Measurement & Monitoring: 20th Quarterly Literature Update

These references have been added to the literature database developed for the Measurement and Monitoring Technologies for the 21st Century (21M^2) website. The searchable archive of abstracts is located at http://www.clu-in.org/programs/21m2/litsearch.cfm

The Advanced Monitoring Systems Initiative: Performance Monitoring for DOE Environmental Remediation and Contaminant Containment
Haas, W.J. (Ames Laboratory, Iowa State Univ.); R.J. Venedam, C.F. Lohrstorfer, and S.J. Weeks (Bechtel Nevada).
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H42B-03, 2005

This presentation describes (1) the needs for sensors and performance monitoring for environmental systems as seen by the DOE Long Term Stewardship Science and Technology Roadmap and the Long Term Monitoring Sensors and Analytical Methods Workshop, and (2) Advanced Monitoring System Initiative (AMSI) operating characteristics and progress in addressing those needs. The presentation addresses vadose zone and groundwater tritium monitoring, a wireless moisture monitoring system, hexavalent chromium and carbon tetrachloride monitoring using a commercially available "universal sensor platform," strontium-90 and technetium-99 monitoring, and area chemical monitoring using an array of multi-chemical sensors.

Analysing Contaminated Soil On-Site with Portable XRF
Radosevich, Bill, Thermo Electron Corporation, Minneapolis, MN.
International Environmental Technology, Vol 16 No 3, May 2006

X-ray fluorescence (XRF) analysis is often used for the determination of heavy metals (e.g., Pb, As, Cd, Cr, Hg, Zn, Cu, Ni, Mn, Se). This article discusses the performance of the NITON field-portable XRF analyzers from Thermo Electron. The analyzers offer the ability to simultaneously identify multiple contaminants in real time, which is an advantage in designing remediation strategies. The ability to provide results in seconds allows for extensive geographic profiling, which can detail metal contaminants and quantifies their levels without missing 'hot spots.' Additionally, the ability to achieve laboratory-quality results in the field can decrease remediation costs significantly by reducing downtime waiting for traditional wet lab results.
http://www.envirotechpubs.com/pdf/iet/2006/05/iet200605_018.pdf

An Analytical Procedure for Determination of Sulphur Species and Isotopes in Boreal Acid Sulphate Soils and Sediments
Backlund, K., A. Boman, S. Frojdo, and M. Astrom.
Agricultural and Food Science, Vol 14 No 1, p 70-82, May 2005

A procedure for the analysis of boreal acid sulfate (AS) soils and sediments can be used to quantify and discriminate among acid volatile sulfide, cold chromium reducible sulfur, hot chromium reducible sulfur, elemental sulfur, sulfate sulfur, organic sulfur, total reducible sulfur, and total sulfur. The sulfur fractions are recovered as either Ag2S or BaSO4 precipitates and can be used further for isotope analysis. The method was applied on reduced sediment from an AS soil locality and a brackish lake in western Finland and the results, including S-isotopes, are discussed.

Application of Borehole Radar for Monitoring Steam-Enhanced Remediation of a Contaminated Site in Fractured Limestone, Maine, USA

Gregoire, C., J.W. Lane Jr., and P.K. Joesten.

Engineering Geology for Infrastructure Planning in Europe--a European Perspective, Lecture Notes in Earth Sciences. Springer-Verlag, Berlin, Germany, p 385-392, 2004

Steam-enhanced remediation (SER) has been successfully used to remove DNAPL and LNAPL contaminants from porous media. Between August and November of 2002, SER was tested in a fractured limestone at the former Loring Air Force Base. During the SER, USGS conducted a series of borehole radar surveys to evaluate the effectiveness of radar methods for monitoring the movement of steam and heat through the fractured bedrock. The radar data were collected before the start of the injection, about 10 days after the injection started, and 2 months later, just prior to the end of the injection. In this paper, theoretical modelling predicts small changes in radar wave velocity and attenuation due to heating in the bedrock. The borehole fluid temperature and borehole radar tomography transmission data collected during the SER also are presented and discussed. Before inverting the travel times and the attenuations, the radar tomography data were calibrated using crosshole data collected on the same day. The inversions of travel time and attenuation differences show a small increase in attenuation and a small decrease in velocity of electromagnetic waves at the same depths where large increases in temperature were observed. Though the changes in medium properties were small, the borehole radar method was sensitive to the heating produced by the SER. The authors conclude that borehole radar has potential for monitoring the decrease of electromagnetic wave velocity and increase in attenuation in fractured limestone in response to steam injection. A PowerPoint presentation that illustrates the paper is at http://www.gap2005.uni-muenchen.de/presentations/cg.pdf

Application of Nucleic Acid-Based Tools for Monitoring MNA, Biostimulation and Bioaugmentation at Chlorinated Solvent Sites

Lebron, C.A. (NFESC); E. Petrovskis (GeoSyntec Consultants); F. Loffler (Georgia Tech); K. Henn (Tetra Tech NUS, Inc.); C. Casey (EFD SOUTH, U.S. Navy).

Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-25, 2005

Dehalococcoides (Dhc) strains play key roles in the complete reductive dechlorination of tetrachloroethene (PCE) and trichloroethene (TCE) to ethene. Nucleic acid-based tools based on Dhc 16S rRNA genes have been designed to assess the presence of Dhc in soil or groundwater samples. Real time (RTm) polymerase chain reaction (PCR) techniques have been developed to quantify Dhc populations at concentrations as low as a few cells per milliliter of groundwater, or gram of aquifer material. Nucleic acid-based tools, such as the Dhc 16S rRNA genes, have been rigorously tested in the laboratory and are commercially available; however, the beneficial use and value of the tools have not been established in field studies. The 16S rRNA gene-based approach is limited by its inability to distinguish Dhc populations with similar or identical 16S rRNA genes having different dechlorinating activities. Additional target genes for enzymes involved in the reductive dechlorination process (e.g., tceAB, bvcA, and vcrA) are available, but their use has not been validated in the field. Also, little is known about the minimum number of the Dhc cells needed for sustained complete reductive dechlorination activity under natural or stimulated conditions. The objectives of this ESTCP funded project (ER-0518) are to (1) demonstrate correlations between volatile organic compound (VOC) reductions and the presence and abundance of Dhc populations by RTm PCR; (2) validate functional genes responsible for dechlorination activity; and (3) verify limitations of the nucleic acid-based approach and specify conditions where the tools provide meaningful information. The researchers will create a database with chemical, geochemical, and toolkit data, and develop a guidance protocol for the application of nucleic acid-based tools and interpretation of the results. This protocol can be used to support sites where MNA is being evaluated, predict sites where biostimulation will be successful, and identify sites where bioaugmentation is required.

Applying Petrophysical Models to Radar Travel Time and Electrical Resistivity Tomograms: Resolution-Dependent Limitations
Day-Lewis, F.D. (U.S. Geological Survey, Storrs, CT); K. Singha (Pennsylvania State Univ., University Park); A.M. Binley (Lancaster Univ., Lancaster, UK).
Journal of Geophysical Research, Vol 110, 2005

This paper provides a framework to assess tomograms for geologic parameter estimation and insights into the different patterns of correlation loss for electrical-resistivity tomography (ERT) and radar travel time tomography (RTT). Whereas ERT generally performs better near boreholes, RTT performs better in the interwell region. Application of petrophysical models to the tomograms in the examples would yield misleading estimates of water content. Though the examples presented illustrate the problem of correlation loss in the context of near-surface geophysical imaging, the results have clear implications for quantitative analysis of tomograms for diverse geoscience applications.

Automated Geophysical Monitoring of In Situ Engineered Treatments
Lane, J.W. Jr. and F. Day-Lewis (U.S. Geological Survey); K. Singha (Penn State); R. Versteeg (Idaho National Lab).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-34, 2005

Innovative in situ engineered treatment (ISET) technologies promise to accelerate aquifer remediation while reducing costs. Using subsurface amendment injections (e.g., electron donors and acceptors, chemical oxidants/reductants, micro-organisms, and/or microbial substrates), ISET aims to stimulate or augment contaminant degradation (e.g., chlorinated hydrocarbons). Currently, ISET implementation is limited by (1) the lack of cost-effective spatial and temporal amendment monitoring methods, (2) the lack of field methods to verify the extent of contaminant degradation, and (3) inadequate understanding of ISET amendment effects on field-scale aquifer properties. Conventional characterization approaches (e.g., monitoring wells or direct-push technology) do not provide the dense spatial and temporal information required to address these problems and realize the full promise of ISET remedial technologies. Minimally invasive, continuous, automated geophysical monitoring technologies can be used to optimize and verify ISET operations. This presentation is divided into three parts: (1) a theoretical basis for geophysical monitoring of common ISET technologies; (2) an approach to develop field-scale petrophysical relations linking site-specific lithology, heterogeneity, and geophysical methods that addresses discrepancies between the support volume of indirect geophysical measurements and direct measurements of the parameter of interest (e.g., permeability, concentration, saturation); and (3) case studies and ongoing work demonstrating the potential of radar and other geophysical methods for ISET monitoring and geophysical measurement of hydraulic and biochemical parameters of interest.

Breaking Up Isn't Hard to Do: A View of NAPL Using Electrical Resistivity Imaging
Halihan, Todd, John Billiard, and Stuart McDonald.
L.U.S.T.Line Bulletin, No 51, p 21-25 & 37, Dec 2005

Characterizing a site affected by fugitive fuel products from spills, leaks from tanks and lines, or an accidental release is a prerequisite to any cleanup project. Assessing the lateral and vertical extent of sources and the associated environmental impact is the first step in knowing how to address these issues and to develop an appropriate project schedule and budget. On most sities affected by nonaqueous phase liquids (NAPLs), drilling programs are the usual first step in cleanup, closely followed by a best-judgment interpolation between discrete sampling data from soil borings and wells to create a site conceptual model. This industry standard methodology sometimes leads to the creation of inaccurate site conceptual models that guide planning for marginally successful remedial work to remove the NAPL. This article examines some fundamental problems that plague the characterization and cleanup processes, and presents case studies of an improved electrical resistivity imaging (ERI) geophysics approach that yielded innovative views of the subsurface at several difficult sites. The case studies illuminate a relatively new conceptual model for consideration when characterizing and remediating sites. Specifically, when using ERI geophysics followed by drilling to support the results of the image, NAPL sources in these cases are confirmed to exist as "blobs," not as continuous layers or plumes. ERI geophysics can help locate the NAPL blobs and find the related dissolved-phase impacts, making cleanup strategies more predictable and more reliable.
http://www.neiwpcc.org/lustline/lustline_pdf/lustline_51.pdf

A Case Study on the Use of Innovative Methods for Comprehensive Site Characterization at Former Manufactured Gas Plant Sites
Electric Power Research Institute (EPRI), Palo Alto, CA. Report No 1006932, 2002

This report is a case study on using innovative technologies for investigating a former manufactured gas plant (MGP) site located in the city of Pottsville, PA, on property owned by PFG Gas, Inc. Investigation at the Pottsville former MGP site took place in three phases: a geophysical survey, a direct-push cone penetrometer testing/fuel fluorescence detector (CPT/FFD) study, and a conventional investigation that consisted of soil borings, soil sampling, and test pits. The results of both Phases 1 and 2 were used to plan the Phase 3 investigation, and results generally coincided with those of the first two phases. All three phases were consistent over a broad view of the site and generally showed similar results. Inconsistencies were apparent on a smaller point-by-point analysis. Soil remediation also was performed on site, and findings were compared to investigation results. Comparison of actual soil remediation findings and investigation results revealed several consistencies; however, they also identified areas where the investigations did not fully delineate subsurface conditions.

Catastrophic Leak Detector Is ATEX Approved
Industrialsafetytalk.com, 30 May 2006

Quantitech's ShurShot HF Catastrophic Leak Detector from PMS has received the Euopean Union's ATEX approval for monitoring hydrofluoric acid (HF) in potentially explosive environments. ShurShot is a monitor designed to quickly detect and alert for catastrophic HF leaks in refineries, petrochemical plants, or other applications where HF leaks are considered a risk. The device is suited for leak monitoring of flanges, pumps, seals, and other components that are at risk of releasing HF. ShurShot reportedly produces no false alarms. Detection is based on very specific reaction of HF with a glass-like coating on the sensor chip. This coating, in the form of a blue surface on a shiny substrate, is etched away during the reaction. The surface of the chip is continuously monitored by shining light from a red LED through an optical fiber onto the sensor chip. The light reflected is picked up by another optical fibre and transmitted back to a photo sensor, where it is converted to an analog 4-20 mA signal. As the HF reacts with and removes the coating, the amount of light reflected back increases until all the coating is gone, and then the signal reaches maximum value. This increase of light intensity, monitored in the form of a current level change, provides a positive indication of detection.

Cavity Ring-Down Spectroscopy Mercury Continuous Emission Monitor (Report for October 1, 2001 through December 15, 2004)
Sensor Research and Development Corp., Orono, ME.
NTIS: DE2005-850501, 122 pp, Jan 2005

The Sensor Research & Development Corporation has undertaken the development of a continuous emissions monitor (CEM) for mercury based on the technique of cavity ring-down (CRD) spectroscopy. The project involves building an instrument for the detection of trace levels of mercury in the flue gas emissions from coal-fired power plants. The project has occurred over two phases. The first phase concentrated on the development of the ringdown cavity and the actual detection of mercury. The second phase has dealt with the construction and integration of the sampling system, used to carry the sample from the flue stack to the CRD cavity, into the overall CRD instrument.

Characterization and Monitoring of Natural Attenuation of Chlorinated Solvents in Ground Water: A Systems Approach
Gilmore, T. (PNNL); B.B. Looney (SRNL); et al.
Report No: WSRC-TR-2005-00199, 66 pp, Feb 2006

The objective of this document is to examine the use of a phased approach to characterize and monitor (C&M) natural and enhanced attenuation processes and to identify promising tools and techniques by which to accomplish the C&M. Developing techniques are identified, such as molecular-based assessment tools, as well as existing tools that traditionally have not been used for monitoring the performance of environmental remediation technologies. Case studies are used to provide examples of how non-traditional methods are being employed as tools for characterizing and monitoring natural and enhanced attenuation. The first four sections are devoted to overarching conceptual approaches to monitored natural attenuation (MNA) and define the context for the later sections. The first section describes the role of characterization and monitoring in MNA. The second section describes a phased approach to characterization and

monitoring that is intended to comprehensively define the MNA process from start to end and be used in conjunction with the regulatory guidance. The next two sections describe the use of a mass balance approach as the central concept for characterization and monitoring. Sections 5.0 and 6.0 are a review of new or developing techniques that appear to hold promise for more direct measurement of attenuating mechanisms and for non-traditional long-term monitoring approaches.
http://sti.srs.gov/fulltext/2005/tr2005199r0.pdf

Characterization of a Gas Station Site Contaminated with Fuel Hydrocarbons using Geophysical and Hydrogeological Investigations
Kim, C., K. Ko, J. Kim, S. Park, J. Son, J. Jeong, and S. Cho, Korea Inst. of Geoscience and Mineral Resources, Daejeon, Korea.
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H23A-1407, 2005

Geophysical and hydrogeological investigations were conducted to characterize a former gas station site contaminated with gasoline and diesel hydrocarbons. LNAPL free product was identified in the downgradient monitoring wells at the site and found in the seepage adjacent to a small stream 50 meters downstream of the gas station. The results from a ground penetrating radar (GPR) survey revealed the presence of seven underground storage tanks (USTs), including one unexpected UST, and two fuel lines. Electrical resistivity surveys and additional GPR surveys were conducted to map the water table and to characterize shallow geologic structures over an inclined area covered with grass and plants, and these geophysical results agreed with sediment core logging results. The investigators concluded that geophysical methods can be a very useful tool for characterizing contaminated sites.

Characterization of PCBs in Groundwater Using a Drive Point Sampler
Electric Power Research Institute (EPRI), Palo Alto, CA. Report No TR-113372, 60 pp, 1999

A tailored collaboration project used an innovative drive point sampling approach to investigate PCB-contaminated groundwater at a substation in Pennsylvania. This report describes the investigation and discusses the application of the drive point method to other utility sites with PCB spills or leaks. The project team designed a program to sample and analyze the environmental media inside the substation yard and in the drainage swale area outside it. A manual drive point sampler was initially used to collect groundwater samples at eight predetermined locations and at multiple depths within the substation and drainage swale areas. The investigators collected near-surface and subsurface soils at three- to five-depth intervals proximate to five of the groundwater sampling locations using a hand auger and core sampler. They used the drive point sampling method again during supplemental work conducted the following month at five predetermined locations and at three to five depth intervals. They conducted a third groundwater investigation later using the same method at nine locations to determine the extent of attenuation for the affected area. The data confirmed that detectable concentrations of PCBs were localized to the groundwater in the uppermost portion of the saturated zone. The drive point method was very successful not only in expediting the investigation at a lower cost, but also in achieving a more precise delineation of PCB concentrations in groundwater than could be obtained by the installation and sampling of conventional monitoring wells. The success of the method resulted in the Pennsylvania DEP accepting it as an efficient investigatory method.

Characterizing Perfluorooctanoate in Ambient Air near the Fence Line of a Manufacturing Facility: Comparing Modeled and Monitored Values
Barton, C.A., L.E. Butler, and C.J. Zarzecki (DuPont, Wilmington, DE); J. Flaherty (State College, PA); M. Kaiser (DuPont).
Journal of the Air & Waste Management Association, Vol 56 No 1, Jan 2006

Two studies of perfluorooctanoic acid (PFOA) salts in air were performed along the fence line of a fluoropolymer manufacturing facility. First, a six-event, 24-hr monitoring series was performed around the fence line using the OSHA versatile sampl (OVS) system. The data indicated that the majority of the PFOA was present as a particulatem and no vapor-phase PFOA was detected above ~0.07 ug/m3. A subsequent study using a high-volume cascade impactor verified the range of concentrations observed in the OVS data. Both studies aligned with the major transport direction and range of concentrations predicted by an air dispersion model, demonstrating that model predictions agreed with monitoring results. The PFOA concentration measured at the site fence over the 10-week sampling period ranged from 0.12 to 0.9 ug/m3.

Chemiluminescence Determination of Cyanide Ions
Gavrilov, A. (Academy of Civil Protection, Moscow, Russia); A. Druzhinin, K. Zakharov, V. Ishutin, and S. Nemkov (Military Academy of Radiation, Chemical, and Biological Protection, Moscow, Russia); I. Pushkin (Academy of Civil Protection).
Journal of Analytical Chemistry, Vol 60 No 11, p 1029-1034, Nov 2005

Alkaline solutions of luminol exhibit chemiluminescence in the presence of p-nitrobenzaldehyde (p-NBA), hemin, and cyanide ions. Air oxygen dissolved in the solutions is an essential component of the process. The authors detail a proposed procedure for generating a series of reactions resulting in chemiluminescence via superoxide radicals formed in the p-NBA-catalyzed reaction between hemin-activated air oxygen and hydrated p-NBA species. The application of this procedure for cyanide ions is discussed.

Coherent Optical Frequency Domain Reflectometry for Interrogation of Bend-Based Fiber Optic Hydrocarbon Sensors
Lopez, R.M. (CICESE, Ensenada, Mexico); V.V.V. Spirin; M.G. Shlyagin; S.V. Miridonov; G. Beltran; E.A. Kuzin; A. Marquez Lucero.
Optical Fiber Technology, Vol 10 No 1, p 79-90, Jan 2004

A distributed fiber optic bending sensor has been developed for petroleum hydrocarbon leak detection based on the coherent optical frequency domain reflectometry (C-OFDR) technique. A sensitive polymer is employed that reversibly swells under hydrocarbon influence. Lumped reflectors (fiber Bragg gratings) were placed between distributed sensitive elements to accomplish distributed detection with section localization of perturbation. In tests, the C-OFDR technique with bending sensor detected hydrocarbon presence within a few minutes at 20-cm perturbation length with spatial resolution ~0.5 m for strong perturbation.

Collaborative Statistical and Molecular Microbiological Research to Elucidate Complex Systems Involving Polychlorinated Biphenyls

VanBriesen, J.M., Small, M. Brown, W. Minkely, E. Karcher, S. Wang, Carnegie Mellon Univ.

2005 AEESP Research and Education Conference, 23-27 July 2005, Clarkson University, New York.

A collaborative project is described that involves statistical modeling methods in conjunction with molecular biological analyses. The crux of the work depends upon the hypothesis that differences in dechlorination patterns in PCB-contaminated sediments in different locations are caused by specific microbial population differences controlled by sediment geochemistry. This hypothesis was evaluated using (1) microcosm experiments with different sediments and different biogeochemical conditions, (2) statistical analyses of distributions of PCB congeners in Aroclor mixtures and in weathered sediments, and (3) numerical modeling of potential PCB biotransformation pathways. Pursuit of these research directions concurrently and collaboratively allows the integration of an understanding of microbial population dynamics in response to environmental conditions with statistical methods that determine PCB transformation probability in natural systems. The goal is to couple molecular microbiological analyses of microbial populations in different sediments with statistical analyses of congener distributions in sediments to answer the questions: Has PCB transformation occurred in this sediment? Is PCB transformation occurring in this sediment now? Could PCB transformation be stimulated by changes to the biogeochemical conditions that would change the microbial populations present? Current results indicate that different river sediments contain populations that demonstrate distinct anaerobic PCB dechlorination pathways. These sediments respond differently to changes in biogeochemical conditions (e.g., addition of nutrients). The study has identified pairs of congeners that maintain the same relative concentration ratio in all original source Aroclors. Evaluation of the differences between this original condition and the observed concentration ratios in field sites allows a determination of whether or not transformation has occurred at those sites.

Comparison of Open Path and Extractive Long-Path FTIR Techniques in Detection of Air Pollutants

Bacsik, Z., V. Komlosi, and T. Ollar (Hungarian Academy of Sciences, Budapest, Hungary); J. Mink (University of Veszprem, Veszprem, Hungary).

Applied Spectroscopy Reviews, Vol 41 No 1, p 77-97, 2005

A comparison is presented of long-path extractive and open-path FTIR techniques, drawing upon a review of available literature and the authors' own experience at the wastewater treatment plant of a chemical factory. Emissions from two small equalization basins were investigated at the plant facility. Optimal spectral parameters (resolution, scan numbers, path length) were chosen for field and laboratory measurements. The S/N ratio of laboratory spectra was about 50 to 100 times higher than that of field spectra, which resulted in higher precision and lower detection limits of the measurements. When the lab measurements were compared to field measurements, an additional compound (chloroform) was detected, whereas extremely polar ammonia was not detectable by the extractive technique. With the open-path method, time-dependent concentration changes of the pollutants were monitored, and xylenes, isopropanol, and methanol were detected in the air above the basin. Comparing the results measured by the two different techniques, the discrepancies in the concentrations were dependent on the compound under determination. In some cases, the concentrations agreed well, but did not agree in other cases. The authors conclude that application of both methods is desirable in some cases, such as when the extractive method is used for preliminary investigations.

Compendium of Perimeter Air Quality Monitoring Methods for Manufactured Gas Plant Site Remediation
Electric Power Research Institute (EPRI), Palo Alto, CA. Report No 1005167, June 2002

This report presents the tools currently available to a manufactured gas plant (MGP) site manager to monitor air emissions from a site remediation. The report is a compilation of information obtained from multiple sources, including EPA and the National Institute for Occupational Safety and Health (NIOSH) Standard Methods, with additional information obtained from protocols developed in utility remediation programs. Several utilities provided case studies. Advances in real-time monitoring instrumentation and data retrieval have led to the establishment of programs for ambient air monitoring at the perimeter of a remediation site. The objective of this project was to identify methods available to monitor chemicals of concern in ambient air at MGP sites; determine the applicability, usefulness, and limitations of the different methods; and provide a framework for applying the methods during site remediation.

Constraining Rates of Biodegradation of Chlorinated Ethenes at Steep Concentration Gradients Using Stable Carbon Isotopes
Morrill, P.L. (Carnegie Inst. of Washington); D.J. Seepersad, G. Lacrampe-Couloume, E.A. Edwards, and B.E. Sleep (Univ. of Toronto, Toronto, ON, Canada); M.L. McMaster and D.W. Major (Geosyntec Consultants, Guelph, ON Canada); B. Sherwood Lollar (Univ. of Toronto).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B31A-0983, 2005

Enhanced biodegradation of dense non-aqueous phase liquid (DNAPL) sources of tetrachloroethene (PCE) was monitored in a 2-D model aquifer and in a Dover Air Force Base pilot field study using the stable carbon isotope values of PCE and its biodegradation products to quantify first-order biodegradation rate constants during a study that assessed the potential for biological enhancement of PCE DNAPL dissolution. A maximum isotope fractionation of 2.3 per mil was observed in the dissolved PCE downgradient, while close to the source zone the carbon isotopic signature of the dissolved PCE remained largely unchanged, due to the continuing dissolution of unfractionated PCE DNAPL. Significant carbon isotopic fractionation was observed adjacent to and/or downstream from the source in the degradation products trichloroethene, 1,2-dichloroethene, and vinyl chloride. Close to the source zone, confirmation of PCE degradation is based primarily on the appearance of the lesser chlorinated ethene degradation products and isotopic signatures of those products consistent with biodegradation. This trend was observed on a small scale in the model aquifer and similar trends were observed in the field at a larger scale.

Continuous Contaminated Site Monitoring (CCSM): Integrated Remote Real-Time Supervision Methodology Applied to an Old Polluted Industrial Site
Portet, F., K. Szafnicki, A. Laboudigue, J. Bourgois.
Land Contamination & Reclamation, Vol 13 No. 3, p 275-289, 2005

"Continuous contaminated site monitoring" (CCSM) is a methodology that comprises several stages: real-time physico-chemical data acquisition and analysis, maintenance and supervision of in situ sensors and analyzers to evaluate measurement validity, and determination of the state and evolution of the site to support decisions regarding optimal site decontamination and recovery methods. At a former coking plant active between 1906 and 1950, significant quantities of PAHs, BTEX, and ammonium have been left in the soil. CCSM will be implemented to deal with real-time pollutant concentration monitoring in a few strategic points to track evolution and transfer in the saturated and unsaturated zones. The developed methodology aims at interactive and convenient access to the data using an integrated decision-making support tool. Site managers should be able to access any aspect of the information and identify the relevant indicators, which can then be compared with weather data and/or complementary simulation results for diffuse pollution plumes at different time scales.

Continuous Underground Monitoring of Gas Leaks
Khalil, G., F. Kimura, and A. Chin (Univ. of Washington, Seattle); M. Ghandehari (Polytechnic Univ., Brooklyn, NY); R. Wan (LIPS, Tacoma, WA); W. Shinoki, M. Gouterman, J. Callis, and L. Dalton (Univ. of Washington, Seattle).
Research in Nondestructive Evaluation, Vol 16 No 3, p 119-130, July/Sep 2005

A gas leak-detection system was designed based on the concept of oxygen-level measurement. Optical fibers were produced with gas-permeable polymeric cladding material doped with oxygen-responsive porphyrin sensor molecules and subsequently interrogated via the evanescent field along the fiber length. The authors present the sensor sensitivity, response time, and reversibility results in tests performed with simulated methane gas leaks in air and under dry and saturated sand.

A Cospectral Method for Leak Detection in One-Way Access Pipelines
Lapshin, B. and A. Ovchinnikov, Research Institute of Introscopy, Tomsk, Russia.
Russian Journal of Nondestructive Testing, Vol 40 No 9, p 587-592, Sep 2004

A spatial-processing algorithm of acoustic-emission signals for leak detection in one-way access pipelines is discussed with basic formulas and results from numerical calculations.

Decision Support System for Evaluating Source Depletion at Chlorinated Solvent DNAPL Sites
Newell, C.J., T. McGuire, J. McDade, P. Newberry, D. Adamson, and I. Cowie, Groundwater Services, Inc., Houston, TX.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation No 61, p F-41, 2005

A decision support system was developed to aid the evaluation of source zone remediation at sites impacted with chlorinated solvent dense nonaqueous phase liquid (DNAPL). The decision support system consists of four modules: (1) a performance database for source depletion sites; (2) a performance database for untreated sites; (3) a cost database for source depletion sites; and (4) a literature summary of other source depletion projects. The project was one component of a project funded by SERDP focusing on DNAPL source zone remediation. The performance database for treated sites includes temporal groundwater concentration data from before and after active remediation for 144 wells at 59 chlorinated solvent sites. Sites in the database used one of the following source depletion technologies: enhanced bioremediation, chemical oxidation, thermal treatment, and surfactant/cosolvent treatment. The decision support system allows the user to generate custom concentration versus time curves using various site characteristics as selection criteria. For each custom data set, summary statistics of concentration reductions from before and after treatment are provided. The performance database for untreated sites includes temporal groundwater concentration data for 52 wells at 23 natural attenuation sites. Only sites with at least five years of monitoring data were included in the database; the length of the monitoring record for the sites in the database ranged from five to 15 years. The decision support system allows the user to generate custom concentration versus time curves using various site characteristics as selection criteria. For each custom data set, summary statistics of concentration change over the monitoring period are provided. The cost database summarizes treatment cost data for 36 sites where source depletion technologies were used to treat chlorinated solvent DNAPL source zones. The decision support system allows the user to generate custom cost data using various site characteristics as selection criteria. Cost data is summarized in terms of US dollars per cubic yard treated for each site. The literature summary module includes recent data from three other SERDP-funded DNAPL remediation research projects on the following topics: development of assessment tools for evaluating benefits of source zone treatment, mass transfer of entrapped DNAPL from sources undergoing remediation, and assessment of the benefits of partial source removal through experimentation and modeling.

