Measurement & Monitoring:
14th Quarterly Literature Update

Active Remote Detection of Natural Gas Pipeline Leaks
Stearns, S.V. and R.T. Lines (Eastman Kodak Company, Rochester, NY); C.J. Grund (Coherent Technologies Inc., Louisville, CO); C.R. Philbrick (Penn State Univ., University Park, PA).
Technology Status Report, 11 pp, Dec 2003

Optical remote sensing technologies using active techniques for the detection of natural gas leaks have attracted a great deal of attention throughout the natural gas pipeline industry. The developed applications included the measurement of weather parameters, measurement of chemical species, and remote sensing techniques that involve mapping of terrain. Active sensing techniques provide advantages in the areas of sensitivity, specificity, rapid response, large area coverage, and efficiency, combined with the ability to achieve extremely low false alarm rates. This article provides a brief overview of the science behind the various active sensor technologies and discusses the additional hardware components required to create an integrated system designed to monitor leaks in natural gas pipelines.
http://www.netl.doe.gov/scng/projects/transmission/ngi/td/pubs/DOENETL%20Technology%20Status%20ReportFINAL.pdf

Advanced High-Power Superluminescent Light Sources for Environmental, Chemical, and Biological Sensing Applications
Maiorov, M.; C.-F. Hsu; I. Kudryashov; A. Lunev; N. Morris; R. Roff; J. Connolly; D. Garbuzov.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 133-140, 2004

New high-power GaAs-based and InP-based superluminescent diodes (SLD) with tilted waveguides emit in 8xx nm and 15xx nm spectral ranges, respectively. Different cavity lengths bring about a tradeoff between output power and spectral width. Power levels of about 200 mW for 820 nm SLDs and about 100 mW for 1590 nm SLDs have been demonstrated for longer cavity devices.

Advances in The Determination of Perchlorate in Drinking Water and Ground Water Using IC and IC/MS Methods
Joyce, Robert J. (Dionex Corporation, Sunnyvale, CA), D.W. Later, R. Slingsby, D.H. Thomas.
The Pittsburgh Conference: PITTCON 2003, Presentation 2060-3.

Using IC with an MSQ mass spectrometric (MS) detector equipped with an enhanced low mass option (ELMO), perchlorate can be determined with an MDL of 0.05 ug/l. This exceptionally low MDL, combined with the unique mass selective detection that MS offers, makes IC/MS a good choice for accurate and sensitive ultra-low level perchlorate determinations. The effect of high concentrations of total dissolved solids on both IC and IC/MS methods are discussed.

Airborne EM and Magnetic Surveys Find Faults at the Slufus Bank Mercury Mine Superfund Site
Hammack, R.W. and J.S. Mabie.
The Leading Edge, Vol 21 No 11, p 1092-1094, Nov 2002

Abstract not available.

Airborne Sensor Technology Assists Emergency Responders
Los Alamos National Lab News Release, 27 Aug 2003

Scientists at Los Alamos National Laboratory and EPA emergency first-responders have developed airborne infrared sensor technology that can aid emergency crews by detecting and mapping hazardous and toxic chemical plumes unleashed by disasters or terrorist acts. The Airborne Spectral Photometric Collection Technology, known as ASPECT, is an aircraft-borne, high-tech sensor package that allows for timely surveillance of gaseous chemical releases from a safe distance. ASPECT gives emergency first responders on the ground critical information regarding the size, shape, composition, and concentration of gas plumes emanating from disaster scenarios, such as a derailed train, a factory explosion, or a terrorist attack. The system involves two sensors mounted aboard an Aerocommander 680 aircraft operated by an EPA disaster first-responder crew. The first sensor, called a Fourier transform infrared spectrometer, detects and locates chemical vapors (even through smoke and dust) to get an accurate measurement of the location and concentration of the vapor plume. The second sensor, a high-resolution infrared line scanner, records an image of the ground below and plume information as well. These data are combined with high-resolution digital imagery and Global Positioning System information to create an accurate map of the land surface and the chemical vapor plume hazard. ASPECT can show the main plume, as well as places where gas has collected and settled, such as in low-lying areas or locations where there is little or no air movement. The vapor hazard plume map can be transmitted within minutes to emergency response commanders on the ground--usually the local fire chief or emergency manager--by fax, computer, or other means. If emergency responders lack computer equipment, ASPECT will drop a working computer via parachute to the crew before the plane starts taking measurements. An ASPECT system can cover a multistate area, thus reducing the amount of resources needed for an emergency response. Contact: James E. Rickman, 505-665-9203, jamesr@lanl.gov.

AMES Laboratory Pursues New Standard in Sensor Technology: Innovative Sensor Could Have Wide-Ranging Applications
GlobalTechnoScan, 20-26 Mar 2002

Scientists at DOE's Ames Laboratory, in collaboration with scientists at the University of Michigan at Ann Arbor, have developed and demonstrated a novel, fluorescence-based chemical sensor that is more compact, versatile, and less expensive than existing technology of its kind currently used for monitoring oxygen, inorganic gases, volatile organic compounds, biochemical compounds, and biological organisms. Within the field of molecular diagnostics for biomedical and biochemical research, the sensor could be used for point-of-care medical testing, high-throughput drug discovery, and detection of pathogens and other warfare agents. Ames Lab senior physicist Joseph Shinar and members of his group studied the photophysics of luminescent organic thin films and organic light-emitting devices, or OLEDs, i.e., those that luminesce, or emit light, when a voltage is applied.

Collaboration with University of Michigan researchers, led by chemist Raoul Kopelman, resulted in the creation of an integrated OLED/optical chemical sensor. The OLED/optical chemical sensor is unique in the simplicity of integration of the detector and the OLED light source that excites the fluorescence. Early in 2001, Shinar and his collaborators successfully demonstrated an quick-response oxygen-sensor prototype in which the OLED was integrated with oxygen-sensor film. The versatility, flexibility and cost-effectiveness of OLEDs offer excellent opportunities for developing OLED/optical chemical sensor arrays and high-density microarrays. Such systems, in principle, could contain up to 16x16 = 256 sensors on a single, one-square-millimeter chip. Contact: Joseph Shinar, Condensed Matter Physics, 515-294-8706.
http://www.globaltechnoscan.com/20thMarch-26thMarch02/sensor_technology.htm

Analysis of Low-Level Pesticides from High-Elevation Lake Waters by Large Volume Injection GC/MS
Rosal, Charlita (U.S. EPA, NERL/ESD, Las Vegas, NV), D.F. Bradford, P.L. Ferguson, E.M. Heithmar, G.-M. Momplaisir, L. Riddick, N. Tallent-Halsell, K.E. Varner.
The Pittsburgh Conference: PITTCON 2003, Presentation 2000-9.

A method has been developed for the determination of ultra-low level pesticides from high-elevation lake waters by large-volume injection programmable temperature vaporizer (LVI-PTV) GC/MS. The pesticides of interest include organophosphorus, organochlorine, carbamate, synthetic pyrethroid, and sulfonic acid compounds, as well as triazine, aniline, thiocarbamate, amide, phthalate, and substituted urea herbicides. This paper describes optimal LVI-PTVGC/ MS conditions, presents analytical figures of merit of the method, and compares its performance with that of GC/MS with conventional pulsed-splitless sampling. The experiments were carried out on an Agilent GC 6890A and 5973N MSD with a Gerstel MPS-2 autosampler and CIS 3 injector.

Analysis of Partitioning Interwell Tracer Tests
Dwarakanath, V. (Duke Engineering & Services, Austin, TX); N. Deeds; G.A. Pope.
Environmental Science & Technology, Vol 33 No 21, p 3829-3836, 1999

Partitioning interwell tracer tests (PITTs), a useful tool in characterizing the volume of nonaqueous phase liquids (NAPLs) in contaminated aquifers, require an accurate determination of the confidence limits of the volume of NAPL estimated from PITT data for an effective interpretation of PITT results. This necessitates a description of the various errors, both systematic and random, associated with the measurement and analysis of PITT data. This paper presents an approach for performing error analysis for both vadose-zone and saturated-zone PITTs based upon identifying the various sources of errors in both the measurement of PITT data and the errors from the data analysis using the method of temporal moments.

Analysis of Polybrominated Dibenzo-p-Dioxins and Dibenzofurans in Flue Gas from Hazardous Waste Incinerator by HRGC/HRMS
Duh, Jing-Min (CESH, Industrial Technology Research Inst., Taiwan, ROC), Hsiu-Min Chen, Meng-Yuh Chen, Chien-Ping Chou, Yong-Chien Ling, Lih-Jiuan Sheu.
The Pittsburgh Conference: PITTCON 2003, Presentation 240-2.

The authors describe an analytical method for the determination of polybrominated dibenzo-p-dioxins (PBDDs) and polybrominated dibenzofurans (PBDFs) in the flue gas from hazardous waste incinerators. The approach involved a modified method 5 (MM5) train for sampling of the PBDDs/PBDFs in incineration flue gas. A measured volume of flue gas sample was passed through a cartridge containing XAD-2 resin, onto which the PBDDs/PBDFs were adsorbed. The adsorbed compounds were recovered by solvent extraction, then the cleanup procedures were performed by florisil column, multi-layer silica gel column, and alumina column. These samples were used for HRGC/HRMS (ThermoFinnigan MAT 95XL) analysis.

Analysis of Vapour Emission to Guide the Development of Explosive Vapour Detectors
Groves, D.M. (Defense Science & Technology Lab, Fort Halstead, Sevenoaks, Kent, UK) S.R. Dixon.
The Pittsburgh Conference: PITTCON 2003, Presentation 1900-3

Canine olfaction is currently the most effective technique for explosive vapour detection. The aim of the program described in this presentation is to determine the relative importance of the various components within the headspace of plastic explosives for canine detection to find out whether vapour detection of plastic explosives can be specifically achieved without detection of the explosive itself. A set of specially manufactured RDX-based plastic explosive samples were prepared in which each sample lacked one or more components of the full mixture. The headspace of these depleted samples, along with the full composition and the raw ingredients, were analyzed by GC-MS to identify the compounds present and their relative concentrations. Canines initially trained to detect samples of the whole explosive were exposed in blind trials to vapors from each of the depleted samples. Correlation of their responses with the lab results allowed deduction of the relative importance of the canine-detected components. Further work will be done to isolate individual compounds from each of the components and build up increasingly complex mixtures to present to the canines.

An Analytical Quantification of Mass Fluxes and Natural Attenuation Rate Constants at a Former Gasworks Site
Bockelmann, A., T. Ptak, and G. Teutsch, Centre for Applied Geosciences, Univ. of Tubingen, Germany.
Journal of Contaminant Hydrology, Vol 53 No 3-4, p 429-453, 2001

A new integral groundwater investigation approach has been used to quantify natural attenuation rates at field scale. In this approach, pumping wells positioned along two control planes were operated at distances of 140 and 280 m downstream of a contaminant source zone at a former gasworks site polluted with BTEX and PAH compounds. First-order natural attenuation rate constants could be estimated based on the quantified changes in total contaminant mass fluxes between the control planes, ranging from 1.4e-02 to 1.3e-01/day for BTEX and 3.7e-04 to 3.1e-02/day for PAHs. An increase in dissolved iron mass flux and a reduction in sulfate mass flux between the two control planes indicated microbial degradation activity at the site, and an analysis of the concentration-time series measured at the control planes also allowed semi-quantitative delineation of the aquifer regions most likely to be contaminated by BTEX and PAHs.

The Applicability of Dissolved Helium and Neon as Dense Nonaqueous Phase Liquid (DNAPL) Partitioning Tracers
Divine, Craig Eric, Master’s thesis, Colorado State University, Fort Collins. 106 pp, 2000

The partitioning interwell tracer test (PITT), which originally was developed to measure residual hydrocarbons by workers in the oil industry, also can be used to locate and quantify subsurface dense nonaqueous phase liquid (DNAPL) zones. The PITT involves an analysis of the average travel times of partitioning and conservative tracers through the test region. Average DNAPL saturation is estimated from the observed retardation of the partitioning tracer relative to the transport of the conservative tracer. Tracer retardation is dependent upon the DNAPL/water partition coefficient and DNAPL saturation. Laboratory investigation indicates that dissolved helium and neon are appropriate partitioning tracer candidates for field-scale PITT application. Batch experiments with trichloroethene (TCE) showed the average error in calculated TCE saturation to be approximately 11% by direct integration of the tracer breakthrough curve (BTC) and 13% by fitting a dual-porosity transport model to the partitioning tracer BTC. A sensitivity analysis indicates that low tracer quantitation limits are more important than tracer measurement precision, and that accurate characterization of the tail region of the BTC is particularly important. Based upon their relatively low TCE/water partition coefficients, helium and neon are best suited as partitioning tracers for TCE saturation values greater than 0.077 for helium and 0.056 for neon. Due to their high dimensionless Henry's coefficients, dissolved helium and neon may not be appropriate partitioning tracer candidates if trapped air is present within the aquifer.
http://www.mines.edu/students/c/cdivine/Divinethesis.pdf

Application of Gas-Phase Partitioning Tracer Tests to Characterize Immiscible-Liquid Contamination in the Vadose Zone Beneath a Fuel Depot
Brusseau, M.L., K.M. Bronson, S. Ross, N.T. Nelson, and T.D. Carlson, Univ. of Arizona, Tucson. Vadose Zone Journal, Vol 2, p 148-153, 2003

Gas-phase partitioning tracer tests were conducted at a fuel depot to evaluate the utility of the partitioning tracer method for characterizing organic immiscible-liquid contamination in the vadose zone. One test was conducted within the boundaries of an existing fuel dispensing island and former underground fuel tank facility after 30 months of operation of a soil vapor extraction (SVE) system. Analysis of hydrocarbon concentrations in the SVE effluent indicates that ~355,000 L of hydrocarbons were recovered during the operation period. Comparing this value to the initial volume of hydrocarbons present, estimated to be ~454,000 L based on core data, produces an estimate of 99,000 (64,000 to 134,000) L of hydrocarbons remaining within the area influenced by the SVE system. Extrapolation of the tracer test results to the SVE-impacted zone produces an estimate of 107,000 (59,000 to 155,000) L of hydrocarbon present. The two values and associated approximate uncertainty ranges are relatively similar. A second test was conducted approximately 200 m from the former tank facility, and analysis of the results produced a hydrocarbon saturation value of 0.37%, which is significantly smaller than the initial value (i.e., before SVE operation) of approximately 1.9% estimated from core data. The lower level of vadose-zone contamination suggests that the source of immiscible liquid contamination found at the second location may be related to lateral migration of floating free product along the water table from the upgradient tank facility, rather than vertical migration from the surface above. This work illustrates the utility of the gas-phase partitioning tracer method for characterizing immiscible liquid contamination in the vadose zone.

Application of Microwave Assisted Extraction for the Determination of Chlorinated Solvents in Low Permeability Media

Gorecki, T. (Univ., Waterloo, ON, Canada), Luliana Dincutoiu.
The Pittsburgh Conference: PITTCON 2003, Presentation 2610-1.

The authors describe research undertaken to develop new, rapid techniques for determination of volatile organic compounds (VOCs) in low permeability media. Native clay and rock samples contaminated with trichloroethene (TCE) were used to test the new techniques against the reference method. Microwave Assisted Extraction (MAE), which applies microwave energy to heat the extracting solvent and water contained in the pores of the sample at elevated pressure, was used in the investigations. A laboratory-built pressurized PTFE vessel and commercially available vessels were used for extraction investigations. TCE analysis was performed using gas chromatography with electron capture detection. A comparison of TCE recoveries from samples extracted using the new method and the standard technique proved that the two methods were equally efficient. The major advantage of the MAE technique was the very short extraction time, which makes it possible to analyze a large number of samples without the need for sample preservation or prolonged storage.

Application of Multivariate Calibration Methods to Chemiresistor Array Data for In-Situ Environmental Monitoring

Rivera, D.A. (Sandia National Labs, Albuquerque, NM); K. Alam; C.E. Davis, C.K. Ho.
The Pittsburgh Conference: PITTCON 2003, Presentation 1980-3.

Chemiresistors are a unique class of environmental sensors in that they require only a load voltage and have no moving parts; however, the measured resistance can be affected significantly by changes in environmental temperature and humidity. The resistors also display a large amount of historesis and drift, but calibration models can be constructed that accounts for these effects. Experiments and multivariate calibration techniques such as partial least squares (PLS) have been used to model chemiresistor response to TCE at different temperatures and humidities. This paper discusses the effect of the experimental design on the predictive ability of the model along with the ability of the multivariate methods to handle changing environmental conditions based on field experiments.

Application of Passive Sampling Devices in the Development of an Ecological Soil Screening Level for Pyrene

Lanno, Roman P. and Nicholas T. Basta, Ohio State Univ., Columbus.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 103, 2003

EPA has recently published guidance on the development of ecological soil screening levels (EcoSSLs), screening values that can be used routinely to identify contaminants of concern in soils that may require further evaluation in a baseline risk assessment. EcoSSLs are derived from primary literature data meeting specific exclusion criteria and use total chemical concentrations in soil as a measure of exposure. The objective of the described research is to present various methods for the determination of pyrene bioavailability and how they can be applied to EcoSSL derivation. Toxicity tests assessing reproductive effects were conducted with earthworms, collembola, and enchytraeids in five different soil types with a wide range of physical/chemical characteristics. Exposure is expressed both as chemical measures of bioavailability (organism residues, solid-phase microextraction fibers, C18 disks) and total pyrene levels in soil for comparison. A comparison of EcoSSLs derived from the various measures of exposure are made and the applicability of chemical measures of bioavailability to the EcoSSL derivation process are discussed. Draft Eco-SSLs for pyrene based upon Collembola and Enchytraeid data only are (approximately) total pyrene = 20.2 mg/kg, SPME pyrene = 30.0 ug/kg, and C18 pyrene = 3.3 mg/kg. This project is funded by SERDP.

Approach to the Vadose Zone Monitoring in Hazardous and Solid Waste Disposal Facilities
Twardowska, Irena.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 151-160, 2004

At solid waste disposal sites, particularly at unlined facilities, vadose zone monitoring should include the anthropogenic vadose zone (i.e., the waste layer and pore solutions in the landfill) in addition to the natural soil layer beneath the landfill. Vadose zone screening along the vertical profile of solid waste facilities with direct invasive soil-core and soil-pore liquid techniques shows vertical downward redistribution of inorganic (macroconstituents and heavy metals) and organic (PAHs) contaminant loads in water infiltrating through the waste layer. To avoid damage to protective/reactive permeable barriers and liners, installation of stationary monitoring systems for near real-time data generation along the waste layer profile should be considered during the construction of a landfill. Instruments should include permanent samplers of pore solution with a periodic pump-induced transport of collected solution to the surface (preferably with instant field measurements) and chemical sensors with continuous registration of critical parameters. These measures would provide an early alert if the waste profile indicates an excessive contaminant load approaching ground water. This paper addresses the problems concerning invasive and stationary monitoring of the vadose zone in solid waste disposal facilities with regard to monitoring data results and the properties of permeable protective/reactive barriers considered for use.

Archaeo-Geophysical, Panchromatic, Thermal, and Multispectral Data Synergy at Four DoD and DOE Archaeological Sites
Kvamme, K.L. (Univ. of Arkansas, Fayetteville); E.G. Ernenwein; T.L. Sever; D.L. Harmon; W.F. Limp; M. Hargrave; L.E. Somers.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 202, 2003

SERDP Project CS-1263 combines high-resolution ground-based geophysical (magnetometry, resistivity, conductivity, magnetic susceptibility, ground penetrating radar), aerial (thermal, panchromatic, multispectral), and space-based (panchromatic, multispectral) sensor data with GIS-based data fusion methods that mix contextual with multiple-layer statistical patterns to enhance results by enabling superior visualization of the complex, high-dimensional data sets. These new methods are being developed to maximize recovery of detailed information about subsurface archaeological content and significantly reduce large expenditures of funds, labor, and the destruction associated with traditional archaeological excavations. Capabilities under variable environmental and archaeological conditions are being assessed based on data from the following sites: (1) Army City (ca. 1917-1921), a commercial complex associated with historic Camp Funston at Fort Riley, KS; (2)

Escondida Pueblo (1200-1400), a large adobe-walled pueblo at Fort Bliss, NM; (3) Kasita Town (1625-1835), a large village at Fort Benning, GA; and (4) Silver Bluff (1740-1790), a trading post that evolved into a plantation adjacent to the DOE Savannah River Complex, SC. Existing site data from two additional locations also are being investigated: Whistling Elk, a 14th century village in the Great Plains (SD), and the remains of the antebellum Mt. Comfort church (1840s-1863), AR. All ground-based geophysical data sets have been acquired, the data have been processed, and preliminary fusions have been generated using hyper-dimensional computer graphics, color composites, principal components analysis, and supervised and unsupervised classification techniques. These results show outstanding details and many new insights about each site. The presentation compares initial multispectral, thermal, and panchromatic images with the geophysical data sets.

Assessment of LNAPL Movement from Transformer Leaks in Cottesloe Sand
Daubermann, Kerry, Honours Project, Dept. of Environmental Engineering, Univ. of Western Australia. 101 pp, Nov 2002

Transformers owned by electrical utilities use large volumes of transformer oil for insulating and cooling purposes. Leaks from flanges and gaskets on transformers occur often over the life span of a transformer installation. This research investigates the migration of transformer oil through the subsurface. Extensive field work was carried out at a single substation site to gather soil samples, which in turn were tested in the lab for hydraulic conductivity and saturation-pressure constitutive relationships. Previous studies have shown that LNAPL migration in the subsurface is largely influenced by subsurface heterogeneity, therefore 3-D random correlated permeability fields were created for the substation based on permeability statistics generated from the laboratory results. A 3-D multiphase numerical model was used to determine the effect of subsurface heterogeneity and various release characteristics on the behavior of simulated spills. Oil migration was found to be relatively insensitive to spill surface area, infiltration rate, rain, and the geostatistics of the subsurface, due primarily to the relative homogeneity of the aquifer at the tested location. The results of this study show that the movement of transformer oil in Cottesloe Sand can be modeled using average subsurface properties.
http://www.cwr.uwa.edu.au/cwr/publications/ug/02thesis/dauberman_02_DR.pdf

Assessment of Metal Loads in Watersheds Affected by Acid Mine Drainage by Using Tracer Injection and Synoptic Sampling--Cement Creek, Colorado, USA
Kimball, B.A. (U.S. Geological Survey, Salt Lake City, UT), R.L. Runkel, K. Walton-Day, K.E. Bencala.
Applied Geochemistry, Vol 17 No 9, p 1183-1207, Sep 2002

The authors delineate hydrogeologic characteristics determining the transport of metals from the watershed to a stream in the watershed of Cement Creek, CO. Spatially detailed load profiles are quantified by combining the injection of a chemical tracer (to determine a discharge) with synoptic sampling (to obtain chemistry of major ions and metals). With the discharge and load profiles, the authors identify sampled inflow sources emanating from undisturbed and previously mined areas; demonstrate that unsampled, likely dispersed subsurface inflows are significant, based on simple hydrologic balance; and estimate attenuation. Mixing zones can have local areas of pH that are high enough for sorption and precipitation reactions to have an effect. Principal component analysis classified inflows into seven groups with distinct chemical signatures that represent water/rock interaction with different mineral-alteration suites in the watershed. The approach provides a detailed snapshot of metal load for the watershed to support remediation decisions, and quantifies processes affecting metal transport.

Atomic Fluorescence: a Powerful Analytical Solution Preferred for Analyzing Mercury, Arsenic and Other Hydride Forming Elements
Liang, Dong (Aurora Instruments Ltd., Vancouver, BC, Canada) and Yong Xie.
The Pittsburgh Conference: PITTCON 2003, Presentation 590-5P.

The advantages of atomic fluorescence spectroscopy as used to determine Hg, Se, As and other hydride elements are ultra low noise and low interference, low detection limit (as low as 0.001ppb Hg in particular), large linear working range (up to magnitude of 103), and excellent sensitivity. The unique design of AI 3200 (by Aurora Instruments Ltd.) offers·dual channels for simultaneous two-element analysis, two channels of independent high intensity power supply for improved sensitivities and lower detection limits,·a built-in hydride/vapor generation and peristaltic pump, a high-energy source and high efficiency optics for a high signal-to-noise ratio, Windows-based software, user-friendly Graphical interfaces, LIMS compatibility, and a small footprint (65 x 37 x 55 cm).

ATTO Molar Detection of Organophosphorous Pesticides Using Recombinant Acetylcholinesterase-Based Biosensor
Chaniotakis, N.A. (Univ. of Crete, Iraklion, Crete, Greece), S. Sotiropoulou, V. Vamvakaki.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-7.

The detection limit of a biosensor system depends on both the enzyme sensitivity and the amount of immobilized enzyme. The researchers used a recombinant Drosophila melanogaster acetylcholinesterase (AChE) with increased sensitivity for the organophosphorus pesticide dichlorvos. The mutagenesis on two amino acid positions increases the sensitivity of the enzyme by a factor of 25,000 over the commonly used electric eel AChE. The design of this third-generation biosensor is based on a 3-D carbon-based transducer the for the immobilization of a controlled amount of enzyme. The optimized biosensor system exhibits atto molar detection limit (atto is the numerical prefix designating 10^{-18}) for dichlorvos in aqueous solutions. This value is achieved in a flow analysis system, with incubation time of 10 minutes at a flow rate of 0.5mL/min.

Automated Multianalyte Sensor Using Antibody Microarrays
Ligler, F.S. (Naval Research Lab, Washington, DC); J.B. Delehanty; J.P. Golden; C.A.R. Taitt; K.A. Sapsford; L.C. Shriver-Lake; Y. Shubin.
The Pittsburgh Conference: PITTCON 2003, Presentation 370-2.

The array biosensor is an automated, portable detection device for simultaneous analysis of multiple samples for multiple analytes. The biochemical component of the multi-analyte biosensor consists of a patterned array of biological recognition elements immobilized on the surface of a planar waveguide; a fluorescence assay is performed on the patterned surface, yielding an array of fluorescent spots, the loci of which are used to identify what analyte is present. A diode laser for fluorescence excitation provides signal transduction and a CCD camera provides image capture. Data analysis software quantifies the fluorescent signals in each spot. Simultaneous analysis of 192 spots (6 separate samples, 32 spots each) has been demonstrated in 10 minutes. Applications explored to date include infectious disease detection, toxin detection, food and water monitoring, and environmental monitoring.

Available and Emerging Analytical and Sampling Techniques, Methods, and Tools for Perchlorate, and the Importance of Data Quality
Sample, Jacqueline H., U.S. Navy, Naval Sea Systems Command, Charleston, SC.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Technical Abstracts, p 85, 2003

At this time, the only EPA-approved method for the analysis of perchlorate is Method 314.0, which was developed and validated for use in potable water (drinking water) samples. The method reporting level (MRL), (i.e., the lowest concentration at which perchlorate measurements are reliable and repeatable within defined criteria) for Method 314.0 in pure drinking water is 4ppb, but it will not be possible to meet this MRL in all drinking water samples or in other environmental media, because Method 314.0 is a "non-specific" method, subject to false positive results due to interferences from numerous sources. Alternative analytical methods are commercially available on a limited basis, but none has yet been published or approved for use by EPA. The DoD Environmental Data Quality Workgroup (EDQW) and the Intergovernmental Data Quality Task Force are collaborating on an initiative, the Perchlorate Roundtable discussion (October 2003), to examine problems and limitations with current perchlorate sampling and testing methods, discuss emerging technology, and recommend a path forward for developing, validating, and publishing improved, performance-based perchlorate sampling and analysis methods. In addition, the EDQW is in the process of developing detailed guidance for the characterization of perchlorate across DoD, expected to be issued late in FY04. The guidance will address the development and design of sampling programs, as well as specific sampling and testing methodology.

Bacterial Integrated Circuits
Science at NASA, 10 June 2004

University of Tennessee microbiologist Gary Sayler and his colleagues have developed a device that uses chips to collect signals from specially altered bacteria. The researchers have already used these devices, known as BBICs, or Bioluminescent Bioreporter Integrated Circuits, to track pollution on earth. Now, with the support of NASA's Office of Biological and Physical Research, they're designing a version for spaceships. Sayler's group, which includes Tennessee researchers Steve Ripp, Syed Islam, and Ben Blalock, as well as collaborators at JPL and the Kennedy Space Center, bioengineered microbes that glow blue-green in the presence of contaminants. Then they joined those bacteria to microluminometers--chips designed to measure the light. BBICs offer a low-cost, low-energy way to detect pollutants. Each BBIC is about 2 mm by 2 mm, and the entire device, including its power source, will probably be about the size of a matchbox. The circuits monitor their surroundings continuously. BBICs can be crafted to sense almost anything: ammonia, cadmium, chromate, cobalt, copper, proteins, lead, mercury, PCBs, ultrasound, ultraviolet radiation, zinc--the list goes on and on.
The system is surprisingly rugged. Microbes thrive in a wide range of environments, so it's possible to design BBICs that can survive in extreme or highly contaminated surroundings. Contact: Gary Sayler,

CEB, University of Tennessee, Knoxville, 865-974-8080, sayler@utk.edu.

Belt, Montana Acid Mine Drainage Mitigation
Botsford, W.S. (Montana DEQ, Helena); T. Duaime (Montana Bureau of Mines and Geology, Butte).
25th Annual Conference of the Association of Abandoned Mine Land Programs, 28 September - 1 October 2003, Louisville, Kentucky. 3 pp, 2003

The development of a 3-D model in ESRI's geographic information system, ArcGIS, will provide insight into the relationships between surface water recharge, groundwater discharge, mine works, and geologic stratigraphy and structure. The model will facilitate Montana's abandoned mine reclamation program in developing a strategy for reducing groundwater flow through, and surface recharge to, mine workings, thus cutting off the source of acid mine drainage (AMD). The hydrogeologic data, groundwater elevations and gradients will be superimposed on a 3-D visualization of the geological structure developed with historic mine workings data. Multi-spectral analysis of satellite imagery is being collected to identify other, possibly hidden, sources of discharge to the receptor streams, and should help to identify AMD subsurface pathways in intermittent or ephemeral stream courses.
http://www.surfacemining.ky.gov/aml/naamlp/technical_sessions.htm

Biosensor for Toxicity Detection in Industrial and Municipal Effluents
Bellemare, Francois, Lab Bell Inc., Shawinigan, Quebec, Canada.
The Pittsburgh Conference: PITTCON 2003, Presentation 1200-100.

The LuminoTox is a fast monitoring and screening test for the detection of toxic substances (herbicides, derivatives sulphites, PAH, divalent cations, phenolic derivatives, etc.) in municipal and industrial effluents (e.g., agricultural, chemical, paper, mining). The technology of the biosensor is based on the degradation of the photosynthetic activity of higher plants and algae, following the action of toxic substances in a plant's thylakoid membranes, which the pollutants target. The biosensors have been devised as stabilized thylakoid membranes prepared from plant leaves and achieve results in about 10 minutes. The LuminoTox is simple, efficient, and can easily be automated for a periodic monitoring reading.

Broadband LIBS: A New Sensor Technology for Field Applications
Miziolek, A.W. (U.S. Army Research Lab, AMSRL-WM-BD, Aberdeen Proving Ground, MD); F.C. DeLucia, Jr.; B.K. Gullett; K.L. McNesby; S.D. Serre; R.A. Walters; J. Rose.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 25, 2003

Laser Induced Breakdown Spectroscopy (LIBS) sensor technology is a straightforward technique that converts tiny amounts (nanograms or less) of the target material into a high temperature plasma wherein the light from the plasma is collected and analyzed by the spectrometer. LIBS attributes include real-time response and no sample preparation. The EPA has partnered with the U.S. Army Research Laboratory (ARL) to apply broadband LIBS to the detection of various toxic metals captured on filters as part of a SERDP-funded project CP-1247: Temporal and Modal Characterization of DoD Source Air Toxic Emission Factors. ARL is working with industry to develop a portable field LIBS sensor containing a compact broadband spectrometer, computer, and batteries in a medium-size backpack. It will also include a handheld probe, which produces the LIBS spark at the tip and contains a new compact Nd:YAG laser in the handle. With spectral coverage in the 200-980 nm range, this field-portable sensor will be capable of detecting and identifying a very wide range of hazardous materials, because all chemical elements emit light at specific wavelengths in this spectral range in a microplasma environment.

Can Degradation Products Be Used as Documentation for Natural Attenuation of Phenoxy Acids in Groundwater?
Reitzel, L.A. (Technical University of Denmark, Lyngby), N. Tuxen, A. Ledin, and P.L. Bjerg.
Environmental Science & Technology, Vol 38 No 2, p 457-467, 2004

A literature survey on the production history of phenoxy acids and degradation pathways has shown that metabolites of phenoxy acid herbicides also are impurities in the herbicide products, which makes the bare presence of these compounds useless as in situ indicators for demonstrating natural attenuation. These impurities can make up more than 30% of the herbicides. Field observations at two phenoxy acid-contaminated sites showed the occurrence of several impurities including metabolites in the groundwater. Neither microcosm experiments nor field observations verified that metabolites were produced or accumulated in situ, though the impurity/parent herbicide ratios can be useful in situ indicators of degradation.

Carbon Isotope Fractionation of PCE and TCE During Dechlorination by Vitamin B12
Slater, G.F.; B. Sherwood Lollar; S. Lesage; S. Brown.
Groundwater Monitoring & Remediation, Vol 23 No 4, p 59-67, Fall 2003

Stable carbon isotopic analysis, an effective and powerful tool for the investigation and monitoring of contaminant remediation, was used to characterize the isotopic effects of reductive dechlorination of PCE and TCE by vitamin B12 in laboratory microcosms. The occurrence of large enrichment factors indicates that isotopic analysis can be used to monitor the dechlorination of PCE and TCE by vitamin B12 and remediation of ground water plumes.

Characterization of a Contaminant Plume Due to a Hydrocarbon Spill Using Geoelectrical Methods.
Ana Osella, Matías de la Vega, and Eugenia Lascano, Univ. of Buenos Aires, Argentina.
Journal of Environmental & Engineering Geophysics, Vol 7 No 2, p 78-87, 2002

A situation where a 1.5 m-thick layer of gasoline was detected at 7 m depth, floating over the water table, is a case in which a resistive contaminant like hydrocarbon can be located in a conductive medium. In these circumstances, geoelectrical prospecting is particularly good for characterizing the zone. In a study area of ~100 × 140 square meters with thicknesses involving more than 20 m of, in many cases, very conductive materials, a field design was required that would cover the zone with deep penetration and optimize lateral resolution at the same time. The investigators achieved the electrical imaging of the contaminated zone and a description of the surrounding soil by combining Wenner and dipole/dipole configurations.

Characterization of an Aquitard and Direct Detection of LNAPL at Hill Air Force Base Using GPR AVO and Migration Velocity Analyses
Deeds, Jake and John Bradford.
GPR 2002: 9th International Conference on Ground Penetrating Radar, 29 April - 1 May 2002, Santa Barbara, California.

Abstract not available.

Characterization of an Old Diesel Fuel Spill -- Results of a Multi-Receiver OhmMapper Survey
Pellerin, Louise (Consulting Geophysicist, Berkeley, CA); Douglas Groom and Jeff Johnston, (Geometrics, Inc., San Jose, CA).
SEG International Exposition and 73rd Annual Meeting, 26-31 October 2003, Dallas, Texas. Extended Abstracts. Society of Exploration Geophysicists, Tulsa, OK. p 5008-5011, 2003

Geoelectric data were acquired with the OhmMapper TR4 (OM-TR4) over a former tank farm at the Camp Parks Reserve Forces Training Area to map the near subsurface resistivity and possible association with a 30- to 40-year-old hydrocarbon plume and to locate any additional pipelines and subsurface infrastructure. The OM TR4 is a towed capacitively coupled resistivity system that comprises one transmitter and four receivers in the dipole/dipole array configuration. Apparent resistivity maps and 2-D inverse models were used in an attempt to correlate geophysical signatures with soil samples analyzed for hydrocarbons. The investigators noted some correspondence between conductive zones in the lower vadose zone/shallow saturated zone to concentrations of petroleum hydrocarbons in the diesel range of 140 ppm at a depth of 2.4 m and 470 to 17000 ppm at 3.6 m. Concentrations of less than 100 ppm were detected at a depth of 1 m, and corresponding resistivity values were relatively high.
http://seg.org/publications/archive/exAbsHist/

Characterization of Groundwater Seeps and Implications for Design of Enhanced Bioremediation of Chlorinated Solvents
Majcher, E.H. (U.S. Geological Survey, Baltimore, MD); M.M. Lorah; M. Voytek; D.J. Phelan; J. Wrobel.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 131, 2003

In the West Branch Canal Creek tidal wetland discharge area at Aberdeen Proving Ground, MD, combined maximum concentrations of 1,1,2,2-tetrachloroethane, tetrachloroethene, trichloroethene, and carbon tetrachloride and their degradation products were most commonly observed along stream channel boundaries, corresponding to areas with the greatest observable discharge from seeps. A preliminary estimate of specific discharge from a seep area indicated a two-to-three order of magnitude increase when compared to other areas of the wetland. Though many of the seep areas contain methane concentrations indicative of methanogenesis, the seeps with the highest detected VOC concentrations correspond to the lowest detected methane concentrations. Genetic analyses of the seep sediments suggest the presence of a similar yet less abundant microbial community compared to the known dechlorinating microbial community previously identified in nearby portions of the wetland. Results indicate that increased groundwater velocity and a likely decreased diversity and abundance of the necessary microbial community are the primary factors controlling contaminant breakthrough, and thus are the primary factors that will govern the design of the targeted enhanced bioremediation.

