 2004 issue of Agricultural Research magazine.

Using Helicopter Electromagnetic Surveys to Identify Environmental Problems at Coal Mines
Hammack, R.W.; E.I. Love; G.A. Veloski; T.E. Ackman; and W. Harbert.
Mine Water and the Environment, Vol 22 No 2, p 80-84, 2003

DOE's National Energy Technology Laboratory has used helicopter-mounted electromagnetic (HEM) surveys to delimit conductive mine pools and groundwater plumes at seven areas in the eastern United States that contain abandoned surface and underground coal mines. The surveyors used HEM to delineate the source areas and flow paths of acidic, metal-containing groundwater to aid future remediation efforts. This paper presents information from the HEM survey of Kettle Creek Watershed, Clinton County, PA. Fugro Airborne Surveys performed this survey using their 6-frequency "Resolve" bird. The HEM survey accurately located contaminated pools within underground mines, acid-generating mine spoil at surface mines, and areas of groundwater recharge and discharge.
http://www.netl.doe.gov/products/r&d/techpapers/2003-149.pdf

Using Helicopter FDEM to Monitor the Fate of Conductive Water Co-Produced with Methane in the Powder River Basin of Wyoming
Hammack, Richard, James Sams, and Garret Veloski (National Energy Technology Laboratory, Pittsburgh, PA); Brian Lipinski, Mark Zellman, and Bill Harbert (Univ. of Pittsburgh, Pittsburgh, PA).
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. p 322-329, 2004

Produced water from the development of coalbed methane resources in the Powder River Basin of Wyoming and Montana is disposed of by land application, infiltration basins, or injection wells. Because the chemistry of produced water differs from that of surface waters, there is concern as to the ultimate fate of some 248,000 acre-ft of produced water. Airborne frequency domain electromagnetic (FDEM) surveys have been used to trace the movement of produced water away from infiltration basins and leaking containment basins. This paper describes surveys taken at three locations. The first FDEM survey identified leaks at two containment basins before down-slope seeps were observed at ground level. The second survey identified a dilution zone on the Powder River floodplain where produced water from an infiltration basin was diluting more conductive groundwater in a shallow aquifer. In the third survey, the long-term effect of deep groundwater being applied to the surface and infiltrating into near-surface aquifers was observed at a flowing well, where groundwater from a coalbed aquifer has been flowing onto the surface for almost 50 years. The hydrology of the flowing well site may be indicative of the future hydrology at infiltration impoundment sites.

Using Resistivity to Map Acidic Waters at the May Day Mine Dump, Silverton, Colorado
Smith, Bruce D. and David L. Campbell (U.S. Geological Survey, Denver, CO); Winfield G. Wright (U.S. Geological Survey, Durango, CO).
SAGEEP 2001: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 4-7 March 2001, Denver, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, AML-2, 12 pp, 2001

The May Day Mine dump is located on a mountainside above Cement Creek, north of Silverton, CO. As Cement Creek flows past the May Day Mine, dissolved metal loads increase in the stream, though no tributaries enter the stream reach. Induced polarization studies show local pockets in the upper bench of the May Day Mine dump with acidic pore waters. The pore water appears to get less acidic as it migrates through the dump; however, water samples from a well located at the toe of the dump are highly acidic and contain large concentrations of dissolved metals. An airborne EM survey flown over the area shows a linear conducting feature that enters Cement Creek just south of the May Day Mine dump. The airborne survey was followed with ground geoelectrical surveys, which confirm the existence of the conducting feature and suggest that it dips steeply and extends to a depth of at least a few tens of meters. This conductor may reflect a fissure zone that carries water, a potential source of some of the water that enters Cement Creek near the May Day Mine, which suggests that the metals dissolved in that water might originate through natural processes.

Using Respirometry to Measure Hydrogen Utilization in Sulfate Reducing Bacteria in the Presence of Copper And Zinc

Holder, Edith L. and Margaret J. Kupferle (Univ. of Cincinnati, Cincinnati, OH); Henry H. Tabak and John R. Haines (U.S. EPA, Cincinnati, OH).

The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, University of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

A respirometric method has been developed to measure hydrogen utilization by sulfate-reducing bacteria (SRB). The method has been applied to test inhibitory metals effects on the SRB culture used in a novel acid mine drainage treatment technology. As a control parameter for that technology, it is necessary to know the metal concentration that has either an inhibitory or toxic effect on the bacteria both alone and in the acid mine waste matrix. Respirometers (NCON Systems Inc.) were adapted to measure H2 uptake in an enrichment culture of SRB that uses carbon dioxide (CO2) and acetate as the carbon sources and hydrogen (H2) as the electron donor for the conversion of sulfate to hydrogen sulfide (H2S). Hydrogen uptake by SRB causes the production of hydrogen sulfide. Produced biogenic H2S is removed with a zinc acetate trap, analogous to an alkaline trap for CO2 in aerobic respirometry. In H2 respirometry, CO2 is retained in the headspace. Respirometry can differentiate between either a toxic effect (suppression of hydrogen uptake) or an inhibitory effect (indicated by an increased lag time relative to a control.) Metal complexation can be a problem in testing inhibition effects because most bacteriological media contain components that can form metal complexes, thereby reducing the metal bioavailability. The respirometric and chemical data and biomass measurements show that soluble zinc has an inhibitory effect between 10 and 25 ppm and soluble copper inhibits between 1 and 17 ppm. Zinc is toxic at 50 ppm and copper at 27 ppm.