Delineation of Coal Tar Dense Nonaqueous Phase Liquid and Groundwater Plumes at a Former Manufactured Gas Plant Site

Electric Power Research Institute (EPRI), Palo Alto, CA. Report No: TR-111537, 132 pp, 1998

This report presents the results of a field investigation at a former manufactured gas plant (MGP) site in the Midwest. The focus of the investigation was delineating the distribution of coal tar (a dense nonaqueous phase liquid) and the associated dissolved-phase constituents in groundwater using a combination of analysis methodologies. The results will be used to determine remediation needs at the site. EPRI initiated a collaborative study with the utility to evaluate and compare several methods for the horizontal and vertical delineation of coal tar DNAPL. The delineation methods included conventional soil sampling using a standardized set of descriptors, delineation based on chromatographic "fingerprints" generated from the analysis of soil samples, and delineation based on chemometrics and analysis of groundwater quality data. The migration of dissolved-phase constituents was also assessed. Based on the data from closely paired wells installed for the chemometrics analysis, the dissolved-phase plume occurs only in a relatively narrow halo around the DNAPL. Dissolved-phase concentrations decrease by one to two orders of magnitude between the well pairs at the DNAPL boundary. Similarly, groundwater concentrations of dissolved coal tar constituents decreased by almost two orders of magnitude within 2 vertical feet of the visible DNAPL zone. The extent of the dissolved plume was much less than calculated based solely on advective groundwater flow rates. The results suggest that migration of the dissolved-phase tar constituents may be limited by the rate of fluid tar migration and attenuation processes within the aquifer. Contaminant movement appears to be controlled primarily by the characteristics of the tar, the topography of a low-permeability glacial till unit beneath the site, and the presence of coarse-grained soils immediately above the till. The result is a thin layer of slowly moving tar that does not appear to be amenable to pumping for removal.

Demonstration and Validation of a Regenerated Cellulose Dialysis Membrane Diffusion Sampler for Monitoring Groundwater Quality and Remediation Progress at DoD Sites
Trotsky, J. (Naval Facilities Engineering Service Center, Port Hueneme, CA); T. Imbrigiotta (U.S. Geological Survey).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-28, 2005

Dialysis membrane diffusion samplers are made of regenerated-cellulose dialysis membrane material and have an advantage over polyethylene diffusion bag (PDB) samplers in that they can be used for both dissolved inorganic and dissolved organic chemicals (volatile/nonvolatile) sampling in groundwater. The objectives of this project are to demonstrate and validate in coordination with the Interstate Technology and Regulatory Council (ITRC) how long it takes for dialysis membrane diffusion samplers to equilibrate with ground-water concentrations of a range of inorganic and organic constituents and to compare the results of field samples collected using these samplers with samples collected using the standard low-flow purging technique. In the lab, dialysis samplers equilibrate within 3-7 days for most cations and trace metals and within 1-3 days for anions, silica, methane, dissolved organic carbon, and all VOCs (including MTBE). Dialysis samplers equilibrate in essentially the same time period at lower concentrations as they do at higher concentrations. Lower temperatures were found to have a small affect in lengthening equilibrium times for several inorganic constituents from 3 days to 7 days. Field-comparison testing has shown high correlations between the concentrations of most inorganic and organic parameters collected with dialysis samplers and the concentrations of these same constituents collected with low-flow purging. Comparability is best when the dialysis sampler is positioned at the depth of the highest mass flux of a contaminant into the screened or open interval of a well. The ITRC Diffusion Sampling Team may publish a new document that will include the findings and protocols of this project. This work is funded under ESTCP project ER-0313.

Designing of a Prototype Fiber Optic Raman Sensor
Tiwari, V.S., R.R. Kalluru, F.-Y. Yueh, J.P. Singh, and S.K. Khijwania.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 59-64, Nov 2005

A novel fiber optic prototype sensor based on Raman spectroscopy for qualitative and quantitative monitoring of various chemicals in a sample employs a high-power 670nm laser diode as an excitation light source and a specially designed fiber optic Raman probe with launching and collecting fibers. The Raman signal is collected by six optical fibers, filtered, and fed to the spectrometer through another optical fiber bundle. The sensor is compact and stable in configuration, combining a carefully aligned laser diode, filter holder, and miniature spectrometer. The sensor is immune to ambient light fluctuation and offers a cost-effective solution for probing several species in harsh environment.

Detailed Field Investigation of Vapor Intrusion Processes
McHugh, Thomas (Groundwater Services, Inc.); Ivette O'Brien (AFCEE).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-20, 2005

At three DoD facilities, high-density monitoring networks have been installed around individual buildings located above groundwater containing dissolved volatile organic compounds (VOCs). The large dataset obtained for each building has provided a detailed understanding of vapor intrusion processes and has served to validate cost-effective vapor intrusion investigation methods. Analysis of this dataset has shown that (i) naturally-occurring radon can serve as a sensitive tracer for the evaluation of vapor migration across the building foundation, (ii) short-term temporal variability in VOC distribution is not a major source of uncertainty in the evaluation of vapor intrusion, and (iii) mass-flux analyses provide a useful tool for tracking the movement of VOCs along the vapor intrusion pathway from groundwater to indoor air. Analysis of VOC concentrations at all 33 sample points on two days within a single week showed that short-term variability in VOC concentration is low in all subsurface media. All the paired groundwater samples and 85% of paired soil gas samples showed a relative percent difference of less than 30%, qualifying them as duplicate samples based on standard data quality objectives. For the first test site, VOC concentrations in all subsurface media (i.e., deep soil gas, groundwater, and subslab) exceeded EPA screening levels for the evaluations of vapor intrusion; however, analysis of the entire dataset clearly indicated that an indoor vapor intrusion impact had not occurred. This illustrates the importance of non-VOC measurements for understanding vapor intrusion. The data obtained from these three investigation sites will support the development of vapor intrusion screening procedures based on the evaluation of key site characteristics controlling the vapor intrusion processes. This research was supported by ESTCP Project ER-0423.

Detecting Abrupt Leaks in Blended Underground Storage Tanks
Gill, Ryan (Univ. of Louisville, KY); Jerome Keating (Univ. of Texas at San Antonio); Michael Baron (Univ. of Texas at Dallas).
Communications in Statistics: Theory and Methods, Vol 35 No 4, p 727-742, 2006

Two multiple change-point algorithms (segmentation and sequential) are presented and compared for accurate detection of the onset of abrupt leaks in blended underground storage tanks. These algorithms are applied to two simulated scenarios to demonstrate the advantages of the sequential algorithm. The sequential algorithm is then applied to data from the Cary blended site.

Detecting Heavy Metals in Soil Using Field Portable X-Ray Fluorescence
Nummi, Esa, Oxford Instruments Analytical.
International Environmental Technology, Vol 15 No 7, July 2005

With a field-portable XRF analyzer, a large number of in situ tests can be performed quickly, allowing thorough pollutant profiling for heavy elements and their levels. Contamination hot spots can be quickly mapped, which allows the remediation process to begin immediately. In many situations, the field-portable XRF provides better overall decision making data than laboratory analysis, because of its ability to overcome spatial variability through increased sampling density. XRF is also totally non-destructive of samples, which allows the same sample to be sent to the lab for confirmatory analysis. A modern field-portable XRF consists of four main components: X-ray tube, detector, pulse processing electronics, and Personal Data Assistant (PDA) as a user interface. This article discusses the handheld XRF analyzer produced by Oxford Instruments. The X-MET3000TXS is a dedicated soil analyzer, designed specifically for measuring heavy metals in soil and particularly for soil screening, where operators perform tests directly to soil on site to quickly profile contamination patterns.
http://www.envirotechpubs.com/pdf/iet/2005/07/iet200507_048.pdf

Detecting Hydrolysis Products of Blister Agents in Water by Surface-Enhanced Raman Spectroscopy
Inscore, Frank and Stuart Farquharson, Real-Time Analyzers, Middletown, CT.
Advanced Environmental, Chemical, and Biological Sensing Technologies III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5993, p 19-22, Nov 2005

Scientists have been investigating the ability of surface-enhanced Raman spectroscopy (SERS) to detect microgram per liter (or part per billion) concentrations of chemical agents in water. It is equally important to detect and distinguish the hydrolysis products of these agents to eliminate false-positive responses and evaluate the extent of an attack. Previously reported studies of the SER spectra of GA, GB, VX, and most of their hydrolysis products have been extended to include the chemical agent sulfur-mustard, also known as HD, and its principle hydrolysis product thiodiglycol.
http://www.real-time-analyzers.com/docs/Paper-SPIE2005-5993-HD-TDG.pdf

Detection of Biological Warfare Agents with Fiber-Optic Microsphere-Based DNA Arrays
Song, Linan and David R. Walt.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 32-38, Nov 2005

Rapid, sensitive, and reliable detection systems are being developed to detect the release of biological warfare agents. The authors report on the development of a high-density DNA array with fast response times and high sensitivity for detecting biological agents in real environmental samples. An optical fiber bundle containing approximately 50,000 individual 3.1 um diameter fibers was chemically etched to yield an array of microwells and used as the substrate for the array. Single-stranded 50-mer DNA probes designed to be specific for target biological agents were covalently attached to 3.1-um microspheres. The microspheres were distributed into the microwells to form a randomized high-density DNA array.

Detection of Chemical Signatures from TNT Buried in Sand at Various Ambient Conditions: Phase II
Baez, B., V. Florian, S.P. Hernandez-Rivera, A. Cabanzo, S. Correa, M. Irrazabal, J.G. Briano, and M.E. Castro.
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p 495-504, May 2006

This paper presents work on the detection of the spectroscopic signature of TNT and its degradation products buried in sand. Experiments were conducted using a series of soil tanks with controlled environmental conditions. Gas chromatography and solid-liquid extraction with acetonitrile were used for explosives analysis. The researchers found that TNT and 2,4-DNT are the main explosives that reach the surface of tanks. Temperature and water content play an important role in the degradation and diffusion of TNT. When the tanks were disassembled and sampled to obtain a concentration profile, the highest concentration was located 5 cm from the surface.

Detection of Industrial Gaseous Chemical Plumes Using Hyperspectral Imagery in the Emissive Regime
Farrell, Michael D. Jr. and Russell M. Mersereau, Georgia Inst. of Technology.
Atmospheric and Environmental Remote Sensing Data Processing and Utilization: Numerical Atmospheric Prediction and Environmental Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5890, p 91-102, Aug 2005

This work contains an evaluation of the utility of a set of hyperspectral exploitation techniques applied to the task of gas detection. This set of techniques is a sampling of approaches that have appeared in the literature, and all of the methods discussed--signature-based detection, anomaly detection, transformations (i.e. rotations) of the spectral space, and dedicated band combinations and scatter plots--have demonstrated utility in the reflective regime. Using real LWIR hyperspectral data recently collected on behalf of U.S. EPA, the authors compare performance in detecting three different industrial gases.

Detection of Nitro-Aromatic Compounds by Optical Gas Sensors Based on Sensitive or Photoluminescent Polymers
Lamarque, T., P. Le Barny, E. Obert, E. Chastaing, B. Loiseaux, and I. Leray.
Optical Sensing II. Proceedings of SPIE--The International Society for Optical Engineering, Vol 6189, p 204-215, Mar 2006

Thin layers of a specially developed sensitive polymer (PLG, which belongs to the polysiloxane family) were deposited onto the surface of optical transducers. In one case, a relief grating was coated with the sensitive polymer. A small variation of the refractive index of this layer, due to the presence of pollutant, induces a variation of the intensity of the diffracted orders that can be measured. In another case, one arm of integrated MZ interferometers was coated with the polymer. The variation of the refractive index of the polymer causes a phase shift in the measuring arm that can be measured by the modification of the output intensity. An assessment is presented of the detection of nitroaromatic compounds using a PLG-sensitive layer on both sensors and compared to the response of a SAW-based sensor coated with the same polymer. The authors also report on the synthesis, spectroscopy, and fluorescence-quenching behavior of a N-(2,5-ditertio-butylphenyl)-1,8-naphthalimide functionalized polystyrene (PST-NI) synthesized by free-radical polymerization of the corresponding monomer. At a 1-minute exposure to DNT vapor, a 5.5 nm thick film of PST-NI exhibited a 45% drop in its fluorescence intensity.

Determination of Cr(VI) by Using a Polymeric Membrane Ion Selective Electrode with Aliquat336
Choi, Young-Woo and Seung-Hyeon Moon, Kwangju Inst. of Science and Technology.
The 4th International Symposium on Advanced Environmental Monitoring, 4-6 December 2002, Jeju, Korea.

The ion-selective electrodes (ISEs) developed in previous studies for determination of Cr(VI) had some drawbacks, such as inadequate selectivity, short lifetime, poor reproducibility in preparation, potential drift, and long response time. In a newer study, a supported liquid membrane was employed for selective measurement of Cr(VI) to support work to develop a Cr(VI) sensor with Aliquat336-embedded SLMs.

Determination of Elements in Natural-Water, Biota, Sediment, and Soil Samples Using Collision/Reaction Cell Inductively Coupled Plasma-Mass Spectrometry
Garbarino, John R., Leslie K. Kanagy, and Mark E. Cree.
U.S. Geological Survey Techniques and Methods, Book 5-B1, 88 pp, 2006

A new analytical method for the determination of elements in filtered aqueous matrices using inductively coupled plasma/mass spectrometry (ICP/MS) has been implemented at the U.S. Geological Survey National Water Quality Laboratory that uses collision/reaction cell technology to reduce molecular ion interferences. The updated method can be used to determine elements in filtered natural water and other filtered aqueous matrices, including whole water, biota, sediment, and soil digestates. Helium or hydrogen is used as the collision or reaction gas, respectively, to eliminate or substantially reduce interferences commonly resulting from sample-matrix composition. Helium is used for molecular ion interferences associated with the determination of As, Co, Cr, Cu, K, Mg, Na, Ni, V, W and Zn, whereas hydrogen is used for Ca, Fe, Se, and Si. Other elements that are not affected by molecular ion interference also can be determined simply by not introducing a collision/reaction gas into the cell. Analysis time is increased by about a factor of 2 over the previous method because of the additional data acquisition time in the hydrogen and helium modes.
http://pubs.usgs.gov/tm/2006/tm5b1/PDF/TM5-B1.pdf

Developing a Framework for Performance Monitoring to Assess the Use of Monitored Natural Attenuation for Remediation of Inorganic Contaminants in Ground Water
Ford, R., R. Wilkin, and R. Puls (U.S. EPA, Ada, OK); R. Wilhelm and K. Lovelace (U.S. EPA, Washington, DC).
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H43C-02, 2005

EPA is leading an effort to develop technical documentation that provides the policy and scientific and technical framework for assessing the viability of monitored natural attenuation (MNA) for inorganic contaminants in groundwater. Development of the Inorganics Framework Document is being carried out in conjunction with site-specific assessments of the viability of MNA at sites with groundwater contamination. At one site, researchers are assessing the potential for natural attenuation of arsenic within a contaminated groundwater aquifer. Arsenic (As) is considered to be a contaminant for which MNA may be of marginal success. The mobility of arsenic in groundwater is strongly dependent on partitioning to immobile aquifer solids, but arsenic is susceptible to changes in chemical speciation due to shifts in redox chemistry resulting from abiotic and biotic processes. These potential changes in chemical speciation require that detailed information for assessing the stability of immobilized arsenic be collected in space and time. The field study has established that As partitioning to sediments results in significant removal of As from the aqueous phase; however, the partitioning process readily reverses under reducing conditions, indicating that MNA cannot be used as a sole remedy for arsenic site cleanup.

Development and Applications of Advanced Fluorometry Technologies for Monitoring the Health of DoD Coral Reef Communities
Gorbunov, M.Y. (Inst. of Marine and Coastal Sciences, Rutgers); T. Bibby; L. Haramaty; Y. Helman; P. Falkowski; F. Natale; D. Tchernov.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, p G-105, 2005

Coral reef ecosystems are particularly susceptible to anthropogenic insult and are rapidly degrading worldwide, including areas at and around DoD installations. The unfavorable factors include both natural stresses and anthropogenic insult specific to military activity. The development of advanced technologies for environmental monitoring of these ecosystems requires the selection of non-invasive monitoring protocols that are most appropriate for the identification and quantification of particular stresses. SERDP project SI-1334 focuses on the development of bio-optical methods and instrumentation for sensitive, rapid and non-destructive assessment of the viability and health of coral reef communities. New instrumentation, the Fluorescence Induction and Relaxation (FIRe) System, measures a comprehensive suite of photosynthetic parameters of the organisms. In combination with conventional biochemical and molecular biological methods, the FIRe technique was employed to study the impact of common natural stresses (episodes of elevated temperature and excess irradiance), as well as selected anthropogenic factors (heavy metal contamination) on coral. The analysis revealed that different stresses lead to specific damage to the coral symbioses and are characterized by unique FIRe fluorescence signatures. This presentation shows how these signatures can be used for quantitative assessment of coral health and selective identification of the stresses. The technology can be readily used for biomonitoring all groups of photosynthetic organisms (both aquatic and terrestrial) and it is envisioned that the technology will be employed in a variety of environmental monitoring programs.

Development and Validation of a Field-Deployable Optical Spectrometer for Real-Time, Natural Abundance Measurements of O and H Isotopes of Water

Gupta, M., T. Owano, D. Baer, R. Provencal, K. Ricci, and A. O'Keefe (Los Gatos Research, Mountain View, CA); C. Kendall, D. Doctor, M. Rollog, and S. Silva (USGS, Menlo Park, CA); J. McDonnell (Oregon State Univ., Corvallis).

Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H41C-0423, 2005

The authors report on the development and independent validation of a novel water isotope ratiometer based on cavity-enhanced laser absorption spectroscopy techniques (Off-Axis Integrated Cavity Output Spectroscopy) to quantify 18O/16O, 17O/16O, and D/H to better than 0.3, 0.5, and 2 per mil, respectively. The analyzer provides continuous monitoring of either ambient water vapor (without preconcentration) or repeatedly injected liquid samples. The instrument's capabilities have been independently validated, and results from recent field tests are discussed.

Development of a Multi-Analyte Integrated Optical Sensor Platform for Indoor Air-Quality Monitoring

McGaughey, O., R. Nooney, A.K. McEvoy, C. McDonagh, and B.D. MacCraith, Dublin City Univ., Ireland.

Advanced Environmental, Chemical, and Biological Sensing Technologies III.

Proceedings of SPIE--The International Society for Optical Engineering, Vol 5993, p 172-183, Nov 2005

A multi-analyte sensor chip device based on miniature waveguide structures, porous sensor materials, and compact optoelectronic components has been fabricated using poly(methyl methacrylate), or PMMA, as the waveguide material. These platforms employ a novel optical configuration along with rapid prototyping technology, which facilitates the production of an effective sensor platform. Sensing films developed for oxygen, carbon dioxide, and humidity consist of a fluorescent indicator dye entrapped in a porous immobilisation matrix. The analyte diffuses through the porous matrix and reacts with the indicator dye, causing changes in the detected fluorescence. The reaction between the dye and the analyte is completely reversible with no degradation of the signal after detection of different concentrations of the analyte. A single LED excitation source is used for all three analytes, and the sensor platform is housed in a compact unit containing the excitation source, filters, and detector.

Development of a Protocol and Screening Tool for Selection of DNAPL Source Area Remediation Technologies

Lebron, C.A. (NFESC, Port Hueneme, CA); J. Konzuk, S. O'Hara, and C. Aziz (GeoSyntec Consultants); M. West, A. Richards, and B. Kueper (Queens Univ.); D. Major (GeoSyntec Consultants).

Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation No 64, p F-44, 2005

A dense nonaqueous phase liquid (DNAPL) remediation screening tool is currently being developed under ESTCP. The tool will provide users with observed performance for various technologies applied at similar sites, and aid the user in determining the remedial approach that will best meet the specific site remedial goals. This screening tool will have as its basis a comprehensive database of case studies of DNAPL remediation compiled from performance data from actual sites, lab studies, and numerical simulations. This information will be supplemented with results from numerical simulations of "template" sites representing typical geological settings and conditions encountered at DoD facilities contaminated with DNAPLs. These simulations will provide more detailed information on remedial performance and demonstrate long-term impacts (i.e., spanning decades) that cannot be determined from field applications due to the extended timeframe. A protocol consisting of a 3-D matrix of critical site characteristics, remedial technologies and performance metrics is being developed from the information in the database through analysis of the fundamental interaction of the site-specific factors influencing remedial performance. The tool takes into consideration key factors that contribute to successful performance of DNAPL remediation technologies, i.e., (1) adequate knowledge of the distribution of DNAPL in the subsurface; (2) an understanding of the properties governing DNAPL fate and transport (e.g., solubility, density, soil heterogeneity including low hydraulic conductivity zones where diffusion dominated transport governs remedial effectiveness, etc.); (3) adequate hydraulic contact with all areas of DNAPL; and (4) correct technology design and/or application. The relative influence of these factors varies among sites because of the history of DNAPL use and release, the degree of site characterization, site-specific geological conditions, and the specific type of DNAPL that is present. Since these factors are site-specific, it is difficult to accurately estimate a priori the expected performance of various DNAPL remediation technologies. In addition, remedial goals vary in terms of targeted mass removal, reduction of aqueous phase contaminant flux and concentrations, reduction in source zone lifespan, and shortening of the aqueous phase plume. The screening tool being developed will be able to estimate performance at a particular site based on site characteristics, preference for remedial approach, and performance metrics.

Development of a Quantum Cascade Laser-Based Detector for Ammonia and Nitric Acid
Zahniser, M.S., D.D. Nelson, J.B. McManus, J.H. Shorter, S. Herndon, and R. Jimenez,
Aerodyne Research, Inc., Billerica MA.
Report No: ARI-RR-1409, 43 pp, 2005

A compact, robust, atmospheric trace gas detector has been developed based on mid-infrared absorption spectroscopy using pulsed quantum cascade (QC) lasers. The spectrometer is suitable for airborne measurements of ammonia, nitric acid, formaldehyde, formic acid, methane, nitrous oxide, carbon monoxide, nitrogen dioxide and other gases that have line-resolved absorption spectra in the mid-infrared spectral region. The QC laser light source operates near room temperature with thermal electric cooling instead of liquid nitrogen which has been previously required for semiconductor lasers in the mid-infrared spectral region. The QC lasers have sufficient output power that thermal electric-cooled detectors can be used in many applications with lower precision requirements. The instrument developed in this program has been used in several field campaigns from both the Aerodyne Mobile Laboratory and from the NOAA WP3 aircraft. The Phase II program has resulted in more than 10 archival publications describing the technology and its applications. Over 12 instruments based on this design have been sold to research groups in Europe and the United States, making the program both a commercial and technological success. The development of a sensitive, cryogen-free, mid-infrared absorption method for atmospheric trace gas detection will have wide benefits for

atmospheric and environmental research. The substitution of near-room temperature QC lasers for cryogenic lead salt TDLs and the resulting simplifications in instrument design and operation will greatly expand the range of applications.
http://www.osti.gov/bridge/servlets/purl/862034-L5Fsl6/862034.PDF

Diagnostic Tools for Performance Evaluation of Innovative In Situ Remediation Technologies at Chlorinated Solvent Contaminated Sites
Kavanaugh, M., R.A. Deeb, D. Navon, and K. Goldstein (Malcolm Pirnie, Inc.); B. Parker, J. Cherry, and K. Sorenson (CDM); T. Macbeth (Northwind, Inc.); L. Alvarez-Cohen (Univ. of California, Berkeley).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-51, 2005

The performance of remediation systems at chlorinated solvent-contaminated sites has been evaluated using point measurements of dissolved contaminant concentrations in aquifers (e.g., changes in maximum concentrations, plume extent, etc.). Such an approach has significant limitations. First, detailed monitoring of contaminant plumes in granular geologic media has shown that the distribution of dissolved contaminants is often spatially complex due to factors that include spatial variability of contaminant distribution in the subsurface source zone, variability of groundwater flow rate and direction, and variation in water level. Thus it may often be difficult or impossible for typical groundwater monitoring efforts, especially those relying on sparse networks of long-screened wells, to determine where the majority of the contaminant mass is migrating and whether or not remediation systems are effective in reducing that migration. Second, at sites with complex geologies such as fractured rock sites, the evaluation of in situ technology performance is complicated by contaminant migration through discrete fractures. To better evaluate the success of in situ remedial systems at chlorinated solvent contaminated sites, a set of diagnostic tools is being applied at three hydrogeologically distinct sites employing in situ chemical and biological treatment technologies. The proposed diagnostic procedures include technology- and geology-specific tools, as well as those that can be used widely irrespective of the type of technology or site conditions. Mass flux measurement 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 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. ESTCP project ER-0318.

Distinguishing Abiotic and Biotic Reductive Dechlorination of Tetrachloroethylene by Stable Carbon Isotope Fractionation
Butler, E.C. (Univ. of Oklahoma, Norman); X. Liang; Y. Dong; T. Kuder; L. Krumholz; R.P. Philp.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, p G-19, 2005

Stable carbon isotope fractionation is a promising tool for monitored natural attenuation (MNA) assessments to evaluate the fate of chlorinated organic compounds. Researchers assessed whether stable carbon isotope fractionation could be used to distinguish abiotic and biotic reductive dechlorination of tetrachloroethylene (PCE). Abiotic microcosms were set up using different iron minerals, including iron sulfide, green rust, pyrite, and magnetite simultaneously with biotic microcosms containing two isolated pure cultures (Dehalospirillum multivorans and Desulfuromonas michiganensis strain BB1) and one bacteria consortium (BioDechlor INOCULUM, or BDI [TM])). Significant fractionation of carbon isotopes was observed in the abiotic reductive dechlorination of PCE by iron sulfide. The study results show that stable carbon isotope analysis can distinguish abiotic (beta-elimination) and biotic (hydrogenolysis) reductive dechlorination of PCE, at least under certain conditions, and may be useful as a tool in MNA assessments. This project (ER-1368) receives SERDP funding.

A Distributed Fiber Optic Chemical Sensor for Hydrogen Cyanide Detection
Cordero, S.R., M. Beshay, A. Low, H. Mukamal, D. Ruiz, and R.A. Lieberman.
Advanced Environmental, Chemical, and Biological Sensing Technologies III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5993, p 1-8, Nov 2005

The sensing element of a fiber-optic hydrogen cyanide (HCN) sensor runs its entire length. The multimode optical fiber consists of a pure fused-silica core and an HCN-sensitive cladding. Upon exposure to HCN gas, the cladding quickly changes color, resulting in attenuation of the fiber's light throughput. The fiber will detect HCN at part-per-million levels. Prior to exposure, the fiber attenuation measures less than 1 dB/m, making it possible to detect hydrogen cyanide on a continuous length of fiber on the scale of tens of meters, which could replace the need to have a collection of point-detectors to cover a large area.

Effect of Geosynthetics on the Hydraulic Performance of Leak-Detection Systems
Rowe, R. Kerry and T. Iryo.
Canadian Geotechnical Journal, Vol 42 No 5, p 1359-1376, 2005

In an examination of the hydraulic performance of a leak-detection/secondary leachate collection system below a composite liner consisting of a geomembrane over a geosynthetic clay liner (GCL), the effect of the initial conditions in the underlying foundation layer, distance from the leakage point to the drainage point, properties of the GCL, hydration history of the GCL, and the presence or absence of a foundation layer were investigated. The time in which leakage was detected was highly dependent on the material below the composite liner, the initial degree of saturation of the material, and the distance between the hole wrinkle and the drainage point in the system, which means that leakage could go undetected for a considerable period of time in some cases. Predicted leakage was similar in magnitude to leakage reported in field monitoring. A comparison of an analytical solution for steady-state conditions with the numerical solution showed excellent agreement.

Electrochemical Biosensors for Rapid Determination of Pesticide Residues in Agricultural Products
Jiang, Xuesong, Jianping Wang, Yibin Ying, Zunzhong Ye, and Yanbin Li.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 228-237, Nov 2005

Biosensors consisting of electrodes and immobilized antibodies for specific target molecule recognition are able to convert the binding event between antigen and antibody to a detectable signal. These sensors were developed for rapid detection of organophosphate (OP) pesticides. Anti-OPs antibodies were immobilized onto indium-tin-oxide coated interdigitated microsensor electrodes. The biosensing procedure is simple and rapid and can be completed within 1 hour.

Environmental Biomonitoring of Cr and As in Shallow Groundwater: Do Red Oak Trees Preserve Long-Term Records of Contaminant Loading?
Shailer, M. (EEOS, UMass-Boston); D. Brabander (Wellesley College, Wellesley, MA).
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract B33B-02, 2005

In a variety of geochemical settings, Cr and As can be mobile in the groundwater/root environment and are subsequently taken up by trees and stored in xylem tissues specifically associated with groundwater transport. To determine historical patterns in Cr and As bioavailability at a Woburn, MA, superfund site along the Aberjona River, Quercus rubra (red oak) sectioned tree rings were analyzed. Sub-annual dendrochemical analyses were used to identify different As and Cr loading pathways in oak stem wood. A sixty-year record of [As] and [Cr] in stem wood was obtained, and results suggest seasonally dependent correlations with Aberjona River flow and with pumping rates for a municipal well in close proximity to the sampling location. The researchers conclude that these two hydrological pathways likely dominate in providing a flux of dissolved As and Cr into oak stem wood.