Characterization of Mixed TiO_2 and SiO_2 Sol-Gel Membranes for Volatile Organochloride Sensing
Schiza, M.V., D.A. Nivens, F.P. Milanovich, S.M. Angel, Univ. of South Carolina.
Chemical, Biochemical, and Environmental Fiber Sensors X.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3540, p 164-174, Feb 1999

The authors have demonstrated new sensors based on composite sol-gel membranes with up to four adjacent SiO_2 and TiO_2 layers. This paper provides preliminary data for a PCE sensor based on the photooxidative power of a TiO_2/SiO_2 membrane.

Characterization of Particulate Emission: Size Characterization and Chemical Speciation
Strategic Environmental Research & Development Program. Compliance CP-1106, 1 pp, June 2000

The objectives of this project were to develop advanced methods for the measurement of the size distribution and composition of PM emitted from mobile and stationary sources and to provide the tools needed to characterize and control PM emissions. Two innovative techniques for the rapid measurement of fine PM were used in combination with a dilution sampler. The first is an aerosol time of flight mass spectrometer (ATOFMS) that measures the size and composition of individual particles. The second is a photoelectric aerosol sampler (PAS) which, in combination with a photoacoustic detector for carbon, provides rapid measurement of the polycyclic aromatic hydrocarbon (PAH)-laden carbonaceous particles that dominate emissions from combustion sources. The approach was to apply these devices in parallel with conventional measurement techniques to establish their validity for characterizing PM emissions. Multiorifice impactors combined with chemical analysis will be used to obtain sufficiently detailed chemical characterization information in order to close material balances on the emissions. Optical particle counters and differential mobility analyzers will be used to obtain detailed size distributions to calibrate the ATOFMS and PAS. Project completed FY 2002. Contact: Dr. Adel Sarofim, Univ. of Utah, Salt Lake City, 801-585-9258, sarofim@reaction-eng.com.

Characterization of SnO_2 Ceramic Gas Sensor for Exhaust Gas Monitoring of SVE Process
Yang, J.-W. (Korea Adv. Inst. of Sci./Technology, Daejon, South Korea); H.-J. Cho; S.-H. Lee; J.-Y. Lee.
Environmental Monitoring and Assessment, Vol 92 No 1-3, p 153-161, 2004

A Figaro-type gas sensor system was investigated for the monitoring of BTEX volatile organic compounds in the exhaust gas from a soil vapor extraction (SVE) process. Though the composition of the exhaust gas from the SVE process and the amount of each component changed with time, the sensor could be used to estimate the residual amount of contaminants by measuring the total concentrations in the exhaust gas. The proposed ceramic gas sensor system can satisfy the essential monitoring necessities of SVE processes and has many advantages over other instrumentation, as a cost-effective device with long-term monitoring stability that can allow remediators to determine the point at which system operation can be stopped.

Chemical Warfare Agent Detection by Surface-Enhanced Raman Spectroscopy
Farquharson, S. (Real-Time Analyzers, East Hartford, CT), S.D. Christesen, P. Maksymiuk, W. Smith.
The Pittsburgh Conference: PITTCON 2003, Presentation 280-9.

Research into the utility of surface-enhanced Raman spectroscopy (SERS) to provide rapid identification of chemical agents is based on the ability of Raman spectroscopy to identify molecular structure through vibration information provided in spectra and the ability of SERS to detect extremely low concentrations (parts per billion) through the enhancement of Raman scattering by six orders of magnitude or more. The ability of metal-doped sol-gels as SERS media that provide continuous (i.e., reversible) and quantitative (i.e., reproducible) measurements is being examined with the goal of developing a portable analyzer. This paper contains SERS measurements of chemical agent simulants, chemical agent hydrolysis products, and actual agents.

Chemical Weapons Screening by Photoionization MS
Evans, Matt D. (Syagen Technology, Inc., Tustin, CA), Ryan Beckley, Karl Hanold.
The Pittsburgh Conference: PITTCON 2003, Presentation 2010-5.

Photoionization mass spectrometry (PI MS) was employed to detect chemical weapons compounds in various solvents and matrices. Samples were directly injected by syringe using an autosampler coupled to a low pressure PI (LPPI) source. The LPPI source achieves nearly universal detection of chemical weapons, precursors, and decomposition products. Direct LPPI allows for direct sample introduction with no sample preparation, minimizes matrix effects, and provides higher throughput than conventional methods. The LPPI source is part of a quadrupole ion-trap time-of-flight (QitTof) mass spectrometer system. The instrument enables MS/MS analysis for compound confirmation. When presented with a 48-compound library of chemical weapons convention treaty-scheduled compounds, the PI/QitTof MS instrument detected 46 compounds with minimal fragmentation. The authors present results from the operation of the Syagen Radiance Pro LPPI/QitTof MS instrument at the Edgewood Chemical and Biological Center Surety Laboratory.

Chemiluminescence Detection Systems for the Analysis of Explosives
Jimenez, A. M. and M.J. Navas, Univ. of Seville, c/o Prof. García Gonzalez S/N, Seville, Spain.
Journal of Hazardous Materials, Vol 106 No 1, p 1-8, Jan 2004

This paper provides a comprehensive review of explosive detection by chemiluminescence through a summary of the relevant literature from the last five years and a synopsis of current research topics and developments. Most explosives compounds contain either nitro or nitrate groups that make possible their detection and quantification using detection systems based on chemiluminescent reactions. The literature reviewed is specially addressed for the detection of a group of high explosives, containing nitrogen compounds.

Chlorinated Ethenes from Groundwater in Tree Trunks
Vroblesky, D.A. (U.S. Geological Survey, Columbia, SC); C.T. Nietch; J.T. Morris.
Environmental Science & Technology, Vol 33 No 3, p 510-515, 1999

The authors describe an investigation to determine whether tree-core analysis could be used to delineate shallow ground-water contamination by chlorinated ethenes (cis-DCE and TCE). Analysis of tree cores from bald cypress, tupelo, sweetgum, oak, sycamore, and loblolly pine appeared to reflect the configuration of the chlorinated-solvent ground-water contamination plume. Tree coring seems to offer a potentially cost-effective and simple approach to optimizing well placement.

Coastal Contaminant Migration Monitoring Technology Review
Chadwick, D.B.; M. Kito; A.C. Blake; B. Harre.
Report No: SSC-TR-1898, DTIC: ADA417679, 54 pp, June 2003

Growing evidence suggests that submarine groundwater discharge may represent an important migration pathway for natural and anthropogenic constituents entering coastal waters. To address this issue, technologies were investigated for their applicability toward direct quantification of coastal contaminant migration via groundwater. The technologies were divided into two categories: those for quantifying groundwater flow to coastal waters (seepage meters, thermal gradient flow meters, piezometers, thermal infrared aerial imagery, tracer injection, a colloidal borescope, and natural geochemical tracers), and those for detecting contaminants in the groundwater/coastal water exchange zone (porewater probes, mini-wells, diffusion samplers, seepage meters, and in situ chambers). For each of the technologies, this report provides a description and discussions of the developmental status and the applications and limitations.
http://handle.dtic.mil/100.2/ADA417679

Coastal Contaminant Migration Monitoring: The Trident Probe and UltraSeep System. Hardware Description, Protocols, and Procedures
Chadwick, D.B.; B. Harre; C.F. Smith; J.G. Groves; R.J. Paulsen.
Report No: SSC/SD-TR-1902, DTIC: ADA416834, 50 pp, June 2003

Building on historical advances, a collaborative effort between the Environmental Sciences Laboratory at SSC San Diego and the Cornell Cooperative Extension Marine Program set out to develop improved methods for accurately measuring the groundwater seepage across the sediment-water interface and identifying the spatial location where exchange is likely to take place. This report describes the initial hardware development, testing, and field protocols for new techniques for identifying potential areas of groundwater impingement into surface waters (the Trident Probe), as well as techniques for quantifying the flow rates and contaminant levels of groundwater at the surface water interface (the UltraSeep System).
http://handle.dtic.mil/100.2/ADA416834

The Combined Use of the CALUX Bioassay and the HRGC/HRMS Method for the Detection of Novel Dioxin Sources and New Dioxin-like Compounds
Hoogenboom, Ron, State Inst. for Quality Control of Agricultural Products (RIKILT), Wageningen, The Netherlands.
Environmental Science & Pollution Research, Vol 9 No 5, p 304-306, 2002

A project sponsored by the Dutch Ministry of Agriculture was started by Wageningen University, the

University of Michigan, and RIKILT, aiming at the development and implementation of a novel bioassay. A new reporter gene assay was developed, initially using a mouse hepatoma cell-line and then a rat hepatoma cell-line. The test was subsequently implemented at RIKILT and an extraction procedure was developed for testing milk fat samples. The complete approach, an acid silica cleanup, and the rat cells were subsequently validated.
http://www.scientificjournals.com/sj/espr/Pdf/aId/5343

Comparison of Soxhlet and Accelerated Solvent Extraction in the Analysis of Dioxins and Furans from Animal Feed
S.Shojaee, J.C.Archer, R.Vocque, FDA/ORA/Arkansas Regional Laboratory, 3900 NCTR Rd., Jefferson, AR 72079
2003 FDA SCIENCE FORUM -- FDA Science: Protecting America's Health. The 9th FDA Science Forum, 24-25 April 2003, Washington, DC

There are advantages to using the Accelerated Solvent Extractor (ASE-300) over conventional Soxhlet extraction for animal feeds: (1) reduction in extraction time, from 18-24 hours to less than 0.3 hours, making extraction and cleanup possible in one day; (2) temperature programming and the ability to use a variety of solvents for a more practical and rigorous extraction; (3) reduction of solvent usage by 50%; and (4) larger sample size. This presentation report on experiments in which five grams of various feed samples were spiked with the internal standard 13-C-12-labeled dioxin and furan congeners, with Ottawa sand serving as the method blank. The ASE-300 extraction conditions were completed at 125 degrees C under 1500 psi in approximately 20 minutes using the solvents hexane and dichloromethane (1:1). The extracts were subjected to a cleanup process of multi-layered silica gel and alumina columns and analyzed by gas chromatography/high resolution mass spectrometry.

A Comparison of the CALUX® Bioassay and Traditional Methodology for Dioxin Analysis
Archer, J.C., L.M. Pence, L. Bluhm, C. Earnheart, J.J. Eckert, 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

In the Chemically Activated LUminescence eXpression (CALUX®) bioassay, the presence of dioxins and furans in a sample triggers the production of light via a genetically engineered cell line containing the luciferase gene. The CALUX® methodology allows for the simultaneous analysis of a large number of samples, making it a useful screening method for prioritizing sample analyses and reducing the number of samples analyzed by traditional means, i.e., Gas Chromatography/High Resolution Mass Spectrometry (GC/HRMS). Before the CALUX® method could be used routinely, it was necessary to show that the assay was as sensitive as traditional methods and that there was good agreement between the methods according to established guidelines. Samples representing various types of matrices (feed and feed components; vitamins, minerals, fats, etc.) were analyzed using the CALUX® method. The results from the CALUX® method were then compared to results obtained by traditional methods (extraction, GC/HRMS). Archived samples representing high, moderate and low total Toxic Equivalency (TEQ) values were chosen for the comparison to assess the accuracy, precision, and sensitivity of the detection method over a wide range.

Comparative Studies of Real Time Mercury Vapor Analyzers vs. the NIOSH 6009 Mercury Analysis Method

Singhvi, Raj, U.S. EPA, Edison, NJ.
The Pittsburgh Conference: PITTCON 2003, Presentation 590-10P.

Metallic mercury vapor levels in indoor air were measured under various conditions inside a van and a trailer using Lumex RA915+ and Mercury Tracker 3000 real-time mercury analyzers, and confirmed by laboratory analysis using a modified NIOSH 6009 method. Mercury monitoring data from several mercury spill sites around the United States also were used in this comparison study. Based on statistical analysis, the use of the Lumex RA915+ and Tracker 3000 mercury field analyzers is recommended to provide real-time screening of suspected contaminated areas, to assess initial extent of metallic mercury contamination, to identify "hot spots," and to monitor decontamination progress at a spill site.

Competitive Assays Using Near-Infrared Fluorophores and Molecularly Imprinted Polymer Affinity Layers

Coolbaugh, M.T. (American Research Corporation of Virginia, Radford, VA), E.C. Aquino, H.P. Groger, R.J. Polidoro.
The Pittsburgh Conference: PITTCON 2003, Presentation 2350-5.

Molecularly imprinted polymers (MIP) are highly cross-linked polymers prepared in a manner that creates cavities around template molecules. On removal of the template molecules, the cavities remain and yield a material that will selectively rebind template molecules. MIP materials offer advantages over antibodies for small molecule detection, such as ease of development and an ability to function in organic solvents. Difficulties related to signal transduction must be overcome before these advantages can be fully exploited in sensor system design. Immunological assays for small molecules generally are not based on direct detection of binding events but usually are competition assays in which the analyte competes with a dye- or enzyme-labeled analogue for binding sites. The author describes an effort to develop an automated MIP-based competitive assays for atrazine and 2,4-D and discusses the development of thin-film MIP affinity layers and near infrared competition reagents.

Continuous Real-Time Monitoring of Elemental and Oxidized Mercury in Waste Incinerator Stack Emissions

Almond, D.A. (Genesis Laboratory Systems, Inc., Grand Junction, CO), R.L. Ballantyne, B. Genereaux, B.N. Radford.
The Pittsburgh Conference: PITTCON 2003, Presentation 460-3.

Genesis Laboratory Systems has developed a continuous emission mercury monitor (CEMM) capable of monitoring incinerator stack gas emissions in real time, producing updated mercury concentration readings every second. Elemental mercury in stack gas is monitored by direct atomic absorption spectroscopy (AAS). Oxidized mercury compounds are converted catalytically to ground-state mercury and then analyzed by AAS in a separate path. Results for both paths are combined to provide total gaseous mercury concentration. The system has been demonstrated in the EPA-sponsored Environmental Technology Verification Program, and this paper discusses the performance of the mercury stack monitor in the demonstration program.

Controlled Validation of Optical Remote Sensing Method for Flux Measurement from Non-Point Sources
Sullivan, P.D. (Air Force Research Lab, AFRL/MLQF, Tyndall AFB, FL); R.M. Varma; R. Hashmonay; R.H. Kagann; M. Modrak; R.R. Segall.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 13, 2003

Optical Remote Sensing is a powerful method for measuring air contaminant emissions from fugitive area sources. A new radial plume-mapping (RPM) method to directly characterize emissions from area sources is based on an optical sensor mounted on a scanner that sequentially directs an optical beam from a single location to multiple reflectors. An optimization algorithm is used for mapping the field of concentration across the plume of contaminant. When scanning is performed on a horizontal plane, hot spots of fugitive emissions can be located. The RPM method, along with the wind measurements, can also be used to measure emission fluxes from an area source, when the scanning is performed on a vertical plane downwind of the area source. This presentation describes the results from a controlled RPM demonstration study performed during November 2002 to May 2003 at the Duke Forest Facility of Duke University, Chapel Hill, NC, to map the controlled release of gases such as nitrous oxide, ethylene, acetylene, propylene, and propane. The results show that the source locations were reconstructed successfully to within a few meters and the calculated mass fluxes agreed with the known release rates to within +/- 10%, using the RPM method. This work is funded under ESTCP project CP-0214: Optical Remote Sensing Method to Determine Strength of Nonpoint Sources.

A Cost-Effective Strategy for DNAPL Characterization
Schneider, W.H. (Weston Solutions, Inc., Albuquerque, NM); M. McCaughey; D. Strobridge; J. Wrobel; K. Davies; S. Pack.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 139, 2003

This paper presents a cost-effective, six-step strategy for characterizing dense nonaqueous phase liquids (DNAPLs) that are recognized sources of enduring groundwater contaminant plumes. The strategy involves contaminant fate and transport modeling; high-resolution lithologic logging using cone penetrometer testing; hydrostratigraphic modeling; adaptive field sampling (soil cores collected via direct push technologies), testing, and analysis; partitioning analysis; and DNAPL distribution modeling to characterize DNAPLs within an alluvial aquifer setting. A comprehensive case study of at the J Field Site, Aberdeen Proving Ground, MD, illustrates the successful application and cost advantages of this six-step, DNAPL characterization strategy.

A Critique of the Internal Tracer Method for Estimating Contaminant Degradation Rates
Martian, Peter; Kent S. Sorenson Jr.; Lance N. Peterson.
Ground Water, Vol 41 No 5, Sep/Oct 2004

The internal tracer method for estimating contaminant degradation rates separates the attenuation effects not associated with degradation by using a co-disposed recalcitrant internal tracer to normalize the degrading contaminant concentration. The remaining attenuation between the internal tracer and degrading contaminant is attributed to degradation, and the degradation rate half-life is estimated from the first-order decay equation. An analytical solution of the advection/dispersion equation was used to evaluate flow-and-transport conditions that could result in incorrect estimates of contaminant degradation rate constants, to estimate the magnitude of error associated with using the internal tracer method at an example site, and to explain different degradation rates estimated using tracers with different decay rate constants.

Cyanide Detection on a Capillary Electrophoresis Microchip
Collins, Greg E. (Naval Research Lab, Washington DC), Richard H. Bromund.
The Pittsburgh Conference: PITTCON 2003, Presentation 1710-4.

The authors discuss the sensitive, fluorescent detection of cyanide on a capillary electrophoresis (CE) microchip. The laboratory-on-a-chip platform has attractive features, such as potential portability, minimal waste generation, rapid separation times, small sample size requirements, ease of integration, and low cost. To detect cyanide, the chip utilizes the reaction of cyanide with 2,3-naphthaldehyde and taurine to form the fluorescent derivative, 1-cyanobenz[f]isoindole. The fluorescent derivative formed is separated on a CE microchip and detected with a violet diode laser excitation source. The presentation addresses the optimization of the CE conditions and various analytical points of merit, e.g., detection limit, linearity, dynamic range, selectivity, reproducibility, etc.

Decision Support System to Evaluate Effectiveness and Cost of Source Zone Treatment
Strategic Environmental Research & Development Program. Cleanup CU-1292, 1 pp, Nov 2003

The objective of this research is to develop new, easy-to-use tools that will help the ground-water community decide whether or not source-zone DNAPL remediation is economically and technically justifiable at a particular site. A Source-Zone Database consisting of 20-30 sites that have well characterized DNAPL sources will be developed. A Source Remediation Cost and Performance Database will also be developed to include capital and long-term operating and monitoring costs for DNAPL remediation, using past cost experience and data from the literature. A family of 'source settings' that show long-term concentration vs. time predictions will then be developed. Each source setting will consist of a subsurface DNAPL distribution that is often encountered at impacted sites. These modular source settings will form components of complete source settings that model actual sites. The concentration vs. time behavior of each individual source setting will be predicted using analytical and numerical models of DNAPL dissolution and ground-water transport. Once developed, the source settings will be applied to sites in the Source Zone Database for three different cases of source treatment. From the cost of DNAPL remediation at each of the sites in the database, site data, and the modeling results, the project team and expert panel will compile a list of general rules regarding when and what type of intensive remediation is appropriate, and when some form of long-term plume management should be pursued. A decision support system will also be developed to assist environmental professionals in evaluating cost effectiveness of source zone remediation at sites where application of general rules is difficult. This project began in FY 2003. Contact: Dr. Charles Newell, Groundwater Services, Inc., Houston, TX, 713-522-6300, cjnewell@gsi-net.com.

Defining TCE Plume Source Areas Using the Membrane Interface Probe (MIP)
McAndrews, Beth, Kim Heinze, and William DiGuiseppi, Earth Tech, Englewood, CO.
Soil and Sediment Contamination, Vol 12 No 6, p 799-813, Nov-Dec 2003

The Membrane Interface Probe (MIP) offers significant advantages over traditional drilling and direct-push methods for site screening. A principal MIP disadvantage is a relatively high detection limit (approximately 100 ppbv in soil gas, 100 ppm in soil and 100 ppb in groundwater), which makes the method useful for source characterization but limited for delineating lower levels of contamination. When used to define TCE plume source areas at F.E. Warren AFB in Cheyenne, WY, and a security products manufacturing site in Tennessee, the near-continuous MIP analysis minimized the number of soil and groundwater samples required to fully delineate the extent of the plume-head source areas.

Demonstration of Remote Monitoring Technology for Cathodic Protection Systems
Van Blaricum, Vicki L.; W.R. Norris; M.J. Szeliga; J.B. Bushman.
Report No: FEAP-TR-97/76, 116 pp, 1997

The Army owns and maintains more than 3000 miles of buried natural gas pipeline, 20,000 underground storage tanks (USTs), and more than 300 elevated water storage tanks. Cathodic protection (CP) is required by regulation on many of these structures to prevent corrosion. Periodic testing is required to ensure proper CP system operation, but many Public Works directorates lack sufficient resources to conduct such tests regularly, and malfunctions can remain undetected until the structure corrodes and leaks. Several companies have begun manufacturing remote monitoring units (RMUs) for CP systems. This technology allows personnel to monitor multiple CP systems from a central location so problems can be detected and repaired immediately. An 8-month field evaluation of CP RMUs was performed to determine the effectiveness of systems from three manufacturers. RMU readings were compared with manual method readings throughout a variety of conditions. Units from only one manufacturer performed successfully. New systems have entered the market since the demonstration began.
http://owww.cecer.army.mil/TechReports/Vancatho/Vancatho.pdf

Demonstration of Remote Monitoring Technology for Cathodic Protection Systems: Phase II
VanBlaricum, Vicki L.; J.T. Flood; M.J. Szeliga; J.B. Bushman.
Report No: FEAP-TR-98/82, 43 pp, May 1998

Cathodic protection (CP) is used to prevent corrosion on many buried and submerged metallic structures such as underground pipes and tanks. Periodic testing is required to ensure proper CP system operation, but many Public Works departments lack sufficient resources to conduct such tests regularly. Several companies have begun manufacturing remote monitoring units (RMUs) for CP systems. The technology allows personnel to monitor multiple CP systems from a central location so problems can be detected and repaired immediately. RMUs from three manufacturers were evaluated during Phase I of this study (FEAP-TR-97/76, 1997) to determine their effectiveness. Only one of them performed successfully. During Phase II, RMUs from two additional manufacturers were evaluated. Results showed that both of the systems from Phase II performed successfully and are suitable for use at Army installations.
http://owww.cecer.army.mil/techreports/van_cpr2/van_cpr2.flm.post.pdf

Desert Varnish Shines as Environmental Monitoring Tool
Los Alamos National Laboratory News Release, 31 March 2004

David Wayne, a University of California researcher working at Los Alamos National Lab in collaboration with scientists from the University of Nevada-Las Vegas and Eastern Washington University has discovered that desert varnish -- a thin brownish to black coating that forms naturally on rock surfaces in deserts and other arid places all over the world -- may be an ideal passive environmental monitor for atmospherically-deposited heavy and potentially toxic metals, including radionuclides. Using a technique called Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS), Wayne and his colleagues vaporized the top layer of desert varnish from samples taken from a site near Fallon, NV, from another location just outside of Las Vegas and from the San Juan River in southeastern Utah. The technique is so sensitive that only an area of varnish 2 to 4 millimeters square is removed during the analysis. The vaporized rock varnish aerosol is transported in a stream of pure argon gas into a mass spectrometer to identify and quantify the chemical elements present in the sample. The focus of the investigation was on the trace elements -- elements that are present at levels less than 1000 parts per million -- in the varnish. The components of desert varnish are very adept at capturing heavy metals, like lead, arsenic, zinc, cobalt, uranium and tungsten, that have been dispersed into Earth's atmosphere through natural phenomena and industrial activities like mining, smelting, oil refining, chemical processing, and nuclear plant operations. Wayne and his colleagues discovered that desert varnish collected near Fallon contained 10 to 100 times more tungsten than the varnish from other localities, and that the top-facing surface of varnish-coated pebbles from the San Juan River contained five to 10 times more lead, arsenic, and cadmium than the bottom-facing surfaces. Because desert varnish captures and preserves airborne heavy metals and other elements, such as radionuclides, scientists could analyze it to infer what sorts of activities have been going on nearby or to determine if nuclear materials have been released (either intentionally or unintentionally) into the environment.

Design and Installation of a Remotely Controllable Autonomous Resistivity Monitoring System at the Gilt Edge Mine Superfund Site, South Dakota
Versteeg, R. and G. Heath (INEEL); K. Wangerud (U.S. EPA); D. Paul (U.S. Bureau of Reclamation). SEG International Exposition and 73rd Annual Meeting, 26-31 October 2003, Dallas, Texas. Extended Abstracts. Society of Exploration Geophysicists, Tulsa, OK. p 1187-1190, 2003

Acid mine site remediation requires minimizing the production of acid mine drainage, which sometimes can be accomplished by covering exposed rock and mine tailings. Detailed monitoring information on cap and rock behavior allows for rapid and cost-effective intervention in case of cap failure. A remotely controllable autonomous resistivity system was integrated in the geomembrane cap at the Gilt Edge Mine Superfund site. The structure of this system allows users to have access to raw and processed data in real time.
http://seg.org/publications/archive/exAbsHist/

Design of a SWIR Computed Tomographic Imaging Channeled Spectropolarimeter
Locke, Ann M.; Dave Salyer; Derek S. Sabatke; Eustace L. Dereniak.
Polarization Science and Remote Sensing.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5158, p 12-23, 2003

The SWIR Computed Tomographic Imaging Channeled Spectropolarimeter (CTICS) is a snapshot imaging spectropolarimeter with 54X46 pixel spatial resolution and 10-band spectral resolution from 1.25 to 1.99 um for the purpose of object identification. The authors present the design of the two main parts--the computed tomography imaging spectrometer and the channeled spectropolarimetry components--discuss the reconstruction technique, and present the final assembled system and testing results. The system provides imaging spectropolarimetry with no moving parts and snapshot capability and has potential application in fields such as such as mining, biomedical imaging, and astronomy.

Detecting Buried Nonmetal Objects Using Soil Magnetic Susceptibility Measurements
Huang, Haoping; I.J. Won; Bill San Filipo.
Detection and Remediation Technologies for Mines and Minelike Targets VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 1181-1188, 2003

An M19 anti-tank mine is physically large (33cm×33cm×9cm), but has so little metal that metal detectors can miss it. When an M19 is buried in soil, it produces a cavity in magnetic susceptibility, which can be detected as a region of low or anomalous apparent susceptibility compared to the surrounding area. The authors derived a simple formula to compute the apparent magnetic susceptibility from the in-phase data at the resistive limit when using an electromagnetic (EM) induction sensor. The behavior of the apparent susceptibility for layered earth models was studied using synthetic data. Apparent susceptibility anomalies were predicted from these studies based on the susceptibility contrast and the geometry of the sensor and target. Experimental data were obtained using two sensors, a GEM-2 and a GEM-3.

Detection and Quantification of Specific Bacterial Populations Using PNA Molecular Beacons in an Integrated Microfluidic System
Xi, Chuanwu, L. Raskin, and S.A. Boppart, Univ. of Illinois at Urbana-Champaign.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 80, 2003

Research is under way to develop an integrated microfluidic system for the detection of specific bacteria using peptide nucleic acid (PNA) molecular beacons. Molecular beacons are oligonucleotide probes that can be used to detect specific DNA or RNA sequences in an aqueous solution without immobilizing either the target nucleic acid or the probe as is necessary in traditional hybridization assays. DNA and PNA molecular beacons were successfully used to detect ribosomal RNA (rRNA) in solution and to detect whole cells in fluorescence in situ hybridization (FISH) experiments without a wash step. PNA molecular beacons were superior compared to the DNA molecular beacons in three different ways: the hybridization kinetics of PNA molecular beacons were much faster, the signal to noise ratio of PNA molecular beacons hybridization outputs was much higher, and it was possible to use PNA molecular beacons to quantify rRNA. DNA molecular beacons were used to study (1) basic hydrodynamic properties in microfluidic channels, such as diffusion and mixing and (2) hybridization kinetics with extracted nucleic acids in microfluidic channels. PNA molecular beacons were used to detect and quantify extracted rRNA and bacterial cells in microfluidic channels in real time. PNA molecular beacons will be used to detect and quantify bacterial cells in a system that integrates excitation and detection fibers into the microfluidic channel and couples them with a miniaturized laser diode or light emission diode as the light source and a miniaturized spectrometer for detection.

Detection Capabilities of Different Molecular Lasers in Infrared Spectroscopic Diagnostics of Multicomponent Gas Mixtures
Ivanov, Sergey V.; A.A. Ionin; A.A. Kotkov; A.Y. Kozlov; L.V. Seleznev; O.G. Buzykin.
Laser Applications in Medicine, Biology, and Environmental Science.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5149, p. 161-168, 2003

Researchers evaluated and compared the capabilities of different molecular gas lasers (CO2, HF, DF, NH3, N2O and CO, including fundamental and first overtone transitions) in infrared absorption diagnostics of multicomponent mixtures. Analytical frequencies were selected for the lasers using spectroscopic databases to detect organic and inorganic pollutants using either low- or high-resolution spectra. Quantitative parameters characterizing the sensitivity and the selectivity of specific gas detection were calculated and compared for minimum detectable concentration, partial sensitivity, and partial selectivity. The NH3 and CO lasers exhibited the best spectroscopic detection characteristics.

Detection of Bacterial Toxin Using Biosensor with Bioengineered Enzymes
Marty, J.-L. (Univ/ De Perpignan, Perpignan, Pyr-Or, France), S. Andreescu, L. Barthelmebs, D. Fournier.
The Pittsburgh Conference: PITTCON 2003, Presentation 2310-9.

Fresh water neurotoxins, such as anatoxin-a(s), and hepatotoxin, such as microcystins, irreversibly inhibit acetylcholinestertase and protein phosphatase, respectively, and interfere with the detection of these compounds. The standard analytic method for detection involves HPLC and mass spectroscopy, but an alternative approach uses the strong inhibition of AChE by anatoxin-a(s) and of protein phosphatase by microcystin as sensors. For the detection of anatoxin-a(s), investigators produced an AChE sensitive to anatoxin-a(s) to obtain a high sensitivity and, in a four-mutant set, two mutants sensitive to the anatoxin-a(s) and two sensitive to insecticides, which led to the unambiguous identification of the toxin. The mutated enzyme brought the sensitivity below the nanomole per liter level. For the detection of microcystins, an improved protein phosphatase was engineered. The two sensors were developed using screen printing electrodes, and detection is based on the amperometric method.

Detection of Cyanide, Perchlorate, and Other Terrorist Weapons at ppb Levels in Water by FTIR Spectroscopy
Strauss, Steven H., Colorado State Univ., Fort Collins.
PITTCON 2003, March 9-14, Orlando, Florida. Abstract 1550-4.

A particular commercially-available silicon ATR-FTIR probe can be used to detect aqueous perchlorate ion down to 80 ppm with 60 minutes of signal averaging. When the same probe was coated with a redox-recyclable ion-exchange compound, the detection limit for aqueous perchlorate was lowered to 3 ppb at 30 minutes of contact time, an improvement in detection limit by a factor of more than 25,000. In another case, the detection limit for aqueous cyanide (pH 10) with a bare probe was 26 ppm with 60 minutes of signal averaging. When the probe was coated with a different ion-exchange compound, the detection limit decreased by a factor of 10,000 times to 2.6 ppb at 45 minutes of contact time. The author discusses this methodology and relates progress in lowering the detection limit of G-type nerve-agent hydrolysis products from the ppm to the ppb range.

Detection of Leaks in Underground Storage Tanks Using Electrical Resistance Methods
Ramirez, A.; W. Daily; A. Binley; D. LaBrecque; D. Roelant.
Journal of Environmental and Engineering Geophysics, 1, p. 189-203, Dec 1996

Two field experiments were performed under a 15 m diameter steel tank mockup located at the Hanford Reservation, WA, to evaluate the performance of electrical resistance tomography (ERT) as a leak detection method. This paper provides a summary of experiment results and supporting numerical simulations. In the first event, about 3800 liters of saline solution were released along a portion of the tank's edge and another 1900 liters were later released in the second event near the tank's center. The release rate averaged about 26 liters/hour for the leak on the tank's side and about 3.0 liters/hour for the center leak. Tomographs were calculated using data collected before, during, and after each spill. The 2- and 3-D tomographs mapped the spatial and temporal evolution of resistivity changes caused by the leak. As the solution penetrated the soil, readily detectable resistivity decreases were observed and used to map the associated plume. The metal tank had significant effects on the results obtained, primarily in reducing sensitivity to the leak. The plume associated with these releases could be reliably detected after release of approximately 190 liters. The metal tank and metal-cased boreholes were used as large electrodes. The authors extrapolate how these techniques could be used to detect and locate leaks and to delineate any plumes resulting from underground storage tank releases.

Detection of Mines Using Hyperspectral Remote Sensors and Detection Algorithms
Winter, Edwin M.
Detection and Remediation Technologies for Mines and Minelike Targets VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 625-630, 2003

With a high quality VNIR/SWIR hyperspectral sensor, it is possible to detect land mines as spectral anomalies using techniques that have been previously applied to the detection of military targets. Algorithms developed for the military surveillance application can be directly applied to the surface mine problem. This paper explores two different spectral anomaly approaches: the first is a local spectral anomaly detection algorithm that examines the color of each pixel for differences with its surroundings; the second is a global spectral anomaly detection algorithm that measures the color of each pixel relative to its occurrence in the whole scene.

Detection of Volatile Organic Compounds by Passive Fourier Transform Infrared Measurements from an Aircraft Platform
Wan, Boyong (Ohio Univ./Clippinger Laboratories, Athens, OH); Gary W. Small.
The Pittsburgh Conference: PITTCON 2003, Presentation 1180-21P.

Passive Fourier transform infrared (FT-IR) remote sensing measurements can be used to implement an automated detection algorithm for volatile organic compounds. Through a combination of pattern recognition methods and data preprocessing techniques, the detection procedure can be performed directly with short segments of the interferogram data collected by the FT-IR spectrometer. Digital filters are first applied to extract specific frequencies associated with the spectral bands of the target analyte vapor, while eliminating unwanted features arising from the infrared background. Independent component analysis (ICA) is then used to remove the dependencies of the variables by estimation of the underlying independent components of the data. This step enhances the extraction of the analyte-specific signals that comprise the data. Subsequently, pattern classification methods can be applied to the independent components to provide a yes/no decision regarding the presence of the analyte signature. When the spectrometer is mounted on an aircraft platform, these processing steps allow the implementation of an automated, real-time analysis technique to quickly survey a site for the presence of a target vapor. The authors discuss a methodology for the detection of plumes of ethanol and methanol released from heated stacks using a passive FT-IR spectrometer mounted on an aircraft platform to collect data in a downward-looking mode.

Determination of Explosives in Ground Water Using HPLC-UV-HV-EC
Marple, Ronita L. (Univ. of Maryland Baltimore County, MD), William R. LaCourse.
The Pittsburgh Conference: PITTCON 2003, Presentation 1980-7.

EPA 8330 Method is used for determining nitro compounds employing high performance liquid chromatography (HPLC) with ultra violet (UV) detection, but UV detection is not highly selective and requires large sample sizes with extensive sample preparation, plus groundwater samples shipped to a laboratory may degrade over time. For use in an on-site field unit, the authors have developed an enhanced EPA 8330 Method consisting of post-column photochemical derivitization and electrochemical detection (hv-EC) for improved determination of nitro compounds. The sensitivity of hv-EC, with detection limits in the sub-ppb range, allows a reduction in sample size from the one liter required by 8330 to two milliliters. Enhanced selectivity enables minimal on-line sample pretreatment. Dual detector confirmation for analyte characterization eliminates misidentification. This real-time analytical methodology coupled with vertical profiling can be used to characterize the vertical distribution of contaminants in groundwater. The development of this technique allows for a reduction in cost per analysis and for more accurate site assessment.

Determination of Henry's Law Constant for Methyl tert-Butyl Ether (MTBE) at Groundwater Temperatures
Fischer, A.; M. Muller; J. Klasmeier.
Chemosphere, Vol 54 No 6, p 689-694, 2004

The dimensionless Henry's law constant was determined for MTBE at six temperatures (3, 5, 10, 15, 20 and 25 degrees C) in a thermostatted flask (430 ml) containing an aqueous MTBE solution. The ratio between the gas phase and the water phase in the flask was approximately 1.7:1. The aim of this study was to acquire data needed to model the behavior of MTBE at groundwater conditions. The dimensionless Henry's law constant at 10 degrees C is approximately 0.01, but is 0.03 at 25 degrees C. In a second experiment, the water solubility of MTBE was determined to be 62.1 g/L at 5 degrees C and 35.5 g/L at 20 degrees C). This high solubility at low temperatures could result in the rapid spread of MTBE plumes from spills.

Determination of the Heavy Metal Binding Capacity of Aquatic Samples Using MetPLATE™: a Preliminary Study
Huang, F., G. Bitton, I.-C. Kong.
The Science of the Total Environment, Vol 234, p 139-145, 1999

The MetPLATE kit is specific to heavy metals and will detect and measure such substances in mixtures of other toxicants. For a visual qualitative measurement, the change in color of the test wells containing the samples is compared against the controls. The visual procedure is valuable in field testing, especially when screening large numbers of samples. Quantitative measurement requires a standard laboratory microplate reader or a portable reader with a 575 nm optical filter. A laboratory assistant can run more than 180 MetPLATE assays per day (one blank per sample, with no dilutions) in a production-style work area running many MetPLATE plates simultaneously. The use of MetPLATE to rapidly determine the heavy metal binding capacity of a wide range of surface waters from Florida and Georgia shows that the impact of physical and chemical parameters on the toxicity of metals in aquatic environments can be quickly assessed using rapid and low-cost microbiotests.

Determination of Ultratrace Fe, Cu, Cr, and Co Ions in Water Using a Miniaturized On-Line Luminescence System
Lim, H. (Dankook Univ., Seoul, Korea); H. Hong; D. Kim; J. Park.
The Pittsburgh Conference: PITTCON 2003, Presentation 90-51P.