Utilization of Fractal Dimension Analysis to an On-line Biological Early Warning System Using Japanese Medaka (Oryzias latipes) for Monitoring of Water Quality

Kang, I.J. (SEIKO Electric Co., Ltd., Fukuoka, Japan); Y, Oshima; H. Kunimaru; M. Yamasuga; F. Okamoto; T. Honjo.

Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Poster PH236, 2004

Aquatic organisms can be used in an on-line biological early warning system to detect unexpected toxicant substances and complex harmful chemicals in aquatic environments. The authors detail the development of an on-line fish-sensor system incorporating Japanese medaka (medaka-sensor, Seiko Electric Co., Ltd, Japan) to rapidly detect harmful toxicants. It takes less than 15 minutes to detect abnormal water quality via the behavior of medaka exposed to 1 ppm of potassium cyanide. In tests conducted in an aquarium with a continuous flow system, two cameras tracked the behavior of medaka exposed to potassium cyanide (0.1, 1 and 10 mg/L) and phenol (12.5, 25 and 50 mg/L) for 1 hour. Images from the cameras were used to calculate the behavior of the fish in three dimensions. These data were analyzed on a computer in real time to detect abnormal or deviant behaviors (e.g., swimming speed, swimming position). The researchers examined the use of fractal dimension analysis for the system to enhance detection speed in real-time monitoring.

Utilizing Routine Water Quality Instruments for Monitoring Distribution System Security
Byer, David E., Ph.D. thesis, Colorado State Univ., Fort Collins.
Report No: AFIT-CI-04-531, NTIS: ADA425560, 193 pp, 2004

Significant purposeful contamination of a water system currently can't be properly characterized until post-symptomatic epidemiological events manifest in the affected community. One approach to mitigating a potential disaster includes online monitoring of drinking water distribution systems. Four credible-threat chemical drinking water contaminants (aldicarb, sodium arsenate, sodium cyanide, and sodium fluoroacetate) were analyzed at different concentrations to determine their detectability in a drinking water distribution system using commonly measured parameters. Online monitoring that measured conductivity, pH, chlorine residual, turbidity, and total organic carbon was completed to determine baseline water quality indicators. The contaminants were mixed with tap water and analyzed in beakers to determine their contaminant/instrument response at various concentrations with bench top instruments. These data were then used to determine dosing into a bench scale distribution system. The contaminants were added at the specified concentrations to determine detectability using the online monitoring equipment. Results indicate that the four chemical contaminants can be detected at relatively low concentrations with routine monitoring.
http://handle.dtic.mil/100.2/ADA425560

Vapor Sampling Device for Interface with Microtox(TM) Assay for Screening Toxic Industrial Chemicals
Rogers, K. and G. Robertson, U.S. EPA, National Exposure Research Laboratory, Las Vegas, NV.
Fourth SETAC World Congress, 25th Annual Meeting in North America, 14-18 November 2004, Portland, Oregon. Society of Environmental Toxicology and Chemistry, Pensacola, FL. Platform Presentation IP048, 2004

A time-integrated sampling system interfaced with a toxicity-based assay has been developed for monitoring volatile toxic industrial chemicals. Semipermeable membrane devices (SPMDs) using dimethyl sulfoxide (DMSO) as the fill solvent accumulated each of 17 chemicals from the vapor phase. The effect of each of the chemicals on the Microtox(TM) bacterial luminescence assay was determined from both a direct assay and a vapor accumulation assay using SPMDs. Microtox EC50 values (concentration yielding 50 percent inhibition) were determined for each of the chemicals analyzed. The rank order of the Microtox EC50 values for each compound measured directly from liquid was similar but not identical to the Apparent (App) EC50 values determined from the vapor accumulation assay. The ratios of the EC50 and the AppEC50 values were used to calculate toxicity-derived Concentration Factors that ranged from 17 to 5400 and primarily reflected differences in partitioning characteristics between air and DMSO for each compound. The authors discuss the development of this system as an initial screening tool for mid to high acute vapor-phase toxicity determinations.