Estimation of Arsenic Contamination in Groundwater by the Passive Flux Meter
Clark, C., K. Hatfield, M. Annable, and P. Gupta (Univ. of Florida, Gainesville); T. Chirenje (Stockton College of New Jersey, Pomona).
Environmental Forensics, Vol 6 No 1, March 2005, p 77-82(6)

Using modeling, scientists evaluated the ability of the passive flux meter (PFM) to estimate arsenic in groundwater. Activated alumina was evaluated as the internal sorbent for the PFM. Arsenic recovery was estimated at 87.33 to 99.08% in the wells in a model aquifer incorporating PFMs. Arsenic mass recovery from extraction of the activated alumina ranged from 89.26 to 89.29%.

Evaluating Groundwater Pesticide Loading Using 1-D Vadose Zone Models

Angier, J.T. and D.F. Young, U.S. EPA/OPPTS, Washington, DC.
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H13B-08, 2005

The vadose (unsaturated) zone is a major pathway for pesticide entry into groundwater. Absent reliable monitoring data, computer models are often used to estimate pesticide concentrations in groundwater. Three models--PRZM, RZWQM, and LEACHP--were evaluated for the purpose of estimating groundwater pesticide loading through the vadose zone. The investigators explored the use of deep vadose zone porewater chemical concentrations as a surrogate for shallow groundwater concentrations, as well as modeling/integrating macropore flow contributions to groundwater. Values obtained from these models were compared with field groundwater data to determine the suitability of methodology and relative accuracy of each predictive model. Preliminary data indicate that, at least under near-steady-state conditions (i.e., in the absence of major rainfall events that would trigger substantial macropore flow), vadose zone porewater concentrations generally reflect shallow groundwater concentrations.

An Evaluation of a Field-Based Method to Prepare Fresh Water Samples for Analysis of Sulfite and Thiosulfate by High-Performance Liquid Chromatography (HPLC), Version 1.0

Bates, Anne L., William H. Orem, Harry E. Lerch, Margo D. Corum and Marisa Beck.
U.S. Geological Survey Open-File Report 2005-1436, 24 pp, 2006

This study provides an evauluation of a high-performance liquid chromatrograph method for analyzing sulfite and thiosulfate in fresh-water field samples. Unlike other methods used for the analysis of sulfite and thiosulfate, this technique offers the advantage of being suitable for analysis of samples collected in the field far from a laboratory. Sulfite and thiosulfate are stabilized in the field by fixation with a derivatizing agent. The sulfite- and thiosulfate-derivative complexes are then stabilized on C-18 syringe cartridges. The cartridges are transported to the laboratory for analysis at a later date. This study attempts to reproduce the results reported in the literature and to adapt this method to the equipment available in the USGS laboratory and to the fresh surface-water and pore-water samples collected in south Florida. Results of recovery experiments indicate that the thiosulfate-derivative complex is fully recovered and stable with a maximum error of +/-15% at the lowest concentrations for thiosulfate. The sulfite-derivative complex is fully recovered; however, the sulfite-derivative peak areas increase with time. To quantify sulfite, a peak enhancement correction factor must be applied, which increases the error from +/-15% to +/-20% at lower concentrations of sulfite.
http://pubs.usgs.gov/of/2005/1436/

Evaluation of a Portable Device for Volumetric UST Tightness Testing

Michlin, Y. and A. Pistiner, Technion-Israel Inst. of Technology, Haifa, Israel.
Advances in Environmental Research, Vol 7 No 4, p 871-880, June 2003

Volumetric tightness testing of underground storage tanks is an important aspect of fuel leak control. This paper reports on a portable device for these tests, considers means for its improved application, and outlines a theoretical background for its periodic inspection. Volumetric tightness testing devices have to be periodically checked under field conditions at low rates of artificial change of the fuel volume. A modified plan is proposed for sequential testing of the subject devices, with a view to reducing the necessary number of measurements, as well as a criterion for early termination of the procedure.

Evaluation of Molecularly Imprinted Polyurethane as an Optical Waveguide for PAH Sensing
Chen, Yin-Chu, Jennifer J. Barzier, Mingdi Yan, and Scott A. Prahl.
Nanosensing: Materials and Devices. Proceedings of SPIE--The International Society for Optical Engineering, 5593, p 513-520, Vol Dec 2004

A numerical model has been developed for the fluorescence output efficiency of a molecularly imprinted polymer (MIP) waveguide sensing system. A polyurethane waveguide imprinted with a polycyclic aromatic hydrocarbon (PAH) molecule was fabricated using micromolding in capillaries. The polyurethane MIP was found to be an effective waveguide but absorbed much shorter wavelengths, especially in the UV region, hence the transmission of light appeared orange/red in color. The high background absorption of polyurethane in the spectrometric regions of interest was a critical problem for sensor sensitivity. The numerical model shows that the fluorescence output is only 2x10(-6) of the input excitation for 25 mM anthracene for a 5 mm polyurethane waveguide.
http://www.bme.ogi.edu/~prahl/pubs/pdf/chen04d.pdf

Evaluation of PELAN as a Landmine Confirmation Sensor
Vourvopoulos, George and Robert A. Sullivan
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p 511-516, May 2006

PELAN (Pulsed ELemental Analysis with Neutrons) is a man-portable system for the detection of explosives and chemical warfare agents, weighing less than 45 kg. It is based on the principle that explosives and other contraband contain various chemical elements, such as H, C, N, and O, in quantities and ratios that differentiate them from other innocuous substances. The pulsed neutrons are produced with a pulsed 14 MeV (d-T) neutron generator. Separate gamma-ray spectra from fast neutron, thermal neutron, and activation reactions are accumulated and analyzed to determine elemental content. Data analysis is performed in an automatic manner and a final result of whether a threat is present is returned to the operator. Tests have been performed using the PELAN for landmine detection, showing that PELAN can detect the organic material of the mine and differentiate the mine from battlefield debris, such as shrapnel. This presentation describes the results of PELAN evaluation with blind tests in Croatia and the U.S. using anti-personnel and anti-tank landmines.

Evaluation of Perchlorate Origin and Fate Using Stable Isotope Analysis
Hatzinger, P.B. (Shaw Environmental, Inc.); N. Sturchio and A. Beloso, Jr (Univ. of Illinois at Chicago); J.K. Bohlke and G. Orris (USGS); B. Gu, G. Brown, and J. Horita (ORNL); W.A. Jackson (Texas Tech Univ.); G. Harvey (USAF).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, p F-14, 2005

The perchlorate anion has been detected in 35 states. With the increasing number of detections and the expanding list of potential sources, forensic tools to determine the origin of perchlorate in the environment take on new importance. Isotopic methodologies have recently been developed for perchlorate, and isotopic analysis of a wide variety of perchlorate sources has been funded under ESTCP project ER-0509. The isotopic signatures of chlorine (37-Cl: 35-Cl) and oxygen (18-O: 16-O) have been observed to differ significantly between naturally-occurring and anthropogenic perchlorates. In addition, the natural perchlorate analyzed to date is enriched in 17-O, a characteristic which is not observed for any of the man-made material. Based upon the isotopic differences between natural and man-made perchlorate sources, groundwater sampling is underway at several locations for which perchlorate origin is unknown. In combination with other key hydrogeological and geochemical parameters, isotope ratio mass spectrometry (IRMS) is expected to provide critical evidence for perchlorate origin in groundwater plumes. In addition to forensics, laboratory and field studies have shown that chlorine isotope analysis is a sensitive technique to document perchlorate biodegradation and potentially to distinguish this process from other non-biological mechanisms leading to reduced perchlorate levels during in situ remediation efforts. An overview of stable isotope analysis and its application for perchlorate biodegradation and forensics will be provided.

An Evaluation of Three Methods for Estimating Free-product LNAPL Flow Rates through Contaminated Porous Media
Iltis, Gabriel and Tom Sale, Colorado State University, Fort Collins.
Abstracts: Hydrology Days 2006,

Since the 1860s, the petroleum industry has been refining crude oil into a variety of products. Best management practices at petroleum refineries over the last 100 years have resulted in large volumes of petroleum products being released onto refining property. If these releases consist of light nonaqueous phase liquid (LNAPL), they will infiltrate the soil and come to rest at the water table. A variety of laboratory studies have been conducted and field techniques developed to try to understand LNAPL lens stability. The three predominant field evaluation techniques are baildown tests, direct measurement using tracer dilution techniques, and petrophysical methods. Each of these methods are evaluated and compared in a laboratory sand tank and in the field. The limitations of each technique are discussed, and recommendations based on the relative accuracy of each technique are made. Based on empirical data, baildown tests appear to overestimate LNAPL flow rates through soil formations by a factor of ten, depending on input parameters chosen during data analysis. Tracer dilution techniques directly measure the flow rate of LNAPL through a well. Tank studies suggest that the maximum error associated with direct measurement of LNAPL flow rates is an overestimate on the order of a factor of two. Estimations of LNAPL transmissivity based upon petrophysical methods are still in progress.

Evaluation of Two New Arsenic Field Test Kits Capable of Detecting Arsenic Water Concentrations Close to 10 ug/L
Steinmaus, C.M., C.M. George, D.A. Kalman, and A.H. Smith, Univ. of California, Berkeley.
Environmental Science & Technology, Vol 40 No 10, p 3362-3366, 15 May 2006

Arsenic concentrations were measured in 136 water sources in western Nevada using two relatively new arsenic test kits and compared to laboratory measurements done with atomic fluorescence spectroscopy (AFS). Spearman's rank correlation coefficients comparing the Quick Arsenic and Hach EZ kits to laboratory measurements were 0.96 ($p < 0.001$) and 0.95 ($p < 0.001$), respectively. When analyzed in seven exposure categories, test kit and AFS measurements were in the same category in 71% (Quick Arsenic) and 62% (Hach EZ) of samples, and within one category of each other in 99% (Quick Arsenic) and 97% (Hach EZ) of samples. Both kits identified all water samples with high arsenic concentrations (> 15 µg/L) as being above EPA's drinking water standard for arsenic of 10 ug/L.

Evaluation of Various Hybrid Analytical Techniques for Resolving Arsenic Species in Soils and Natural Waters from Korea
Kim, Y. (Yonsei Univ., Seoul, Korea); H. Yoon, M. Shin, and C. Yoon (Korea Basic Science Inst., Seoul, Korea); N. Woo (Yonsei Univ.).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B31A-0959, 2005

Arsenic species can be transformed rapidly by slight changes in redox condition during experimental manipulation. Previously documented techniques concern only total arsenic concentration. The authors have tested various hybrid techniques using ICP to separate arsenic species in different types of samples. The anion exchange cartridge (Accell Plus QMA, Waters) or column (PRP X-100, Hamilton) was used in separation and (HG)-ICP-AES or (HG)-ICP-MS for detection coupled. The hydride generation (HG) method was used to improve detection limits. If there is a probability of leaching considerable amounts of organic matter and transition metals during soil extraction, the HG technique with a purification procedure and the use of a masking agent should be applied to complete analysis of each arsenic species.

Extracting Syringe for Determination of Organochlorine Pesticides in Leachate Water and Soil-Water Slurry: A Novel Technology for Environmental Analysis
Barri, Thaer (Lund Univ., Lund, Sweden); S. Bergstrom; A. Hussen; J. Norberg; J.-A. Jonsson.
Journal of Chromatography A, Vol 1111 No 1, p 11-20, 7 Apr 2006

The Extracting Syringe (ESy) is a novel membrane-based sample preparation technique directly coupled as an auto-sampler to gas chromatography. The ESy has been applied to the analysis of organochlorine pesticides (OCPs) in raw leachate water, as well as to the extraction of OCPs from contaminated soil samples. This paper describes the testing and performance of the Esy technique, which has shown its competency in comparison to LSE and ASE technologies in its demonstrated utility for environmental analysis of organic pollutants.

Extraction Spectrophotometric Determination of Trace Amounts of Perchlorate Based on Ion-Pair Formation with Thionine
Pourreza, N. and H. Mousavi, Shahid Chamran Univ., Ahvaz, Iran.
Journal of Analytical Chemistry, Vol 60 No 9, p 816-818, Sep 2005

A rapid, simple, and sensitive extraction-spectrophotometric method for the determination of trace amounts of perchlorate is based on the extraction of perchlorate as an ion pair with thionine into isobuthyl methyl ketone and measuring the absorbance of the organic phase at 603 nm. The researchers identify optimum conditions for successful perchlorate determination and discuss the application of the method to perchlorate in water samples, achieving a detection limit of 23 ng/mL.

FAQs from the NWGLDE … All You Ever Wanted to Know About Leak Detection, but Were Afraid to Ask
L.U.S.T.Line Bulletin, No 48, Nov 2004

The National Work Group on Leak Detection Evaluation (NWGLDE) is an independent work group of 10 members--eight representing various states and two from the U.S. EPA. The mission of the NWGLDE is threefold: (1) to review leak detection system third-party evaluations to determine if each evaluation was performed in accordance with an acceptable leak-detection test method protocol and to ensure that the leak-detection system meets EPA and/or other applicable regulatory performance standards, (2) to review only draft and final leak-detection test method protocols submitted to the work group by a peer review committee to ensure they meet equivalency standards stated in the U.S. EPA standard test procedures, and (3) to make the results of such reviews available to interested parties. The NWGLDE's website contains a vendor index of specific leak-detection test methods. The Work Group is providing a new column in LUSTLine, "FAQs from the NWGLDE," to publish the answers to questions received from regulators and people in the industry on leak detection. The question answered in this column is "Can ELLDs Be Used as a Line-Tightness Test Method?" Submit questions at questions@nwglde.org
http://www.nwglde.org/lustline/lustline_FAQ1.pdf

FAQs from the NWGLDE: What's All the Fuss about Equivalency?
L.U.S.T.Line Bulletin, No 49, Mar 2005

This second installment of FAQs from the National Work Group on Leak Detection Evaluations (NWGLDE) focuses on continuing questions about automatic line-leak detectors and line-tightness tests.
http://www.nwglde.org/lustline/lustline_FAQ2.pdf

FAQs from the NWGLDE: Old and New CITLDS Protocols--What’s That About?
L.U.S.T.Line Bulletin, No 50, Aug 2005

This third installment of FAQs from the National Work Group on Leak Detection Evaluations (NWGLDE) focuses on the different protocols used to certify continuous in-tank leak detection systems (CITLDS), as well as which protocol the NWGLDE believes meets the federal requirements for manufacturer's certification of equipment performance.
http://www.nwglde.org/lustline/lustline_FAQ3.pdf

FAQs from the NWGLDE: CITLDS and Throughput
L.U.S.T.Line Bulletin, No 51, Dec 2005

This fourth installment of FAQs from the National Work Group on Leak Detection Evaluations (NWGLDE) discusses continuous in-tank leak detection systems (CITLDS) protocol throughput limitations. It may help to look back at the August 2005 FAQs concerning CITLDS protocols to better understand the discussion.
http://www.nwglde.org/lustline/lustline_FAQ4.pdf

FAQs from the NWGLDE: Automatic Mechanical Line Leak Detectors (MLLD) -- Part I
L.U.S.T.Line Bulletin, No 52, May 2006

In this fifth installment of FAQs from the National Work Group on Leak Detection Evaluations (NWGLDE), the operation of automatic mechanical line leak detectors (MLLDs) is discussed with regard to product type. The next installment in this series will address the effects of piping type and installation location on MLLD operations. This article does not apply to electronic line leak detectors (ELLD).
http://www.nwglde.org/lustline/lustline_FAQ5.pdf

Feasibility of Landmine Detection Using Transgenic Plants
Deyholos, M., A.A. Faust, M. Miao, R. Montoya, and D.A. Donahue.
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p 700-711, May 2006

To date, none of the systems developed for TNT detection by plants and microorganisms has demonstrated the sensitivity and specificity to be effective under field conditions. To increase the potential effectiveness of these and related biological detection systems, the authors are conducting DNA microarray experiments with plants treated with TNT-degradation products, and characterizing the inducibility of reporter gene expression by these promoters. They are also evaluating the dynamics and limiting factors in the transmission of artificial signals from roots to shoots to increase the ability of soil-based TNT perception strategies to effect human-readable changes in shoot morphology as part of a practical plant-based explosives detection system.

Field Comparison of Optical and Clark Cell Dissolved Oxygen Sensors in the Tualatin River, Oregon
Johnston, Matthew W. and John S. Williams.
U.S. Geological Survey Open-File Report 2006-1047, 15 pp, 2006

Comparison of two Clark cell type dissolved oxygen sensors with three optical sensors in the Tualatin River, OR, indicated that the optical sensors were less prone to fouling drift and calibration drift. In two cleanings and calibrations over the 3-week study, the Clark cells had fouling drifts ranging from 0.17 to 0.37 mg/L and calibration drifts ranging from -0.22 to 0.03 mg/L. The optical sensors had fouling drifts ranging from 0 to 0.02 mg/L and calibration drifts ranging from -0.09 to 0.02 mg/L after 2 to 3 weeks of deployment. Measurements by the Clark

cell and optical sensors compared well to each other and to point measurements of oxygen concentration using the Winkler method, indicating that the optical sensors were as accurate as the Clark cell sensors under the study conditions.
http://pubs.usgs.gov/of/2006/1047/

Field Evaluation of a Transportable Open-Path FTIR Spectrometer for Real-Time Air Monitoring
Ross, K.R. (U.S. Coast Guard Integrated Support Command, Boston, MA); L.A. Todd (Univ. of North Carolina, Chapel Hill).
Applied Occupational and Environmental Hygiene, Vol 17 No 2, p 131-143, 1 Feb 2002

The prototype of a new transportable instrument is a cross between extractive and open-path Fourier transform infrared spectrometers. It measures chemicals passively and in real time in the vicinity of the breathing zone. The spectrometer has a folded optical path that can be enclosed, similar to an extractive system. The enclosure can be removed, enabling the optical path to be open to the atmosphere, so the instrument could be operated as an open-path spectrometer. This paper describes the results of a field study conducted in three different occupational settings: a prosthodontics dental laboratory, a surgery recovery area, and a cytology laboratory. No significant difference was observed between the mean time-weighted averages (TWAs) of the prototype instrument and the results from the NIOSH analytical methods used alongside the new device. The instrument produced results comparable to recognized analytical methods under field conditions and shows promise as a useful tool in industrial hygiene air monitoring applications.

Forensic Identification of Anthropogenic and Naturally Occurring Sources of Perchlorate
Duncan, P., R. Morrison, and E. Vavricka, DPRA, Inc, San Diego, CA.
Environmental Forensics, Vol 6 No 2, p 205-215, June 2005

This article discusses known sources of perchlorate and available forensic techniques to distinguish between naturally occurring and anthropogenic origins. The techniques identified include stable isotopic analysis, surrogates analysis (nitrates, sodium, chlorides, phosphate, nitroglycerins, metals, strontium), historical information assessment (aerial photography, propellant use and chemistry, firing range usage), geologic analysis, x-ray diffraction, and scanning electron microscopy. The detection of a source of naturally occurring perchlorate in soil and groundwater associated with the Mission Valley Formation in San Diego California illustrates the use of some of the forensic analysis methods.

Geophysical Monitoring of Cr(VI) Bioreduction at the Hanford 100H Site
Hubbard, S., J. Peterson, J. Chen, K.H. Williams, M. Conrad, and B. Faybishenko (LBNL, Berkeley, CA); P. Long (PNNL, Richland, WA); A. Willett (Regenesis, San Clemente, CA); T. Hazen (LBNL).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H44C-03, 2005

Scientists examined the use of geophysical data for providing information on the distribution of chemical amendments in association with a Cr(VI) bioreduction experiment at the Hanford 100H site. Seismic and radar tomographic data were initially used with borehole flowmeter data in a principle components analysis to estimate hydrogeological zonation at the site. Pumping was subsequently initiated to create a steady-state flowfield between an injection and monitoring well, and a slow-release polylactate amendment (HRC(TM)) was injected into a sandy formation to reduce Cr(VI) into insoluble Cr(III) complexes. Laboratory analyses were performed to assess the expected geophysical responses to the injectate, as well as to the formation of gases and precipitates that can form during biostimulation procedures. Field-scale, time-lapse tomographic data, as well as wellbore geochemical data were collected during and after pumping was stopped. These datasets were used jointly to assess the spatio-temporal changes in the subsurface system associated with the biostimulation, such as the distribution of an amendment plume and a reaction halo. The field-scale geophysical data were useful for detecting chemical transformations associated with the biostimulation. This study suggests that high resolution, field-scale, cross-borehole geophysical techniques hold significant potential for monitoring biostimulation efficacy and for investigating the role of heterogeneity on remediation processes.

Geophysical Monitoring of Vegetable Oil Emulsion Biostimulation Using Cross-Hole Radar Methods
Lane, John William, thesis, Columbia University. ISBN: 0-542-13148-X, 175 pp, 2005
University Microfilm (UMI) publication AAT 3174833.

This work describes the application of cross-hole radar tomographic methods to the geophysical imaging and monitoring of field-scale vegetable oil emulsion (VOE) biostimulation in saturated unconsolidated sediments. The study combined petrophysical modeling, laboratory-scale experiments, synthetic forward and inverse modeling, and field demonstration at a VOE biostimulation site at Fridley, MN. The complex refractive index model and petrophysical relationships between electromagnetic (EM) wave attenuation, Archie's law, and pore-fluid specific conductance were used to (1) predict VOE dielectric permittivity as a function of emulsion vegetable-oil fraction, (2) predict bulk dielectric permittivity changes resulting from VOE injection into saturated sand, and (3) develop methods to predict VOE saturation and changes in ground-water total dissolved solids (TDS) based on measurement of radar slowness and attenuation differences. The results illustrate pixel-based tomographic inversion limitations, including poor target resolution, overestimation of target horizontal extent, anomaly blurring and streaking, and a general underestimation of anomaly magnitude. In contrast, using optical borehole imaging (OBI), the vertical and horizontal extent and shape of the target anomalies were accurately reproduced and anomaly magnitude errors were small, consistent with the data error. In geologic environments where VOE injection is controlled by horizontally stratified sediments, OBI slowness/difference tomograms can be analyzed to estimate VOE saturation and interpreted with greater confidence than pixel-based tomograms. Results of cross-hole radar monitoring of VOE injection demonstrate for the first time that radar-imaging methods can be used as a field scale remote sensing method for imaging and monitoring VOE biostimulation. The field study results indicate application of an appropriate inversion approach such as OBI can produce tomograms that delineate VOE injectate and provide a means to assess the magnitude of VOE pore-fluid displacement though estimation of VOE saturation.

Glenburn and Bucks Harbor, Maine Sites Characterize Bedrock Using Innovative Geophysical Technique

Defense Environmental Programs Annual Report to Congress: Fiscal Year 2005 -- Success Stories. Apr 2006

Fractured bedrock contains many pathways through which contaminants may move. Knowing exactly which fractures contain contamination has historically been difficult to determine. Use of hydrophysics, an innovative geophysical technique, and ground-water sampling using straddle packers helped delineate contamination at the Glenburn and Bucks Harbor sites in Maine. During the 1950s and 1960s, DoD was responsible for the protection of the east coast from missile attack. The highly specialized radar systems used at sites such as Glenburn and Bucks Harbor were susceptible to oxidation, corrosion, and electrical shorts due to oils used on the equipment and exposure to damp environments. Chlorinated solvents, such as trichloroethene (TCE), were used to clean the electronics. TCE was also occasionally used as a defoliant to eradicate unwanted weeds or woody vegetation at DoD facilities. Both the Glenburn and Bucks Harbor formerly used defense sites have TCE contamination in the bedrock aquifer. The geology of these locations in New England is generally fractured rock mantled with a thin overburden layer. Initially, the U.S. Army Corps of Engineers performed fracture trace studies to determine the general regional fracture orientations. DOE's Argonne National Laboratory geophysics team performed a surface geophysics study at specific areas either on, or along, the fractures migrating through the contaminant source areas. The results of these studies at the Bucks Harbor site allowed monitoring wells to be located along bedrock aquifer flow paths. USGS performed an extensive suite of borehole geophysical logging tests. To further define the fracture flow zones and the respective contamination, the Corps used highly sensitive and innovative ground-water flow measuring equipment. The hydrophysical borehole flow measuring technique was employed at both the Bucks Harbor and Glenburn sites. This equipment measured vertical and horizontal flow across the borehole down to one-hundredth of a gallon per minute. By processing the data in near-real time, the Corps made decisions in the field to determine portions of the borehole for additional testing. Advanced wireline straddle packer tests provided both projects with a definition of the vertical extent of contaminated ground water with one mobilization. The wireline straddle packer tests provided detailed hydrogeologic evaluation and allowed high-quality, interval-specific ground-water samples and hydraulic test data to be obtained. Due to the success of the hydrophysical methods employed at the site, the nature and extent of contamination was defined with a confidence level that allows treatment options to be explored in the feasibility study. For further information, contact Robert Leitch, Project Manager, 978-318-8033, robert.a.leitch@nae02.usace.army.mil or Sam Bass, Geologist, 402-697-2654, don.b.bass@nwd02.usace.army.mil.

Gold-Functionalized DNAzyme Nanosensors to Quantify Heavy Metal Gradients

Adriaens, P. and R. Vannela, Univ. of Michigan, Ann Arbor.

Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B22A-06, 2005

DNAzymes, single-stranded DNA molecules with catalytic capabilities, are isolated from random-sequence DNA libraries by in vitro selection. DNAzymes provide unique molecular tools for metal detection in aqueous environment. The authors describe the selection and characterization of an RNA-cleaving autocatalytic DNAzyme that links chemical catalysis with real-time fluorescence signaling in the single molecule. The catalytic activity can be characterized in terms of metal specificity, speciation, and affinity, and the catalytic DNA serves as a sensor for a variety of metal ion species. These specific and sensitive nanosensors will be embedded on gold particle arrays for enhanced signal amplification to detect metal concentration gradients in situ.

GPR Response to the Introduction of LNAPL in the Vadose Zone
Pyke, K.A., J.J. Daniels, and S.A. Eyuboglu, Ohio State Univ., Columbus.
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H41F-0481, 2005

Ground penetrating radar data were collected during an experiment to simulate the introduction of distant point-source LNAPL contamination in the vadose zone under fluctuating water table conditions. The experiment was conducted in a step-wise fashion in a polyethylene tank containing a non-reactive sand matrix. Various conditions (unsaturated, saturated, residual saturation) were characterized with GPR measurements. The study results indicate that under saturated conditions, the main reflector of GPR energy is indicative of the capillary fringe and not the actual water table. The introduction of LNAPL at the base of the tank during the experiment yielded a complex GPR signal from the gasoline table, and the amplitude of this reflector decayed as stabilization was achieved. The amplitude of the reflection from the bottom of the tank initially decreased when gasoline was pumped into the system, but the amplitude increased with time as a result of the redistribution of fluids in the subsurface. The reflection coefficient between gasoline-saturated sand and the polyethylene tank was ~30% lower than that observed for water-saturated sand in the polyethylene tank, indicating that the amplitude variation is directly related to the distribution of fluids at depth. After gasoline was pumped into the tank and stabilization was achieved, the experiment included increasing the height of the gasoline table through the addition of water. Again, an initial increase in amplitude for the fluid table reflector was observed that decays with time to background noise level. Interpretation of the radar measurements after pumping stopped indicated a redistribution of fluids at depth, creating a gradational boundary that decreased the electrical property contrast. This behavior has been observed in the field and has been interpreted as a muted signal related to the presence of LNAPL. This work has helped to define a more quantitative approach to LNAPL detection and product volume estimation from GPR measurements.

Groundwater Samples and Monitoring Wells
van Dijk, Gerard, Eijkelkamp Agrisearch Equipment, Giesbeek, The Netherlands.
International Environmental Technology, Vol 15 No 9, Sep 2005

A new way of installing bentonite plugs into a groundwater monitoring well is described.
http://www.envirotechpubs.com/pdf/iet/2005/09/iet200509_050.pdf

GSS (Gas Sensitive Semi-Conductor) Technology Introduction
Mills, Jim (Air Monitors Ltd., Staunton, Gloucestershire, UK); Paul Pickering (Aeroqual Ltd).
International Environmental Technology, Vol 16 No 3, May 2006

Gas Sensitive Semiconductor (GSS) technology combines smart measurement techniques with mixed metal-oxide semiconductor sensors that exhibit an electrical resistance change in the presence of a target gas. This resistance change is caused by a loss or a gain of surface electrons as a result of adsorbed oxygen reacting with the target gas. If the oxide is an n-type, there is

either a donation (reducing gas) or subtraction (oxidizing gas) of electrons from the conduction band. Thus, n-type oxides increase their resistance when oxidizing gases (NO2 and O3) are present, while reducing gases (CO and hydrocarbons) lead to a reduction in resistance. The converse is true for p-type oxides where electron exchange due to gas interaction leads either to a rise (oxidizing gas) or a reduction (reducing gas) in electron holes in the valence band. This then translates into corresponding changes in electrical resistance. Quantitative response from the sensor is possible as the magnitude of change in electrical resistance is a direct measure of the concentration of the target gas present. It is beneficial to maximize the surface area to intensify the response to gas because the surface reaction is what causes the change in electrical resistance in the sensing oxide. To take advantage of this effect, commercial gas sensors consist of highly porous oxide layers, which are either printed or deposited onto alumina chips. A heater track is also applied to the chip to ensure the sensor runs hot, which minimizes interference from humidity and increases the speed of response. The microstructure of the oxide, its thickness, and its running temperature are optimized to improve selectivity.
http://www.envirotechpubs.com/pdf/iet/2006/05/iet200605_i.pdf

High Organic Carbon Loading in Groundwater: Diagnostic Tools to Determine and Help Overcome Limitations on Biodegradation Rates
Lutes, C.C., D Liles, and M. Addison, ARCADIS, Durham, NC.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, p G-14, 2005

A variety of factors can limit biodegradation: (1) microbial inhibition by certain components of the mixture (2) lack of sufficient quantity of energetically favorable electron acceptors (oxygen, nitrate, iron, etc.), (3) limitations of available macronutrients, (4) cold temperatures, and (5) limitations on the bioavailability of the contaminant mixture. Design and testing of efficient in situ remedial strategies for contaminated sites requires accurate determination of the predominant limitations on microbial growth and contaminant degradation. The authors present the theory and discuss example applications of a systematic approach for identifying biodegradation rate limitations. Tools discussed include (1) systematic analysis of biogeochemical indicators and site history to discern the "zonation" of microbial processes spatially and temporally, (2) characterization of the in-situ microbial consortium using phospholipid fatty acid analysis (PLFA), DNA analysis by denaturing gradient gel electrophoresis (DGGE), and/or specific enumeration/detection techniques for different metabolic classes of bacteria (i.e., nitrate reducing, iron reducing -- biological activity reaction tests (BART), (3) efficient microcosm treatability testing tools, including observation of contaminant degradation, respirometry, and changes in microbial consortiums in response to enhancements, (4) integration of these data into a conceptual site model, and (5) field pilot testing of biodgradation rate enhancement strategies.