This paper presents an on-line method to determine Cr(VI) using a highly sensitive and miniaturized on-line chemiluminescence lab-made system. The system consists of sample delivery robotics, chemical reservoirs, a detection cell, and a data acquisition system. The sample solution was delivered and injected into the small reaction cell by a capillary air pump with a robotic system. The instantaneous emission signal from the cell was detected with a pin type photomultiplier tube. For the determination of Cr(VI) in the presence of Fe, Cu, Co, or Cr(III), the system was consisted of a column filled with ion exchange resin to remove interferences, a reaction coil to reduce to Cr(III), and pumps. Precipitates produced in the reduction process were filtered and removed in the line by a peristaltic pump. The reaction order and rate of each metal with luminal (or 5-amino-2,3-dihydro-1,4-phthalazinedione) in the presence of hydrogen peroxide was determined as well. The use of an on-line capillary pump for sample injection produced endurable linear calibration curves and longer system life. Even when the sensitivity was reduced by dilution during the reduction, the automatic Cr(VI) detection system successfully determined 100ppb of Cr(VI).

Determination of Volatile Organohalogen Compounds in Contaminated Rocks
Gorecka, M. (Univ. of Waterloo, Waterloo, Ontario, Canada), B.L. Parker.
The Pittsburgh Conference: PITTCON 2003, Presentation 310-7P.

A new method has been developed for the determination of chlorinated solvents in contaminated rocks. Samples of rock cores were crushed immediately after collection in a custom-made hydraulic crusher. The crushed rock was transferred to glass jars filled with methanol. Extraction time profiles were determined for the extraction of trichloroethene (TCE) over several weeks, with the samples being periodically agitated on an orbital shaker. 1-mL aliquots of the extracts were collected at regular time intervals and analyzed by gas chromatography with electron capture detection. Direct on-column injection of the methanolic extracts into the GC column was used. The experiment showed that TCE concentration levels in the extracts in most cases reached steady state after approximately four weeks. A similar experiment on rocks from a different site contaminated with a broader spectrum of organochlorine compounds showed that analyte concentration levels in the extracts also reached steady state after approximately four weeks. The estimated method detection limits for TCE and PCE were 0.1 ug/kg rock. Several thousand samples from contaminated sites across North America have been analyzed by this robust and reliable method.

The Development and Comparison of Mercury Determination Technologies for Flue Gas Produced from Coal Combustion Process
Pan, Wei-Ping (Western Kentucky Univ., Bowling Green, KY), K. Liu, J.T. Riley.
The Pittsburgh Conference: PITTCON 2003, Presentation 460-4.

Two mercury determination technologies (OHM and SCEM) are being investigated: the Ontario Hydro Method, and the mercury semi-continuous emission monitor. The authors discuss factors affecting mercury emissions sampling, such as type of atmosphere and load and compare the SCEM and OHM with regard to the utilization limitation of OHM and SCEM in a coal-fired facility.

Development of a Passive, In Situ, Integrative Sampler for Hydrophilic Organic Contaminants in Aquatic Environments
Alvarez, D.A. (U.S. Geological Survey, Columbia, MO); J.D. Petty; J.N. Huckins; T.L. Jones-Lepp; D.T. Getting; J.P. Goddard; S.E. Manahane.
Environmental Toxicology and Chemistry, Vol 23 No 7, p 1640-1648, July 2004

A passive in situ sampling device, the polar organic chemical integrative sampler (POCIS), has been developed that integratively concentrates trace levels of complex mixtures of hydrophilic environmental contaminants, enables the determination of their time-weighted average water concentrations, and provides a method of estimating the potential exposure of aquatic organisms to the complex mixture of waterborne contaminants. Using a prototype sampler, linear uptake of selected herbicides and pharmaceuticals was observed for up to 56 days. Use of POCIS in field validation studies targeting the herbicide diuron resulted in the detection of the chemical at estimated concentrations of 190 to 600 ng/L. These values agree with reported levels found in traditional grab samples taken concurrently.
http://etc.allenpress.com/entconline/?request=get-document&issn=0730-7268&volume=023&issue=07&page=1640

Development of a Potentiometric Immunosensor for Herbicide Simazine and its Application for Food Testing
Yulaev, M.F. (Samarkand Medical Inst., Samarkand, Uzbekistan); R.A. Sitdikov; N.M. Dmitrieva; E.V. Yazynina; A.V. Zherdev; B.B. Dzantiev.
Sensors and Actuators B: Chemical, Vol 75 No 1-2, p 129-135, 30 Ap 2001

An immunosensor for the herbicide simazine has been developed based on the potentiometric detection of the peroxidase label after a competitive immune reaction on the electrode surface. Gold planar electrodes provided the most effective supports for the immunosensors. Total assay time is 14 minutes (including the electrode regeneration), the limit of simazine detection is 3 ng/mL, the operating lifetime of the sensor is 15 days, and 250 tests can be carried out with a signal decreasing not more than 10%. Two immunoanalytical techniques were applied to detect simazine in meat extracts, milk, tomatoes, cucumbers, and potatoes. For the first three substances, the herbicide was detected quantitatively without pre-treatment. Cucumber and potato matrices caused sorption of endogenous peroxidase, but this effect could be eliminated by 5 minutes of boiling.

Development of a Real Time In Situ Zinc Analyser and Water Sampler -- Results From High Resolution Monitoring of a Stream Impacted by Acid Rock Drainage
Chapin, T.P. and R.B. Wanty.
ICARD 2003: Sixth International Conference on Acid Rock Drainage, 14-17 July, Cairns, QLD. AusIMM Publications, Carlton South, Victoria 3053, Australia. ISBN: 1-875776-98-2, p 987-990, 2003

Most investigations of biogeochemical cycling in acid rock drainage (ARD) systems have involved synoptic sampling over longer time periods (one sample per week or month) or intensive time series studies over a few hours or days, but many important episodic loading events, such as seasonal meltwater and storm events, occur on time scales that are rarely captured by these traditional sampling approaches. The researchers have developed two novel instruments -- the Zn-DigiScan and the DigiSampler -- to examine low- and high-frequency temporal changes in ARD areas. The Zn-DigiScan is a battery-powered, real-time in situ chemical analyzer designed for long-term deployments with hourly analyses of Zn. Stream physical parameters (temperature, conductivity, dissolved oxygen, pH, turbidity, etc) are measured every 15 minutes with a water quality sonde. The DigiSampler provides for the long-term daily sampling of biogeochemically active elements and can take either discrete samples or samples integrated over 24 hours. The DigiSampler collects 2 ml samples in a Teflon coil that are separated by 0.2 ml nitrogen bubbles. The sample coil is returned to lab and the 2 ml samples are diluted 1:10 and analyzed for trace metals by ICP-MS. This paper provides the initial results from a three-day technology deployment of the two systems at Fisher Creek, MT.

Development of a Simple Scheme to Determine the Chemical Toxicity of Mine Wastes
Wildeman, T.R. and J.F. Ranville (Colorado School of Mines, Golden); J. Herron and R.H. Robinson (Colorado Division of Mineral and Geology, Denver).
2003 National Meeting of the American Society of Mining and Reclamation and 9th Billings Land Reclamation Symposium, 3-6 June 2003, Billings, MT. American Society of Mining and Reclamation, Lexington, KY.

A decision tree that uses simple physical and chemical tests has been developed to determine whether a mine waste poses a toxicity threat to the aquatic environment. For the chemical portion of the tree, leachate tests developed by the U.S. Geological Survey, the Colorado Division of Minerals and Geology, and a modified EPA 1311 TCLP test have been used extensively. The multi-element power of modern inductively coupled plasma, atomic-emission spectroscopy (ICP-AES) is also a necessary component of the scheme. Two field sites provided sediment and water samples for the analysis of 21 elements by ICP-AES. This paper details the results.

Development of an Eco-Sensor Based on Bilayer Lipid Membrane for the Continuous Monitoring of Environmental Pollutants
Ishimori, Y., K. Kawano, M. Ishizuka, M. Murahashi, E. Tamiya.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 86-93, Mar 2004

An eco-sensor for the measurement of environmental pollutants is based on lipid membranes for continuous monitoring of ground water at industrial sites. Modified lipid membranes serve as good models for cell membranes because they would be ideal hosts for receptor molecules of biological origin or disruptive environmental pollutants. The eco-sensor detected a 10 ppb level of volatile organic chlorinated compounds (VOCs) such as trichloroethene in ground water. The developers made a novel automatic bilayer lipid membrane preparation device and a new system for the continuous measurement of environmental pollutants in ground water.

Development of an IC/MS/MS Method for Low Level Determination of Perchlorate in Environmental Samples
Kurtz, Kristine (Clayton Group Services, Novi, MI) and Kem Charron.
The Pittsburgh Conference: PITTCON 2003, Presentation 740-3.

For determination of perchlorate in drinking water, EPA Method 314.0 employs ion chromatography (IC) and conductivity detection, with a reporting limit of 4 ug/L and method detection limit (MDL) of 0.53 ug/L. The report limit of 4 ug/L corresponds to the minimum reporting level established by the EPA for monitoring purposes. Improved analytical methodology sensitivities for perchlorate determination are needed because the current minimum reporting limit and state action levels approach the detection and quantitation capabilities of 314.0. The authors present an IC/MS/MS method that couples IC and tandem mass spectrometry (MS/MS) for the determination of low-level perchlorate in environmental samples. Greatly improved sensitivity and selectivity provide for a calculated MDL of 0.02 ug/L in reagent water. The method is applicable to various environmental matrices, and due to the inherent sensitivity and selectivity of MS/MS detection, matrix interferences are significantly reduced for biological samples such as vegetation and animal tissue.

Development of an In-Situ Microsensor for the Measurements of Chromium and Uranium in Groundwater at DOE Sites
Wang, Joseph, PI, New Mexico State Univ.
DOE/ER/62306, 12 pp, 2000

The goal of this program is to develop and test miniaturized analyzers for field monitoring trace levels of chromium (Cr) and uranium(U). Two avenues based on highly sensitive electrochemical stripping analysis have been explored for monitoring Cr and U in the field. The technique is based on an adsorptive accumulation of the metal complex, followed by electrochemical measurement of the surface complex. A novel hand-held micromachined hand-held flow stripping analyzer and remotely deployed submersible stripping probes have been developed and characterized. Both routes should allow testing of these and other trace metals more rapidly and easily in a field setting. The new devices should lead to substantially more effective and economic monitoring of priority metal pollutants. This report

summarizes activity over the 4 years of the project.
http://www.osti.gov/em52/final_reports/54639.pdf

Development of an Intelligent Polymerized Crystalline Colloidal Array Sensor for Organophosphate Chemical Warfare Agents
Walker, Jeremy P. (Univ. of Pittsburgh, Pittsburgh, PA) and Sanford A. Asher.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-1.

Researchers have developed an Intelligent Polymerized Crystalline Colloidal Array (IPCCA) chemical sensor for organophosphate compounds by attaching the enzyme acetylcholinesterase to polymerized crystalline colloidal array (PCCA) sensing materials. These IPCCAs are composed of monodisperse, highly charged polystyrene particles 100 to 1000 nm in diameter. These particles form an fcc crystalline periodic array, which is embedded into a polyacrylamide hydrogel network. Molecular recognition agents are attached to the polyacrylamide backbone of the hydrogel. When the analyte binds to the molecular recognition agent on the IPCCA, the hydrogel undergoes a volume phase transition, changing the periodicity of the CCA, which results in a shift in the wavelength diffracted. Acetylcholinesterase (AChE) is inhibited by the organophosphate compounds commonly found in chemical warfare agents and pesticides, and displays a high binding affinity for organophosphates. The organophosphates become charged species upon binding to AChE on the hydrogel, causing the hydrogel to undergo a volume phase transition, resulting in an increase in the spacing of the imbedded colloidal particles, which shifts the wavelength of light diffracted by the IPCCA. The shift can be monitored by the human eye or by a spectrophotometer. The magnitude of the wavelength shift of the diffracted light can be used to determine the concentration of the organophosphate present.

Development of Assessment Tools for Evaluation of the Benefits of DNAPL Source Zone Treatment
Strategic Environmental Research & Development Program. Cleanup CU-1293, 1 p, Nov 2003

The primary objective of this research is to develop and evaluate a suite of tools that can be used by site managers to predict and monitor plume development following DNAPL source zone treatment (e.g., in situ flushing) and to perform cost/benefit analysis during the selection of a source zone remediation technology. This research is a multidisciplinary integration of laboratory, field, and modeling studies designed to provide a more comprehensive understanding of the impacts of DNAPL source-zone treatment on contaminant mass flux, contaminant bioavailability, and future plume development. The effect of DNAPL source zone treatments on dissolved-phase contaminant concentrations in heterogeneous aquifer systems will be quantified under controlled laboratory conditions that are representative of DNAPL field sites. The potential for microbial reductive dechlorination following source zone treatment by surfactant flushing and air sparging will also be evaluated. A multiphase remediation simulator for applications to field-scale source zone mass removal estimation and post-treatment contaminant mass flux predictions in a variety of settings will be refined and validated. Using the bench-scale measurements and numerical simulations, sampling protocols designed to quantify near source zone contaminant mass flux and to estimate the uncertainty in these flux estimates will be developed and evaluated. Finally, cost-benefit analysis 'tools' that will provide site managers with an efficient and effective means to compare alternative source zone treatment methods, relative to baseline pump-and-treat plume containment, will be developed. This project began in FY 2002.
Contact: Dr. Linda Abriola, Tufts University, Medford, MA, 617-627-3237, linda.abriola@tufts.edu.

Development of Bacteriophage-Based Bioluminescent Bioreporters for Monitoring of Microbial Pathogens
Ozen, A., K. Montgomery, P. Jegier, S. Patterson, K.A. Daumer, S.A. Ripp, J.L. Garland, G.S. Sayler.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 58-68, Mar 2004

A bacteriophage is metabolically inactive, only achieving replicative capabilities upon infection of its specific host bacterium. Bacteriophage bioluminescent bioreporters contain a genomically inserted luxI component. During an infection event, the phage genes and accompanying luxI construct are taken up by the host bacterium and transcribed, resulting in luxI expression and subsequent activation of a homoserine lactone inducible bioluminescent bioreporter. The researchers constructed a vector carrying the luxI gene under the control of a strong E. coli promoter and cloned it into E. coli, which can induce luminescence up to 14,000 counts per second when combined with the bioreporter strain. These sensors will be developed as fully independent microelectronic monitors for microbial contamination, requiring only exposure of the biochip to the sample, with on-chip signal processing downloaded directly to the local area network of the environmental control system.

Development of Extraction Tests for Determining the Bioavailability of Metals in Soil
Strategic Environmental Research & Development Program. Cleanup CU-1165, 1 pp, Nov 2003

The primary objective of this project is to develop a suite of simple and easy-to-use extraction tests to predict human and ecological exposures to metals in soil. Soils used in the project will be characterized for metal species and soil parameters to provide a mechanistic basis for any differences in metals bioavailability among the samples. The results will also provide an understanding of how various species of a metal may differ in bioavailability and how various soil properties may affect metals bioavailability and the stability of the measured bioavailability estimates. This project will be framed around specific metals (i.e., arsenic, cadmium, copper, lead, nickel, and zinc) that are cost drivers for soil remediation at DoD sites and will focus on the most important receptors and exposure pathways for these metals. Historically, oral exposures to humans and terrestrial receptors have dominated risk assessments. Recently, dermal exposures have become more important in human health risk assessments as EPA adopts default dermal absorption values for some metals. A second aspect of the project will focus on assessing dermal absorption of arsenic and cadmium from soil. Dermal absorption of these metals from weathered soils has not been demonstrated to date. Initial studies will include animal studies and in vitro studies using human cadaver skin. After testing dermal absorption of these metals from weathered soils, development of a simple extraction test for dermal absorption will begin. This project began in FY 2001. Contact: Michael Ruby, Exponent, Boulder, CO, 303-444-7270, rubym@exponent.com.

Development of Spectroelectrochemical Sensors for Monitoring Mercury and Lead
Maghasi, Anne T. (Univ. of Cincinnati, Cincinnati, OH), William R. Heineman, Carl J. Seliskar.
The Pittsburgh Conference: PITTCON 2003, Presentation 230-8.

The authors have developed a sensor that couples stripping voltammetry with attenuated total reflectance spectroscopy. Stripping voltammetry is a standard technique applied to the detection of trace metals in many kinds of samples. Combining the preconcentration ability of stripping voltammetry with spectroscopy allows for even more sensitive detection. Optically transparent indium tin oxide (ITO) electrodes are used to deposit the metals and absorbance measurements are made as the metals selectively strip off the ITO at their characteristic potentials. The sharp re-oxidation signals from preconcentrated ions (Pb2+ and Hg2+) allow adequate detection, and selectivity from interferences. These reoxidation peaks correlate with an increase in sensor absorbance as the metals leave the ITO surface. Changes in sensor absorbance correlate with concentration, and linear calibration curves have been generated to detect trace amounts of mercury and lead.

Development of SPR-Based Sensors

Asano, Yasukazu, Hachinohe National College of Technology, Aomori, Japan.
The Pittsburgh Conference: PITTCON 2003, Presentation 330-1P.

A simple analytical instrument based on surface plasmon resonance (SPR) for the rapid screening of toxic substances in environmental samples incorporates a new light interface PVC membrane. The new membrane performance was sticky, stable, and practical after the researchers improved it by heating. An electrode constructed for field use involved a PVC membrane, Au-coated cover glass, and a sensor epoxy-body. When the Sprode SPR was used for immuno-sensing, a good calibration curve was obtained in the range of 0.1 to 30 ppm 2,4 dichlorophenol, which is similar to dioxin. The experimental results indicate that the new Sprode sensor method for SPR could be put into practice for toxic low-molecular organic substances, such as environmental hormones.

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, R.G.; 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

To better evaluate the success of in situ remedial systems at sites affected by chlorinated solvents, researchers are applying a set of diagnostic tools at three hydrogeologically distinct sites where innovative in situ chemical, biological, and physical treatment technologies are being implemented. 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 is used as 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, and are useful for a real-time diagnosis of remedial technology success. Technology- and geology-specific tools include rock core sampling, isotopic fractionation, molecular tools and integrated conventional techniques. The poster for this ESTCP-funded, 3-year project addresses the technical accomplishments to date.

Diamond Microelectronic Gas Sensor for Detection of Benzene and Toluene
Gurbuz, Y. (Sabanci Univ., Istanbul, Turkey); W.P. Kang; J.L. Davidson; D.V. Kerns.
Sensors and Actuators B: Chemical, Vol 99 No 2-3, p 207-215, 1 May 2004

Steady-state and transient responses of a diamond chemical sensor applied to detect benzene and toluene reveal that the sensor shows a large sensitivity, fast response, high selectivity, wider dynamic range, and repeatable/reproducible response for benzene and toluene gases. The detection mechanisms of the sensor for both gases have been analyzed. Activation energy analysis of the sensor for both gases resulted in a very small values, confirming fast response and high sensitivity. The authors discuss the production of a structurally optimum sensor.

Diffusion Samplers as an Inexpensive Approach to Monitoring VOCs in Ground Water
Vroblesky, D.A. and W.T. Hyde.
Ground Water Monitoring and Remediation, p 177-184, Summer 1997

Diffusion samplers installed in observation wells were found to be capable of yielding representative water samples for chlorinated volatile organic compounds. The samplers consisted of polyethylene bags containing deionized water and relied on diffusion of chlorinated volatile organic compounds (VOCs) through the polyethylene membrane. In wells at the study area, the VOC concentrations in samples obtained using the samplers without prior purging were similar to concentrations in water samples obtained from the respective wells using traditional purging and sampling approaches. The low cost associated with this approach makes it a viable option for monitoring large observation-well networks for VOCs.

Diffusive Partitioning Tracer Test for Nonaqeous Phase Liquid (NAPL) Detection in the Vadose Zone
Werner, D.; P. Hohener, Swiss Federal Inst. of Technology (EPFL), ENAC-ISTE-LPE, Lausanne, Switzerland.
Environmental Science & Technology, Vol 36 No 7, p 1592-99, 2002

A new partitioning tracer test for nonaqueous phase liquid (NAPL) detection in the vadose zone involves the injection into the vadose zone of a mixture of chlorofluorocarbons as gaseous tracers to form a point source at the injection point. While the tracers diffuse away, small volumes of gas are withdrawn from the injection point. The quantitative determination of the NAPL saturation is based on a comparison of the concentration decline of tracers with different air/NAPL partitioning coefficients. The rapid and inexpensive new method was used successfully for repeated NAPL quantification in a large-scale field lysimeter spiked with artificial kerosene. This test is potentially of value for site investigations in combination with soil gas measurements, because it requires similar equipment. The method could be applied to source delineation and repeated NAPL quantification in situ during a remediation.

Direct Investigation of the Fate of NAPL Contaminations in a Hydrating Cement Matrix by Means of Magnetic Resonance Techniques
Nestle, N. (Univ. Leipzig, Leipzig, Germany), P. Galvosas, C. Zimmermann, F. Stallmach, J. Karger.
Environmental Science & Technology, Vol 38 No 3, p 880-885, 2004

This paper presents the results of a study of the changes in the behavior of the solvent phases during the setting of cement pastes. Heavy water was used in the preparation of the cement pastes, and NMR relaxometry and pulsed field gradient (PFG) NMR diffusometry were used to study selectively the behavior of the nonaqueous phase liquid (NAPL) phases. The experimental results agree with observations from earlier studies concerning the behavior of toluene in hydrating cement. The researchers found surprisingly large networks of connected droplets of aliphatic solvents (cyclooctane, n-hexanol) in the cement matrices.

Disposable Potentiometric Enzyme Sensor for Direct Determination of Organophosphorus Insecticides
Gaberlein, Sonja; Meinhard Knoll; Friedrich Spener; Christiane Zaborosch.
Analyst, Vol 125 No 12, p 2274-2279, 2000

A potentiometric disposable enzyme sensor for the direct and fast determination of organophosphorus pesticides was developed by using an organophosphorus hydrolase (OPH) immobilized on an ion-selective electrode. The disposable screen-printed transducer was based on double matrix membrane technology, which allows easy mass production. The H+-sensitive electrode with integrated Ag/AgCl reference electrode was prepared with N,N-dioctadecylmethylamine as the H+-sensitive ionophore, and pH calibration resulted in slopes of 55 mV/decade over a pH range from 11 to 6. OPH was isolated from recombinant Escherichia coli DH5 and immobilized within poly(carbamoyl sulfonate) prepolymer on the surface of the H+-sensitive electrode without any further fixation membrane. The enzyme sensor exhibited a linear calibration range of 0.01-0.15 mM chlorpyrifos, 0.05-0.35 mM diazinon, 0.05-0.4 mM paraoxon and 0.007-0.05 mM parathion, respectively, and reaching 95% of maximum change in potential in 5 minutes or less.

DNAPL Site Characterization Using a Partitioning Interwell Tracer Test at Site 88, Marine Corps Base, Camp Lejeune, North Carolina
Duke Engineering, 131 pp, 1999

A partitioning interwell tracer test (PITT) was completed at Site 88, a dry cleaner site at the Marine Corps Base Camp Lejeune, NC. The PITT was conducted to estimate the saturation, volume, and spatial distribution of tetrachloroethene (PCE) present as a dense nonaqueous phase liquid (DNAPL) within the selected test area. The PITT results provide characterization of the initial DNAPL conditions at the site, in preparation for a surfactant-enhanced aquifer remediation (SEAR) demonstration to remove DNAPL from the surficial site aquifer. The PITT data have confirmed the results of earlier soil and ground-water investigations, which indicated that the highest DNAPL saturations are located in the shallow aquifer regions adjacent to the dry cleaning building, and within a layer of low-permeability sediments (i.e., clayey silt) just above a clay aquitard. A summary of the DNAPL investigations and other field activities conducted in conjunction with the PITT are provided in this report, along with the PITT results and data analysis.
http://enviro.nfesc.navy.mil/erb/erb_a/restoration/fcs_area/dnapl/dnapl-rpt_text.pdf

DNAPL Source Zone Characterization by the Stochastic Fusion of Information: Blueprint and Preliminary Results
Illman, Walter A. and T.-C. Jim Yeh, Univ. of Iowa, Iowa City.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 147, 2003

The spatial distribution, mass, and composition that dense nonaqueous phase liquids (DNAPLs) present in a source zone need to be characterized in great detail so that efficient remediation schemes can be designed. The authors present a blueprint and preliminary results of a technology that delineates DNAPL source zones in three dimensions without extensive invasive sampling. This new technology, based on the stochastic fusion of information methodology, assimilates results of hydraulic, conservative, and partitioning tracer tomography surveys to derive the best estimate of the DNAPL residual distribution and its uncertainty. It first analyzes the information derived from hydraulic tomography to identify the 3-D hydraulic heterogeneity of the aquifer, then improves the estimate of the heterogeneity by incorporating new information acquired from the conservative tracer tomography, and then the improved estimate of heterogeneity is used to simulate the hydraulic tomography such that more detailed information about the response of the subsurface becomes available. This new information again is fed back to the technique to update the estimate of the heterogeneity. The iterative process continues until the available information and measurements are fully utilized to identify the heterogeneity that controls the spatial distribution of DNAPLs. The newly derived knowledge of heterogeneity is used to design partitioning tracer tomography tests to accurately depict the spatial distribution of DNAPL residual saturation in the source zone. The proposed techniques will be tested and validated in both numerical experiments and a sandbox under SERDP Project CU-1365.

Electrical Resistance Tomography
Daily, W. and A. Ramirez (LLNL, Livermore, CA); A. Binley (Lancaster Univ., UK); D. Labrecque (Multi-Phase Technologies, LLC, Sparks, NV).
The Leading Edge, Vol 23 No 5, p 438-442, May 2004

Due to the development of robust inversion routines and suitable data acquisition systems, electrical resistance tomography (ERT) has been applied to a wide range of environmental and engineering problems, including the monitoring of vadose zone water movement, steam injection, and air sparging. Earlier applications concentrated on dc resistivity imaging. More recently, extensions that allow treatment of resistivity as a complex (real and imaginary) value have been developed, driven by experimental observations of relationships between complex resistivity and both lithology and pore fluid contamination. The authors describe the testing of a system in which ERT surveys can be carried out remotely. This setup uses satellite communications to remotely control a field measurement system, which reduces the need for site visits to a minimum and allows frequent, cost-effective surveys.
http://www.es.lancs.ac.uk/es/people/teach/amb/Publications/Daily_et_al_2004.pdf

Electrical Resistance Tomography for Steam Injection Monitoring and Process Control
Ramirez, A.L., Daily, W.D., and Newmark, R.L.,
Journal of Environmental and Engineering Geophysics, No 1, p 39-51, July 1995

Electrical resistance tomography (ERT) was used to map, in near-real time, the subsurface effects of two in situ thermal treatment processes--steam injection and ohmic heating--as part of a demonstration of Dynamic Underground Stripping at a gasoline-contaminated site. ERT uses a dipole-dipole measurement technique to measure the bulk electrical resistivity distribution in the soil mass. The investigators detected the effects of steam invasion and ohmic heating by mapping spatial and temporal changes in soil resistivity. During steam injection, the resistivity changes in the saturated zone were caused primarily by increases in pore water and soil temperatures, and to a lesser extent by changes in liquid saturation and groundwater electrical conductivity. During ohmic heating, the resistivity changes were caused by temperature increases, liquid saturation changes, and changes in the groundwater's electrical conductivity. This test demonstrated that ERT tomographs, used in combination with other data, can be used reliably to monitor and control the progress of subsurface thermal remediation.

Embedded Sidewall Samplers and Sensors to Monitor the Subsurface
Murdoch, Lawrence C.; William W. Slack; William Harrar; Robert L. Siegrist.
Ground Water, Vol 38 No 5, p 657-664, Sep 2000

To improve the resolution of subsurface monitoring, a method has been developed for accessing the sidewall of a vertical or angled borehole at many discrete intervals along the entire length of the borehole. The method uses an access device that embeds sensors or sediment samplers laterally through the borehole sidewall into the undisturbed formation to distances slightly less than the diameter of the borehole. The access device also can obtain a core sample up to 15 cm long and 4 cm in diameter, and then insert a permeable sleeve for extracting fluid samples (water, gas, NAPL). The system has been used under field conditions in the U.S. and Denmark to place electrodes capable of measuring water content (using TDR waveguides), Eh (using platinum electrodes), or electrical resistivity (using a 4-conductor electrode). The device also has been used to measure in situ Eh at a site where strong chemical oxidants were injected to remediate sediments contaminated by organic chemicals.

Encyclopedia of Sensors
American Scientific Publishers, Stevenson Ranch, CA. ISBN: 1-58883-056-X, 8000 pp, 2005

This publication will be the first encyclopedia ever published in the field of sensors. The multivolume encyclopedia will provide complete coverage of most recent advances and emerging new sensor technologies in the fields of science, engineering, and medicine. Although there are many books focused on sensors, no encyclopedic reference work has yet been published. This encyclopedia will cover all aspects of sensor science and technology dealing with all types of sensor materials, their synthesis and spectroscopic characterization, sensor designs, fabrication and, manufacturing techniques, sensor probes, features, physical, chemical and biosensors, their applications in electronics, photonic and optoelectronic industries, medicine, surface sensing, food industry, environmental engineering, and nanotechnology. It is written for a wide range of audience from non-scientists to active scientists and engineers, professionals, and experts working in the field of sensors.

Engineering Geology Field Manual, 2nd Edition
U.S. Dept. of the Interior, Bureau of Reclamation, 2 vols., 2001

The manual establishes common guidelines, procedures, and concepts for the collection, evaluation, and presentation of geologic information. The analysis of geologic conditions, the preparation of designs and specifications, and effective monitoring of construction require consistent, comprehensive, and timely geologic information. The use of these guidelines for collecting, documenting, evaluating, and presenting geological and geotechnical data promotes consistency, helps assure that the required evaluations and data are complete, and promotes integration and coordination of geological and engineering activities. Volume I contains material commonly needed in the field, and Volume II includes reference and supplementary information.
http://www.usbr.gov/pmts/geology/fieldmap.htm

Engineers Develop New Chemical Sensor Based on Experimental Physics Breakthrough
GlobalTechnoScan, 9-15 Jan 2002

When molecules interact with metal surfaces, tiny electrical currents are produced. This discovery may enable the development of a new generation of chemical detectors. Investigators led by Eric McFarland at the University of California, Santa Barbara, were searching for what they call "chemicurrent," or electrons excited by low-energy chemical reactions. The team incorporated a Schottky diode into a new chemical sensor. A Schottky diode comprises a thin metal film nearly one hundred-millionth of a meter thick, made of silver, gold, platinum or another metal, sprayed onto a silicon wafer. The Schottky sensor can capture the energized electrons, producing a measurable electrical signal. The researchers found that the diode can function as a species-specific gas detector because different kinds of molecules produce different signals. Different metals are better for detecting particular molecules, and every detectable chemical produces a characteristic signal, so the sensor can differentiate among a variety of species. Multiple sensors also can work together as arrays. The Schottky detector can operate at a wide range of temperatures, between 23 to 150 degrees C, is inexpensive to produce, and can be reactivated simply by warming its surface. The new findings and the associated detector technology may one day find wide use in a variety of industrial applications, and the group has already sold prototype devices to a major electronics manufacturer for use in semiconductor materials production. The work was funded by the National Science Foundation. Contact: Josh Chamot, National Science Foundation, 703-292-8070, jchamot@nsf.gov.

Enhanced Access Penetration System (EAPS). Draft Final Technical Report
Applied Research Associates, Inc., 66 pp, Jan 2004

DOE funded the development of a direct push (DP) system able to drill through refusal points. This report describes an evaluation study of the Enhanced Access Penetration System (EAPS), which extends cone penetrometer penetration depth. EAPS consists of four major components: (1) a Wireline CPT/Gas sampling probe and wireline soil and groundwater sampling system, (2) a small diameter air rotary drilling system, (3) environmental sensors that are used to detect and characterize contamination in both real and near-real time, and (4) an integral drill spoils collection and filtration system.
http://clu-in.org/download/char/enhanced_dp_evaluation_report.pdf

An Enlightened Approach to Screening for Dioxins
Environmental Health Perspectives, Vol 105 No 11, p 1176-1177, Nov 1997

Scientists have had a bright idea about how to screen for environmental toxins. Researchers at the University of California at Davis have developed a bioassay system to detect polyhalogenated aromatic hydrocarbons such as dioxins in environmental samples. Dubbed the CALUX (for chemically activated luciferase gene expression) system, the assay is based on recombinant cell lines into which researchers have inserted the firefly luciferase gene. When exposed to dioxin-like compounds, the recombinant cells luminesce.
http://ehp.niehs.nih.gov/docs/1997/105-11/forum.html

Environmental Geotechnics in the New Millenium
Benson, Craig H., Univ. of Wisconsin-Madison.
Geotechnics for Developing Africa: Proceedings of the 12th African Regional Conference on Soil Mechanics and Geotechnical Engineering (G. Wardle, G. Blight, and A. Fourie, eds.).
Balkema, Rotterdam, ISBN: 9058090825, p 9-22, 1999

This paper reviews the development of environmental geotechnics and describes thrust areas for future work. The discussion focuses on four key areas: site characterization, remediation, waste containment, and beneficial reuse of industrial byproducts. Thrust areas for the new millennium include innovative remediation technologies such as reactive walls and other treatment methods not constrained by mass transfer limitations, risk-based cleanup, bioreactor landfills, and beneficial reuse of industrial byproducts.
http://www.uwgeotech.org/pubs/r_benson_environmental.pdf

Environmental Magnetism: Principles and Applications of Enviromagnetics
Evans, Michael E. and Friedrich Heller.
Academic Press/Elsevier Science, San Diego, CA. International Geophysics Series, v. 86. ISBN 0-12-243851-5, 299 pp, 2003

This text explores the applications of magnetism to materials in the natural environment. The table of contents indicates that all aspects of enviromagnetics are explored -- what it is, what the magnetic substances and their properties are, where they came from, how they are measured and what the techniques are, processes that lead to magnetic signals, chronological factors, and the areas of study in which environmental magnetism are applied (e.g., climate change, environmental pollution, magnetism in the biosphere). The book is geared toward advanced undergraduates, graduate students, and interested professionals. Most of the information is data-driven and conveyed in the form of examples, scientific research results, and graphical illustrations. The book contains a glossary that brings together the jargon of all specialists in the perceived reading audience -- from "astronomers to zoologists."

Environmental Monitoring and Characterization
Artiola, J.F.; I.L. Pepper; M.L. Brusseau (eds.).
Academic Press, ISBN: 0-12-064477-0. 300 pp, 2004

This text reviews the latest methods for monitoring environmental information and interpreting it in relation to specific site characteristics. From remote sensing to soil and ground-water testing, the contributors review techniques for monitoring changes in soil and the vadose zone, surface and ground water, and near-surface air quality. The authors describe in detail how to collect, evaluate, and interpret environmental data, including statistical analysis and model development for some scenarios.

Environmental Monitoring Using Optical Techniques
Svanberg, Sune.
12th International School on Quantum Electronics: Laser Physics and Applications.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5226, p. 234-237, 2003

The author presents an overview of the following optical techniques for environmental monitoring: differential absorption lidar, fluorescence lidar, diode lasers for atmospheric gas analysis, and the gas correlation principle for real-time imaging of hydrocarbons. Several types of such optical environmental monitoring are illustrated with examples from research at the Lund Institute of Technology, Sweden.

An Environmentally Friendly Decontamination Protocol for Ground Water Sampling Devices
Parker, Louise V. and Thomas A. Ranney.
Groundwater Monitoring & Remediation, Vol 23 No 2, p 84-91, Spring 2003

Investigators tested several detergent-washing/air-drying decontamination protocols to determine their ability to remove residual organics contamination from two types of groundwater sampling devices: a simple bailer and a much more complex bladder pump. A hot-detergent wash, hot-water rinse, and hot-air drying protocol proved to be effective.

ESTCP Cost and Performance Report: Applied Innovative Technologies for Characterization of Explosives-Contaminated DoD Building Foundations and Underlying Soils (CU-0130)
U.S. DoD, Environmental Security Technology Certification Program (ESTCP), 49 pp, Feb 2004

ESTCP evaluated a variety of methods for characterizing foundations, adjacent areas, and underlying soils without having to remove the buildings and foundations first. As part of this demonstration, field test methods--Raman spectroscopy, Expray colorimetric indicator, and the Cold Regions Research and Engineering Laboratory (CRREL) Royal Demolition Explosive (RDX) colorimetric field screening method--were evaluated at five buildings to determine the presence and/or concentration of nitrocellulose or nitroglycerine in soil samples and concrete slabs. Raman spectroscopy was also evaluated for identifying the presence of organic compounds used in the manufacturing processes.
http://www.estcp.org/documents/techdocs/cu-0130.pdf

Evaluation of Perchlorate Biodegradation Using Chlorine Isotope Analysis
Hatzinger, P.B. (Shaw Environmental, Inc., Lawrenceville, NJ); N.C. Sturchio; M.D. Arkins; C. Suh; L.J. Heraty.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4

December 2003, Washington, DC. Poster Session Abstracts, p 170, 2003

When evaluating the biological degradation of perchlorate in the field, evaluating the performance of in situ bioremediation is complicated by the difficulty of distinguishing chemical loss due to biodegradation from abiotic loss mechanisms, such as dilution and adsorption. In addition, it is often difficult to document slow biodegradation processes that are occurring naturally over time (i.e., intrinsic bioremediation). Stable isotope analysis of light elements (e.g., H, C, N, Cl) has been used to successfully differentiate biodegradation of common pollutants, such as chlorinated solvents, gasoline constituents, and nitrate, and from other non-biological loss mechanisms for these compounds, but little information exists concerning the application of this technique for evaluating perchlorate biodegradation. Researchers quantified chlorine isotope fractionation during perchlorate reduction by Dechlorosoma suillum JPLRND, an isolate initially obtained from a perchlorate-contaminated groundwater source in southern California. The values of the chlorine isotopic fractionation factor were derived from two studies with this organism. The values show that the rate of the 35ClO4 reduction by this organism is ~1.3-1.7% faster than that of the 37ClO4 reduction. This large isotope effect suggests that chlorine isotope analysis will be a sensitive technique to document in situ bioremediation of perchlorate in groundwater. Additional studies are underway to evaluate chlorine isotope fractionation during microbial perchlorate reduction in a field setting and to evaluate the use of isotope analysis to distinguish perchlorate sources.

