Measurement & Monitoring:
31st Quarterly Literature Update & Grant Survey

The references selected for this update have been added to the searchable literature database developed for the Measurement and Monitoring Technologies for the 21st Century (21M^2) Web site: www.clu-in.org/programs/21m2/litsearch.cfm

Accurate Quantitative Determination of Monoaromatic Compounds for the Monitoring of Bioremediation Processes
Farhadian, M., D. Duchez, C. Vachelard, and C. Larroche.
Bioresource Technology, Vol 100 No 1, p 173-178, Jan 2009

The protocol for the sample treatment necessary to removing microbial biomass prior to an analysis is a critical issue for obtaining accurate results when volatile compounds are present. Two phenomena were observed: solute adsorption and stripping in the gas phase in contact with the liquid. The most effective protocol involved centrifugation using poly-tetra-fluoro-ethylene (PTFE) capped tubes completely filled with the liquid suspension, i.e., without any gas phase inside it. This approach allowed a solute loss <1%. The results also indicated that the optimum centrifugation conditions were 10,000 g at 10 degrees C for 10 min. Alternatively, the developed centrifugation technique could be used for the experimental determination of the activity coefficient of solubilized volatile compounds. This study highlighted the fact that polyvinylidene fluoride micro filters (PVDF) and propylene GH polypro membranes (GHP) with a pore size of 0.45 um can be used for biomass separation, despite the presence of 10 to 12% monoaromatic adsorption by membrane. A simple and sensitive method using high performance liquid chromatography with a UV detector set at the optimum point of 208 nm was developed for assessing the concentrations of BTX in samples taken from bioremediation processes. Minimum detection limits of 5, 4, and 10 ug/L were obtained for benzene, toluene, and mixed xylenes, respectively.

Adaptive Long-Term Monitoring at Environmental Restoration Sites
Harre, K., T. Chaundhry, R. Greenwald, W. Jian, C. Davis, M. Zavislak, and B. Minsker.
Environmental Security Technology Certification Program (ESTCP), Project ER-0629, TR-2317-ENV, 419 pp, May 2009

The primary objective of this ESTCP project was to demonstrate and validate the use of the Sampling Optimizer and Data Tracker software (from Summit Envirosolutions) at three DoD sites: former George Air Force Base, Victorville, CA; former Nebraska Ordnance Plant, Mead; Camp Allen Landfill site, Norfolk, VA. MAROS also was applied at one of the three demonstration sites. The Summit Software demonstrated in this ESTCP project provides a set of tools for long-term monitoring optimization (LTMO), and consists of two major modules: (1) the Sampling Optimizer identifies redundant sampling locations (spatial optimization), or redundant locations and frequencies (spatiotemporal optimization), in historical data, and (2) the Data Tracker allows current monitoring data to be reviewed against selected historical data (i.e., background data) to identify cases where current data deviate from expectations based on the background values and patterns. Model Builder is an additional component within the software with two functions: one for model fitting, visualization, and analysis (with kriging or inverse distance weighting); and another for visualizing relative uncertainty. The level of effort and computation time for applying the software at the demonstration sites and a basis for estimating the costs of applying the software at other sites are provided in this report. Individual reports

detailing the application of the Summit Software at the three demonstration sites are presented in appendices. A User's Guide for the software was finalized as part of this project and was submitted to ESTCP as a separate deliverable. The software and User's Guide are now available for use at government sites by government personnel and their contractors.
Report at http://www.estcp.org/Technology/upload/ER-0629-FR.pdf

Advances in On-Site Analytical Approaches for Vapor Intrusion Assessments
Hartman, B. (H&P Mobile Geochemistry); T.S. Bussy (Fort Lewis Environmental Restoration Program).
Joint Services Environmental Management Training Conference & Exposition, 5-8 May 2008, Denver, Colorado. Abstract ID 8181, 2008

Many of the methods currently being used for vapor intrusion assessments, such as indoor air and soil gas sampling, are limited by confounding factors, such as contamination from background sources, lack of control, false positives from sampling equipment, and temporal and spatial variability. Onsite analysis allows real-time recognition of confounding data and the ability to make decisions regarding additional sampling locations while still on site. Mobile air laboratories now exist that can analyze indoor air and soil gas samples by GC/MS methods 8260 and TO-15 on site in real time. New mass spectrometry software allows simultaneous Scan/SIM mode enabling analysis of more than 60 VOCs in Scan mode with low detection limits (<1 ppbv) in SIM mode for a selected list of VOCs. The analysis fulfills all method QA/QC. This capability allows real-time assessment inside houses without all of the intrusive hardware and protocols required for collection in canisters. Comparison data from two DoD sites show on-site analysis of indoor air grab samples matching data from 24-hour integrated samples collected in canisters. Automated analyzers now exist that can sample continuously from up to 15 sample zones at a site and report the data back to an office in real time via the Internet. Sampling zones can consist of soil vapor probes, sub-slab points, indoor air locations, and ambient air to allow simultaneous comparison of soil gas, sub-slab soil gas, and indoor and outside air concentrations continuously around the clock. In a recent study conducted at Vandenberg Air Force Base, soil gas concentrations from TCE in groundwater were measured continuously 24/7 for a period of 6 weeks at 13 sampling points ranging in depth from 3 ft to 17 ft bgs. Over 11,000 analyses were collected by the automated continuous analyzer, resulting in approximately 750 analyses per probe.

Amperometric Biosensors for Real Time Assays of Organophosphates
Pohanka, M., D. Jun, and K. Kuca.
Sensors, Vol 8 No 9, p 5303-5312, 2008

An amperometric biosensor based on acetylcholinesterase (AChE) immobilized in gelatin was used to develop an assay for the organophosphate paraoxon. The more traditional approach of preincubation was used for comparison between measurement procedures, although the aim of the study was to examine the performance of the biosensor for real-time monitoring of organophosphates. The biosensor was immersed in a reaction chamber and paraoxon was injected inside. The sensor was able to detect 200 pg of paraoxon within one minute, or 2.5 ppb when the biosensor was preincubated in the sample solution for 15 minutes. The practical impact of these results and expectations for the biosensor are discussed.
http://www.mdpi.com/1424-8220/8/9

Amperometric Sensor for Detection of Chloride Ions
Trnkova, L., V. Adam, J. Hubalek, P. Babula, and R. Kizek.
Sensors, Vol 8 No 9, p 5619-5636, 2008

Chloride ion sensing is important in many fields, such as clinical diagnosis, environmental monitoring, and industrial applications. The authors measured chloride ions variously using a carbon paste electrode (CPE) and a CPE modified with solid AgNO3, a solution of AgNO3, and/or solid silver particles. Detection limits (3 S/N) for chloride ions were 100 uM, 100 uM, and 10 uM for solid AgNO3, solution of AgNO3, and/or solid silver particles, respectively. The CPE modified with silver particles was the most sensitive to the presence of chloride ions. In subsequent work, measurements were carried out on a miniaturized instrument consisting of a potentiostat (35 x 166 x 125 mm), screen-printed electrodes, a peristaltic pump, and a PC with control software. Under optimum experimental conditions (Britton-Robinson buffer, pH 1.8, and working electrode potential 550 mV), the limit of detection (3 S/N) was estimated at 500 nM. http://www.mdpi.com/1424-8220/8/9

Analysis of Emerging Contaminants in Sewage Effluent and River Water: Comparison Between Spot and Passive Sampling
Zhang, Z., A. Hibberd, and J.L. Zhou, Univ. of Sussex, Brighton, UK.
Analytica Chimica Acta, Vol 607 No 1, p 37-44, 2008

A polar organic chemical integrative sampler (POCIS) was tested extensively to optimize its performance under both controlled and field conditions. The passive sampler subsequently was used for the sampling and analysis of estrone, 17beta-estradiol, 17alpha-ethynylestradiol, bisphenol A, propranolol, sulfamethoxazole, meberverine, thioridazine, carbamazepine, tamoxifen, indomethacine, diclofenac, and meclofenamic acid in sewage effluent and river water. Under laboratory conditions, the kinetics of compound uptake by POCIS were linear during 10 days of exposure. POCIS sampling rates of the target compounds were significantly greater using polyethersulfone rather than polysulfone membrane and were enhanced with increasing sorbent exposure area. Along with spot water sampling, the optimized POCIS was deployed in a river to obtain field-derived sampling rates for endocrine-disrupting chemicals (EDCs) that were significantly higher than those from laboratory experiments. Both spot and passive sampling demonstrated that most of the target chemicals were detected frequently in sewage effluent and river waters, and that the daily changes in the pollutant concentrations were greater for pharmaceuticals than for EDCs. The aqueous concentrations of all compounds were elevated at a sewage outfall, which is confirmed to be an important source of the target compounds in the river. The validated POCIS then was used successfully to estimate the concentrations of the target compounds in effluent and river water, which agreed well with results from spot sampling for pharmaceuticals.

Anodic Voltammetry of Thioacetamide and Its Amperometric Determination in Aqueous Media
Cinghita, D., C. Radovan, and D. Dascalu.
Sensors, Vol 8 No 8, p 4560-4581, 2008

Thioacetamide (TAA) is used as a sulfur source in the synthesis of organic compounds (rubber chemicals, curing agents, crosslinking agents, metallurgy, pesticides, pharmaceuticals) and as a stabilizer of motor fuels. TAA is a harmful, presumptive pollutant in drinking water and wastewater. The electrochemical behavior of TAA was investigated at a boron-doped diamond (BDD) electrode both in unbuffered 0.1 M Na2SO4 and buffered solutions as supporting electrolytes. The anodic oxidation of TAA showed well-defined limiting currents or current peaks and a good linearity of the amperometric signal vs. concentration plots. The analytical parameters of sensitivity, RSD and LOD, obtained under various experimental conditions, suggest the suitability of the BDD electrode for electroanalytical purposes. Low fouling effects, good reproducibility and stability, as well as the sharpness of the amperometric signals in both unbuffered/ buffered acidic or neutral media, were superior to those obtained using a glassy carbon electrode. These qualities recommend the unmodified BDD electrode as a promising potential amperometric sensor for environmental applications, such as the direct anodic determination of TAA in aqueous media. http://www.mdpi.com/1424-8220/8/8

Application of a Bioassay Using DR-EcoScreen Cells to the Determination of Dioxins in Ambient Air: A Comparative Study with HRGC-HRMS Analysis
Anezaki, K., K. Yamaguchi, S. Takeuchi, M. Iida, K. Jin, and H. Kojima.
Environmental Science & Technology, Vol 43 No 19, p 7478-7483, 1 Oct 2009

A bioassay system using highly sensitive DR-EcoScreen cells (DR-cell assay) was applied to the determination of low levels of dioxins in ambient air samples. The dioxins from 80 ambient air samples were extracted, purified by cleanup procedure, and applied to both DR-cell assay and high-resolution gas chromatography/high-resolution mass spectrometry (HRGC-HRMS) analysis. The toxic equivalents (TEQ) values obtained from the DR-cell assay were closely correlated with those from the HRGC-HRMS analysis (r2 = 0.957). Although the cell-based TEQ values were relatively (3.66-fold) higher than the TEQ values from the HRGC-HRMS analysis, this discrepancy was thought to be due to the difference between the toxic equivalency factor (TEF) and the relative potency (DR-REP) determined for individual dioxins. The authors multiplied the TEQ values from the DR-cell assay by a conversion coefficient (0.273, the reciprocal of 3.66) and approximated the values from the HRGC-HRMS analysis. These results suggest at the DR-cell assay might be a promising method for the rapid and low-cost screening of dioxins in ambient air samples.

Application of a Dry-Gas Meter for Measuring Air Sample Volumes in an Ambient Air Monitoring Network
Fritz, B.G.
Health Physics: Operational Radiation Safety, Vol 96 No 5, p S69-S75, May 2009

In 2004, mechanical dry-gas meters were incorporated into the ambient air sample collection system at DOE's Hanford facility to allow the direct measurement of sample volumes. These meters replaced an airflow measurement system that required two manual flow measurements and a sample duration measurement to determine sample volume. A 6-month evaluation of the dry-gas meters compared sample volumes calculated using the original flow-rate method to the sample volume measured directly by the dry-gas meter. The two methods provided sample volumes that were within 15% of each other 87% of the time. For instances where the sample volume measured by the two methods differed by more than 15%, the dry-gas meter method provided a more accurate sample volume measurement, as well as more accurate sample volumes for all samples, resulting in greater confidence in the calculated concentration results.

Application of Passive Sampling Devices for Screening of Micro-Pollutants in Marine Aquaculture Using LC-MS/MS
Martinez Bueno, M.J., M.D. Hernando, A. Aguera, and A.R. Fernandez-Alba, Univ. of Almeria, Spain.
Talanta, Vol 77 No 4, p 1518-1527, 15 Feb 2009

Data on the presence of micro-pollutants were gathered during a 1-year monitoring campaign carried out in a fish farm located on the Mediterranean Sea. An analytical procedure was developed that made use of passive sampling with polar organic chemical integrative samplers (POCIS) in pharmaceutical configuration and of the LC-QLIT-MS system. The development of the analytical procedure entailed laboratory-based calibration with the POCIS for calculating uptake rates and sampling rates of compounds representative of a wide range of polarity. Uptake of the target compounds in the POCIS followed a linear pattern for most compounds, and sampling rates varied from 0.001 to 0.319l/d. The calibration experiments showed that the POCIS pharmaceutical configuration could be used for sampling other non-target compounds, such as pesticides and biocides. The sampling rates for each selected compound were obtained using spiked seawater for further estimation of time-weighted average concentration of micro-pollutants in the water column during the field study. An analytical method was developed with the LC-QLIT-MS system and validated to ensure a satisfactory performance for the detection of the target micro-pollutants in water. The limits of detection achieved were between 0.01 and 1.50 ug/L. The monitoring campaign detected metronidazole, erythromycin, simazine, atrazine, diuron, terbutryn, irgarol, trimethoprim, carbaryl, flumequine, TCMTB, and diphenyl sulphone (DPS). Most of the target compounds found were at average concentrations, which ranged from 0.01 to 75 ng/L. Irgarol, simazine, diuron, atrazine, and DPS were the micro-pollutants detected most frequently over the monitoring period.

Application of X-Ray Fluorescence Analytical Techniques in Phytoremediation and Plant Biology Studies
Necemer, M., P. Kump, J. Scancar, R. Jacimovic, J. Simcic, P. Pelicon, M. Budnar, Z. Jeran, P. Pongrac, M. Regvar, and K. Vogel-Mikus.
Spectrochimica Acta - Part B, Atomic Spectroscopy, Vol 63 No 11, p 1240-1247, 2008

In phytoremediation and plant biology studies, it is important that the analytical procedures for elemental determination in plant tissues and soil should be fast and cheap, with simple sample preparation, and of adequate accuracy and reproducibility. The aim of this study was therefore to present the main characteristics, sample preparation protocols, and applications of X-ray fluorescence-based analytical techniques (energy dispersive X-ray fluorescence spectrometry [EDXRF], total reflection X-ray fluorescence spectrometry [TXRF], and micro-proton induced X-ray emission [micro-PIXE]). Element concentrations in plant leaves from metal polluted and non-polluted sites, as well as standard reference materials, were analyzed by these techniques, and additionally by instrumental neutron activation analysis (INAA) and atomic absorption spectrometry (AAS). The results were compared and evaluated to assess the performance and capability of EDXRF-based techniques in phytoremediation and plant biology studies. EDXRF is recommended as suitable for analyses of a large number of samples because it is multi-elemental, requires only simple preparation of sample material, and it is analytically comparable to the most frequently used instrumental chemical techniques. TXRF is compatible to FAAS in sample preparation, but relative to AAS it is fast, sensitive, and multi-elemental. The micro-PIXE technique requires expensive instrumentation, but offers multi-elemental analysis on the tissue and cellular level.

Assessing the Use of High Resolution Satellite Imagery to Inventory Abandoned Mine Land Features in Virginia
Osborne, D., J. San Souci, D. Kestner, R. Davis, A. McDavid, and K. Britton.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. p 55, 2009

The Virginia Division of Mined Land Reclamation (VA DMLR) and the Office of Surface Mining used high resolution satellite imagery along with other GIS tools to assist in the inventory of abandoned mine land (AML) sites and identification of re-mined areas in southwestern VA. Inventory of AML sites was conducted through feature extraction of QuickBird-2 satellite imagery to identify new AML sites and locate existing AML sites more precisely. The AML features identified as priority for mapping by VA DMLR were dangerous highwalls, apple cores, gob piles, clogged streams, clogged stream lands, portals, subsidence, acid mine drainage, hazardous equipment and facilities, spoil piles containing high coal content for re-mining consideration, and re-mined areas. The initial results of the image feature extraction included locating acid mine drainage areas, determining linear feet of dangerous highwalls, and locating gob piles and spoil piles containing high coal content and areas identified for re-mining consideration. Clogged streams and clogged stream lands required acquisition of summer imagery to conduct feature extraction. Additional field data collection is planned to classify portals and subsidence features as well as to complete an accuracy assessment of the final classification.

Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites: Ground Water Issue
B.H. Kueper (Queen's University, Kingston, ON, Canada); K.L. Davies (U.S. EPA).
EPA 600-R-09-119, 20 pp, Sep 2009

This document provides a framework for not only assessing the presence of DNAPL, but also for delineating the spatial extent of the DNAPL source zone, a priority at many sites due to the increasing use of in situ remediation technologies. The described strategy utilizes converging lines of evidence that incorporate scientific advances in the field, expand the applicability of the document to include both unconsolidated deposits and fractured bedrock, and encourage an iterative, flexible site investigation approach.
http://www.epa.gov/ada/download/issue/600r09119.pdf

Assessment of Heavy Metals Remobilization by Fractionation: Comparison of Leaching Tests Applied to Roadside Sediments
Perez, G., M. Lopez-Mesas, and M. Valiente.
Environmental Science & Technology, Vol 42 No 7, p 2309-2315, 2008

The available amounts of heavy metals along a highly traveled highway in Barcelona and the surrounding area were determined by applying different leaching tests and calculating the concentration enrichment ratio (CER) and the environmental concentration guideline values (ECG). To gain information on heavy metals fractionation, a sequential extraction scheme was implemented, and the results were compared with those obtained by single leaching tests. An anthropogenic enhancement of certain metals was observed after considering both the CER and ECG values. When only ECG values were considered, overestimation of the anthropogenically enhanced pollutants resulted due to disregarding geochemical and particle size variability. CER values provide a more realistic assessment by determining different levels of anthropogenic impact. Thus, CER values suggest a minimum anthropogenic apportion for metals such as Cd, Cr, and Ni, whereas different situations from significant to extreme anthropogenic contribution were observed for Zn, Pb, and Cu. These results have been complemented by other leaching tests that minimize time-consuming environmental evaluation. In this study, HCl extraction produced suitable results for a quick screening because they correlated well with the corresponding sequential extraction scheme: Cu(r2 = 0.798), Pb(r2 = 0.958) and Zn(r2 = 0.901). Application of mild extractants to highly polluted samples was limited due to their low leaching power. The information obtained following this procedure identified hazardous areas requiring remediation.

Assessment of In Situ Reductive Dechlorination Using Compound-Specific Stable Isotopes, Functional Gene PCR, and Geochemical Data
Carreon-Diazconti, C., J. Santamaria, J. Berkompas, J.A. Field, and M.L. Brusseau.
Environmental Science & Technology, Vol 43 No 12, p 4301-4307, 2009

Isotopic analysis and molecular-based bioassay methods were used in conjunction with geochemical data to assess intrinsic reductive dechlorination processes for a site in Tucson, AZ, contaminated with chlorinated solvents, such as PCE and its metabolites, TCE, cis-1,2-DCE, vinyl chloride, and ethene, as well as compounds associated with free-phase diesel. Compound-specific isotope analysis was performed on samples of the site's groundwater to characterize biotransformation processes influencing the transport and fate of the chlorinated contaminants. Polymerase chain reaction (PCR) analysis was used to assess the presence of indigenous reductive dechlorinators. The target regions employed were the 16s rRNA gene sequences of Dehalococcoides sp. and Desulfuromonas sp. and DNA sequences of genes pceA, tceA, bvcA, and vcrA, which encode reductive dehalogenases. The results indicate that relevant microbial populations are present and that reductive dechlorination is presently occurring at the site. The results also show that potential degrader populations as well as biotransformation activity is distributed non-uniformly within the site. The results of laboratory microcosm studies conducted using groundwater collected from the field site confirmed the reductive dechlorination of PCE to DCE. This study illustrates the use of an integrated, multiple-method approach for assessing natural attenuation at a complex chlorinated solvent-contaminated site.

An Automated Tool for Three Types of Saturated Hydraulic Conductivity Laboratory Measurements
Wietsma, T.W., M. Oostrom, M.A. Covert, T.E. Queen, and M.J. Fayer.
Soil Science Society of America Journal, Vol 73 No 2, p 466-470, 2009

This paper presents a new apparatus that is able to determine hydraulic conductivity values in an automated fashion with the falling head, constant head, and constant flux methods. In addition, the columns are designed to force water to flow in a nominally 1-D manner throughout the porous medium. Hydraulic conductivity data for standard laboratory sands are presented and compared to results obtained using a standard Tempe cell configuration. Hydraulic conductivity values obtained with the new tool for laboratory sands are consistent with literature data. For highly permeable sands, the newly obtained hydraulic conductivity values are considerable larger then values acquired using a Tempe cell configuration. The lower conductivity values for the Tempe Cell configuration mainly are the result of insufficient spreading of water in the inlet and outlet reservoirs.

Bacterial Biosensors for Measuring Availability of Environmental Pollutants
Tecon, R. and J.R. van der Meer.
Sensors, Vol 8 No 7, p 4062-4080, 2008

Bacterial sensor-reporters detect bioavailable and/or bioaccessible compound fractions in samples. Currently, a variety of environmental pollutants can be targeted by specific biosensor-reporters. Although most of the strains are still confined to the lab, several recent reports have demonstrated the utility of bacterial sensing reporting in the field, with method detection limits in the nanomolar range. This review illustrates the general design principles for bacterial sensor-reporters, and presents an overview of the existing biosensor-reporter strains, with emphasis on organic compound detection. The focus throughout is on the concepts of bioavailability and bioaccessibility and how bacteria-based sensing reporting systems can help to improve the basic understanding of the different processes at work.
http://www.mdpi.com/1424-8220/8/7/4062

Beryllium: Environmental Analysis and Monitoring
Brisson, M.J. and A.A. Ekechukwu (eds.).
Royal Society of Chemistry, Cambridge, UK. ISBN: 978-1-84755-903-6, 214 pp, 2009

This comprehensive book describes all aspects of the current sampling and analysis techniques for trace-level beryllium in the workplace. It offers both a historical perspective and a description of the state of the art in a single place. It covers the challenges inherent in sampling procedures such as reproducibility, limited sample volume, surface sampling materials, and collection efficiency. It also deals with the problems involved in analytical techniques, including lower detection limits, identification and compensation for matrix interferences, greater sensitivity requirements and the need for more robust preparation techniques. Future trends, including development of real-time beryllium sampling and analysis equipment, are also explored. Readers will gain an understanding of sampling and analytical techniques best suited for sensitive and accurate analysis of beryllium at ultra-trace levels in environmental and workplace samples. Many standard sampling and analysis techniques have weaknesses that this book will help users avoid. Written by recognized experts in the field, the book provides a single point of reference for professionals in analytical chemistry, industrial hygiene, and environmental science.