High-Performance Field-Portable Imaging Radiometric Spectrometer Technology for Hyperspectral Imaging Applications
Chamberland, M., V. Farley, A. Vallieres, A. Villemaire, L. Belhumeur, J. Giroux, J.-F. Legault.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 169-179, Nov 2005

Telops has developed a man-portable instrument for standoff chemical imaging that can not only provide an early warning for chemical agents and toxic chemicals, but also provides a chemical "map" of the field of view. The FIRST (Field-portable Imaging Radiometric Spectrometer Technology) instrument is based on a modular design that includes a high-performance infrared FPA and data acquisition electronics, onboard data-processing electronics, a high-performance Fourier transform modulator, dual integrated radiometric calibration targets, and a visible boresight camera.

How Fast are Microbes Growing in the Environment?
Cutter, M.R. and P.G. Stroot, Univ. of South Florida, Tampa.
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B23C-05, 2005

A molecular biology-based method called RT-RiboSyn has been developed to measure the specific growth rate of microbial populations. This method analyzes mixed culture samples that have been exposed to chloramphenicol for specific periods of time. Chloramphenicol disrupts ribosome synthesis, which causes a buildup of the level of precursor 16S rRNA within the cells. A single fluorescently labeled primer is employed that is specific for a microbial population and targets an interior region of both pre16S and 16S rRNA. The pre-16S/16S can be determined by separating the RT&PE products, which have different lengths, and measuring the fluorescent intensity of each. Specific microbial populations can be targeted because of signature sequences present in both precursor and mature 16S rRNA. The RT&PE method has the potential to identify members of a microbial population that are growing rapidly relative to the other members present. The method measures the rate of increase of the precursor 16S rRNA within the cells, which is used to measure the specific growth rate of a specific microbial population.

Hydrochemical and Isotopic Evidence of Natural Attenuation at the Gas Station Contaminated with Fuel Hydrocarbon
Ko, K. (Korea Inst. of Geosciences & Mineral Resources, Daejeon, Korea); I. Oh (Kongju Univ., Kongju, Korea); H. Suk (Korea Inst. of Water and Environment); K. Lee (Korea Basic Science Inst., Daejeon, Korea).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H23A-1406, 2005

Investigators measured groundwater flow, hydrochemistry, and the carbon isotope composition (deltaC-13) of dissolved inorganic carbon (DIC) to monitor natural attenuation induced by biodegradation of petroleum hydrocarbon at an abandoned gas station contaminated by fuel hydrocarbons. Contaminant transport modeling using GMS showed the contaminants, BTEX, moving in two main directions, south and southwest from the underground storage tank and pipeline. These results were confirmed by observation of BTEX in groundwater seepage into streams south and southwest of the area. A geochemical indicator of natural attenuation, red iron precipitate, was also observed in the groundwater seepage. Hydrochemical indicators--Fe(II), Mn(II), sufides, and methane--indicated methanogenesis and a sulfate-reducing environment. The deltaC-13 values of DIC ranged from -20.2 to -9.3 per mil, increasing in the source zone due to microbial degradation of hydrocarbon under methanogenic condition. The enrichment of isotopically heavy C is caused by the production of light (12)CH4 from microbial respiration. The molar ratio of Ca to HCO3 is about 2.5, and this indicates microbial oxidation of fuel hydrocarbon to DIC in groundwater. Geochemical modeling using PHREEQC showed the oversaturation of siderite, rhodocrosite, and goethite, and the saturation index of calcite increased with the increase of bicarbonate, indicating enhanced microbial degradation.

Identification of Active Dehalorespiring Microbial Populations in Anoxic River Sediment by RNA-Based Stable Isotope Probing

Kittelmann, S. and M.W. Friedrich, Max Planck Institute for Terrestrial Microbiology, Marburg, Germany.

Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B13A-1046, 2005

A study was undertaken to detect potentially novel PCE-dehalorespiring microorganisms by stable isotope probing (SIP), a technique that allows the user to directly identify the function of uncultivated microbial populations. A pristine river sediment was incubated in the presence of PCE at a steady, low aqueous concentration. Dehalogenation activity in microcosms was detected after 4 weeks at 20 degrees C with indigenous sediment electron donors. The incubated microbial community was probed with C-13-labeled acetate as electron donor and carbon source at 15 degrees C for 3 days. After RNA extraction, "heavy" C-13 rRNA and light C-labeled rRNA were separated by isopycnic centrifugation, and bacterial populations in gradient fractions were characterized by terminal restriction fragment length polymorphism analysis and cloning. The scientists found that C-13-labeled acetate was incorporated into bacterial rRNA more effectively in PCE-respiring microcosms. rRNA/SIP provides strong evidence for the presence of PCE-dehalorespiring populations utilizing C-13-labeled acetate in river sediment microcosms. Cloning/sequencing analysis identified the prominent members of the heavy gradient fractions as members of the phylum Chloroflexi, which are only distantly related to cultivated dechlorinating Dehalococcides species.

An Improved Technique for Soil Solution Sampling in the Vadose Zone Utilizing Real-Time Data

Singer, J.H. and J.C. Seaman (Univ. of Georgia, Savannah River Ecology Lab, Aiken, SC); S.A. Aburime (Clark Atlanta Univ., Atlanta, GA); J. Harris and D. Karapatakis (Univ. of Georgia).

Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H21E-1390, 2005

Manual soil sampling techniques are traditionally performed without specific knowledge of the conditions in the soil at the time of sampling, which can lead to samples that are not representative of the event of interest, missed samples, and unsuccessful sampling. To target specific soil conditions at the point of sampling that are conducive to successful sample acquisition, an automated lysimeter sampling and fraction collector system was developed. An innovative technique has been demonstrated that couples real-time data with soil solution sampling methods to improve the efficiency and accuracy of contaminant sampling in the field. The system infrastructure can also be implemented in the laboratory as an aid to model development.

In Situ Characterization of NAPL with TarGOST(R) at MGP Sites
St. Germain, Randy; Steven Adamek; Thomas Rudolph.
Land Contamination & Reclamation, Vol 14 No 2, p 573-578, 2006

At former manufactured gas plant (MGP) and wood treating facilities, coal tar and creosote (often found in the form of nonaqueous phase liquids, or NAPL) tend to be distributed very heterogeneously in the subsurface. Due to the high cost of standard methods for analyzing polycyclic aromatic hydrocarbons (PAHs), cost considerations may restrict the number of discrete samples that can be subjected to laboratory analysis. The Tar-specific Green Optical Screening Tool (TarGOST(TM)) is a direct-push, probe-delivered, laser-induced fluorescence (LIF) instrument that logs the NAPL vs. depth. The instrument does this by logging the fluorescence of PAHs that exist in the NAPL at high concentrations. TarGOST(TM) is a modified version of the Rapid Optical Screening Tool (ROST), a mature and well-tested system used at hundreds of petroleum, oil, and lubricant release sites since 1994 in the United States, Europe, and Japan. Dakota Technologies developed TarGOST(TM) because the ultraviolet laser wavelength used in ROST performed inconsistently at detecting and quantifying the heavier coal tars commonly found at former MGP sites. TarGOST(TM) utilizes visible wavelength fluorescence spectroscopy to yield a monotonic response for MGP NAPL on soil. Logging production rates of 300 to 500 ft per day at 10 to 20 separate probing locations is typical, allowing NAPL characterization at greatly reduced cost compared to typical discrete sampling and analysis programs. The technology's high-density electronic data also support visualization and modeling using 3-D data visualization methods when combined with bore location and GIS information.

In Situ Sensing of Volatile Organic Compounds in Groundwater: First Field Tests of a Mid-Infrared Fiber-Optic Sensing System
Steiner, H.; M. Jakusch; M. Kraft; M. Karlowatz; T. Baumann; R. Niessner; W. Konz; A. Brandenburg; K. Michel; C. Boussard-Pledel; B. Bureau; J. Lucas; Y. Reichlin; A. Katzir; N. Fleischmann; K. Staubmann; R. Allabashi; J.M. Bayona; B. Mizaikoff.
Applied Spectroscopy, Vol 57 No 6, p 607-613, June 2003

A prototype mid-infrared sensor system for the determination of volatile organic pollutants in groundwater comprises a portable Fourier transform infrared spectrometer, coupled to the sensor head via mid-infrared transparent silver halide fiber-optic cables. A 10 cm unclad middle section of the 6-m-long fiber is coated with ethylene propylene copolymer to enrich the analytes within the penetration depth of the evanescent field protruding from the fiber sensor head. The prototype sensor was tested in an artificial aquifer system containing a mixture of tetrachloroethene, dichlorobenzene, diethyl phthalate, and xylene isomers at concentrations in the low ppm region. Within one hour of immersion at a depth of 30 cm, the analytes were clearly identified in the fingerprint region of the IR spectrum. Five out of six analytes could be discriminated simultaneously.

Individual and Simultaneous Determination of Selected Pesticides by Biosensors
Starodub, N.F., V.E. Krivenchuk, and V.F. Shapovalenko, National Academy of Sciences, Kyiv, Ukraine.
Prague 2003: Sixth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe and the Commonwealth of Independent States, 1-4 September 2003, Prague, Czech Republic. Abstracts, No 201, p 135, 2003

Immune sensors based on ISFET and electrolyte insulator structures (EIS) were tested for the detection of the commonly used pesticides simazine (2-chloro-4,6-di(N-ethylamino)-1,3,5-triazine) and 2,4-D (2,4-dichlorophenoxyacetic acid). Under optimal conditions, the sensitivity of the ISFET-based immune sensor toward simazine was 0.1 ng/ml. The sensitivity toward 2,4-D detection was about 0.05 ng/ml. The sensitivity of the immune sensor based on EIS was much lower (about one order) than the sensitivity of the ISFET sensor. Despite the relatively lower sensitivity of the EIS-based immune sensor, it attracts attention because of the simple analysis procedure and the potential for multi-parametric control. Replaceable membranes make it suitable for repeated analysis. The overall analysis time for both the immune sensors is the same, about 40 min. If the chips (ISFETs) and membranes are prepared in advance, analysis time may be 10 min. The EIS-based immune sensor is simple in design compared to the ISFET-based sensor. Membranes are simple to prepare, are relatively cheap, and can be stored for a long period in a refrigerator. The ISFET-based sensor could be used to verify the results of preliminary screening.
http://www.prague2003.fsu.edu/content/pdf/201.pdf

Indoor Air Vapor Intrusion (IAVI) Database

The Indoor Air Vapor Intrusion (IAVI) Database is designed for regulators and other stakeholders to submit site-specific vapor-intrusion data to support development of screening-level predictions of vapor attenuation. High-quality, representative, and reproducible measurements of soil gas, groundwater, and indoor air contaminant concentrations at VI sites are needed to verify that the screening-level model predictions are protective, to improve understanding of the operating physical phenomena, and to help EPA evaluate and improve predictive models and screening algorithms for the VI pathway. This website was developed for public use and in support of Agency activities, but it is not an official U.S. EPA website. It is operated by RTI International, under contract to EPA, for developing and maintaining an indoor air vapor intrusion database, along with other activities to improve EPA's Vapor Intrusion Guidance. The website contains guidance documents, other reports, and presentations and supporting materials for several workshops, such as the one sponsored by EPA and AEHS and held March 16, 2006, in San Diego: "A Summary Workshop in the Context of EPA's VI Guidance Revisions."
http://iavi.rti.org/index.cfm

Infrared DIAL for Remote Sensing of Atmospheric Pollutants
Vaicikauskas, V., V. Kabelka, Z. Kuprionis, and M. Kaucikas.
Lasers and Applications. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5958, p 387-393, Sep 2005

A new development is described of a differential absorption DIAL spectrometric system based on the mid-infrared tunable optical parametric oscillator (OPO) and pumped by compact Q-switched lasers. Mobile LIDAR was assembled in a truck and for selective pollutant analysis at ranges extending from hundred of meters to a few kilometers.

Innovative Characterization of Multi-Component DNAPL in a Heterogeneous Aquifer
Meyers, E., L. Davies, N. Scroggins, and J. Perdicaris (Earth Tech, Orlando, FL); B. Goeb (Universal City Property Management, Orlando, FL).
EST2005: Proceedings from the First International Conference on Environmental Science & Technology 2005, 23-26 January, New Orleans, Louisiana. American Science Press, New Orleans, LA. ISBN 0-9768853-5-2, 2005

Groundwater assessment activities at a former unlined industrial landfill have delineated a 5-acre dissolved-phase groundwater plume that extends to a depth of 150 feet below land surface (bls). Dissolved-phase concentrations in excess of 10% solubility were detected for several contaminants, providing presumptive evidence that nonaqueous phase liquids (NAPLs) may be present at the site. A membrane interface probe (MIP) equipped with a soil conductivity detector was used to obtain real-time qualitative contaminant distribution and geophysical data, which assisted in determining the subsurface distribution of NAPL. Though preliminary groundwater analytical data indicated the potential for NAPL to exist throughout a large area of the plume, MIP investigation results and subsequent soil sampling indicate that the NAPL source area is smaller and more localized than groundwater solubility data suggest. The data obtained during the MIP investigation will reduce the time and cost of site remediation by focusing remedial actions on a smaller source area.

Innovative Methods for Integrating Knowledge for Long-Term Monitoring of Contaminated Groundwater Sites: Understanding Microorganism Communities and Their Associated Hydrochemical Environment
Mouser, P.J., D.M. Rizzo, G. Druschel, P. O'Grady, and L. Stevens, Univ. of Vermont, Burlington.
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H41F-0477, 2005

An interdisciplinary study integrated hydrochemical and genome-based data to estimate the redox processes occurring at long-term monitoring sites. Groundwater samples were collected from a well-characterized aquifer contaminated with landfill leachate. Primers from the 16S rDNA gene were used to amplify bacteria and archaea in groundwater taken from monitoring wells located in clean, fringe, and contaminated locations within the aquifer. Polymerase chain reaction-amplified rDNA were digested with restriction enzymes to evaluate terminal restriction fragment length polymorphism (T-RFLP) community profiles. The rDNA was cloned and sequenced, and the partial sequences were matched against known organisms using the NCBI Blast database. Phylogenetic trees and bootstrapping were used to identify classifications of organisms and compare the communities from clean, fringe, and contaminated locations. Artificial Neural Network (ANN) models were used to incorporate microbial data with hydrochemical information for improved understanding of subsurface processes at this site.

Integrated Methods for Site Characterization and Conceptual Model Development for a Contaminated Fractured-Bedrock Aquifer
Johnson, C.D. (USGS, Storrs, CT); J.R. Kastrinos (Haley and Aldrich, Boston, MA); F.P. Haeni, (FP Haeni, LLC, Deep River, CT).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H41B-0405, 2005

A multi-disciplined, team-based approach integrated geophysical, hydrologic, and chemical data to characterize lithology, fractures, and hydraulic properties of fractured crystalline bedrock and to determine the nature and extent of ground-water contamination from a landfill and former chemical-waste disposal pits at the University of Connecticut. Multiple methods were used in phases to corroborate the interpretation of individual methods and to guide the design and implementation of additional testing at the site. The use of geophysical data early in the investigation allowed the team to obtain detailed subsurface information with a minimum of boreholes. Surface geophysical methods targeted potential contaminant discharge from the landfill for further investigation. Borehole geophysical methods were used to investigate the anomalies identified by surface geophysical methods, the location and orientation of fractures that intersect and surround each well, the direction and magnitude of ambient flow in the wells, and the transmissive fractures that could provide pathways for contaminant migration. Borehole geophysical and hydraulic data were used to design discrete-zone monitoring systems for the collection of hydraulic head and chemical data and to prevent cross contamination through the boreholes. The results of the geophysical surveys together with hydraulic and geochemical data from discrete-zone monitoring systems in bedrock wells, chemical data from private water supply wells, surface-water-quality data, and drive-point profiling data were used to develop a conceptual model of the ground-water flow and contaminant distribution at the site. This investigation demonstrated the value of discrete-zone isolation and long-term monitoring in fractured-rock aquifers to prevent cross-contamination while permitting head measurements and water-quality sampling, thus allowing characterization of contaminant migration over time, which might not have been identified without the discrete-interval data.

Intercomparison of Groundwater Flow Monitoring Technologies at Site OU1, Former Fort Ord, California
Daley, P.F. (Lawrence Livermore National Lab.); J. Jantos and W.H. Pedler (RAS Integrated Subsurface Evaluation, Inc., Golden, CO); W.A. Mandell (USAEC).
Report No: UCRL-TR-215567, 37 pp, Aug 2005

This report presents an intercomparison of three ground-water flow monitoring technologies at a trichloroethene (TCE) ground-water plume at Operational Unit 1 (OU-1) adjacent to the former Fritzsche Army Airfield at the former Fort Ord Army Base in Monterey County, CA. Soil and ground water at this site became contaminated by fuels and solvents that were burned in the Fire Drill Area as part of firefighter training from 1962 and 1985. Contamination is believed to be restricted to the unconfined aquifer, where water is 60 to 80 feet below the ground surface. The aquifer is from 15 to 20 feet in thickness, and is bounded below by a dense clay layer, the Salinas Valley Aquitard. Soil excavation and bioremediation were

initiated at the fire training site in the late 1980s. Since that time, pump and treat has been largely successful at reducing ground-water contamination in this source area; however, a TCE plume extends approximately 3,000 ft to the northwest away from the fire training area. Flow monitoring equipment permanently installed in an earlier project has been augmented with additional flow monitoring devices deployed in existing monitoring wells: the Hydrotechnics® In-Situ Permeable Flow Sensor (ISPFS), the RAS Integrated Subsurface Evaluation Hydrophysical Logging (HPL) tool, and the Lawrence Livermore National Laboratory Scanning Colloidal Borescope Flow Meter (SCBFM). All three devices produce ground-water flow velocity measurements, and the ISPFS and SCBFM systems also generate flow direction estimates. The ISPFS probes are permanently installed and are non-retrievable, but they produce long-term records with essentially no operator intervention or maintenance. The HPL and SCBFM systems are lightweight, portable logging devices that employ recording of electrical conductivity changes in wells purged with deionized water (HPL) or imaging of colloidal particles traversing the borehole (SCBFM) as the physical basis for estimating the velocity of ground-water flow through monitoring wells. All three devices gave estimates of ground-water velocity that were in reasonable agreement, but the SCBFM direction data were in poor agreement with the other two.
Report at http://www.llnl.gov/tid/lof/documents/pdf/325275.pdf

Investigating the Potential for Long-Term Permeable Reactive Barrier (PRB) Monitoring from the Electrical Signatures Associated with the Reduction in Reactive Iron Performance
Slater, Lee D.; N. Korte; J. Baker.
Report No: DOE/ER/63506/FIN, 74 pp, Dec 2005

Laboratory and field experiments were conducted to determine the sensitivity of low frequency electrical measurements (resistivity and induced polarization) to the processes of corrosion and precipitation that are believed to limit permeable reactive barrier (PRB) performance. The research was divided into four sets of experiments that were each written up and submitted to a peer-reviewed journal: (1) a laboratory experiment to define the controls of aqueous chemistry (electrolyte activity, pH, valence) and total zero-valent iron (ZVI) available surface area on the electrical properties of ZVI columns, (2) a laboratory experiment to determine the impact of corrosion and precipitation on the electrical response of synthetic ZVI columns as a result of geochemical reactions with NaSO4 and NaCO3 electrolytes, (3) lab experiments on a sequence of cores retrieved from the Kansas City PRB to determine the magnitude of electrical and geochemical changes within a field-active PRB after eight years of operation, and (4) field-scale cross borehole resistivity and induced polarization monitoring of the Kansas City PRB to evaluate the potential of electrical imaging as a technology for non-invasive, long-term monitoring of indicators of reduced PRB performance. This report first summarizes the findings of the four major experiments conducted under this research. The four papers are attached in Appendices 1 through 4. Appendices 5 and 6 contain two technical reports written by co-PI Korte describing supporting geochemical measurements and the coring procedure conducted at the Kansas City PRB as part of this project.
Report at http://www.osti.gov/bridge/servlets/purl/861332-RqnWey/861332.PDF

Investigation of Chlorine Treatment DNA-Based Detection of the Bacillus anthracis Spore
Calomiris, J.J. and P.A. Vercellone-Smith, Air Force Research Lab, Aberdeen Proving Ground, MD.
AFRL-HE-WPTR-2006-0040, DTIC: ADA446244, 58 pp, Dec 2005

There is a crucial need for technology that allows rapid and reliable detection of waterborne pathogens that pose a public health threat to drinking water supplies. Recently, there has been concern that pathogenic microorganisms such as Bacillus anthracis spores could deliberately be introduced into a water supply as an act of bioterrorism. Bacillus anthracis, the causative agent of anthrax, ranks high on the list of bioterrorism agents that pose a threat to drinking water supplies. Dormant spores are capable of surviving in both aquatic and terrestrial environments for long periods. While molecular-based systems such as Polymerase Chain Reaction (PCR) offer great potential for effective pathogen detection, intricacies of these methods can pose limitations to practical application. One of the primary obstacles for PCR-based detection of pathogens is gaining access to the cellular DNA from a wide range of microbial types. While the DNA of many microorganisms can be released from the cells with relative ease, gaining access to the DNA of bacterial spores, such as those produced by B. anthracis, is extremely difficult. Since the permeabilization of spores presents one of the most formidable cellular barriers to rapid DNA-based detection, the disruption of anthrax spores was the primary focus of this research. This effort involved investigating processes that would enhance the permeability of microorganisms for DNA-based detection. This report describes and investigation of the potential effectiveness of chlorine, as well as antimicrobial peptides, to disrupt spores prior to DNA-based detection.
http://handle.dtic.mil/100.2/ADA446244

Investigation of NA Processes at Reactive Fringes: Sampling Bias Introduced by High Resolution Multi-Level Monitoring
Piepenbrink, M. (Univ. of Tuebingen, Tuebingen, Germany); T. Ptak (Univ. of Goettingen, Goettingen, Germany); P. Grathwohl (Univ. of Tuebingen).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B31A-0966, 2005

High-resolution multi-level sampling (MLS) in the order of decimeters or less is an essential prerequisite for the investigation of natural attenuation processes at the reactive fringes at field scale. In contrast to engineered remediation techniques that usually address high contaminant concentration levels close to the source zone, monitored natural attenuation (MNA) relies heavily on the accuracy of the low concentration levels (down to the legal limits) measured in the plume. These data are often strongly biased due to the monitoring equipment. This paper presents results from ongoing controlled laboratory material tests and research on high-resolution MLS at six field sites. The focus was on a optimized site-specific hydraulic design and contaminant/MLS-material interaction. The most acceptable solutions (MLS resolution on the order of 0.1m) were found using sampling tubes with a small inner diameter (3-4 mm), which resulted in a small stagnant water volume prior to sampling, but was still not problematic with respect to the flow induced hydraulic losses within the tube. The authors present two major conclusions of the study to date. (1) Due to sorptive losses in dedicated, pristine tubing material, MLS systems tend to underestimate the contaminant concentrations, which leads to an overestimation of the NA potential. To avoid this false negative concentration bias, the most inert tubing material should be used. (2) Due to leaching of plasticizers (e.g., phthlates) out of the pristine tubing material, MLS systems tend to overestimate TOC sum parameters. To avoid this false positive concentration, only polymers with no or low plasticizer content should be used.

Investigation of the Feasibility of Fast Neutron Analysis for Detection of Buried Landmines
Faust, Anthony A., John E. McFee, H. Robert Andrews, and Harry Ing.
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p 712-723, May 2006

The application of neutron-based methods is useful in bulk material detection and identification because the neutron can penetrate deep into materials, and its nuclide-specific interactions can be used to make direct measurements of a target's elemental composition. Defence R&D Canada's initial work in the area of penetrating radiation resulted in the development of the recently commercialized Minespec, a thermal neutron analysis system for buried-explosives detection. Co-developed with Bubble Technology Industries Inc. as the confirmation detector for a multi-sensor anti-tank landmine detection system, system improvements have included the incorporation of an electronic pulsed neutron generator, which presents the possibility of utilizing fast neutron analysis methods to improve the system's detection capability.

Investigation of the Transport Behaviour of Selected Organic Compounds at the Electrochemical Remediation of Contaminated Soils [Tracer Techniques]
Jentsch, T., Fraunhofer Inst. for Nondestructive Testing (IZFP), Dresden, Germany.
Tracer 3: International Conference on Tracers and Tracing Methods, Ciechocinek (Poland), 22-24 June 2004.
Inst. of Nuclear Chemistry and Technology, Warsaw, Poland. Report No: INIS-PL--2005-0001, OSTI: DE20585447, ISBN: 83-909690-2-5, p 149-155, 2004

A special semi-automatically operating experimental setup was developed and applied to investigate, without sampling, the transport behavior of pollutants in soils undergoing electrochemical remediation. In an investigation of the transport of bromophenol in different soils at several electrical field conditions, a small part of bromophenol was labeled with radioactive Br-82. Synthesis of labeled bromophenol from phenol and irradiated ammonium bromide in a single step was developed. The experimental results for remediation of the investigated soils showed that generally the transport of bromophenolate ions occurred toward the anode. In some cases, transport in the opposite direction was demonstrated during the first trial period. Transport velocities could be calculated from the results. The knowledge of transport behavior and velocities supports the planning of real decontamination processes and a prediction of the necessary remediation duration.

Ion Chromatographic Determination of Sulfide and Cyanide in Real Matrices by Using Pulsed Amperometric Detection on a Silver Electrode
Giuriati C., S. Cavalli, A. Gorni, D. Badocco, and P. Pastore, Univ. of Padua, Padua, Italy.
Journal of Chromatography A, Vol 1023 No 1, p 105-112, 9 Jan 2004

The determination of free sulfide and cyanide by pulsed amperometric detection (PAD) at a silver-working electrode was improved through a deep de-oxygenation (at least 10 min) of both standard and real solutions containing the two analytes and adopting a two-potential waveform able to eliminate Ag working electrode fouling. Detection limits were 1.0 and 2.0 ug/L for S2- and CN, respectively. The authors discuss the accuracy, repeatability, and demonstrated good performance of the optimized method, as well as its and long-term stability; the electrode surface required no manual polishing procedure for at least 1 month at 20 analyses per day.

Isotope Tracking of Contaminant Movement in the Hanford Vadose Zone
Conrad, M.E., J.N. Christensen, and D.J. DePaolo (Lawrence Berkeley National Laboratory, Berkeley, CA); P.E. Dresel (Pacific Northwest National Laboratory, Richland, WA).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H21E-1384, 2005

A suite of isotopic measurements of vadose zone soil samples and groundwater has been used to identify sources of groundwater contamination at DOE's Hanford site. The isotopic composition of nitrate can be used to distinguish high-level tank waste and low-level process wastes from the relatively high background concentrations of nitrate in the site groundwater. Isotope Sr-97/Sr-86 of strontium is typically higher than background in areas where large volumes of water have been flushed through the vadose zone, whereas interaction between high-level caustic waste and feldspars in the vadose zone sediments releases low Sr-97/Sr-86. Uranium isotope ratios have been useful for distinguishing different generations of nuclear fuel processing, allowing identification of waste in the vadose zone and groundwater derived from known or suspected leaks or spills. The authors present data from a site adjacent to one of the high-level tank farms where several potential sources of contamination are suspected of causing high (and increasing) concentrations of Tc-99 and nitrate in groundwater. The isotopic composition of nitrate from a multi-level well is an example of vertical mixing of high-nitrate low-level waste with concentrated high-level waste. Sr and U isotope data are helping to define the possible sources of the high-level and low-level waste components in the groundwater.

Laboratory Investigation of a Multiple-Model State Estimation Scheme for Detection and Isolation of Leaks in Pipelines
Khulief, Y. and H. Emara-Shabaik, King Fahd Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia.
Proceedings of the I MECH E Part I Journal of Systems & Control Engineering, Vol 220 No 1, p 1-13, 2006

A model-based estimation scheme was developed and tested as a basis for real-time monitoring of fluid flow in pipelines. In this estimation scheme, the fluid flow in a pipeline is modeled by a set of non-linear partial differential equations and represented in a state-space form. A modified extended Kalman filter (MEKF), with its internal model defined by the obtained state-space form, is invoked with feedforward computations to establish an adaptive multimodel state estimation technique. An experimental laboratory test-rig was constructed to test the validity and effectiveness of the leak detection and localization scheme. The test results show that the developed scheme effectively detects and locates leaks in pipelines within a short timeframe.