Evaluation of the Performance of the Disposable En Core® Sampler to Store Low Concentrations of VOCs and EPA Method 1311 Volatile Organic Analytes
Sorini, S.S., J.F. Schabron, and J.F. Rovani, Jr.
American Society for Testing and Materials, West Conshohocken, PA. ASTM Research Report D34-1013, 2001

To generate data for inclusion in ASTM Practice D 6418, "Standard Practice for Using the Disposable En Core® Sampler for Sampling and Storing Soil for Volatile Organic Analysis," a study was performed in which soil samples in the En Core® Samplers were spiked with low-level concentrations of VOCs at approximately 100 g/Kg and stored under various conditions prior to analysis. A second study also was performed to generate data on the performance of the 25-gram disposable En Core® sampler to store soil samples spiked with EPA Method 1311, "Toxicity Characteristic Leaching Procedure," volatile organic analytes under various conditions for 14 days. The storage of samples destined for characterization using EPA Method 1311 is another use of the En Core® sampler for which performance data are beneficial. This research report describes the study that was conducted to generate data on the performance of the En Core® sampler to store soils spiked with low-level concentrations of VOCs. The data are presented in Appendix X1 of ASTM Practice D 6418. This report also describes the study that was conducted to generate data on the performance of the 25-gram En Core® sampler to store soil samples spiked with EPA Method 1311 volatile organic analytes. These data are presented in Appendix X2 of ASTM Practice D 6418.

Evaluation of Two Portable Lead-Monitoring Methods at Mining Sites
Drake, P.L. (NIOSH, Spokane, WA); N.J. Lawryk; K. Ashley; A.L. Sussell; K.J. Hazelwood; R. Song.
Journal of Hazardous Materials, Vol 102 No 1, p 29-38, 15 Aug 2003

Two methods for measuring airborne lead with field-portable instruments have been developed by the National Institute for Occupational Safety and Health (NIOSH). NIOSH Method 7702 uses X-ray fluorescence (XRF), and Method 7701 employs ultrasonic extraction (UE) followed by anodic stripping voltammetry (ASV). Lead concentrations measured by both portable technologies in the field were found to be highly correlated with the laboratory method, suggesting that they are suitable as screening methods for airborne lead at mining sites.

Evaluation Report with Appendix: Certification Statement for HAPSITE(R) Portable Gas Chromatograph Mass Spectrometer Manufactured by: INFICON(R) Inc.
CalEPA, California Environmental Technology Certification Program. 75 pp, Mar 2004

California EPA's Department of Toxic Substances Control (DTSC) has certified the analytical capabilities of the HAPSITE portable gas chromatograph-mass spectrometer (GC-MS) system as a field-based analytical method as well as a laboratory instrument for measuring volatile organic compounds (VOCs) in water, soil and soil gas. This certification report evaluates the performance of the HAPSITE instrument based on a detailed review of data packages submitted by the technology proponent, field data generated by independent parties, and new data collected under the oversight of the California Environmental Technology Certification Program.
http://www.clu-in.org/download/techdrct/tdcalepa_hapsite_cert_report.pdf

Explosive Chemical Emissions from Landmines
Phelan, J.M.; J.L. Barnett; J.V. Romero; D.R. Kerr; F.A. Griffin.
Detection and Remediation Technologies for Mines and Minelike Targets VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 746-754, 2003

Chemical sensing for buried landmines involves mine chemical emissions, soil chemical transport and degradation, and detection at the ground surface. Mine chemical emission tests were performed on four antipersonnel landmines using whole landmines in soil flux chambers. Soil flux chambers are simple containers that surround landmines with dry soil that act as an adsorbent. After a certain soak time, residue analysis of the soil provides the total chemical emission -- a combination of both permeation and leakage. An evaluation of permeation differences into wet soil versus dry soil was completed using thin polymer coupon sections.

Eyes in the Sky ... Remote Sensing Technology Maps Flow of Groundwater from the Air
U.S. DOE, National Energy Technology Laboratory.
TechLine, 28 Aug 2003

DOE is using remote sensors suspended from helicopters to map the flow of groundwater that might be affected by energy projects. With aerial remote sensing techniques, researchers are "seeing" through solid ground to create 3-D images of the flow of groundwater as deep as 1,000 feet below the earth's surface. By mapping groundwater flow, DOE's Office of Fossil Energy seeks to guard against mining disasters, protect precious water resources, and clean up the environment. To map the flow of groundwater, a helicopter flies a prepared grid pattern at about 200 feet above the ground. Dangling about 100 feet beneath the belly of the helicopter is one of two types of remote sensors, both of which

operate somewhat like sonar or radar, sending out signals and receiving back a sort of echo. The frequency-domain sensor looks something like a torpedo or a super-sized sausage and sends out six different frequencies of electromagnetic waves. The time-domain sensor, which looks like a giant spider web, uses a single, lower-frequency signal that penetrates deeper into the ground. Different substances echo differently, so researchers are able to distinguish between solids and liquids, rocks and water. The technology also can roughly determine the quality of the water. More contaminated or salty water returns a stronger signal. The aerial data are supplemented with more detailed, on-the-ground data collected with hand-held sensors. By analyzing the data using a geographic information system database, researchers can produce a 3-D image of groundwater flow called a conductivity depth image. The toolbox approach deploys different sensing devices depending on what the researchers are looking for. Electromagnetic sensing is the 'workhorse' used in almost every flyover, but it can be supplemented with other kinds of remote sensing, such as thermal infrared, which detects groundwater seeping out of the ground, and magnetometry, which provides information about underground faults and other geologic features. Contact: David J. Anna, DOE National Energy Technology Laboratory, 412-386-4646, anna@netl.doe.gov.
http://www.netl.doe.gov/publications/press/2003/tl_flyovers.html

A Fast, Economical and Reliable Method for the Analysis of Aromatic Compounds in Carbon Dioxide
Hillard, R.M. (GOW-MAC Instrument Company, Bethlehem, PA); P.S. Mathieu; W.T. Robertson.
The Pittsburgh Conference: PITTCON 2003, Presentation 750-7.

In the beverage industry, contamination of raw carbon dioxide with benzene, toluene, ethylbenzene, and the xylenes (especially benzene) is of tremendous concern to beverage bottlers because of the obvious health considerations, as well as the enormous expense and unfavorable public relations fall-out of a publicized contamination event with subsequent product recall. The GOW-MAC Instrument Company Series 200 Aromatic Hydrocarbon Analyzer utilizes a newly designed photoionization detector coupled with a proprietary speciation system capable of non-interfering detection of BTEX (with detection limits less than 5 ppb) within the matrix of carbon dioxide impurities. The Series 200 is designed for hands-free operation via a simplistic user interface to a newly developed data handling system for fast and easy constant monitoring and reporting.

Femtosecond LIDAR: New Perspectives of Atmospheric Remote Sensing
Rodriguez, M.; R. Bourayou; J. Kasparian; G. Mejean; A. Mysyrowicz; E, Salmon; R.A. Sauerbrey; H. Wille; L. Woste; J.-P. Wolf; J. Yu; W. Zimmer.
Laser Applications in Medicine, Biology, and Environmental Science.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5149, p 135-146, 2003

The authors present the basic concepts of the femtosecond lidar and the results of laboratory experiments and recent atmospheric measurements.

Fiber Optic Biosensors for Halogenated Organics in Groundwater
Acha, V. (Colorado State Univ., Fort Collins); W.B. Willis; K.F. Reardon.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 81, 2003

Fiber optic biosensors have been developed for detection of certain chlorinated organics in groundwater based on measurement of a pH change generated by the sensor's biocomponent. This pH shift is proportional to the analyte concentration. Biosensors for 1,2-dichloroethane, atrazine, and ethylene dibromide (1,2-dibromoethane) have been developed and characterized. The sensors have detection limits of less than 0.1 ppb with linear response ranges of at least 2 to 4 orders of magnitude.

Fiber-Optic Chemical Sensors and Biosensors
Wolfbeis, O.S.
Analytical Chemistry, Vol 76 No 12, p 3269-3284, 2004

Abstract not available.

Fiber Optic Multimeter for Interrogating an Array of Absorption-Based Optochemical Sensors
Paolesse, R.; C. Di Natale; A. Macagnano; S. Nardis; A. D'Amico; A.A. Mencaglia; P. Bizzarri; A.G. Mignani.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 140-144, 2004

The authors describe a fiber-optic multimeter, consisting of a platform for interrogating an array of absorption-based chemical sensors, that has been validated on a set of porphyrin-based materials with gas-sensor potential. Discrimination between different kinds of gases has been demonstrated.

Field Demonstration of a Microcantilever Sensor for Monitoring Mercury in Water
Hu, Zhiyu (Oak Ridge National Lab, Oak Ridge, TN), G.M. Brown, P.G. Datskos, T. Thundat.
The Pittsburgh Conference: PITTCON 2003, Presentation 2580-3.

A stand-alone, fieldable, microcantilever-based sensor has been developed for the measurement of the mercury concentration in water. The gold-coated microcantilever sensors are ideally suited for real-time, remote, long-term monitoring of the concentration of mercury in surface water or groundwater. A silicon or silicon nitride microcantilever, coated on one side with a thin layer of gold, will bend when exposed to small concentrations of either mercury vapor or Hg(II) ions in solution because the mercury spontaneously amalgamates with the gold, stressing the thin film and causing the microcantilever to bend. This paper describes the design of a portable, two-cantilever system with provisions for the flow of ground or surface water through the cantilever chip liquid cell. Cantilever deflection is determined optically in a rugged design that requires 120V power and a laptop computer for operation. The ideal system would operate on battery power and detect and monitor Hg in surface water at <200 parts per trillion.

Field Evaluation of an Echellette-Based Aerosol Beam Focused Laser-Induced Plasma Spectrometer
Cheng, M. (Oak Ridge National Lab, Oak Ridge, TN); L. Alejo; J. Kornuc; H. Brown.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 16, 2003

An aerosol measurement technology utilizing an improved version of laser-induced plasma emission spectroscopy (aerosol beam focused laser-induced plasma, or ABFLIPS) was tested in the field to measure, in near real time, the elemental composition of airborne particles. A compact, rugged Echellette spectrometer enabled the real-time, multi-element measurement capability of ABFLIPS. The latest field test of ABFLIPS was conducted under low-temperature and low-moisture conditions at the Naval Aviation Depot in San Diego in July 2003. Prepared solutions containing three elements (Cr from K2Cr2O7, Ni from NiCl2, and Cd from CdCl2) at three selected strengths were used as targets for experiments. A pneumatic nebulizer produced metal-laden aerosol particles with approximately 106 particles per cc containing all three elements of different concentrations. Plasma emission lines for elements embedded in the aerosol particles were identified. Many spectra were collected for each test case, resulting in gigabytes of data for the field campaign. The test sources were a chromium plating shop, an electrode-less nickel bath area, and a Kirk site smelting pot. Variation in the element concentrations due to spiking of aerosol elements was detectable by ABFLIPS at all three sites; other elements present in the original waste stream also were identified. Quantitative determination of the identified target elements in the Echellette spectra remains a challenge for further work. The ABFLIPS was operated either from a roof area or on a 3' by 8' man-lift platform 30' above the ground adjacent to the emission duct, demonstrating high flexibility and field mobility of the unit. The preliminary results are presented.

Field Fluorometers as Dispersed Oil-in-Water Monitors
Lambert, P., M. Goldthorp, B. Fieldhouse, Z. Wang, & M. Fingas (Environment Canada, Ottawa, ON); L. Pearson & E. Collazzi (Alaska Dept. of Environmental Conservation, Juneau).
Journal of Hazardous Materials, Vol 102 No 1, p 57-79, 15 Aug 2003

A laboratory study of the Turner Instrument flow-through models 10AU and 10 fluorometers was conducted to review their ability to measure real-time oil-in-water concentrations, to compare the results to other total petroleum hydrocarbon (TPH) procedures and to improve the understanding of the relationship of the fluorescence to the chemical composition of the oils. The signal outputs of the fluorometers showed that the fluorometer data could not be directly linked to the concentration of any specific aromatic hydrocarbon, such as naphthalene, or to the sum of the polycyclic aromatic hydrocarbon (PAH) compounds. The fluorescence signal may be generated by a combination of PAH compounds and/or be influenced by the presence of volatile aromatic compounds such as benzene, toluene, ethyl benzene and xylene (BTEX) and C3-benzenes (BTEX + C3B) in combination with the PAH compounds.

A Field Program to Identify TRI Chemicals and Determine Emission Factors from DoD Munitions Activities
Strategic Environmental Research & Development Program. Compliance CP-1197, 1 pp, Nov 2000

The objective of this project is to demonstrate a methodology for measuring emissions of Toxics Release Inventory (TRI) chemicals from munitions activities and to apply the method to determine emission factors from munitions activities at DoD facilities. An instrument package will be assembled to measure a target list of TRI and related chemicals. This instrument package will be tested and optimized in the laboratory and then deployed in a mobile laboratory for field campaigns. Two types of campaigns will be conducted: one will focus on emissions from the discharge of weapons (point of discharge studies), and the other will focus on emissions from explosion on impact (point of impact studies). These field campaigns will be conducted at the Aberdeen Test Center in Maryland. The project began in FY 2001. Contact: Dr. Chet Spicer, Battelle Columbus, Columbus, OH, 614-424-5319, spicerc@battelle.org.

Field Screening Protocols and Use of SCAPS Petroleum Hydrocarbon Sensor Technology for Real-Time Indirect DNAPL Detection

Kram, Mark L.
Journal of Soil Contamination, Vol 7 No 1, p 73-86, 1998

The Site Characterization and Analysis Cone Penetrometer System (SCAPS), with real-time POL hydrocarbon detection capabilities, was used to delineate subsurface contaminant releases at a former Fire Fighter Training Facility where both petroleum hydrocarbons and chlorinated solvents were released. Petroleum compounds present in the deeper soils suggest that chlorinated solvents (which are denser than water) transported them to these unexpected depths as they migrated via gravity and advection. Analyses of soil samples taken from the subaqueous depths in question confirmed that vinyl chloride was co-mingled with petroleum hydrocarbons. This discovery suggests that the SCAPS fuel hydrocarbon detection system may be capable of indirectly delineating associated dense nonaqueous phase liquid (DNAPL) in the subsurface at contaminant release sites.

Field Testing APVO/GPR Techniques at a NAPL Contaminated Site

Jordan, T.E. and G.S. Baker (Univ. at Buffalo); K. Henn (Tetra Tech NUS); J.-P. Messier (U.S. Coast Guard).
SEG International Exposition and 73rd Annual Meeting, 26-31 October 2003, Dallas, Texas. Extended Abstracts. Society of Exploration Geophysicists, Tulsa, OK. p 1177-1179, 2003

This paper presents results and data collection techniques used for field testing amplitude and phase variation with offset analysis of ground penetrating radar data (APVO/GPR) at a site that experienced a release of light non aqueous phase liquid (LNAPL) to silty sand soils. The results indicate that APVO/GPR techniques may be a more robust method for delineating LNAPL (JP-4 and JP-5) at the water table relative to the use of common offset GPR surveying methods. The use of APVO/GPR techniques also may be useful for identifying and differentiating anomalous amplitude responses due to stratigraphic or hydrogeologic changes from the presence or absence of NAPL.
http://seg.org/publications/archive/exAbsHist/

The First Vadose Zone Partitioning Interwell Tracer Test for Nonaqueous Phase Liquid and Water Residual

Mariner, P.E. (Duke Engineering & Services, Grand Junction, CO); M. Jin; J.E. Studer; G.A. Pope.
Environmental Science & Technology, Vol 33 No 16, p 2825-2828, 1999

A partitioning interwell tracer test conducted in 1995 in the vadose zone beneath two buried organic liquid disposal trenches at Sandia National Laboratories in New Mexico was carried out to estimate the amount and distribution of trichloroethene (TCE) trapped by capillary forces as residual dense nonaqueous phase liquid (DNAPL). The most useful of the seven tracers injected were sulfur hexafluoride (nonpartitioning), perfluoro-1,3,5-trimethylcyclohexane (TCE-partitioning), and difluoromethane (water-partitioning). Both a TCE-partitioning tracer and a water-partitioning tracer were needed to determine average TCE DNAPL saturation. Average saturations of DNAPL and water were measured as 0.11 +/- 0.02% and 23 +/- 2.0%, respectively, in the shallow zone between 3.0 and 10.7 m. There was no evidence of DNAPL below a depth of 9 m. These results had important implications for remedial actions at the site.

Flexible Time Domain Reflectometry Probe for Deep Vadose Zone Monitoring
Dahan, Ofer (Desert Research Institute, Reno, NV); E.V. McDonald; M.H. Young.
Vadose Zone Journal, Vol 2 No 2, p 270-275, May 2003

The authors present a new methodology using time domain reflectometry (TDR) for water content monitoring in deep vadose zone horizons. The method uses flat, flexible, waveguides pressed against the wall of a borehole. The flexible TDR waveguides are attached to the outer side of a flexible sleeve filled with a liquid resin. The resin generates hydrostatic pressure that forces the flexible waveguides against the borehole wall, ensuring a close fit to the irregular shape of the borehole walls. The probe can involve either a standard TDR technique, which uses a cable tester for collecting waveforms, or a water content reflectometer, which provides a direct electrical output and can be sampled using a data logger. The method has proved reliable and capable of providing accurate water content measurements in deep vadose zone horizons in lab tests and in a full-scale field experiment.

A Flow-Injection Electronic Tongue Based on Potentiometric Sensors for the Determination of Nitrate in the Presence of Chloride
Gallardo, J., S. Alegret, & M. del Valle, Autonomous Univ. of Barcelona, Bellaterra, Catalonia, Spain.
Sensors and Actuators B: Chemical, Vol 101 No 1-2, p 72-80, 15 June 2004

In a novel strategy applied to the determination of nitrate in the presence of chloride interferent, the determination is performed employing the flow-injection analysis technique with four potentiometric sensors featuring cross-term response. Processing the signal with a multivariate data treatment, in this case an artificial neural network based on the Bayesian regularization, permits quantification of the concentration of nitrate ion between 0.1 and 100 mg/L NO_3^- without the need to eliminate chloride interferent. Results obtained with this approach compared with the direct determination of nitrate using its ion-selective electrode show that the new strategy attains a better correlation of obtained versus expected values, especially at the lower concentration levels.

Flower-Power Could Help Clear Land mines
Schang, Elinor, Reuters.
Environmental News Network, 28 Jan 2004

A genetically modified weed has been coded to change color when its roots come in contact with nitrogen dioxide (NO_2) evaporating from explosives buried in soil. Within three to six weeks from being sowed over mined areas, the small plant, a Thale cress, will turn a warning red whenever close to a land mine. It is a normal reaction in the Thale cress plant to turn red or brown when subjected to stressful conditions such as cold or drought, but the developer has genetically coded it to react only to

NO2. Based on research at the Institute of Molecular Biology at Copenhagen University, Aresa Biodetection has succeeded in growing the genetically modified plant and hopes to launch restricted tests this year and to apply for field tests in Denmark and abroad after that. Simon Oestergaard, chief executive of Aresa, says a prototype could be on the market within a couple of years. The company has filed for intellectual property protection under the Patent Cooperation Treaty (PCT) because Aresa's scientists are not the only ones trying to use genetically modified plants to detect land mines. The problem of sowing the seeds in mined land could be overcome by clearing strips through a field by conventional methods or by broadcasting seed from crop planes. The modified weed is infertile and unable to spread its seeds, meaning the risk of unwanted spread is minimal. Aresa also hopes to use the Thale cress for detecting and cleaning soil contaminated by heavy metals, such as lead, copper, zinc, and chromium.

Fluorescent Test of Water Toxicity
Lacki, Piotr and Antoni Nowakowski.
Optical Techniques for Environmental Sensing, Workplace Safety, and Health Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4887, p 17-22, July 2002

Abstract not available.

From Battlefield to Backyard...Military Landmine Detector Successfully Adapted to Pinpoint Buried Natural Gas Pipelines
U.S. DOE, National Energy Technology Laboratory.
TechLine, 4 Aug 2003

A spinoff to a DOE-sponsored advanced landmine detection system being developed for the U.S. Army may make pinpointing the precise location of buried natural gas pipelines much easier. At a DOE-sponsored field test in 2003, CyTerra Corporation demonstrated a new, lightweight, handheld detector that can pinpoint the exact location of both metallic and plastic underground pipes, even if the pipes are buried 10 feet deep. CyTerra, headquartered in Waltham, MA, developed the detector with funding from DOE's natural gas research program. Termed LULU -- for Low-Cost Utility Location Unit -- the technology is an adaptation of the company's Hand-Held Stand-Off Mine Detection System. The new detector is expected to be especially beneficial in preventing "third party" damage, which can occur when construction or excavation crews inadvertently strike underground utility lines. The LULU technology relies on ground penetrating radar. To make it suitable for pipeline detection, Cyterra engineers altered the frequency band and antenna size of the system to increase the depth detection range from shallow mine depths of inches up to10 feet for pipeline detection. When the radar passes over a buried pipeline, signal-processing techniques provide real-time output by producing a series of beeps to alert an operator. The technology can discriminate between metal and plastic pipes. Current commercial detection methods rely on magnetic devices and cannot detect plastic pipelines. Technical Contacts: Christopher Freitas, DOE Office of Natural Gas & Petroleum Technologies, 202-586-1657, Christopher.Freitas@hq.doe.gov; or Rodney Anderson, DOE National Energy Technology Laboratory, 304-285-4709, rander@netl.doe.gov.

FTIR Instrumental Modification and Data Manipulation for Single Digit ppb Formaldehyde in

Combustion Sources
Zemek, Peter G., Midac Corporation, Irvine, CA.
The Pittsburgh Conference: PITTCON 2003, Presentation 460-8.

The design of a device for detecting single digit ppb formaldehyde includes a high-energy cold filtered infrared source and re-designed extremely sensitive InSb detector. Detection limits are on the order of 4 ppb. Midac chose to design the formaldehyde instrument with a standard path length of 10 meters (1.9 liter), but with a modified halogen infrared source and detector that provided low noise signature. i.e., a very sensitive Indium Antinomide detector with a redesigned preamp. The Midac Autoquant software allows the user to select first-order Savitsky-Golay differentials of reference spectra for the analytical method. The result is a linear calibration curve with good stability, near-real time results, and trace-level detection capabilities. The instrument can be modified for other compounds.

Gas Microchromatograph for Detection of Gas and/or Fire Hazard in Mining
Mroz, Jerzy; M. Szczygielska; M. Malachowski; J. Dziuban.
Optoelectronic and Electronic Sensors V.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5124, p 270-277, 2003

This paper presents methods of gas concentration measurement used for air monitoring in underground hard coal mines and/or in mine rescue operations. The authors discuss an innovative chromatograph design for application to the measurement of underground mine atmosphere, functional examination of the microchromatograph, and analyses of gas mixtures.

Gas Pipeline Monitoring in Europe by Satellite SAR
Smith, Arthur.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4886, p 257-267, 2003

At present, gas pipeline networks in Europe are routinely monitored by vehicle and air patrols to protect them against damage by soil movement and third party interference. Because of the expenses, pipeline operators are investigating the possibilities to replace these traditional monitoring methods by remote sensing from space. A preliminary analysis shows that considerable savings can be achieved by deploying a user network of ground stations to receive the Synthetic Aperture Radar (SAR) data of the ENVISAT, RADARSAT-2, ALOS and TerraSAR satellites.

Geophysical Investigation of Vadose Zone Conductivity Anomalies at a Hydrocarbon Contaminated Site: Implications for the Assessment of Intrinsic Bioremediation
Atekwana, Estella A., William A. Sauck, Gamal Zidan Abdel Aal, and D. Dale Werkema Jr.
Journal of Environmental & Engineering Geophysics, Vol 7 No 3, p 103-110, 2002

Electromagnetic (EM-31), dc resistivity, and ground penetrating radar (GPR) methods were used to investigate part of a former refinery site in Kalamazoo, MI. The study area is underlain by about 9 to 12 m of heterogeneous glacial drift deposits overlying a sandy outwash unit. EM-31 surveys revealed eight remnants of buried pipe (remaining after removal of three aboveground storage tanks) ranging from 20 m to more than 100 m in length, as well as other anomalies. GPR and dipole-dipole resistivity surveys performed along selected profiles with anomalous conductive zones revealed a channel form within the shallow subsurface. Shallow hand-augured soil borings into these conductive zones encountered hydrocarbons perched on thin clay lenses, or trapped in low permeability sandy-silt layers, while borings in background conductivity areas showed only clean sand and silt. Areas underlain by clays in association with perched hydrocarbons exhibited a higher conductivity (greater than 15 mS/m and up to 100 mS/m) when compared to areas underlain by uncontaminated clays. The investigators infer that the conductivity anomalies may be due to the occurrence of intrinsic biodegradation of the hydrocarbons. They suggest that a conductive model originally proposed for aged hydrocarbon spills at the water table can be extended upward to include vadose zone occurrences of biodegradation of these contaminants.

Geophysical Mapping of a Shallow Contaminant Plume in Thin Glacial Till, Northeast Newfoundland: Part II Interpretation of New Data
Miller, H.G. (Memorial Univ. of Newfoundland, St. John's, Newfoundland, Canada), D.S. McCallum, and G.K. Guzzwell.
Journal of Environmental & Engineering Geophysics, Vol 7 No 3, p 119-129, 2002

The authors discuss geophysical techniques used to detect the presence and map the lateral extent of a groundwater contaminant plume in a region of thin glacial till overburden at a domestic waste disposal site in Newfoundland. This site is typified by waste cells containing significant quantities of material above the water table. The geophysical methods presented are the inversion of terrain conductivity data acquired using four different coil positions relative to the ground at two elevations and two coil orientations, the results from DC resistivity sounding and profiling, and imaging of selected profiles using ground probing radar. The paper also covers an earlier investigation, documenting the use of various electromagnetic methods to detect the presence of a contaminant plume in the groundwater and to determine the bedrock topography that constrains the flow of the plume. The earlier study demonstrated the correlation of the electromagnetic signatures of the plume with the presence of chloride ions in the groundwater as detected at water monitoring wells in the study area. The new study provides additional information on geophysical techniques that work in this environment.

GPR Application for Mapping Toluene Infiltration in a Heterogeneous Sand Model
al Hagrey, Said Attia, Kiel University, Kiel, Germany.
Journal of Environmental & Engineering Geophysics, Vol 9 No 2, p 79-85, 2004

A high resolution radar technique was applied for monitoring an infiltrated hydrocarbon liquid (i.e., toluene) in a partially saturated heterogeneous sand medium as a function of time. Toluene is a frequently found light nonaqueous phase liquid (LNAPL) contaminant that is electrically insulating and has a low relative dielectric constant r of 2.2. This paper describes the conduct and results of a laboratory experiment. Radar measurements using 1.5 GHz antenna showed that mapping toluene is in principle possible in some fully and partially saturated zones, but fails in other parts. Weak reflections within the low-saturation region may be related to the weak electromagnetic impedance contrast at the interface between the toluene, which replaced the pore water, and air.

Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and

Implementation
U.S. EPA, Washington, DC.
OSWER Directive 9355.4-28, 64 pp, Jan 2004

This U.S. EPA guidance document presents a framework for developing and implementing technically defensible Monitoring Plans for hazardous waste sites in support of the One Cleanup Program. It was written for site managers who are legally responsible for managing removal and remedial site activities. The document is intended for use at hazardous waste sites that have completed site characterization, risk assessment, and remedy selection and are in the process of implementing a removal action or site mitigation.
http://www.epa.gov/superfund/action/guidance/dir9355.pdf

Handheld Analytical Biosensors for Arsenic Detection
Laing, L.G. (Regenesis Bioremediation Products, Belmont, MA), D. Weinkle; S. Koenigsberg.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 85, 2003

In a novel application of surface plasmon resonance and allosteric biopolymers, Regenesis has developed a biosensor platform for quantitative analysis in a palm-sized device with broad applications for environmental issues. The platform is very sensitive for arsenic species and can be applied to many other analytes where sub-ppb sensitivity, selectivity, and highly accurate quantitative analyses are required. This paper presents a discussion of the technical accomplishments for all aspects of the platform.

Hand-Held Hyperspectral Imager for Chemical/Biological and Environmental Applications
Hinnrichs, Michele and Bob Piatek.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 10-18, Mar 2004

Sherlock, a small, hand-held, battery-operated imaging infrared spectrometer, has been developed by Pacific Advanced Technology. The device was field-tested in early 2003 for remote gas leak detection, but its architecture is versatile enough that it can be applied to chemical and biological agent detection and medical and pharmaceutical applications, as well as to standard research and development. This paper describes the Sherlock camera, the theory of its operation, and current and potential future applications. The Sherlock has an embedded Power PC and performs real-time image processing in an embedded FPGA and can be easily controlled from a remote location. Software upgrades can be performed over the ethernet, eliminating the need to remove the camera for retrofit. With a mouse and key board connected, the camera can be used in a laboratory as a stand-alone imaging spectrometer.

Heat as a Tool for Studying the Movement of Ground Water Near Streams
Stonestrom, David A. and Jim Constantz, eds.
U.S. Geological Survey Circular 1260, 105 pp, 2003

This U.S. Geological Survey report describes the general principles and procedures by which the natural transport of heat can be utilized to infer the movement of subsurface water near streams. This

information sets the foundation for understanding the advanced applications in chapters 2 through 8. Each of these chapters provides a case study, using heat tracing as a tool, of interactions between surface water and ground water for a different location in the western United States. Technical details of the use of heat as an environmental tracer appear in appendices.
http://water.usgs.gov/pubs/circ/2003/circ1260/

Helium and Neon Groundwater Tracers to Measure Residual DNAPL: Laboratory Investigation
Divine, C.E. (Colorado School of Mines, Golden); W.E. Sanford; J.E. McCray.
Vadose Zone Journal, Vol 2, p 382-388, 2003

A laboratory investigation was conducted to evaluate the applicability of dissolved He and Ne as partitioning tracers for detecting and quantifying two common dense nonaqueous phase liquid (DNAPLs), tetrachloroethene (PCE) and trichloroethene (TCE), in the saturated zone. Multiple partitioning tracer tests (PTTs) were conducted in columns, and residual TCE saturations (STCE) ranging from 4.7 to 10.5% were successfully measured by the tracers. The low analytical detection limits possible with dissolved He and Ne (4 to 5 orders of magnitude below aqueous solubility) may permit better tracer curve characterization than commonly used alcohol partitioning tracers, and is a notable advantage for these tracers. Due to their high Henry's Law constants, these gases will partition into trapped air present in the tracer sweep zone. The authors present equations for estimating both trapped air and NAPL saturation for PTTs where three phases--water, trapped air, and residual NAPL--are present.

Honey Bee/Lidar System for Detection and Mapping of Explosives, UXO, and Land Mines
Bromenshenk, J. (Univ. of Montana, Missoula); C. Henderson; R. Seccomb; S. Bender; P. Rodacy; J. Shaw; N. Seldomridge; J. Wilson.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 55, 2003

Three years of lab and field research funded by DARPA's Controlled Biological Systems program has proved that honey bees can be conditioned to search for explosives based on vapor plume. Bees are capable of detecting vapors at concentrations in the low parts per trillion (ppt) to parts per quadrillion (ppq), and possibly lower. Trials on a test mine field at Ft. Leonard Wood, MO, proved that conditioned bees can locate buried land mines, either to provide area reduction or localization of individual mines. Behaviorally conditioned bees easily differentiated between a mined test area and an adjacent unmined control area. Bee counts over individual plume sources made by visual observations and video recordings appear to correlate with plume concentrations, as determined by preliminary chemical analysis. Concurrent with the tests at Ft. Leonard Wood, LIDAR was evaluated as a potential technology for tracking and mapping bee positions over suspect mine fields. With LIDAR, it was possible to detect individual bees, map their positions, and find individual mines. It proved useful when an undocumented DNT/TNT source was found in the unmined control area. The hot spot was first observed during LIDAR scans as a concentration of bees in the blank area. The bee-indicated hot spot was later confirmed by chemical analysis to be contaminated with TNT and DNT residues. Thus, it was possible to 'see' bees at ranges up to 200 meters and map them as they grouped over individual mines.

Hue Algorithm for Plant Healthiness Monitoring Using Multispectral Infrared Camera System
Fujigaki, M.; M. Miwa; A. Nakashima; M. Soga; H. Tanikawa; K. Kato.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4886, p 64-71, Mar 2003

Scientists have developed a multispectral infrared camera system five infrared bandpass filters for monitoring plant health. Plant 'hue' (coloration and intensity of color) is defined from the five infrared images. Several experiments have confirmed that hue changes with a decline in plant health and that hue in healthy parts of plants is more stable than in weak parts when circumambient conditions, such as sunshine, are changed. The authors propose a method for evaluating plant health by monitoring hue changes over time, which could prove useful for monitoring phytoremediation applications.

Identification and Characterization of Mining Waste Using Landsat Thematic Mapper Imagery, Cherokee County, Kansas
Vandeberg, Gregory S., Kansas State Univ., Manhattan.
National Meeting of the American Society of Mining and Reclamation and the 9th Billings Land Reclamation Symposium, 3-6 June 2003, Billings, Montana. Book of Abstracts. ASMR, Lexington, KY.

Many tools, such as Landsat Thematic Mapper (TM) images, have been used and proposed for the rapid inventory and characterization of heavy metals and acid mine drainage often associated with mine wastes and tailings. A Landsat TM image of the Cherokee County, KS, portion of the Tri-State mining district was evaluated in an attempt to inventory mining waste and tailings in the county and characterize the gross mineralogy of these wastes. False color TM composites were used to perform supervised and unsupervised landcover classifications of Cherokee County to identify the locations of mining waste and tailings, and several TM band combinations (mineral indices) were evaluated to characterize the mineralogy of these wastes. The accuracy of the classifications in differentiating mining wastes from other land types was less than 60%; however, false color composites of Landsat TM bands had some value for identifying the wastes and determining their gross mineralogy.

Improved Analysis Algorithms for UXO Filler Identification Using Pulsed Neutron Analysis
Holslin, Dan, Science Applications International Corporation, San Diego, CA.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 80, 2003

The pulsed fast thermal neutron analysis technique (PFTNA) has been used in several applications for non-intrusively identifying materials found within containers. Irradiating substances with pulsed neutrons results in several types of interactions resulting in the emission of gamma rays. The gamma ray energy is characteristic of the nuclei with which the reaction occurred, and can therefore be used as an indicator of a particular atomic species, thus leading to the identification and classification of dangerous substances such as explosives. The use of pulsed neutron sources permits the time separation of gamma spectra into inelastic and capture gamma components that are easier to interpret. The PELAN system applies the PFTNA technique by using a portable pulsed neutron generator and recording the energy spectra of the induced gammas in different time intervals for materials classification. The Navy at Indian Head has supported the development of PELAN for identifying UXO filler in battlefield environments. PELAN can also be used to identify UXO filler for cost-effective and safe environmental remediation purposes.

Improvements in Pesticide Detection for GCMS
Lyle, Charles R. (Shimadzu Scientific Instruments, Columbia, MD), M. Marrale, R.D. Snelling.
The Pittsburgh Conference: PITTCON 2003, Presentation 870-4P.

The performance of a GC-MS system for the analysis of pesticides in matrix has been improved by advances in several areas of sample handling and detection: (1) the ability to program the injection port temperature to improve the transfer of analytes from solvent to column for labile compounds; (2) higher flow capacity for higher sample loading flow for more efficient transfer of analytes to the column; (3) minimizing sample loss during injection by means such as an electronic flow programmable septum purge; (4) minimizing labile pesticides breakdown by improving system inertness; and (5) enhancing low-level detection by more efficient ion generation, high transmission ion optics, and an improved electron multiplier. Data are presented that demonstrate system sensitivity improvements to analytes. The authors also discuss the linearity of analyte response and detection limit data showing lower than 0.1 ppb detection for many pesticide compounds.

Improving the Detection of Explosive Compounds by Ion Mobility Spectrometry
Denson, S.C. (Univ. of Arizona, Tucson, AZ); G.A. Buttigieg; M.B. Denton; R.P. Sperline.
The Pittsburgh Conference: PITTCON 2003, Presentation 890-3P.

The most commonly used detector element in ion mobility spectrometry (IMS) is a Faraday plate, though its low resolution and poor dynamic range in commercial IMS systems can lead to both false positive and false negative results. A new detector has been developed consisting of an array of finger-shaped electrodes, each connected to a charge sensitive capacitive transimpedance amplifier. As opposed to current-sensing Faraday plates, this micro-Faraday finger array is an integrator and requires only 100 ions to produce a signal. A micro-Faraday array was recently coupled to a commercial ion mobility spectrometer and successfully detected both positive and negative ions. The new detector technology improved the limit of detection for TNT by at least one order of magnitude and also has improved detection limits for HMX, RDX, and TATP (triacetone triperoxide). TATP is an easily synthesized explosive that eludes conventional screening methods because the compound lacks nitro groups.