Bioavailability of Cd, Zn, and Hg in Soil to Nine Recombinant Luminescent Metal Sensor Bacteria
Bondarenko, O., T. Roelova, A. Kahru, and A. Ivask.
Sensors, Vol 8 No 11, p 6899-6923, 2008

A set of 9 recombinant heavy metal-specific luminescent bacterial sensors belonging to Gram-negative (Escherichia and Pseudomonas) and Gram-positive (Staphylococcus and Bacillus) genera and containing various types of recombinant metal response genetic elements

was characterized for heavy metal bioavailability studies. All 9 strains were induced by Hg and Cd and 5 strains also by Zn. As a lowest limit, the sensors were detecting 0.03 ug/L Hg, 2 ug/L Cd, and 400 ug/L of Zn. Limit of determination depended mostly on metal-response element, whereas the toxicity of those metals toward the sensor bacteria depended mostly on the type of the host bacterium, with Gram-positive strains more sensitive than Gram-negative ones. When the sensor set was used to evaluate bioavailability of Hg, Cd, and Zn in spiked soils, the bioavailable fraction of Cd and Zn in soil suspension assay (2.6 to 5.1% and 0.32 to 0.61% of the total Cd and Zn, respectively) was almost comparable for all the sensors, whereas the bioavailability of Hg was about 10-fold higher for Gram-negative sensor cells (30.5% of total Hg), compared to Gram-positive ones (3.2% of total Hg). For Zn, the bioavailable fraction in soil/water suspensions and respective extracts was comparable (0.37 versus 0.33% of the total Zn); however, for Cd, the bioavailable fraction in soilwater suspensions exceeded the water-extracted fraction about 14-fold for all the sensors used and for Hg concerning only Gram-negative sensor strains. This result indicates that upon direct contact, an additional fraction of Cd and Hg was mobilized by the sensor bacteria. Thus, for robust bioavailability studies of heavy metals in soil, any type of genetic metal-response element could be used for the construction of the sensor strains; however, Gram-positive and Gram-negative sensor strains should be used in parallel as the bioavailability of heavy metals to those bacterial groups can vary.
http://www.mdpi.com/1424-8220/8/11

Changes in Contaminant Mass Discharge from DNAPL Source Mass Depletion: Evaluation at Two Field Sites
Brooks, M.C., A.L. Wood, M.D. Annable, K. Hatfield, J. Cho, C. Holbert, P.S.C. Rao, C.G. Enfield, K. Lynch, and R.E. Smith.
Journal of Contaminant Hydrology, Vol 102 Nos 1-2, p 140-153, 2008

Changes in contaminant fluxes resulting from aggressive remediation of dense nonaqueous-phase liquid (DNAPL) source zones were investigated at Hill Air Force Base (AFB), Utah, and at Ft. Lewis Military Reservation, Washington. Passive flux meters (PFM) and a variation of the integral pumping test (IPT) were used to measure fluxes in 10 wells installed along a transect downgradient of the trichloroethene (TCE) source zone and perpendicular to the mean groundwater flow direction. At both sites, groundwater and contaminant fluxes were measured before and after the source-zone treatment. The measured contaminant fluxes were integrated across the well transect to estimate contaminant mass discharge from the source zone. Transect-wide average TCE mass flux prior to source treatment at the Ft. Lewis site (~2 g/m^2/day) was similar to that at the Hill AFB Panel 5 site (~3 g/m^2/day). Contaminant flux measurements made using both PFM and IPT approaches at these two DNAPL sites indicate that TCE mass depletion (>60%) in the source zone through aggressive treatment (surfactant flooding; resistive heating) resulted in substantial (>90%) reduction in TCE mass discharge at the source control plane. At Hill AFB, enhanced biodegradation in the source zone after surfactant flooding manifested in increased cis-dichloroethene (DCE) flux. TCE flux measurements made 1 year after source treatment at the Hill AFB site decreased to ~5 g/day, while increased fluxes of DCE in tests subsequent to remediation at the Hill AFB site suggest enhanced microbial degradation after surfactant flooding. At Ft. Lewis, mass discharge rates subsequent to thermal remediation of the source zone decreased to ~3 g/day for TCE and ~3 g/day for DCE 1.8 years after remediation. Data from these and other studies suggest that use of either PFM or IPT tests to characterize DNAPL source zone will provide critical data needed for more efficient targeting of aggressive treatment to achieve the desired reduction in source strength. http://www.thermalrs.com/news/newsView.php?pdf=40

Characterizing Mass Transfer and Mass Flux for DNAPL Source Zones
National Institutes of Health, National Institute of Environmental Health Sciences, Superfund Basic Research Program. CLU-IN Webinar Archive, 22 Jan 2008

As summarized in recent reports released by the EPA, ITRC, NRC, and SERDP, the presence of denser-than-water immiscible liquids (DNAPLs) in the subsurface remains one of the most critical issues associated with hazardous waste sites. Immiscible liquids serve as long-term sources of contamination, and their presence can greatly impact the costs and time required for site remediation. To assess the human health risks associated with DNAPLs in the subsurface accurately and to design effective remediation systems for such contamination, it is essential to understand contaminant mass-transfer and mass-flux behavior associated with DNAPL source zones. The contaminant mass flux or mass discharge emanating from a source zone, also referred to as the source strength or source function, is a primary determinant of the risk associated with a contaminated site. Concomitantly, the reduction in mass flux achieved with a specific level of source-zone mass removal (or mass depletion) is a key metric for evaluating the effectiveness of a source-zone remediation effort. Thus, there is great interest in characterizing, estimating, and predicting relationships between mass flux reduction and mass removal. The nature of the relationship between mass-flux reduction and mass removal will be mediated by the properties and distribution of the porous medium and of the DNAPL (source-zone architecture), and their resultant impacts on the pore-water velocity field and mass-transfer dynamics. In addition, the relationship between mass-flux reduction and mass removal may change with time due to temporal changes in source-zone architecture and mass-transfer dynamics (i.e., source-zone aging). Furthermore, the mass-flux reduction/mass removal relationship can be affected by source-zone remediation efforts. In this 1.5-hour session, these issues are illustrated using the results of studies spanning a range of spatial and temporal scales.
http://www.clu-in.org/conf/tio/toolkitdnapl_020508/

Chemical and Toxicologic Assessment of Organic Contaminants in Surface Water Using Passive Samplers
Alvarez, D.A., W.L. Cranor, S.D. Perkins, R.C. Clark, and S.B. Smith, U.S. Geological Survey.
Journal of Environmental Quality, Vol 37 No 3, p 1024-1033, 2008

Passive sampling methodologies were used to conduct a chemical and toxicologic assessment of organic contaminants (PAHs, PCBs, and organochlorine pesticides) in the surface waters of three geographically distinct agricultural watersheds. The current-use agrochemicals and persistent organic pollutants were targeted using polar organic chemical integrative samplers (POCIS) and semipermeable membrane device passive samplers. In addition to the chemical analysis, the Microtox assay for acute toxicity and the yeast estrogen screen (YES) were conducted as potential assessment tools in combination with the passive samplers. In Spring 2004, the passive samplers were deployed for 29 to 65 days at 3 sites: Leary Weber Ditch, IN; Morgan Creek, MD; and DR2 Drain, WA. Chemical analysis of the sampler extracts identified the agrochemicals predominantly used in those areas, including atrazine, simazine, acetochlor, and metolachlor. Other chemicals identified were deethylatrazine and deisopropylatrazine, trifluralin, fluoranthene, pyrene, cis- and trans-nonachlor, and pentachloroanisole. Screening using Microtox resulted in no acutely toxic samples. POCIS samples screened by the YES assay failed to elicit a positive estrogenic response. http://jeq.scijournals.org/cgi/content/full/37/3/1024

Combining Passive Samplers and Biomonitors to Evaluate Endocrine Disrupting Compounds in a Wastewater Treatment Plant by LC/MS/MS and Bioassay Analyses
Liscio, C., E. Magi, M. Di Carro, M.J.-F. Suter, and E.L.M. Vermeirssen.
Environmental Pollution, Vol 157 No 10, p 2716-2721, Oct 2008

Two types of integrative sampling approaches--passive samplers and biomonitors--were tested for their sampling characteristics of selected endocrine disrupting compounds (EDCs). Chemical analyses (LC/MS/MS) were used to determine the amounts of five EDCs (nonylphenol, bisphenol A, estrone, 17beta-estradiol, and 17alpha-ethinylestradiol) in polar organic chemical integrative samplers (POCIS) and freshwater mussels (Unio pictorum). Both samples and biomonitors had been deployed in the influent and effluent of a municipal wastewater treatment plant in Genoa, Italy. Estrogenicity of the POCIS samples was assessed using the yeast estrogen screen (YES). Estradiol-equivalent values derived from the bioassay showed a positive correlation with estradiol equivalents calculated from chemical analyses data. As expected, the amount of estrogens and EEq values in the effluent were lower than those in the influent. Passive sampling proved to be the preferred method for assessing the presence of these compounds as the use of mussels had disadvantages both in sampling efficiency and sample analyses.

Comparison between the Polar Organic Chemical Integrative Sampler and the Solid-Phase Extraction for Estimating Herbicide Time-Weighted Average Concentrations During a Microcosm Experiment
Mazzella, N., T. Debenest, and F. Delmas,.
Chemosphere, Vol 73 No 4, p 545-550, Sep 2008

Polar organic chemical integrative samplers (POCIS) were exposed for 9 days in two different microcosms that contained river waters spiked with deethylterbuthylazine, terbuthylazine and isoproturon. The experiment was performed with natural light and strong turbulence (flow velocities of about 15 to 50 cm/s) for reproducing natural conditions. The concentrations were kept relatively constant in the first microcosm (2.6 to 3.6 ug/L) and were variable in the second microcosm (peak concentrations ranged from 15 to 24 ug/L during the 3 day pulse phase). The time-weighted average (TWA) concentrations were determined with both POCIS and repetitive grab sampling followed by solid-phase extraction. The results showed a systematic and significant overestimation of the TWA concentrations with the POCIS, probably due to the use of sampling rates derived under a low-flow scenario. The results showed also that peak concentrations of pollutants are fully integrated by this passive sampler. Even if the POCIS does not provide very accurate concentration estimates without the application of adequate sampling rate values or the use of performance reference compounds, it can be a useful tool for detecting episodic or short-term pollution events (e.g., increased herbicide concentrations during a flood) that might be missed with classical and low-frequency grab sampling.

Comparison of Low Cost Miniature Spectrometers for Volcanic SO2 Emission Measurements
Kantzas, E.P., A.J.S. McGonigle, and R.G. Bryant.
Sensors, Vol 9 No 5, p 3256-3268, 2009

Miniature ultraviolet USB-coupled spectrometers have been applied over the last decade for measuring volcanic SO2 emission rates. The dominantly applied unit recently was discontinued, which raises the question of which currently available devices perform this type of stand-off sensing most effectively. The authors evaluated the measurement performance and thermal behavior of a variety of inexpensive compact spectrometers. This paper presents the recommendations based on their observations. Of the studied units, the Avaspec demonstrated the best prospects for the highest time resolution applications, but in the majority of cases, users likely will prefer the less bulky USB2000+s. http://www.mdpi.com/1424-8220/9/5

Comparison of Nitrate Attenuation Characterization Methods at the Uranium Mill Tailing Site in Monument Valley, Arizona
Carroll, K.C., F.L. Jordan, E.P. Glenn, W.J. Waugh, and M.L. Brusseau.
Journal of Hydrology, Vol 378 Nos 1-2, p 72-81, 15 Nov 2009

Several methods for characterizing the occurrence and rate of nitrate attenuation were tested at a field site near Monument Valley, AZ. Spatial and temporal nitrate concentration data collected from a transect of monitoring wells located along the plume centerline were analyzed to evaluate the overall rates of natural attenuation. Additionally, the occurrence and rate of denitrification was evaluated through microcosm experiments, nitrogen isotopic fractionation analysis, and solute-transport modeling. First-order denitrification-rate coefficients calculated with each method were comparable, and the composite natural attenuation rate coefficient was similar to the denitrification-rate coefficients, which suggests that microbially induced decay primarily controls nitrate attenuation at the site. This research illustrates the benefits of a multiple-method approach for the characterization of natural attenuation.

Comparison of Soil Pollution Concentrations Determined Using AAS and Portable XRF Techniques
Radu, T. and D. Diamond, Dublin City University, Ireland.
Journal of Hazardous Materials, Vol 171 Noss 1-3, p 1168-1171, 15 Nov 2009

Past mining activities in the area of Silvermines, Ireland, have resulted in heavily polluted soils. The possibility of spreading pollution to the surrounding areas through dust blow-offs poses a potential threat for the local communities. Because conventional environmental soil and dust analysis techniques are slow and laborious, there is a need for fast and accurate analytical methods that can provide real-time in situ pollution mapping. Laboratory-based aqua regia acid digestion of the soil samples collected in the area followed by the atomic absorption spectrophotometry (AAS) analysis confirmed very high pollution, especially by Pb, As, Cu, and Zn. In parallel, samples were analyzed using portable X-ray fluorescence (XRF) radioisotope and miniature tube-powered NITON instruments, and their performance was compared. Overall, the portable XRF instrument gave excellent correlation with the laboratory-based reference AAS method.

Delineation of Carbon Dioxide Flux Fields on Reclaimed Mine Spoils to Prevent Accumulation in Homes
Awuah-Offei, K., M. Mathiba, and A. Baldassare.
National Association of Abandoned Mine Land Programs 2009 Annual Conference, 27-30 September, Rogers, Arkansas. [Abstract only] 2009

Incidents of carbon dioxide (CO2) migration and accumulation at dangerously high levels in basements of buildings on reclaimed coal mine spoils have been reported in Western Pennsylvania and other Appalachian coal mining states. This study investigates the feasibility of using chamber-based CO2 flux measurement to delineate flux fields and discriminate between anthropogenic and natural sources of CO2 in the reclaimed coal mine spoils. CO2 flux measurements were taken using USDA's GRACEnet chamber-based trace gas measurement protocol. The LI-8100 Automated Flux System by LI-COR Biosciences was used to take flux readings on square grids over a reclaimed mine in Pennsylvania. The data then were analyzed using geostatistical methods. The preliminary results show there is great potential to discriminate between CO2 from reactions in mine spoil and natural sources. The results also show that the modeling of CO2 efflux on reclaimed mine land can be used to predict the potential for high accumulations in homes built on such land. Further research will concentrate on fine-tuning the geostatistical methods and the addition of temporal variability in the models.

Demystifying the DMA (Demonstration of Method Applicability)
U.S. EPA, Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 28 July 2008

The DMA is critical in evaluating and understanding the utility of any real-time measurement technology or novel approach at a site. In accordance with Triad's goal of managing decision uncertainty, a DMA provides an initial look at any technology or strategy performance in terms of its ability to meet project decision criteria and guide dynamic work strategies. The DMA can take many forms, such as a comparison of a field-based analytical method to a more established laboratory method or an evaluation of whether a particular tool or approach will work at a specific site. The format of a DMA is dictated by site characteristics and the intended use of the data. The resulting efforts provide many project benefits: strategies to deal with matrix heterogeneity, testing a preliminary CSM to refine sampling protocols, development of field based action levels, designing appropriate QA/QC requirements, using collaborative data sets, improving data management, determining contingencies, and evaluating sample throughput, project staffing, or other logistics. This 2-hour session includes an overview of the DMA process and provides examples of how DMAs have been structured under Triad projects. Examples highlight the multitude of activities than can be considered for a DMA while demystifying the process and providing a platform to design a DMA. http://www.clu-in.org/conf/tio/dma_072808/

Designer Molecule Detects Tiny Amounts of Cyanide, Then Glows
Indiana University News Release, 21 Oct 2009

A small molecule designed to detect cyanide in water samples works quickly, is easy to use, and glows under ultraviolet (UV) light. Although the fluorescent molecule is not yet ready for market, its Indiana University Bloomington creators report in the Journal of the American

Chemical Society that the tool is able to sense cyanide below the toxicity threshold established by the World Health Organization. The system works in water at normal pH levels and can be modified at will to enhance its reactivity. IU Bloomington chemist Dongwhan Lee led the research. His team is now looking at how to make the detector more sensitive. Graduate student Junyong Jo is the report's first author. One of the reasons the detector is not ready for market is that its optical properties need to be improved to emit light at longer wavelengths with less interference from background signals, especially those of biological origin. Because pond or river water is likely to contain living organisms and other organic matter, the detector system must be perfected. Another unique aspect of the detector molecule is its modular structure. The detector is essentially a 3-component chemical device with an activator, a receptor, and a reporter module. The 3 components can be changed at will, either to make the detector more sensitive or to have it detect an entirely different toxin by sending out signals as different colors of light. Because of the structure's modularity, a change in one of the three components does not really affect the others. The design of this novel system takes advantage of the structure-organizing "beta turn" motif commonly found in protein structures. The detector is essentially inert, except in the presence of cyanide, with which it preferentially reacts. The addition of cyanide induces a subtle but important structural change in the detector that turns it into a pigment that absorbs UV light (currently 270 nm) and converts to light emission at around 375 nm, a purplish color at the very edge of human beings' normal vision range. The research is supported by grants from the U.S. Army Research Office, the National Science Foundation, and the Alfred P. Sloan Foundation.

Design of a Water Environment Monitoring System Based on Wireless Sensor Networks
Jiang, P., H. Xia, Z. He, and Z. Wang.
Sensors, Vol 9 No 8, p 6411-6434, 2009

A proposed water environmental monitoring system based on a wireless sensor network consists of three parts: data monitoring nodes, a data base station, and a remote monitoring center. This system is suitable for the monitoring of complex, large-scale water environments, such as reservoirs, lakes, rivers, swamps, and shallow or deep groundwater. This paper explains and illustrates the new system design. The system had successfully accomplished automatic online monitoring of the water temperature and pH value of an artificial lake. The system's measurement capacity ranges from 0 to 80 degrees C for water temperature, with an accuracy of +/- 0.5 degrees C, and from 0 to 14 on pH value, with an accuracy of +/- 0.05 pH units. Sensors applicable to different water quality scenarios can be installed at the nodes to meet the monitoring demands for a variety of water environments and to obtain different parameters.
http://www.mdpi.com/1424-8220/9/8

Detecting AhR Ligands in Sediments Using Bioluminescent Reporter Yeast
Leskinen, P., K. Hilscherova, T. Sidlova, H. Kiviranta, P. Pessala, S. Salo, M. Verta, and M. Virta.
Biosensors & Bioelectronics, Vol 23 No 12, p 1850-1855, 2008

Many of the persistent organic pollutants that pollute sediments in the industrialized world contain ligands of the aryl hydrocarbon receptor (AhR). Bioassays that can detect the presence of AhR ligands in environmental samples offer a relatively rapid and cost-effective means of prioritizing samples before more elaborate, laborious, and costly chemical analyses are applied. This paper presents a new bioluminescent yeast assay based on transcriptional activation of AhR. Its applicability for determining AhR ligands in complex environmental samples was demonstrated by analyzing a set of sediment samples from the River Kymi in Finland. The results from the assay are consistent with those from both a chemical analysis and an H4IIE-luc bioassay. The yeast assay procedure is simple and can be performed within 1 day. The yeasts grow rapidly, are easy to handle, and do not require continuous cell culturing. The robustness of the yeast allows the application of the test to crude extracts or sediment suspensions. The described yeast assay can be useful for screening and prioritizing samples prior to chemical analysis. Moreover, the strain can be used in the construction of fiber-optic biosensors.

Detecting Leachate Plumes and Groundwater Pollution at Ruseifa Municipal Landfill Utilizing VLF-EM Method
Al-Tarazi, E., J. Abu Rajab, A. Al-Naqa, M. El-Waheidi.
Journal of Applied Geophysics, Vol 65 Nos 3-4, p 121-131, 2008

A very low frequency-electromagnetic (VLF-EM) survey was carried out in two domestic waste sites at old and recent landfills. The landfill structures lie on a major highly fractured limestone aquifer of shallow groundwater less than 30 m bgs, the main source of fresh water in the Amman-Zarqa region. Eighteen VLF-EM profiles were conducted with length ranges between 250 and 1500 m. Hydrochemical and biochemical analysis of water samples from wells in the region also were conducted. The integrated results of previous DC resistivity survey of the same study area and the outcomes of the 2-D tipper inversion of VLF-EM data proved the efficiency of this method in locating shallow and deep leachate plumes with resistivity <20 ohm m and enabled the mapping of anomalous bodies and their extensions down to 40 m depth. Signs of groundwater contamination were noticed in many surrounding wells, showing high numbers of fecal coliform bacteria and total coliform bacteria, and an increase in inorganic parameters such as chloride. The pollution of groundwater wells in the landfill area is attributed to the leachate bodies flowing through the upper part of the Wadi Es Sir or Amman-Wadi Es Sir Aquifer. Several structural features were detected, and the direction of local groundwater movement has been determined. The structural features have critical effects on leachate plume flow toward the north-northeast and west-southwest of the potable aquifer in the area.