Liquid Pipeline Leak Detection System: Model Development and Numerical Simulation
Abhulimen K.E. and A.A. Susu, Univ. of Lagos, Lagos, Nigeria.
Chemical Engineering Journal, Vol 97 No 1, p 47-67, 15 Jan 2004

A new model to detect leaks optimally in liquid pipelines used the Liapunov stability criteria to evolve a criterion for pipeline leak detection. A flow model was derived for a typical pipeline flow system, and the inclusion of leak factor kL in the flow model indicates the relative degree of deviation from equilibrium (no leaks). The simulation profiles of eigenvalues of a crude-oil-transporting pipeline segment show that pressure deviations are a more sensitive parameter for leak detection than volume deviations. Volume deviations appear to be good indicators for larger leak systems. This paper analyzes and discusses a single leak situation as well as double leak situations in a pipeline system.

List of Leak Detection Evaluations for Storage Tank Systems, Thirteenth Edition, 2006
National Work Group on Leak Detection Evaluations (NWGLDE), 420 pp, Mar 2006

This list of leak detection evaluations was prepared by a work group consisting of state and EPA members. The list is limited to evaluations of leak detection equipment and procedures or systems conducted by an "independent third-party evaluator" and then reviewed by the work group. The NWGLDE does not evaluate the methods or equipment, and appearance on this list does NOT mean they are "approved" or automatically acceptable for use in any particular state or local jurisdiction. On each data sheet, this list reports parameters and data values for methods, equipment, and software that are specific to the most current third-party evaluation submitted to the NWGLDE. Subsequent modifications or changes to the method, equipment, or software may produce parameters and data values that are significantly different than the listed third-party evaluation parameters and data values. It is the responsibility of the local implementing agency to accept or reject those modifications or changes. Updates to this list are posted on the NWGLDE website (www.nwglde.org) under "News and Events."
http://www.nwglde.org/downloads.html

Long-Term Performance Assessment of Permeable Barriers Based on Eight Years of Monitoring at Naval Air Station Moffett Field
Gavaskar, A., W.-S. Yoon, V. Lal, N. Gupta, B. Sass, J. Sminchak, and J. Hicks (Battelle); N. Ruiz and C. Reeter (NFESC).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-24, 2005

A permeable reactive barrier (PRB) filled with granular zero-valent iron (ZVI) was installed at former Naval Air Station Moffett Field in April 1996. This pilot-scale PRB intercepts the more concentrated core of a relatively large regional groundwater plume of chlorinated VOCs two miles long and a mile wide. The primary contaminant in the plume is TCE, though some PCE and DCE are also present. The PRB at Moffett Field is one of the earliest PRBs installed; it has been monitored periodically for 8 years in the field; its hydrologic performance has been verified using computerized modeling tools and a field tracer test; and its field performance evaluation has been supplemented with a long-term laboratory column study that simulated 30 years of operation of the PRB. Field monitoring conducted in July 2004 revealed the first indication of a treated water front emerging on the downgradient side of the PRB. The long time lag between the installation of a PRB and the attainment of cleanup goals at a downgradient compliance boundary has long been a point of discussion between site owners and regulators at several sites because it creates years of uncertainty regarding the hydraulic and reactive performance of a PRB. At many PRB sites, uncertainty also is created by the fact that water level differences on the scale of a PRB's flow path are small and difficult to discern, which makes it difficult to verify flow through the PRB. The groundwater chemistry data patterns were instrumental at this site in verifying residence time and groundwater flow trends in and around the PRB, thus substantiating its hydraulic performance. This study illustrates how PRB performance uncertainties can be handled with the use of temporary compliance points, indicator groundwater parameters that can be monitored, and safety factors that can be built into a more robust PRB design.

M-Scale: A Novel Tool for Uncertainty-Based Multi-Scale Site Characterization
Adriaens, P. and M.-Y. Li (Univ. of Michigan, Ann Arbor); N. Barabas (Limno-Tech, Inc.).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-39, 2005

The collection of limited sediment cores in time and space for sediment characterization and presents significant challenges to site managers to interpret the contamination baseline and impact of remedial strategies. The base of the problem is often that it is rarely known what the structure of the available dataset is, and therefore the implementation of geostatistical models to predict concentrations at unsampled locations is fraught with substantial uncertainty. Under SERDP funding, an alternative approach (M-Scale) to interpolating the data in space was developed; validated using a range of datasets exhibiting normal, bimodal, and skewed behavior; and applied to dioxin data from the Passaic River in New Jersey. The model takes into account multiple scales and multiple resolutions to optimize the reliability of sampled data. The model not only serves as a tool to evaluate parameter relationships over different scales by their covariances and data uncertainty, but also makes further use of these covariances and data uncertainty as basis for a precision-optimized estimator. Information from each scale is weighted by the projected similarity to the scales of interest, with adjustments considering the different precision they provide. Unlike conventional geostatistic tools that are based on the point-to-point spatial structures, the multi-scale model introduces a new framework for spatial analysis in which regional values at different scales are anchored by the correlations of each other. Spatial dioxin distributions and microbial dechlorination signatures were used as benchmarks for comparison of M-Scale to ordinary kriging. The results from cross-validation and jackknifing approaches applied to these datasets were analyzed using Quantile-Quantile and P-P plots. These plots indicated that that M-Scale better preserves the local features of hotspots during data interpolation to a basin-wide scale. Current efforts focus on mapping microbial abundance and respiratory competence in the Anacostia River, based on measurements at three different scales. The outcomes of this work will be used to develop an uncertainty-based spatial decision tool for site remediation in this watershed.

Magnetic Microparticle-Based Capture Matrices to Extract Trace Amounts of Chemical Species from Complex Matrices
Boss, Pamela A., SPAWAR Systems Center San Diego, CA.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-22, 2005

Magnetic microparticles have been utilized extensively in diagnostics and other applications for the capture of biomolecules, cells, and cell organelles. Advantages of the use of magnetic microparticles for these applications are extraction/concentration of the target from a complex matrix, ease of separation, and suitability for automation. The same features that make magnetic microparticles attractive for biomagnetic separations also make them ideal for extracting and concentrating trace amounts of chemical species from complex environmental samples. The amine and carboxyl functional groups of the magnetic microparticles can be used to bind recognition elements specific for a given chemical species or class of compounds. For example, octadecyl groups can be used to capture polycyclic aromatic hydrocarbons, crown ethers can be used to capture alkali metals, and quaternary amines to attract anions. Once captured, the chemical(s) can be identified and quantified by any given analytical technique, using traditional instrumentation, such as chromatography, electrochemistry, or spectroscopy. Because of the small dimensions of the magnetic micro/nanoparticles, they can even be employed as concentrators for lab-on-a-chip microfluidic devices. Magnetic fields can then be used to manipulate the positioning of the particles within the device. Feasibility studies demonstrating the fabrication and use of SERS-active capture matrices to detect naphthalene and anions were funded by SERDP.

Man-Portable LIBS for Landmine Detection
Harmon, Russell S., Frank C. De Lucia, Aaron LaPointe, Andrzej W. Miziolek
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p. 154-160, May 2006

Laser Induced Breakdown Spectroscopy (LIBS) is an emerging, minimally-destructive sensor technology for in situ, real-time chemical species identification and analysis. The Army Research Laboratory has been engaged in LIBS analysis for over a decade and recently has been investigating the potential to use broadband LIBS analysis in a handheld, confirmatory sensor for landmine detection. Laboratory tests with a prototype man-portable LIBS system have shown considerable success in identifying landmine casings.

Man-Tech Associates Inc. Titrasip(TM) SA System Continuous Multi-Parameter Water Quality Monitor. Environmental Technology Verification Report
James, R., A. Dindal, Z. Willenberg, and K. Riggs, Battelle, Columbus, OH.
EPA 600-ETV-06-007, 52 pp, Oct 2005

The TitraSip(TM) is designed for multi-parameter water quality testing. The system used for this verification test analyzed pH (following EPA Method 150.1, including calibration buffers with pHs of 4, 7, and 10), conductivity (following Standard Method [SM] 2510, which used a

1,413 microSiemens per centimeter standard for calibration), total alkalinity (following SM 2320B), total chlorine (following SM 4500-Cl B, with a potentiometric rather than a color, endpoint), temperature (following EPA Method 170.1), and turbidity (following SM 2130B, including calibration solutions of 0, 10, and 100 nephelometric turbidity unit polymer standards). Additional water quality parameters and modules (i.e., autosampler) may be added. TitraSip(TM) collects a sample from a free-flowing source (e.g., overfill cup) into the TitraSip(TM) Analysis Vessel and automatically completes analysis cycles at set time intervals (in this case, once every 30 minutes) to complete the analysis for all six water quality parameters without user intervention. The system includes a personal computer, software, interface, burets, turbidity module, pump/valve system for adding calibrants and standards, electrodes, overfill sample cup, and TitraSip(TM) Analysis Vessel. The system used for this verification test was positioned on a table top equipped with shelving for the sampling and analysis equipment. The total system was 30 in high and 36 in wide, excluding the personal computer. Data are automatically collected at the conclusion of each cycle of sample analysis. The PC-Titrate software controls all aspects of TitraSip(TM) operation. Data can be viewed directly on the personal computer as they are acquired, or they can be exported as a database or spreadsheet file. The cost of the TitraSip(TM) used for the verification test was approximately $30,000. In addition, the calibration reagents cost approximately $220 per month, preventive maintenance costs approximately $2,797 (parts only) per year, and electrode replacement costs approximately $1,220 per year, assuming that new electrodes are needed every six months.
http://www.epa.gov/etv/pdfs/vrvs/600etv06007/600etv06007.pdf

Mass Flux Toolkit to Evaluate Groundwater Impacts, Attenuation, and Remediation Alternatives
Newell, C.J. (Groundwater Services, Inc., Houston, TX); S. Farhat (GSI); E. Nichols (LFR Levine-Fricke); E. Becvar (AFCEE).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, p G-15, 2005

The Mass Flux Toolkit is an easy-to-use software tool that enables users to learn about different mass flux approaches, calculate mass flux from transect data, and apply mass flux values to manage groundwater plumes. The Toolkit presents the user with three main options. (1) A module to calculate the total mass flux across one or more transects of a plume, analyze the uncertainty in the calculation, and plot mass flux vs. distance to show the effect of remediation/impact of natural attenuation processes. (2) A module allowing users to perform critical dilution calculations for plumes approaching production wells or streams. An additional feature calculates the capture zone of the supply well and compares it to the transect used to calculate mass flux. (3) A module that provides a review of theory and methods of estimating mass flux. Uncertainty in mass flux estimates is a key issue in using mass flux as a metric. The Toolkit provides two options for analyzing uncertainty in the mass flux estimates derived from the transect method. One option utilizes the Monte Carlo approach to analyze uncertainty in the actual concentration, hydraulic conductivity, and gradient measurements, allowing practitioners to estimate the accuracy of the hydrologic measurements being used for the mass flux calculation. The second option provides a tool for estimating the contribution of each individual observation to the total mass flux. The Toolkit attempts to assist site managers and site consultants perform mass flux calculations quickly and cheaply, permitting their inclusion in more evaluations of groundwater plumes. With mass flux data, the progress of natural attenuation and remediation systems can be demonstrated more vividly and directly to regulators, making the entire remediation process clear, effective, and efficient. The toolkit, developed under ESTCP project ER-0430, runs on Microsoft Excel. This free software is available online at http://www.gsi-net.com/Software/massfluxtoolkit.htm

Measurements of Underground Characteristics Using Flexible Borehole Liners

Keller, C., Flexible Liner Underground Technologies, Santa Fe, NM.

Prague 2003: Sixth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe and the Commonwealth of Independent States, 1-4 September 2003, Prague, Czech Republic. Abstracts. No 22, p 83, 2003

Flexible everting/inverting liners were originally developed in 1989 for the collection of pore liquid samples in horizontal, unsaturated, fractured-rock boreholes. The application of flexible liners has evolved to measurements of pore fluids and flow characteristics in all geologic media in vertical, angled, and horizontal crooked holes. Simple liners are used to seal against contaminant migration in boreholes. Liners are used to carry multi-level groundwater sampling systems into holes with up to 20 sampling ports per liner. The thin, tough liner provides an excellent seal of the borehole, isolating the sampling intervals from one another. Another application is the transport of a color-reactive cover into a borehole wherein the liner presses the cover against the borehole wall and develops a colored stain mapping the location of free-phase DNAPL (dense non aqueous phase liquid). This mapping system is commonly installed via pushrod systems (direct-push installation). Another new application is the mapping of borehole conductivity by measuring the velocity with which the everting liner descends during installation into the borehole.

Metal-Containing Cyclophanes for the Detection of Explosives and Propellants

Prokopuk, N. (Naval Air Warfare Center, China Lake, CA); R. Chapman; L. Baldwin; T. Groshens; S. Hawkins; M. Seltzer.

Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-38, 2005

To identify areas of military ranges that require decontamination, samples must be taken back to the lab for expensive and time consuming analysis,.A rapid, screening-level field test for explosives and propellants is currently unavailable. A chemical assay that responds to both ionic perchlorates and nitroaromatic explosives (TNT, DNT) with high sensitivity would provide a convenient technique for assessing whether a testing range and the surrounding area must be cleaned. Chemical sensors based on molecular recognition events promise chemical detection with high selectivity and sensitivity. Supramolecular guest-host chemistry provides an artificial means for mimicking the high specificity found in biological systems. For example, cyclophanes and metallacycles contain molecular-sized cavities that demonstrate selectivity in binding ionic and aromatic analytes. To transduce the binding event into a readable output, the electrical or photophysical properties of the complex must reflect the coordination state of the host molecule. Organic cyclophanes containing potential binding sites suitable for coordinating lanthanide and transition metal centers to the macrocycle have been synthesized. The electrochemical and photophysical properties of the metals are highly dependent on the conformation of the cyclophane and any guest molecules within the cavity. This dependence provides an optical transduction mechanism for detecting the presence of analyte molecules (explosives and propellants) within the host unit. The work is funded through SERDP project ER-1418.

Methods for the Environmental Detection of Perchlorate-Reducing Bacteria
Bender, Kelly, and Susan M. O'Connor (BioInsite, LLC); John D. Coates (Univ. of California-Berkeley); Laurie A. Achenbach (Southern Illinois Univ.).
BIO 2006, 10-12 April 2006, Chicago, Illinois.
Content Management Corporation, CD-ROM, 2006

Using the chlorite dismutase enzyme as a biomarker, BioInsite has developed both immunological- and PCR-based methods for targeting perchlorate-reducing bacteria to monitor them in the environment. These techniques can detect and quantify perchlorate-reducing bacteria and be used to monitor the degradative activity of the population.

Microdevice Based on Integration of Capillary Electrophoresis Microchips with Electrochemical Detector for Monitoring of Explosives
Lin, Yuehe (Pacific Northwest National Lab); Joseph Wang (Arizona State Univ.)
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-37, 2005

A portable analytical system based on a microfabricated capillary electrophoresis/ electrochemical detector is being developed for fast separation/detection of explosives and their degradation products in groundwater. Such a system has the potential to provide reliable, cost-effective characterization of groundwater contamination at sites undergoing remediation and closure. A capillary electrophoresis (CE) microdevice, based on the combination of microfabricated separation chips and thick-film electrochemical detector strips, was developed. The microdevice consists of a planar screen-printed carbon line electrode mounted perpendicular to the flow direction. Such coupling obviates the need for permanent attachment of the detector, to allow easy and fast replacement of the working electrode. Variables influencing the separation efficiency and amperometric response, including the channel-electrode spacing, separation voltage, or detection potential, are assessed and optimized. The versatility, simplicity, and low-cost advantages of the design are coupled to an attractive performance, with low detection limits, and good precision. Applicability for assays of mixtures of nitroaromatic explosives has been demonstrated. On-line coupling of preconcentration/microchip separation for explosives is also presented.

Miniature and Low-Cost Wireless Sensor Platform for Environmental Monitoring
Kostov, Yordan, Univ. of Maryland, Baltimore.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-40, 2005

Several types of sensors have been developed and deployed in the past for the common environmental parameters (DO, turbidity, pH); however, the systems tend to be bulky, power-hungry, and too expensive for deployment in large numbers for distributed measurements. Due to excessive biofouling, the commercially available sensors do not perform satisfactorily beyond a couple of weeks of continuous field deployment. A SERDP-funded project targets the development of a low-cost, wireless, miniature sensor platform for monitoring environmental parameters. Three recently developed miniature optical sensors for dissolved oxygen (DO), turbidity, and pH will be packed into one field-deployable platform with the capability to communicate data to a central server through a wireless transmitter. The prototype will provide reading of O2, pH, and turbidity every 15 minutes and be able to operate from AA size alkaline batteries for period of at least 1 month of continuous use. The sensing elements will have also adequate anti-biofouling protection for use in streams and/or coastal areas. The use of a common detection principle enables design unification for the various sensors. The platform will also be amenable to future expansion to include additional sensing elements that are under development at UMBC and elsewhere for the detection of specific substances and contaminants such as CO2, heavy metals, PAHs, or even the nerve agent Soman.

Modeling Tools for Assessing the Benefits of DNAPL Source Zone Remediation

Abriola, L.M. (Tufts Univ., Medford, MA); J.A. Christ (U.S. Air Force Academy); K. Li and C.A. Ramsburg (Tufts Univ.).

Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation No 62, p F-42, 2005

Quantifying the benefits of partial mass removal from chlorinated dense nonaqueous phase liquid (DNAPL) source zones has emerged as a key issue in the decision to implement active source-zone treatment technologies. Researchers at Tufts University and Georgia Tech are collaborating under SERDP Project ER-1293 to develop assessment tools to quantify these benefits. To evaluate the utility of incorporating upscaled mass transfer coefficients into simplified transport models for the prediction of source-zone mass discharge and source longevity, predictions of flux-averaged concentrations and source longevity obtained with an upscaled model were compared to 3-D multiphase numerical simulations of tetrachloroethene (PCE)-NAPL dissolution for an ensemble of nonuniform initial PCE saturation distributions. Incorporation of a limited amount of site-specific information (e.g., initial flux-averaged concentration and source-zone ganglia-to-pool mass ratio) enhanced the accuracy of the upscaled approach, facilitating its application to remedial alternative evaluation at a broad range of sites. Modification of a compositional multiphase simulator to include metabolic reductive dechlorination kinetics has facilitated the simulation of enhancements in DNAPL dissolution due to source-zone dechlorination processes. This modeling tool has been validated against laboratory batch and 1-D column data and is being used to determine the sensitivity of bioenhanced dissolution to source zone characteristics (e.g., NAPL contaminated length, saturation), flushing conditions (e.g., ground water velocity, electron donor amendment), and biomass distribution. Results from this effort will facilitate the refinement of biostimulation and bioaugmentation strategies for enhanced source zone dechlorination. Geostatistical approaches are being used to develop and refine a tool which uses local concentration and permeability measurements to estimate downstream dissolved mass flux and to quantify the uncertainty in these estimates. The refined tool employs a multi-stage sampling strategy to overcome the limitations on estimate precision created by the presence of spatial discontinuities (hot spots) in the concentration field commonly found at DNAPL sites. Results indicate that the refined tool can rapidly improve the accuracy and precision of the derived mass flux probability distribution. Examples demonstrate that a 25% increase in sampling frequency can improve estimate accuracy and precision by more than 50%.

Monitoring of Microbiological Potential for the Remediation of Petroleum Hydrocarbons in Ozonated Soil
Ahn, Y., H. Jung, I.S. Kim, and H. Choi, Kwangju Inst. of Science and Technology (K-JIST), Gwangju, Korea. The 4th International Symposium on Advanced Environmental Monitoring, 4-6 December 2002, Jeju, Korea.

Though ozonation has been shown to be effective for the remediation of soils contaminated with petroleum hydrocarbons, few studies have paid attention to its effect on indigenous microorganisms. This paper describes a study undertaken to evaluate degradative potential and community composition of microorganisms in ozonated soil previously contaminated with diesel. Soils ozonated for 0 to 900 min were incubated up to 9 weeks and used for the analyses. Total petroleum hydrocarbons (TPH) and aromatic hydrocarbons decreased with increased ozone injection time, while total number (CFU) of viable heterotrophs in ozonated soils decreased sharply with increased ozonation as determined by plate counting. Plate counting and the spray plate method showed increase in reduced cell numbers during the incubation period; total viable heterotrophs and polycyclic aromatic hydrocarbon- and alkane-degraders. DNA hybridization was performed to detect genes encoding degradative enzymes for aromatic hydrocarbons and alkanes that are major components of diesel. Comparative analysis of detected aromatic hydrocarbon and alkane degradative genes agreed with the increase in numbers of degraders for the chemicals during the incubation period. Further removal of TPH observed during the incubation of ozonated soils could be due to the activity of indigenous microorganisms as evidenced by increased cell number and detected genes for aromatic hydrocarbon and alkane degradations. Among the ozonated soils, 180-min ozonated soil showed highest increase (approximately one order of magnitude) in total viable heterotroph counts and further removal of TPH during the 9-week incubation. Further removal of TPH in soil ozonated for 900 min was negligible. Fluorescence in situ hybridization (FISH) with 16S rRNA-targeted oligonucleotide probes showed that ozonation changed the phylogenetic composition of indigenous microorganisms. This study indicates that an appropriate ozonation duration for the soil of a contaminated site is not only cost-effectiveness but can also accommodate bioremediation by indigenous microbes that survive in situ ozonation.

Monitoring of Water and Contaminant Migration at the Groundwater-Surface Water Interface
Chadwick, D.B. (SPAWAR Systems Center San Diego, CA); A. Hawkins; J. Groves; C. Smith; R. Paulsen; J. Guerrero; M. Singletary; B. Nwokike; K. Paulsen; A. Sims.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-21, 2005

New technologies for assessing discharge of contaminants from groundwater to surface water were demonstrated at Naval Training Center Orlando Operable Unit 4, Orlando, FL, to isolate discharge zones, quantify discharge rates and mass flux, and characterize the attenuation of VOCs at the interface relative to upland and shoreline monitoring wells. The Trident probe, a direct-push, integrated temperature sensor, conductivity sensor, and porewater sampler, was used to screen the site for areas of potential groundwater discharge to the surface water based primarily on differences in subsurface temperature. The integral porewater sampler was then used to rapidly evaluate the subsurface distribution of VOCs in the suspected discharge zones and outlying areas. In areas where subsurface VOCs were detected near the interface, the UltraSeep system, an integrated seepage meter and water sampling system, was used to quantify discharge rates and VOC mass flux from groundwater to Druid Lake. The UltraSeep was used to continuously monitor the discharge over a 24-hour period while collecting 10 flow-proportional samples from the discharge water. This allowed a determination of the presence or absence of groundwater flow and associated VOC flux across the interface. Results from the Trident sensors indicated a zone of cooler subsurface water along the eastern shore of the lake. Subsequent water sampling with the porewater probe and on-site analysis indicated that the VOC discharge to the lake was limited to this near-shore discharge zone. UltraSeep deployments at three stations within this zone confirmed that discharge was occurring, with a general decrease in the discharge of both groundwater and VOCs with distance from the shore. The results allowed for a clear isolation and delineation of the discharge zone, and an accurate assessment of the mass flux and attenuation occurring in the interface zone. The results will be used to assess the effectiveness of the treatment system at the site and to determine if the treatment should be continued or transitioned to a monitored natural recovery system. This work was funded under ESTCP project ER-0422.

Monitoring Volatile Organic Tank Waste Using Cermet Microsensors: SBIR Phase I Report
Gatliff, Edward G., Laura R. Skubal, and Michael C. Vogt, Applied Natural Sciences, Inc.
25 pp, Mar 2006

Few inexpensive technologies exist in the marketplace that can determine the contents of tank waste or monitor the chemistry of tank constituents in near-real time. The researchers addressed this problem by developing and assessing ceramic/metallic based microsensors for determining the constituents of a liquid organic storage tank by examining the gases in the headspace of the tank. Overall, the WBO and YSZ sensors responded well to the chemicals in this study. Responses to various concentrations were distinguishable visually. This is a clear indication that pattern recognition tools will be effective in resolving the constituents and concentrations. In tests, such as the test with acetophenone, one sensor, the WBO sensor is not extremely effective. However, the other sensor, the YSZ sensor, is effective in resolving the concentrations. This supports the need to use an array of sensors, as one sensor may be reactive to a compound while another is not. In the course of this research, several interesting phenomena surfaced. New sensors that were fabricated but not used in a contaminant gas seemed to function more effectively and predictably if a conditioning step was imposed upon them prior to use in square wave voltammetry. A conditioning step consists of running cyclic voltammetry prior to running square wave voltammetry. This step cleanses the sensor surface by providing a full -1.0 V to +1.0V sweep and both oxidizing and reducing compounds on the sensor surface. [Note: squarewave voltammetry will simply oxidize or reduce compounds -- it will not induce both reactions.] This sweep is essential for recovery between samples. This research was funded under Small Business Innovation Research Program Solicitation No. DOE/SC-0075 SC-32.
http://www.osti.gov/bridge/servlets/purl/877280-HiQpGo/877280.PDF

Monolithic DFB Laser Diodes Emitting at 785 nm for In Situ SER Spectroscopy
Maiwald, M., G. Erbert, A. Klehr, B. Sumpf, H. Wenzel, H. Schmidt, and H.-D. Kronfeldt.
Advanced Environmental, Chemical, and Biological Sensing Technologies III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5993, p 9-18, Nov 2005

A distributed feedback (DFB) laser diode emitting at 785 nm was used as light source for Raman spectroscopy, from which an in situ surface enhanced Raman spectroscopic (SERS) sensor was developed to detect polycyclic aromatic hydrocarbons (PAHs) in the marine environment at concentration levels down to nmol/L. For trace detection of chemicals in the marine environment, SERS-active substrates were employed based on silver colloids encapsulated in a sol-gel derived matrix. The authors present the resulting spectra, and a limit of detection of phenathrene (34 nmol/L) as an example for PAHs in seawater. A concentration of 1 nmol/L of pyrene was detected.

A Multi-Channel Continuous Water Toxicity Monitoring System: Its Evaluation and Application to Water Discharged from a Power Plant
Kim, Byoung and Man Gu, Gwangju Inst. of Science and Technology (GIST).
Environmental Monitoring and Assessment, Vol 109 Nos 1-3, p 123-133, Oct 2005

A multi-channel continuous water toxicity monitoring system that uses several recombinant bioluminescent bacteria was used to sample water discharged from power plants to detect and classify toxicity. Each channel of the system comprises a series of two mini-bioreactors to enable continuous operation. A different recombinant bacterial strain was present in each channel. Phenol and mitomycin C (MMC) were the test chemicals used to evaluate system performance. The test samples were injected into the second mini-bioreactor in a step or bell-curve manner. Each channel showed specific bioluminescent (BL) response profiles due to the toxic compounds present in the water samples. Comparing the BL signals between the standard toxic chemical samples and discharged water samples, the equivalent toxicity of the field water could be estimated. This novel continuous toxicity monitoring system can be used as an alternative tool for quick monitoring and control of water quality, as well as an aid in setting up of a new monitoring strategy to prevent polluted water discharge.

Multiobjective Ambient Groundwater Quality Monitoring Network Design
Ammar, K.A., A.F. Khalil (Columbia Univ.); M. Mckee (Utah Water Research Lab, Logan).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H11C-1280, 2005

A sparse Bayesian learning approach called relevance vector machines (RVMs) provides the basis for a new methodology for designing an optimal multi-objective ambient groundwater quality monitoring network. RVMs adopt a fully probabilistic framework with the inherent capacity to simultaneously address model complexity and all sources of uncertainty. The application of RVMs to monitoring network design is more efficient in terms of the number of monitoring wells than a network acquired by application of support vector machines (SVMs). The RVM methodology has been used to identify redundancy in wells monitoring for nitrate in the West Bank aquifers in Palestine. Tradeoff analyses between reducing the sampling cost and minimizing uncertainty was carried out to devise the optimal monitoring network design. The authors present results that highlight the cost-effectiveness and accuracy of this design option.

Multi-Scale Characterization of Hydraulic Parameters Using Borehole Permeametry and Image-Based Grain Size Statistics
Ward, A. (PNNL); G. Anderson (SPAWAR); G. Seedahmed, F. Zhang, and J. Keller (PNNL).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-29, 2005

A complex problem in the design and evaluation of remedial systems is characterization of permeability heterogeneity and data sufficiency over the range of saturations and spatial scales at which contaminant behavior is affected. Even when in situ point measurements of permeability are made, there is still some uncertainty about the scale at which they are applicable and the procedure for upscaling to the scale of a grid block used in numerical models. The objective is to develop a modular tool for deployment by cone penetrometer that integrates high-resolution borehole images with downhole permeameter and resistivity measurements for improved data coverage from the scale of laminae up to the formation-scale. The first phase has focused on developing a prototype permeameter and algorithms for unsupervised image registration and segmentation for estimating grain size distributions. A prototype borehole tension infiltrometers was used to measure steady state infiltration rates, Q, at four heads, h (-4.0, -3.0, -3.0, -1.0, and -0.5 kPa, applied in that order) in homogeneous sand and silt loam soils. These data were used to estimate hydraulic conductivity, K(h) which was compared with predictions with the STOMP numerical simulator. Both measured and predicted permeameter measurements show a log-linear relationship between Q and h from which a unique estimate of the K(h) could be determined under laboratory conditions. Field measurements at multiple locations in the same sediments showed good agreement, though saturated hydraulic conductivity was underestimated relative to known values. A region-based segmentation algorithm has been developed to partition sediment images into homogenous units for textural classification and correlation with K(h). Initial results of segmentation showed strong correlation to known grain size distributions and grain-size statistics calculated from these distributions appear to be strongly correlated with K(h). The results collectively suggest that sub-atmospheric permeameter measurements made at one scale may yield accurate estimates of K(h), which appears to be strongly correlated with grain-size statistics derived from high-resolution downhole images obtained at a different scale. Funding for this work, Project ER-1366, is from SERDP.