Vehicle-Mounted Natural Gas Leak Detector Passes Key "Road Test": Spots Natural Gas Leaks from 30 Feet Away at Speeds Approaching 20 Miles per Hour
U.S. DOE, National Energy Technology Laboratory.
TechLine, 2 Oct 2003

Physical Sciences Inc. (PSI) conducted a successful test of a prototype mobile natural gas detector at the company's research facilities in Andover, MA. The leak detector demonstrated that it could spot natural gas leaks from a distance of up to 30 feet from a vehicle moving at speeds approaching 20 miles per hour. Leakage surveys are critical to maintaining the integrity and safety of the nation's pipelines and gas distribution system, and gas utility companies are actively seeking remote detection technology to improve the efficiency and reduce maintenance costs of leak detection. Current technology requires that an optical methane detector mounted to a service vehicle be driven through a natural gas leak to detect it, so if the leak occurs away from the street, detection can be a problem. PSI'a low-cost, lightweight, mobile natural gas leak detector extends the range of remote detection of natural gas leaks in distribution and transmission pipelines. The technology will be able to quantify and distinguish natural gas pipeline leaks from other hydrocarbon leaks or from methane sources. The device, about the size of a bread box, can be mounted on top of a vehicle. The detector uses a scanning laser beam on the roadway in front of the vehicle to detect leaking gas. Further work on the prototype detector will concentrate on mounting the detector on a utility service vehicle and demonstrating the mobile detection of natural gas leaks from an operating distribution pipeline. The project cost is $195,244, with DOE-cost sharing $156,190 of the total.

Waste Volume Estimation Using Geophysical Methods in a Complex Geologic Setting
Thompson, Mike (U.S. DOE, Argonne National Laboratory); Drew Clemens; Steve Miller; John Tesner; Wayne Mandell; Phil Durgin; Bill Davies; Jim McKenna.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 733-743, 2004

Investigators employed geophysical surveys using electrical resistivity and seismic refraction profiling to estimate waste volume at Radford Army Ammunition Plant (RFAAP), VA. An extremely heterogeneous and anisotropic subsurface environment consisting of a complex sequence of folded and faulted carbonate and clastic units greatly complicates environmental characterization and evaluation of remedial alternatives for the facility. 2D electrical resistivity imaging tended to overestimate the base of the waste area, but the final interpretation was made with reference to results from seismic refraction profiling and borehole geophysical surveying. The combined borehole and surface geophysical methods established a defensible, more accurate estimate of waste boundaries and volumes. Because the waste base was much shallower than originally thought, subsurface characterization was completed more quickly using less expensive methods. The resulting conceptual site model provided an improved assessment of the subsurface heterogeneities. Borehole geophysics proved an invaluable QA tool for highlighting inconsistent interpretations and verifying conceptual site models. The complementary methods used in this effort increased the level of confidence in the resulting models.

Water Quality Monitoring Using Remote Sensing Technique
Adsavakulchai, Suwannee and Paweena Panichayapichet.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4886, p 498-503, 2003

The rapid growth of shrimp farming in a coastal area has increased the generation of domestic and industrial wastes, which are disposed of locally. Conventional methods of monitoring the water quality of this large region in any detail are costly and time-consuming. The researchers examined the use of high-resolution satellite data (LANDSAT TM) to develop mathematical models for monitoring chlorophyll-a in the coastal area. Comparison between the empirical relationship of spectral reflectance with chl-a and the band ratio between the near infrared (NIR) and red was suggested to detect chlorophyll in water. The information gained from this study will be useful in locating point and non-point sources of pollution and will help in designing and implementing controlling structures.

A Wire Net Design for Electrical Monitoring of Barriers
Bernstone, C., T. Dahlin, and P. Ulriksen.
Proceedings of the 5th Meeting of the European Association for Environmental and Engineering Geophysics, 5-9 September 1999, Budapest, 2 pp, 1999

This paper describes a wire net concept for monitoring environmental barriers used for leachate control at permanent installations. The presentation includes results from a laboratory study and from an installation constructed below a brine pond mineral liner at the Filborna landfill in Southern Sweden.
http://www.tg.lth.se/resist/eegs99m.pdf

Wurtsmith Air Force Base Revisited
Smart, Laura A. (Western Michigan Univ., Kalamazoo MI); Mike Nash; William A. Sauck.
SAGEEP 2004: Symposium on the Application of Geophysics to Engineering and Environmental Problems, 22-26 February 2004, Colorado Springs, Colorado.
Environmental and Engineering Geophysical Society, Denver, CO. CD-ROM, p 374-385, 2004

Bioremediation at hydrocarbon-contaminated sites has been known to change the pore water chemistry in such a manner that the conductivity increase due to the bioremediation is visible through geophysical imaging. The FT-02 plume at Wurtsmith Air Force Base contains both hydrocarbon and chlorinated contaminants. It was surveyed extensively during the summer of 1996 with ground-penetrating radar and electrical resistivity (dipole-dipole). These surveys distinctly imaged the lateral and vertical extents of the higher-conductivity plume, correlating with the available hydrochemical data from well samples. The area was revisited during the summer of 2003 to resurvey the original profiles. This paper details the changes that occurred to the geophysical signature of this well-known plume, which has undergone initial passive bioremediation and subsequent active remediation.