Detection of Gaseous Plumes Using Basis Vectors
Chilton, L. and S. Walsh.
Sensors, Vol 9 No 5, p 3205-3217, 2009

The methods currently being used to detect gaseous plumes can be grouped into two categories: those that use a chemical spectral library and those that do not. The approaches that use chemical libraries include physics-based least squares methods (matched filter), which are optimal only if the plume chemical is actually in the search library but risk missing chemicals not in the library. The methods that don't use a chemical spectral library are based on a statistical or data analytical transformation--e.g., principle components, independent components, entropy, Fourier transform--applied to the data. These methods do not explicitly take advantage of the physics of the signal formulation process and therefore don't exploit all available information in the data. This paper describes generalized least squares detection using gas spectra, presents a new detection method using basis vectors, and compares detection images resulting from applying both methods to synthetic hyperspectral data. http://www.mdpi.com/1424-8220/9/5

Determination of Antimony (III) in Real Samples by Anodic Stripping Voltammetry Using a Mercury Film Screen-Printed Electrode
Domínguez-Renedo, O., M.J. Gomez Gonzalez, and M.J. Arcos-Martinez.
Sensors, Vol 9 No 1, p 219-231, Jan 2009

This paper describes a procedure for the determination of antimony (III) by differential pulse anodic stripping voltammetry using a mercury film screen-printed electrode as the working electrode. The procedure has been optimized using experimental design methodology. In terms of residual standard deviation, the repeatability (3.81%) and the reproducibility (5.07%) of the constructed electrodes were both analyzed under these conditions. The detection limit for Sb(III) was calculated at a value of 1.27 x 10(-8) M). The linear range obtained fell between 0.99 x 10(-8) - 8.26 x 10(-8) M. An analysis of possible effects due to the presence of foreign ions in the solution was performed, and the procedure was applied successfully to the determination of antimony levels in pharmaceutical preparations and sea water samples. http://www.mdpi.com/1424-8220/9/1

Determination of Glyphosate, Its Degradation Product Aminomethylphosphonic Acid, and Glufosinate, in Water by Isotope Dilution and Online Solid-Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry
Meyer, M.T., K.A. Loftin, E.A. Lee, G.H. Hinshaw, J.E. Dietze, and E.A. Scribner.
U.S. Geological Survey Techniques and Methods, Book 5, Chap. A10, 32 pp, 2009

Glyphosate is a broad-spectrum, systemic herbicide used to kill weeds. The U.S. Geological Survey method (0-2141-09) presented is approved for the determination of glyphosate, its degradation product aminomethylphosphonic acid (AMPA), and glufosinate in water. It was validated to demonstrate the method detection levels, compare isotope dilution to standard addition, and evaluate method and compound stability. The original USGS method (0-2136-01) was developed using liquid chromatography/mass spectrometry and quantitation by standard addition. Lower method detection levels and increased specificity were achieved in the modified method, 0-2141-09, by using liquid chromatography/tandem mass spectrometry (LC/MS/MS). Compound stability experiments were conducted on 10 samples derivatized four times for periods between 136 to 269 days. The glyphosate and AMPA concentrations remained relatively constant in samples held up to 136 days before derivatization. The half life of glyphosate varied from 169 to 223 days in the underivatized samples. Derivatized samples were analyzed the day after derivitization, and again 54 and 64 days after derivatization. The derivatized samples analyzed at days 52 and 64 were within 20% of the concentrations of the derivatized samples analyzed the day after derivatization. http://pubs.usgs.gov/tm/tm5a10/

Determination of Parathion and Carbaryl Pesticides in Water and Food Samples Using a Self Assembled Monolayer/Acetylcholinesterase Electrochemical Biosensor
Pedrosa, V.A., J. Caetano, S.A.S. Machado, and M. Bertotti.
Sensors, Vol 8 No 8, p 4600-4610, 2008

An acetylcholinesterase (AchE) based amperometric biosensor was developed by immobilizing the enzyme on a self-assembled modified gold electrode. Cyclic voltammetric experiments performed with the SAM-AchE biosensor in phosphate buffer solutions (pH = 7.2) containing acetylthiocholine confirmed the formation of thiocholine and its electrochemical oxidation at Ep = 0.28 V vs. Ag/AgCl. An indirect methodology involving the inhibition effect of parathion and carbaryl on the enzymatic reaction was developed and employed to measure both pesticides in spiked natural water and food samples without pre-treatment or pre-concentration steps. Values higher than 91 to 98.0% in recovery experiments indicated the feasibility of the proposed electroanalytical methodology to quantify both pesticides in water or food samples. HPLC measurements also were performed for comparison, and they confirmed the values measured amperometrically. http://www.mdpi.com/1424-8220/8/8

Determination of the Content of Heavy Metals in Pyrite Contaminated Soil and Plants
Antonijevc, M.M. and M. Maric.
Sensors, Vol 8 No 9, p 5857-5865, 2008

Acidification of pyrite-contaminated soil was corrected by calcium carbonate and followed by addition of mineral nutrients and organic matter (NPK, dung, earthworm cast, straw, and coal dust). This amended soil was used for oat production. Determination of the soil's total heavy metal content (Cu, Pb, Zn, Fe) was performed by atomic absorption spectrophotometry, with additional analysis of plant material (stems and seeds). Total concentrations of the heavy metals in the plant materials were greater than in a crop obtained in uncontaminated control soil. http://www.mdpi.com/1424-8220/8/9

Development of an Electronic Seepage Chamber for Extended Use in a River
Fritz, B.G., D.P. Mendoza, and T.J. Gilmore.
Ground Water, Vol 47 No 1, p 136-140, 2009

An electronic seepage chamber has been developed specifically for long-term use is a large river where hydraulic gradient reversals occur frequently with river stage variations. A bi-directional electronic flow meter coupled with a custom-built seepage chamber was used to measure temporal changes in the magnitude and direction of water flux across the water/sediment interface. The seepage chamber can measure average specific discharge as low as 1 x 10(-6) cm/s over a 15-min period. The specific discharge measured from the seepage chamber compared favorably with measurements of vertical hydraulic gradient and vertical hydraulic conductivity measured adjacent to the seepage chamber, demonstrating the effectiveness of the electronic seepage chamber to quantify water flux in two directions over a multi-month period.

A Differential Pressure Instrument with Wireless Telemetry for In-Situ Measurement of Fluid Flow across Sediment-Water Boundaries
Gardner, A.T., H.N. Karam, A.E. Mulligan, C.F. Harvey, T.R. Hammar, and H.F. Hemond.
Sensors, Vol 9 No 1, p 404-429, 2009

An instrument has been built to carry out continuous in situ measurement of small differences in water pressure, conductivity, and temperature in natural surface water and groundwater systems. A low-cost data telemetry system provides data on shore in real time if desired. The immediate purpose of measurements by this device is the continuous inference of fluxes of water across the sediment/water interface in a complex estuarine system; however, direct application to assessment of sediment/water fluxes in rivers, lakes, and other systems is also possible. Key objectives of the design include both low cost and accuracy on the order of +/- 0.5 mm H2O in measured head difference between the instrument's two pressure ports. These objectives have been met, although a revision to the design of one component was necessary. Deployments of up to 9 months, and wireless range in excess of 300 m have been demonstrated. [NOTE: This article is freely available under Open Access.]
http://www.mdpi.com/1424-8220/9/1/404

Dioxin-Like Compounds in Agricultural Soils Near E-Waste Recycling Sites from Taizhou Area, China: Chemical and Bioanalytical Characterization
Shen, C., Y. Chen, S. Huang, Z. Wang, C. Yu, M. Qiao, Y. Xu, K. Setty, J. Zhang, Y. Zhu, and Q. Lin.
Environment International, Vol 35 No 1, p 50-55, Jan 2009

A study was conducted to characterize dioxin-like compounds in the Taizhou area, one of the largest e-waste recycling centers in China, using both chemical analysis and in vitro bioassay. Agricultural soil samples were screened for aryl hydrocarbon receptor (AhR) activity with EROD bioassay in H4IIE cells, and the concentrations of the target AhR agonists (PCDD/Fs, PCBs, PAHs) were determined by instruments. The bioassay-derived TCDD equivalents (TEQbio) and the chemical-calculated TCDD equivalents (TEQcal) were then compared, and mass balance analysis was conducted to identify the contributors of the observed response. Raw soil extracts from all locations induced significant AhR activities, whereas the TEQbio ranged from 5.3 to 210 pg/g dry weight soil (pg/g dw). The total concentrations of 17 PCDD/Fs, 36 PCBs, and 16 PAHs varied from 210 to 850 pg/g dw, 11 to 100 ng/g dw, and 330 to 20,000 ng/g dw, respectively. Profile characterization of the target analytes revealed that similar sources originated from the crude dismantling of electric power equipments and the open burning of e-waste. A significant relationship was noted between TEQcal and TEQbio. Based on the mass balance analysis, PCDD/Fs, PCBs and PAHs could account for the observed AhR responses in vitro elicited by soil extracts, though their respective contributions varied depending on sample location. The combination of chemical analysis and bioanalytical measurements used in the study proved valuable for screening, identifying, and prioritizing the causative agents within complex environmental matrices.

DNAPL Mapping by Ground Penetrating Radar Examined via Numerical Simulation
Wilson, V., C. Power, A. Giannopoulos, J. Gerhard, and G. Grant.
Journal of Applied Geophysics [In Press, available online 3 October 2009]

A study was conducted to evaluate the potential of ground-penetrating radar (GPR) to map realistic DNAPL-spill scenarios within heterogeneous subsurface environments, and to monitor the progress of subsequent remedial efforts. The investigators created a novel link between two published numerical models: DNAPL3D-MT to generate a realistic DNAPL scenario, and GPRMAX to simulate a sequence of GPR surveys applied at the surface. A published volumetric mixing model permitted conversion of an evolving hydrogeological domain into a bulk permittivity domain. A field-scale, 2-D surface release of a chlorinated solvent DNAPL into heterogeneous silty sand provided a demonstration case and included complete DNAPL remediation by dissolution and its mapping by time-lapsed 100 MHz surface GPR scans. Qualitative and quantitative interpretation of the results reveal that realistic GPR scans can be simulated, generating a complex GPR response that is sensitive to both variations in DNAPL saturation and intrinsic subsurface heterogeneity. As a result, deconvoluting the response in the absence of a pristine site scan remains challenging, but with the aid of the newly developed GPR analysis tools presented here, including the combination of 'sequential scan subtraction' with 'normalized radar trace and radar section sum of squares,' changes in DNAPL distribution (mass reduction and remobilization) are quantifiable. Periodic monitoring with GPR of time-lapsed remediation of the source zone shows particular promise.

Early-Stage Leaking Pipes GPR Monitoring via Microwave Tomographic Inversion
Crocco, L., G. Prisco, F. Soldovieri, and N.J. Cassidy.
Journal of Applied Geophysics, Vol 67 No 4, p 270-277, Apr 2009

This paper addresses the problem of imaging leaking pipes from single-fold, multi-receiver ground-penetrating radar (GPR) data by means of a novel microwave tomographic method based on a 2-D "distorted" scattering model that incorporates the available knowledge on the investigated scenario (i.e., pipe position and size). To design the features of the approach and test its capabilities in controlled but realistic conditions, the authors exploited an advanced, full-wave, 2.5-D finite-difference, time-domain forward modeling solver capable of simulating real-world GPR scenarios in electromagnetically dispersive materials. The latter approach supports a reliable imaging procedure, allows detection of the presence of leakage in early stages of development, is robust against uncertainties, and provides information that cannot be inferred from raw-data radargrams or conventional tomographic methods based on a half-space background.

Effect of the Temperature-Emissivity Contrast on the Chemical Signal for Gas Plume Detection Using Thermal Image Data
Walsh, S., L. Chilton, M. Tardiff, and C. Metoyer.
Sensors, Vol 8 No 10, p 6471-6483, 2008

Detecting and identifying weak gaseous plumes using thermal imaging data is complicated by many factors, such as variability due to atmosphere, ground and plume temperature, and background clutter. This paper presents an analysis of one formulation of the physics-based radiance model, which describes at-sensor observed radiance. The background emissivity and plume/ground temperatures are isolated, and their effects on chemical signal are described. This analysis shows that the plume's physical state, emission or absorption, is directly dependent on the background emissivity and plume/ground temperatures. It then describes what conditions on the background emissivity and plume/ground temperatures have inhibiting or amplifying effects on the chemical signal. These claims are illustrated by analyzing synthetic hyperspectral imaging data with the adaptive matched filter using two chemicals and three distinct background emissivities. http://www.mdpi.com/1424-8220/8/10

Efficient Chemical Sensing by Coupled Slot SOI Waveguides
Passaro, V.M.N., F. Dell'Olio, C. Ciminelli, and M.N. Armenise.
Sensors, Vol 9 No 2, p 1012-1032, 2009

A new guided-wave chemical sensor designed for the detection of environmental pollutants or biochemical substances is based on an asymmetric directional coupler employing slot optical waveguides. The use of a nanometer guiding structure where optical mode is confined in a low-index region permits a very compact sensor (device area about 1200 um2) to be realized, having the minimum detectable refractive index change as low as 10(-5). Silicon-on-insulator technology has been assumed in sensor design, and a very accurate modeling procedure based on finite element method and coupled mode theory has been pointed out. Sensor design and optimization have allowed a very good tradeoff between device length and sensitivity. http://www.mdpi.com/1424-8220/9/2

Electrical Resistivity Correlation to Vadose Zone Sediment and Pore-Water Composition for the BC Cribs and Trenches Area
Serne, R.J., D.F. Rucker, A.L. Ward, D.C. Lanigan, W. Um, M.W. Benecke, and B.N. Bjornstad.
PNNL-17821, 679 pp, 2009

This technical report documents the results of comparing electrical-resistivity characterization (ERC) to geochemical measurement on sediment obtained from four boreholes drilled in the BC Cribs and Trench area at DOE's Hanford facility. The geochemical characterization was conducted to determine the efficacy of ERC methodology for use at the site and was focused on addressing three data quality objectives specified in the sampling and analysis plan. As a whole, the ERC data do correlate with the presence of high-concentration sodium nitrate salt plumes as determined by extensive sediment sampling. The surface-based ERC data were sufficient to indicate the lateral and (to some extent) vertical distribution of mobile contaminants. The surface-based geophysical survey data seemed to suffer from a sort of "myopia," where looking down from the ground surface, the maximum pore-water salt concentration depths were difficult to resolve. Further, ERC measures bulk resistivity, which is related to dissolved electrolyte content and not individual chemical species. Because technetium-99 has transport attributes that are similar to nitrate, the ERC measurements fortuitously correlate to technetium-99 in the vadose zone. The concentrations of elevated technetium-99 range from 90 to 146 pCi/g sediment, 34 to 51 pCi/g sediment, and 64 to 107 pCi/g sediment in different wells. One specific outcome of the BC Cribs and Trenches area ground-truthing exercise was confirmation that separate contaminant plumes exist for the cribs and nearby trenches. Because ERC data were used to select the borehole locations for three of the new boreholes outside the footprints of BC Cribs and Trenches, and contaminants were found (or not found) as expected, ERC is shown to be a very useful guide for selecting vadose zone sampling locations, particularly when the targeted subsurface plumes exhibit high ionic strength. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17821.pdf

Electrocatalytic Detection of Amitrole on the Multi-Walled Carbon Nanotube: Iron(II) tetra-aminophthalocyanine Platform
Siswana, M., K.I. Ozoemena, and T. Nyokong.
Sensors, Vol 8 No 8, p 5096-5105, 2008

An iron(II) tetra-aminophthalocyanine complex electropolymerized onto a multi-walled carbon nanotube-modified basal plane pyrolytic graphite electrode greatly enhanced the electrocatalytic detetion of amitrole (a toxic herbicide), resulting in a very low detection limit (0.5 nM) and excellent sensitivity of 8.80 +/- 0.44 uA/nM. This result compares favorably to any other work reported so far. The electrocatalytic detection of amitrole at this electrode occurred at less positive potential (~0.3 V vs Ag/ACl) and also revealed a typical coupled chemical reaction. The authors discuss the mechanism for this response. The electrode gave satisfactory selectivity to amitrole in the presence of other potential interfering pesticides in aqueous solutions.
http://www.mdpi.com/1424-8220/8/8

Electronic Nose Sniffs out Toxins
NIH/National Institute of Environmental Health Sciences (NIEHS) News Release, 13 Sep 2009

Dr. Kenneth S. Suslick, the M.T. Schmidt Professor of Chemistry at the University of Illinois at Urbana-Champaign, and his colleagues have created what they refer to as an optoelectronic nose, an artificial nose for the detection of toxic industrial chemicals (TICs) that is simple, fast, inexpensive, and works by visualizing colors. The disposable 36-dye sensor array changes colors when exposed to different chemicals. The pattern of the color change is a unique molecular fingerprint for any toxic gas and also tells its concentration. By comparing the pattern to a library of color fingerprints, the TICs can be identified in a matter of seconds. The power of this sensor to identify many volatile toxins stems from the increased range of interactions that are used to discriminate the response of the array. To test the application of their color sensor array, the researchers chose 19 representative examples of toxic industrial chemicals, such as ammonia, chlorine, nitric acid, and sulfur dioxide, at concentrations known to be immediately dangerous to life or health. The arrays were exposed to the chemicals for two minutes. Most of the chemicals were identified from the array color change in seconds and almost 90% of them were detected within two minutes. The researchers have developed a fully functional prototype handheld device that uses inexpensive white LED illumination and an ordinary camera, which will make the whole process of scanning more sensitive, smaller, faster, and less expensive. It will be similar to a card scanning device. The technology uses components that are readily available and relatively inexpensive. The investigators hope to be able to market the wearable sensor within a few years. This innovation brings workers one step closer to having a small wearable sensor that can detect multiple airborne toxins. Additional information: Lim, S.H., et al. 2009. An optoelectronic nose for detection of toxic gases. Nature Chemistry, DOI: 10.1038/NCHEM.360.

Electronic Nose and SPME Techniques to Monitor Phenanthrene Biodegradation in Soil
De Cesare, F., S. Pantalei, E. Zampetti, and A. Macagnano.
Sensors and Actuators, B: Chemical, Vol 131 No 1, p 63-70, 14 Apr 2008

Phenanthrene is a hydrophobic organic pollutant, composed of three-fused benzene rings belonging to PAHs, which are produced by incomplete combustion of organic matter. The presence of PAHs in contaminated soils usually is detected by classical extraction techniques, such as solvent extractions through a Soxhlet extractor. In this paper, two recently developed techniques--solid phase microextraction (SPME) and electronic nose (EN)--for analysis of the headspace of solid or liquid samples were used to monitor the possible degradation of phenanthrene in a spiked soil. SPME analysis showed a drastic decrease of phenanthrene content after 30 days of incubation (92%) and different treatments with nutrient solutions and/or surfactant improve this rate up to 97%. The analysis of soil headspaces by EN, processed by principal component analysis (PCA), showed that contaminated and uncontaminated soil samples (controls) could be distinguished on a temporal scale. PCA showed that phenanthrene-contaminated soil samples produced delayed chemical images relative to controls at the same period of incubation. The application of partial least square-discriminant analysis (PLS-DA) to chromatograms obtained by SPME pointed out the presence, in the headspace of phenanthrene-treated soils, of a series of possible indicators involved in phenanthrene degradation that were completely absent in relatively unpolluted controls. Results suggest that the two techniques do not necessarily represent mutually exclusive alternatives, but give different information and may be considered complementary.

Enzyme-Linked Immunosorbent Assay for Screening Dioxin Soil Contamination by Uncontrolled Combustion during Informal Recycling in Slums
Trindade, M., M. Nording, M. Nichkova, E. Spinnel, P. Haglund, M.S. Last, S. Gee, B. Hammock, J.A. Last, G. Gonzalez-Sapienza, and B.M. Brena.
Environmental Toxicology and Chemistry, Vol 27 No 11, p 2224-2232, Nov 2008

This paper describes a first approach toward the use of a dioxin antibody-based enzyme-linked immunosorbent assay (ELISA) as the basis for a sustainable, simple, and low-cost monitoring program to assess the toxicological impact of uncontrolled trash combustion in slums. A panel of 16 samples was analyzed by GC-HRMS and ELISA on split extracts. Close to 20% of the analyzed samples showed dioxin concentrations up to almost twice the guidance level for residential soil in several countries, pointing out the need for performing a large-scale monitoring program. Despite the potential for variations in dioxin congener distribution due to the mixed nature of the incinerated material, there was a good correlation between the toxic equivalents as determined by GC-HRMS and ELISA. An interlaboratory ELISA validation showed that the capacity to perform the dioxin ELISA was successfully transferred between laboratories. The authors concluded that the ELISA method performed very well as a screening tool to prioritize samples for instrumental analysis, which cutting costs significantly.

Estimating Persistent Mass Flux of Volatile Contaminants from the Vadose Zone to Ground Water
Truex, M.J., M. Oostrom, and M. Brusseau.
Ground Water Monitoring and Remediation, Vol 29 No 2, p 63-72, 2009

Contaminants can persist for long time periods within low-permeability portions of the vadose zone where they cannot be treated effectively, thereby providing a potential continuing source of contamination to groundwater. The authors consider 1-D approaches for estimating transport of volatile contaminants in the vadose zone and compare them to a 1-D flux continuity-based assessment of vapor-phase contaminant movement from the vadose zone to groundwater. The flux continuity-based assessment illustrates how the ability of the groundwater to move contaminant away from the water table controls the vapor-phase mass flux from the vadose zone across the water table. Limitations of the 1-D approaches are discussed with respect to the need for further method development and application of 2- or 3-D numerical modeling. The carbon tetrachloride plume at DOE's Hanford facility is used as an example of a site where persistent vadose zone contamination needs to be considered in the context of groundwater remediation. SEE ALSO the archived Feb 2008 Clu-In webinar presented by M. Brusseau, "Characterizing Mass Transfer and Mass Flux for DNAPL Source Zones," at http://www.clu-in.org/conf/tio/toolkitdnapl_020508/

Evaluation of Geochemical Associations as a Screening Tool for Identifying Anthropogenic Trace Metal Contamination
Anderson, R.H. and M.J. Kravitz, U.S. EPA, Cincinnati, OH.
Environmental Monitoring & Assessment, [Epub ahead of printing], 2009

Geochemical association plots are employed as a screening tool for environmental site assessments and use empirical log-log relationships between total trace metal concentrations and concentrations of a major (i.e., reference) soil metal constituent, such as iron (Fe), to identify sites with naturally elevated trace metal levels from sites with anthropogenic contamination. Log-log relationships have been consistently observed between trace metal and reference metal concentrations and are often considered constant. A regional geochemistry data set was employed to evaluate background trace metal/Fe log-log associations across soils with highly diverse composition. Results indicate that, although geochemical associations might be proportional, they differ significantly across predominant USDA soil orders, which suggests that highly complex interactions between soil-forming factors and variable secondary clay mineral composition affect the ratio of trace metal/Fe concentrations in soils. Intra-order variability in trace metal/Fe ratios generally ranged multiple orders of magnitude, which suggest that the order level of the USDA soil taxonomic system is insufficient to classify background trace metal concentrations. Geochemical association plots are a useful screening tool for environmental site assessments, but ubiquitous application of generic background metal data sets could result in erroneous conclusions. Because significantly different ratios were observed across predominant USDA soil orders, an agglomerative clustering technique was used to elucidate hierarchical patterns of association. The results are presented as a mechanism to aid environmental assessors in screening candidate background metal data sets for their applicability to site-specific soil composition, although site-specific background metal data should be used if pristine reference sites with similar (i.e., sub-order) soil composition can be identified and sampled.

Evaluation of Mine Drainage Abatement Projects: Comparison of Results from Simple Field Tests of Water Quality with Laboratory Analyses
Behum, P. and B. Hicks, Office of Surface Mining Reclamation & Enforcement, Alton, IL.
National Association of Abandoned Mine Land Programs 2009 Annual Conference, 27-30 September, Rogers, Arkansas. [Abstract only] 2009

The Mid-Continent Region of the Office of Surface Mining Reclamation and Enforcement has assisted in reconnaissance of acid mine drainage (AMD) problem sites, design of treatment systems, and evaluation of constructed passive treatment systems. This paper discusses the application and suitability of field test methods, such as colorimetric analysis of key anions and cations. Field measurements are statistically compared with data generated from conventional laboratory techniques, such as inductive coupled plasma and ion chromatography. The purpose of this work is to demonstrate the ability of low-cost field methods to supplement conventional analytical techniques. Important applications include reconnaissance sampling, which can be followed by laboratory testing once field conditions are understood, and diagnostic tests to evaluate the performance of AMD passive treatment systems. Several field methods have been found to be comparable with laboratory tests, while others are useful only for an estimation of water quality. The ferrous iron colorimetric method is considered the standard method for this constituent and is recommended over laboratory testing.