In-Situ Apparent Conductivity Measurements and Microbial Population Distribution at a Hydrocarbon-Contaminated Site
Atekwana, E.A. (Univ. of Missouri, Rolla); D.D. Werkema, Jr.; J.W. Duris; S. Rossbach; E.A. Atekwana; W.A. Sauck; D.P. Cassidy; J. Means; F.D. Legall.
Geophysics, Vol 69 No 1, p 56-63, Jan/Feb 2004

A study was undertaken to assess if high conductivity observed at sites affected by aged light nonaqueous phase liquid (LNAPL) might be related to microbial degradation of LNAPL. The results show higher bulk conductivity coincident with LNAPL-impacted zones, in contrast to geoelectrical models that predict lower conductivity in such zones. The highest bulk conductivity was observed to be associated with zones impacted by residual and free LNAPL. Data from bacteria enumeration from sediments close to the resistivity probes show that oil-degrading microbes make up a larger percentage (5 to 55%) of the heterotrophic microbial community at depths coincident with the higher conductivity compared to ~5% at the uncontaminated location. The coincidence of a higher percentage of oil-degrading microbial populations in zones of higher bulk conductivity suggests that the higher conductivity in these zones may result from increased fluid conductivity related to microbial degradation of LNAPL, consistent with geochemical studies that suggest that intrinsic biodegradation is occurring at the site.

In Situ Method to Measure Effective and Sorption-Affected Gas-Phase Diffusion Coefficients in Soils
Werner, D. and P. Hohener, Swiss Federal Inst. of Technology (EPFL), ENAC-ISTE-LPE, Lausanne, Switzerland.
Environmental Science & Technology, Vol 37 No 11, p 2502 -2510, 2003

The authors present a field method to determines the tortuosity factor and the mass fraction in the air phase of a volatile compound in situ. The compound is injected into the unsaturated zone together with a conservative gaseous tracer to form a point source. Concentrations are monitored at the injection point over an 8-hour period and evaluated with an analytical equation for reactive transport. The air-filled porosity is determined independently. From these data, both the effective and the sorption-affected diffusion coefficients are obtained. Results are reported for volatile organic pollutants in both a lysimeter and a sandy soil.

In Situ Monitoring of Vapor Phase TCE Using a Chemiresistor Microchemical Sensor
Ho, Clifford K. and Charles F. Lohrstorfer.
Groundwater Monitoring & Remediation, Vol 23 No 4, p 85-90, Fall 2003

A chemiresistor microchemical sensor has been developed to detect and monitor volatile organic compounds in unsaturated and saturated subsurface environments. A controlled study was conducted at the HAZMAT Spill Center at the Nevada Test Site, where the sensor was tested over a range of temperature, moisture, and trichloroethene (TCE) concentrations. Results showed that the detection limit of the chemiresistor to TCE vapor in the presence of fluctuating environmental variables (i.e., temperature and water vapor concentration) was on the order of 1000 parts per million by volume, which is about an order of magnitude higher than values obtained in controlled lab environments. The researchers recommend automated temperature control and preconcentration to improve the stability and sensitivity of the chemiresistor sensor.

Incorporation of Field-Portable XRF into the Environmental Chemistry Lab: A Pilot Study
Bachofer, Steven J., Saint Mary's College of California, Moraga, CA.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract CHED 1180, 2003

Field-portable XRF (FP-XRF) instruments are sufficiently robust for specific metal screening and are commonly used to minimize environmental sampling costs. The incorporation of this technology into an environmental chemistry course was explored by conducting field sampling to learn the limitations of the methodology, analyzing the spectral data, and discussing the results in context with the social concerns that environmental scientists must address. A rented FP-XRF instrument was used to analyze for lead in painted surfaces in government-owned housing, to evaluate a gradient of metal concentration adjacent to a major highway, and to screen for elements of concern at a local elementary school.

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.
Report No: EPA 600-R-04-028, 94 pp, May 2004

During the technology demonstration, the PDV 6000 exhibited the following desirable characteristics of a field mercury measurement device: (1) field acceptable accuracy, (2) good precision, (3) good sensitivity compared to the PRGs, (4) high sample throughput, (5) measurement costs comparable to laboratory analytical costs, (6) exceptional portability, and (7) relative ease of use. During the demonstration, the PDV 6000 was found to be limited by sample digestion requiring nitric acid and hydrogen peroxide, and generation of a secondary waste stream from sample digestion.
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.
Report No: EPA 600-R-04-012, 89 pp, May 2004

During the technology demonstration, the DMA-80 exhibited the following desirable characteristics of a field mercury measurement device: (1) good accuracy, (2) good precision, (3) high sample throughput, (4) low measurement costs, and (5) ease of use. The DMA-80 was limited by its lack of portability due to the instrument's size and weight. The demonstration findings collectively indicated that the DMA-80 is a reliable field measurement device for mercury in soil and sediment.
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.
Report No: EPA 600-R-03-149, 86 pp, May 2004

The demonstration showed the X-MET 2000 had an MDL of between 16.5 and 26.9 mg/kg and a PQL of approximately 64 mg/kg; however, the 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 laboratory’s 20.6%), but 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 at $33.28 per sample, or $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 indicate 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.
Report No: EPA 600-R-03-148, 94 pp, May 2004

Results for the XLt 792 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 $9,396 for NITON's XLi 792 rental option at $47.69 per sample, or $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.
Report No: EPA 600-R-03-147, 86 pp, May 2004

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 rental cost, the cost for analyzing the 197 samples was $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, and no major health and safety concerns. Portability is somewhat limited by the size of the device. The instrument is readily available for purchase or lease. The demonstration findings collectively indicated that the RA915+/RP-91C is a reliable field mobile measurement device for mercury in soil.
http://www.epa.gov/ORD/SITE/reports/600r03147/600r03147.htm

Instrument for Airborne Remote Sensing of Transmission Pipeline Leaks: State-of-the-Art Review
Reichardt, Thomas A., Sanjay Devdas, and Thomas J. Kulp (Sandia National Laboratories, Livermore, CA); Wayne Einfeld (Sandia National Laboratories, Albuquerque, NM).
Technology Status Report, 5 pp, Jan 2003

The Remote Sensing Group at Sandia National Labs is researching standoff leak detection for different gas industry sectors. They are working to develop a person-portable shoulder-mounted gas imager for

use at oil refineries, a smaller handheld gas imager for natural-gas leak detection in and around homes, and a vehicle-mounted laser-based mapping procedure to detect gas-plume concentrations near the operational threshold of an FID. A remote-sensing instrument for detection of natural gas leaks with the performance requirements for long-range airborne testing will be demonstrated in 2003. The system will then be ruggedized sufficiently for an airborne test and an airborne test will be performed in the following performance period.
http://www.netl.doe.gov/scng/publications/t&d/tsa/NETL_review_27dec02.pdf

Integrated Automated Analyzer for Monitoring of Explosives in Groundwater
Strategic Environmental Research & Development Program. Cleanup CU-1297, 1 pp, July 2002

The objective of this project is to develop a prototype of a portable analytical system based on the on-line/on-chip coupling of a miniaturized, meso-scale sequential injection (SI) system for fast and automated sample processing with a microfabricated capillary electrophoresis (CE)/electrochemical detector (ECD) for fast separation/detection of explosives and their degradation products in groundwater. The main problems involved in the determination of explosives and their degradation products are the low concentration levels of analytes and the complexity of environmental sample matrices, which makes sample preconcentration and purification necessary prior to subsequent analysis. In this project, automatic sample processing will be integrated with the CE/ECD device. Fast separation protocols and a CE/ECD on-chip will be developed. The researchers also will focus on on-line/on-chip coupling of a SI pretreatment system with microfabricated CE/ECD. Finally, the integrated analyzer will be evaluated for analysis of groundwater samples. This SEED Project began in 2002. Contact: Dr. Yuehe Lin, Pacific Northwest National Lab, Richland, WA, 509-376-0529, yuehe.lin@pnl.gov.

Integrated Biomonitoring of Dioxin-Like Compounds for Waste Management and Environment
Sakai, Shin-ichi and Hidetaka Takigami, National Inst. for Environmental Studies, Ibaraki, Japan.
Industrial Health, Vol 41, p 205-214, 2003

The CALUX bioassay (chemical-activated luciferase gene expression) can detect the sum of dioxin-like activity (including unknown substances) in complex waste and environmental samples. This paper gives a description of the bioanalytical method and application examples to analyze dioxin-like compounds in waste management samples of thermal/chemical dechlorination processes. The CALUX bioassay is considered useful for the rapid and integrated monitoring of environmental emissions and for residual samples pre-screening or in combination with chemical analysis.
http://www.niih.go.jp/en/indu_hel/2003/pdf/ih_41_3_10.pdf

Integrated Chemical and Biological Defense Research, Development and Acquisition Plan: Chemical & Biological Point Detection, Decontamination, & Information Systems
U.S. DoD, U.S. DOE, and U.S. Department of Justice. 90 pp, Apr 2003

This technology area roadmap is a living document intended to facilitate coordination and cooperation between DOE and DoD at both the high level of national policy and planning and at the working level in the technology focus areas. It depicts participating organization R&D programs and plans for testing and transitioning technologies into the acquisition process. Sensor/system R&D programs include

chemical and biological point detection and identification, reagents/assay development, and supporting technologies. Biological point detection and identification programs are further subdivided into major activity areas: genetic detection, detector on a chip, mass spectrometry, handheld systems, and other programs that have not yet been categorized.
http://www.acq.osd.mil/cp/rdaplancbpointdecon_apr03.pdf

Integrated Use of DInSAR and GIS for Detection of Abandoned-Mining-Induced Surface Movements
Petrat, Lutz.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5239, p 365-375, 2004

This paper presents a general approach to realize a monitoring system by the integrated use of Differential Interferometric Synthetic Aperture Radar (DInSAR) and additional data provided by a Geographic Information System (GIS). Qualitative DInSAR results showing surface deformations in a specific area of investigation are classified into potentially abandoned mine-induced surface deformations and other anomalies in combination with mine-related background information and standard GIS functionality.

An Integrative Approach for Monitoring the Vadose Zone
Yeh, Tian-Chyi Jim and Shuyun Liu, Univ. of Arizona, Tucson.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 140, 2003

Electrical resistivity tomography (ERT) has emerged as a potentially cost-effective, non-invasive tool for imaging changes of moisture content in the vadose zone; however, the accuracy of the ERT survey has been the subject of debate because of its non-unique inverse solution and spatial variability in the parameters of the resistivity/moisture content relation. An integrative inverse approach for ERT has been developed to derive the best unbiased estimate of the moisture content distribution. Unlike classical ERT inversion approaches, this new approach assimilates both prior information about the geological structure of a given geological medium and sparse point measurements of the moisture content, electrical resistivity, and electric potential. Using all these types of data and considering the spatial variability of the parameters in the resistivity/moisture content relation, the new approach directly estimates 3-D moisture content distributions, instead of simply the changes in moisture content in the vadose zone. First, numerical experiments were conducted to investigate the effect of uncertainties in the prior information on the estimate. The study then examined the effects of the spatial variability in the resistivity-moisture content relation parameters on the interpretation of the change of moisture content, based on the change in electrical resistivity from the ERT survey.
Finally, the usefulness of the integrative approach was demonstrated by directly estimating moisture distribution in several three-dimensional, heterogeneous vadose zones. Results show that the integrative approach can produce images of the true moisture content distributions and that incorporation of point measurements of moisture content is essential to improve the estimate.

Intelligent Pipelines Using Fiber Optic Sensors
Tennyson, Rod C.; W. D. Morison; Gerald N. Manuelpillai.

Smart Structures and Materials 2003: Smart Sensor Technology and Measurement Systems. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5050, p 295-304, 2003

This paper presents an investigation of the application of "long gage" fiber optic sensors (FOS) to monitor the behavior and integrity of pipelines. Tests were conducted on pipe sections under a variety of load conditions. Long gage sensors were bonded to the pipes and displacements measured using a FOX-TEK FTI 3300 instrument that employs an interferometric technique to obtain displacements to an accuracy of 20 microns. Results obtained showed that the FOS could track changes in loads, detect prebuckling deformations, and measure post-buckling plastic strains. The long gage sensors also were applied to a tailings pipeline in northern Alberta (Canada) to monitor continuously the pipe wall thinning due to erosion/corrosion. With a PC containing an Aircard for wireless transmission, test data were monitored remotely through Internet access.

Investigation of Hazardous Waste Sites and Their Environment Using the BGR Helicopter-Borne Geophysical System
Siemon, Bernhard, C. Stuntebeck, K.-P. Sengpiel, B. Rottger, H.-J. Rehli, and D.G. Eberle.
Journal of Environmental & Engineering Geophysics, Vol 7 No 4, p 169-181, 2002

The Federal Institute for Geosciences and Natural Resources of Germany (BGR) completed a research and development project aiming at optimizing its helicopter-borne geophysical system for high resolution site characterization. The overall objective was to adapt the existing helicopter-borne geophysical system used for groundwater and mineral exploration to survey conditions where the anomalies to be recorded are small. The helicopter-borne system permits simultaneous electromagnetic (AEM), magnetic (AMAG), and gamma-ray surveying. The system has been improved over the previous system and now operates at five frequencies with an increase of up to 25% in the transmitter and receiver dipole moments. The system also is now calibrated during flight. The sensitivity to waste objects was augmented by reducing the sensor heights from more than 30 m (AEM) and 45 m (AMAG), respectively, to less than 20 m above ground surface by installing a magnetic sensor and a laser altimeter in the AEM bird. Enhanced spatial resolution was achieved by decreasing the sampling distance along line from about 10 m to 3 m and by reducing the line separation from about a hundred meters to less than 50 m due to better navigational and positioning instruments. The modified system was tested over two former military training areas south of Berlin, Germany, to locate steel drums, scrap metal, steel pipes, petrol tanks, ordnance, buried at depths from 0.3 to 1.5 m. Due to the extremely weak AEM and magnetic anomalies produced by these materials, suitable detection algorithms were developed to recognize and to identify them. More than 90% of the anomalies selected for verification could be confirmed either by visual inspection of the ground surface or ground geophysical surveying or excavation.

Investigation on the Usage of Clay Modified Electrode for the Electrochemical Determination of Some Pollutants
Manisankar, P. (Alagappa Univ., Karaikudi, Tamilnadu, India); C. Vedhi; S. Viswanathan; H.G. Prabu.

Journal of Environmental Science and Health - Part B Pesticides, Food Contaminants, and Agricultural Wastes, Vol 39 No 1, p 89-100, 2004

Redox behaviors of three pollutants--endosulfan (EN), o-chlorophenol (OCP), and direct orange 8 (D08)--were investigated electrochemically using a sodium montmorillonite clay-modified glassy carbon electrode. The influence of pH, scan rate, and concentration were studied on the voltammetric response. The electrochemical reactions of the three pollutants demonstrated the suitability of a clay-modified electrode for electroanalysis. The researchers developed a differential pulse stripping voltammetric procedure for the determination of the three pollutants with ppb limits of determination of 5 to 300 (EN), 10 to 800 (OCP), and 50 to 800 (D08).

Jet-REMPI-TOFMS Detection of Hazardous Air Pollutants Using a Compact Tunable UV Laser Source
Oser, H. (SRI International, Menlo Park, CA); K. Briggs; S.E. Young; M.J. Coggiola.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 24, 2003

Jet-REMPI technology combines the principles of optical spectroscopy and mass spectrometry to provide 2-D detection selectivity. Simultaneous detection by both mass and optical wavelength yields extremely high chemical selectivity that is crucial for identifying one trace compound amidst many other similar species. The high selectivity and sensitivity of the technique allow real-time measurements to be obtained within seconds, without the need for pre-concentration or additional separation. This paper describes research to develop a compact tunable UV laser system for the real-time detection of aromatic hydrocarbon hazardous air pollution vapors at sub-ppb levels using the jet-REMPI technique. The technique has already proven highly effective for the real-time measurement of complex mixtures of hydrocarbon vapors, but so far has required a large, complex, and delicate high-resolution tunable UV laser system. By reducing the size and increasing the ruggedness of the tunable laser component, the initial step has been made towards taking this powerful technology from the lab and developing a field-portable instrument. The primary task was assessing the effect of the lower spectral resolution of the laser on chemical specificity and detection sensitivity, with a focus on a small group of single-ring aromatics: benzene, toluene, xylenes, and chlorobenzene. Detection sensitivity measurements were taken for pure compounds, samples with complex mixtures of non-isomers, and mixtures of isomers. SERDP Project CP-1247 and EPA support the research.

Laboratory Comparison of Polyethylene and Dialysis Membrane Diffusion Samplers
Ehlke, Theodore A.; Thomas E. Imbrigiotta; Jeffrey M. Dale.
Groundwater Monitoring & Remediation, Vol 24 No 1, Winter 2004

In a lab study, researchers compared the ability of diffusion samplers constructed from regenerated cellulose dialysis membrane against that of low-density, flat polyethylene tubing to collect volatile organic compounds (VOCs) and inorganic ions. Concentrations of vinyl chloride, cis-1,2-dichloroethene, bromochloromethane, trichloroethene, bromodichloromethane, and tetrachloroethene collected by both types of diffusion samplers reached equilibrium with the concentrations of these compounds in test solution within three days. Concentrations of bromide and iron collected by the dialysis membrane diffusion samplers reached equilibrium with the concentrations of these compounds in a test solution within three to seven days. No detectable concentrations of bromide or iron were found in polyethylene diffusion samplers even after 21 days. No measurable concentrations of aluminum, arsenic, barium, cadmium, chromium, iron, mercury, manganese, nickel, and lead, or sulfide, were leached out of dialysis membrane samplers over seven days. Compared with

using a gas-tight syringe to sample the diffusion sampler, clipping the bag and pouring the water sample into a sample vial resulted in only a small 6.2% average loss of VOCs.
http://www.diffusionsampler.org/Documents/Ehlke%20et%20al%202002%20Lab%20Polyeth%20Diff%20Samp.pdf

Labs-on-a-Chip to Detect Milk Contamination
Whitaker Foundation News Release, Arlington, VA, 13 May 2004

Dr. David Beebe of the University of Wisconsin-Madison has developed a process to make miniature sensors on demand for a wide variety of poisons, including naturally occurring contaminants and intentionally introduced toxins. The sensors can be constructed to test for a particular toxin in as little as an hour with test results available in minutes. One focus area involves the nation's milk supply, which comes from a widely dispersed system in which large amounts of the highly perishable product are quickly collected and distributed. With a short cow-to-consumer timeline, contamination could affect large numbers of people before being detected. If sensors could be incorporated in the packaging, consumers could tell if the package has been disturbed or if the contents are contaminated. With collaborator Eric Johnson, Beebe has tested the technique to rapidly detect the botulism toxin, the most poisonous substance known. Beebe's design and fabrication process, which he calls microfluidic tectonics, uses light to freeze a liquid into the solid shape of a component, such as a valve, in the precise physical location where the component is needed. Biological tests can require different steps performed in different sequences. Each test requires a particular arrangement of components, such as check-valves, channels, mixers, pumps, and filters. Beebe's modular approach allows the flexibility to design and fabricate a wide range of test chips from a single toolbox of components. A sample is placed in a chamber on the chip and the test is set into motion by squeezing the chamber. Positive results appear as a color change visible to the naked eye. The current research was supported by the Defense Advanced Research Projects Agency. Contact: David Beebe, University of Wisconsin-Madison, djbeebe@wisc.edu; or Frank Blanchard, The Whitaker Foundation, frank@whitaker.org, 703-528-2430.
http://www.whitaker.org/news/beebe.html

A Literature Review of Portable Fluorescence-Based Oil-in-Water Monitors
Lambert, P., Environment Canada, Ottawa, ON.
Journal of Hazardous Materials, Vol 102 No 1, p 39-55, 15 Aug 2003

This paper presents the results of a literature search on fluorescence-based portable detectors to measure the real-time concentration of oil, with specific information extracted from references about how the instruments were used (including setup and calibration procedures), the oil and dispersant measured, and the approximate concentration range of the oil in the water column, as well as how the real-time data compared to traditional laboratory techniques.

Littoral Assessment of Mine Burial Signatures (LAMBS): Buried-Landmine Hyperspectral Data Collections
Kenton, A.C.; D.M. Geci; J.A. McDonald; K.J. Ray; C.M. Thomas; J.H. Holloway, Jr.; D.A. Petee; N.H. Witherspoon.

Detection and Remediation Technologies for Mines and Minelike Targets VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 150-160, 2003

Scientists are researching whether electro-optical spectral discriminants exist that are useful for the detection of land mines located in littoral regions. Statistically significant buried mine overburden and background signature data were collected over a wide spectral range (0.35 to 14 um) to identify robust spectral features that might serve as discriminants for new airborne sensor concepts. The project further expands the hyperspectral database previously collected and analyzed on the U.S. Army's Hyperspectral Mine Detection Phenomenology program to littoral areas where tidal, surf, and wind action can additionally modify spectral signatures. This paper summarizes characteristics of buried mine collections conducted at three beach sites: an inland bay beach site, an Atlantic beach site, and a Gulf beach site. Characteristics of the spectral signatures of the various dry and damp beach sands are presented.

Long-Term Monitoring for Explosives-Contaminated Groundwater
Fisher, Mark, Nomadics, Inc., Stillwater, OK.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 117, 2003

Under SERDP SEED Project CU-1298, Nomadics has developed a prototype TNT groundwater monitoring sensor. Laboratory proof-of-concept testing has been completed, demonstrating the ability of the sensor to detect low parts-per-billion (ppb) levels of TNT and explosive-related compounds in groundwater. The goal of the project is to produce a monitoring system for rapid, on-site analysis of high explosives (HE) in groundwater that requires minimal intervention by users. The sensor may provide a cost-effective alternative for monitoring the extent of energetic material contamination in groundwater on and near live fire ranges and formerly used defense sites. The sensor is based on amplifying fluorescent polymers (AFPs) that fluoresce intensely in the absence of molecules of nitroaromatic explosives such as TNT, but when molecules of target analytes bind to thin films of the polymers, the fluorescence intensity decreases. The reduction in emission intensity (quenching) is measured by a photodetector in the sensor. The reduction in emission intensity is proportional to the mass of quencher contained in the sample. The quenching response is amplified due to the fact that a single molecule of TNT binding to the film causes quenching of many polymer repeat units, as opposed to sensory materials that exhibit quenching of only the specific chromophore to which analyte binds. The prototype monitoring system yields results in near real time and requires no use of chemical reagents. Preliminary laboratory test results suggest that the polymer sensory materials deployed in the sensor are stable in water, making it possible deploy the sensor in a groundwater monitoring well for extended periods of time. The prototype has not been field-tested, but the prototype is adapted from a sensor that was developed and tested successfully for sensing TNT in a marine environment.

Long-Term Monitoring of Chlorophenols in the Flue Gas from Waste Incinerators by Two Types of Sequential Automated-Analytical Instrument Using HPLC/ECD
Watanabe, I. (National Inst. of Public Health, Tokyo, Japan), S. Goto, M. Kudo, Y. Kurata, and K. Yamasaki.
The Pittsburgh Conference: PITTCON 2003, Presentation 1780-5P.

This paper presents the results of monitoring for chlorophenols in flue gas. Chlorophenols are important precursors of polychlorinated dioxins and furans. Two types of sequential automated analytical instrument (FGSA-1 and -2) using HPLC with an electrochemical detector (ECD) were tested at incinerators for industrial, medical, and municipal waste. Sampling occurred at 50-min intervals.

Low Cost OP-FTIR for Workplace Air Quality Monitoring
Rentz, J.H. (OPTRA, Inc., Topsfield, MA); J.R. Engel; D.L. Carlson; D.J. Mansur; R. Vaillancourt; G. Genetti; P. Griffiths; H. Yang.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 29, 2003

An Air Force SBIR Phase II contract to develop a low-cost open-path Fourier transform infrared spectrometer was recently completed by OPTRA, Inc., for air quality monitoring inside an aircraft refurbishing hangar. OPTRA researchers have demonstrated the utility of a low-resolution instrument in measuring medium-sized organic molecules, offering higher signal to noise without sacrificing selectivity relative to high-resolution systems. A low-cost encoder-based reference metrology has been implemented in place of a traditional laser interferometer, and an uncooled DLATGS detector was used in place of an LN2-cooled HgCdTe detector. The researchers have successfully manufactured a plastic injection molded retroreflector array at a fraction of the cost of a typical array composed of individual hollow retroreflectors. Intelligent algorithms based on Artificial Neural Networks and Partial Least Squares have been implemented to automatically detect and quantify a list of 105 organic molecules from the measured spectra. Algorithms have been incorporated into Windows-based Graphical User Interface. Phase II work effort has produced a prototype OP-FTIR spectrometer measuring 10.5 x 8.5 x 7.25 inches and weighing just under 14 lbs (including a 6" telescope). The spectrometer is powered and controlled through a portable "suitcase" PC that contains two custom-designed PCI boards for the OP-FTIR and one commercially available A to D. Finally, a 24" plastic retroreflector array weighing just under 16 lbs has been produced.

Low Level (Subppb) Analysis of Perchlorate
Medina, V.F. (U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS); A. Bednar; A. Weathersby.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 167, 2003

Perchlorate is associated with the manufacture and use of solid rocket motors, and is found at many military facilities. It is a highly soluble compound and can be mobilized in surface and ground water. Perchlorate was placed on the Contaminant Candidate List (CCL) by the EPA in 1998, and the state of California is currently developing a maximum contaminant level (MCL) that may be as low as 1 ppb. This research investigates analytical techniques for perchlorate in natural waters at low levels (ppb and sub-ppb). Lowering detection limits can assist in the successful monitoring and subsequent validation of innovative treatment techniques. Use of anion exchange resin cartridges has been shown to be applicable to perchlorate analysis, giving concentration factors of 10 to 100. Additionally, other commercially available cartridges can be used to remove competing anions, such as chloride and sulfate, which might cause interferences in IC with conductivity detection. Use of ion chromatography with suppressed ion conductivity and an isocratic mobile phase of 100mM sodium hydroxide gives a detection limit of 0.9 ppb. Coupling these two techniques should yield perchlorate quantitation in the sub-ppb range.

Luminescence Lifetime-Based Sensor for Cyanide and Related Anions
Anzenbacher, P. Jr., D.S. Tyson, K. Jursíkova, and F.N. Castellano, Bowling Green State Univ., Bowling Green, OH.
Journal of the American Chemical Society, Vol 124 No 22, p 6232 -6233, 2002

This paper describes a new Ru(II) complex that serves as a luminescence lifetime-based sensor for fluoride and cyanide anions. The chromophore displays observable changes in its UV-vis and steady-state luminescence spectra upon cyanide binding. This work represents the first example of a direct method for the lifetime-based indication of anions by luminescence.

Mass Transfer from Entrapped DNAPL Sources Undergoing Remediation: Characterization Methods and Prediction Tools
Strategic Environmental Research & Development Program. Cleanup CU-1294, 1 pp, Nov 2003

The technical objectives of this project are to understand, quantify, and model the process of mass transfer from source zones in heterogeneous aquifers where DNAPLs are undergoing physical, chemical, and biological transformation during remediation. It is necessary to understand the tracer interaction and mass transfer during remediation under controlled conditions. This approach combines batch and bench-scale experimentation and controlled experiments in intermediate-scale laboratory soil tanks. First, the hypothesis that the tracer partitioning and mass transfer coefficients change during chemical and biological transformations will be tested. Transformations associated with biotreatment, surfactant enhanced dissolution, and chemical oxidation will be studied and quantified. The data generated in columns and in two-dimensional test cells will be used to develop methods to scale up the "point-scale" mass transfer coefficients to multi-dimensional flow conditions encountered in the field. Experiments conducted in large soil tanks will generate an accurate data set to obtain insight into tracer behavior and mass transfer in heterogeneous systems with complex DNAPL entrapment architecture. In the final phase of the study, data from the tank experiments will be used to validate numerical modeling tools and scaleup methodologies. Two exiting multiphase flow and transport numerical codes will be used. Necessary modifications to these codes will be made to enable their use as decision tools. This project began in FY 2002. Contact: Dr. Tissa Illangasekare, Colorado School of Mines, Golden, 303-384-2126, tissa@Mines.edu.

Mass Transfer from Entrapped DNAPL Sources Undergoing Remediation: Characterization Methods and Prediction Tools
Illangasekare, T.H. (Colorado School of Mines, Golden, CO); D. Dail; J.M. Marr; K. Soga; R. Siegrist.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 133, 2003

After a DNAPL spill, the final NAPL distribution architecture is present as zones of entrapment at low saturation (residual, ganglia and blobs) and high saturation (pools at permeability barriers and macro-scale entrapment zones resulting from capillary barriers). The contamination problem associated with these entrapped sources is a result of the DNAPL dissolving into the flowing groundwater, thus creating a downstream contaminant plume. Technologies that remove, change, or stabilize the free phase in the source zone through controlled physical, chemical, or biological activity are designed ultimately to reduce the net mass transfer from the zone of the aquifer where the NAPL is entrapped. Any type of risk analysis to determine the effectiveness of remediation has to be based on the mass flux emanating from the source zone. In its second year of funding, SERDP project CU-1294 is in progress to understand, quantify, and model the process of mass transfer from source zones with complex entrapment architecture. The work investigates pre- and post- treatment mass transfer associated with four remediation technologies: biotreatment, surfactant flushing, resistive heating and in situ chemical oxidation. The data will be used to validate models and develop up-scaling methods to apply these models to field problems for decision-making. This poster presents the results from the ongoing study. The preliminary results have helped to validate mass transfer models and develop a framework for parameter up-scaling.

The Measurement of Arsenic at New Compliance Levels in Drinking Water
Grosser, Zoe A. (PerkinElmer Instruments, Shelton, CT), Lee J. Davidowski, Laura Thompson.
The Pittsburgh Conference: PITTCON 2003, Presentation 1970-7.

The EPA methods allowed for measurement at the new arsenic compliance concentration of 10 ppb are 200.8 (ICPMS), 200.9 (GFAA), and 3114B (Hydride generation AA). The ICP-OES method, 200.7, is no longer allowed, due to generally insufficient detection limits. The authors discuss the variety of techniques available to detect arsenic (including those not mentioned in the current rule) and explore the tradeoffs in analytical capability, productivity, and effort.

Methane Detection
Mallon, Tom, TIger Optics, LLC, Warrington, PA.
The Pittsburgh Conference: PITTCON 2003, Presentation 900-400.

The MTO-1000-CH4 analyzer measures methane in toxic, corrosive, and inert gases. Based on cavity ring-down spectroscopy (CRDS), the MTO provides parts-per-billion sensitivity for methane. The MTO is the first commercially available device employing CRDS. The MTO-1000 uses robust, highly tuned continuous wave diode lasers to measure absorption characteristics of individual molecules. The MTO can be configured with a four-gas manifold to allow the operator to measure 4 individual gas streams in series, thereby eliminating the need for individual dedicated analyzers. The CRDS technique measures moisture in addition to species such as CO, CO2, HF, and NH3.

MEMS-Based Biosensors for Environmental Monitoring
Endo, Tatsuro; Yasutaka Morita; Eiichi Tamiya.
Environmental Monitoring and Remediation III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5270, p 101-110, 2004

Enzyme-linked immunosorbent assay (ELISA) chips fabricated by micro electromechanical system (MEMS) technology have been developed for quantitative determination of dioxins. Glass or polystyrene beads immobilize an antibody on these chips. The beads are introduced into a micro-flow channel or microchamber. As a competitive ELISA, sample solution mixed with horseradish peroxidase (HRP)-conjugated antigen, and non-HRP conjugated antigen was allowed to react in the microchamber or flow channel. As a sandwich assay, sample solution and HRP-conjugated antibody were sequentially added to the chamber. After the antigen/antibody reaction, addition of PBS buffer, hydrogen peroxide, and fluorogenic substrate produced the fluorescent dye. The resulting change in the fluorescence intensity was monitored by a fluorescence microscope.

Mercury and Gamma Spectra Measurements in Federal Superfund Stockpile Soils
Smith, T.M. and M.E. Pizzulli (P.W. Grosser Consulting, Inc., Bohemia, NY); B.S. Bowerman, J.W. Adams, P.D. Kalb, and A. Lockwood (BNL, Upton, NY); G. Walsh (Stockton College of New Jersey). Conference on Geology of Long Island and Metropolitan New York, 12 April 2003, SUNY Stony Brook.

Characterization of 7,000 cubic yards of stockpiled soil at Brookhaven National Lab identified the soils as non-hazardous low-level radioactive waste, but confidence in the waste classification was uncertain due to mercury findings exceeding hazardous criteria at the disposal facility. BNL initiated an extensive sorting, segregation, and characterization project to ensure debris removal, characterization of the large quantity of heterogeneous soil, and eventual disposal. To provide near real-time data, as well increased confidence levels in soil classification, a field laboratory equipped with instrumentation to test for total mercury, RCRA metals, and gamma spectroscopy and a tumbler for performing a modified Toxicity Characteristic Leaching Procedure (TCLP) protocol was set up in a trailer close to the stockpile site. Laboratory instrumentation was used for screening total mercury levels above 260 ppm and for TCLP mercury at levels above 200 mg/L. Radiological instrumentation was used to identify soil contaminants above BNL background levels. The field laboratory was instrumental in providing extensive characterization, near real-time data, increased confidence in soil classification, and acceleration of the project schedule.
http://pbisotopes.ess.sunysb.edu/lig/Conferences/abstracts-03/smith/smith.htm

Mercury Speciation: an Intra-Laboratory Evaluation of a Microwave-Assisted Extraction Method for Use in Soils and Sediments
Rahman, G.M. Mizanur (Duquesne Univ., Pittsburgh, PA) and H.M. 'Skip' Kingston.
The Pittsburgh Conference: PITTCON 2003, Presentation 780-2.

Determination of total mercury is frequently not sufficient for understanding the toxicological impact and pathway of mercury species in the environment, because some forms (e.g., methylmercury) are far more toxic than others. To perform mercury speciation analyses, the principal requirements of an extraction method are the reliable separation of the analyte from the interfering matrix and adequate concentration methodology for analyte detection. Appropriate concentration levels must be achievable minimizing analyte loss, sample contamination, or changes in chemical species. The purpose of this evaluation is to develop a microwave-assisted extraction procedure capable of quantitatively extracting inorganic mercury and alkyl mercury (methylmercury) from soils and sediments in a closed-vessel microwave system. Nitric acid was evaluated as an extraction solvent. Temperature, power, time, solvent concentration, solvent volume, and amount of sample are assessed and optimized for extraction of mercury species, including inorganic and methylmercury. The method has been applied to extract mercury species from real soil and sediment samples.

Method Comparison Study for Weak Acid Dissociation Cyanide Analysis
Evans, J.D. (SAIC, Idaho Falls, ID); L. Thompson (Pintail Systems Inc., Aurora, CO); P.J. Clark (U.S. EPA, Cincinnati, OH); S.W. Beckman (SAIC, Hackensack, NJ).
Environmental Science & Technology, Vol 37 No 3, p 592 -596, 2003

Method comparison studies of two different methods for the analysis of weak acid dissociable cyanide revealed analytical flaws and/or matrix interference problems with both procedures. Draft EPA Method 1677 using a Perstorp 3202 CN analyzer was compared to Standard Method 4500 CN I. The Perstorp analyzer produced more precise and accurate results following modification of the procedural steps from the EPA draft method. The two methods were compared using samples containing high concentrations of cyanide and metals obtained from a mining site.

Microsensors for the Ultrasensitive Detection of Hexavalent Chromium In Groundwater
Brown, G.M. (Oak Ridge National Lab, Oak Ridge, TN), V. Boiadjiev, P.V. Bonnesen, H.-F. Ji, L.A. Pinnaduwage, T. Thundat.
The Pittsburgh Conference: PITTCON 2003, Presentation 2580-2.

Trace amounts of chromium(VI) in water can be detected using a silicon microcantilevers coated on one side with gold. The gold surface is modified with a monolayer of triethyl-12-mercaptododecylammonium bromide, and the microcantilever undergoes bending due to sorption of chromate ions on the quaternary ammonium terminated monolayer. Unfortunately, this monolayer becomes unstable over a period of several weeks, and other approaches to achieving selectivity at high sensitivity are being investigated. Monolayers formed from 4-mercaptopyridine and 4-(2-mercaptoethyl)pyridine on gold-coated cantilevers also were shown to be sensitive and selective for Cr(VI). The influence of varying the potential of the gold solution interface was studied with the result that polarization of the pyridine-modified microcantilever at a positive potential makes it more sensitive for the sorption of Cr(VI). Polarization at more negative potentials leads to reduction of Cr(VI) to Cr(III), allowing the sensor to be regenerated for reuse. Other methods for modifying microcantilever surfaces to make them sensitive and selective for Cr(VI) sorption are discussed, as well as methods for analysis of groundwater.

Minefield Edge Detection Using a Novel Chemical Vapor Sensing Technique
Fisher, Mark E. and John Sikes, Nomadics, Inc.
Detection and Remediation Technologies for Mines and Minelike Targets VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5089, p 1078-1087, 2003

Nomadics has developed a novel sensing technology that detects the chemical signature of explosives emanating from buried landmines. Nomadics is the exclusive licensee of novel amplifying fluorescent polymer materials developed by the Massachusetts Institute of Technology. These materials enable detection of ultra-trace concentrations of nitroaromatic compounds such as TNT. When vapors of nitroaromatics are presented to the sensor, the fluorescent polymers emit light at a greatly reduced intensity, a property that enables rapid detection of trace quantities of explosives using relatively low-cost electronics and optics. It is possible for the chemical signature of a mine to extend some distance from the mine position, hence the sensor may have greater utility in detecting the edges of minefields. This paper presents the latest findings related to minefield edge detection at several test sites.