Nanostructure-Engineered Chemical Sensors for Hazardous Gas and Vapor Detection
Li, Jing and Yijiang Lu.
Nanosensing: Materials and Devices. Proceedings of SPIE--The International Society for Optical Engineering, 5593, p 222-231, Vol Dec 2004

A nanosensor has been developed using structures such as single-walled carbon nanotubes (SWNTs) and metal oxides nanowires or nanobelts on a pair of inter-digitated electrodes (IDE) processed with a silicon-based microfabrication and micromachining technique. Both in situ growth of nanostructure materials and casting of the nanostructure dispersions were used to make chemical sensing devices. These sensors have been exposed to hazardous gases and vapors--acetone, benzene, chlorine, and ammonia--at concentrations of ppm to ppb at room temperature. The electronic molecular sensing in the sensor platform can be understood by electron modulation between the nanostructure engineered device and gas molecules. As a result of this modulation, the conductance of the nanodevice will change.

NASA Partners with Industry for Field Chem Analysis
FLC NewsLink, 22 June 2004

Collaboration between NASA's Marshall Space Flight Center (MSFC) and an industry partner has resulted in the development of a portable vacuum X-ray fluorescent analyzer that performs on-the-spot chemical analyses--a task previously possible only in a chemical laboratory. MSFC engineers in Huntsville, AL, teamed with KeyMaster Technologies of Kennewick, WA, to develop a "chemistry lab in your hand" that weighs about 4 pounds and is capable of detailed material analysis, even under field conditions. This capability promises to be a boon to the aerospace community because of unique requirements for instance, the need to analyze Space Shuttle propulsion systems on the launch pad. The newly developed vacuum X-ray fluorescent analyzer can identify and characterize a wide range of elements, and is capable of detecting chemical elements with low atomic numbers, such as sodium, aluminum and silicon. Aluminum alloy verification is of particular interest to NASA because vast amounts of high-strength aluminum alloys are used in the Space Shuttle propulsion system—the external tank, main engine, and solid rocket boosters. KeyMaster's work in developing the scanner technology with NASA was enabled by the agency's Technology Transfer Program and resulted in an exclusive license. For more information on KeyMaster, contact John Landefeld, 509-783-9850. For more information about licensing agreements with NASA, contact Sammy Nabors, 256-544-5226.

Navy's SSC San Diego Signs License for QwikLite 200(TM) Technology
Federal Laboratory Consortium Far West Region, June 30, 2005

The Office of Research and Technology Applications (SSC San Diego Technology Transfer Office) announced the signing of an exclusive license with Assure Bioassay Controls, Inc., a Carlsbad company specializing in the measurement and reporting of toxicity for civilian and military requirements. The new products from the company will use technology from Dr. Dave Lapota, Environmental Sciences and Applied Systems Branch, who invented the first laboratory instrument and patented the technique. In 2003, the American Society for Testing and Materials validated Dr. Lapota's system and published a standard for conducting toxicity tests with bioluminescent plankton. The commercialized instrument uses selected species of plankton that can be cultivated, packaged, and shipped to measure changes in bioluminescence and fluorescence when the plankton are exposed to toxic water or soil samples. This field-deployable product is the market's first economical, easy-to-use system for fast determination of harmful substances in the environment. The briefcase-sized QwikLite 200(TM) is a portable, battery-operated instrument that interfaces to a handheld personal digital assistant, laptop, or personal computer. Disposable test kits of the packaged plankton are exposed to suspected toxic samples. The operator uses a bar-code scanner to begin the testing and document the results. At required intervals of 24, 36, and 48 hours the exposed test tubes are inserted into a light-tight chamber with the lid closed, and the bioluminescence is measured. Unlike the other test organisms the plankton make their own food, need no special handling except exposure to light periodically, and are easy to use. The testing kit weighs only ounces and has a shelf life of four to six weeks at room temperature. The DoD-funded Center for Commercialization of Advanced Technology (CCAT) played a key role in facilitating the commercialization of this technology. Under the exclusive license signed between the Navy and Assure Bioassay Controls, royalty payments are paid to the government in exchange for use of the government funded and patented technology.

New Approach for Ground Water Detection Monitoring at Lined Landfills
Yenigul, N.B. (TU Delft, Delft, The Netherlands); A.M.M. Elfeki (King Abdulaziz Univ., Jeddah, Saudi Arabia); C. van den Akker (TU Delft).
Ground Water Monitoring & Remediation, Vol 26 No2, p 79-86, Spring 2006

A widely applied three-well monitoring system (the minimum regulatory requirement) is the conventional monitoring approach at lined landfills, but it is likely to be inadequate due to the limited capture zone of the monitoring wells. This paper introduces a proposed new design of a highly efficient, cost-effective, three-well system that increases the interception of contaminant plumes at early stages. This is accomplished by broadening the capture zone of the monitoring wells simply by continuous pumping from the monitoring wells at a small pumping rate. In simulations, the efficiency and the cost of the three-well monitoring network have been compared for conventional and proposed monitoring approaches, with indications of a significant improvement in the efficiency of the monitoring system with the application of the proposed approach.

New Measurement Techniques for the Monitoring of Landfills
Munnich, K.; J. Bauer; K. Fricke.
Land Contamination & Reclamation, Vol 13 No1, p 49-59, 2005

A landfill must be supervised for long periods after the waste disposal phase has ceased, but it is still unclear what parameters should be determined within what timeframe, and how to interpret the measured values. Researchers at the Technical University of Braunschweig are investigating a landfill monitoring concept and new measurement instruments for the determination of leachate discharge and the horizontal deformation of shafts in landfills. Results of measurements and an overview are presented.

A New On Site Analysis Method for Poly Aromatic Hydrocarbons
Green, Colin, QROS Ltd.
International Environmental Technology, Vol 16 No 1, Jan 2006

This article describes the introduction of a new method that allows accurate and reliable analysis of polycyclic aromatic hydrocarbons (PAHs) on site. On-site PAH analysis by UV fluorescence is suitable for classifying soil samples during site investigation and remediation projects. For all the samples, the method will correctly identify if their classification is clean, contaminated, or hazardous. The difference in ratios of the total fluorescence to the fluorescence of the Target 16 PAHs is shown for the standard and various individual PAHs. Naphthalene, phenanthrene, and pyrene are shown as they contribute the highest proportion of PAHs in most samples. The data show how variation in the concentration of these compounds will change the ratio of the total to the Target 16 fluorescence. The ratios for creosote and the old industrial samples show a significant difference, which is expected as creosote contains a very high

proportion of naphthalenes, while the samples from the industrial area contain almost no naphthalenes at all. This effect provides the method of adjusting the calibration curve so that the best calibration factor is used for the final determination of the sum of the 16 EPA target PAHs. The ratio analysis also provides an additional feature: samples with a high Target 16 fluorescence compared to the total fluorescence contain a low concentration of the compounds amenable to bioremediation. Using the ratios could be a way of predicting how effective bioremediation or other soil treatments would be. They could also be used to monitor bioremediation, soil washing, or thermal treatment as the ratio increases as the lighter PAHs are removed.
http://www.envirotechpubs.com/pdf/iet/2006/01/iet200601_071.pdf

A New, Rapid, Precise and Sensitive Method for Chlorine Stable Isotope Analysis of Chlorinated Aliphatic Hydrocarbons
Van Acker, M.R. (Univ. of Reading, Reading, UK); A. Shahar and E.D. Young (UCLA, Los Angeles, CA); M.L. Coleman (Jet Propulsion Laboratory, Pasadena, CA).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H22A-03, 2005

A new analytical procedure is presented to measure chlorine stable isotope values using a gas chromatograph coupled to a multi-collector inductively coupled mass spectrometer (GC-MC-ICP-MS). The GC has a Porapack Q-packed column. The carrier gas was helium and the temperature was constant at 160 degrees C. The GC was coupled to the MC-ICP-MS by heated stainless steel tubing. Two pure chlorinated aliphatic hydrocarbons (CAHs), trichloroethene (TCE) and tetrachloroethene (PCE), were used for zero enrichment (sample relative to itself) and standard-sample difference measurements. Tests of the GC-MC-ICP-MS method showed that reproducible and accurate Cl isotope values could be obtained using an internal standard. This method also offers increased sensitivity (down to 20 micrograms chlorine) and a quicker and simpler procedure allowing its possible application to a wider range of CAH samples and other organic compounds.

New Surface-Enhanced Raman Spectroscopy Substrates via Self-Assembly of Silver Nanoparticles for Perchlorate Detection in Water
Wang, Wei and Baohua Gu, Oak Ridge National Laboratory, Oak Ridge, TN.
Applied Spectroscopy, Vol 59 No 12, p 1509-1515, Dec 2005

New sol-gel-based surface-enhanced Raman spectroscopy (SERS) substrates were developed for perchlorate (ClO4-) detection by self-assembly of silver colloidal nanoparticles with various functionalized silane reagents. These substrate materials were tailored to allow detection of ClO4- in water with improved sorptivity, stability, and sensitivity and with the ability to detect ClO4- at concentrations as low as 100 ug/L with good reproducibility. Capillary SERS flow cells were fabricated by assembling functionalized silver nanoparticles capable of attracting ClO4- to the SERS surface or the internal wall of glass capillaries. These capillary flow cells could be configured for in situ, nondestructive detection of ClO4- via fiber optics.

Nitro Explosive Detection: From Basic Science to Detection at a Distance
Osorio, Celia, Carlos Peroza, Samuel Hernandez, and Miguel Castro.
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p 672-681, May 2006

This paper summarizes the authors' efforts toward detection of TNT for landmine detection, from traces to bulk amounts, based on the absorption fingerprint of TNT. Light absorption by TNT is broken into three regions: visible light absorption by TNT, formation and detection of NO2 upon UV irradiation of TNT, and formation and detection of NO following UV absorption by NO2. The absorption spectrum of TNT powder and particles has been determined from spectral analysis of backscattered visible light in traditional optical and near field optical microscopy measurements, respectively. The smallest amount of TNT detected in the near-field measurements is 7 femtograms.

A Novel Approach to Estimate the Distribution of Reducible Iron Within Different Pore Fractions of Structured Media.
Kamolpornwijit, W. (PNNL, Richland, WA); S.C. Brooks and Y. Kim (ORNL, Oak Ridge, TN); T.D. Scheibe (PNNL).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B24B-07, 2005

The success of bioremediation processes employing iron-reducing bacteria depends on several factors, one of which is the availability of Fe(III) as an electron acceptor. In a new approach to determining the distribution of reducible iron, scientists extracted Fe from different pore classes of intact cores of structured saprolite. The extracting solution (0.2 M ammonium oxalate) was introduced to an unsaturated column at specific tension. Unit gradient across the cores was maintained with a Marriotte device and vacuum chamber at the column inlet and outlet, respectively. Nonreactive tracers were included in the extractant solution to quantify transport properties. When the iron content in the effluent fell below detection limit, the tension was decreased (higher degree of saturation). The process repeated until the column operated at saturated conditions. The distribution of extractable iron within different pore fractions was obtained directly from the experiment. The flow distribution, affected area, and mass concentration of iron can be estimated using transport parameters obtained from non-reactive tracer tests under both saturated and unsaturated conditions, providing a novel approach to supplement bulk extraction procedures.

Novel Diagnostic In Situ Monitoring Technology
Halden, Rolf and Todd R. Miller, Johns Hopkins Bloomberg School of Public Health.
BIO 2006, 10-12 April 2006, Chicago, Illinois.
Content Management Corporation, CD-ROM, 2006

Scientists at Johns Hopkins University have developed the in situ microcosm array (ISMA), a field-deployable device designed to capture, monitor, and enrich for microorganisms in their natural habitat. The device contains 96 capillary microcosms packed with sterile filter material or sediment that can be amended with chemical substrates, activators, or inhibitors. As ambient surface or groundwater is pumped through the device, microorganisms are captured in the microcosms and allowed to interact with the chemical test substances. The overall response of the community is then measured using a variety of common post-processing assays, and further enrichment of captured organisms can be performed to isolate specific organisms of interest. The model system was tested on Sphingomonas wittichii RW1, the only dioxin-mineralizing bacterium known. Its genome is currently being sequenced. Using a monoculture of S. wittichii RW1, the ISMA was able to homogenously capture RW1 cells across all 96 microcosms with a standard deviation of less than 5%. In individual experiments, positive dose-response curves were obtained for various carbon substrates versus RW1 abundance, indicating that the chemicals presented in the microcosms were available to captured bacteria. In addition, a novel assay for the direct and rapid proteomic analysis of catabolic enzymes was introduced. ISMA supports a rapid, automated study of the metabolic activity of microbial phenotypes. Using a mixed community of bacteria, including S. wittichii RW1, selective enrichment of RW1 in dibenzofuran-amended microcosms was achieved successfully as measured by denaturing gradient gel electrophoresis. The effect of other chemical substrates (e.g., biphenyl, benzoate, acetate) or inhibitors (e.g., antibiotics and heavy metals) on bacterial community structure was also studied in individual microcosms of the microcosm array. Results from these experiments indicate that the proteomics-enabled ISMA represents a valuable new tool for cultivating and studying microorganisms in situ under experimental conditions.

A Novel Technique for Monitoring Contaminant Transport Through Soils
Kumar, P. (Alemaya Univ., DireDawa, Ethiopia); D. Singh (Indian Institute of Technology Bombay).
Environmental Monitoring and Assessment, Vol 109 Nos 1-3, p 147-160, Oct 2005

An experimental setup has been developed that is capable of both the simulation and the monitoring of contaminant transport through a soil mass. Tests of the setup have been compared to the results obtained from the argentometric method. Reynolds number (Re) and the Peclet number (Pe) have been found to be less than unity, which indicates that flow of the solute through soil mass is laminar and the dominant contaminant transport mechanism is diffusion.

On-line Monitoring of Solvent Emission Rates Using an Open Path FTIR Analyser
Raisanen, J. and R. Niemela, Finnish Inst. of Occupational Health, Vantaa, Finland.
Annals of Occupational Hygiene, Vol 46 No 5, p 501-506, 2002

Solvent mixture concentrations in paint and resin manufacture were monitored on line using a portable open-path Fourier transform infrared (OP-FTIR) analyzer to determine solvent emission rates into workspaces. The OP-FTIR instrument and advanced spectra analysis software facilitated a rapid identification of solvent mixtures and on-line concentration monitoring with good temporal resolution and without need for sampling lines, pumps, or sample cells. The analyzer seems to be particularly useful in industrial hygiene applications where spatial average concentrations are needed.

On-Site and In-Situ Analysis of Contaminated Soils Using Laser Induced Fluorescence Spectroscopy
Schultze, R.H. and F. Lewitzka.
Remote Sensing for Environmental Monitoring, GIS Applications, and Geology V.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5983, p 202-211, Oct 2005

A former military site contaminated with petroleum hydrocarbon has been investigated and the results from the on-site laser-induced fluorescence (LIF) measurements were compared to the results of additional laboratory analysis. A 3-D dataset of analyte concentrations has been prepared, and the extent, distribution, and origin of the contamination are discussed. A fiber optical probe developed for in situ LIF investigations in the subsurface has been tested in soil columns and with in situ measurements at a former gaswork site.

Open Path Trace Gas Measurements Using a Pulse Quantum Cascade Laser
Taslakov, Marian, Valentin Simeonov, and Hubert van den Bergh.
13th International School on Quantum Electronics: Laser Physics and Applications.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5830, p 347-351, Apr 2005

A pulsed distributed feedback (DFB) quantum cascade laser (QCL) has been applied to open-path spectroscopic monitoring of ozone, ammonia, water vapor, and carbon dioxide at a distance of 6 km. The thermal chirp during a 200 ns long excitation pulse is used for fast wavelength scanning of about 1/cm in the spectral range 1043-1049/cm. This tuning method is not affected by the atmospheric turbulence, the intrinsic haze immunity of mid-IR laser sources is an additional advantage of mid-IR open path spectroscopy, and it is possible to measure many more organic and inorganic atmospheric species than with UV-visible DOAS.

An Optical-Fiber-Based Microsensor for Explosives Detection
Walsh, Graham, Cunqiang Sun, Hai Xiao, Ning Liu, Junhang Dong, and Van Romero.
Detection and Remediation Technologies for Mines and Minelike Targets XI.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6217, p. 489-494, May 2006

A new type of optical chemical sensor recently developed and demonstrated for highly sensitive, in situ detection of explosives. The sensor consists of a dense silica thin film grown on the straight-cut endface of a standard, 125 um telecommunication optical fiber. Silicalite is an all-silica MFI-type zeolite with an effective pore size of 0.55nm. MFI zeolite is highly hydrophobic and selectively adsorbs organics of appropriate molecular size. The sensor device operates through measuring the optical refractive index or optical thickness of the coated zeolite film, which changes in response to the adsorption of molecular species in its crystalline structure. The sensor shows different responses to simulants such as triisopropylbenzene, TNT, p-xylene, and o-xylene trace vapor in helium carrier gas.

Optimization of KMnO4 Injection and Distribution by Color Tracking
Defense Environmental Programs Annual Report to Congress: Fiscal Year 2004 -- Success Stories. Apr 2005

Multiple applications of injected potassium permanganate (KMnO4) solution were made during in situ remediation of tetrachloroethene (PCE) in ground water at the U.S. Air Force Academy in Colorado Springs, CO. Complex hydrogeologic conditions at the site presented challenges for predicting injected KMnO4 distribution in the aquifer. These challenges were addressed by using groundwater color tracking and mapping using data from KMnO4 application to optimize injection and distribution for the second KMnO4 application. During the first application, a 1% KMnO4 solution was injected, via direct push, into closely spaced, variable depth injection locations. Ground-water samples for color observation were collected from monitoring wells bi-weekly for 14 weeks after injection. During this monitoring period, water within the wells generally changed from dark purple to light pink or clear, indicating KMnO4 was being consumed, diluted, and transported with ground water. Color samples collected during the monitoring period were used to create a computer-generated color ramp scale using geographic information systems. This color ramp provided qualitative concentrations of KMnO4 in samples collected from the monitoring wells. Color contour maps provided a simple method of interpreting KMnO4 distribution after the first application and were used to optimize the plan for KMnO4 injection and distribution during subsequent applications. Results, to date, indicate most of the PCE has been neutralized. Site closure is expected shortly.

Optimized Protection against Explosion Hazards and Toxic Gases: Using Photo Ionisation Detectors
Bleichert, Horst, Drager Safety AG & Co. KGaA, Lubeck, Germany.
International Environmental Technology, Vol 15 No 9, Sep 2005

Many combustible gases and vapors are toxic long before they reach their lower explosion warning limit. An additional measurement of volatile organic compounds in the ppm range with a photoionization detector (PID) provides greater protection for exposed workers. A PID is also well-suited for leak detection in a variety of settings, such as pipelines in refineries and tanks in chemical factories, refineries, and service stations. If a leak is identified or an accident involving hazardous materials occurs, it is important to determine whether the soil in the vicinity of the leak has been contaminated. Due to its high sensitivity and fast response time, the PID is suitable for such tasks. The technology also allows a preliminary classification of soil samples to be conducted; a screening test can indicate whether laboratory analysis is necessary.
http://www.envirotechpubs.com/pdf/iet/2005/09/iet200509_018.pdf

Performance Standards for Open Path Ambient Air Quality Monitoring Systems Using Differential Optical Absorption Spectrometry (DOAS), Version 1
Environment Agency, UK. 26 pp, Jan 2004

The UK Environment Agency has established its Monitoring Certification Scheme (MCERTS) to promote quality monitoring based on international standards. MCERTS performance standards and testing procedures are already available for continuous ambient air quality monitoring systems (CAMS). This document provides the performance standards for open path ambient air-quality monitoring systems (OPAMs). OPAMs are instrumental systems

that continuously monitor ambient pollutant concentrations over an open path and automatically produce results. The following air pollutants are covered: nitrogen monoxide (NO), nitrogen dioxide (NO2), sulphur dioxide (SO2), carbon monoxide (CO), ozone (O3), ammonia, formaldehyde, benzene, toluene, xylene, and methane. The main instrument performance characteristics against which OPAMs will be assessed by a combination of laboratory and field testing are response time; laboratory repeatability standard deviation, detection limit; zero and span drift; linear fit; cross-sensitivity to interfering substances; influence of surrounding air temperature and pressure; effect of supply voltage variations; susceptibility to physical disturbances (where required); assessment of maximum path length for equivalence with a point analyser (based on the existing comparative studies); effect of calibration cell length on path length-pollutant concentration product; effect of light level change due to lamp intensity on measurement result; effect of light level change due to transmitter-receiver misalignment on measurement result; field repeatability; long-term zero and span drift; and availability (maintenance interval).
http://www.s-t-a.org/Files%20Public%20Area/MCERTS%20EA%20docs/CAMS/aqstandards2004_v1_643973.pdf

Portable AOTF Raman Integrated Tunable Sensor (RAMiTS) for Chemical and Biosensing
Chen, K., M.E. Martin, and Tuan Vo-Dinh, Oak Ridge National Lab..
Advanced Environmental, Chemical, and Biological Sensing Technologies III.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5993, p 23-30, Nov 2005

A compact, self-contained, and portable Raman Integrated Tunable Sensor (RAMiTS) for chemical and biosensing consists of a frequency-stabilized diode laser for excitation, an acousto-optic tunable filter (AOTF) for wavelength discrimination, and an avalanche photodiode (APD) for detection. It can provide direct identification and quantitative analysis of chemical and biological samples in a few seconds under field conditions. Instrument control and data acquisition is coordinated by software developed at Oak Ridge National Lab using the C language. The high spectral resolution of this instrument was demonstrated by the discrimination of several structurally similar molecules--benzene, toluene, naphthalene, and isomers of xylene.

A Practical Examination of the Use of Geostatistics in the Remediation of a Site with a Complex Metal Contamination History
Glavin, R. and P. Hooda, Kingston Univ., Kingston-upon-Thames Surrey, UK.
Soil and Sediment Contamination, Vol 14 No 1, p 155-169, 2005

Geostatistical techniques were used to delineate the spatial distribution of heavy metals across a contaminated site for the pupose of targeting the remediation strategies. The geostatistical analysis of data for the presence of As, Sb, Hg, Pb, Cd and Cu in samples taken at three depths in 50 sample locations enabled the identification of contamination hotspots and trends. Though it has been demonstrated that kriging has the potential to map the spatial distribution of contaminants, the possibility of an undetected hotspot remains, even when probabilistic modelling and a secondary phase of validation sampling are used. This possibility, plus the large number of samples required, may preclude the commercial use of geostatistics in the remediation of contaminated land.

A Preliminary Assessment Tool for Use of In Situ Thermal Technologies at DNAPL-Impacted Sites
Johnson, P.C., P. Dahlen, and J.T. Kingston (Arizona State Univ.); B. Alleman and S, Yoon (Battelle); J. Saenz (U.S. Navy).
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-59, 2005

The objective of this project is to develop a tool that can be used by practitioners, regulators, and site owners to anticipate the likely performance of thermal-based technologies at their sites. It will tie together results from an empirical analysis of field data, field sampling at target sites, and considerations from idealized scenario-based modeling. Data collection on in situ thermal remediation sites has identified 93 sites, plus two sites scheduled to begin in situ thermal treatments within the next year. There are 30 electrical resistance heating, 33 steam injection, 15 conductive heating, 9 radio-frequency and microwave, 2 hot air injection, and 4 combination/other/unknown sites. The amount of data collected for each of these sites varies, ranging from no documentation to sufficient data at 9 of the sites to perform a full technology performance assessment and to calculate pre- and post-treatment contaminant fluxes from the source zone. Data collection is ongoing. The vision of the final product is a document in which performance experience and theoretical bounds on performance expectations are linked to a small number of generalized scenario site descriptors. The user will choose the generalized scenario that most closely resembles their site and then go to a table where they can quickly assess: (a) how the technology has been applied to date in that type of setting, (b) the designs employed, (c) the operating conditions, (d) the performance monitoring that results are based on, (e) the performance observed, (f) indicators of success at other sites, and (f) reasonable bounds on expected performance.

A Probabilistic Screening Model for Evaluating Pyrethroid Surface Water Monitoring Data
Spurlock, F. (California Dept. of Pesticide Regulation), J. Bacey, K. Starner, and S. Gill.
Environmental Monitoring and Assessment, Vol 109 Nos 1-3, p 161-179, Oct 2005

Filtration of pyrethroids is avoided during sample workup because these pesticides are extremely hydrophobic, tending to sorb to most surfaces. The resultant analytical pyrethroid concentrations reflect both dissolved pyrethroid and pyrethroid associated with suspended sediment in the water column. A simple probabilistic model has been developed to allow a screening-level assessment of pyrethroid whole-water monitoring data. Model refinement will depend on future work that more firmly establishes the relationship between pyrethroid partitioning and bioavailability, and addresses the potential influence of dissolved organic carbon on pyrethroid sorption and bioavailability.

Probing Arctic Sediment Constituents for Their Ability to Promote the Degradation of Persistent Organic Pollutants
Dague, H.L. and A.M. Grannas (Villanova Univ., Villanova, PA); D.M. Scully and P.L. Miller (Rose-Hulman Inst. of Technology, Terre Haute, IN).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B33C-1050, 2005

For a study of the ability of Arctic sediment constituents to promote the transformation of persistent organic pollutants (POPs), several sediments were collected from various locations in Toolik, AK, and the reactive sediment constituents were extracted with MilliQ water. The extracts were screened for their ability to promote reduction reactions by spiking with the chemical probe, pentachloronitrobenzene. The target POPs--aldrin, dieldrin, hexachlorobenzene, 2,2',6,6'-tetrachlorobiphenyl, and 3,3',4,5'-tetrachlorobiphenyl--were spiked into the most reactive of the sediment extracts, and their degradation was monitored over several weeks. Selective degradation of persistent organic pollutants was observed in these Alaskan sediments. The researchers found that pentachloronitrobenzene was a useful probe in predicting sediment reductive reactivity.

Probing the Atmosphere with Differential Optical Absorption Spectroscopy.
Ulrich Platt. Institut für Umweltphysik, Universität Heidelberg, INF 229, D-69120 Heidelberg Germany.
The 4th International Symposium on Advanced Environmental Monitoring, 4-6 December 2002, Jeju, Korea.

Differential optical absorption spectroscopy (DOAS) makes use of the strongly structured (fingerprint) absorption of radiation (in particular in the UV and visible spectral ranges) by many atmospheric trace gases. The strength of DOAS lies in the absence of wall losses, excellent specificity, inherent calibration, and the potential for real time measurements and its remote sensing capabilities. The first property makes spectroscopic techniques well suited for the detection of unstable species like free radicals. Today, there are many variants of the DOAS technique in use. A new, extremely important application is satellite-borne DOAS pioneered by the GOME and the recent SCIAMACHY instruments. This application allows observation of global stratospheric and tropospheric trace gas distributions. 8. It also is now possible to determine the photon path-length distribution in clouds by ground-based observation of O2 and O4 bands. This paper addresses new requirements and possibilities for investigating the key processes of atmospheric chemistry in urban environments with DOAS, particular observations of tropospheric trace gases gained from the satellite instruments GOME and SCIAMACHY.

Questions, Myths and Misconceptions About Using Photoionization Detectors
Henderson, R.E., BW Technologies, Calgary, AB, Canada.
International Environmental Technology, Vol 15 No 7, July 2005

Monitoring with photoionization detectors (PIDs) is increasingly viewed as the best choice for measurement of VOCs at exposure limit concentrations. The author refutes 10 common misconceptions about the use of PIDs.
http://www.envirotechpubs.com/pdf/iet/2005/07/iet200507_092.pdf

Raman Spectroscopic Analysis of Cyanogenic Glucosides in Plants: Development of a Flow Injection Surface-Enhanced Raman Scatter (FI-SERS) Method for Determination of Cyanide
Thygesen, L.G. (Royal Veterinary and Agricultural Univ., Frederiksberg, Denmark); K. Jorgensen; B.L. Moller; S.B. Engelsen.
Applied Spectroscopy, Vol 58 No 2, p 212-217, Feb 2004

In a study of cyanogenic glucosides using Raman spectroscopy, surface-enhanced Raman spectroscopy (SERS) was demonstrated to be a sensitive method that enabled determination of the cyanogenic potential of plant tissue. The SERS method was optimized by flow injection (FI) using a colloidal gold dispersion as effluent. Potential problems and pitfalls of the method are discussed.