Evaluation of Passive Samplers for Long-Term Monitoring of Organic Compounds in the Untreated Drinking Water Supply for the City of Eugene, Oregon, September-October 2007
McCarthy, K.A., D. Alvarez, C.W. Anderson, W.L. Cranor, S.D. Perkins, and V. Schroeder.
U.S. Geological Survey Scientific Investigations Report 2009-5178, 20 pp, 2009

Two types of passive samplers, polar organic chemical integrative samplers (POCIS) and semipermeable membrane devices (SPMDs), were deployed at three sites in the McKenzie River basin during September/October 2007. The McKenzie River is the source of drinking water for the city of Eugene, Oregon, and the work presented in this paper was designed to evaluate the use of POCIS and SMPDs as part of a long-term monitoring plan for the river. Various compounds were detected in extracts from the POCIS and SPMDs, indicating that some compounds of concern are present in the McKenzie River basin, including the intake for the drinking water plant; however, most concentrations were near the quantitation limits of the analytical methods used—generally at subnanogram-per-liter concentrations—and would not have been detectable with conventional water sampling and analysis methods. These results indicate that both POCIS and SPMDs are well suited to monitor organic compounds in the McKenzie River basin.
http://pubs.usgs.gov/sir/2009/5178/

Evaluation of Various Ion Exchange Resins for Determining Uranium Groundwater Flux
Stucker, V., J.F. Ranville, S. Cabaniss, and K. Hatfield.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. Poster presentation, p 117, 2009

Ion exchange resins were evaluated for use in passive flux meters (PFM). The PFMs will be installed in uranium-containing aquifers to measure groundwater flow via a displaced tracer, as well as the uranium flux through the meter. Resins were tested in the laboratory for maximum adsorption of uranium in various solution compositions and also in contaminated groundwater from the Rifle, CO, site using a fixed amount of resin. After a 24-hour equilibration time, the solution and resins were separated. Percent sorption was determined by difference following analysis of the original solution and the solution exposed to the resin. To examine recovery, which is essential to determining uranium flux, uranium was desorbed from the resin using 1% nitric acid. Uranium analyses were performed by inductively coupled plasma/mass spectrometry. At a pH of 7.3 in synthetic waters, Dowex 21K, Lewatit S6328 A, and Purolite A500 anion exchange resins adsorbed over 99, 95, and 94% of the uranium, respectively. These resins performed equally at 99% in natural waters. Effect of pH on the aqueous uranium speciation has some influence on the adsorption of uranium, but these effects are complicated by the presence of nitrate in the system. A solution acidified by hydrochloric acid showed little to no sorption by anion exchange, which is expected due to the dominance of UO(2)(2+) at the pH examined (3.8); however, pH adjustment to 3.8 with nitric acid showed a similar or reduced amount of sorption when compared to pH 7.3. Acid treatment showed 100% recovery of the adsorbed uranium from both resins. Tracer capacity and cost analysis will be done on these resins to determine the material used in the PFMs. These PFMs will be useful in studying the flow of uranium in the groundwater during ISR operations as well as in post-ISR monitoring.

Fast and Direct Screening of Solid Materials for Their Potential Liberation of Hydrophobic Organic Compounds Using Hot Cell Membrane Inlet Mass Spectrometry
Lauritsen, F.R., A. Jensen, and C.H. Nielsen, Copenhagen Univ., Denmark.
Rapid Communications in Mass Spectrometry, Vol 22 No 14, p 2234-2240, 2008

Solid materials can be screened directly and without any pretreatment for their potential liberation of chemicals into the surroundings using a hot (150-250 degrees C) sample cell membrane inlet mass spectrometer with electron ionization. Three different types of solids were tested: polymers, tea leaves, and pesticide-contaminated soil. From the polymers, phthalates and other additives were liberated; from the tea leaves, flavor additives and caffeine; and from the contaminated soil, degradation products of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid. In all cases, characteristic compounds were detected directly from the untreated sample with an analytical turnover of 8 to 10 samples per hour. Improved selectivity of compounds penetrating the membrane was achieved either by operating the hot cell at different temperatures or by using variations in the time trend of individual ions following insertion of a piece of the solid material into the hot cell.

Field GPS vs. Remote Sensing Workflows for Landform Review: Selecting the Right Technology for the Job
Calhoun, R., L. Evans, M. Shank, and M. Richmond.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. p 12, 2009

The Office of Surface Mining Reclamation and Enforcement and the West Virginia Department of Environmental Protection reviewed the costs and benefits of two different types of data gathering by generating cross sections of large land disturbances using Trimble Geo Explorer series GPS receiver units ranging from the submeter GeoXT with EVEREST(tm) multipath rejection technology to the GeoXH with Trimble H-Star(tm) and optional Zephyr(tm) external antenna capable of approximately 25 cm. vertical accuracy post processed. They then tested the suitability of LIDAR data for the same purposes and generated projected cost using that method on the same sites. By maintaining an accounting of the time associated with both methods, the agencies gained a better perspective on the costs and benefits of these technologies for future decisions. The project involved comparing pre, proposed and final graded slopes on 8 large surface mines in steep slopes in West Virginia as part of the review of approximate original contour requirements. The agencies found that use of remote sensing technologies, such as aerial based LIDAR, can be a cost savings over obtaining digital information using GPS field devices on the ground.

Framework for Assessment of Performance of Soil Aquifer Treatment Systems
Sharma, S.K., C.M. Harun, and G. Amy, UNESCO-IHE Inst. for Water Education, Delft, Netherlands.
Water Science and Technology, Vol 57 No 6, p 941-946, 2008

Removal of organic matter is a critical parameter in soil aquifer treatment (SAT) as it governs and influences the removal of other contaminants (trace organics, nitrogen species, and microbes) by biodegradation. A framework for analysis and prediction of the performance of SAT systems with respect to removal of organic matter under different water quality and process conditions was developed based on an extensive literature review and data analysis. Guidelines were developed to make preliminary estimates of the removal of organic matter during SAT using primary, secondary, and tertiary effluents from wastewater treatment plants. These guidelines can be used as a quick tool to analyze the performance of existing SAT systems and serve as a decision support tool for feasibility studies and to save time for further detailed experimentation and design of SAT systems. The authors also analyzed the effects of soil type and redox conditions on organic matter removal during SAT.
http://www.switchurbanwater.eu/outputs/pdfs/WP3-2_PAP_Framework_for_assessment_of_SAT_systems.pdf

Free Base Porphyrins as Ionophores for Heavy Metal Sensors
Vlascici, D., E.F. Cosma, E.M. Pica, V. Cosma, O. Bizerea, G. Mihailescu, and L. Olenic.
Sensors, Vol 8 No 8, p 4995-5004, 2008

Two functionalized porphyrins--5,10,15,20-tetrakis(3,4-dimethoxyphenyl) porphyrin (A) and 5,10,15,20-tetrakis(3-hydroxyphenyl)porphyrin (B)--were obtained, characterized, and used as ionophores (I) for preparing PVC-based membrane sensors selective to Ag+, Pb2+, and Cu2+. The membranes were prepared using three different plasticizers: (bis(2-ethylhexyl)sebacate (DOS), dioctylphthalate (DOP), o-nitrophenyl octyl ether (NPOE), and potassium tetrakis(4-chlorophenyl)borate (KTClPB) as additive. The functional parameters (linear concentration range, slope, and selectivity) of sensors with a membrane composition of I:PVC:KTClPB:Plasticizer in different ratios were investigated. The best results were obtained for the membranes in the ratio I:PVC:KTClPB:Plasticizer at 10:165:5:330. The influence of pH on the sensors response also was studied. The sensors were tested for a period of four months on synthetic and real samples. http://www.mdpi.com/1424-8220/8/8

Geophysical Experiments to Image the Shallow Internal Structure and the Moisture Distribution of a Mine Waste Rock Pile
Poisson, J., M. Chouteau, M. Aubertin, and D. Campos.
Journal of Applied Geophysics, Vol 67 No 2, p 179-192, Feb 2009

Field surveys of a waste rock pile were carried out during the summers of 2002 and 2003 using ground-penetrating radar, electromagnetic conductivity, and DC resistivity imaging. The waste rock deposit is prone to generate acid mine drainage (AMD) due to the oxidation of sulfidic minerals. Unsaturated water flow and the ensuing moisture distribution in the waste rock are critical factors that lead to the production of AMD. The geophysical characterization study, performed over a 30 m x 30 m test zone, was designed to image the internal structure controlling the water flux at shallow depth. The subsurface consisted of 3 zones for the first 6 m of the pile, mainly based on electrical resistivities: a thin superficial conductive material; an intermediate, highly resistive zone 2 to 3 m thick; and a lower, more conductive medium. Using hydrogeological tests, chemical analyses, and two 2.5 m-deep trenches, the investigators found that the two conductive zones correlate with fine-grained waste rock and the resistive zone correlates with a coarser material. In the two deeper zones, the contact between the two types of waste rock typically is highlighted by a sharp resistive/conductive boundary. The data also show an increase in resistivity from the top to bottom of the slope, in accordance with expected particle segregation, from fine-grained material at the top to coarser material at the bottom. Wide-angle reflection GPR monitoring during large scale infiltration tests seems to indicate preferential flow paths toward the direction of coarser, more pervious material (which also appears to be less oxidized). Water flows preferentially through the coarse-grained material, but it is stored by capillary forces in the fine-grained material. Apart from the deposition methods, the results strongly suggest that factors such as machinery-induced mechanical alteration, construction history of the pile, and increased oxidization near the edges could explain the resistivity model. The model interpreted from geophysical imaging agrees well with the conceptual model of the rock pile. The resistivity and GPR methods appear to be efficient geophysical methods to characterize the internal structure and preferential flow patterns within unsaturated waste rock piles.

A GIS Model-Based Screening of Potential Contamination of Soil and Water by Pyrethroids in Europe

Pistocchi, A., P. Vizcaino, and M. Hauck, European Commission, Joint Research Centre, Italy.
Journal of Environmental Management, Vol 90 No 11, p 3410-3421, Aug 2009

A geographic information system (GIS) model-based approach was developed for analysis of potential contamination of soil and water by pyrethroids (pesticides) for the European continent. An assessment exercise demonstrates how accessible information and GIS-based modeling allow estimation of the spatial distribution of chemical concentrations and fluxes at a screening level. The assessment highlights potential hot spots and the main environmental transport pathways in a quick and simple fashion. By combining information on pesticide use, crop distribution, and landscape and climate parameters, potential problem areas are identified to help focus the monitoring campaign. The presented approach can be applied to virtually all pesticide classes used over a large domain and is suitable for the screening of large quantities of chemicals, even ones that have not yet undergone any systematic environmental monitoring program. The method has been tested through benchmarking with other well-established models. Further research, however, is needed to evaluate it against experimental observations.

Groundwater Long-Term Monitoring Optimization at MCB Camp Lejeune

Bozzini, C. (CH2M Hill); R. Lowder (Camp Lejeune EMD).
JSEM 2008: 2008 Joint Services Environmental Management Training Conference and Exhibition, 5-8 May 2008, Denver, Colorado: Abstracts. Abstract 8146, 2008

The groundwater long-term monitoring (LTM) program at Marine Corps Base (MCB) Camp Lejeune in North Carolina historically included sampling of 276 monitoring wells, surface water, and sediment at 13 different sites on a semi-annual basis. Samples were analyzed for VOCs, SVOCs, and/or natural attenuation indicator parameters (NAIPs). To reduce monitoring costs, the Navy carefully examined the program for redundancies and opportunities to reduce the amount of sampling. Optimization of the LTM program followed a two-tiered approach. The first tier involved records review to determine each site's regulatory requirements. The second tier involved evaluating parameters and sampling points for their appropriateness within the overall LTM program. The evaluators used Monitoring and Remediation Optimization System (MAROS) software. MAROS follows simple statistical and heuristic methods and is appropriate for use after a site is fully characterized and remediation is in place; it is not used for modeling or plume delineation. MAROS provided a means to identify essential data and reduce redundancy regarding the number of wells, frequency and duration of sampling, and data management and reporting. Changes were implemented that resulted in LTM program savings in level of effort and cost while addressing all regulatory requirements. The number of monitoring points and frequency of sampling were reduced by over 50%. The analyte list was reduced. Efficiency of current field procedures increased by over 50% by switching to sample collection using passive diffusion bags in half of the monitoring wells remaining in the LTM program. Finally, reporting and data management protocols were reduced by 40% by submitting a single annual monitoring report. The cost of the optimization effort was roughly $75,000. After one year of implementation, the cost savings of the optimization recommendations was roughly $800,000, paying for itself 7 times over in the first year.

Guide for Development of Sample Collection Plans for Radiochemical Analytes in Environmental Matrices Following Homeland Security Events
U.S. EPA, National Homeland Security Research Center.
EPA 600-R-08-128, 43 pp, Feb 2009

The purpose of this document is to provide a framework to assist incident commanders, project managers, state and local authorities, contractors, and enforcement divisions in developing and implementing an approach for sample collection during the cleanup of an urban environment after a radiological homeland security event. Information in this document can be used to develop a systematic and integrated methodology to sample collection, which will meet data use needs and site disposition objectives. This document incorporates site-specific optimization processes to include quantitative and qualitative assessments applied at each stage of site cleanup decision making, from initial scoping and stakeholder outreach, to evaluation of cleanup options, to implementation of the chosen alternative.
http://www.epa.gov/nhsrc/pubs/600r08128.pdf

High-Resolution Monitoring of Biogeochemical Gradients in a Tar Oil-Contaminated Aquifer
Anneser, B., F. Einsiedl, R.U. Meckenstock, L. Richters, F. Wisotzky, and C. Griebler.
Applied Geochemistry, Vol 23 No 6, p 1715-1730, June 2008

The authors describe groundwater sampling across a BTEX plume in a sandy aquifer via a novel, high-resolution, multi-level well (HR-MLW). Distinct and steep biogeochemical gradients were present at the centimeter and decimeter scale, which could not be resolved with a conventional multi-level well. The thin BTEX plume with a vertical extension of only 80 cm exhibited a decline in contaminant concentrations by two orders of magnitude within a few centimeters in the upper and lower fringe zone. The small-scale distribution of sulfate, sulfide, and Fe(II) in relation to the contaminants and elevated delta(34)S and delta(18)O values of groundwater sulfate strongly indicated sulfate and iron reduction to be the dominant redox processes involved in biodegradation. High microbial activities and biomass especially at the plume fringes and the slope of chemical gradients supported the concept that the latter are regulated by microbial processes and transverse dispersion, i.e., vertical mixing of electron donors and acceptors. Transverse dispersion was suggested to be a driving factor controlling biodegradation in porous aquifers but not exclusively limiting natural attenuation processes at this site. Broad overlapping zones of electron donors and electron acceptors point toward additional factors limiting anaerobic biodegradation in situ. The identification of small-scale gradients contributed substantially to a better understanding of biodegradation processes and therefore is a prerequisite for the development of reliable predictive mathematical models and future remediation strategies.

High-Throughput Screening Of Dioxins in Sediment and Soil Using Selective Pressurized Liquid Extraction with Immunochemical Detection

Chuang, J.C., J.M. Van Emon, and M.E. Schrock.
Chemosphere, Vol 77 No 9, p 1217-1223, Nov 2009

For a high-throughput screening method using selective pressurized liquid extraction (SPLE) and enzyme-linked immunosorbent assay (ELISA) for monitoring dioxins in sediment and soil, SPLE conditions were developed by extracting sediment or soil together with alumina, 10% AgNO3 in silica, and sulfuric acid-impregnated silica (acid silica) using dichloromethane (DCM) as the solvent at 100 degrees C and 2000 psi. Post-extraction cleanups were not required for ELISA. Two reference sediments (NIST SRM 1944 and Wellington Laboratories WMS01) were analyzed by the SPLE-ELISA method. The ELISA utilized a polyclonal antibody and 2,3,7,8-TCDD as the calibrant. Recoveries of ELISA-derived TCDD equivalents (EQ) relative to the expected gas chromatography/high resolution mass spectrometry (GC/HRMS)-derived dioxin toxic equivalent (TEQ) values were 116+/-11% for SRM 1944 and 102+/-13% for WMS01. ELISA TCDD EQs were consistent with the dioxin TEQs as measured by GC/HRMS for 25 soil/sediment samples from seven different contaminated sites. The ELISA had an approximate method detection limit of 10 pg/g with a precision of 2.6 to 29% based on the relative percentage difference for duplicate samples. Estimated sample throughput for the SPLE-ELISA was three times or more than that of the GC/HRMS method employing PLE with a multi-column cleanup.

i-LAB Hand Held Analyzing Spectrometer

R&D Magazine's Product Showcase, 28 Oct 2009

The i-LAB(r) hand-held analyzing spectrometer from MicrOptix Technologies has broad applicability for field research, lab, and process plant applications. The i-LAB features software that allows users to create customized spectral measurements and analysis routines for use in the i-LAB. The instrument is available in two measurement ranges: the visible light range (400 to 700 nm) and now the NIR Range (650 to 1050 nm). The i-LAB features several sample adaptor options for use with a variety of liquids, as well as a surface reader adaptor for conducting solid surface reflectance measurements. Several measurement methods for QA/QC are included.

ICx Releases Enzyme-Based Chemical Agent Detection Spray
Department of Homeland Security Daily Open Source Infrastructure Report for 28 January 2008

ICx Technologies, a developer of advanced technology solutions for homeland and military security, has announced the availability of ICx Agentase Disclosure Spray, an enzyme-based, chemical-agent detection system in a spray formulation that changes color when sprayed on surfaces contaminated with nerve agents. Agentase Disclosure Spray pinpoints the exact location of agents on surfaces, allowing decontamination teams to focus their regimens accurately. Post-decontamination, the spray helps users determine that affected areas have been thoroughly cleaned. Agentase Disclosure Spray's active ingredients are stored as powders for extended shelf life and are dissolved in water just prior to deployment through the use of a two-chamber sprayer. Color enhancers and thickeners enable usage on dark-colored surfaces or on areas with unusual geometries. The spray also carries components devised to illustrate when surfaces are too basic or too acidic for agent detection. In the field, Agentase Disclosure Spray can detect the presence of CWAs at sub-microgram levels within five minutes, eliminating the need for costly and time-consuming sampling, transportation, and laboratory analysis of potentially harmful agents.

Identification and Mapping of Heavy Metal Pollution in Soils of a Sports Ground in Galway City, Ireland, Using a Portable XRF Analyser and GIS
Carr, R., C. Zhang, N. Moles, and M. Harder.
Environmental Geochemistry and Health, Vol 30 No 1, p 45-52, 2008

During a previous investigation of urban soils in Galway City, Ireland, a pollution hotspot of Pb, Cu, Zn, and As was identified in the sports ground of South Park in the Claddagh. The sports ground formerly was a dump site for both municipal and industrial wastes. In the present study, investigators employed a portable X-ray fluorescence (PXRF) analyzer to obtain rapid in situ elemental analyses of the topsoil (~5 to 10 cm depth) at 200 locations on a 20x20-m grid in South Park. Extremely high values of the pollutants were found. Geographic information system techniques were applied to the data set to create elemental spatial distribution maps, 3-D images, and interpretive hazard maps of the pollutants in the study area. Immediate action to remediate the contaminated topsoil is recommended to safeguard human health on the playing field.

Immunochemical Analysis of 2,4,6-Tribromophenol for Assessment of Wood Contamination
Nichkova, M., M. Germani, and M.P. Marco.
Journal of Agricultural and Food Chemistry, Vol 56 No 1, p 29-34, 2008

2,4,6-Tribromophenol (2,4,6-TBP) has been used as a wood preservative and flame retardant and is a synthetic intermediate in important brominated flame retardants. An efficient and reliable immunochemical method for analysis of TBP in wood samples consists of alkaline wood extraction followed by analysis on a microplate ELISA (enzyme-linked immunosorbent assay). TBP is efficiently extracted from wood samples in 10 min and directly measured after 10-fold buffer dilution to avoid matrix interferences. The analytical procedure has a limit of detection of 45 ng/g of TBP in wood (1.5 ug/L in extracts). The method has been applied to the analysis of contaminated real wood samples, showing that the levels of contamination can reach high TBP concentrations (up to 2,000 ug/L). An excellent correlation was observed between

TBP levels in wood extracts determined by ELISA and gas chromatography-mass spectrometry analysis. The precision found is below 22% CV. The immunoanalytical method developed is fast, reliable, and cost-effective; shows good high-throughput screening capabilities; and can be an excellent tool for assessment of wood contamination at lumber mills or related industries. The TBP ELISA has the potential to be used for environmental, food, and biological monitoring of brominated phenolic compounds, which now are referred to as emerging pollutants.

Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program

U.S. Army Corps of Engineers, Interim Guidance 09-02, 58 pp, July 2009

This interim guidance describes the general sampling principles, concepts, and other considerations necessary for the successful application of incremental sampling (also called multi-increment sampling, or MIS) to sampling of surface soil for munitions constituents at Military Munitions Response Program projects. Due to the broad ranges of project objectives, contaminant properties, and site conditions to which incremental sampling can be applied, the document does not provide specific "cookie-cutter" sampling designs, but instead provides general guidelines for designing sampling plans and evaluating incremental sampling data. The guidance is based on published sampling theory and field demonstrations of the incremental sampling methodology. Demonstration studies for sampling energetic compounds, conducted at active ranges, form the basis of sample collection and processing recommendations made in U.S. EPA Method 8330B. The concepts and approaches presented in this guidance address additional munition constituent analytes, and a broader range of project objectives applicable to formerly used defense sites as well as active sites, and to projects in preliminary assessment, site inspection, and remedial investigation phases. The greatest source of error (uncertainty) in environmental soil sampling data is not from laboratory analytical error, but rather results from sample collection and processing procedures that inadequately address the non-uniform distribution of contaminants in soil. This heterogeneity occurs at all scales, from the variation in composition of individual soil particles, to the uneven distribution of contaminants across a site. Incremental sampling is a sample collection and processing methodology having specific elements designed to control data variability due to heterogeneity in contaminant distribution. Required elements are in both the field collection and laboratory processing and sub-sampling procedures. The objective is to obtain a single sub-sample that contains all analytes in exactly the same proportion as the entire sampled area. This is achieved by collecting a sufficient number of discrete "increments" (typically 30 to 100) in an unbiased manner from throughout a specified area (the sampling unit), combining and variously processing the increments, and incrementally sub-sampling the processed material to obtain a representative aliquot for analysis. Properly executed, the method provides unbiased, representative, and reproducible estimates of the mean concentration of analytes in the sampling unit; however, the practical application of incremental sampling for munitions constituents in soil is a relatively new and evolving subject. Several sections in this interim guidance are the subject of current research, particularly the processing of munitions constituent metals. This interim guidance will be updated as more information is obtained and more experience gained.

Guidance at http://www.hnd.usace.army.mil/oew/policy/IntGuidRegs/IGD%209-02v2.pdf

An Improved Gravimetric Method to Determine Total Petroleum Hydrocarbons in Contaminated Soils

Villalobos, M. (Univ. Nacional Autonoma de Mexico (UNAM), Coyoacan), A.P. Avila-Forcada, and M.E. Gutierrez-Ruiz.