Miniature, Multiple Sensor Systems for Continuous Detection of Metals, pH, and Other Parameters
Strategic Environmental Research & Development Program. Conservation CS-1266, 1 pp, June 2002

A one-year project is designed to develop a miniaturized sensor system based on ion-selective electrodes and other electrochemical measurements that individually detect Cu(I), Cu(II), pH, temperature, conductivity, chloride (or sodium), and turbidity. Because the measurements are determined in seconds, this sensor package will be suitable for rapid surveying of the marine environment. A number of sensor systems will be developed and packaged together. Copper(I), Cu(II), chloride, and pH will be detected by modification of membrane ion-selective electrodes. Conductivity, oxidation/reduction potential, temperature, and turbidity will be detected through miniaturization of existing technology such as alternating current measurement absorbance for turbidity, a voltage divider, and pH electrode. Of the desired sensor systems, only Cu(I) requires extensive experimentation. To demonstrate that Cu(I) ion-selective electrodes are feasible, a hydrophobic (a requirement for membrane electrodes) carrier molecule for Cu(I) was synthesized and incorporated into a liquid-filled electrode. Data from preliminary experiments using this ion-selective electrode show a limit of detection of about 20 ppb with a response time of 30 to 60 seconds. Based on the performance of other ion-selective electrodes, the sensitivity and response time of the prototype electrode is expected to increase with experimentation. The actual selectivity for this electrode will
be fully characterized. A stable reference electrode will be tested and evaluated. Laboratory studies have shown these electrodes to be stable, relatively non-fouling, cost-effective, and easily manufactured. This SEED Project began and ended in 2002. Contact: Dr. David Kidwell, Naval Research Lab, Washington, DC, 202-767-3575, kidwell@ccf.nrl.navy.mil.

Miniaturized Culturing Devices to Screen for Mycolata in Environmental Samples
Polaczyk, A.L., H. Bindu, I. Papautsky, B. Kinkle, & D.B. Oerther, Univ. of Cincinnati, Cincinnati, OH. The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003. Abstract ENVR 82, 2003

The authors have developed a new BioMEMS device to address some of the major limitations of existing technology to screen for Mycolata (mycolic acid-containing bacteria) in environmental samples. BioMEMS stands for micro-electrical-mechanical systems with a biological component. The devices are designed to culture target microorganisms on a miniature scale. In preliminary studies using pure cultures of G. amarae and Escherichia coli, the device behaved in a quantitative fashion, detecting target microorganisms over a range of concentrations and showing limited attachment of non-target organisms (e.g., E. coli). Future work to characterize this device will include field studies and direct comparison of the effectiveness of the new BioMEMS device to existing Mycolata screening technology.

A Model Study for the Simultaneous Optical Quantification of Heavy Metal Cation Mixtures by Spectral Data Analysis Based on Neural Network Inversion
Suzuki, K. (Keio Univ./JST/KAST, Yokohama, Kanagawa, Japan), D. Citterio, M. Hagiwara, D.

Mikami, T. Ohki, K. Yamaji.
The Pittsburgh Conference: PITTCON 2003, Presentation 1370-7.

A new method based on artificial neural networks (ANN) for the processing of spectrophotometric data is demonstrated on the example for the simultaneous quantification of mixtures of zinc, cadmium, and mercury cations in aqueous solutions. Several types of chromoionophores or metallochromic indicators were used as a simple model to create spectral data analogous to those normally received from an optical sensor array. The data processing approach presented is based on a two-step procedure: (1) the training of a separate back-propagation artificial neural network (BP-ANN) to correlate the ion concentrations with the spectra of known training samples for every sensor in the array, and (2) the estimation of concentrations in mixtures from measured absorption spectra by network inversion (ANNI) for test samples not used during the network training.

Modeling Chemical Detection Sensitivities of Active and Passive Remote Sensing Systems
Scharlemann, Ernst T.
Lidar Remote Sensing for Environmental Monitoring IV.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5154, p 126-138, 2003
[UCRL-JC-151751, 13 pp.]

Lawrence Livermore National Laboratory (LLNL) has developed a set of performance modeling codes for both Active and Passive Remote Sensing (APRS) systems. These codes emphasize chemical detection sensitivity in the form of minimum detectable quantities with and without background spectral clutter and in the possible presence of other interfering chemicals. The codes have been benchmarked against data acquired in both active and passive remote sensing programs at LLNL and Los Alamos National Laboratory. The codes include, as an integral part of the performance modeling, many of the data analysis techniques developed in the DOE's active and passive remote sensing programs (e.g., "band normalization" for an active system and principal component analysis for a passive system).
http://www.llnl.gov/tid/lof/documents/pdf/245797.pdf

Modifying Polymers by Self-Organisation for the Mass-Sensitive Detection of Environmental and Biogeneous Analytes
Dickert, F.L. (Vienna Univ., Vienna, Austria); P. Lieberzeit; S. Gazda-Miarecka; K. Halikias; K.-J. Mann.
Sensors and Actuators B: Chemical, Vol 100 No 1-2, p 112-116, 1 June 2004

This paper presents advancements in the field of sensor layer design, such as double imprinting procedures for the detection of polyaromatic hydrocarbons (PAHs) in water, analyte separation for detecting organic solvents in water, and the analysis of biogeneous analytes, such as viruses. By double imprinting, the sensitivity of polyurethane layers toward PAHs is increased by almost an order of magnitude, and detection limits down to 100ng/L pyrene are achieved. For the detection of organic solvents in wastewater, the sensor is mounted above a membrane separating the liquid and the gas phase, thus making use of the reduced noise level in gases and permitting detection of contaminants in the low ppm range. Increasing the template surface concentration on the stamp produces highly ordered structures of TMV imprints, which leads to an increase in sensor response by about a factor of 4. The resulting frequency shifts arise from the incorporation of virus clusters into the material.

Molecular Templating for Highly Selective Detection of Relatively Small Molecules
Addleman, R.S. and G.E. Fryxell (PNNL, Richland, WA); J.T. Bays (U.S. Military Academy, West Point, NY); E.D. Bott (Whitman College, Walla Walla, WA); Z. Wang (PNNL); P.L. Gassman (EMSL, Richland, WA).
Environmental Molecular Sciences Laboratory 2003 Annual Report, Section 2-2-5, 2004

Molecular templating using a mesoporous support promises to provide a highly selective, robust, and reliable method of detecting specific, relatively small molecules from among many interfering species. Previous and ongoing work has focused on the creation and functionalization of a high surface-area silica layer (mesoporous silica) bound to a silicon substrate. Mesoporous materials with a surface area of approximately 1000 m2/g covered with a variety of monolayer coatings are now readily available. The self-assembled monolayer (SAM) consists of functional groups tethered to the silicon surface to form a self-assembled monolayer on a mesoporous support (SAMMS). Functional groups are chosen for their ability to directly bind with either a molecule of interest, or to coordinate to lanthanide ions to which a molecule of interest may bind. The molecule of interest can be templated for "lock-and-key" selectivity. The researchers focused on samples functionalized with acetylphosphonate and trimethoxybenzene. The acetylphosphonate functional group is expected to bind to a lanthanide, such as europium. The trimethoxybenzene functional group is expected to interact by pi-stacking with aromatic molecules, such as those found in TNT or picric acid. Tests have confirmed several properties of the SAMMS: (1) SAMMS are transparent to ultraviolet and visible light; (2) despite electron micrograph images showing an oriented grain to the SAMMS surface, there appears to be no polarization of reflected light; and (3) the strength of emissions spectra are proportional to europium loading. The baseline successes demonstrated by this work confirm the potential of SAMMS materials to provide a highly selective and sensitive detector for a variety of materials.
http://www.emsl.pnl.gov/docs/annual_reports/2003/2-2_ESB.pdf

Molecularly Imprinted Materials: Sensors and Other Devices, 2-5 April 2002, San Francisco, California
Shea, Kenneth J.; M. Yan; M.J. Roberts; P.S. Cremer; R.M. Crooks (eds.).
Materials Research Society Symposium Proceedings, Vol 723, 172 pp, Apr 2002 [DTIC: ADA412559]

This symposium proceeding contains papers presented at Symposium M, "Molecularly Imprinted Materials," and Symposium O, "Chemical and Biological Sensors: Materials and Devices," held April 2-5 at the 2002 Materials Research Society Spring Meeting in San Francisco, CA. Symposium M was the first of its kind at an MRS meeting. The symposium consisted of 17 talks and 15 posters and brought together scientists in the field to discuss the current state of the art in molecular imprinting. Topics included microfabrication, imprinted membranes, and nanoparticles, covalent and non-covalent methods of molecular imprinting, separate technology, and sensor applications. Symposium O contained 45 presentations on topics such as microfluidics and sensing systems, sensor arrays and devices, sensing with nanoparticles, monolayers, bilayers, cells, and silicon.
http://handle.dtic.mil/100.2/ADA412559

Monitoring Arsenic in the Environment: a Review of Science and Technologies for Field

Measurements and Sensors
Melamed, Dan, U.S. DOE. Report No: EPA 542-R-04-002, 29 pp, Apr 2004

This report reviews field assays and other technologies with the potential to measure and monitor arsenic in the environment. The author discusses the strengths and weaknesses of the various assays with respect to their sensitivity, ability to detect the chemical states of arsenic, performance in various media, potential interferences, and ease of operation. The report, which relies mainly on government documents and the published literature, examines the state of the science and development efforts of selected technologies.
http://clu-in.org/download/char/arsenic_paper.pdf

Monitoring Carbon Dioxide Floods Using Electrical Resistance Tomography (ERT): Sensitivity Studies
Ramirez, A.L. (LLNL, Livermore, CA); R.L. Newmark, and W.D. Daily.
Journal of Environmental & Engineering Geophysics, Vol 8 No 3, p 187-208, Sep 2003

Numerical and physical modeling studies conducted to evaluate the sensitivity of electrical resistance tomography (ERT) to electrical resistivity changes caused by CO2 injection and sequestration in geologic reservoirs were based on the Maljamar CO2 flood pilot study. The researchers also constructed physical models in a water tank to evaluate some of the conclusions of the numerical study. The study quantifies the effects of a variety of factors that affect the resolution and accuracy of the ERT method under realistic conditions of scale, contrast, and measurement error. It considers scenarios where vertical arrays of point electrodes are used and where metal-cased boreholes are used as long electrodes. Long electrode tomographs provide information as to the shape, location, and lateral extent of the flood. When point electrode arrays or horizontal wells are available, the approximate vertical extent of the flood and coarse estimates of sequestered CO2 volume can be deduced. These study results suggest that the ERT method can help confirm the containment of CO2.

Monitoring Changes in Microbial Ecology During Sulfate Amendment of a BTEX-Contaminated Aquifer Using BIO-SEP(R) Traps
Sublette, Kerry L., C. Mehta, & T. Mathew (Univ. of Tulsa, Tulsa, OK); A. Peacock & D. White (Univ. of Tennessee, Knoxville); D. Beckman; R. Kolhatkar; D. Cook; G. Davis.
The 10th Annual International Petroleum Environmental Conference, 11-14 November 2003, Houston, TX. The Integrated Petroleum Environmental Consortium (IPEC), Univ. of Tulsa, OK. 11 pp, 2003 [abstract only]

A gasoline-contaminated aquifer in Washington state has been under remediation since 1999 using soil-vapor extraction and catalytic oxidation following a period of free product removal. By late 2002, the highest benzene concentrations in the plume were 0.8-4 mg/L. A field trial is testing the enhancement of natural hydrocarbon attenuation at the site by amending the aquifer with sulfate, which is introduced into the aquifer using an infiltration trench in 1,000-gal batches. Prior to initiation of the field trial, five monitoring wells were investigated to predict the effect of the sulfate amendment on subsurface microbial ecology by incubating two types of Bio-Sep(R) traps in each well. In each well, one trap contained non-baited Bio-Sep(R) beads. The second trap contained both non-baited beads and beads in which Na2SO4 had been incorporated during fabrication. The baited beads provided a source of slow-release sulfate in the trap to mimic the effect of sulfate amendment of the aquifer. After 30 days of incubation, the trap biofilms were analyzed using phospholipid fatty acid (PLFA) analysis and analysis of PCR-amplified 16S rDNA. Biofilms from the sulfate-baited traps and the non-baited traps had distinctly different community structures. Sulfate-baited traps were more likely to contain lipid anaerobic biomarkers, biomarkers for sulfate-reducing bacteria, and specifically identified anaerobes like Geobacter sp. The aquifer is being monitored with non-baited Bio-Sep(R) traps to determine whether the predicted shifts in the subsurface microbial ecology are observed as the sulfate amendment is introduced. Initial results have shown that the aquifer has become aerobic due to the inadvertent addition of oxygen during sulfate injection. Anaerobes are still present in the ground water; however, since the initiation of sulfate injection they have not been found in the Bio-Sep(R) beads, indicating that they are not actively growing under the current aquifer conditions.

Monitoring Metal Species Using a Novel New Technique for Environmental Applications -- Capillary Electrophoresis Linked to a High Resolution ICP/MS (CE-HRICP/MS)
Hoffman, Eric L., Yakov Kapusta, and M. Dzierzgowska, Activation Laboratories Ltd.
Proceedings of the Sudbury 2003 Mining and the Environment Conference, 25-28 May 2003, Sudbury, ON, Canada. Laurentian Univ., Sudbury, ON, Canada. Centre for Environmental Monitoring, ISBN: 0-88667-051-9. 2 Vols or 2 CD-ROMs [abstract only].

Trace elements in natural ecosystems rarely exist in a native condition or as free ions. Usually they occur as part of a species. It is important to be able to distinguish between species because relative toxicity or non-toxicity could depend on the state of the element. Arsenic, chromium, mercury, antimony, and selenium are examples of elements that exist in a variety of forms, some more toxic than others. Capillary electrophoresis (CE) offers several advantages as an analytical separation technique for these metal species, including very high separation efficiencies, rapid analysis times, relatively simple analysis methodologies, and small sample volume requirements. When CE is interfaced to a high-resolution inductively coupled plasma mass spectrometer (CE-HR ICP/MS) as the final measurement device, an ultra-sensitive metal speciation capability is available. The authors use examples from environmental baseline studies to illustrate the application of this technique in geological and biological systems.

Monitoring of PCDDs, PCDFs and PAHs in Waste-Water with Use of Semipermeable Membrane Devices (SPMD)
Sztamberek-Gola, Izabela (Inst. of Mineral Building Material, Opole, Poland); Adam Grochowalski and Ryszard Chrzszcz (Technical Univ. of Cracow, Poland).
Dioxin 2003: 23rd International Symposium on Halogenated Organic & Persistent Organic Pollutants, 24-29 August 2003, Boston, Massachusetts. 4 pp, 2003

A new semipermeable membrane dialysis (SPMD) method has been developed for the determination of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in wastewater samples containing lower than 1pg-TEQ/m3. The passive sampling procedure is based on semipermeable membrane dialysis for preconcentration by selective absorption in triolein. The clean-up method was introduced in laboratory practice for the determination of PCDDs and PCDFs using GC-MS/MS system. The method is suitable for other aqueous samples, such as the determination of dioxins in mineral waters. This method is not suitable for preconcentration of dioxins in input streams

in wastewater treatment plants due to the high fat content. This SPMD method for sampling has so far only been tested.
http://www.dioksyny.pl/files/Grochowalski_Sztamberek_2003.pdf

Monitoring of Pollutant in Waste Water by Infrared Spectroscopy Using Chalcogenide Glass Optical Fibers
Michel, K. (Univ. de Rennes, Rennes, France); B. Bureau; C. Boussard-Pledel; T. Jouan; J.L. Adam; K. Staubmann; T. Baumann.
Sensors and Actuators B: Chemical, Vol 101 No 1-2, p 252-259, 15 June 2004

Infrared optical fibers based on chalcogenide glass provide sensors for the determination of volatile organic pollutants in groundwater. The system works on fiber evanescent wave spectroscopy (FEWS). It was tested in situ, in real time, under real-world conditions using an FTIR spectrometer (BRUKER V22) coupled with the fiber (about 2 m) and a cooled mercury-cadmium-telluride detector. A special kit provided by Bruker was connected on the spectrometer to focus the infrared beam from the black body at the entry of the fiber. Preliminary pilot-scale tests in an artificial aquifer show that the fiber permits access to the absorption line positions in a wide range. The innovative design of the fiber enables detection of weak concentrations of pollutants down to 1 ppm of C2Cl4. This type of sensor might be installed as a permanent checking device in monitoring wells at a landfill.

Monitoring Partitioning Tracer Testing and Surfactant Flooding by In-Line Gas Chromatography Techniques
Silva, Jeff A.K.; Paul E. Mariner; Hans W. Meinardus; Jon S. Ginn.
Groundwater Monitoring & Remediation, Vol 23 No 1, p 85-93, Winter 2003

An automated in-line analytical system has been developed to provide near real-time results for partitioning interwell tracer testing (PITT) and surfactant enhanced aquifer remediation (SEAR). The analytical methodology is based on gas chromatography (GC) with flame ionization detection and direct aqueous injection. The system components are linked electronically to facilitate autonomous operation. For field trials, the in-line GC method provided superior or comparable PITT and SEAR data compared to conventional sample collection followed by shipment and analysis at a commercial analytical laboratory. The use of the in-line GC resulted in an 85 and 74% reduction in analytical costs per PITT and SEAR, respectively.

Monitoring Polynuclear Aromatic Hydrocarbons in Aqueous Environments with Passive Low-Density Polyethylene Membrane Devices
Carls, M.G., L.G. Holland, J.W. Short, R.A. Heintz, and S.D. Rice, NOAA, Alaska Fisheries Science Center, Juneau.
Environmental Toxicology and Chemistry, Vol 23 No 6, p 1416-1424, June 2004

The authors describe laboratory and field verification that low-density polyethylene membrane devices (PEMDs) without triolein provide reliable, relatively inexpensive, time-integrated hydrocarbon sampling from water. For comparison, polynuclear aromatic hydrocarbon (PAH) uptake in semipermeable membrane devices (SPMDs) and pink salmon eggs also was studied. Total concentrations of PAH accumulated by PEMDs were highly correlated with concentrations in water (r2 0.99) and linear over the range tested (0 to 17 ug/L). Higher-molecular-mass PAH preferentially accumulated in PEMDs and in pink salmon eggs, but the source of oil in PEMDs remained identifiable. Accumulations of PAH were highly similar to those in SPMDs. The PEMDs retained approximately 78% of accumulated total PAH for 40 days in clean water, which suggests that these membranes can be conveniently used for environmental monitoring, particularly during situations in which contaminant concentrations are low (in the parts-per-billion range), variable, and intermittent.

Monitoring Volatile Organic Compounds in Karst Springs
Williams, S.D. and J.J. Farmer.
Proceedings: 12th Tennessee Water Resources Symposium, Burns, Tennessee, 2002.
Tennessee Section of the American Water Resources Association, p 2A-70, 2002

The U.S. Geological Survey (USGS), in cooperation with the Tennessee Department of Environment and Conservation, Division of Superfund, is studying the occurrence, fate, and transport of chlorinated solvents in karst regions of Tennessee. One objective of this study was to evaluate water-quality monitoring techniques that may be suitable for karst areas. Automatic volatile organic compound (VOC) samplers, portable gas chromatographs (GCs), and passive adsorption samplers were evaluated as potential monitoring techniques at three karst springs in middle Tennessee. Automatic VOC samplers and a portable GC were used to collect VOC data at intervals ranging from 30 minutes (during selected storms) to 1 week (during base-flow conditions). Passive adsorption samplers were deployed concurrently with the automatic samplers to obtain time-integrated data. The usefulness of continuous water-quality monitors in the development of VOC sampling strategies also was examined. Water temperature, specific conductance, pH, and dissolved oxygen data were collected over a 15-month period to characterize the variability in water quality at the karst springs. Results from this investigation indicate that continuous water-quality data are useful in documenting the water-quality signatures of karst springs and can aid in the development of site-specific VOC sampling strategies. Results from this investigation also indicate that automatic VOC samplers and portable GCs can be used to document the variability in VOC concentrations in karst springs. VOC concentrations measured in samples collected using automatic VOC samplers were comparable to results from replicate samples analyzed by the USGS National Water Quality Laboratory. Results from this investigation suggest that passive adsorption samplers may be potential tools for monitoring VOC concentrations in karst springs, though further study is needed.

Natural Gas Leak Detection in Pipelines
Sivathanu, Yudaya, En'Urga Inc., West Lafayette, IN.
Technology Status Report, 10 pp, Nov 2003

This report reviews the current status of optical and non-optical technologies for detecting leaks from natural gas pipelines. The first part briefly reviews leak detection methods generally used for natural gas pipelines, the second part reviews optical methods used for natural gas leak detection, and the final part reviews sensors that can be used with optical methods.
http://www.netl.doe.gov/scng/publications/t&d/tsa/scanner_technology_0104.pdf

Natural Gradient Tracer Test to Evaluate Natural Attenuation of MTBE Under Anaerobic Conditions
Amerson, Illa and Richard L. Johnson.
Groundwater Monitoring & Remediation, Vol 23 No 1, p 54-61, Winter 2003

A natural gradient tracer test using perdeuterated MTBE was conducted in an anaerobic aquifer to determine the relative importance of dispersion and degradation in reducing MTBE concentrations in groundwater. After one year of transport, the tracer plume was characterized in detail, and a mass-balance analysis accounted for 110% of the injected mass and indicated that no significant mass loss occurred. Longitudinal dispersion was identified as the dominant mechanism for lowering the perdeuterated MTBE concentrations. The plume structure was created by zones of higher and lower hydraulic conductivity at the site was complex, consisting of several localized areas of high tracer concentration in a lower concentration plume. The tracer plume followed a curved flowpath that deviated from the more macroscopic direction of groundwater flow inferred from local ground water elevation measurements and the behavior of the existing plume. Understanding the mass balance, plume structure, curvature of the tracer plume, and consequently natural attenuation behavior required a detailed sampling approach. A detailed understanding of site hydrogeology and an extensive sampling network may be critical for the correct interpretation of monitored natural attenuation of MTBE.

Near-Field Fiber-Optic Surface Plasmon Resonance Sensors Applied to Microfluidic Devices
Kazuyoshi, K. (Keio Univ., Yokohama, Kanagawa, Japan), S. Koji, N. Osamu, T. Tatsuya, I. Yuzuru.
PITTCON 2003, March 9-14, Orlando, Florida. Abstract 1710-8.

Surface plasmon resonance (SPR) is a surface-sensitive analytical method for biochemical sensing. The mechanism is based on the detection of refractive index (RI) changes due to the specific adsorption of molecular recognition. An SPR microdevice using the technology for near-field scanning optical microscopy (NSOM) is being developed. This paper describes the application of the SPR microdevice to microfluidic systems, which is an important step toward its practical use in biosensors.
A near-field fiber-optic SPR microdevice based on the NSOM probe technology uses a selective chemical etching method, which provides a cone-shaped core with a sharp tip. The SPR microdevice has a thin gold metallic film with approximately a 10-nm thickness on the tapered fiber and a cone angle of about 30 degrees. The optical system was constructed as two linear polarizers placed in the crossed nicols' configuration. Changes in the refractive index of the SPR microdevice were accomplished using a microfluidic device with a small hole of 1 mm diameter. The device was applied to the determination of methanol and 1-propanol.

A New Approach to Dioxin Sample Preparation
Mobley, R.J., J.C. Archer, P. Barnes, V. Litman, S. Shojaee, M.K. Halbert, and J.J. Eckert, 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.

Typical sample preparation for dioxin analysis utilizes an acidified silica gel or acetonitrile cleanup that may be followed by further cleanup using activated carbon. Cleanup of high fat samples with acid silica requires large quantities of reagents. Under these conditions, the recoveries are inconsistent. The traditional cleanup using acetonitrile suffers from low recoveries. An improved method, FDA LIB

4084, uses a silica gel cleanup followed by a reusable carbon column, then a micro acid silica/alumina fractionation. Although LIB 4084 generally gives acceptable results for low fat samples, frequent problems have been encountered with high fat matrices. The analysis of samples such as vegetable oils, butter, shortening, fish oil, and Vitamin E frequently result in carryover problems with analyses when reusing carbon columns. Dioxin elution profiles with toluene reveal the elution solvent volume is significantly affected by the matrix. This results in the need to replace the carbon column or use large volumes of toluene to clean the carbon column between analyses. This paper proposes the use of a single-use carbon column with high lipid samples. The benefits of this approach are elimination of re-extractions caused by carryover from previous extractions, lower solvent usage, and ability to use an auto-feed technique.

A New Approach to Trace Element Analysis in Environmental Matrices
Coler, David G. (Philips Analytical, Natick, MA), Mark Dirken, Simon Milner.
The Pittsburgh Conference: PITTCON 2003, Presentation 2190-2P.

The main thrust in wavelength dispersive X-ray fluorescence spectrometry (WDXRF) has been towards coupling higher power instrumentation with improved background and spectral overlap corrections. This approach yields very precise determination of net intensities for heavy elements and allows quantification at low ppm levels. In combining the recent advances in WDXRF with the advantages of an energy dispersive XRF (EDXRF) system, the authors present a unique instrument for the analysis of contaminants in soils, sludges, air filters, and food products. The new instrument uses a combination of a high energy X-ray source, polarized optics with specialized secondary targets and a highly efficient solid state detector to provide optimal detection of inorganics such as Cd, Pb, and As. Soil detection limits of sub-ppm to 2 ppm also are achievable for the elements of interest. The reproducibility of Cd, As, and Pb measurements in soils carried out over a 10-day period shows relative standard deviations of only 1 to 2%. The excellent detection limits and long-term stability of this new instrument make it an effective tool for the cost-effective analysis of heavy trace elements in environmental matrices.

New 'Conformable' Sensor Accurately Maps Natural Gas Pipeline Corrosion: Energy Department-Funded Prototype Passes Field Test, Moves Closer To Commercial Use
U.S. DOE, National Energy Technology Laboratory.
TechLine, 29 Oct 2003

A conformable array sensor provided accurate, automated measurements of corrosion on the exterior of pipes during a recent field test at Southwest Research Institute (SwRI) in San Antonio. The sensor is being developed by SwRI in cooperation with Houston's Clock Spring Company and DOE's National Energy Technology Laboratory. Pipeline corrosion results from water, condensation, scratches, or other actions that can damage a pipe's protective coating and sensitive joints. Like rust on a car, pipeline corrosion can extend far down into the metal, well beyond the visual signs on the surface. Detecting and measuring corrosion is essential to determine the strength and life expectancy of the pipe. The traditional method for detecting pipeline corrosion requires excavation to expose a pitted section of pipe, sandblasting to remove all dirt and debris, and then manual measurement of the surface using a hand-held gauge and bridging bar. Time-consuming and expensive, this method is subject to the technician's interpretation. The new sensor also requires that a pipeline be exposed, but it does not require sandblasting. The flexible sensor is about 6 inches square and designed to conform to the contours of the pipe. Two rigid circuit boards attach to the sensor at opposite ends, making a rectangular unit about 6 in x 12 in. Rugged enough for field use, the unit is applied to a pipeline's exterior, and the sensor takes an image of the overlaid area. The unit is then moved and new images taken until a picture has been produced of the pipe's circumference. The data are transmitted to a computer in real time through a cable attached to one of the circuit boards. The computer forms a composite image of corrosion from the individual snapshots, and analyzes the extent of the damage. The analysis is used to assess the strength and integrity of the pipeline, and the pipe can be repaired, replaced, or monitored as needed. Contact: David J. Anna, DOE National Energy Technology Laboratory, 412-386-4646, david.anna@netl.doe.gov.

A New Detector For Halogenated Organic Compounds
Driscoll, John N., Process Analyzers, LLC, Walpole, MA.
The Pittsburgh Conference: PITTCON 2003, Presentation 1690-1.

Scientists at Process Analyzers have developed a new GC detector for analysis of halogenated compounds. This detector will respond either to fluorine or to chlorine, bromine, and iodine as the sensor is changed. The sample is decomposed at high temperatures, passes into a scrubber and is detected electrochemically by the sensor(s). Single or multiple sensors can be used simultaneously to detect various halogenated compounds. Preliminary results indicate low ppb detection limits for mono or halogenated compounds with a linear dynamic range of >4 decades. Sub-ppb-level detection limits of the chlorinated compounds can be achieved with the use of a concentrator/thermal desorber. This detector should provide an alternative to the electron capture detector (ECD) that is more sensitive and/or selective.

A New Electron Capture Detector for Improved Pesticide Analysis
Snelling, Ronald D. (Shimadzu Scientific Instruments, Columbia, MD), C.R. Lyle, M. Marrale.
The Pittsburgh Conference: PITTCON 2003, Presentation 90-42P.

A new electron capture detector (ECD) for improved analysis of pesticides and pesticide residues has a reduced cell volume for increased sensitivity and revised geometry for improved stability. The detector has single-digit femtogram detection limits for pesticides. The gas chromatograph features third-generation electronic flow control on all flow zones for enhanced retention time and area reproducibility. All detector and GC parameters, including optional autosampler, can be controlled either through menus using the graphical display built into the GC or by the optional data collection and processing software. The authors provide examples of the sensitivity and linear range of the new ECD using both standards and spiked matrix extracts.

New Membrane Perchlorate-Selective Electrodes Containing Polyazacycloalkanes as Carriers
Lizondo-Sabater, J., M.-J. Segui, J.M. Lloris, R. Martinez-Manez, T. Pardo, F. Sancenon, and J. Soto, GDDS, Univ. Politecnica de Valencia, Valencia, Spain.
Sensors and Actuators B: Chemical, Vol 101 No 1-2, p 27-29, 15 June 2004

PVC membrane anion-selective electrodes containing synthesized polyazacycloalkanes as ionophores give a linear response in the presence of perchlorate. Researchers have determined the EMF response characteristics and selectivity coefficients of these membrane-based perchlorate-selective electrodes. The synthesized polyazacycloalkanes are 1,4,8,11-tetra(n-octyl)-1,4,8,11-tetraazacyclotetradecane, 1,4,7,10,13-penta(n-octyl)-1,4,7,10,13-pentaazacyclopentadecane, and 1,4,7,10,13,16-hexa(n-octyl)-1,4,7,10,13,16-hexaazacyclooctadecane.

A New Method to Reduce the Desorption Time of a QCM Sensor, Using a Halogen Spot for Heating
Maric, S., J.W. Lorgen, U. Herrmann, U. Schramm, and J. Bargon, Univ. of Bonn, Bonn, Germany.
Sensors and Actuators B: Chemical, Vol 101 No 1-2, p 265-267, 15 June 2004

The quartz crystal microbalance (QCM) can be used as a mass sensor in the gas phase. It is suitable for online monitoring of volatile organic compounds (VOCs) in the workplace or in industry, e.g., to control the ripening of cheese. This paper details a new implementation method using two standard halogen spots. In one spot the light bulb is replaced with a QCM and the socket is modified to hold the quartz. Both spots are merged with a brass ring in the middle for gas inlet and outlet. Switching on the light bulb during the desorption phase reduces the desorption time substantially.

A New Miniature Cylindrical Ion Trap Mass Spectrometer For Detection of Chemical Warfare Agents in Air
Riter, L.S. (Purdue Univ., West Lafayette, IN), R.G.G. Cooks, A. Guymon, B. Laughlin, J.M. Wells.
The Pittsburgh Conference: PITTCON 2003, Presentation 890-17P.

The Paul ion trap is a more appealing instrument for miniaturization than other types of mass analyzers due to its high sensitivity, ability to operate at higher pressures (~1mTorr), and ability to perform multiple stages of mass analysis in a single analyzer. The cylindrical ion trap (CIT) with its simple electrode design, flat endcaps, and a cylindrical ring electrode, is easier to machine than hyperbolic ion traps and can therefore be miniaturized more readily. The mass spectrometer used in these studies is based on a miniature CIT mass analyzer operated with an rf drive frequency of 2MHz and a maximum voltage of 1000V(0-p). This instrument is much smaller than the previous generation miniature CIT mass spectrometer, though it retains all features of the previous version. In addition, improved data acquisition and instrument control (LabVIEW) have allowed single and multiple ion monitoring with an alarm mode when a preprogrammed ratio of ions is observed. The limit of detection for the simulant methyl salicylate was determined in terms of both absolute amount of material and concentration, as 1pg (neat vapor direct inlet) and 24pptr (in air by trap & release MIMS), respectively. The linear dynamic range of the instrument, established with an unheated MIMS system and toluene in air, was from the LOD, 23ppb, to the limit of the sample preparation technique, 1ppm.

A New Multi-Level Ground Water Monitoring System Utilizing Multi-Channel Tubing
Einarson, Murray D. (Einarson & Associates, Palo Alto, CA); John A. Cherry (Univ. of Waterloo).
Ground Water Monitoring and Remediation, Vol 22 No 4, p 52-65, Fall 2002

A new multi-level groundwater monitoring system has been developed that uses custom-extruded, flexible, 1.6-inch, outside-diameter, multi-channel HDPE tubing (or CMT, for continuous multi-channel tubing) to monitor as many as seven discrete zones within a single borehole in either overburden or bedrock. This paper describes the system components, installation, and operation. More

than 1000 CMT multi-level wells have been installed in North America and Europe to depths up to 260 feet below ground surface. These wells have been installed in boreholes created in overburden and bedrock using a wide range of drilling equipment including diamond-bit coring, hollow-stem auger, sonic, air rotary, and direct push. The authors discuss three field trials of the system that demonstrate its versatility and illustrate the type of depth-discrete data the system can collect.
http://www.solinst.com/Res/cmt/52to65%20Fall02GWMR.pdf

New Optical Detection Strategies For Biological Threat Detection
Treado, Patrick J. (ChemIcon Inc., Pittsburgh, PA), C.W. Gardner, L.J. Grudowski, G.S. Vanni.
The Pittsburgh Conference: PITTCON 2003, Presentation 470-4.

As the use of biological and chemical agents by terrorists becomes a reality, there is an increasing need to develop tools that can rapidly and accurately detect and classify these agents at a molecular level without coming into contact with them. ChemIcon has developed a new class of optical diagnostic technology, Chemical Imaging, that dramatically enhances the previous capabilities of molecular spectroscopy by combining the capabilities of molecular spectroscopy and advanced digital imaging to detail material morphology, composition, structure and concentration with a high degree of specificity and sensitivity. By providing both image and spectral information, each analyte can be matched to a database and uniquely identified even in the presence of complex matrices. This paper details the results of testing obtained in collaboration with various government agencies.

A New Tool for Characterization of Microbial Activity in Contaminated Soils During Remediation and Restoration
Sublette, K.L., C. Mehta, A. Moralwar, and L. Ford (Univ. of Tulsa, Tulsa, OK); K. Duncan (Univ. of Oklahoma, Norman); G. Thoma (Univ. of Arkansas, Fayetteville); A. Peacock and D. White (Univ. of Tennessee, Knoxville); G. Davis (Microbial Insights, Inc., Rockford, TN).
The 10th Annual International Petroleum Environmental Conference, 11-14 November 2003, Houston, TX. The Integrated Petroleum Environmental Consortium (IPEC), Univ. of Tulsa, OK. [abstract only]

Bio-traps containing Bio-Sep(R) beads have been used to monitor subsurface microbial communities in soil where crude oil was remediated with and without fertilizer addition and in associated tilled and undisturbed prairie controls. Beads were deployed at 1, 3, and 5 inches in each plot in triplicate in mesh bags for five weeks in May and June of 2003. The soil surrounding the beads also was retrieved. Triplicates (soil and beads) were then composited and analyzed for biomarkers, including phospholipids fatty acids and 16S rDNA. The microbial communities in the beads were found to be enriched in C16 fatty acids relative to the soil communities, were more aerobic in character, and exhibited faster growth rates. Bead communities were less diverse than soil communities, and dominant bacteria in the soil were not necessarily dominant in the beads. Differences could be seen in bead communities within the same plot at different depths, which was not the case for soils. Bio-Sep(R) beads appear to offer potential advantages over soil analysis in the sampling of soil microbial communities in terms of selection of the more active community members and detection of subtle differences with depth.

A Novel Analytical Approach for Visualizing and Tracking Organic Chemicals in Plants

Wild, E., J. Dent, J.L. Barber, G.O. Thomas, and K.C. Jones, Lancaster Univ., Lancaster, UK.
Environmental Science & Technology, Vol 38, June 2004

A two-photon excitation microscopy (TPEM) has been coupled with plant autofluorescence to visualize and track trace levels of an organic contaminant in living plant tissue, without any form of sample modification or manipulation. Anthracene--a polynuclear aromatic hydrocarbon (PAH)--was selected for study in living maize leaves. Anthracene was tracked over 96 hours as it moved through the epicuticular wax and plant cuticle, and was observed reaching the cytoplasm of the epidermal cells. Anthracene was identifiable in five separate locations within the leaf: (1) as a thin diffuse layer in the upper surface of the epicuticular wax; (2) as thick diffuse bands extending from the epicuticular wax through the cuticle to the cell walls of the epidermal cells; (3) on the external surface of epidermal cell walls; (4) on the internal surface of epidermal cell walls; and (5) within the cytoplasm of the epidermal cells. This technique provides a powerful nonintrusive tool for visualizing and tracking the movement, storage locations, and degradation of organic chemicals within vegetation using only plant and compound autofluorescence.