Real-Time Analysis of Water by Membrane Introduction/Laser Ionization Time-of-Flight Mass Spectrometry
Oser, H. (SRI, Menlo Park, CA); A. Irwin (Amherst College, Amherst, MA); C. Mullen and M.J. Coggiola (SRI).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H11C-1279, 2005

Two-photon resonance enhanced multiphoton ionization (REMPI) provides a unique ionization method for mass spectrometry with high sensitivity and selectivity. This method has been used successfully for monitoring combustion processes, automotive exhaust, and the formation chemistry of polychlorinated dioxins and furans in waste incineration. Because REMPI is a gas-phase method, it has been applied to gas-phase systems or combined with laser desorption and subsequent laser ionization. Recently, a combination of MIMS and REMPI with time-of flight mass spectrometry (ToF MS) has been developed for the direct analysis of water samples. The application of ToF MS provides high transmission, robustness, and the ability to record a mass spectrum per each laser shot. The authors describe research undertaken to achieve the detection of trace amounts of aromatic contaminants (particularly BTEX) in aqueous solutions without interference or clogging of the inlet. MIMS allows the simultaneous introduction of all analytes into the mass spectrometer, which results in a rapid analytical method, suitable for on-line applications. In contrast to conventional ionization method (e.g., electron impact ionization) applications, the laser photoionization method, which generally can be adjusted not to photofragment the compounds, allows identification from the parent ion masses only. It offers the advantages both of sensitive, rapid analysis without prior separation or preparation process, and of parent ion mass identification without deconvolution of multiple mass peaks.

Real-Time Measurement of Radionuclides in Soil: Technology and Case Studies
Interstate Technology and Regulatory Council (ITRC) Radionuclides Team.
Report No: RAD-4, 177 pp, Feb 2006

Real-time measurement systems allow radionuclides in both surface and subsurface soil to be measured more rapidly than they can be with traditional sampling approaches. The basic technologies for these real-time systems are two different types of solid-crystal gamma detectors: sodium iodide and germanium. Understanding the advantages and limitations of each is an important consideration when planning a real-time survey. When these instruments are combined with new location technologies, the ability of real-time measurement systems to present data in

an immediately useful format is greatly enhanced. Some of the new positioning technologies provide accuracy down to a sub-centimeter level and can allow for 3-D location control during excavation. The detectors and location devices have been mounted on various platforms to make data acquisition convenient to the specific needs at different sites. These platforms range from hand-pushed carts to tractors to excavators and even to direct-push samplers for characterizing subsurface soils. Two different but complementary tools, the Triad approach and Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), provide these methodologies and frameworks. Triad is an approach to data collection and decision-making that rests on three legs: systematic planning, dynamic work plans and real time measurement. MARSSIM provides detailed guidance on planning, implementing, and evaluating environmental and facility radiological surveys. These surveys are specific to radiological contamination and are aimed at demonstrating compliance with regulations during the final status survey after remediation has been completed. Both MARSSIM and Triad address the management of uncertainty in the decision-making process. Real-time radiological data collection techniques have now been used at several sites so that the collected experiences can be evaluated for future users. Case studies document the applications of the detectors on various platforms, on various terrains, measuring different contaminants in combination with dynamic work plans. These case studies confirm that cost savings can be realized by utilizing real-time survey methods in characterization, remediation, and verification phases of the cleanup process.
http://www.itrcweb.org/Documents/RAD_4Web.pdf

Real-Time Monitoring of Sediment Concentration at a Lowwater Stream Crossing Using a Unique Sediment Sensor
Zhang, N., Y. Zhang, J. Steichen. D. Oard, P. Woodford, P. Barnes, and S. Hutchinson, Kansas State Univ., Manhattan, KS.
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation No 99, F-101, 2005

Under SERDP project SI-1339, an optical sensor has been developed to measure sediment concentration in streams at low-water crossings. The sensor is different from traditional turbidity sensors in that it is insensitive to non-soil objects, such as algae, organic matter, and various microorganisms, so that the measurement reflects pure sediment concentration. The sensor was designed to measure concentrations of soil sediments with different texture compositions. To reduce the effects of water color on the accuracy of sediment measurement, spectral characteristics of three types of waters--distilled water, lake water, and stream water--were measured using a spectrometer. Based on the spectral analysis, three significant wavelengths were identified. Light Emitting Diodes (LED) with spectral responses peaking near these wavelengths were used in a prototype sensor as the light sources. Four phototransistors were placed at various angles from the incident lights to measure transmitted, scattered, and backscattered lights, respectively. The prototype sensor was tested at combinations of four water types and five soil textures. The experiment was designed to produce three statistically independent data sets, one of which was used to train statistical and neural-network models for predicting soil sediment concentration, while the remaining two sets were used to validate the models. Models developed for individual soil types in all waters provided very accurate sediment concentration measurements with r2 values higher than 0.99, indicating almost complete elimination of the influence of water color on measurement accuracy. When all soil types were combined, the r2 values derived for the training and the two validation data sets were 0.974, 0.951, and 0.958, respectively. Three prototype sensors in water-proof packages were fabricated and placed in the downstream location of a low-water stream crossing at Fort Riley. The sensors were placed at three depths to provide the vertical profile of sediment concentrations during and after storm events with and without vehicle crossing. A solar panel powers the sensors and the data-acquisition/storage equipment.

Relative Accuracy Testing of an X-Ray Fluorescence-Based Mercury Monitor at Coal-Fired Boilers
Hay, K.J. (U.S. Army Engineer Research and Development Center, Champaign, IL); B.E. Johnsen, P.R. Ginochio, and J.A. Cooper (Cooper Environmental Services, Portland, OR).
Journal of the Air & Waste Management Association, Vol 56 No 5, May 2006

The relative accuracy (RA) of a newly developed mercury continuous emissions monitor, based on X-ray fluorescence, was determined by comparing analysis results at coal-fired plants with ASTM Method D6784-02 and EPA Method 29. The monitor had an RA of 25% compared with the ASTM method, though the ASTM method performed poorly because the mercury concentrations were near the detection limit of the reference method. Compared against EPA Reference Method 29, the monitor had an RA of 16% for arsenic and 17% for mercury, meeting RA requirements of EPA Performance Specification 12a. The monitor was successful at measuring total mercury in particulate and vapor forms.

Remediation Process Monitoring of PAH-Contaminated Soils Using Laser-Induced Fluorescence
Kim, Kyoung-Woong and Eun-Joung Ko, Kwangju Inst. of Science and Technology (K-JIST), Korea. The 4th International Symposium on Advanced Environmental Monitoring, 4-6 December 2002, Jeju, Korea.
Environmental Monitoring and Assessment, Vol 92 Nos 1-3, p 179-91, Mar 2004

Most aromatic hydrocarbons are excited in the ultraviolet and visible spectral range, and their high intensities of fluorescence provide an advantage in the detection of contaminants such as polycyclic aromatic hydrocarbon (PAH). The principal components of a proposed laser-induced fluorescence (LIF) system are the pulsed UV laser as the excitation source, a fiber-optic probe, a detection unit for time and spectrally resolved detection of the fluorescence light, and a control and data acquisition unit. The light of a pulsed UV-laser is guided through an optical fiber into the subject soil, and the light excites existing pollutants to fluorescence. The fluorescence light then is guided back though additional fibers to the detection unit. To investigate the feasibility of LIF application into remediation process monitoring for PAH-contaminated soils, the relationship between PAH concentration and LIF intensity was investigated under different matrix condition in terms of moisture content and soil composition. Higher fluorescence intensity was measured with higher sand and moisture content. The reliability of LIF remediation performance monitoring was compared with the result of traditional analysis by high performance liquid chromatography (HPLC) after implementing a surfactant-enhanced electrokinetic process for PAH-contaminated soil.

Remote Monitoring and Analysis of Ground Contaminants with Multi-Sensor Capability
Simmons, Layne and Curt Rideout (TenXsys Inc., Eagle, ID); Molly Gribb (Boise State Univ.)
Partners in Environmental Technology Technical Symposium & Workshop, 29 November - 1 December 2005, Washington, DC: Abstracts. Poster presentation, G-23, 2005

Inexpensive, minimally invasive, real-time instrumentation and sensor systems for detecting and quantifying environmental contaminants are needed for characterizing contaminated sites during remediation and for long-term monitoring at waste sites where remediation is not possible or economically feasible. TenXsys has developed the Adaptive Data Retrieval and Optimized Intelligent Transfer (ADROIT) technology and will combine this technology with ground monitoring sensors to provide remote ground contamination monitoring. ADROIT integrates almost any type of sensor device output, allowing it to be captured, reformatted, transmitted wirelessly/via satellite connectivity, and presented to users using web-based architecture. This allows the data and information to be remotely accessible across a broad range of devices, from desktop PCs to PDAs, and even Web-enabled cell phones. The system can be configured to provide automated alerts to monitoring personnel when specific parameters are exceeded. With Boise State University, TenXsys will couple ADROIT technology with a modified miniature ion mobility spectrometer sensor to develop a monitoring system to detect and quantify volatile organic compounds in subsurface soils. This project will develop a remote, wireless ground contaminant sensing system network that can be integrated with almost any type of sensor device to provide real-time screening level and decision-quality data about the amount and identity of subsurface soil contaminants to a remote monitoring location.

Remote Sensing of Mercury-Contaminated Soils Through Plant Reflection Spectra
Dunagan, S.C., M.S. Gilmore, and J.C. Varekamp, Wesleyan Univ., Middletown, CT.
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B21C-08, 2005

Previous work indicates that Hg can cause chemical and structural changes in plant tissue, including chlorophyll substitution and cell damage, which may alter the reflectance spectra of plants in a measurable way. To test this hypothesis, mustard spinach plants were grown in Hg-spiked soils and in natural Hg-contaminated field soils under controlled laboratory conditions over a full growth cycle. Foliar Hg concentrations of the plants were positively correlated with Hg concentrations of soils. Leaf Hg increased throughout the growth cycle of the Hg-exposed plants until it decreased at the end of the growth cycle. Reflectance spectra of leaves were measured under artificial light in the laboratory. The potential spectral effects of Hg on the plants were quantified with selected vegetation indices (VIs) and compared to foliar Hg concentrations. Correlations between VIs and foliar Hg concentrations are not statistically significant; however, some indices values of plants grown in Hg-spiked and in field-contaminated soils are lower relative to those from the control plants during the early and middle portions of the growth cycle and decrease more rapidly than those from control plants at the end of the growth cycle. These lower values may be related to lower chlorophyll abundances in the Hg-contaminated plants. The timing of the spectral differences suggests that response to seasonal changes should be a critical component for future studies of both in situ and remote detection of foliar Hg content.

Research into the Variables Affecting Purge and Trap Collection for a Portable Field Trihalomethane Testing Unit
Irwin, A.N., C.D. Mowry, and T.T. Borek III, Sandia National Labs, Albuquerque, NM.
SAND2006-2447, 32 pp, Apr 2006

Trihalomethanes are a group of chemicals formed when chlorine reacts with naturally occurring organic matter and bromide. EPA's recently published the Stage 1 Disinfectants/ Disinfectation Byproducts Rule regulates total trihalomethanes at a maximum allowable annual average level of 80 parts per million. Current methods for trihalomethane testing are costly and slow. Sandia National Laboratories has developed a cost-effective portable testing unit to detect volatile organic compounds via purge and trap, gas chromatography, and surface acoustic wave detection. The research discussed in this report investigates some of the variables unique to a portable testing device. Three things have been determined. First, environmental air can be used as a substitute for helium as a purging gas. Second, the majority of THM removal occurs during the first five minutes of purging. Third, a metal reservoir can be used as a substitute for glass.
http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/2006/062447.pdf

Review of Sensor Technologies Used in Portable Gas Monitors
Kramer, Herman and Kay Mangieri, Industrial Scientific Corporation, Breda, The Netherlands.
International Environmental Technology, Vol 16 No 3, May 2006

The sensors in any gas monitor are the heart of the instrument, and the foundation of gas detection. This summary of gas sensing technologies is not exhaustive, but is presented for comparative purposes. Some of the technology platforms date back fifty years, but research and development efforts continually challenge and improve the performance of sensors used for gas detection.
http://www.envirotechpubs.com/pdf/iet/2006/05/iet200605_014.pdf

Sampling Studies at an Air Force Live-Fire Bombing Range Impact Area
Jenkins, T.F., A.D. Hewitt, C.A. Ramsey, K.L. Bjella, S.R. Bigl, and D.J. Lambert, Engineering Research and Development Center, Hanover NH.
Report No: ERDC/CRREL-TR-06-2, NTIS: ADA444642, 56 pp, Feb 2006
Field sampling experiments were conducted at an Air Force live-fire bombing range. The main objective was to assess the effectiveness of using a systematic/random, multi-increment sampling strategy for the collection of representative surface soil samples in areas where bombing practice is conducted with bombs containing high explosives. Replicate surface soil samples were collected within several craters and in different sized grids (1 m x 1 m, 10 m x 10 m, and 100 m x 100 m). One area sampled had been impacted by a low-order 2,000-lb bomb detonation, and several hundred small chunks of tritonal were present on the surface. Another area sampled had many fewer recognizable chunks of tritonal on the surface. An arroyo located downslope of the area of this live-fire range was heavily impacted where runoff from the area would be captured, and it was also sampled at several locations. TNT was the major energetic compound present within the live-fire bombing area. Short-range heterogeneity in TNT concentrations was very large and the ability to estimate mean concentration using discrete samples even for an area as small as 1 m squared was poor. Much more reproducible estimates of mean concentrations for areas as large as 100 m x 100 m were achieved using multi-increment samples collected with a

stratified systematic/random sampling design compared with that achieved using discrete samples. Results from soil profile samples and samples from the arroyo draining this area indicate that the energetic compounds present at the bombing range are not migrating from the site. Another area sampled was a small demolition range where C4 explosive is used to ensure that practice bombs contain no residual explosive prior to removing scrap metal from the range. RDX and HMX were the energetic compounds detected at the highest concentration in surface soil at the demolition range. These compounds originated from the demolition explosive.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA444642&Location=U2&doc=GetTRDoc.pdf

A Sensor Management Architecture Concept for Monitoring Emissions from Open-Air Demil Operations
Horn, B.A., J. Lipkin, J. Robinson, G. Folk, M. Johnson, and M.C. Stoddard, Sandia National Lab, Livermore, CA.
Report No: SAND2005-2353, 158 pp, Sep 2005

Sandia National Laboratories proposed a sensor concept to detect emissions from open-burning/open-detonation (OB/OD) events. The system would serve two purposes: (1) provide data to demilitarization operations about process efficiency, allowing process optimization for cleaner emissions and higher efficiency, and (2) provide data to regulators and neighboring communities about materials dispersing into the environment by OB/OD operations. The proposed sensor system uses instrument control hardware and data visualization software developed at Sandia National Laboratories to link together an array of sensors to monitor emissions from OB/OD events. The suite of sensors would consist of various physical and chemical detectors mounted on stationary or mobile platforms. The individual sensors would be wirelessly linked to one another and controlled through a central command center. Real-time data collection from the sensors, combined with integrated visualization of the data at the command center, would allow for feedback to the sensors to alter operational conditions to adjust for changing needs (i.e., moving plume position, increased spatial resolution, increased sensitivity). This report presents a systems study of the problem of implementing a sensor system for monitoring OB/OD emissions. The goal of this study is to gain a fuller understanding of the political, economic, and technical issues for developing and fielding this technology. [Note: this report may require several minutes to load, even with a fast line.]
http://www.osti.gov/bridge/product.biblio.jsp?query_id=3&page=0&osti_id=875618

A Simple Method to Vertically Stabilize Line-Suspended, Lightweight Percussion Coring Equipment
Mazzucchi, David, Univ. of Victoria, P.O. Box 3055, Victoria, BC, V8W 3P6, Canada.
Journal of Paleolimnology, Vol 34 No 2, p 281-282, Aug 2005

Non-stretching lines are often required to facilitate core sampling in hundreds of meters of water. These lines are usually negatively buoyant, which makes it difficult to keep the lightweight core assemblies upright while lowering them through the water column. The addition of urethane closed-cell foam to the core head creates buoyancy that vertically stabilizes the coring assembly within the water column and prevents the core barrel from contacting the sediment/water interface non-vertically.

Site Characterization and Performance Evaluation of In Situ DNAPL Remediation Technologies at Launch Complex 34, Cape Canaveral Air Force Station
Yoon, S. and A.R. Gavaskar (Battelle, Columbus, OH); L.L. Gray (Florida State Univ., Tallahassee, FL); J.W. Quinn (NASA, Kennedy Space Center, FL).
Prague 2003: Sixth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe and the Commonwealth of Independent States, 1-4 September 2003, Prague, Czech Republic. Abstracts, No 200, p 135, 2003

Three in situ dense nonaqueous phase liquid (DNAPL) treatment technologies were demonstrated to remediate a DNAPL-contaminated source zone at Launch Complex 34, Cape Canaveral Air Force Station, FL. The site is contaminated with chlorinated solvents, including trichloroethene (TCE), which was used to clean rocket parts. Because of the complex nature of DNAPL characteristics, innovative performance evaluation methods were employed for three independent demonstrations of in situ chemical oxidation (ISCO), electric resistive heating, and steam injection/extraction. Technology evaluations included the selection of soil coring locations determined by unaligned systematic sampling design, and the mass estimation for total TCE and DNAPL based on the TCE analyses of the continuous soil cores. To evaluate the efficiency of each treatment technology, the TCE-DNAPL reduction was estimated by geostatistical kriging analysis as well as by contouring of the TCE distribution. Other evaluation details included the changes in aquifer quality, fate and transport of TCE-DNAPL due to the treatment, and the operating requirements and costs associated with each technology.

Stable and Other Isotope Techniques for Perchlorate Source Identification
Motzer, W. (Todd Engineers, Emeryville, CA); T. Mohr (Santa Clara Valley Water District, San Jose, CA); S. McCraven and P. Stanin (Todd Engineers).
Environmental Forensics, Vol 7 No 1, p 89-100, Mar 2006

The authors discuss the use of stable isotopes of chlorine, oxygen, nitrogen, strontium, and hydrogen as forensic indicators to fingerprint and possibly differentiate perchlorate plumes. Direct analytical methods involve isotope ratio mass spectrometry (IRMS) of deltaCl-37 and deltaO-18, which comprise the perchlorate anion. Indirect analytical methods involve the stable isotopic analysis of substances associated with perchlorate that can be used as surrogates. Stable isotopes of deltaO-18 and deltaH-2 in water can be used to differentiate different groundwater sources.

Standoff Gas Leak Detectors Based on Tunable Diode Laser Absorption Spectroscopy
Frish, M.B., R.T. Wainner, B.D. Green, M.C. Laderer, and M.G. Allen.
Infrared to Terahertz Technologies for Health and the Environment.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 6010, p. 86-94, Nov 2005

The authors report on the Remote Methane Leak Detector (RMLD), a handheld, standoff tunable diode laser absorption spectroscopy (TDLAS) leak survey tool. The RMLD uses a 10 mW 1.6 micron DFB laser to illuminate a non-cooperative topographic surface up to 30 m distant, and analyzes returned scattered light to deduce the presence of excess methane. The eye-safe, battery-powered, 6-pound handheld RMLD enhances walking pipeline survey rates by more than 30%. When combined with a spinning or rastering mirror, the RMLD serves as a platform for mobile leak mapping systems. The RMLD standoff range is being extended to 3,000 m by adding an EDFA to the laser transmitter to enable high-altitude surveying and provide aerial disaster response.

Standoff Raman Spectroscopy System for Remote Chemical Detection
Cull, E.C., M.E. Gehm, B.D. Guenther, and D.J. Brady.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 119-126, Nov 2005

A class of aperture coding schemes for remote raman spectrometers (RRS) has been developed that removes the traditional trade-off between throughput and spectral resolution such that the size of the remote interrogation region can be driven by operational, rather than optical, considerations. The authors present the design of the coded-aperture standoff spectroscopy system and experimental data collected while making remote measurements.

State-of-the-Art Geoenvironmental Site Characterization: A Case Study of Pb Speciation Versus Release in Army Firing Range Soils and Its Implications on Remediation and Maintenance Options
Dermatas, Dimitris, Stevens Inst. of Technology
Arsenic Geoenvironment Laboratory Seminar, 1 November 2005, Gwangju Institute of Science and Technology (GIST). Arsenic Geoenvironment Laboratory (NRL) Newsletter, No 8, p 2, Summer/Fall 2005

A comprehensive geoenvironmental site characterization approach was applied to assess Pb speciation in four firing range soils with significantly different Pb leaching and soil characteristics. Soil gradation tests and other standard geotechnical analyses were complemented by total chemical analyses, X-ray powder diffraction (XRPD), Rietveld quantification, and occasionally optical microscopy and scanning electron microscopy/energy dispersive spectroscopy (SEM/EDS) analyses to comprehensively validate and interpret Pb speciation and leaching behavior by the TCLP and sequential extraction test (SET) methods. The Pb leaching ratio (TCLP/total) was found to be controlled by soil mineralogy and its response to changes in system pH. Modeling with the Visual Minteq geochemical model was performed to predict and compare the Pb leaching from each individual site. The model's predicted values were in good agreement with Pb TCLP leaching data in the absence of significant soil fines content. For soils with a finer texture, accurate model-based predictions were achieved only when Pb speciation effects were correctly accounted for. Interpretation of SET leaching behavior alone was more problematic as the sequential leaching and pH lump Pb extraction into predetermined phase categories that may not be truly representative of the actual soil mineralogy or dominant forms of Pb in the soil. Consequently, both TCLP and SET leaching procedures must be augmented with several soil and mineralogical investigative tools, as well as geochemical models to properly ascertain Pb mobility in firing range soils. By combining the results of model prediction, SET test, and XRPD studies, the role of soil characteristics (grain size and soil mineralogy) on Pb leachability was effectively elucidated.
http://env1.gist.ac.kr/~soillab/file/newsletter_08.pdf

A Structural Approach to Performance Monitoring of Waste Sites: Obtaining Actionable Information

Mattson, E.D., R. Versteeg, M. Ankeny, and A. Richardson, Idaho National Lab, Idaho Falls, ID.
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H42B-01, 2005

The long-term monitoring of waste sites and landfills should provide actionable information on how these sites are evolving, including (but not limited to) information on the success of active or passive remedial treatment methods, compliance with regulatory standards, and evolution of system behavior associated with these sites. Idaho National Laboratory has developed a structural approach to performance monitoring that integrates data collection, data management, information extraction, and information use. This approach has transparent, reproducible procedures for translation of data to information (including coupling of data to models) and a Web-based interface to the monitoring system that provides easy access to data and results by multiple stakeholders. The authors discuss the implementation of the INL long-term monitoring system at an EPA superfund site and several landfill sites.

Structurally Integrated Organic Light-Emitting Device (OLED)-Based Sensors for Industrial and Environmental Security: Sensors For Hydrazine and Anthrax

Zhou, Z., R. Shinar, B. Choudhury, L.B. Tabatabai, C. Liao, and J. Shinar, Iowa State Univ.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 100-108, Nov 2005

A photoluminescent sensor is described for the detection of an industrial pollutant, hydrazine, and for the detection of the enzyme (lethal factor) of the anthrax bacillus. The hydrazine sensor is based on the luminescent product of the reaction of hydrazine with an anthracene derivative. The anthrax sensor is based on the luminescence produced after cleavage of a labeled peptide substrate for the lethal factor enzyme.

Synthetic and Field Based Electrical Tomography of a Permeable Reactive Barrier: Implications for Monitoring Barrier Performance

Slater, L.D. (Rutgers Univ., Newark, NJ); A. Binley (Lancaster Univ., UK); Y. Wu (Rutgers).
Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract H43J-06, 2005

Complex resistivity measurements on laboratory cores from an operational PRB defined the electrical properties of both unreacted and geochemically altered (reacted) iron, as well as the growth rate of the reacted front on the upgradient edge of the barrier. Laboratory results were used to generate models of the electrical structure of the PRB at 0, 15 and 30 years of operation. Synthetic cross-borehole resistivity and induced polarization data were generated and perturbed with errors representative of noise at the site, with results indicating that although the internal structure of inverted images at 15 and 30 years does not accurately reflect the width of the reacted front modeled along the upgradient edge of the barrier, perturbations to the internal structure of the imaged PRB indicate the growth of the reacted front. Cross-borehole electrical data obtained at the field site over a 15-month period suggest that the complex resistivity algorithm can reliably resolve the PRB target. Changes in the electrical properties of the PRB over time were small, but consistent with growth of a reacted front based on the synthetic study.

Techniques for Assessing the Performance of In Situ Bioreduction and Immobilization of Metals and Radionuclides in Contaminated Subsurface Environments

Watson, D.B. and P.M. Jardine, Oak Ridge National Laboratory, Oak Ridge, TN.

Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H42B-04, 2005

DOE researchers have been investigating the possibility of using subsurface microorganisms to convert redox sensitive toxic metals and radionuclides (e.g. Cr, U, Tc, Co) into less soluble, less mobile forms. Much of the research is motivated by the likelihood that subsurface metal-reducing bacteria can be stimulated to alter the redox state of metals and radionuclides such that they are immobilized in situ for long time periods. Because subsurface media and waste constituents are complex, with competing electron acceptors and hydrogeological conditions, biostimulation to achieve contaminant immobilization is a challenge. Performance assessment of in situ biostimulation strategies is also difficult and typically requires detailed monitoring of coupled hydrological, geochemical/geophysical, and microbial processes. The authors discuss contaminant fate and transport problems in humid regimes, efforts to immobilize metals and radionuclides in situ via bioremediation, and state-of-the-art techniques for assessing the performance of in situ bioreduction and immobilization of metals and radionuclides. These techniques include in situ solution and solid-phase monitoring, in situ and laboratory microbial community analysis, noninvasive geophysical methods, and solid-phase speciation via high-resolution spectroscopy.

Technology Opportunity 2004-019: Water Contaminant Sensor for Monitoring PAHs, BTEX, PCBs and Heavy Metals

Technology Opportunity Bulletin, Feb 2006

Queen's University researchers in collaboration with Avensys Inc. have developed a novel optical sensor array suited to applications in environmental monitoring. The combination of chemically selective coatings with fiber-optic sensors will result in a monitoring system that is robust, cheap, and fast. The sensor head is a 20mm fiber-optic refractive index sensor. The technology combines fiber-optic data transmission with a long-period grating (LPG). Acting as an optical filter for some wavelengths of the transmitted light, the LPG will redirect light at these wavelengths from the core of the fiber to the cladding. Light in the cladding is not efficiently contained, and is quickly lost. The amount and wavelengths of the light lost is affected by the refractive index of the medium immediately outside the cladding, which may be water, a polymer jacket, or a sensitized material. If the refractive index of this medium is very different from the refractive index of the fiber-optic material, the wavelengths of the filtered light are unchanged, but if a contaminant is accumulated outside the cladding and thereby increases the refractive index, light at different wavelengths is lost. This principle allows the LPG to be used as a chemical sensor for water contaminants. The advantage of this detection method is that all contaminants increase the refractive index of water, and so a universal detector is possible. The device is ideally suited to continuous monitoring of sites--landfills, industrial plants, mines--contaminated with a mix of organic and inorganic pollutants, including PAHs, PCBs, mercury, copper, chromium, and lead. Though this technique will not permit the differentiation between very closely related contaminants, such as toluene and benzene, it will act as an early warning system, informing users that a contaminant of a certain class has been detected, and thus prompting more detailed examination. Several prototypes have been developed and proof-of-

concept testing has been done. The research group is seeking additional development partners and funds to advance the project to market readiness. Material cost for this sensitive and portable device is less than $500. A telemetry system can be coupled to the device for remote detection. Contact: Anne Vivian-Scott, avivianscott@parteqinnovations.com, 613-533-2342, about Tech ID 2004-019, U.S. Patent 6,842,548.
http://www.parteqinnovations.com/iandi-watersensor.html

Technology Overview of Passive Sampler Technologies
Interstate Technology and Regulatory Council (ITRC) Diffusion Sampler Team.
Report No: DSP-4, 115 pp, Mar 2006

The authors define a passive sampler as one that is able to acquire a sample from a discrete location without the active media transport induced by pumping or purge techniques. All of these passive technologies rely on the sampling device being exposed to media in ambient equilibrium during the sampler deployment period. For example, in wells, the well water is expected to be in natural exchange with the formation water. All of the devices provide a sample from a specific location (i.e., point samples). Spatial integration, if any, is a result of natural ambient flow of the sampled medium. While the initial focus was on passive sampling of ground-water monitoring wells, many of the technologies are applicable to surface water and/or vapor as well. Although not a comprehensive overview of all passive sampling technologies, it is of interest to those concerned with the development and use of passive sampling devices. This document presents technical overviews of 12 passive sampling technologies: HydraSleeve(TM), Snap(TM), regenerated-cellulose dialysis membranes, nylon-screen passive diffusion samplers (NSPDS), passive vapor diffusion samplers (PVDs), peepers, polyethylene diffusion bags (PDBs), rigid porous polyethylene samplers (RPPS), semi-permeable membrane devices (SPMDs), GORE(TM) Sorber Modules, polar organic chemical integrative samplers (POCIS), and passive in situ concentration extraction samplers (PISCES). It describes each technology's basis of operation, intended applications, advantages, limitations, and development status. A summary table highlighting the important attributes of each technology, including appropriate analytes, availability, and cost information, follows the 12 individual text descriptions. Contacts for additional information are provided.
http://www.itrcweb.org/Documents/DSP_4.pdf

Testing an Integrated Ground-Water Monitoring Strategy for Nuclear Waste and Decommissioning Sites
Price, V., Z. Dai, D. Heffner, and T.J. Temples (Advanced Environmental Solutions, LLC, Lexington, SC); T.J. Nicholson (U.S. Nuclear Regulatory Commission, Rockville, MD).
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H43C-03, 2005

The Nuclear Regulatory Commission has sponsored research designed to develop an integrated and systematic strategy for monitoring ground-water flow and transport through the unsaturated zone to the underlying water-table aquifer at waste disposal sites. The goal is to provide scientifically-based guidance for monitoring across a wide range of geologic settings, waste compositions, and site designs. The strategy will couple performance confirmation monitoring to site characterization and performance assessment, and will consist of an ordered and logical sequence of procedures. The strategy will focus on identifying and monitoring critical performance indicators (e.g., water contents over time in the unsaturated zone, and ground-water potentials in the saturated zone) of the hydrologic system, and it will demonstrate the connection between performance indicators and site performance. The monitoring strategy has been developed in draft form, and the testing phase of this work is beginning. This paper lays out the strategy and test plan.