Water, Air, and Soil Pollution, Vol 194 Nos 1-4, p 151-161, 2008

A gravimetric method to determine heavy fractions of total petroleum hydrocarbons (TPH) in soil was adapted and calibrated by modifying previously published standard methods to incorporate energy and cost savings where possible. Artificially contaminated soils with different organic matter content and aged in stationary mode for a period of 8 months were used for calibration. Insufficient solvent evaporation was identified as the most common and largest positive interferent in gravimetric detection. To overcome the interference while minimizing the need for heating, a combination of three 10-min rotary evaporator steps and 30 min of vacuum in a desiccator were applied to a total solvent volume of 60 mL. Hexane was chosen as the extraction solvent, and a 40 to 60 min treatment in an ultrasound bath of 260 W sufficed to extract 80 to 95% of TPH extracted by the Soxhlet method. The use of silica gel for cleanup of co-extracted natural organic matter was unnecessary because of the low amounts co-extracted for soils with up to 5% organic carbon and also because the chemical nature of the co-extracted organic matter prevented its selective adsorption to silica.

An Improved Understanding of Subsurface Acidic Groundwater Flow Pathways through Electrical Geophysical Imaging

Bell, Ron, hydroGEOPHYSICS, Inc., Lakewood, CO

National Association of Abandoned Mine Land Programs 2009 Annual Conference, 27-30 September, Rogers, Arkansas. Abstract only, 2009

Because the electrical conductivity of acidic groundwater is, in general, much greater than that of non-mining-impacted groundwater, host geology, or the unsaturated portions of rock piles, the application of electrical geophysical methods can result in a subsurface map of the spatial variation in pore water content, the location of high-ionic-strength groundwater, and the preferred groundwater flow pathways. High resolution resistivity (HRR) imaging and residual potential mapping (RPM) were applied to the Landusky Mine site, an abandoned gold mine in north central Montana undergoing reclamation, and the characterization of a refractory ore stockpile at an active gold mine in Nevada. In both cases, the 2-D resistivity imaging transects showed areas containing increased concentrations of acidic groundwater. Likewise, the results from the RPM method, where an electric current is made to flow in the subsurface through the placement of an electrode placed at depth in a monitoring well and in a seep, delineated the preferential flowpaths for the acidic groundwater. The data from the geophysical investigations were used in conjunction with data from drilling and other hydrogeological testing to develop an improved understanding of the hydrogeology of each site. The site managers then were able to develop an action plan to mitigate the creation and flow of acidic groundwater.

Improving Temporal Coverage of an Energy-Efficient Data Extraction Algorithm for Environmental Monitoring Using Wireless Sensor Networks

Chatterjea, S. and P. Havinga.

Sensors, Vol 9 No 6, p 4941-4954, 2009

Collecting raw data from a wireless sensor network for environmental monitoring applications can be a difficult task due to the high energy consumption involved. It is especially difficult when the application requires specialized sensors that have very high energy consumption, such as hydrological sensors for monitoring marine environments. This paper introduces a technique for reducing energy consumption by minimizing sensor sampling operations. In addition, the authors illustrate how a randomized algorithm can be used to improve temporal coverage such that the time between the occurrence of an event and its detection can be minimized. The approach was evaluated using real data collected from a sensor network deployment on the Great Barrier Reef. http://www.mdpi.com/1424-8220/9/6

An Insilico Approach to Bioremediation: Laccase as a Case Study
Suresh, P.S., A. Kumar, R. Kumar, and V.P. Singh.
Journal of Molecular Graphics and Modelling, Vol 26 No 5, p 845-849, 2008

Laccase (E.C. 1.10.3.2) is one of the well-studied enzymes used for bioremediation of xenobiotics, such as phenols and anilines. Its broad substrate specificity also has potential for screening pollutants to predict degradation targets. The authors investigated the use of protein-ligand docking as a screening tool. For virtual screening, a set of pollutants were selected from five different industries. X-ray crystal structures of laccase enzymes were taken from the Brookhaven Protein Data Bank (PDB). Two-dimensional structures of pollutants were downloaded from the NCBI Pubchem and then further converted into 3-D structures using CORINA. Protein-ligand docking was carried out using GOLD. Nearly 30 and 17% of the selected datasets showed the best average GOLD fitness score for fungal and bacterial laccase enzyme respectively, with results suggesting that laccase might be able to oxidize these pollutants. Experimental data for anthracene and phenanthrene support this hypothesis.

Investigating Changes of Geoelectrical Resistivity to Identify Groundwater Pollution with Electrical Characteristics of the Saturated Zone Affected by Hazardous Organic Waste
Frohlich, R.K., P.J. Barosh, and T.B. Boving.
Journal of Applied Geophysics, Vol 64 Nos 1-2, p 25-36, 2008

At the Picillo Farm Superfund site in western Rhode Island, predominantly organic contaminants have entered an aquifer comprised of layered glacial deposits and fractured bedrock and spread past the site boundaries with groundwater flow. Hydraulic conductivities in the glacial deposits range over two orders of magnitude and fractures and faults in the granitic bedrock further complicate the spreading of contaminants. Monitoring wells delineate two plumes that extend toward a fault-controlled valley with lakes and wetlands, one to the northwest and the other to the southwest. Investigators studied the electrical characteristics of both plumes. One-dimensional Schlumberger depth soundings were conducted along several profile lines over the plumes and compared to those over non-contaminated sections of the site. High formation factors (ratio of bulk layer to pore water resistivity) between 12 and 45 were observed in the southwestern plume compared to values between 2.5 and 7.7 measured over the non-contaminated sections. High values (>5) of vertical electrical anisotropy (ratio of geoelectrically determined depth to high resistivity bedrock to drilled depth to bedrock) were measured over the contaminated part of the site, and then compared to non-contaminated sites (range: 2 to 3) in glacial stream channels of southern Rhode Island. Overall, the Schlumberger depth soundings are less susceptible to near-surface lateral inhomogeneities than expected from other geoelectrical methods. Also, the disadvantage of a 1-D interpretation was compensated by estimating resistivity and thickness ranges within the concept of non-uniqueness using the Dar Zarrouk parameters. The results over the northwestern plume (showing higher contaminant concentration than the southwestern plume) were mixed and showed no consistent trends. Predominantly reducing conditions, as indicated by the presence of soluble ferric iron hydroxides in groundwater samples, increased the electrical conductivity, and might have compensated the effect of high formation factors on the bulk saturated layer resistivity within the affected area.

Landfill Gas Monitoring Well Functionality at 20 California Landfills
Huff, R.H., J. Bell, and M.B. Beizer.
California Environmental Protection Agency, Integrated Waste Management Board (CIWMB), Sacramento. Publication #IMWB-2008-022, 51 pp, 2008

The intent of this study is to evaluate the functionality of landfill gas (LFG) perimeter migration monitoring probes to assess whether the monitoring data collected is representative of the actual soil gas conditions in the vicinity of the screened portion of each probe. CIWMB preselected 20 landfill sites in northern and southern California for the study. The landfills varied in size, geomorphic and geologic setting, and the presence of relatively deep gas probes (40 to 99 feet or more). Ten probes at each landfill were selected by the contract manager for functionality review and determination. For purposes of this report, we refer to each drilled hole as a well and each individually installed section of PVC as a probe. There is no single way in which to evaluate the functionality of a probe; only through a combination of observations can probe functionality can be determined. For each probe evaluated under this study, SCS reviewed the results from the various components of the sampling program and made a determination as to the probe's functionality for compliance monitoring purposes. The study identified 61 probes as non-functional, 12 probes as "indeterminate," and 117 probes as functional. Based upon these results, the current approach to LFG perimeter migration monitoring probe design, construction, and installation is unsatisfactory. An industry/regulatory standard should be set for probe construction and installation; in the interim, California has developed a list of best management practices for landfill gas monitoring well/probe construction.
http://www.ciwmb.ca.gov/leaCentral/LandfillGas/Monitoring/BMPWellConst.htm

Large Scale Environmental Monitoring through Integration of Sensor and Mesh Networks
Jurdak, R., A. Nafaa, and A. Barbirato.
Sensors, Vol 8 No 11, p 7493-7517, 2008

Networks of wireless sensors can collect physical and chemical samples at high spatial and temporal scales in outdoor environments; however, a central challenge to environmental monitoring applications of sensor networks is the short communication range of the sensor nodes, which increases the complexity and cost of monitoring commodities located in wide geographical areas. The authors propose a new communication architecture that integrates sensor networks with medium-range wireless mesh networks and provides users with an advanced web portal for managing sensed information in an integrated manner. The architecture adopts a holistic approach targeted at improving the user experience by optimizing the system performance for handling data that originates at the sensors, traverses the mesh network, and resides at the server for user consumption. This holistic approach enables users to set high-level policies that can adapt the resolution of information collected at the sensors, set the preferred

performance targets for their application, and run a wide range of queries and analysis on both real-time and historical data. This paper describes all the system components and processes.
http://www.mdpi.com/1424-8220/8/11

Large Zero-Tension Plate Lysimeters for Soil Water and Solute Collection in Undisturbed Soils
Peters, A. and W. Durner.
Hydrology and Earth System Sciences, Vol 13, p 1671-1683, 2009

Water collection from undisturbed unsaturated soils to estimate in situ water and solute fluxes in the field is a challenge, particularly in heterogeneous soils. The authors present a modular plate system that allows installation of large zero-tension lysimeter plates under undisturbed soils in the field. To investigate the influence of the lysimeter on the water flow field in the soil, a numerical 2-D simulation study was conducted for homogeneous soils with uni- and bimodal pore-size distributions and stochastic Miller-Miller heterogeneity. The collection efficiency was found to be highly dependent on the hydraulic functions, infiltration rate, and lysimeter size, and was affected by the degree of heterogeneity. In homogeneous soils with high saturated conductivities, the devices perform poorly, and even large lysimeters (width 250 cm) can be bypassed by the soil water. Heterogeneities of soil hydraulic properties result in a network of flow channels that enhance the sampling efficiency of the lysimeter plates. Solute breakthrough into zero-tension lysimeter appears slightly retarded as compared to the free soil, but concentrations in the collected water are similar to the mean flux concentration in the undisturbed soil. To validate the results from the numerical study, a dual tracer study with 7 lysimeters of 1.25 x 1.25 m area was conducted in the field. Three lysimeters were installed underneath a 1.2 m filling of contaminated silty sand, the others deeper in the undisturbed soil. The lysimeters directly beneath the filled soil material had a water collection efficiency of 45%. The deeper lysimeters did not collect any water. The arrival of the tracers showed that almost all collected water came from preferential flow paths.
http://www.doaj.org/doaj?func=abstract&id=439707

Leeches as Sensor-Bioindicators of River Contamination by PCBs
Macova, S., D. Harustiakova, J. Kolarova, J. Machova, V. Zlabek, B. Vykusova, T. Randak, J. Velisek, G. Poleszczuk, J. Hajslova, J. Pulkrabova, and Z. Svobodova.
Sensors, Vol 9 No 3, p 1807-1820, 2009

A study was conducted to evaluate the use of leeches (Erpobdella) as a means of assessing PCB contamination of watercourses. The River Skalice, heavily contaminated with PCBs, was selected as a model. The source of contamination was a road gravel processing factory in Rozmital pod Tremzinem from which an estimated 1 metric ton of PCBs leaked in 1986. Levels of PCB were measured in leeches collected between 1992 to 2003 from 11 sites covering about 50 km of the river, the first sampling site upstream from the source of contamination and 10 sites downstream. The PCB indicator congeners IUPA numbers 28, 52, 101, 118, 138, 153, and 180 were measured. Levels were highest at the four sampling sites nearest the source of pollution. The highest values of PCB congeners were found in 1992. PCB content decreased from 1992 to 2003 and with distance from the source. The study indicated that leeches of the genus Erpobdella are a suitable bioindicator of contamination in the surface layer of river sediments. http://www.mdpi.com/1424-8220/9/3

Littoral Drifter for Sensing Properties of Shallow Waters and Sediments
Williams, W.G. and L. Centurioni, Clearwater Instrumentation, Inc., Watertown, MA.
ADA487700, 70 pp, Oct 2008

Shallow water environments that exist where rivers and estuaries meet the ocean are often characterized by regimes of energetic currents and shallow rapidly varying bathymetry which in the case of easily mobilized sediments can by spatially modified over short periods. The Riverine drifter has the observational tools to measure the characteristics of the estuarine environment. It combines the position accuracy of GPS locations, 3-dimensional current measuring ability of an Acoustic Doppler Profiling Current meter, depth and bottom characterization of high precision acoustic pinging, and high data rate Iridium telemetry. All of these capabilities are in a compact, stable drifter that weighs less than 10 pounds and that has a very low profile at the sea surface. In addition, this early model of the Riverine Drifter has internal storage that allows many hours of data to be stored and retrieved at a later time to facilitate development of sampling and analysis strategies. Riverine Drifter generates and internally records high quality data describing the aquatic environment it drifts through. A distillation of this information is sent to the user in Iridium data messages sent every ten minutes. Riverine Drifter has been tested in the field in three deployments in Boston Harbor. The device was developed with DoD funding under STTR Topic N05-027, Phase 2.
http://handle.dtic.mil/100.2/ADA487700

Mapping Vegetation Change on a Reclaimed Surface Mine Using Quickbird
Shank, M.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. p 73, 2009

Two methods were implemented for visualizing and mapping vegetation change on a large surface mining complex in southern West Virginia. Quickbird image sets acquired in 2003 and 2007 were used to identify vegetation trends and to map significant change events manifested during the 4-year interval. Vegetation trends were visualized using normalized difference vegetation index difference images, which proved to be a simple and effective means of identifying vegetation change events for further investigation. The investigators then evaluated Feature Analyst--a commercial analysis package--for its ability to map and quantify two of the most significant change events identified in the study area: the defoliation of stands of black locust, and a significant increase in area dominated by deciduous shrub vegetation, which was caused by rapid growth in autumn olive. A field investigation used handheld GPS receivers equipped with ArcPad software and GPS-equipped cameras to verify the cause of the two events. Feature Analyst was able to delineate the extent of black locust defoliation, estimated at over 152 acres on several reclaimed permits. In the second case, the analysis estimated that deciduous shrub cover expanded from 32 acres to over 81 acres on one permit, representing an increase from 6.5% to 16.5% of the total permit area. Feature Analyst showed significant promise for extracting vegetation features from the source images, including individual trees. Feature Analyst's ability to utilize panchromatic and multispectral image sets effectively suggests it is an effective tool for use with increasingly high resolution data available from commercial vendors.

Membrane Based Measurement Technology for In Situ Monitoring of Gases in Soil
Lazik, D., S. Ebert, M. Leuthold, J. Hagenau, and H. Geistlinger.
Sensors, Vol 9 No 2, p 756-767, 2009

A measurement method has been developed for gas concentration and fluxes in heterogeneous soils that is based on selective permeation of gases through tubular membranes. Combining the specific permeation rates of gas components for a membrane and Dalton's principle, the gas concentration (or partial pressure) can be determined by the measurement of physical quantities (pressure or volume) only. Due to the comparatively small permeation constants of membranes, the influence of the sensor on its surrounding area can be neglected. The design of the sensor membranes can be adapted to the spatial scale from the bench scale to the field scale. The sensitive area for the measurement can be optimized to obtain representative results. A continuous time-averaged measurement is possible where the time for averaging is simply controlled by the wall-thickness of the membrane used. The measuring method is demonstrated for continuous monitoring of O2 and CO2 inside a sand-filled lysimeter. Using three sensor planes inside the sand pack installed normal to the gas flow direction and a reference measurement system, the authors demonstrate the accuracy of gas detection for different flux-based boundary conditions. http://www.mdpi.com/1424-8220/9/2

A MEMS-Based Benzene Gas Sensor with a Self-Heating WO3 Sensing Layer
Ke, M.-T., M.-T. Lee, C.-Y. Lee, and L.-M. Fu.
Sensors, Vol 9 No 4, p 2895-2906, 2009

A novel MEMS-based benzene gas sensor consists of a quartz substrate, a thin-film WO3 sensing layer, an integrated Pt micro-heater, and Pt interdigitated electrodes (IDEs). When benzene is present in the atmosphere, oxidation occurs on the heated WO3 sensing layer, which causes a change in the electrical conductivity of the WO3 film, and hence changes the resistance between the IDEs. The benzene concentration then is computed from the change in the measured resistance. A specific orientation of the WO3 layer is obtained by optimizing the sputtering process parameters. The sensitivity of the gas sensor is optimized at a working temperature of 300 degrees C. At the optimal working temperature, experimental results show that the sensor has a high degree of sensitivity (1.0 Kohm/ppm), a low detection limit (0.2 ppm), and a rapid response time (35 s). http://www.mdpi.com/1424-8220/9/4

MEMS Fabricated Nanopores and Micropores Functionalized with Chromate-Selective Solvent Polymeric Membrane
Rieck, Daniel C., Master's thesis, Washington State University, 49 pp, Dec 2008

Ion-selective electrode (ISE) technology, despite its numerous benefits, has not been adapted to regulatory monitoring of heavy metals because of its shortcomings in sensitivity and selectivity. One approach to solving this problem is to combine miniaturized ISEs with lab-on-a-chip preconcentration and preseparation technologies. This thesis presents a manuscript submitted for publication in "Sensors and Actuators B: Chemical" that treats fabrication methods for producing nano- and microsized chromate-selective ISEs compatible with lab-on-a-chip separation technology; characterizes these sensors; and compares their function to coated wire electrodes. UV lithography and focused ion beam were used to make single micropores in SU-8 photoresist and nanopores in silicon nitride (Si3N4) thin films, respectively, functionalizing them with solvent polymeric membrane. The membrane formulation consisted of 7.7:62.2:31.1 wt%

Aliquat336:2-NPOE:PVC. The coated wire electrode arrays exhibited a response slope of -61.7+/-2.4 mV/decade, limit of detection (LOD) of 3.0'10(-6), and potentiometric selectivity coefficients ranging from 1.3'10(-2) for thiocyanate (SCN-) to 5.0'10(-5) for sulfite (SO32-). A nanoscale ISE 100 nm in diameter achieved a response slope of -65.2+/-4.1 mV/decade and a LOD of 1.8'10(-5) M, versus -58.6+/-5.6 mV/decade and 2.1'10(-5) for a microscale ISE 30 um in diameter. Response times averaged 29 s for the nanoscale ISE and 40 s for the microscale ISE. Predicted pore diameters based on these measurements showed -3% and +18% agreements with actual diameters for a 100 nm nanopore and a 30 um micropore, respectively. Atomic force microscopy imaging of the microscale ISE revealed a properly formed micropore and cast membrane, with exposed membrane diameter exceeding that of the pore opening by 1.7 times. AFM was found to be incapable of distinguishing nanoscale ISEs from Si3N4 thin film surface features and dust particles.
http://www.dissertations.wsu.edu/Thesis/Fall2008/d_rieck_012609.pdf

Method Validation Guide for Qualifying Methods Used by Radiological Laboratories Participating in Incident Response Activities
U.S. EPA, National Air and Radiation Environmental Laboratory, Montgomery, AL.
EPA 402-R-09-006, 71 pp, June 2009

This document describes project method validation guidance with which a radioanalytical laboratory should comply to validate methods used to process samples submitted during a radiological or nuclear incident, such as that caused by a terrorist attack. EPA laboratories using radioanalytical processes consistent with the guidance provided in the "Radiological Laboratory Sample Analysis Guide for Incidents of National Significance" should first validate their methods according to the guidance provided in this document. The use of the guidance in these documents will assist in fulfilling EPA's responsibilities as outlined in the National Response Framework Nuclear/Radiological Incident Annex, i.e., response and recovery actions to detect and identify radioactive substances and coordination of federal radiological monitoring and assessment activities. Additionally, this document identifies a formalized process for development and testing of new methods so that there is confidence that radioanalytical results will meet project-specific data requirements. This document is one in a planned series designed to present radioanalytical laboratory personnel, incident commanders (and their designees), and other field response personnel with key laboratory operational considerations and likely radioanalytical requirements, decision paths, and default data quality and measurement quality objectives for samples taken after a radiological or nuclear incident, including incidents caused by a terrorist attack.
http://www.epa.gov/narel/reports/Method%20validation%20Final%20with%20web%20cover%206-24-09.pdf

Methods for Assessing the Relative Amounts of Groundwater Discharge into the Columbia River and Measurement of Columbia River Gradient at the Hanford Site's 300 Area
Fritz, B.G., D.P. Mendoza, R.D. Mackley, G.W. Patton, and E.V. Arntzen.
PNNL-17836, 20 pp, Sep 2008

In 2007 and 2008, two studies were conducted to develop methods for evaluating the relative groundwater discharge at different locations, and a third study to help in future uranium discharge modeling efforts. The first study used specific conductance and temperature monitoring probes buried in an array along the river bed for qualitative differentiation of the spatial and temporal distribution of groundwater discharge. The second study developed and applied a slug testing method to small-diameter aquifer tubes to determine the hydraulic conductivity of the formation under the river at multiple locations. The slug testing method is similar to methods applied in piezometers, but has never been evaluated for use on aquifer tubes. Given the large number of aquifer tubes installed along the Hanford Reach, a viable slug test method has the potential to identify locations with a high likelihood of groundwater discharge (e.g., high hydraulic conductivity). A third study conducted in 2008 measured Columbia River gradient in the vicinity of the 300 Area. The determination of river gradient provides a means to estimate river stage at varying points along the shoreline. This is necessary for groundwater flow models developed for the 300 Area as river stage fluctuations control groundwater movement in the 300 Area. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17836.pdf

Micromirror Chip for Use in Portable Spectrometers for Enhanced Accuracy and Low Cost
Tech Alert from the University of Florida, Office of Technology Licensing, July 2009

The University of Florida is seeking companies interested in commercializing a micromirror chip for use in a variety of optical spectrometers. Spectrometers, particularly in infrared (IR), are very useful for chemical sensing applications; however, conventional IR spectrometers are bulky, expensive, and immobile. Micro-electro-mechanical systems (MEMS) micromirrors are small, fast, and low-cost, but the small scan ranges of existing MEMS mirrors yields very low spectral resolution for IR spectrometers. Researchers at the University of Florida have developed a large vertical-displacement (LVD) MEMS microactuator weighing less than 100 grams whose application demonstrates the concept of a new generation of miniature, high-resolution spectrometers that are portable, wearable, and inexpensive. This advanced, reliable device provides for measurement and quality control in one light-weight, portable spectrometer for chemical biosensing and detection of explosives and toxic gases. Its developers have demonstrated the world-record scan range for MEMS mirrors. To discuss this technology with a licensing officer, call 352-392-8929 or email jmuir@ufl.edu and ask about record UF ID: 12844. Technology alert at http://apps.research.ufl.edu/otl/viewTechInfo.cfm?case=12844

Mid-Infrared Sensing of Organic Pollutants in Aqueous Environments
Pejcic, B., M. Myers, and A. Ross.
Sensors, Vol 9 No 8, p 6232-6253, 2009

The development of chemical sensors for monitoring the levels of organic pollutants in the aquatic environment has received a great deal of attention. The mid-infrared (MIR) sensor based on attenuated total reflectance (ATR) is a particularly promising analytical tool that has been used to detect a variety of hydrocarbon compounds (i.e., aromatics, alkyl halides, phenols) dissolved in water. Under certain conditions, the MIR-ATR sensor is capable of achieving detection limits in the 10 to 100 ppb concentration range. Because the infrared spectral features of every single organic molecule are unique, the sensor is highly selective and can distinguish between many different analytes simultaneously. This review paper discusses the parameters (membrane type, film thickness, conditioning) that dictate MIR ATR sensor response. The performance of various chemoselective membranes used in the fabrication of the sensor is evaluated, and some of the challenges associated with long-term environmental monitoring are discussed. http://www.mdpi.com/1424-8220/9/8

Mine Inspection Assistance Using Remote Sensing Imagery
Bailey, C., N.A. Osborne, N.L. Carter, and D.T. Beaman.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. p 4, 2009

The use of satellite imagery and remote sensing technology has the potential to reduce the costs associated with field inspection of larger mine sites. As part of its West Virginia oversight process, the Office of Surface Mining (OSM) Charleston Field Office normally procures a helicopter service to fly an OSM reviewer over a sample of active and bond-released mine sites. Drainage controls, downslope spoil placement, fly rock, and fill construction are observed on active operations. Bond-released mine sites are reviewed for seeps, vegetation, highwall elimination, and overall reclamation success for postmining land use. A project is under way to determine if satellite imagery is economically and technologically feasible to reduce the cost associated with helicopter overflights. The project also is attempting to identify any mining features that are available only when using satellite imagery and remote sensing technology. Four study areas were selected in West Virginia. Helicopter overflights have been completed and satellite imagery received. The multi-spectral and panchromatic imagery was reviewed and analyzed for mining features. A preliminary cost analysis indicates that viewing the satellite imagery for current mining activities is more cost effective than performing a conventional field inspection. Development of a tool to aide in identifying relevant features is being considered.