Novel Analytical Techniques Based on an Enhanced Electron Attachment Process
Pinnaduwage, Lal A. (Univ. of Tennessee, Knoxville); M.V. Buchanan and G.B. Hurst (ORNL).
Report No: DOE/ER/62304, Project Number 55328, 28 pp, 2001

This final research report for work done between October 1996 and September 2000 is focused on techniques for the sensitive and selective detection of DNAPLs and other toxic organic compounds. The researchers have worked on three novel analytical techniques based on enhanced negative-ion formation via electron attachment to highly-excited electronic states of molecules. In one of the proposed techniques, the excited states of the analyte molecules are populated via laser excitation; the resulting negative ions are mass analyzed for identification. The other two techniques utilize a specialized gas discharge for the formation of excited species (and low-energy electrons for attachment), and thus will provide a cost-effective method if successful. In one version, the negative ions will be mass analyzed--as in the laser-based technique--and in the other, the decrease in electron density due to excited state attachment will be monitored in electron-capture detector mode. A plasma mixing scheme will be employed to excite the analyte molecules so that the excited states of the analyte molecules will not be destroyed by the discharge.
http://www.osti.gov/em52/final_reports/55328.pdf

Novel Membrane Technology for Food and Water Monitoring
Senecal, Kris J.; J.W. Soares; C.M. Mello; P. Pivarnik; A. Senecal.
Monitoring Food Safety, Agriculture, and Plant Health.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5271, p 140-146, 2004

Electrospinning is a process by which high static voltages are used to produce an interconnected membrane-like web of small fibers with diameters ranging from 50-1000 nanometers. These nanofibrous membranes can have surface areas approximately one to two orders of magnitude higher than those found in continuous films. The association of molecular recognition elements with electrospun fibers presents the opportunity for developing both biosensor detection platforms with increased surface area and membrane concentrators. The available surface area demonstrated by this technique should provide increased sensitivity, capture efficiency, and fast response time in sensing applications. Antibodies and peptide-based receptors were selectively immobilized onto these nanoporous membranes for bioaffinity capture. Initial results involving fluorescent and chemiluminescent imaging for quantifying attachment and activity in association with the electrospinning process are discussed.

Novel Optical Detection Schemes for In-Situ Mapping of Volatile Organochlorides in The Vadose Zone
Angel, S. Michael, Univ. of South Carolina.
Report No: DOE/ER/62881, 19 pp, 2004

The long-term objective of this research is to develop a system for measuring and identifying a wide range of volatile organic hydrocarbons, including organochlorides, at ppb levels in the subsurface using a fiber-optic REMPI probe. The researchers propose to expand the range of analytes to include contaminated soil and certain metal pollutants, such as Hg and Pb, in a ruggedized system compatible with existing fiber-optic sensors, Raman and fluorescence probes, and image guides. The specific focus of much of the proposed work is to identify and optimize those experimental parameters that effect the in situ determination of organic molecules using resonance-enhanced multi-photon ionization (REMPI). The researchers will systematically investigate the dependence of REMPI on laser wavelength, power, and other experimental parameters for a variety of high-priority groundwater and vadose zone contaminants to determine optimal measurement conditions. Emphasis will be placed on visible or fiber-optic compatible wavelengths of excitation so that the high transmission of fiberoptics can be fully utilized. A fiber-optic REMPI system is being designed for integration into an existing cone penetrometer system being delivered by Lawrence Livermore National Lab (LLNL). Fiber-optic probe designs tested in the first studies will be refined by LLNL. Probe performance will be predicted using electrostatic field models and previously developed optical techniques.
http://www.osti.gov/dublincore/gpo/servlets/purl/823367-RNu6Ny/native/823367.pdf

Novel Technology for Wide-Area Screening of ERC-Contaminated Soils
Strategic Environmental Research & Development Program. Cleanup Project CU-1228, 1 pp, Oct 2001

This project seeks to develop innovative methods for the screening of large areas for energetic materials rapidly, at low cost, and with high confidence. During the testing, the relevance to wide area screening of the soil sampling and detection methods developed for landmine detection will be evaluated. The following technical objectives will be pursued: (1) Exploit existing Nomadics amplifying fluorescent polymer (AFP) technology for the problem of wide-area detection of energetic compounds; and (2) Develop standoff detection methods based on AFP technology. The AFP technology used in the Nomadics FIDO sensor for landmine detection can detect extremely small masses of TNT and related explosive compounds. Direct vapor sampling with the FIDO detector as well as a novel soil collection technique will be applied for wide-area detection. Using a proprietary electrostatic precipitator, fine particulate matter will be quickly and easily collected from the soil surface. These samples will be analyzed with the FIDO sensor to determine the levels of contamination in the environment surrounding unexploded ordnance (UXO). The contamination levels will be mapped and a determination will be made as to when thresholds are exceeded or nearing their limits. For the development of standoff detection methods, small polymer beads will be coated with AFP and a marker dye. This material will then be distributed across the area to be assessed. A conservative proof-of-concept experiment will be performed to demonstrate the viability of this method and provide insight into the short- to medium-range spatial heterogeneity of the contaminated soils. This is a FY 2001 New Start project. Contact: Colin Cumming, Nomadics, Inc., Stillwater, OK, 405-372-9535, ccumming@nomadics.com.

Novel Technology for Wide Area Screening of ERC-Contaminated Soils
Cumming, Colin, Nomadics, Inc., Stillwater, OK.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2003, Washington, DC. Poster Session Abstracts, p 118, 2003

Studies of the fate and transport of energetic compounds in the environment have shown the spatial distribution of HE and ERCs is often highly heterogeneous. The heterogeneity of the distribution of contamination within an area places unusual requirements on sampling protocols to ensure that samples collected accurately represent the area sampled. Within a large area, there may be only a few small 'islands' of contamination that require remediation. Under SERDP Project CU-1228, Nomadics is developing novel sample collection methods with on-site sample analysis using Fido, an extremely sensitive handheld detector. The sampling methods under investigation make it possible to rapidly collect a sample of vapor and particulate matter from a large area. The sample can then be analyzed for the presence of nitroaromatics in the field with the Fido sensor in less than a minute without using any chemical reagents. If a sample collected over a large area is contaminated at levels high enough for concern, the area can then be subdivided into smaller sectors and resampled to enable a more precise location of the specific areas of contamination. If the method ultimately proves to be successful, a significant reduction in costs for screening ranges for contamination will result due to the greatly reduced number of samples required compared to more traditional screening methodologies. The cost per sample is also much less than for currently accepted laboratory methods, further decreasing costs. Since samples will be analyzed in the field, the turnaround time for results will be kept to a minimum, which will provide range managers with a tool to make informed, on-site decisions for more efficient and cost-effective range management.

Numerical and Laboratory Investigations of Electrical Resistance Tomography for Environmental Monitoring
Dhu, Tania and Graham Heinson, Univ. of Adelaide, Adelaide, SA, Australia.
Exploration Geophysics, Vol 35, p 33-40, 2004

Numerical and laboratory studies have been conducted to test the ability of electrical resistance tomography (ERT)--a technique used to map the electrical resistivity of the subsurface--to delineate contaminant plumes. Two-dimensional numerical models were created to investigate survey design and resolution. Optimal survey design consisted of both downhole and surface electrode sites. Resolution models revealed that while the bulk fluid flow could be outlined, small-scale fingering effects could not be delineated. Laboratory experiments were conducted in a narrow glass tank to validate theoretical models. A visual comparison of fluid flow with ERT images also showed that, while the bulk fluid flow could be seen in most instances, fine-scale effects were indeterminate.
http://www.seg.or.kr/mullitamsa/2004/vol7_no1/06EG351Dhu_(33-40).pdf

Object-Based Inversion of Crosswell Radar Tomography Data to Monitor Vegetable Oil Injection Experiments
Lane, John W., Jr. (U.S. Geological Survey, Mansfield, CT); Frederick D. Day-Lewis, Roelof J. Versteeg, and Clifton C. Casey.
Journal of Environmental & Engineering Geophysics, Vol 9 No 2, p 63-77, 2004

Developers implemented object-based inversion (using a constrained, non-linear, least-squares algorithm) to improve results from pixel-based inversion approaches using regularization criteria, e.g., damping or smoothness. The approach requires pre- and post-injection travel-time data. Parameterization of the image plane comprises a small number of objects. The nature and geometry of the objects are based on hydrologic insight into aquifer characteristics, the nature of the experiment, and the planned use of the geophysical results. The object-based inversion was demonstrated with synthetic and crosswell radar field data acquired during vegetable-oil injection experiments at a site in Fridley, MN. The area where oil has displaced ground water is discretized as a stack of rectangles of variable horizontal extents. The inversion provides the geometry of the affected region and an estimate of the radar slowness change for each rectangle. By applying petrophysical models to these results and porosity from neutron logs, the vegetable-oil emulsion saturation can be estimated in various layers. With synthetic- and field-data examples, object-based inversion is an effective strategy for inverting crosswell radar tomography data acquired to monitor the emplacement of vegetable-oil emulsions.
http://water.usgs.gov/ogw/bgas/publications/SAGEEP03_Lane/

Ocular Scanning Instrumentation: Confirmation of Biomarkers for Anticholinesterase and Cyanide Exposure
Molnar, L.R.; K.A. Henry; J.V. Odom; C.J. Kolanko.
Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Defense and Law Enforcement II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5071, p 33-40, Sep 2003

The sensitivity of the eye's reaction to a wide variety of chemicals/toxins has been extensively researched via many scientific disciplines. Ocular Scanning Instrumentation (OSI) technology involves the use of an automated device for the continuous or programmed monitoring of optically apparent characteristic(s) and attributes of the eye that may serve as an early-warning system for possible complications based upon generalized information obtained from ocular biomarkers. This paper describes the analysis of primary ocular biomarkers for organophosphate (miosis) and cyanide (venous blood coloration) exposure.

Oil Dispersion of AgI/Ag2S Salts as a New Electroactive Material for Potentiometric Sensing of Iodide and Cyanide
Tana, J. (Univ. of Santo Tomas, Manila, Philippines); J.H. Bergantin, Jr.; A. Merkoci; S. Alegret; F. Sevilla, III.
Sensors and Actuators B: Chemical, Vol 101 No 1-2, p 57-62, 15 June 2004

The authors report on oil dispersion of AgI/Ag2S salts as a new electroactive material for potentiometric sensing of iodide and cyanide. The sensing membrane was optimized to be 5:1 (w/w) silver salt to paraffin oil. The sensor exhibited high sensitivity to both targets, with a fast response time of 30 seconds for iodide and 1 minute for cyanide. The sensor can be used repeatedly in measuring iodide solutions without the need for surface renewal and polishing, but it gives reproducible results in the presence of cyanide solutions only upon renewal of the surface.

On the Reliability of Methods for the Speciation of Mercury Based on Chromatographic Separation Coupled to Atomic Spectrometric Detection
Qvarnstrom, Johanna, Ph.D. thesis, Umea University, Sweden. 41 pp, May 2003

This thesis deals with the reliability of methods for the speciation of mercury in environmental and biological samples. Problems with speciation methods that couple chromatography to atomic spectrometric detection and how to overcome the problems are discussed. The primary analytical techniques studied and evaluated are high performance liquid chromatography-cold vapor-atomic absorption spectrometry (HPLC-CV-AAS), HPLC-inductively coupled plasma-mass spectrometry (HPLC-ICP-MS), capillary electrophoresis-ICP-MS (CE-ICP-MS), and gas chromatography-ICP-MS (GC-ICP-MS). Applying a multi-capillary approach increased the analyte amount injected into a CE-ICP-MS system and improved the overall sensitivity. A microconcentric nebulizer with a cyclone spray chamber was shown to improve the detection limits for mercury species 3 to 13 times in HPLC-ICP-MS and 11-19 times in CE-ICP-MS compared to a cross-flow nebulizer with a Scott spray chamber. To decrease the interference of water vapour in HPLC-CV-AAS, a Nafion dryer tube was inserted between the CV-generation and the detector. Methyl mercury was lost in the Nafion unless it was reduced to elemental mercury prior transport through the dryer tube. During sample pre-treatment, incomplete extraction, losses, and transformation (alkylation, dealkylation, oxidation, and reduction) of mercury species can lead to significant errors (underestimation and overestimation) in determination of the concentrations. The thesis presents methods to detect and determine the degree of transformation as well as correct for errors caused by transformation. The preferable method uses species-specific enriched stable isotope standards in combination with MS detection and a matrix-based calculation scheme. This approach is very powerful, as both the concentrations of the species as well as the degrees of transformation can be determined within each individual sample.
http://publications.uu.se/umu/fulltext/nbn_se_umu_diva-111.pdf

On-Line Measurements of Beryllium, Chromium, and Mercury by Using Aerosol Beam Focused Laser-Induced Plasma Spectrometer and Time-Integrated Filter Sampling Reference Method
Cheng, M.-D.; R.W. Vannice.
Report No: ORNL/TM-2003/56, 33 pp, May 2003

A novel real-time monitor for aerosol particles in flue gas has been developed by researchers at Oak Ridge National Laboratory (ORNL). The monitor was tested at the Eastman Chemical Company in July 2001 on the emissions from a waste incinerator. To investigate the behavior and response of the monitor under simulated/known conditions, stock solutions of prepared metal concentration(s) were nebulized to provide spikes for the instrument testing. Strengths of the solutions were designed such that a reference method (RM) was able to collect sufficient material on filter samples that were subsequently analyzed in a laboratory to produce 30-minute average data points. Parallel aerosol measurements were performed with the ORNL instrument. A recorded signal of an individual element was processed and the concentration calculated from a calibration curve established prior to the campaign. RM data were able to reflect the loads simulated in the spiked waste stream, though it

missed one beryllium sample. The possibility of bias exists in the RM determination of chromium that could lead to erroneous comparison between the RM and the real-time monitoring data. With real-time detection capability, the ORNL instrument was able to reveal the emission variation by making seven measurements within a 30-minute cycle. The ability of the instrument also enables the reconstruction of the baseline chromium emission concentration. The measurements for mercury by both methods are in good agreement.
www.osti.gov/dublincore/gpo/servlets/purl/814217-AqbVZA/native/

On-Site Processing and Subsampling of Surface Soil Samples for the Analysis of Explosives
Hewitt, Alan D. and Marianne E. Walsh, Cold Regions Research and Engineering Lab, Hanover NH.
Report No: ERDC/CRREL-TR-03-14, DTIC: ADA416817, 26 pp, Aug 2003

The on-site implementation of a sampling and analysis plan for the determination of explosives residues exposed a large uncertainty in the ability to quickly obtain representative subsamples from either large (>500 g) composite and/or large discrete samples. To improve the representativeness of on-site analysis, a simple on-site processing (grinding and mixing) and subsampling protocol was evaluated. Surface samples from three firing range characterization activities were taken through a procedure where the bulk samples were air-dried, sieved (#10, 2 mm), ground with a portable hand-operated mill, mixed, and then subsampled using layered bedding technique. This approach reduces laboratory subsampling variance for both sparsely vegetated and vegetated surface soils. Moreover, during a subsequent dynamic sampling and analysis effort, this protocol was successful in ranking explosives residue concentrations associated with a specific military training activity.
http://handle.dtic.mil/100.2/ADA416817

Optical Fiber as a Whole Surface Probe for Chemical and Biological Applications
Lin, Wen Bin (IFOS, Ecole Centrale de Lyon, Ecully, France, and Nankai Univ., Tianjin, PR China); Nicole Jaffrezic-Renault; Jean Marc Chovelona; Monique Lacroix.
Sensors and Actuators B: Chemical, Vol 74 No 1-3, p 207-211, 15 Apr 2001 [Europt(r)ode V Special Issue]

A novel fiber-optic sensor based on monochromatic skew ray excitation of surface plasmon resonance is shown in this paper as a whole surface probe. The monitoring of the self-assembled monolayer (SAM) formation and the immunoassay prove its value and reveal its potential in chemical and biological applications.

Optical Sensors: a Path to Better Gas Detection
Hirst, B. and S. Gillespie (Shell Research and Technology Centre); M. Padgett and W. Sibbett (St. Andrews University); J. Lenney, and N. Hedges (Siemens Environmental Systems).
Physics World, Vol 11, p 37-40, Aug 1998

Technologies pioneered in the petrochemical industry have been adapted for general atmospheric and environmental monitoring. The development of better, cheaper, and more robust gas sensors is vital for obtaining information on industrial emissions, which is needed for governments to decide on priorities for environmental policy and to make the best use of limited resources. A UK-based collaboration between the University of St Andrews, Siemens Environmental Systems, Shell Research, BG Technology, Halbo Optics and Dräger has recently developed a new type of gas sensor. The instrument is based on a novel Fourier transform spectrometer invented at St Andrews in the early 1990s, and the industrial partners have helped to adapt it into a practical and commercial system. The authors use their case to describe how universities can work closely with industry to develop world-beating products.

Optimal Search Strategy for the Definition of a DNAPL Source
Strategic Environmental Research & Development Program. Cleanup CU-1347, 1 pp, July 2003

The objective of this project is to develop, test, and evaluate a computer-assisted analysis algorithm to identify the location and geometry of a DNAPL source. The technical approach exploits the concept that DNAPL is indicated by the presence of a DNAPL species concentration in excess of a specified value attributable to dissolution as described by formulae based on Raoult's law. Development of a computer-based search strategy that uses ground-water flow and transport modeling under uncertainty, a linear Kalman filter to combine modeling information and field data, and an optimization algorithm will assist the ground-water professional in defining the DNAPL source. The algorithm will indicate where, and if necessary when, to sample ground-water quality in order to define the location of the DNAPL-containing area identified with the pre-specified concentration of the target compound. The search strategy is interactive and will provide information on the location and approximate shape of the source and the plume simultaneously and in real time. This project began in FY 2003. Contact: Dr. George Pinder, Univ. of Vermont, Burlington, 802-656-8697, pinder@uvm.edu.

OTDR Fiber-Optical Chemical Sensor System for Detection and Location of Hydrocarbon Leakage
Buerck, J., S. Roth, K. Kraemer, & H. Mathieu, Inst. Instrumentelle Analytik--IFIA, Karlsruhe, Germany.
Journal of Hazardous Materials, Vol 102 No 1, p 13-28, 15 Aug 2003

A distributed sensing system for apolar hydrocarbons is built from a polymer-clad silica fiber adapted to an optical time domain reflectometer (OTDR) setup. OTDR measurements allow locating and detecting chemicals by measuring the time delay between short light pulses entering the fiber and discrete changes in the backscatter signals caused by local extraction of hydrocarbons into the fiber cladding. The light-guiding properties of the fiber are affected by interaction of the extracted chemicals with the evanescent wave light field extending into the fiber cladding. A pulsed laser diode emitting at the 850 nm telecommunication wavelength was applied in the mini-OTDR to locate the hydrocarbons by analyzing the step drop (light loss) in the backscatter signal, which is induced by local refractive index increase in the silicone cladding due to the extracted hydrocarbon. The prototype instrument can be applied for monitoring petroleum leakage in large technical installations, such as tanks, chemical pipelines, or chemical waste disposal containments.

Perchlorate Selective Membrane Electrodes Based on a Phosphorus(V)-Tetraphenylporphyrin Complex
Shamsipur, M. (Razi Univ., Kermanshah, Iran); A. Soleymanpour (Shiraz Univ., Shiraz, Iran); M. Akhond; H. Sharghi; A.R. Hasaninejad.
Sensors and Actuators B: Chemical, Vol 89 No 1-2, p 9-14, 1 Mar 2003

When novel polymeric membrane and coated glassy carbon perchlorate-selective electrodes based on a phosphorus(V)-tetraphenylporphyrin complex were tested, the electrodes exhibited near-Nernstian responses over a wide range of perchlorate ion concentrations and very low detection limits. The electrodes possess low resistances, very fast response times, relatively long lifetimes, and good selectivities relative to a variety of other common anions. The potentiometric response of the electrodes is independent of the pH of test solution in the pH range of 4.0 to 10.0. The sensors were used to determine perchlorate ion in water and human urine.

The Performance of Electrical Methods for Assessing the Integrity of Geomembrane Liners in Landfill Caps and Waste Storage Ponds
Binley, A. and W. Daily.
Journal of Environmental & Engineering Geophysics, Vol 8 No 4, p 227-237, Dec 2003

Geomembrane leak location methods have been established based on injecting electrical current through the liner into the surrounding soil. High potential gradients associated with current leakage can be identified using pairs of electrodes above the liner. Permanent electrode arrays have been installed at some sites as a means of monitoring of the integrity of a landfill liner over the long term; unfortunately, no scientific study has so far addressed the performance of such systems. The authors apply a physical scale model of a landfill liner/cap to investigate the usefulness of grid based and boundary electrode arrays for detecting multiple leaks in a landfill liner or cap. Comparisons of the two electrode geometries under a series of controlled electrical leak experiments show some of the limitations of the method. For example, present data-processing schemes can give misleading results when there are multiple leaks, and variation in resistivity of the soil above or below the liner and boundary current leakage can have a significant impact on the results and subsequently affect the practical value of electrical lead detection systems unless they are taken into account.

Performance of the En Core® Sampler: A Summary of Testing Results
Sorini, S.S., D.E. Turriff, J.F. Schabron, and J.F. Rovani, Jr.
Proceedings of the First International Congress on Petroleum Contaminated Soils, Sediments, and Water, 14-17 August 2001, Imperial College, London, UK. 2001

American Society for Testing and Materials (ASTM) Practice D 6418, "Standard Practice for Using the Disposable En Core® Sampler for Sampling and Storing Soil for Volatile Organic Analysis," describes use of the En Core® sampler to collect and store a soil sample of 5 to 25 grams for volatile organic analysis. Three studies were conducted to generate data on the performance of the sampler for the ASTM practice. The first study evaluated the performance of the sampler for storage of soil samples spiked with VOCs at high concentrations of approximately 2,500 g/kg. This analyte concentration was selected to limit the influence of the analytical method on the data. The second study was conducted to evaluate the performance of the sampler to store soil samples spiked with VOCs at low-level concentrations of approximately 100g/kg. The third study evaluated the performance of the 25-gram En Core® sampler to store soil samples spiked with volatile organic analytes listed in U.S. EPA Method 1311. The results from the three studies are summarized in this paper.

Persistent PCE In A Surficial Sand Aquifer Caused By Auger Cross-Contamination of DNAPL From An Underlying Aquitard
Baine, Trevor H., Beth L. Parker, and John A. Cherry, Univ. of Waterloo, Waterloo, ON, Canada.
2001 International Containment and Remediation Technology Conference and Exhibition, 10-13 June 2001, Orlando, Florida. 3 pp, 2001

An unexpected and persistent PCE plume was found in 1995 in the surficial sand aquifer in one of the Borden groundwater experiment areas. This plume was delineated using detailed depth-discrete groundwater sampling along transects orthogonal to groundwater flow. Several lines of evidence indicate that the plume was caused by a small mass of PCE DNAPL introduced into the aquifer between 1991 and 1994 due to augering into the underlying clayey aquitard, where DNAPL occurs locally in thin sand beds. The plume extends over 300 ft to a small stream, where nearly complete attenuation occurs. Direct push or rotosonic drilling can be used to avoid causing this type of contamination during site investigations.
http://www.containment.fsu.edu/cd/content/pdf/312.pdf

pH Dependence of Methyl Phosphonic Acid, Dipicolinic Acid, and Cyanide by Surface-Enhanced Raman Spectroscopy
Farquharson, Stuart; Alan Gift; Paul Maksymiuk; Frank E. Inscore; Wayne W. Smith.
Chemical and Biological Point Sensors for Homeland Defense.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5269, p 117-125, 2004

Portable analyzers are being developed that can identify and quantify potential chemical agents in water supplies at microgram per liter concentrations within 10 minutes. The authors have been working on a surface-enhanced Raman spectroscopy-based portable analyzer and developing silver-doped sol-gels to generate SER spectra of chemical agents and their hydrolysis products. This paper presents SER spectra of methyl phosphonic acid and cyanide as a function of pH, as well as those of dipicolinic acid, a chemical signature associated with anthrax-causing spores.

Phase I Results From Ground and Hyperspectral Remote Sensing Analysis of Natural and Anthropogenic Acidic Drainage
Hauff, P.L.; D.C. Peters; M.A. Sares; D.W. Coulter; D. Bird; E. Prosh; F.B. Henderson III.
ICARD 2003: Sixth International Conference on Acid Rock Drainage.
AusIMM Publications, Carlton South, Victoria 3053, Australia. ISBN: 1-875776-98-2, p 761-770, 2003

This presentation discusses NASA-funded research on the ability of hyperspectral remote sensing to map diagnostic acid rock drainage (ARD) mineralogy that adversely affects water quality within a watershed and to determine the relative contributions of natural ARD sources of metals and acidity to that drainage. Ground-based reflectance spectroscopy, combined with water chemistry, is used to identify mineralogical and chemical variations throughout a watershed. Integrated with hyperspectral data acquired from airborne remote sensing platforms, such as the NASA Airborne Visible Infrared Imaging Spectrometer (AVIRIS) sensor, a methodology has been developed that should improve environmental assessments and tracking of impacts on and from drainages. Phase I of this project focuses on a drainage basin (Lake Creek), tributary to the upper Arkansas River in central Colorado, which is impacted by natural acid rock drainage from areas of high-sulfide hydrothermal alteration.

Precision of the Performance of the En Core® Sampler to Store Low VOC Concentrations
Sorini, S.S., J.F. Schabron, and J.F. Rovani, Jr.
Journal of Testing and Evaluation, Vol 31 No 3, p 247-252, 2003

Soil sampling and storage practices for volatile organic analysis must be designed to minimize loss of volatile organic compounds (VOCs) from samples. The En Core® sampler is designed to collect and store soil samples in a manner that minimizes loss of contaminants due to volatilization and/or biodegradation. ASTM D 6418, "Standard Practice for Using the Disposable En Core® Sampler for Sampling and Storing Soil for Volatile Organic Analysis," describes the use of the En Core® sampler to collect and store a soil sample for volatile organic analysis. This paper details a study of the device's performance when used to store soil samples spiked with low concentrations (<200 mg/kg) of VOCs.

Push-Pull Partitioning Tracer Tests Using Radon-222 to Quantify Nonaqueous Phase Liquid Contamination
Davis, M., J.D. Istok, and L. Semprini.
Journal of Contaminant Hydrology, Vol 58, p 129-146, 2002

Naturally occurring radon in groundwater can be used as an in situ partitioning tracer for locating and quantifying nonaqueous phase liquid (NAPL) contamination in the subsurface. When combined with the single-well, push/pull test, this methodology has the potential to provide a low-cost alternative to inter-well partitioning tracer tests. During a push/pull test, a known volume of test solution (radon-free water containing a conservative tracer) is first injected into a well; flow is then reversed, and the test solution/groundwater mixture is extracted from the same well. In the presence of NAPL, radon transport is retarded relative to the conservative tracer. Assuming linear equilibrium partitioning, retardation factors for radon can be used to estimate NAPL saturations. The utility of this methodology was evaluated in laboratory and field settings. Laboratory push/pull tests were conducted in both non-contaminated and trichloroethene (TCE)-contaminated sediment. The methodology was then applied in wells located in non-contaminated and light NAPL-contaminated portions of an aquifer at a former petroleum refinery. The method of temporal moments and an approximate analytical solution to the governing transport equations were used to interpret breakthrough curves and estimate radon retardation factors; estimated retardation factors were then used to calculate TCE saturations. The laboratory and field push/pull tests demonstrated that radon retardation does occur in the presence of TCE and LNAPL and that radon retardation can be used to calculate TCE saturations.
http://wrhsrc.oregonstate.edu/semprini/pub_pdfs/Davis_et_al_2002.pdf

Push-Pull Tests for Assessing In Situ Aerobic Cometabolism
Kim, Young, Jonathan D. Istok, and Lewis Semprini.
Ground Water, Vol 42 No 3, p 329-337, May/June 2004

Three types of single-well push/pull tests--transport, biostimulation, and activity tests--were developed for use in assessing the feasibility of in situ aerobic cometabolism of chlorinated aliphatic hydrocarbons (CAHs). Transport tests conducted to evaluate the mobility of solutes used in subsequent tests included bromide or chloride (conservative tracers), propane (growth substrate), ethylene, propylene (CAH surrogates), dissolved oxygen (electron acceptor), and nitrate (a minor nutrient). Biostimulation tests conducted to stimulate propane-utilizing activity of indigenous microorganisms consisted of sequential

injections of site groundwater containing dissolved propane and oxygen. Biostimulation was detected by the increase in rates of propane and oxygen utilization after each injection. Activity tests of the transformation of injected CAH surrogates ethylene and propylene to the cometabolic byproducts ethylene oxide and propylene oxide provided evidence that activity of the monooxygenase enzyme system, responsible for aerobic cometabolic transformations of CAHs, had likely also been stimulated. The series of push/pull tests developed and tested in this study should prove useful for conducting rapid, low-cost feasibility assessments for in situ aerobic cometabolism of CAHs.
http://wrhsrc.oregonstate.edu/semprini/pub_pdfs/329-337%20GW%20M-J%2004.pdf

Quantitative Infrared Reference Library. Volume 1
Ditillo, John and C.C. Keiser (Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD); B.R. Williams (EAI Corp., Abingdon, MD).
Report No: ECBC-TR-297-VOL-1, DTIC: ADA417260, 72 pp, July 2003

The U. S. Army's Chemical Biological Applications and Risk Reduction Business Unit (CBARR) at Aberdeen Proving Ground, MD, is actively involved in Chemical Warfare Materiel (CWM) air monitoring and sample analysis for a variety of missions. These include CWM investigations, remediation of chemical disposal sites, and environmental assessments. To enhance CBARR's ability to accomplish these tasks, the organization is continually examining and evaluating new technologies in this arena. The instrument of interest for this study was the TravelIR by Sensir, Inc. It is a lightweight, portable, closed cell Fourier Transform Infrared (FTIR) Spectrometer designed to measure and collect radiation in the mid-infrared band. Infrared detection is performed with a DTGS detector that operates at room temperature. The gas cell used has a 2.4-m path length, L. Data were acquired by co-adding 64 spectra at 2 cm(exp -1) resolution. The experiment was run with a series of quantitative concentrations of analyses, to include sarin, distilled mustard, tabun, and soman.
http://handle.dtic.mil/100.2/ADA417260

Raman Spectroscopy for Homeland Defense Applications
Kawai, Nancy T. and Kevin M. Spencer.
Spectroscopy Magazine, p 54-58, 2 June 2004

Surface enhanced Raman spectroscopy (SERS) has been demonstrated for the detection of trace levels of explosives, CW agents, and bacteria both in the vapor phase and in aqueous solution. There is strong potential to use an array of SERS sensors for the rapid analysis of ambient air and drinking water supplies. Resonance Raman spectroscopy (RRS) is another technique resulting in enhanced Raman scattering. In RRS, the laser excitation wavelength is matched to the UV absorption of the analyte molecule, which results in lower detection limits compared to exciting at longer wave-lengths while avoiding interfering fluorescence backgrounds. This article discusses the role of Raman spectroscopy for forensic analysis and homeland defense.
http://www.spectroscopymag.com/spectroscopy/data/articlestandard/spectroscopy/242004/97816/article.pdf

Remote Detection of Methane by Infrared Spectrometry for Airborne Pipeline Surveillance: First Results of Ground-Based Measurements

Harig, Roland; G. Matz; P. Rusch; J.-H. Gerhard; K.P. Schaefer; C. Jahn; P. Schwengler; A. Beil.
Remote Sensing of Clouds and the Atmosphere VIII.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5235, p 435-446, 2004

The authors investigated remote detection of methane by passive Fourier-transform infrared (FTIR) spectrometry for pipeline surveillance. The study focused on fast measurements to enable methane detection from a helicopter during regular inspection flights. Two remote sensing systems were used for the detection of methane: a scanning infrared gas imaging system and a new compact passive scanning remote sensing system. To achieve a high spectral rate, which is required due to the movement of the helicopter, measurements are performed at low spectral resolutions, which results in overlapping signatures of methane and other constituents of the atmosphere in the measured spectrum. The spectra are analyzed by a detection algorithm, which includes simultaneous least squares fitting of reference spectra of methane and other atmospheric species. The field measurement results show that passive remote sensing by FTIR spectrometry is a feasible method for remote detection of methane.

Remote Monitoring Equipment for Cathodic Protection Systems
Van Blaricum, V.L. & W.R. Norris, U.S. Army Construction Engineering Research Lab, Champaign, IL.
FEAP User Guide 97/75, 30 pp, Apr 1997

Several companies have recently begun manufacturing remote monitoring units (RMUs) that are tailored for evaluating cathodic protection (CP). This technology allows personnel to conduct measurements on multiple CP systems from a central location so that problems can be detected and repaired immediately. A field evaluation of CP RMUs was performed over an 8-month period to determine the effectiveness of systems from three different manufacturers. Manufacturers were selected based upon system cost, features, and availability, and whether the system is made in the United States. The evaluation at Fort Drum, NY included two identical units from each manufacturer installed on indoor rectifiers. The evaluation at USACERL included one unit from each manufacturer installed on an outdoor rectifier. Readings from the RMUs were compared with readings taken using traditional manual methods throughout a variety of weather- and operator-varied conditions. Units from only one of the three manufacturers performed successfully. Several new or improved systems have entered the market since this demonstration began. There are also units available that are more expensive or that are manufactured outside the United States. Additional FEAP funding is being sought to demonstrate those systems. In the interim, units that meet the criteria in this guide are a viable alternative to manual CP monitoring.
http://owww.cecer.army.mil/TechReports/Vancprem/Vancprem.pdf

Remote Monitoring of Leaks in Storage Tanks using Electrical Resistance Tomography: Application at the Hanford Site
Daily, W. and A. Ramirez (Lawrence Livermore National Lab, Livermore, CA); A. Binley (Lancaster Univ., Lancaster, UK).
Journal of Environmental & Engineering Geophysics, Vol 9 No 1, p 11-24, 2004

A field experiment to evaluate the performance of electrical resistance tomography (ERT) to detect leaks from metal underground storage tanks was carried out under conditions simulating those expected during actual remediation of a single-shell tank at DOE's Hanford facility. Approximately 54,000 liters of concentrated sodium thiosulfate (simulating tank waste) were episodically released from a steel tank in a blind test lasting 110 days. ERT data were collected from an array of point electrodes installed in boreholes around the tank. Each day during the test, a leak or no-leak condition was declared based solely on analysis of the electrical data. The success rate of the declarations made during the test was only 57%, but further analysis carried out at the end of the test resulted in a significant improvement of the success rate. These final results suggest that ERT, used with either custom-built electrode arrays or existing steel-cased wells, can provide an effective means of monitoring the remediation or the long-term integrity of underground storage tanks.

Remote, Spectral Photo-Elastic Sensor and Portable Spectrometer for Environment Monitoring
Konwerska-Hrabowska, Joanna.
Optical Techniques for Environmental Sensing, Workplace Safety, and Health Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4887, p 11-16, July 2002

Abstract not available.

Remotely Sensed Density Measurements of Volcanic Sulfur Dioxide Plumes Using a Spectral Long Wave Infrared Imager
Mares, Aimee G., Master's thesis, Naval Postgraduate School, Monterey, CA.
DTIC Order No: ADA408292, 146 pp, Sep 2002

This thesis examines the process of detecting and quantifying volcanic SO2 plumes using the Airborne Hyperspectral Infrared Imager (AHI) developed by the University of Hawaii. AHI was flown over Pu'u'O'o Vent of Kilauea Volcano in Hawaii to collect data on SO2 plumes. In conjunction with these observations, data were taken with the Hawaii Volcano Observatory's Correlation Spectrometer (COSPEC) and University of Hawaii's FLYSPEC. These are ultraviolet remote sensors with a successful history of monitoring volcanic SO2 plumes at 0.3 micron. AHI is a LWIR pushbroom imager sensitive to the 7.5 to 11.5 micron region. Spectral analysis and mapping tools were used to identify and classify the SO2 plume in both radiance and emissive space. MODTRAN was used to model the radiance observed by the sensor as it looked to the ground through an SO2 plume. A spectral library of radiance profiles with varying ground surface temperatures and SO2 concentrations was developed, and the AHI data fitted to the varying model profiles. Reasonable values of SO2 emission were obtained, though the values directly over the vent obtained by AHI were much higher than those obtained by the UV sensors some distance away.
http://handle.dtic.mil/100.2/ADA408292

Researchers Create Potential Toxic Sensor Chip by Combining Electronics with Living Cell
Yang, Susan.
University of California at Berkeley News Release, 9 June 2003

In experiments conducted at the University of California, Berkeley, researchers have found a way to tap into the telltale electrical signals that mark cell death, opening the door to the creation of a "canary on a chip" that can be used to sound the alarm of a biochemical attack or test drug toxicity on human tissue.

The researchers used a microchip to electrically determine cell viability by detecting changes in the electrical resistance of a cell membrane within milliseconds after it is exposed to a toxic agent. They found that after a cell is exposed to a toxin, its electrical resistance experiences a quick spike before dropping dramatically when it dies. This MEMS (micro-electromechanical) device could be invaluable in the immediate detection of a biochemical attack. Three years ago, Boris Rubinsky and Yong Huang invented a chip that merges a living biological cell with electronic circuitry. The bionic chip has since been patented by UC Berkeley and exclusively licensed to Excellin Life Sciences, a Milpitas-based biotech startup. The chip has implications for use as a biochemical sensor that soldiers could wear on a nametag or that could be stationed as a remote sensor in the field. In the design of the bionic chip, a cell essentially lives in a nutrient-rich culture between two electrodes on a silicon wafer. The electrodes continuously probe the cell membrane and track the amount of electrical current that is able to pass. A live, intact membrane will not allow ions to pass through, except in very constrained conditions. The membrane in a dead cell becomes leaky. The leaks allow various ions to move through the cell membrane, making a circuit that can be easily measured. This change in membrane permeability forms the basis for traditional cell viability assays that use colorimetric or fluorescent dyes.