Trends in Remote Spectroscopic Sensing and Imaging: Experimental Techniques and Chemometric Concepts
Vogt, Frank, Univ. of Tennessee, Knoxville.
Current Analytical Chemistry, Vol 2 No 2, p 107-127, Apr 2006

Optical spectroscopy is a powerful method because active and passive sensing is feasible over large distances using techniques like light detection and ranging (lidar), differential optical absorption spectroscopy (DOAS), open-path FTIR spectroscopy, and chemical imaging. These sophisticated techniques need innovative statistical data evaluation (chemometric) techniques for reliable sensor calibration and data analyses. All spectroscopic open-path techniques are inherently hampered by unpredictable and changing measurement conditions, as well as by incomplete chemical knowledge during calibration. This paper presents new methods that calibrate models and prevent artifacts from affecting the quantification of pollutants. Although these techniques enable multicomponent analyses at unprecedented spatial and temporal resolution, spectroscopic imaging produces enormous data sets that pose challenges in data storage and evaluation. Recent data compression algorithms are discussed that utilize multidimensional wavelet transformations for shrinking data sets prior to chemometric evaluation and archiving.

Tubular Potentiometric Detector Used to Determine As(V) in Sediment Extracts by Flow Injection
Barrado, E. and J.A. Rodriguez (Univ. de Valladolid, Valladolid, Spain); M.B. Quinaz and J.L.F.C. Lima (REQUIMTE/Univ. do Porto, Porto, Portugal).
International Journal of Environmental and Analytical Chemistry, Vol 86 No 8, p 563-572, 15 July 2006

A tubular potentiometric detector sensitive to As(V) ions is composed of a FeOOH-SiO2-graphite composite agglutinated with an epoxy resin. For As(V) ions, the sensor is used as the selective electrode in an FIA system along with a commercial Ag/AgCl reference electrode. In optimal conditions, the practical limit of detection is 4×10(-6) mol/L at a sampling rate of 40/h. The construction of this device is detailed and accompanied by an evaluation of performance when it was applied to estimate As(V) levels in sediments of a drinking water distributor in an area known to be polluted with arsenic.

Tunable Thin Film Filters for Low Cost Optical Sensors from 0.8 - 10 um
Domash, Lawrence, Aegis Semiconductor Inc., Woburn, MA.
Chemical and Biological Sensors for Industrial and Environmental Security.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5994, p 161-168, Nov 2005

The use of tunable thin films based on thermo-optic effects in amorphous semiconductors has been extended to longer wavelengths in the mid-infrared to produce a new family of gas and chemical sensors based on narrowband, micro-tunable, mid-infrared emitters. A prototype Firefly(TM) emitter designed for detection of carbon dioxide using the 4.2 µm absorption band has been constructed and demonstrated. The emitter, packaged in a TO5 can, consists of a high speed blackbody membrane, a micro-tunable membrane filter, and a blocking filter. The emitter produces about 1 mW of IR output in a bandwidth of approximately 50 nm, and the wavelength can be modulated from 4150 to 4300 nm at a frequency of about 10 Hz. A CO2 sensor is completed simply by adding a detector.
http://newsroom.spie.org/x3113.xml

Use of Borehole Radar Methods and Borehole Geophysical Logs to Monitor a Field-Scale Vegetable Oil Biostimulation Pilot Project at Fridley, Minnesota
Lane, J.W. (USGS, Storrs, CT); C.C. Casey (U.S. Navy, Charleston, SC); F.D. Day-Lewis (USGS, Storrs); A. Witten (Univ. of Oklahoma, Norman); R.J. Versteeg (INEEL).
Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, 24-27 May 2004, Monterey, California.
Battelle Press, CD-ROM, 9 pp, 2005

Cross-hole and surface-to-borehole radar and conventional borehole geophysical logs were used to monitor subsurface injections of vegetable oil emulsion conducted as part of a field-scale biostimulation pilot project at the Anoka County Riverfront Park (ACP), located downgradient of the Naval Industrial Reserve Ordnance Plant (NIROP), in Fridley, MN. The pilot project was undertaken to evaluate biostimulation using emulsified vegetable oil for treatment of groundwater contaminated with chlorinated hydrocarbons. The objectives of the geophysical investigations were to delineate the distribution of vegetable oil injected at NIROP and to evaluate the utility of adding geophysical tracers to the vegetable oil emulsions. Geophysical data were acquired by USGS in five site visits over 1.5 years. This paper presents (1) level-run radar traveltime and amplitude data; (2) radar cross-hole traveltime tomograms; (3) vertical-radar profile diffraction tomograms; and (4) borehole electromagnetic induction logs. Based on comparison of pre- and post-injection data sets, a conceptual model was developed to define the distribution of emulsified vegetable oil and the extent of ground water having altered chemistry resulting from injections and, possibly, enhanced microbial degradation of chlorinated hydrocarbons. Radar slowness (reciprocal velocity) anomalies indicate that the emplaced oil emulsion remained close to the injection wells, whereas attenuation anomalies indicate changes in groundwater chemistry downgradient of all three injections.
http://water.usgs.gov/ogw/bgas/publications/Battelle_2004/index.html

Use of Different Methods for Detection of Thermophilic Biosurfactant-Producing Bacteria from Hydrocarbon-Contaminated and Bioremediated Soils
Plaza, G.A. (Inst. for Ecology of Industrial Areas, Katowice, Poland); I. Zjawiony; I.M. Banat.
Journal of Petroleum Science and Engineering, Vol 50 No 1, p 71-77, 16 Jan 2006

Bacterial strains isolated from soils contaminated with petroleum hydrocarbons were screened for biosurfactants/bioemulsifiers production in liquid culture containing crude oil under thermophilic conditions. Blood agar lysis, drop-collapse method, stalagmometric, and oil spreading techniques and surface tension measurements were used to detect biosurfactant production. Blood hemolytic activity did not give clear indicative results for biosurfactant production, whereas the drop-collapse and oil spreading techniques provided quick and easy screening for biosurfactant producers but were not always conclusive. Surface tension reduction was a good measure of biosurfactant production, but it did not correlate well with emulsion ability. Several isolates had good emulsifying abilities with all hydrocarbons tested. The simplicity of the above techniques allows effective screening of biosurfactant-producing microorganisms.

The Use of Direct Push Well Technology for Long-Term Environmental Monitoring in Groundwater Investigations
Interstate Technology and Regulatory Council (ITRC) Sampling, Characterization and Monitoring Team. SCM-2, 177 pp, Mar 2006

This ITRC technical/regulatory guidance document describes direct-push well technology, equipment and installation requirements, known regulatory barriers and concerns, technology advantages and limitations, and health and safety issues. In multiple case studies, it presents comparative data between direct push and conventionally drilled wells used for contaminant detection and water level measurements. The results from short-term and long-term ground-water monitoring studies have shown that samples taken from direct-push wells are comparable in quality to those obtained from conventionally constructed wells. Although Direct Push wells can be extremely cost-efficient, their use for long-term monitoring is prohibited in many states by existing regulations that require a larger annular space than can be obtained with Direct Push methods. This document is intended to provide the information required to make an informed decision regarding the use of direct-push wells for long-term monitoring of ground-water chemistry and static ground-water levels. References for further information are provided to address specific concerns and questions of the reader.
http://www.itrcweb.org/Documents/SCM_2_ForWeb.pdf

The Use of High Resolution Areal and Vertical Sampling at a Wood Pole Storage Yard
Electric Power Research Institute (EPRI), Palo Alto, CA. Technical Brief 113581, 1999

For the transmission and distribution of electric power, electric power utilities use tens of millions of wood poles and crossarms treated with wood preservatives such as pentachlorophenol (PCP) or creosote. While placed on racks or timbers in pole storage yards, the pole elements are exposed to weathering, which can result in the leaching of wood preservatives into the soil. This Tech Brief describes EPRI's use of innovative, high-resolution sampling at a wood pole storage yard at the Ross Complex of the Bonneville Power Administration, where soil contamination resulted when chemicals leached from PCP- and creosote-treated wood poles. The sampling and analysis program conducted at the Ross Complex highlights the fact that high-resolution sampling programs, while more costly than conventional site assessment techniques, can result in a net savings to site owners when decreased remediation costs are taken into account.

Use of SPME Extraction to Determine Organophosphorus Pesticides Adsorption Phenomena in Water and Soil Matrices

Pasquale, C. De (Univ. degli Studi di Palermo, Palermo, Italy); A. Jones; A. Charlton; G. Alonzo.

International Journal of Environmental Analytical Chemistry, Vol 85 No 15, p 1101-1115, 20 Dec 2005

The possible use of solid-phase micro extraction (SPME) for the simultaneous analysis of several organophosphorus (OP) insecticides was investigated. Six commercial certified soils and six OPs--methamidophos, omethoate, dimethoate, parathion methyl, malathion, and parathion ethyl--were investigated using SPME coupled with gas chromatography. Three SPME fibers coated with different stationary phases--polydimethylsiloxane, carbowax-divinylbenzene (CW-DV), and polyacrylate--were examined. The optimized experimental conditions were sample volume 10 ml at 20 degrees C, equilibration time 16 min, pH 5, and presence of 10% w/v sodium chloride. Data obtained using both solid-phase extraction (SP) and SPME were comparable, and the analytical procedure, developed using the CW-DVB fibre, was suitable for the quantitative evaluation of adsorption phenomena of the investigated OPs.

Using a Gel Probe Equilibrium Sampler to Measure Arsenic Mobilization and Sorption Gradients in Haiwee Reservoir Sediments

Campbell, K.M. (California Inst. of Technology, Pasadena); R. Root and P.A. O'Day (Univ. of California, Merced); J.G. Hering (California Inst. of Technology, Pasadena).

Eos Trans. AGU, Vol 86 No 52, Fall Meet. Suppl., Abstract B24B-06, 2005

A gel probe equilibrium sampler was used to measure gradients in porewater concentrations and arsenic sorption chemistry in situ in Haiwee Reservoir sediments. The gels were composed of an inert polyacrylamide matrix (92% water). They were inserted into a ladder-like Plexiglas holder and covered with a membrane filter. The probe was allowed to equilibrate for 24 hours with the sediment porewaters. Two types of gels were deployed simultaneously in the probe: undoped (clear) gels to measure porewater composition and hydrous ferric oxide (HFO)-doped gels to determine arsenic sorption behavior as a function of porewater composition. Upon removal from the sediments, the gels were re-equilibrated in acid, and a suite of metals and metalloids were measured using ICP-MS. Arsenic speciation was also measured in the clear gels using LC-ICP-MS. Using the gel probe in combination with sediment cores, regions of iron reduction, arsenic mobilization, and arsenic sorption were observed and correlated to other metals, such as Sr, Mo, Ba, and W, as well as to organic carbon. The authors observed that sediment porewater composition likely affects arsenic resorption onto the solid phase.

Using Fruit Fly as the Test-System to Detect Soil Pollution by Heavy Metals
Kozeretskaya, I.A. and I.A. Topchij, Shevchenko Univ., Kyiv, Ukraine.
Prague 2003: Sixth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe and the Commonwealth of Independent States, 1-4 September 2003, Prague, Czech Republic. Abstracts. No 26, p 84, 2003

Researchers used aqueous extracts from lead-polluted soil as the affecting factor for fruit flies (Drosophila melanogaster) to examine the effect of the presence of a particular pollutant on fruit fly genes. Tests of sex-linked recessive lethal mutations and the recombination test were applied. The soil aqueous extracts were introduced directly into the milieu for the heterozygous females. For lead salts, at concentrations 20, 100, and 200 times higher than background, a decrease in the recombination frequency was observed between the genes "white" and "cut," which are located in the first chromosome. Further research is necessary to understand the mechanisms of the effects observed and to determine whether fruit flies are appropriate for pollution monitoring in this context.
http://www.prague2003.fsu.edu/content/pdf/026.pdf

Using Geophysics to Locate Elevated Soil Zinc and Natural Organic Matter to Influence Metal Bioavailability
Brosky-Dorsey, R., J. Cull, and A.F. Patti (Australia).
Advanced Technology in the Environmental Field. Acta Press, Calgary, AB, Canada. ISBN: 0-88986-552-3 (paper) or ISBN: 0-88986-554-X 2006 (CD), 2006

Conductivity and chargeability data obtained in the field by time-domain induced polarization (TDIP) were used as a non-invasive means of determining elevated soil zinc concentrations. A comparison of chargeability data with zinc concentration data, obtained by total soil digestion in the laboratory, showed that soil with high chargeability also had elevated soil zinc concentrations (300 to 4,750 mg/kg soil). Glasshouse phytoremediation experiments were conducted on these soils, as well as on lateritic soils with high nickel concentrations (2,250 to 4,000 mg/kg soil), to determine if natural organic amendments increased phytoextraction potential and biomass production of perennial ryegrass. Zinc and nickel were shown to be extracted from the amended soils and accumulated into the aboveground parts of ryegrass in concentrations less than that of unamended control soils because the organic amendments (particularly Colac peat) decreased bioavailability of the metals.

Using Molecular Tools to Monitor a Microbial Consortium Degrading a 12-Chemical Mixture
Hanson, R.E. (Colorado State Univ., Fort Collins); C. Sans (Univ. de Barcelona, Barcelona, Spain); M. Hoelscher, A. Pruden, and K.F. Reardon (Colorado State Univ.).
AGU Hydrology Days 2006, 20 - 22 March, Colorado State University.

Recent developments in molecular biological methods to characterize microbial communities have made it feasible to address the question of whether an aquifer microbial community changes along the length of a contaminant plume. To evaluate these methods, a study was performed in which the dynamics of a microbial community in a well mixed continuous-flow bioreactor were tracked after two perturbations: disruption of wall growth and a change in feed composition. The microbial consortium was grown on a 12-chemical mixture consisting of benzene, toluene, phenol, dimethyl phenol, p-cresol, m-xylene, chlorobenzene, dichlorbenzene, trichlorbenzene, acetone, 2-butanone, and hexanone. A suite of complementary molecular techniques, including cloning and sequencing of 16S rDNA genes, denaturing gradient gel electrophoresis (DGGE), and capillary electrophoresis-single strand conformation polymorphism (CE-SSCP), were used to profile the microbial consortium. DGGE and CE-SSCP were used to track changes in the microbial community profile with respect to time. CE-SSCP was also used in conjunction with cloning and sequencing 16S rDNA to identify dominant members of the community. Additionally, pure cultures were isolated on each of the 12 individual chemicals to link structure and function of the microbial community. Although chemical removal was stable throughout the 12-month monitoring period, the composition of the consortium varied, and the changes were observed to correlate with wall-cleaning events and changes in substrate composition. Based on analysis of DGGE gels, the composition of the consortium that tended to grow on the walls was found to differ from the composition of the suspended growth consortium. These results indicate that the applied methods are capable of revealing changes in the microbial population and could be applied to laboratory and field bioremediation studies.

Using TarGOST(TM) to Delineate the Presence of Coal Tar in Subsurface Soils
Electric Power Research Institute (EPRI), Palo Alto, CA. Report No 1012131, Aug 2005

The Tar Green Specific Optical Screening Tool (TarGOST(TM)) laser-induced fluorescence (LIF) profiling method was applied at the Former Hackensack Gas Works site and adjacent property. EPRI and PSEG SC evaluated the results and effectiveness of the tool to locate coal tar in the subsurface due to the availability of recently collected site characterization information and the need to characterize the presence of coal tar that appeared to have migrated from the site onto an adjacent property. This evaluation was accomplished by advancing the TarGOST(TM) technology at as many boring locations as possible within a 5-day field period to build a robust data set. Selected TarGOST(TM) probe locations were drilled to both visually compare soil conditions and to evaluate soils using the LIF technology. Information gathered during this technology evaluation program also will be used in the evaluation of remedial action objectives for the site. The investigators first used TarGOST to characterize general subsurface conditions at the site and then used TarGOST to delineate the extent of coal tar formerly observed in specific areas of the site and to determine if coal tar exists beyond those points. Conventional DPT was used to collect soil cores for comparison with and evaluation of the effectiveness of TarGOST. When the data were evaluated, the technology was found to be an effective coal tar characterization and delineation tool. TarGOST is useful to site managers in the following applications: characterizing and delineating the extent of coal tar; limited differentiation between separate, unique sources of coal tar within a study area; better geologic characterization when coupled with conventional soil borings; and rapid screening of large areas before collecting confirmatory delineation samples.

Web Based Autonomous Geophysical/Hydrological Monitoring of the Gilt Edge Mine Site: Implementation and Results
Versteeg, R.J. (Idaho National Lab, Idaho Falls, ID); K. Wangerud (U.S. EPA Region 8, Denver, CO); E. Mattson, M. Ankeny, A. Richardson, and G. Heath (INL, Idaho Falls, ID).
Eos Trans. AGU, Vol 86 No 18, Jt. Assem. Suppl., Abstract H43C-01, 2005

The Ruby Gulch repository at the Gilt Edge Mine Superfund site is a capped waste rock repository. EPA and its subcontractor, the Bureau of Reclamation, recognized the need for long-term monitoring system to provide information on the repository behavior. The monitoring system needed to (1) provide information on the integrity of the newly constructed surface cover and diversion system, (2) continually assess the wastes' hydrological and geochemical behavior to support adjustment to the operation of the cover and liner system, (3) provide easy access to information pertaining to system performance to stakeholders, and (4) integrate various data sources to produce information to enhance future cover designs. A long-term monitoring system was designed and implemented to allow EPA to meet these objectives. The long-term monitoring system integrates the data from a set of 522 electrodes resistivity electrodes (462 surface electrodes and 60 borehole electrodes in 4 wells with 15 electrodes each); an outflow meter at the toe of the repository; an autonomous, remotely accessible weather station; and four wells (average depths of 250 feet) with thermocouples, pressure transducers and sampling ports for water and air. Results from this system over a year of monitoring have shown the diurnal variation in rockmass behavior and movement of water through the waste (allowing estimated in-residence time).

Wetland Delineation with IKONOS High-Resolution Satellite Imagery, Fort Custer Training Center, Battle Creek, Michigan, 2005
Fuller, L.M.; T.R. Morgan; S.S. Aichele.
U.S. Geological Survey Scientific Investigations Report 2006-5051, 8 pp, 2006

The National Wetlands Inventory (NWI) data provide a primary wetland-boundary resource, but a check on scale and accuracy of the wetland boundary information for the Fort Custer Training Center (FCTC) was needed. USGS used an early spring IKONOS pan-sharpened satellite image to delineate the wetlands and create a more accurate wetland map for the FCTC. USGS tested automated approaches (supervised and unsupervised classifications) to identify the wetland areas from the IKONOS satellite image, but the automated approaches alone did not yield accurate results. To ensure accurate wetland boundaries, the final wetland map was manually digitized on the basis of the automated supervised and unsupervised classifications, in combination with NWI data, field verifications, and visual interpretation of the IKONOS satellite image. The final wetland areas digitized from the IKONOS satellite imagery were similar to those in NWI; however, the wetland boundaries differed in some areas, a few wetlands mapped on the NWI were determined not to be wetlands from the IKONOS image and field verification, and additional previously unmapped wetlands not recognized by the NWI were identified from the IKONOS image.
http://pubs.usgs.gov/sir/2006/5051/

A Wireless Sensor Network for Long-Term Monitoring of Aquatic Environments: Design and Implementation
Keat G. Ong; Xiping Yang; Niloy Mukherjee; Haidong Wang; Shrawan Surender; Craig A. Grimes
Sensor Letters, Vol 2 No 1, March 2004, p 48-57, Mar 2004

This paper presents a wireless sensor network for monitoring lakes, ponds, drinking water reservoirs, or rivers. The aquatic sensor network consists of an array of submerged nodes distributed throughout the monitoring area. Depending upon the application, each node of the network can be equipped with different types of sensors, enabling measurement of physical, chemical, or biological parameters. Each node contains an acoustic transducer for underwater node-to-node communication, with node communication protocols and sensor data processing overseen by a programmable microcontroller. Network information is collected by an uplink node floating on the water and transmitted via radio waves to a host node on shore, which uploads network data to a computer for display and evaluation.

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Oxford X-Met 3000TX XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-008, 222 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a fixed reference laboratory. The X-Met portable XRF analyzer features a miniature, rugged x-ray tube excitation source for analyzing a wide variety of elements and sample materials, including alloys, environmental solids, and other analytical samples. Other features of the X-Met include multiple x-ray beam filters, multiple calibration methods, and adjustable tube voltages and currents. The analyzer weighs 4.5 pounds and can be powered in the field with a lithium-ion battery or 110-volt alternating current (AC). The X-Met XRF analyzer utilizes a Hewlett-Packard (HP) iPAQ personal data assistant (PDA) for data storage of up to 10,000 tests with spectra in its 64 megabyte memory. The iPAQ has a color, high resolution display with variable backlighting and can be fitted with Bluetooth(R) wireless printing and data downloading, an integrated bar-code reader, and wireless data and file transfer accessories. The X-Met analyzer can analyze elements from potassium to uranium in suites of 25 elements simultaneously. This report describes the results of the evaluation of the X-Met analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the X-Met analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06008/540r06008.pdf

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Rigaku ZSX Mini II XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
Report No: EPA 540-R-06-001, 199 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a fixed reference laboratory. The ZSX Mini II is a "wavelength-dispersive" XRF analyzer that can analyze for elements ranging in mass from fluorine to

uranium. The ZSX Mini II differentiates the x-ray energies emitted from a sample by dispersing the x-rays into different wavelength ranges using crystals. By contrast, more common energy-dispersive XRF analyzers differentiate between x-ray energies based on voltages measured by the detector. For some applications, wavelength-dispersive XRF analyzers can achieve high resolutions and very good sensitivity through the reduction of interelement interferences. Wavelength-dispersive XRFs have historically been large, laboratory-bound instruments with significant requirements for power and cooling. The ZSX Mini II is a smaller, transportable unit that can operate without additional cooling fluids on standard 110-volt circuits. The unit can employ an economical gas proportional counter as a detector rather than a diode detector with a multi-channel analyzer (common in energy-dispersive instruments) because wavelength resolution is achieved with the crystals. This report describes the results of the evaluation of the ZSX Mini II analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the ZSX Mini II analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06001/540r06001.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Innov-X XT400 Series XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
Report No: EPA 540-R-06-002, 208 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument’s results with data generated by a fixed reference laboratory. The Innov-X XT400 portable XRF analyzer features a miniature, rugged x-ray tube excitation source for analyzing a wide variety of elements and sample materials, including alloys, environmental solids, and other analytical samples. The x-ray tube source and Light Element Analysis Program (LEAP) technology analyzes elements that would require three isotope sources in an isotope-based XRF analyzer. Other features of the XT400 include multiple x-ray beam filters, multiple calibration methods, and adjustable tube voltages and currents. The analyzer weighs 4.5 pounds and can be powered in the field with a lithium-ion battery or 110-volt alternating current (AC). The XT400 XRF analyzer utilizes a Hewlett-Packard (HP) iPAQ personal data assistant (PDA) for data storage of up to 10,000 tests with spectra in its 64 megabyte memory. The iPAQ has a color, high resolution display with variable backlighting and can be fitted with Bluetooth(R) wireless printing and data downloading, an integrated bar-code reader, and wireless data and file transfer accessories. The XT400 analyzer can analyze elements from potassium to uranium in suites of 25 elements simultaneously. This report describes the results of the evaluation of the XT400 analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the XT400 analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06002/540r06002.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Niton XLi 700 Series XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-003, 204 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument’s results with data generated by a fixed reference laboratory. The Niton XLi portable analyzer features a choice of either a full suite of traditional isotope (the XLi) or a miniaturized x-ray tube (the XLt which was evaluated in a separate report) for rapid chemical characterization of soils, sediment, and other thick homogeneous samples. The pre-set factory calibration allows simultaneous analysis of up to 25 elements, including all eight RCRA metals, in bulk materials with no requirement for site-specific calibrations or standards. Whether testing is performed in situ (directly onto the ground) or ex situ (bagged or prepared samples), sophisticated software automatically compensates for matrix variations from sample to sample, allowing the operator to simply "point and shoot" any bulk sample without unnecessary data entry or additional calibrations. Niton's XLi 700 Series analyzers are easy to operate, lightweight, ergonomic, and an advanced isotope-based environmental XRF instrument. Niton offers various isotope options to best optimize performance for the environmental application. This report describes the results of the evaluation of the XLi analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the XLi analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06003/540r06003.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Niton XLt 700 Series XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-004, 197 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a fixed reference laboratory. The Niton XLt is a small, field-portable instrument designed for chemical characterization of soils, sediment, and other thick homogeneous samples (plastics and metals). The analyzer features a miniaturized x-ray tube for the excitation source and a Peltier-cooled Si-PiN x-ray detector. The analyzer's standard software is programmed to analyze and automatically report 25 elements. The Niton XLt analyzer is designed to be used as either a hand-held instrument for in situ analysis or as a bench-top instrument, in a test stand with a sample drawer below the instrument, for ex situ analysis. The Niton XLt analyzer can be used to analyze elements under three primary scenarios: (1) bulk

sample mode (includes soils, sediments, and metal alloys); (2) thin film mode (includes dust wipes and filters); and (3) plastics mode. XRF analyses using the Niton XLt analyzer comply with EPA Method 6200, "Field Portable XRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment." This report describes the results of the evaluation of the XLt analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the XLt analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06004/540r06004.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Rontec PicoTAX XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-005, 203 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a fixed reference laboratory. The PicoTAX is a transportable bench-top device that provides quantitative and semi-quantitative multielement microanalysis of soils and sediments using total reflection XRF spectroscopy. The spectrometer includes a 40-watt metal-ceramic x-ray tube excitation source and a thermoelectrically cooled silicon drift (Si Drift) x-ray detector. The PicoTAX is capable of detecting up to 75 elements from aluminum to yttrium and from palladium to uranium. The PicoTAX uses an internal standard for instrument calibration; thus, initial calibration is not required. A solution of internal standard that contains a project-specific element is added to each sample to establish response factors (determined by the software). Element quantitation is determined by comparing the response to the unknown element to the response of the internal standard with a known concentration. A laptop computer is used to monitor and control all aspects of PicoTAX system operation. Rontec's Quantum software, which is loaded into the laptop computer, calibrates the instrument, handles measurement data and methods, controls all hardware functions, and provides statistical functions, reporting functions, and data and spectra export. This report describes the results of the evaluation of the PicoTAX analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the PicoTAX analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06005/540r06005.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Xcalibur ElvaX XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-006, 195 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with

certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a reference fixed laboratory. The ElvaX is a portable bench-top energy-dispersive XRF analyzer. The ElvaX is capable of detecting elements from sodium through plutonium and can be applied in the jewelry, metallurgy, customs, forensics, medical diagnostics, food testing, and environmental testing markets. The ElvaX can be used for qualitative or quantative analysis of metal alloys, liquid food, and biological samples. The ElvaX can analyze liquids and powders as well as samples deposited on surfaces or filters. The ElvaX analyzer system includes two primary components: an XRF spectrometer and a personal computer. The XRF spectrometer contains a 5-watt x-ray tube excitation source with tungsten, titanium, or rhodium as the anode target material and with an adjustable 4- to 50-kilovolt power supply. The detector is a Peltier-cooled, solid-state silicon-PiN diode with 180-electron volt resolution. The XRF spectrometer may be set up in the field but must be in a stable environment. No portable battery systems are currently available for the ElvaX spectrometer. A personal computer (laptop) with Microsoft Windows Millennium Edition(R) software is used to operate the XRF spectrometer and specifically to select x-ray tube parameters, store data, and provide radiation safety. The laptop is also used to display the x-ray spectrum and to process the data. Some examples of data processing steps included automatic peak search, overlapped peak deconvolution, background removal, automatic element identification, and background subtraction. This report describes the results of the evaluation of the ElvaX analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the ElvaX analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06006/540r06006.htm

XRF Technologies for Measuring Trace Elements in Soil and Sediment: Oxford ED2000 XRF Analyzer. Innovative Technology Verification Report
U.S. EPA, Superfund Innovative Technology Evaluation (SITE) Program.
EPA 540-R-06-007, 199 pp, Feb 2006

The field demonstration incorporated the analysis of 326 prepared samples of soil and sediment that contained 13 target elements. The prepared samples included blends of environmental samples from nine different sample collection sites as well as spiked samples with certified element concentrations. Accuracy was assessed by comparing the XRF instrument's results with data generated by a fixed reference laboratory. The Oxford ED2000 bench-top XRF analyzer is an energy dispersive XRF analyzer that can be operated in a mobile laboratory or similar setting. The ED2000 can analyze up to 75 elements in a variety of sample matrices, including contaminated soils and sediments, liquids, powders, granules, filter papers, or films. The measurement of light-end elements (sodium to iron) can be determined when the samples are prepared as pressed pellets. Oxford provides a calibration service as an option to customers for specific projects and applications using this analyzer. This report describes the results of the evaluation of the ED2000 analyzer based on the data obtained during the demonstration. The method detection limits, accuracy, and precision of the instrument for each of the 13 target analytes are presented and discussed. The cost of element analysis using the ED2000 analyzer is compiled and compared to both fixed laboratory costs and average XRF instrument costs.
http://www.epa.gov/ORD/SITE/reports/540r06007/540r06007.htm