Monitoring Plan Design for Validation of Enhanced Monitored Natural Recovery of Contaminated Sediment
Chadwick, B., V. Kirtay, V. Magar, J.M. Conder, M. Greenberg, G. Lotufo, and J. Germano.
SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, 2-4 December 2008. Program Abstracts, p G-179, 2008

The authors present a remedy-specific monitoring approach designed to evaluate the performance of enhanced monitored natural recovery (EMNR) at a DoD sediment site to promote a broader understanding of EMNR while developing a set of tools for long-term monitoring. Under ESTCP Project ER-0827, the EMNR remedy is being implemented in the Quantico Embayment, a semi-circular inlet of the Potomac River at the Quantico Marine Corps Base (MCB), VA. Covering 190 acres, the Embayment is adjacent to the Quantico MCB Site 4 Old Landfill, which was operational until 1971. In 2002, analyses of surface sediment grab samples, subsurface sediment core samples, and biological samples collected within the Embayment revealed that DDT and daughter compounds were sufficiently elevated to be of concern for piscivorous birds. Habitat enhancement capping with monitored natural recovery was the preferred alternative, involving the placement of a thin layer (6 to 9 inches) of clean sediment within a remedial footprint delineation. The clean layer facilitates recovery by providing an initial foothold for benthic biota and creating a positive chain reaction where surface sediment concentration reductions promote additional colonization and recovery. As the clean sediment layer mixes with underlying sediments, recovery extends to deeper layers and ultimately results in ecosystem recovery at higher trophic levels. This presentation details the various monitoring approaches to assess the physical stability of thin layer caps (TLC), the rate and extent to which TLC material is mixed into the sediment bed, and the rate and extent of benthic community recovery following TLC application. The effect of EMNR in reducing surface contaminant concentrations, toxicity, and bioaccumulation are also addressed.

Monitoring the Freely Dissolved Concentrations of Polycyclic Aromatic Hydrocarbons (PAH) and Alkylphenols (AP) around a Norwegian Oil Platform by Holistic Passive Sampling
Harman, C., K.V. Thomas, K.E. Tollefsen, S. Meier, O. Boyum, and M. Grung.
Marine Pollution Bulletin, Vol 58 No 11, p 1671-1679, Nov 2009

Polar organic chemical integrative samplers (POCIS) and semi-permeable membrane devices (SPMDs) were deployed around an oil platform and at reference locations in the North Sea to assess the environmental impact of aquatic discharges from the offshore oil industry. Exposure to PAHs and alkylated phenols was determined from passive sampler accumulations using an empirical uptake model, the dissipation of performance reference compounds, and adjusted laboratory derived sampling rates. Exposure was relatively similar within 1 to 2 km of the discharge point, with levels dominated by short chained C1-C3 alkylated phenol isomers (19 to 51 ng/L) and alkylated naphthalenes, phenanthrenes, and dibenzothiophenes (NPDs, 29 to 45 ng/L). Exposure stations showed significant differences to reference sites for NPDs, but not always for more hydrophobic PAHs. These concentrations are several orders of magnitude lower than those reported to give both acute and sub-lethal effects, although their long-term consequences are unknown.

Molecular Multi-Effect Screening of Environmental Pollutants Using the MolDarT
Liedtke, A., J. Muncke, K. Ruefenacht, and R.I. Eggen.
Environmental Toxicology, Vol 23 No 1, p 59-67, 2008

Molecular effect detection is a useful approach for ecotoxicological screening of chemicals. The molecular DarT (MolDarT) allowed detection of the expression of selected target genes by short-term (120 h) exposure of developing zebrafish (Danio rerio) in subacute multi-effect compound screening. The genes metallothionein 2 (mt2), cytochrome P450 1A1 (cyp1a1), and recombination activation gene 1 (rag1) were used as endpoints to describe detoxification/metal toxicity (mt2), detoxification/PAH toxicity (cyp1a1), and acquired immune system disruption (rag1). Each gene's developmental expression was studied in unexposed zebrafish at 4 h to 120 h past fertilization (hpf), and all three genes were found to be expressed at 120 hpf. Furthermore, mt2 transcripts were present at high levels at 4 hpf, indicating a maternal transfer. For positive toxicity controls, freshly fertilized zebrafish eggs were exposed for 120 hpf to ZnSO(4), 1,5-dimethylnaphthalene (DMN) and CdCl(2). Exposure to 100 and 200 uM ZnSO(4) significantly induced mt2; 10 uM DMN and 20 uM DMN resulted in significantly increased cyp1a1 abundance; and 5 and 10 uM CdCl(2) significantly reduced rag1 expression levels. The authors analyzed the target genes for their expression in zebrafish eggs from a previous exposure study. The eggs were exposed for 120 hpf to the environmental pollutants estradiol, ethinylestradiol, nonylphenol, atrazine, cyproconazol, and bisphenol-A and found differential expression of the three genes. Exposure to the (xeno-)estrogenic compound NP (0.75 uM) significantly lowered mt2 expression. These results shows the potential of short-term in vivo multi-effect screenings within one single subacute exposure using the MolDarT.

Multi-Parameter, Remote Groundwater Monitoring with Referencing Using Crossed Optical Fiber Fluorescent Sensor Arrays
Geissinger, P., Univ. of Wisconsin-Milwaukee.
USGS/Wisconsin Water Resources Research Inst. Project WR06R001, 2008

The sensor platform consists of a rectangular array of junctions of two optical fibers (with adjacent junctions spaced by as little as a few millimeters), at which fluorescent sensors are located. Using pulsed laser excitation and time-resolved detection, every sensor region in the array, in spite of their close proximity, can be read out individually. The sensor molecules are covalently attached to porous gels, which replace the original cladding of the fiber. This sensor active cladding, in turn, is covalently attached to the exposed core of the fiber. Prior to the attachment, the fiber core is functionalized with a hydrophobic, self-assembled monolayer, which in addition to providing attachment sites also protects the fiber core from damage due to hydroxyl penetration through microcracks. This array provides a very general, high-spatial resolution sensing platform, whose functionality depends on the chosen sensor molecules. This project focuses on the development of an array that allows for simultaneous, remote sensing of at least two parameters characterizing the aqueous environment of the sensors: pH and oxygen concentration.
http://www.wri.wisc.edu/Default.aspx?tabid=85&ctl=Details&mid=482&ProjectID=98562293

Nano and Microsensors for Chemical and Biological Terrorism Surveillance
Tok, J.B.-H. (ed.).
Royal Society of Chemistry, Cambridge, UK. ISBN: 978-0-85404-140-4, 224 pp, 2008

This publication provides readers with a brief yet concise collection of the latest advances in chemical and biological agent detection and/or their surveillance. It compiles and gives in-depth detail on several detection schemes so that the reader can be provided with a general sense of these micro- and nanoscale sensing systems and platforms. The book covers both well-established and next-generation micro- and nanoscale sensors and/or sensing platforms. The sensors or sensing platforms covered range from the novel utilization of nanotubes, cantilevers, nano and/or microsized pores, and engineered whole cell, to polymeric transistors for sensing purposes. As a result of these advances, there has been a synergistic marriage of techniques ranging through chemical, engineering, and biological for the development of sensors. The enabling of these new technologies will result in a much improved sensing network for the detection and surveillance of both chemical and biological warfare agents. The book also contains chapters from leading experts in the field of chemical and biological sensing platforms.

A New Gas Chromatography/Mass Spectrometry Method for the Simultaneous Analysis of Target and Non-Target Organic Contaminants in Waters
Gomez, M.J., M.M. Gomez-Ramos, A. Aguera, M. Mezcua, S. Herrera, A.R. Fernandez-Alba.
Journal of Chromatography A, Vol 1216 No 18, p 4071-4082, 1 May 2009

Using large volume injection with backflushing, scientists developed a GC-MS method for the analysis of priority pollutants, personal care products, and other emerging contaminants in waters. Analyses were performed in the SIM/scan mode, so that in addition to the targeted organic contaminants, the method allowed the simultaneous screening of non-target compounds. The scan data were analyzed using deconvolution reporting software (DRS), which screens the results for 934 organic contaminants. Deconvolution helps identify contaminants that are buried in the chromatogram by co-extracted materials and significantly reduces chromatographic resolution requirements, allowing shorter analysis times. All compounds have locked retention times, and the mass spectral library can be continually updated and extended to include new compounds. Linearity and limits of detection in SIM and full-scan mode were studied. Method detection limits (MDLs) in effluent wastewater ranged in most of the cases from 1 to 36 ng/L in SIM mode and from 4 to 66 ng/L in full-scan mode, and in river water from 0.4 to 14 and 2 to 29 ng/L in SIM and full-scan mode, respectively. The researchers obtained a linearity of the calibration curves over two orders of magnitude. The method has been applied to the screening of a large number of organic contaminants--not only to a subset of targets--in urban wastewaters from different wastewater treatment plants and also in river waters. Most of the target compounds were detected at concentration levels ranging from 11 to 8,697 ng/L and from 7 to 1,861 ng/L in effluent wastewater and river waters, respectively. Twelve new compounds were automatically identified using the AMDIS and NIST libraries. Other compounds, such as the 4-amino musk xylene, a synthetic fragrance metabolite, which was not included in the databases, was manually searched in the full-scan chromatograms.

New Technology Detects Chemical Weapons in Seconds
Engineering and Physical Sciences Research Council, 5 Oct 2009

A system developed by scientists at Queen's University Belfast relies on Raman spectroscopy to analyze samples collected by swipes of the area of interest. This is not enough for low-concentration detection, however, so the sample is mixed with silver nanoparticles to amplify the signal of the compounds. The devices will use special gel pads to 'swipe' an individual or crime scene to gather a sample which is then analyzed by a scanning instrument that can detect the presence of chemicals within seconds. This will allow better, faster decisions to be made in response to terrorist threats. The scanning instrument will use Raman spectroscopy, which involves shining a laser beam onto the suspected sample and measuring the energy of light that scatters from it to determine what chemical compound is present. It is so sophisticated it can measure particles of a miniscule scale, making detection faster and more accurate. Normally this type of spectroscopy is not sensitive enough to detect low concentrations of chemicals, so the sample is mixed with nanoscale silver particles, which amplify the signals of compounds, allowing even the smallest trace to be detected. In the future, this technology could have a variety of important applications, from medical diagnostics to environmental monitoring, where the ability to use simple field tests to detect traces of important indicator compounds would be invaluable. The research is being led by Dr Steven Bell of the School of Chemistry and Chemical Engineering at Queen's University of Belfast in collaboration with colleagues from the School of Pharmacy at Queen's University and Forensic Science Northern Ireland. Since 1999, this collaboration has been focused on developing new Raman and SERS methods for analysis of illicit drugs, paints, fibers, materials, and other physical evidence.
http://www.epsrc.ac.uk/PressReleases/chemicalweapons.htm

No-Purge Groundwater Sampling Evaluation at the Massachusetts Military Reservation
Greenberg, M. and N. Tindall, CH2M Hill.
Joint Services Environmental Management Training Conference & Exposition, 5-8 May 2008, Denver, Colorado. Abstract ID 8141, 2008

The no-purge groundwater sampling methodology enables passive collection of a groundwater sample from a discrete interval within a monitoring well screen without the pumping or purging required by conventional techniques, such as low-flow sampling. No-purge sampling relies upon the natural advective movement of groundwater through an open well screen. After sufficient time has elapsed for the sampling device to stabilize, the resulting sample is considered to be representative of the aquifer conditions immediately adjacent to the well screen. The primary advantages of using the no-purge technique include the cost savings associated with reduced sampling time, reduced equipment and materials, the absence of fossil-fuel powered generators, and elimination of purge water when compared to sample collection through conventional methods using pumps. The feasibility of integrating the no-purge sampling methodology into a large groundwater monitoring program was evaluated at the Massachusetts Military Reservation (MMR), where over 1,000 monitoring wells are sampled each year. Two types of no-purge sampling devices were tested and evaluated: the passive diffusion bag sampler (PDB) and the HydraSleeve(r) sampler. A series of side-by-side sampling tests were performed that evaluated the performance of (1) PDBs versus the traditional low-flow pump sampling techniques and (2) PDBs versus HydraSleeve(r) samplers. The testing consisted of a comparison of the analytical data generated using each sampling technique, a qualitative assessment of the usability of the sampling devices, and an evaluation of the potential cost savings of using no-purge techniques against the conventional low-flow pump methods. In addition, the evaluation reviewed the overall benefits and limitations of the no-purge samplers tested against the traditional lowflow pump sampling techniques currently utilized at the MMR.

Non-Discriminating Flash Pyrolysis and Thermochemolysis of Heavily Contaminated Sediments from the Hamilton Harbor (Canada).
Poerschmann, J., Z. Parsi, and T. Gorecki.
Journal of Chromatography A, Vol 1186 Nos 1-2, p 211-221, 2008

Analytical pyrolysis of sediments contaminated with pollutants of medium to high molecular weights (up to ~500 Da) is challenging when using conventional pyrolysis systems due to discrimination of high-molecular-weight analytes. This paper describes an application of non-discriminating pyrolysis and thermochemolysis using rapid heating in a Silcosteel capillary to study organic pollutants in heavily contaminated sediments taken from the Hamilton Harbor. The novel pyrolysis approach, requiring very small amounts of sample, was shown to be a useful rapid screening method, proving superior to commonly used solvent extraction. The main pollutants in the study sediments were aromatic hydrocarbons, chiefly originating from coal tar and petroleum. PAHs beyond 6 rings, including coronene and truxene, were detected. Sequential tetramethyl ammonium hydroxide-induced thermochemolysis performed at 500 and 750 degrees C enabled differentiation between organic pollutants sorbed onto the sediment matrix on the one hand, and structural moieties of the condensed polymeric humic sediment matrix along with bound residues on the other. Thermochemolysis at 500 degrees C removed sorbates quantitatively, leaving only bare polymeric humic matrix. Significant PAH source indicators provided evidence that the lipidic fraction sorbed onto the sediments originated from PAHs formed chiefly in coal combustion processes. Thermochemolysis at 500 degrees C also was used to study fatty acid profiles of the sediments. The fatty acid methyl ester patterns obtained for the two sites under study differed significantly, with strong indications that microbial attenuation of the pollutants at the heavily polluted site 2 was strongly suppressed.

Oil Spill Detection by SAR Images: Dark Formation Detection, Feature Extraction and Classification Algorithms
Topouzelis, K.N.
Sensors, Vol 8 No 10, p 6642-6659, 2008

The detrimental effect of oil spills on fragile marine and coastal ecosystem causes political and scientific concern. This paper provides a comprehensive review of the use of synthetic aperture radar images (SAR) for detection of illegal oily discharges from ships. It summarizes the current state of the art, covering operational and research aspects of the application. The amount of pollutant discharges and associated effects on the marine environment are important parameters in evaluating sea water quality. Satellite images can improve the possibilities for the detection of oil spills as they cover large areas and offer an economical and easier way to patrol continuous coastal areas. SAR images have been widely used for oil spill detection. The author reviews the methodologies used to detect oil spills on the radar images, particularly the manual and automatic approaches to distinguish oil spills from other natural phenomena. The paper covers the most common techniques to detect dark formations on the SAR images, the features that are extracted from the detected dark formations, and the most frequently used classifiers. The discussion concludes with suggestions for further research. http://www.mdpi.com/1424-8220/8/10

On the Relevance of Using Open Wireless Sensor Networks in Environment Monitoring
Bagula, A.B., G. Inggs, S. Scott, and M. Zennaro.
Sensors, Vol 9 No 6, p 4845-4868, 2009

This paper revisits the problem of the readiness for field deployments of wireless sensor networks by assessing the relevance of using open hardware and software motes for environment monitoring. The authors propose a new prototype wireless sensor network that fine-tunes SquidBee motes to improve the lifetime and sensing performance of an environmental monitoring system that measures temperature, humidity, and luminosity. Building upon two outdoor sensing scenarios, the performance of the newly proposed energy-aware prototype solution was evaluated in terms of link quality when expressed by the received signal strength, packet loss and the battery lifetime. The experimental results highlight the potential of using open hardware and software motes when setting up outdoor wireless sensor networks. http://www.mdpi.com/1424-8220/9/6

On the Suitability of Portable X-Ray Fluorescence Analyzers for Rapid Screening of Toxic Elements
Palmer, P., S. Webber, K. Ferguson, and R. Jacobs.
FDA/ORA/DFS Laboratory Information Bulletin, LIB #4376, p 1-15, 2008

X-ray fluorescence (XRF) spectrometry has been used routinely for alloy testing, determination of Pb in paint, and determination of Cd in plastic. Its application to screening for toxic elements in food and medicinal products, however, has been surprisingly limited to date. While XRF is less sensitive than atomic spectrometry methods, such as ICP-AES and ICP-MS, it

offers significant advantages in minimal sample preparation, rapid analysis times, multi-element detection, and hand-held instruments for field use. A study was conducted to evaluate the capabilities and limitations of two different portable XRF analyzers from Niton and Innov-X. Samples of liquid, semi-solid, and solid substances (cranberry juice, yogurt, and chocolate) were fortified with up to four different toxic elements (arsenic, lead, mercury, and/or selenium) to give known concentrations on a weight/weight basis. Samples were analyzed via XRF, and the resulting data were evaluated to ascertain figures of merit for selectivity, limits of detection (LODs), linear dynamic range, accuracy, precision, and speed. Selectivity generally was good, and positive detection can be confirmed through the observation of multiple emission lines for an element. Although accurate quantitation of multiple elements might be compromised by overlap of emission lines, the presence of several toxic elements in a given product was not anticipated. The sensitivity of the Innov-X analyzer was nearly an order of magnitude better than the Niton, with LODs in the 5 to 10 ppm range for all four target elements. Calibration curves were linear across more than three orders of magnitude spanning concentrations from the LOD out to percent levels. The accuracy of the Innov-X analyzer was slightly better than the Niton, with relative errors typically less than 20%, which is remarkable considering that no external calibration procedures were employed and the results were obtained using the manufacturer's standard quantitation algorithms. Precisions were good as well, with percent relative standard deviations of 5% or less. The most attractive features of XRF are its speed and simplicity, with minimal sample preparation required, analysis times as short as a minute or less, and estimated throughputs of ~60 samples per hour using a hand-held device that can be operated by a nonexpert. Collectively, these capabilities make XRF a powerful tool for screening of toxic elements and rapidly responding to emergency situations that require identification and quantitation of toxic elements.
http://bss.sfsu.edu/envstudies/faculty_research/palmer_lib-xrf_suitability.pdf

On-Site Profiling and Speciation of Polycyclic Aromatic Hydrocarbons at Manufactured Gas Plant Sites by a High Temperature Transfer Line, Membrane Inlet Probe Coupled to a Photoionization Detector and Gas Chromatography/Mass Spectrometer
Considine, T. and A. Robbat Jr., Tufts Univ., Medford, MA.
Environmental Science & Technology, Vol 42 No 4, p 1213-1220, 2008

A new high-temperature transfer line membrane-inlet probe coupled to a photoionization detector (PID) and gas chromatograph/mass spectrometer (GC/MS) was used for rapid profiling and speciation of PAHs in the subsurface. PID signals were in agreement with GC/MS results. Correlation coefficients of 0.92 and 0.99 were obtained for discrete and composite samples collected from the same exact location. Continuous probe advancement with PID detection found coal tar, a DNAPL, in soil channels and saturated media. When samples were collected conventionally, split, solvent extracted, and analyzed in the field and confirmation laboratory, GC/MS measurement precision and accuracy were indistinguishable; despite the fact the field laboratory produced data 5 times faster than the laboratory using standard EPA methods. No false positive/negatives were found. PID response indicated total PAH presence/absence in real time, while GC/MS provided information as to which PAH was present and at what concentration. Incorporation of this tool into a dynamic workplan will provide more data at less cost, enabling environmental scientists, engineers, and regulators to achieve a better understanding of coal tar migration and its impact on human health and the environment.

Optimized Munitions Constituents Sampling Using Geophysical and Intrusive Investigation Data
Brook, L. and B. Powers, URS Group, Inc.
JSEM 2008: 2008 Joint Services Environmental Management Training Conference and Exhibition, 5-8 May 2008, Denver, Colorado: Abstracts. Abstract 8312, 2008

About 3,000 acres of closed range area at F.E. Warren Air Force Base, Wyoming (FEW) require munitions response commensurate with proposed future land use. For a remedial investigation under CERCLA of munitions and explosives of concern (MEC) and munitions constituents (MC), geophysical survey data were acquired and evaluated to identify target anomalies that then were investigated intrusively to identify objects producing the anomalies. The resulting distribution of recovered MEC and munitions debris was used to identify munitions response sites (MRS) that were targeted for MC sampling. MC target analytes were identified prior to sampling using DoD's Munitions Items Disposition Action System (MIDAS) database and knowledge of the recovered MEC types at FEW. Soil characterization included collection of biased composite and discrete (grab) samples to determine potential MC impact on soils. Grab samples were collected from beneath completely and partially intact MEC as opportunities arose to collect samples safely during intrusive activities. Composite soil samples were collected from the most highly impacted acres of the defined MRSs in a phased approach to allow for any adjustments based on the first phase of sampling. Both surface and subsurface composite soil samples were analyzed to allow evaluation of the associated risk exposure pathways. Results were compared to site background data and FEW-adopted screening levels to understand any impact or risk resulting from detected MC. With a few exceptions, composite soil sample results generally were less than background and screening levels, while the grab samples yielded different results for intact versus partially intact MEC. Soil samples collected beneath intact MEC generally exhibited non-detect results. Soil samples collected immediately beneath partially intact MEC exhibited elevated concentrations of metals and explosives that declined rapidly with distance from the non-intact MEC.