Block MEMS Receives $2 Million Government Contract to Develop Miniaturized Chemical Agent Detector (ChemPen) for Battlefield and Homeland Defense
MEMS and Nanotechnology Clearinghouse, 9 Oct 2003

Block MEMS, LLC, of Marlborough, MA, announced receipt of a $2 million contract from the U.S. government to develop a miniaturized chemical detector for wide area detection. This new product will be called "ChemPen." Block MEMS will develop ChemPen using state-of-the-art micro-machine technology in conjunction with Worcester Polytechnic Institute and Sandia National Laboratories. The ChemPen will be based on MEMS technology developed by the Defense Advanced Research Projects Agency (DARPA) and Sandia National Labs. MEMS technology adapts silicon fabrication techniques used for decades to make microelectronics to make micron-sized motors, gears, and mirrors all smaller than the thickness of a human hair. The ChemPen will be lightweight, no larger than a fountain pen, and will cost under $1,000, in comparison to current detectors that cost $10,000 to $20,000. Its software can be programmed to detect a wide variety of vapors, including nerve gases and toxic industrial chemicals.

A Review of Dioxin Screening Methods for Soil Analysis
Coakley, William A. (U.S. EPA, Edison, NJ), Gerald A. Ball, Deborah A. Killeen.
The Pittsburgh Conference: PITTCON 2003, Presentation 590-11P.

Immunoassays using colorimetric analysis to measure the bound antibodies and bioassays utilizing the Ah-receptor of mammalian liver cells or isolated proteins (like cytosol) with fluorescence or time-delayed fluorescence for quantitation are innovative methods for screening dioxin in soil samples. All procedures have high sensitivity to the 2,3,7,8-tetra dioxin congener (TCDD) in the low parts per trillion detection range, with varying reaction affinities to the remaining sixteen toxic congeners. Quantitative results can be obtained for each procedure using multi-level calibration curves. A drawback to these procedures is that the methods react to compounds having similar molecular structures to dioxin and result in a high degree of false positives. Interfering compounds include but are not limited to coplanar polychlorinated biphenyls and polyaromatic hydrocarbons. These methods are not considered useful in the field but instead are better suited to an on-site or stationery laboratory facility. This poster summarizes the analytical basis for each dioxin screening method and outlines the advantages and disadvantages with respect to cost, complexity, equipment and instrumentation required, detection range, storage requirements, cross reactivity, congener affinity, and analysis time.

A Review of Emerging Sensor Technologies for Facilitating Long-Term Ground Water Monitoring of Volatile Organic Compounds
Geotrans, Inc.
Report No: EPA 542-R-03-007, 61 pp, 2003

This report summarizes the status of emerging sensor technologies for facilitating long-term groundwater monitoring for volatile organic compounds (VOCs). It also describes factors, including regulatory acceptance and cost-effectiveness, that influence the applicability of these technologies. The focus is on long-term groundwater monitoring (both sensors and probes) generally associated with a selected remedy, such as monitored natural attenuation or pump and treat. The following three technology categories are considered: technologies that provide in situ sampling and analysis of VOCs in groundwater (i.e., sampling and analysis conducted within a monitoring well), commercialized technologies that automate both sampling and aboveground analysis of VOCs in groundwater, and hand-held or otherwise field-portable instruments that can be used for the analysis of VOCs in groundwater at the well where the sample is obtained. Technologies specifically associated with cone penetrometers or direct-push samplers are not considered because these approaches generally are more applicable to site investigations and characterization than to long-term monitoring.
http://clu-in.com/download/char/542r03007.pdf

Selective Pool Optode for Mercury Ion Sensing in Aqueous Solution
Kuswandi, B. (Univ. of Jember, Jember, Indonesia); R. Narayanaswamy (UMIST, Manchester, UK).
Sensors and Actuators B: Chemical, Vol 74 No 1-3, p 131-137, 15 Apr 2001 [Europt(r)ode V Special Issue]

A selective pool optode for mercury ion sensing has been developed based on the reagent pool of safranin/iodide solution trapped behind a Nafion membrane. The membrane is highly permeable to cations and excludes all anions electrostatically. The safranin/iodide reaction occurs specifically in the presence of Hg(II) ions as catalyst; in the absence of Hg(II), no reaction occurs between safranin and iodide. When trace Hg(II) ions are present, the reaction takes place within a few minutes and a color change from red to colorless occurs, which can be spectroscopically detected via optical fibers. The sensor can be applied to measurements in situ.

Sensors in Air and Gas Monitoring
Nowakowski, Antoni.
Optical Techniques for Environmental Sensing, Workplace Safety, and Health Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4887, p 50-54, July 2002

Abstract not available.

Sensors That May Detect Hundreds of Chemicals at Once
GlobalTechnoScan, 30 Jan - 5 Feb 2002

Chemists at the State University of New York at Buffalo have taken a major step toward placing hundreds, and possibly even thousands, of reusable chemical sensors in an area smaller than a dime. The research overcomes a key obstacle in exploiting high-tech materials, called xerogels, into which the UB team has pioneered investigations as the basis of new chemical sensors. Xerogels are porous glasses developed through sol-gel processing techniques in which a special solution reacts to form a porous polymer. The resulting xerogel is a rigid material, like a glass, only it consists of an intricate network of nanoscopic pores. In past work, the UB group has developed innovative ways to stabilize and trap proteins within the xerogels. These proteins then can be put to work to signal the presence of important chemicals in a sample. Traditional xerogel-based sensors are large and designed to detect only one chemical species. The UB researchers wanted to shrink down all of the sensor technology so they could place multiple sensors in a small area and obtain information on the presence of many chemicals in a single, small sample. Pin-printing is a technology widely used in genomics in which an extremely thin pin point sucks up by capillary action small volumes of solution and deposits or prints them onto microscope slides. Using a commercial pin-printer, the UB team contact-prints the sol-gel solution onto the surface directly to form an array of xerogel-based sensors. The team is now working on pin-printing chemical sensors onto the top of an LED to form a fully self-contained sensor array platform. A provisional patent has been filed. The work was funded by the National Science Foundation. Contact: Ellen Goldbaum, goldbaum@buffalo.edu, 716-645-5000 ext 1415.

SERS Detection of CW Agents in Water
Christesen, Steven D., U.S. Army Edgewood CB Center, MD.
The Pittsburgh Conference: PITTCON 2003, Presentation 1550-3.

Surface enhanced Raman spectroscopy (SERS) has been identified as a leading candidate technology to replace the M272 Chemical Agent Detection Kit currently used by the U.S. military. When molecules are adsorbed onto specific solid substrates, an enhanced Raman signal of the adsorbate is obtained, with intensity enhancements of 102 to 1014. In some instances, single molecule detection has been achieved. Using electrochemically roughened gold and silver substrates, researchers have detected nerve agents as well as their hydrolysis products at levels ranging from milligrams to micrograms per liter of water. While the sensitivity for cyanide and the nerve agent hydrolysis products are below or near the required limits, more work needs to be done to improve the sensitivity for the nerve agents themselves. A prototype SERS water monitor comprising a near-infrared laser source, compact spectrograph, CCD array detector, and fiber-optically coupled dipstick probe is currently under construction. The dipstick probe has been tested with agents using a laboratory Raman instrument.

Simultaneous Determination of Low Level Pesticides and EPA Semivolatile Compounds
Phillips, Eric W. (ThermoFinnigan, Austin, TX), Brody Guckenberger, Trisa C. Robarge.
The Pittsburgh Conference: PITTCON 2003, Presentation 610-11P.

The Trace DSQ(TM) allows the operator to perform alternating full scan and single ion monitoring on the same data file. Current methods for the determination of pesticides need to show very low sensitivity. The single-quad dual-stage quadrupole (DSQ) can perform ultra low-level analysis in the

SIM mode. Several ions will be detected for each pesticide--one for quantitation and at least two others for confirmation--set up in a series of segments so that a minimal number of ions will be detected at a given time. The fewer ions analyzed at a given time will maximize the sensitivity for those ions in a single-quadrupole instrument. The alternating scan is a full scan analysis to allow for determination of unknowns, library searches, and meeting the method requirements for semivolatile analyses. The full scan function is programmed at a rate of 7000 amu/s to maximize the number of points across a peak for library searching. To develop the method, the pesticides were initially run at a high concentration in full scan to determine elution time and masses for the SIM method. The pesticides then were spiked into the semivolatile standards for the development of the entire method.

SLAPPM Test: an Easy Method for a Simple Limestone Alkalinity Production Prediction and Monitoring Test for Vertical Flow Pond Type Systems
Denholm, C.F., M.H. Dunn, T.P. Danehy, S.L. Busler, Stream Restoration, Inc., Cranberry Twp, PA.
National Meeting of the American Society of Mining and Reclamation and the 9th Billings Land Reclamation Symposium, 3-6 June 2003, Billings, Montana. Book of Abstracts. ASMR, Lexington, KY.

Limestone is one of the principal materials utilized in passive acid mine drainage treatment systems due to its relatively large percentage of calcium carbonate content. When the limestone is placed in contact with acidic water it dissolves into ionic species, neutralizing acids and raising the pH in order to hydrolyze and precipitate metals. Chemical and physical properties can vary greatly among different mine discharges as well as different kinds of limestone, hence a test is recommended to predict the alkalinity generation of the particular water to be treated with the specific stone to be used before designing the passive system. A Simple Limestone Alkalinity Production Prediction and Monitoring (SLAPPM) Test can be used to predict (roughly) the amount of alkalinity production and acid neutralization per hour for an individual vertical flow pond type system. The data also can be plotted similar to a regression analysis curve and used to determine how well a system is functioning over time and what degree or amount of effective contact time with the limestone is occurring within the system.

Soil Gas Screening for Chlorinated Solvents at Three Contaminated Karst Sites in Tennessee
Wolfe, William J. and Shannon D. Williams.
Groundwater Monitoring & Remediation, Vol 22 No 4, p 91-99, Fall 2002

Soil gas was sampled using active sampling techniques and passive collectors at three sites in Tennessee to evaluate the effectiveness of these techniques for locating chlorinated solvent sources and flowpaths in karst aquifers. Actively collected soil gas samples were analyzed in the field with a portable gas chromatograph, and the passive soil gas collectors were analyzed in the lab with gas chromatography/mass spectrometry. Results of the sampling indicate that the effectiveness of both techniques is highly dependent on the distribution of the contaminants in the subsurface, the geomorphic and hydrogeologic characteristics of the site, and, in one case, on seasonal conditions. Both active and passive techniques identified areas of elevated subsurface chlorinated solvent concentrations at a landfill site where contamination remains concentrated in the regolith. Neither technique detected chlorinated solvents known to be moving in the bedrock at a manufacturing site characterized by thick regolith and an absence of surficial karst features. Passive soil gas sampling had varied success detecting flowpaths for chloroform in the bedrock at a train derailment site characterized by shallow regolith and abundant surficial karst features. At the train derailment site, delineation of the

contaminant flowpath through passive soil gas sampling was stronger and more detailed under winter conditions than summer.
http://tn.water.usgs.gov/pubs/ja/WJW/

Southern Italy Illegal Dumps Detection Based on Spectral Analysis of Remotely Sensed Data and Land-Cover Maps
Notarnicola, Claudia; Mariella Angiulli; Concetta I. Giasi.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5239, p 483-493, 2004

Investigators used data from the sensor Thematic Mapper on Landsat 5 in synergy with digital ortho-photos (1:10000) and land cover map Corine 1990 to create a methodology to identify a dump site in the Apulia Region in Southern Italy. In an early phase, it is impossible to use thermal anomaly as a characteristic sign of dump presence, so identification proceeded through the extraction of spectral signatures of the dump area and of the neighborhood zones. The analysis was developed in three steps: monitoring the change in the zone of interest, picking out the dump presence by the spectral signature specificity, and individuating areas characterized by the same spectral properties. The identification of the dump was a feasible objective because of the temporal stability of its spectral signature with respect to those of the other areas.

Spectral Induced Polarization Measurements at the Carlisle Mine Dump, New Mexico
Campbell, David L. and Shay Beanland.
U.S. Geological Survey Open-File Report 01-0363, 11 pp, 2001

As part of a project to investigate formation of acid mine drainage, a USGS team did integrated geological, geochemical, and geophysical studies of eight mine dumps in Colorado and New Mexico. The apparent resistivity and raw phase data were interpreted using computer program DCIP2D. The investigators' interpretation of the readings suggests that the Carlisle mine dump contains extensive local concentrations of metallic sulfide minerals, but that substantial AMD is not being produced there.
http://pubs.usgs.gov/of/2001/ofr-01-0363/

Spectral Induced Polarization Measurements at the Main Iron Incline Mine Dump Near Leadville, Colorado
Campbell, David L.
U.S. Geological Survey Open-File Report 01-0315, 9 pp, 2001

As part of a project to investigate formation of acid mine drainage, a USGS team did integrated geological, geochemical, and geophysical studies of eight mine dumps in Colorado and New Mexico. The geoelectrical measurements made at the Main Iron Incline Mine Dump allowed the investigators to infer that the material in the Main Iron Incline mine dump is generally uniform in composition. This paper also discusses the results of spectral measurements, with illustrations.
http://pubs.usgs.gov/of/2001/ofr-01-0315/

Spectral Induced Polarization Studies of Mine Waste Piles in Colorado and New Mexico
Campbell, D.L. and R.J. Horton.
SAGEEP 2001: Proceedings for the Symposium on the Application of Geophysics to Environmental and Engineering Problems, Denver, March 4-7, 12 pp, 2001

As part of a project to investigate formation of acid mine drainage, a USGS team did integrated geological, geochemical, and geophysical studies of eight mine dumps in Colorado and New Mexico. The authors report the results of the polarization studies.

Stabilized Liquid Membrane Device (SLMD) for the Passive, Integrative Sampling of Labile Metals in Water
Brumbaugh, W.G., J.D. Petty, J.N. Huckins, and S.E. Manahan.
Water, Air, and Soil Pollution, Vol 133, p 109-119, 2002

The Stabilized Liquid Membrane Device (SLMD, patent no. 6,296,760) is a passive, integrative sampler that provides an alternative or complementary approach to conventional water sampling for trace metals. A water-insoluble organic complexing mixture diffuses in a controlled manner to the exterior surface of the sampler membrane, which provides for continuous sequestration of bioavailable forms of trace metals--cadmium, cobalt, copper, nickel, lead, and zinc--for up to several weeks. In situ deployment of SLMDs in both "bare" and "sheathed" configurations provides for a passive, time-integrated analog of unfiltered and filtered samples. The SLMD also can be used for in-laboratory preconcentration and speciation of bioavailable trace metals from grab water samples.

A Survey of Department of Energy-Sponsored Geophysical Research for Shallow Waste Site Characterization
Guillen, D.P. and R.C. Hertzog, Idaho National Engineering and Environmental Lab, Idaho Falls.
Vadose Zone Journal, Vol 3, p 122-133, 2004

This survey discusses DOE-sponsored research in geophysical characterization of the vadose zone at Idaho National Engineering and Environmental Laboratory (INEEL) and other contaminated sites. Geophysical imaging techniques used to characterize the shallow subsurface include electromagnetic, ground-penetrating radar, electrical, seismic, and nuclear magnetic resonance. The research surveyed in this article has involved the development of high-resolution imaging capabilities to capture important details of the heterogeneous nature of subsurface properties and processes. Also important is the coupling of nonintrusive survey geophysical measurements (e.g., electrical surveys) with detailed quantitative precise point-sensor measurements (e.g., lysimeters and vapor-port systems) or borehole (e.g., NMR, neutron-based moisture, and geochemical tools) measurements to extend high-precision knowledge away from the borehole. The work also has addressed the application of multiple geophysical methods to constrain the uncertainty in determining critical subsurface physical properties. The authors discuss the applications of various geophysical methods to several contaminated areas at INEEL.

Survey of Technologies for Monitoring Containment Liners and Covers
U.S. EPA, Office of Superfund Remediation and Technology Innovation.

Report No: EPA 542-R-04-013, 64 pp, June 2004

Systems designed to monitor releases through liners or provide an early warning of a potential liner failure can be divided into two major groups: those that can chemically speciate and quantitate the materials that escape (or provide a sample of them for analysis) and those that can only indicate that a release is occurring. Examples of the technologies capable of chemical speciation and quantitation are lysimeters, diffusion hoses, and soil gas detectors. Examples of the technologies that simply indicate a release is occurring are electrode grids and other electrical methods, electrochemical sensing wire cables, time domain reflectometry detection cables, capacitance sensors, and neutron probes. Of these, electrochemical sensing wire cables, time domain reflectometry detection cables, and intrinsic fiber optic sensors can be constructed so that they react to certain classes of chemicals. This report discusses the strengths and weaknesses of the different systems.
http://www.clu-in.org/download/char/epa542r04013.pdf

A Survey of the Year 2002 Commercial Optical Biosensor Literature
Rich, Rebecca L. and David G. Myszka, Univ. of Utah, Salt Lake City.
Journal of Molecular Recognition, Vol 16 No 6, p 351-382, Jan 2004

Reviewers have compiled 819 articles published in the year 2002 concerning commercial optical biosensor technology. The literature demonstrates that the technology's application continues to increase as biosensors are contributing to diverse scientific fields and are used to examine interactions ranging in size from small molecules to whole cells. The variety of available commercial biosensor platforms is increasing, and the expertise of users is improving. The survey focuses on the basic types of biosensor experiments: kinetics, equilibrium analysis, solution competition, active concentration determination, and screening. The reviewers illustrate the high information content available in the primary response data and emphasize the impact of including figures in publications to support the results of biosensor analyses.

Technical and Regulatory Guidance for Using Polyethylene Diffusion Bag Samplers to Monitor Volatile Organic Compounds in Groundwater
Interstate Technology & Regulatory Council (ITRC). Report No: DSP-3, 78 pp, Feb 2004

Polyethylene diffusion bag (PDB) samplers are low-density polyethylene bags containing deionized water. They are used to collect water samples in ground-water wells for laboratory analyses of volatile organic compounds (VOCs). These passive samplers rely on the movement of ground water from the aquifer or water-bearing zone through the screen or open interval of a well. VOCs in the aqueous environment diffuse across the bag material until the concentrations in the bag reach equilibrium with those in the surrounding ground water. PDB samplers cannot be used to sample for all contaminants; metals and other inorganic compounds will not diffuse across the membrane, but many VOCs have shown good diffusion characteristics in laboratory tests and are recommended for sampling with PDBs. For these common contaminants, PDB sampling is as valid as low-flow and other conventional methodologies and is often substantially less expensive over the life of a long-term monitoring program. Cost savings in the range of 40 to 70% have been achieved by replacing other sampling methods with PDB sampling. PDB samplers can also be an effective tool to characterize vertical VOC stratification in the screened or open intervals of wells and have been used to identify and delineate

ground-water flow into surface waters. This document provides a guide for regulators, technology users, and stakeholders to facilitate the use of PDB sampling, particularly for long-term monitoring.
http://www.itrcweb.org/DSP-3.pdf

Technology Assessment of On-Line Acoustic Monitoring for Leaks/Infringements in Underground Natural Gas Transmission Lines
Loth, J.L., G.J. Morris, G.M. Palmer, R. Guiler, and D. Mehra, West Virginia University.
Technology Status Report, 34 pp, Jan 2003

The appearance of a rupture, leak, or damage that could cause a leak in a natural gas pipeline usually generates an acoustic signal. During the crack initiation and early crack growth, the steel pipe wall deformation creates a significant acoustic signal that can produce a transducer output ranging from several microvolts to several volts. The amplitude and frequency spectrum and the attenuation behavior are all a function of the pipe-wall material properties. If the damage causes a sudden leak, then the associated rapid change in fluid pressure produces a pressure transient, often referred to as a burst signal. This paper discusses acoustic and non-acoustic damage and leak detection techniques with extensive reference to the literature.
http://www.netl.doe.gov/scng/publications/t&d/tsa/Task%203_5Jan03.pdf

Testing for Arsenic Utilizing a Test Kit
Lewis, Corlyss B. (Industrial Test Systems, Inc., Rock Hill, SC), Ivars Jaunakais, Jeremy Zier.
The Pittsburgh Conference: PITTCON 2003, Presentation 2640-6.

Because environmental background conditions can influence the amount of arsenic (As) that occurs in a particular area, background conditions should be evaluated through testing to determine if the occurrence of As is natural or added by some activity of man. Quick turnaround times and cost effectiveness in this endeavor can be achieved with a Soil Arsenic Test Kit. The chemistry of the Test Kit involves converting As compounds to arsine gas. Tartaric acid enhanced with two metal salts, peroxymonosulfate and zinc dust, are used to produce the arsine gas. The gas reacts with a mercuric bromide test pad on the test strip, producing a color change from white to yellow or brown on the pad of the test strip in a reaction period of approximately 30 minutes. The color on the test pad is compared to a calibrated color chart, which is directly related to the concentration of As in the sample.

Time-Lapse Airborne EM Surveys Across a Municipal Landfill
Beamish, D. (British Geological Survey, Keyworth, UK); Annina Mattsson (Geological Survey of Finland, Espoo, Finland).
Journal of Environmental & Engineering Geophysics, Vol 8 No 3, p 157-165, Sep 2003

The authors consider data obtained from two fixed-wing airborne electromagnetic surveys taken 4 years apart across an active municipal solid waste landfill. In theory, these data can be used both to test the isolation performance of the installation and to monitor mass (leachate) transport behavior within the landfill structure. Single-frequency (3.1 kHz) data obtained at a similar density (100 m flight line spacing) over the 4-year span are presented and compared. These data have an expected mean depth of investigation of about 15 m within the landfill. Conductivities within the landfill are observed to be three orders of magnitude above background. From the initial survey data, a specific distribution of high conductivity material can be identified in three of the landfill cells (peak values of 170 mS/m). Four years later, a considerable redistribution of material is apparent in the results obtained across two of the cells (peak values of 317 mS/m). A third cell shows no change. A subtraction of the two time-lapse conductivity models allows the dynamic components of the conductivity distribution to be mapped within individual cells. All larger conductivity increases are confined to the operational landfill.

Time-Lapse Monitoring in Single Boreholes Using Electrical Resistivity Tomography
Tsourlos, Panagiotis (Aristotle University of Thessaloniki, Thessaloniki, Greece); Richard Ogilvy, Philip Meldrum, and Geoffrey Williams.
Journal of Environmental & Engineering Geophysics, Vol 8 No 1, p 1-14, 2003

Electrical Resistivity Tomography (ERT) has been applied in single boreholes to study leachate generation within a disused and unconfined landfill. Several boreholes were drilled in the landfill to characterize the waste and to establish the concentration and spatial variability of the leachate. Six of the boreholes contained an electrode array installed on the outside of the PVC casing prior to completion. Resistivity measurements were taken every month from December 1999 to November 2000 to monitor the seasonal hydrochemical changes in the chalk immediately beneath the landfill base. Apart from the expected matrix infiltration, the modeling results suggest that contaminant transport in the chalk also may occur as transient pulses in narrow fractures, when the waste is re-activated by changing groundwater levels. The study underlines the advantages of a volumetric imaging technique such as ERT to complement and optimize hydrochemical sampling.

Tiny Cell-Based Chemical Detectors Have Homeland Security Potential
GlobalTechnoScan, 19-15 Mar 2003

A highly sensitive, inexpensive lab-on-a-chip that provides warning within seconds of even trace amounts of toxic chemicals in water was designed and demonstrated recently by National Institute of Standards and Technology (NIST) scientists and collaborators. The prototype sensor system monitors the natural response of bacterial cells bound within the microscopic channels of a plastic microfluidics device--a miniaturized chemical and biochemical analysis system. In the presence of certain chemicals, the cells eject large amounts of potassium, which is detected with an optical sensor that changes color. The prototype was demonstrated as part of an early warning system for industrial pollutants that interfere with sewage treatment, but it also has potential homeland security applications. The device was designed in collaboration with scientists at Virginia Polytechnic Institute and State University in Blacksburg and Veridian Pacific-Sierra Research of Charlottesville, VA. Contact: Laura Ost, National Institute of Standards and Technology (NIST), laura.ost@nist.gov, 301-975-4034.

TiO_2:Mo, MoO_3:Ti, $TiO+WO_3$ and TiO:W Layer for Landfill Produced Gases Sensing
Comini, E. (Univ. di Brescia, Brescia, Italy); V. Guidi; M. Ferroni; G. Sberveglieri.
Sensors and actuators B: Chemical, Vol 100 No 1-2, p 41-46, 1 June 2004

The authors have explored a novel approach to monitoring gaseous emissions at landfills by testing solid-state chemoresistive gas sensors to detect typical complex organic landfill gases--carbon sulfide, methyl sulfide, and xylene. TiO2:Mo, MoO3:Ti, TiO+WO3, and TiO:W mixed-oxides thin films have been prepared by reactive sputtering and processed through selective sublimation. The layers provide remarkable response to carbon disulfide and xylene at very low levels.

Toxicological Exposure of Sediment-Bound Hydrophobic Organic Contaminants as a Function of the Quality of Sediment Organic Carbon and Microbial Degradation
Fredrickson, H.L.; J.W. Talley; J.S. Furey; S. Nicholl, Engineer Research and Development Center, Vicksburg, MS.
Report No: ERDC/TN-EEDP-04-34, DTIC: ADA416025, 17 pp, July 2003

This technical note 1) relates the importance of the toxicological exposure potential of hydrophobic organic contaminants (HOC) in sediments and dredged material to implementation of public laws and regulations governing environmental risk assessment, 2) summarizes recent peer-reviewed literature on sediment HOC exposure potential in the context of the sorbent quality of sediment organic carbon and microbial degradation, and 3) introduces the practical utility of thermal desorption mass spectrometry with respect to identification and quantification of HOC, measuring HOC release energy, and the compatibility of the development of field-portable direct sampling analytical technologies.
Available at http://handle.dtic.mil/100.2/ADA416025

The Use of 3D Electrical Resistivity Tomography to Characterise Waste and Leachate Distribution within a Closed Landfill, Thriplow, UK
Ogilvy, Richard, Philip Meldrum, Jon Chambers, and Geoffrey Williams.
Journal of Environmental & Engineering Geophysics, Vol 7 No 1, p 11-18, 2002

After borehole sampling and a 2-D electrical resistance tomography (ERT) survey downgradient of the boundary of a closed and unconfined landfill failed to detect a pollution plume, a 3-D survey was undertaken to determine the pattern of leachate drainage within the waste so that a more refined contaminant transport model could be developed. A full 3-D survey was undertaken by subdividing the landfill into discrete rectangular blocks and acquiring data on multiple parallel lines. The line data were merged into a single x/y matrix file and then inverted with a 3-D finite-element algorithm. The results are presented as 3-D volumetric tomograms to show the inferred waste distribution and leachate flow-paths. The resistivity models indicate that leachate has accumulated at several discrete localities within the landfill. A narrow leachate plume is indicated in one part of the landfill, migrating downgradient to the northwest. The inferred leachate concentrations in the chalk were subsequently confirmed by drilling and hydrochemical sampling.

Use of a Rapid Bioluminescent Test (QwikLite) Using Dinoflagellates to Assess Potential Toxicity of Sediment Pore Waters
Lapota, D., C.H. Liu, D.E. Rosenberger and J.I. Banu.
SSC San Diego SD 087 Revision 1, 7 pp, May, 1998

The Navy has developed a rapid bioassay system (QwikLite) that is proving to be a valuable asset for conducting bioassays on other test media (e. g., metals, storm drain discharge, ship hull coatings, and

marine sediments). The basis of detection is to measure a reduction in light from the bioluminescent dinoflagellate Gonyaulax polyedra following exposure to a toxicant. The toxic response is usually measured within 24 hours from the start of the test and can be conducted for a 4-day acute test or 7-day chronic test. A measurable reduction or inhibition in bioluminescence is an adverse effect. The endpoint used to measure this light reduction is the IC50 (a 50% reduction in light output when compared to control cells).
http://www.spawar.navy.mil/sti/publications/pubs/sd/087/sd087.pdf

Use of SCAPS Suite of Tools to Rapidly Delineate a Large MTBE Plume
Kram, Mark L. and Ernest Lory.
SAGEEP 1998: Proceedings for the Annual Meeting of the Environmental and Engineering Geophysical Society, 22-26 March 1998, Chicago, Illinois.
Environmental and Engineering Geophysical Society, Denver, CO. p 85-99, 1998

At the Naval Construction Battalion Center in Port Hueneme, CA, the Public Works Center San Diego Site Characterization and Analysis Penetrometer System (SCAPS) team delineated the downgradient extent of a dissolved methyl tert butyl ether (MTBE) plume in an unconfined aquifer beneath the activity. The goal of the investigation was to select appropriate monitoring well installation locations to evaluate whether the plume posed a risk to potential receptors (drainage canals and other surface water bodies). SCAPS was used to help delineate the MTBE plume, prepare an iso-concentration map that displays the 35 ppb contour, identify the optimal monitoring locations, and install microwells in these areas. Fifteen field days were required to collect a total of 44 water samples and install 11 micro-wells. Approximately 33 acres of the MTBE plume were delineated to the satisfaction of the regulators in a rapid and cost-effective manner. The client and the regulators agreed on a site closure strategy less than one month after completion of the field efforts.
http://enviro.nfesc.navy.mil/erb/erb_a/restoration/technologies/invest/access_tools/rpt-scaps-tools.pdf

Use of Stable Isotopes to Examine Metal Attenuation and Release Processes in a Fluvial Tailings Deposit
Smith, K.S. (U.S. Geological Survey, Denver, CO); J.F. Ranville, P.J. Lamothe, B.P. Jackson.
National Meeting of the American Society of Mining and Reclamation and the 9th Billings Land Reclamation Symposium, 3-6 June 2003, Billings, Montana. Book of Abstracts. ASMR, Lexington, KY.

The upper Arkansas River south of Leadville, CO, contains deposits of fluvial tailings from historical metal-mining operations. These sulfide-bearing deposits are possible non-point sources of acid and metal contamination to surface- and ground-water systems. A pilot study was conducted to evaluate the use of stable-metal isotopes to help ascertain metal retention and release mechanisms that influence metal transport from the deposits to shallow ground water. An intact core was excavated from a small fluvial tailings deposit and examined in laboratory column experiments to determine the amount of metals leaching through the core under different geochemical conditions. By comparing the behavior of metal-isotope spikes with total-metal concentrations in the effluent from the core, scientists were able to gain insights into geochemical conditions that might promote release of particular metals from the fluvial tailings deposits to the shallow ground-water system at our field site. Use of stable-metal isotopes facilitated the determination of different metal-attenuation processes, metal-release processes, and metal sources in the fluvial tailings deposit in response to changing geochemical conditions.

Using Caged Mussels to Monitor Dioxins and Furans in the Kennebec River, Maine
M.H. Salazar and S.M. Salazar, Applied Biomonitoring, Kirkland, WA.
Proceedings, 29th Annual Aquatic Toxicity Workshop, 20-24 October 2002, Fairmount Chateau Whistler, Whistler, British Columbia.

During the summer of 2000, a 53-day pilot study was conducted in the Kennebec River, ME, to determine whether caged freshwater mussels would be a reasonable surrogate for resident fish to assess upstream and downstream exposures of dioxins and furans associated with pulp and paper mill effluents. Caged mussels were deployed 13 miles upstream and 11 miles downstream from a pulp and paper mill. These locations were the closest areas where fish could be collected due to the limitations imposed on fish sampling and dams on the river. Mean total dioxin/furan concentrations in mussel tissues increased from below detection before deployment to 4.33 and 4.67 ng/kg-ww (parts-per-trillion) at the upstream and downstream stations after deployment. There was no statistically significant difference between upstream and downstream total dioxin/furan concentrations. More individual dioxin/furan congeners were measured in mussel tissues from both upstream and downstream locations than in either semi-permeable membrane devices (SPMDs) or fish tissues collected during the same time period. This paper addresses the advantages and disadvantages of monitoring with caged mussels, natural fish populations, and SPMDs, along with the benefits of a gradient sampling design relative to using only upstream and downstream comparisons where the fish could be caught by angling.
http://knox.link75.org/mmb/Cybrary/atwkennebecextendedabstract.pdf

Using Real-Time GPS and Tablet Computers to Assess Reclamation Problem Features and Costs on Abandoned and Inactive Mines
Meier, Len, Office of Surface Mining, Alton, IL.
25th Annual Conference of the Association of Abandoned Mine Land Programs, 28 September - 1 October 2003 Louisville, Kentucky. 8 pp, 2003

Real time mobile mapping is now a reality for the determination of abandoned mine lands. Recent innovations in tablet computers, card-type global positioning system (GPS) receivers, and mobile geographic information system (GIS) software make it possible to use existing air photography, satellite imagery and GIS data to easily and accurately locate natural resource problem features, produce ready-to-use GIS data and maps, and seamlessly extract the data back in the office. This paper reviews recent field investigations and mapping activities conducted by the Office of Surface Mining, Mid Continent Regional Coordinating Center, using both tablet and handheld computers, a WAAS enabled card-type GPS receiver, ArcPAD software and Mr. Sid format compressed images to investigate and map bond forfeiture and mine sites to assess site hazards and the costs of reclamation.
http://www.surfacemining.ky.gov/aml/naamlp/technical_sessions.htm

User Guide for Remote Monitoring Equipment for Cathodic Protection Systems: Phase II
Van Blaricum, Vicki L., U.S. Army Construction Engineering Research Lab, Champaign, IL.
FEAP User Guide 98/77, 18 pp, May 1998

Cathodic protection (CP) is required by federal regulation or Army policy on many buried and

submerged structures to prevent corrosion. Periodic testing is required to ensure proper CP system operation, but this testing can be time-consuming and many Army Directorates of Public Works (DPWs) do not have the resources to perform it. Several companies have begun manufacturing remote monitoring units (RMUs) for CP systems. These units allow DPWs to monitor multiple CP systems from a central location. Several commercially available units have been evaluated during a two-phase FEAP demonstration. Beneficial RMU features have been identified and lessons have been learned concerning their implementation. A FEAP User Guide (FEAP UG 97/75) was published based on the results from Phase I. This newer document provides updated information based on Phase II results.
http://owww.cecer.army.mil/techreports/VANFUG2.CPR/vanfug2.cpr.post.pdf

Whole-Cell Bacterial Biosensors and the Detection of Bioavailable Arsenic
Strosnider, Heather, National Network of Environmental Management Studies Fellow for U.S. EPA.
23 pp, Aug 2003

The 'bioavailable fraction' of arsenic is the portion of arsenic that is available for biological uptake. Risk assessments could be over- or under-estimating the potential risk to the environment and human health by not considering the bioavailability of the arsenic at a contaminated site. Methods have been developed to estimate the bioavailability of toxicants such as arsenic. Whole-cell bacterial biosensors are genetically engineered bacteria capable of measuring bioavailable arsenic. A reporter gene is coupled with arsenic resistant genes and inserted into a host bacterial strain. In the presence of arsenic, the biosensor emits light that can be measured and used to determine the bioavailable concentration of arsenic. The purpose of this paper is to provide a detailed analysis of whole-cell bacterial biosensors. It investigates the state and practice of using whole cell bacterial sensors for measuring the bioavailability of arsenic.
http://clu-in.org/download/studentpapers/bacterial_biosensors.pdf

GRANT
Automated Identification and Quantification of VOCs Using Electronic Nose Systems
Polikar, Robi and Kauser Jahan, PIs, Rowan Univ., NJ.
Water Resources Research Institute Grant Proposal, Project ID: 2003NJ48B, 3/1/03 to 3/1/04.

Potential health hazards and environmental degradation resulting from widespread use of VOCs has prompted increasing concern and interest in ambient levels of VOCs in the environment. Analysis, in a laboratory setting, of VOCs found in surface waters requires expensive and bulky equipment that cannot be deployed in the field. Analysis by human odor assessors also has many drawbacks. Electronic nose technology (Enose) has been applied to detection of odorous compounds in wastewater plants, agricultural, and landfill sites. The goal of this research is to develop an artificial neural network based on an automated and portable electronic nose (Enose) for objective, fast, accurate, cost-effective and quantifiable long-term and on-site continuous monitoring of water quality, a multi-year project. Specifically, the focus of this grant will be on the most challenging single aspect of the long-term project, to develop an artificial neural network based system for automated identification of individual components of a mixture. The work has the following objectives: (1) concentrate first on handling binary mixture of compounds, (2) use QCM sensors to enable long-term, continuous, and stable operation fo the system, and (3) use presently available data featuring 24 binary mixtures of 12 different VOCs acquired during earlier work with a 6-QCM array.

GRANT
Dual Sensor for Detecting Xenobiotics and Microorganisms
John, Gilbert; Mario Rivera; Gary Yen, Oklahoma State Univ., Stillwater.
Water Resources Research Institute Grant Proposal, Project ID: 2003OK17B, 3/1/03 to 2/28/04.

The potential for deliberate contamination of drinking water make it imperative to have an efficient, sensitive, specific, and rapid sensor that can detect hazardous xenobiotics and microbial organisms. A multi-discipline group at Oklahoma State University is involved in developing a dual sensor that can be used to continuously monitor drinking water. This proposal addresses two critical areas important to further development of a dual sensor that can detect potentially harmful xenobiotics (toxicants) and pathogenic bacteria in water. The first area addresses the issue of having stable proteins that can maintain their function under various environmental conditions. The cytochrome P450 protein from the human liver is normally involved in detoxifying and toxifying a broad range of xenobiotics, thereby the protein can be used to directly link xenobiotics to human toxicity. Various isoforms are present in the liver, but some of these proteins are stable (CYP1A2), and some are not (CYP3A4). The researchers propose to develop a method of improving stability of CYP 3A4 using molecular modeling, molecular biology, and spectrophotometric techniques that will increase ion-pair interactions in the protein. The second area addresses the specificity of autofluorescence signatures (spectrofluorimetry) from bacteria, as a large collection of different types of bacteria will be tested. Having methods that can improve the stability of cytochrome P450 without compromising function is critical for generating unique spectra used to identify potentially harmful toxicants. Demonstrating that bacteria have unique autofluorescence signatures can provide a powerful method for identifying different types of bacteria. The researchers aim eventually to develop a working dual sensor that can be used to detect both xenobiotics and pathogenic bacterial in drinking water.