ORNL Scientists Hone Technique to Safeguard Water Supplies
Oak Ridge National Laboratory News Release, 28 Aug 2009

A method to detect contaminants in municipal water supplies has undergone further refinements by two Oak Ridge National Laboratory (ORNL) researchers whose findings are published on line in Water Environment Research. The new work demonstrates that the technology that uses algae as sentinels has broader applications than previously reported. For example, under real-world operating conditions, the sensitivity of the algae to toxins has a natural daily cycle that tracks the sun. The algae are less sensitive to the toxins when the sun is overhead and shining brightly. New results show that keeping the water sample in darkness for about 30 minutes prior to testing for toxins restores full sensitivity to the test. The technology can be applied to many different water quality environments—e.g., free-living microalgae combined with 'work-around' strategies can be used as broad-spectrum automated biosensor systems for continuous monitoring of source drinking water. The process uses a fluorometer to measure the fluorescence signal of algae that grow naturally in source water. Water from Tennessee's Clinch River was used in this study. Researchers exploit the known characteristics of Photosystems I and II, which convert light energy into chemical energy to detect any changes in the process of photosynthesis. "Recent advances in optoelectronics and portability make this a powerful technology for monitoring the in situ physiology of aquatic photosynthetic organisms such as green algae and cyanobacteria," the authors wrote. Even low levels of toxins alter fluorescence patterns within minutes. Another significant aspect of this work is the reporting of statistically reliable data on the threshold detection levels for broad classes of toxins, such as blood and nerve agents and agrochemicals. These threshold detection levels are at or near U.S. EPA regulatory guidelines. The researchers looked at five classes of chemical agents in water: Diuron, atrazine, paraquat, methyl parathion, and potassium cyanide. Greenbaum and Rodriguez were able to detect Diuron at 1 part per million as indicated by a 17% decline in the algae's Photosystem II efficiency. The microalgae do not need to be in an optimized state for this technology to detect relatively low concentrations of toxins effectively. This research was funded by DOE's Office of Biological and Environmental Research, the Defense Advanced Research Projects Agency, and BAE Systems. Discussions for commercialization of this technology, to be marketed under the name AquaSentinel, are under way.

Outlier Identification and Visualization for Pb Concentrations in Urban Soils and Its Implications for Identification of Potential Contaminated Land
Zhang, C., Y. Tang, L. Luo, and W. Xu.
Environmental Pollution, Vol 157 No 11, p 3083-3090, Nov 2009

Outliers in urban soil geochemical databases could be used for identification of potentially contaminated land. Different methodologies that can be easily implemented for the identification of global and spatial outliers were applied for Pb concentrations in urban soils of Galway City in Ireland. Due to its strongly skewed probability feature, a Box/Cox transformation was performed prior to further analyses. The graphic methods of histogram and box-and-whisker plot were effective in identification of global outliers at the original scale of the dataset. Spatial outliers could be identified by a local indicator of spatial association of local Moran's I, cross-validation of kriging, and a geographically weighted regression. The spatial locations of outliers were visualized using a geographical information system. The various methods showed generally consistent results, but some differences were observed. The authors suggest that outliers identified by statistical methods should be confirmed and justified using scientific knowledge before they are dealt with.

Passive and Self-Powered Autonomous Sensors for Remote Measurements
Sardini, E. and M. Serpelloni.
Sensors, Vol 9 No 2, p 943-960, 2009

Autonomous sensors enable measurements in harsh or hermetic environments, such as extreme heat, cold, humidity, or corrosive conditions. The use of batteries as a power supply for these devices represents one solution, but the size and sometimes the cost and unwanted maintenance burdens of replacement are important drawbacks. This paper reviews passive and self-powered autonomous sensors without batteries for harsh or hermetical environments; presents their general architectures; and analyzes sensing strategies, communication techniques, and power management. General building blocks of an autonomous sensor are discussed with the design guidelines that such a system must follow. Different proposed applications of autonomous sensors applied in harsh or hermetic environments are reported, and two examples of passive autonomous sensors that use telemetric communication are proposed: the first one for humidity measurements and the second for high temperatures. Other examples of self-powered

autonomous sensors that use a power-harvesting system from electromagnetic fields are proposed for temperature measurements and for airflow speeds.
http://www.mdpi.com/1424-8220/9/2

Passive Sampling of Selected Endocrine Disrupting Compounds Using Polar Organic Chemical Integrative Samplers
Arditsoglou, A. and D. Voutsa, Aristotle Univ., Thessaloniki, Greece.
Environmental Pollution, Vol 156 No 2, p 316-324, Nov 2008

Polar organic chemical integrative samplers (POCIS) for use with pharmaceuticals and pesticides were examined for their sampling efficiency of selected endocrine-disrupting compounds (EDCs). Laboratory-based calibration of POCISs was conducted by exposing them at high and low concentrations of 14 EDCs (4-alkyl-phenols, their ethoxylate oligomers, bisphenol A, selected estrogens, and synthetic steroids) for different time periods. The kinetic studies showed an integrative uptake up to 28 days. Sampling rates for the individual compounds were obtained. The use of POCISs could result in an integrative approach to the quality status of aquatic systems, especially for high variations of water concentrations of EDCs. The efficiency of the pharmaceutical and pesticide samplers under various field conditions was assessed after their deployment in different aquatic environments.

Passive Wick Fluxmeters: Design Considerations and Field Applications
Gee, G.W., B.D. Newman, S.R. Green, R. Meissner, H. Rupp, Z.F. Zhang, J.M. Keller, W.J. Waugh, M. van der Velde, and J. Salazar.
Water Resources Research, Vol 45: Article W04420, 2009

The performance of passive wick fluxmeters for producing reliable estimates of vadose zone water fluxes was compared to that of lysimeters. Knowledge of vadose zone water fluxes is required to optimize water use in agriculture and quantify percolation from landfills and watersheds. Passive wick fluxmeters use a control tube to minimize convergent or divergent flow, while lysimeters measure water flux directly but are expensive and can disrupt flow, causing errors in the measured drainage. Design calculations with a quasi 3-D model illustrate how convergence and divergence can be minimized for a range of soil and climatic conditions under steady-state and transient fluxes using control tubes of varying heights. A critical recharge rate exists for a given wick length, where the fluxmeter collection efficiency is 100% regardless of the height of the control tube. Otherwise, convergent or divergent flow will occur, especially when the control tube height is small. While divergence is eliminated in coarse soils using control tubes, it is reduced but not eliminated in finer soils, particularly for fluxes <100 mm/a. Passive wick fluxmeters were tested in soils ranging from nonvegetated semiarid settings in the United States to grasslands in Germany and rain-fed crops in New Zealand and the South Pacific. Where side-by-side comparisons of drainage were made between passive wick fluxmeters and conventional lysimeters in the United States and Germany, agreement was very good. In semiarid settings, drainage was found to depend upon precipitation distribution, surface soil, topographic relief, and the type and amount of vegetation. In Washington State, soil texture dominated all factors controlling drainage from test landfill covers. As expected, drainage was greatest (>60% annual precipitation) from gravel surfaces and least (no drainage) from silt loam soils. In Oregon and New Mexico (USA) and in New Zealand, drainage showed substantial spatial variability. The New Mexico tests were located in semiarid canyon bottom terraces, with locations prone to flash floods having extremely high drainage/precipitation ratios. In the wettest environments, drainage was found to be closely linked to the rate and duration of precipitation events. http://www.lanl.gov/source/orgs/ees/ees14/pdfs/09Gee.pdf

A Qualitative Reclamation Assessment Handbook for Abandoned Hardrock Mine Lands
Blicker, P.S., D.R. Neuman, and S.R. Jennings.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. p 6, 2009

The Abandoned Mine Lands Inventory System (AMLIS) indicates nearly 1,100 abandoned mines in Montana. The Montana offices of the Bureau of Land Management and the U.S. Forest Service as well as the Montana Department of Environmental Quality AML Program have been working to clean up these abandoned mine lands since 1995. The agencies in general have given priority to sites with mill tailings and waste rock dumps situated in stream channels, and Montana emphasizes the cleanup of impacted lands on a watershed basis through interagency cooperation. To begin monitoring these reclaimed sites in a systematic way, a handbook, "Qualitative Reclamation Assessment Handbook for Abandoned Hardrock Mine Lands," has been developed to provide a common platform to evaluate reclaimed mine sites so that federal agencies responsible for risk management and land management can easily communicate and work in partnership to accomplish their respective missions. The handbook contains assessment forms and protocols designed to evaluate pertinent attributes found at specific locations within a reclaimed mine site (e.g., repository, wetland). These attributes can include vegetation cover, status of a cap or liner, roads, and evidence of acid mine drainage. The outcome envisioned by the agencies includes identifying maintenance needs, generating temporal information for trend analysis, and identifying remedial methods and technologies that have proven to be effective and those that have resulted in poor performance. The data and information collected during a reclamation assessment then can be used to evaluate the status of the reclamation work and whether or not the conditions at the site remain protective. Contact Reclamation Research Group, LLC (RRG) for an electronic copy of the Handbook: http://www.reclamationresearch.net/projects/completed.htm, info@reclamationresearch.net, or 406.624.6571 in Bozeman, Montana.

Quantifying In Situ Contaminant Mobility in Marine Sediments: Final Report
Davidson, B., T. Hampton, and B. Chadwick, SPAWAR Systems Center.
Environmental Security Technology Certification Program (ESTCP), Project ER-9712, 385 pp, 2008

This project addresses the DoD/Navy requirement for compliance, cleanup assessment, and remediation decisions using innovative technology for direct quantification of the mobility and bioavailability of contaminants in marine sediments. Marine sediments serve as a repository for contamination from a wide variety of sources. The environmental risks posed by these contaminants are determined largely by the degree to which they remobilize into the environment. The primary objective of the demonstrations of the BFSD2 was to perform deployments at contaminated sites in San Diego Bay, CA, and Pearl Harbor, Hawaii, under the observation of CalEPA certification evaluators. Other observers, including local, state, and federal regulators, RPMs, academic, industry, and other DoD also attended. Each site offered

different validation opportunities: San Diego Bay was used to show instrument repeatability and comparison with historical trends and Pearl Harbor was used to show site differences and geochemical trend analysis. Organics demonstrations were performed at the same sites. The specific planned objectives of the demonstrations were as follows: (1) Evaluate the quality of water samples collected using the BFSD2, specifically for use in determining if a statistically significant flux was occurring at the test locations in comparison to the blank flux results for the BFSD2. (2) Evaluate the BFSD2 for repeatability. (3) Evaluate the logistical and economic resources necessary to operate the BFSD2. (4) Evaluate the range of conditions in which the BFSD2 can be operated. Other objectives included exposure of various user communities to the technology to encourage continued interest and applications.
http://www.estcp.org/Technology/upload/ER-9712-FR%20(Organics).pdf

Quantifying In Situ Metal and Organic Contaminant Mobility in Marine Sediments: ESTCP Cost and Performance Report
Environmental Security Technology Certification Program (ESTCP), Project ER-9712, 40 pp, Jan 2009

This Cost and Performance Report is a companion to the final report, Quantifying In Situ Metal and Organic Contaminant Mobility in Marine Sediments (ESTCP 2000). To determine whether contaminants are moving into, out of, or remaining immobilized within sediment, a determination of contaminant flux must be made. The environmental risks posed by these contaminants are determined largely by the degree to which they remobilize into the environment. The work on Project ER-9712 included demonstrations of the commercialized Benthic Flux Sampling Device (BFSD2) at sites in San Diego Bay (Paleta Creek) and Pearl Harbor (Middle Loch and Bishop Point). The demonstration results were used by evaluators from the California EPA as part of their Technology Certification Program process. The demonstrations successfully showed accurate, precise, and repeatable results at both locations. The San Diego sites emphasized repeatable performance, and the Pearl Harbor sites emphasized the range of conditions for operation. Routine and standardized methods and procedures were used throughout these operations. The initial project, limited to metal-contaminated sediments, subsequently was extended to organic contaminants. Technical performance, schedule, and cost data were collected during the demonstrations that document the utility of the technology for in situ measurement of the mobility of contaminants in marine sediments effectively, efficiently, and in a timely manner. This approach has no directly comparable technology in current use and thus represents an innovative and new resource for the environmental community.
http://www.estcp.org/Technology/upload/ER-9712-C&P.pdf

Quantifying Uncontrolled Landfill Gas Emissions from Two Florida Landfills
U.S. EPA, National Risk Management and Research Laboratory, Research Triangle Park, NC. EPA 600-R-09-046, 128 pp, May 2009

A study was conducted to evaluate fugitive loss from two different municipal landfills. Each landfill was reported to be operating as a "wet" or bioreactor landfill and had an area regarded as a "control" cell where no additional liquid was added. Fugitive methane emissions were measured at both sites for the wet and control cells using optical remote sensing (ORS) technology. Two different instruments were used -- an open-path tunable diode laser (OPTDLAS) instrument by Boreal, Inc (the Gas-Finder 2.0) and an open-path Fourier transform infrared (OP-FTIR) instrument by IMACC, Inc. The measurements were conducted using vertical radial plume mapping (VRPM) to calculate net methane-flux emission values from the top and side slopes of each landfill cell. In addition to the ORS measurements, SUMMA canister samples were collected from the gas header pipes at the sites to obtain data on trace constituents in landfill gas, such as non-methane organic compounds, hydrogen sulfide, mercury, and other hazardous air pollutants. Using the OP-ORS data, methane emission flux rates were calculated for each cell. The methane flux results for landfill 1 indicate that fugitive methane emissions from the bioreactor cell were about twice that of the control cell (1,500 vs 3,800 kg/day). At landfill 2, methane emissions from the control cell were about 5 times higher than the bioreactor cell (~6,000 vs 1,200 kg/day), which is attributed to the fact that no liquid additions had been added to the bioreactor for several months because of heavy rainfall from a recent series of hurricanes. In addition, a fresh layer of soil had just been added to the surface of the bioreactor cell just prior to when the field measurements were conducted. Estimates of the total site emissions were calculated for Site 1 (5,300 kg/day) and site 2 (7,300 kg/day). As additional tests are conducted, data will be available the better to understand the amount of uncontrolled landfill gas and potential differences in fugitive loss between wet versus traditional landfill design and operation. http://www.epa.gov/ORD/NRMRL/pubs/600r09046/600r09046.html

Quantitative Analysis of Three Chiral Pesticide Enantiomers by High-Performance Column Liquid Chromatography
Wang, P., D. Liu, X. Gu, S. Jiang, and Z. Zhou.
Journal of AOAC International, Vol 91 No 5, p 1007-1012, 2008

Methods for the enantiomeric quantitative determination of 3 chiral pesticides--paclobutrazol, myclobutanil, and uniconazole, and their residues--in soil and water involved a high-performance liquid chromatographic (HPLC)-UV method were developed using an amylose-tris(3,5-dimethylphenylcarbamate, or AD) column for resolving the enantiomers and quantitative determination. The enantiomers were identified by a circular dichroism detector. Validation involved complete resolution of each of the 2 enantiomers, plus determination of linearity, precision, and limit of detection (LOD). The pesticide enantiomers were isolated by solvent extraction from soil and C(18) solid-phase extraction from water. The 2 enantiomers of the 3 pesticides could be separated completely on the AD column using an n-hexane isopropanol mobile phase. The linearity and precision results indicated that the method was reliable for the quantitative analysis of the enantiomers. LODs were 0.025, 0.05, and 0.05 mg/kg for each enantiomer of paclobutrazol, myclobutanil, and uniconazole, respectively. Recovery and precision data showed that the pretreatment procedures were satisfactory for enantiomer extraction and cleanup. This method can be used for optical purity determination of technical material and analysis of environmental residues.

Quick Look at Hyperspectral Imaging of Skidoo, Death Valley
AmEnde, B., The Aerospace Corporation, Chantilly, VA.
National Association of Abandoned Mine Land Programs 2009 Annual Conference, 27-30 September, Rogers, Arkansas. [Abstract only] 2009

Imagery collection is planned for August 2009 over the Skidoo area of Death Valley National Park. The following sensors will be on board the Twin Otter aircraft: (1) SEBASS (Spatially Enhanced Broadband Array Spectograph System), which measures 128 bands each of the midwave and longwave infrared portions of the electromagnetic spectrum; (2) ProspecTIR-V, which measures 256 bands in the visible and near infrared; (3) ProspecTIR-S, which measures 254 bands in the shortwave infrared; and (4) FLIR Photon broadband longwave infrared bolometer. The imagery collect will provide data on the feasibility of using thermal imagery for reconnaissance, following up on previous indications that the entrances to abandoned mines can be identified using broadband thermal imaging. This combined collect of hyperspectral data of hundreds of bands across the entire range from visible to longwave infrared is unprecedented for add-on information about mine entrances, and this project will be used to validate the technique for recognizing known mines using data on known mines supplied by the California Department of Conservation, as well as searching for unrecognized shafts and possibly adits.

Radiello(r) Passive Sampling Method for Evaluating Vapor Intrusion
Brett Shamory - DMS Environmental Services, LLC, Bellefonte, PA
The Business of Brownfields: 2009 Conference Proceedings, 15-17 April, Pittsburgh, PA. [abstract only] 2009

Vapor intrusion assessments conducted at brownfield sites often necessitate the sampling of soil gas, and in some limited cases, indoor air. Samples typically are collected using Summa canisters for vapor collection and storage as required by EPA Compendium Method TO-15. The Radiello(r) passive/diffusive sampling technology presents an alternative method to active sampling that relies on unassisted molecular diffusion of the gaseous agent to migrate from the air onto the sorbent material. The technology requires very little time in the field to deploy and no expensive equipment to maintain, and it eventually may prove to be a significant cost-saving tool for screening-level assessments of vapor intrusion in multiple buildings in urban environments. While this technology is most applicable to sampling indoor air, it is being tested for soil gas application in crawl spaces, sub-slab, or potentially sub-surface. Radiello(r) samplers are being deployed at various petroleum sites following active sampling (TO-15, Summa canisters and TO-17, sorbent tubes) to compare the analytical performance for BTEX compounds.

Radiological Laboratory Sample Analysis Guide for Incidents of National Significance: Radionuclides in Air
U.S. EPA, National Air and Radiation Environmental Laboratory.
EPA 402-R-09-007, 99 pp, June 2009

This guide deals with the analysis of air samples that might have been contaminated as the result of a radiological or nuclear event, such as a radiological dispersal device, improvised nuclear device, or an intentional release of radioactive materials into the atmosphere via mechanical or other methods. In the event of a major incident that releases radioactive materials

to the environment, EPA will turn to selected radioanalytical laboratories to support its response and recovery activities. In order to expedite sample analyses and data feedback, the laboratories will need guidance on EPA's expectations. Each phase of an incident response—early, intermediate, and recovery—will require different and distinct radioanalytical resources to address the different consequences, management, priorities, and requirements of each phase. Important radioanalytical laboratory responsibilities for incident response consist of radionuclide identification and quantification, sample load capability, sample processing turnaround time, quality of analytical data, and data transfer capability. During all phases of an incident response, radioanalytical resources are needed for identifying the radionuclide source term and quantifying the radionuclides in a variety of sample media. Additionally, gross screening of samples to prioritize sample processing or to obtain information related to the general level of contamination in samples is also necessary. This guide has been developed to provide the incident commander and the laboratories used during an incident with a logical processing scheme to prioritize sample processing in relation to the radionuclide air concentrations corresponding to established EPA Protective Action Guides or risk levels.
http://www.epa.gov/narel/reports/Air%20Guide%20Final%20with%20web%20cover%2006-02-09.pdf

Radiological Laboratory Sample Analysis Guide for Incidents of National Significance: Radionuclides in Water
U.S. EPA, National Air and Radiation Environmental Laboratory.
EPA 402-R-07-007, 80 pp, 2008

This guide deals with the analysis of water samples that might have been contaminated as the result of a radiological or nuclear event. If a major incident releases radioactive materials to the environment, EPA will turn to selected radioanalytical laboratories to support its response and recovery activities. To expedite sample analyses and data feedback, the laboratories will need guidance on EPA's expectations. This document is intended to assist the analytical laboratories that will be called upon to provide rapid support to Agency personnel following a radiological or nuclear incident. EPA recognizes that in the immediate and intermediate period following such a release, there may not be sufficient time for the Incident Command Center to coordinate and communicate complete data quality objectives, measurement quality objectives, and analytical priorities to the laboratory; hence, this document will enable laboratories to proceed with a consistent approach to developing and reporting appropriate data suitable for the anticipated use. The ultimate purpose of the screening process described in this guide is to ensure that public health is protected. The recommendations in this guide are based upon EPA's Protective Action Guides and applicable drinking water regulations for radionuclides (40 CFR Parts 9, 141, and 142; Radionuclides—Final Rule, Federal Register 65:76707-76753, Dec 7, 2000). This document presents a series of three analytical scenarios to aid laboratories in establishing priorities for analyzing samples received during the response to a radiological or nuclear incident. A table summarizes the relevant responsibilities of the incident commander and the laboratory manager during such a response. One of the key objectives in this document is to explain these responsibilities in terms of analytical processes. Available at http://www.epa.gov/narel/reports/WaterReport%20Final%20%20w%20Cover%201-16-08.pdf

Rapid Characterization and Post-Injection Monitoring for the Parcel D Groundwater Treatability Study at Hunters Point Shipyard, San Francisco, California
Rhoades, D., Sullivan International Group.
JSEM 2009: 2009 Joint Services Environmental Management Training Conference and Exhibition, 4-7 May 2009, Denver, Colorado: Abstracts. Abstract 8266, 2009

Activities at Hunters Point Shipyard focused on the portions of the treatment areas that exceeded 10 times the compound-specific remediation goal(s) for VOCs (future land uses) and/or trigger levels for metals (San Francisco Bay protection requirements) to provide a clear assessment of treatment effectiveness under relatively low-concentration conditions while still allowing a substantial reduction in the potential risk to human health and San Francisco Bay at a reasonable cost. The team utilized the Triad methodology to accomplish the following general objectives: (1) Assess the extent of contamination within the treatment zones to refine the Phase II zero-valent iron (ZVI) injection points with respect to location, screen intervals, and lithologic impacts on the injection procedures; (2) Increase communication and consensus between stakeholders with regard to project constraints, decisions, and the accepted level of uncertainty in the project data and analyses; (3) Use real-time field observations and on-site laboratory data to collect more data in real time without a significant increase in project cost and duration, thus reducing uncertainty through a larger quantity of data; and (4) Use the data acquired and subsequent modeling efforts to target the treatment zones with the greatest potential for risk reduction during Phase II, thus reducing groundwater treatability study costs. Rapid characterization reduced the 1x remedial goal treatment area by 53%. Identification of the 10x remedial goal groundwater treatment area resulted in a 79% reduction in treatment area. Soil vapor results when used to calculate commercial industrial vapor risks correlated well with the 10x remedial goals for groundwater, justifying the 79% reduced treatment area for VOCs in groundwater. During Phase II, 150 ZVI injections were installed over a 2-month period. The Phase III monitoring program began with a baseline groundwater monitoring event followed by three rounds of post-injection groundwater monitoring to evaluate the removal and destruction of VOCs and hexavalent chromium, and to evaluate the effectiveness of the ZVI injection technology. The baseline round of groundwater monitoring to evaluate initial conditions was completed 1 month before ZVI injections began. Subsequent sampling results from December 2008 to March 2009 are presented.

A Rapid Spectrophotometric Determination of Persulfate Anion in ISCO
Liang, C., C.F. Huang, N. Mohanty, and R.M. Kurakalva, National Chung Hsing Univ., Taiwan.
Chemosphere, Vol 73, p 1540-1543, 2008

A simple measurement of persulfate concentration is desirable to analyze persulfate distribution at designated time intervals on/off a site during implementation of in situ chemical oxidation (ISCO). The distribution helps evaluate ISCO treatment efficacy. This paper proposes a spectrophotometric determination of persulfate based on modification of the iodometric titration method. The analysis of absorption spectra of a yellow color solution resulting from the reaction of persulfate and iodide in the presence of sodium bicarbonate revealed an absorbance at 352nm, without significant interferences from the reagent matrix. The calibration graph was linear in the range of persulfate solution concentration of 0 to 70 mM at 352 nm. The proposed method was validated by the iodometric titration method. The solution pH was near neutral, and the presence of iron activator did not interfere with the absorption measurement. Analysis of persulfate in a groundwater sample using the proposed method indicated a good agreement with measurements by the titration method. The proposed spectrophotometric quantification of persulfate provides a simple and rapid method for evaluation of ISCO effectiveness at a remediation site.

Relationship between Mass Flux Reduction and Source-Zone Mass Removal: Analysis of Field Data
DiFilippo, E.L.and M.L. Brusseau, Univ. of Arizona, Tucson.
Journal of Contaminant Hydrology, Vol 98, p 22-35, 2008

Published field study data were examined to evaluate relationships between mass-flux reduction and source-zone mass removal. The analyzed studies represent a variety of source-zone architectures, immiscible-liquid compositions, and remediation technologies. Two general approaches can be used to characterize the mass-flux-reduction/mass-removal relationship: end-point analysis and time-continuous analysis. End-point analysis, based on comparing masses and mass fluxes measured before and after a source-zone remediation effort, was conducted for 21 remediation projects. Mass removals were greater than 60% for all but 3 of the studies. Mass-flux reductions ranging from slightly less than to slightly greater than one-to-one were observed for the majority of the sites, but these single-snapshot characterizations are limited in that the antecedent behavior is indeterminate. Time-continuous analysis, based on continuous monitoring of mass removal and mass flux, was performed for 2 sites where data were obtained under water-flushing conditions. The reductions in mass flux differed significantly for the two sites (90% vs. not, vert, similar 8%) for similar mass removals (not, vert, similar 40%). The results illustrate the dependence of the mass-flux-reduction/mass-removal relationship on source-zone architecture and associated mass-transfer processes. Minimal mass-flux reduction was observed for a system in which mass removal was relatively efficient (ideal mass-transfer and displacement), whereas a significant degree of mass-flux reduction was observed for a site in which mass removal was inefficient (non-ideal mass-transfer and displacement). The mass-flux-reduction/mass-removal relationship for the latter site exhibited a multi-step behavior, which cannot be predicted using the available simple estimation functions.

Screening Chemicals for the Potential to Be Persistent Organic Pollutants: a Case Study of Arctic Contaminants
Brown, T.N. and F. Wania, Univ. of Toronto Scarborough, ON, Canada.
Environmental Science & Technology, Vol 42 No 14, p 5202-5209, 2008

The presence of persistent organic pollutants (POPs) in remote environments such as the Arctic is of special concern and has international regulatory implications. A methodology has been developed that compares experimentally measured properties, or values predicted from chemical structure alone, to a set of screening criteria. These criteria include partitioning properties that allow for accumulation in the physical Arctic environment and in the Arctic human food chain, and resistance to atmospheric oxidation. At the same time, the extent of structural resemblance to a group of known Arctic contaminants is quantified. Comparison of the substances identified by a mechanistic description of the processes that lead to Arctic contamination with those substances structurally similar to known Arctic contaminants reveals the strengths and limitations of either approach. Within a data set of more than 100,000 distinct industrial chemicals, the methodology identified 120 high-production volume chemicals that are structurally similar to known Arctic contaminants and/or have partitioning properties that suggest they are potential Arctic contaminants. [See a follow-up comment in Environmental Science & Technology 2008 Jul 15;42(14):5034.]

Screening Method for Detection of Hydrocarbon-Oxidizing Bacteria in Oil-Contaminated Water and Soil Specimens
Olga, P., K. Petar, M. Jelena, and R. Srdjan, Trg D. Obradovica, Novi Sad, Serbia.
Journal of Microbiological Methods, Vol 74 Nos 2-3, p 110-113, Aug 2008

To develop a simple screening method for a simultaneous assessment of the count and activity of cultivable hydrocarbon-oxidizing bacteria in an oil-contaminated environment to determine the biodegradation potential, researchers studied the possibility of modifying solid media by adding triphenyltetrazolium chloride reagent as an indicator of the dehydrogenase activity. The modified method appears to be rapid and very suitable for the intended purposes.

Screening Tests for Assessing Treatability of Inorganic Industrial Wastes by Stabilisation/Solidification with Cement
Stegemann, J.A. and Q. Zhou, Univ. College London, UK.
Journal of Hazardous Materials, Vol 161 No 1, p 300-6, 15 Jan 2009

An understanding of cement chemistry and contaminant immobilization mechanisms has been used to propose a series of test methods and performance thresholds for use in efficient evaluation of the treatability of industrial wastes by stabilization/solidification (S/S) with cementitious or pozzolanic binders and optimization of S/S formulations. The approach involves measurement of stabilized/solidified product workability, bleeding and setting time (for flowable mixtures), or Proctor compaction (for compactable mixtures), together with unconfined compressive strength, leachability in a batch extraction with distilled water, and hydraulic conductivity.

Sensing Mercury for Biomedical and Environmental Monitoring
Selid, P.D., H. Xu, E.M. Collins, M. Striped Face-Collins, and J.X. Zhao.
Sensors, Vol 9 No 7, p 5446-5459, 2009

This paper summarizes current sensors for the determination of both abiotic and biotic mercury. The in vivo determination of mercury and the characterization of different forms of mercury are discussed. A wide array of sensors for monitoring mercury is described, including biosensors, chemical sensors, and piezoelectric and microcantilever sensors. Newly developed nanomaterials offer great potential for fabricating novel mercury sensors, and this evaluation covers some of the functional fluorescent nanosensors for the determination of mercury. An outline of the future direction for mercury detection suggests that nanomaterials likely will provide revolutionary tools for biomedical and environmental mercury monitoring.
http://www.mdpi.com/1424-8220/9/7

Sequential Stir Bar Sorptive Extraction for Uniform Enrichment of Trace Amounts of Organic Pollutants in Water Samples
Ochiai, N., K. Sasamoto, H. Kanda, and E. Pfannkoch.
Journal of Chromatography A, Vol 1200 No 1, p 72-79, 2008

A novel extraction procedure for sequential stir-bar sorptive extraction (SBSE) provides more uniform enrichment compared to conventional SBSE over the entire polarity/volatility range for organic pollutants at ultra-trace levels in water. Sequential SBSE consists of SBSE performed sequentially on a 5-mL sample first without modifier using one stir bar, then on the same sample after addition of 30% NaCl using a second stir bar. The first extraction with unmodified sample mainly targets solutes with high Kow (logKow>4.0), the second extraction with modified sample solution (containing 30% NaCl) targets solutes with low and medium Kow (logKow<4.0). After extraction, the two stir bars are placed in a single glass desorption liner and desorbed simultaneously. The desorbed compounds were analyzed by thermal desorption and gas chromatography/mass spectrometry. Recoveries of 80 model pesticides (e.g., organochlorine, carbamate, organophosphorus, pyrethroid) with sequential SBSE were compared against those of conventional SBSE with or without salt addition (30% NaCl). The sequential approach provided very good recovery in the range of 82 to 113% for most of the solutes and recovery <80% for only five solutes with low Kow (logKow<2.5), while conventional approaches (with or without salt addition) showed <80% recovery for 23 and 41 solutes, respectively. The method showed good linearity and high sensitivity (LOD <10ng/L) for most of the model compounds, even with the scan mode in the MS. The method was applied successfully to screening for pesticides at ng/L levels in river water.

Silver(I) Ions Ultrasensitive Detection at Carbon Electrodes: Analysis of Waters, Tobacco Cells and Fish Tissues
Krizkova, S., O. Krystofova, L. Trnkova, J. Hubalek, V. Adam, M. Beklova, A. Horna, L. Havel, and R. Kizek.
Sensors, Vol 9 No 9, p 6934-6950, Sep 2009

The detection limit (3 signal/noise ratio) for novel carbon paste electrodes mated with a standard potentiostat to detect silver ions was estimated as 0.5 uM, indicating the potential for a standard electrochemical instrument for microanalysis of silver(I) ions. A carbon tip (1 mL) or carbon pencil was used as a working electrode. Limits of detection estimated by dilution of a standard were 1 (carbon tip) or 10 nM (carbon pencil). Flow injection analysis coupled with carbon tip was employed to detect silver(I) ions released in various beverages and mineral waters. During weeks 1, 2, and 3, the amount of silver(I) ions releasing into water samples was under the detection limit of the technique used for their quantification. At the end of 13 weeks, the content of silver(I) ions was several times higher than the release detected in the third week--on the order of tens of nanomoles. In subsequent experiments, the influence of silver(I) ions (0, 5, and 10 uM) on a plant model system (tobacco BY-2 cells) during a 4-day exposition was investigated. Silver(I) ions are highly toxic to the cells, which was revealed by a double staining viability assay. In an investigation of the effect of silver(I) ions (0, 0.3, 0.6, 1.2, and 2.5 uM) on guppies (Poecilia reticulata), the content of Ag(I) increased with increasing time of the treatment and applied concentrations in fish tissues. The authors concluded that a carbon tip or carbon pencil coupled with a miniaturized potentiostat can be employed as a small, portable, low-cost, and easy-to-use instrument for detection of silver(I) ions in environmental samples.
http://www.mdpi.com/1424-8220/9/9

A Simple, Low-Cost Method to Monitor Duration of Ground Water Pumping
Massuel, S., J. Perrin, M. Wajid, C. Mascre, B. Dewandel.
Ground Water, Vol 47 No 1, p 141-145, 2009

This paper introduces a simple and inexpensive direct method to determine the duration of pumping of a well by measuring the temperature of its water outlet pipe. A pumping phase is characterized by a steady temperature value close to groundwater temperature. The method involves recording the temperature of the outlet pipe and identifying the different stages of pumping. It is based on the use of the low-cost and small-size Thermochron iButton temperature logger and can be applied to any well, provided that a water outlet pipe is accessible. The temperature time series are analyzed to determine the duration of pumping through manual and automatic post-treatments. The duration of pumping obtained by the iButton method is consistent with the duration of power supply (1.5% difference).

Size-Exclusion Chromatography with Organic Carbon Detection Using a Mass Spectrometer
Warton, B., A. Heitz, B. Allpike, and R. Kagi, Curtin Univ. of Technology, Perth, WA, Australia.
Journal of Chromatography A, Vol 1207 No 1-2, p 186-189, 17 Oct 2008

A novel organic carbon detector for size-exclusion chromatography (SEC) uses the conventional UV-persulfate oxidation method to convert organic carbon to CO(2), which then is detected using a mass spectrometer. This system's mass spectrometer provided lower limits of detection (LOD) and limits of quantification (LOQ) than a previously described system using a Fourier transform infrared (FTIR) spectroscopy 'lightpipe' detector (i.e., when quantification was based on calibration using phthalate standards). When used to analyze natural organic matter (NOM) in water, the mass spectrometer system also exhibited a superior signal-to-noise ratio than the FTIR system. The use of a mass spectrometer to detect organic carbon (as CO(2)) enables the possibility of further characterization of NOM by measuring the stable carbon isotope ratios of the various molecular size fractions of organic carbon, as obtained by SEC.

Standardized Analytical Methods for Environmental Restoration Following Homeland Security Events, Revision 5.0
U.S. EPA, National Homeland Security Research Center.
EPA 600-R-04-126E, 280 pp, Sep 2009

This document provides a compendium of methods that can be used when laboratories are faced with analytical demands associated with an environmental restoration crisis involving hazardous chemical, biological, or radioactive contaminants. Additionally, this document can be used as a tool to identify analytes that require further method development and verification to ensure desired performance. This publication is the fifth version and update to the analytical methods available for use in an environmental crisis event requiring decontamination and restoration. The information contained herein will continue to be revised as new information becomes available.
http://www.epa.gov/nhsrc/pubs/600r04126e.pdf

Sunflower Plants as Bioindicators of Environmental Pollution with Lead (II) Ions
Krystofova, O., V. Shestivska, M. Galiova, K. Novotny, J. Kaiser, J. Zehnalek, P. Babula, R. Opatrilova, V. Adam, and R. Kizek.
Sensors, Vol 9 No 7, p 5040-5058, 2009

To determine heavy metal ions, many analytical instruments can be used; however, most of them are able to quantify only the total metals content. This problem can be overcome using laser-induced breakdown spectroscopy (LIBS) because it is able to provide a high spatial-distribution of metal ions in different types of materials, including plant tissues. The authors discuss the use of LIBS to map the distribution of lead and magnesium in the leaves of sunflower plants and show that the combination of LIBS with other precise analytical techniques, such as high performance liquid chromatography with electrochemical detection and automated spectrometric analysis, can provide useful monitoring results. http://www.mdpi.com/1424-8220/9/7

Super Sensor Sniffs out Disease, Poison, and Environmental Pollution
R&D Daily, 4 Aug 2009

Coupling biological materials with an electrode-based device, Prof. Judith Rishpon of Tel Aviv University's Department of Molecular Microbiology and Biotechnology is able to detect pathogens and pollution in the environment quickly and precisely, as well as small amounts of disease biomarkers in blood. About the size of a stick of gum, the new invention may be applied to a wide range of environments and situations. The aim is for the device to be disposable and cost about $1. Biosensors are critical for detecting pathogens in water, for the food industry, and in medical diagnostics. Rishpon's latest research appeared in the journals "Nanomedicine: Nanotechnology Biology" and "Medicine, Electroanalysis and Bioelectrochemistry." What makes this particular invention particularly appealing is its small size and the fact that it can be connected to a handheld device like a Blackberry or iPhone for quick and reliable results. An electrical signal will pulse "yes" for the presence of a test molecule and a "no" for its absence. The device is capable of detecting many types of substances, even the particular enzymes released before the onset of a heart attack, so this application has obvious uses in an operating room to give a physician warning of an impending attack during a procedure. In additional to medical uses, Prof. Rishpon is investigating the application of her technology to detect pathogens in drinking water, and she believes her device could be part of a future toolkit. Commercial applications of this basic research are already under way. The super sensors are cheap, accurate, and highly sensitive, and in principle they could detect and measure the presence of almost every biologically based material. Ripshon is collaborating on the device with scientists at Arizona State University.

A Survey of Geosensor Networks: Advances in Dynamic Environmental Monitoring
Nittel, S.
Sensors, Vol 9 No 7, p 5664-5678, 2009

Several recent technology trends have influenced the field of geosciences in significant ways. The ready availability of wireless communication networks and progress in the development of low-power, short-range, radio-based communication networks; the miniaturization of computing and storage platforms; and the development of novel microsensors and sensor materials all have changed the type of dynamic environmental phenomena that can be detected, monitored, and reacted to. Another important aspect is the real-time data delivery of novel platforms. This paper surveys the field of geosensor networks, focusing primarily on the technology of small-scale geosensor networks, example applications and their feasibility, and lessons learned, as well as the current research questions posed by today's use of these technologies. The objective is to investigate how this technology can be embedded in the current landscape of intelligent sensor platforms in the geosciences and identify its place and purpose. http://www.mdpi.com/1424-8220/9/7

Synchrotron X-Ray Microtomography and Interfacial Partitioning Tracer Test Measurements of NAPL-Water Interfacial Areas

Brusseau, M.L., H. Janousek, A. Murao, and G. Schnaar.

Water Resources Research, Vol 44 No 1, 2008

Interfacial areas between an immiscible organic liquid (NAPL) and water were measured for two natural porous media using 2 methods: aqueous-phase interfacial partitioning tracer tests and synchrotron X-ray microtomography. The interfacial areas measured with the tracer tests were similar to reported values previously obtained with the method, but the values were significantly larger than those obtained from microtomography. Analysis of microtomography data collected before and after introduction of the interfacial tracer solution indicated that the surfactant tracer had minimal impact on fluid-phase configuration and interfacial areas under conditions associated with typical laboratory application. The disparity between the tracer test and microtomography values is attributed primarily to the inability of the microtomography method to resolve interfacial area associated with microscopic surface heterogeneity. This hypothesis is consistent with results recently reported for a comparison of microtomographic analysis and interfacial tracer tests conducted for an air/water system. The tracer test method provides a measure of effective total (capillary and film) interfacial area, whereas microtomography can be used to determine separately both capillary- and film-associated interfacial areas.

A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems

U.S. EPA, Technology Innovation Program. CLU-IN Webinar Archive, 18 Sep 2008

This seminar presents a systematic approach for the evaluation of capture zones at pump and treat systems and provides an overview of the recently published EPA document (EPA 600-R-08-003, January 2008) from which this session takes its title. The target audience for the course is project managers who review these analyses and/or make decisions based on these types of analyses. This course highlights (1) the importance of capture zone analysis during ground water remediation, particularly for sites requiring containment, (2) key concepts of capture, such as "target capture zones" and "converging lines of evidence", and (3) typical errors made in capture zone analysis. In addition, steps associated with a systematic approach for capture zone analysis are discussed. * Step 1: Review site data, site conceptual model, and remedy objectives. * Step 2: Define site-specific Target Capture Zone(s). * Step 3: Interpret water levels using potentiometric surface maps (horizontal) and water level difference maps (vertical) and water-level pairs (gradient control points). * Step 4: Perform calculations (as appropriate based on site complexity), such as estimated flow rate calculation, capture zone width calculation, and/or modeling (analytical and/or numerical) to simulate water levels, in conjunction with particle tracking and/or transport modeling. * Step 5: Evaluate concentration trends. * Step 6: Interpret actual capture based on steps 1-5, compare to target capture zone(s), and assess uncertainties and data gaps. Examples are used to demonstrate key aspects of capture zone analysis. http://www.clu-in.org/conf/tio/capturezones_091108/

Technology Transfer: LTMO Decision Tool

Air Force Center for Engineering and the Environment (AFCEE), Broad Agency Announcement Award Fact Sheet, 2008

This project will leverage years of long-term monitoring optimization (LTMO) method development, multiple real-world applications, and extensive practical experience into developing a LTMO decision-making tool software application and associated training materials. The goal is to develop map-based data organization, analysis, and display of relevant information with an embedded decision-making framework for conducting multi-tiered qualitative and quantitative optimization evaluations, including well-by-well optimization recommendations and cost-savings summary reports. These tools will focus on evaluating site-based qualitative factors through a rigorous, reproducible decision framework supported by statistical analyses, thus enabling environmental managers and decision makers to analyze and implement LTMO solutions efficiently and effectively by providing an interactive and collaborative application from which to view, analyze, and review LTMO recommendations and rationale, even for sites with insufficient data for intensive statistical analysis. The training materials will consist of interactive LTMO best practices tutorials and a context-sensitive application help manual.
Fact sheet at http://www.afcee.af.mil/shared/media/document/AFD-090618-039.pdf

Thiopental and Phenytoin as Novel Ionophores for Potentiometric Determination of Lead (II) Ions

Rizk, N.M., S.S. Abbas, S.M. Hamza, and Y.M. Abd El-Karem.
Sensors, Vol 9 No 3, p 1860-1875, 2009

Two novel polymeric membrane sensors for the analysis of Pb(II) have been developed based on two therapeutic drugs--thiopental (TP) and phenytoin (PT)--as two new ionophores and on potassium tetrakis(p-chlorophenyl) borate (KTpClPB) as a lipophilic additive. The sensors are encased in plasticized PVC membranes. The sensors show a Nernstian response for Pb(II) ions over the wide concentration ranges of 1x10(-2) - 7x10(-6) M and 1x10(-2) - 8x10(-6) M for the sensors based on thiopental and phenytoin, respectively. The proposed sensors have a fast response time and can be used for more than 9 weeks with no major divergence in potentials. The sensors exhibit comparatively good selectivity with respect to alkaline, alkaline earth, and some transition and heavy metal ions. They were employed for direct determination of lead in solder alloys and in galena rocks, with good agreement with results obtained by atomic absorption spectroscopy. www.mdpi.com/1424-8220/9/3/1860/pdf

Tools for Evaluating and Optimizing Groundwater Monitoring Networks
U.S. EPA, Technology Innovation Program. CLU-IN Webinar Archive, 24 Sep 2008

This seminar provides state, tribal, and federal regulators with information about new methods of optimizing groundwater monitoring programs. Responsible parties, federal facility cleanup managers, and EPA have used long-term monitoring optimization (LTMO) methods at more than 100 sites nationwide and are likely to use them at more sites in the future. These methods support decision making regarding optimal location and frequency of groundwater monitoring and support changes to existing monitoring networks. The seminar defines and describes LTMO and how it can be used to demonstrate progress toward remedial goals. In addition, speakers present information on the appropriate time for LTMO analysis, the types of data usually included in LTMO, qualitative and quantitative methods of long-term monitoring optimization, how to review long-term monitoring plans, and major obstacles to LTMO. Speakers also present a case study illustrating LTMO topics. This seminar is presented jointly by EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) and the U.S. Army Corps of Engineers. Speakers are Dr. Mindy Vanderford, GSI Environmental, Inc. and Dave Becker, U.S. Army Corps of Engineers, both noted experts in long-term groundwater optimization. http://www.clu-in.org/conf/tio/ltmo_092408/

Toxicity and Genotoxicity Evaluation of Acid Mine Drainage Treatment Using Artemia Sp. and Geophagus brasiliensis as Bioindicators
da Silveira, F.Z., T.M. Defaveri, C. Ricken, J.J. Zocche, and C.T. Pich.
Abstracts: Joint Conference of 26th Annual American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, May 30-June 5, 2009, Billings, MT. Poster presentation, p 98, 2009

The objective of this study was to evaluate the possibility of use a microcrustacean (Artemia sp.) and pearl cichlid (Geophagus brasiliensis Quoy & Gaimard, 1824) to assess the toxicity and genotoxicity in a wetland constructed for biopolishing acid mine drainage (AMD). Effluent samples were collected at four stations along the treatment system: (1) pH control and precipitation, (2) second damping pond output, (3) wetland input, and (4) wetland output. Acute toxicity analysis using Artemia sp. was performed at AMD concentrations of 0% 25%, 50%, 80%, 90% (diluted with mineral water), and 100% (not diluted). Genotoxicity analysis was performed using the comet assay on peripheral blood and hepatic cells of G. Brasiliensis. The Artemia sp. test results indicated lethality of 30% at Station 1 and 0% at Station 4 at 100% AMD concentration, indicating that the constructed wetland is effective at reducing the toxicity for this organism. The comet assay indicated that the effluent is genotoxic, with an increase in the DNA damage index from station 1 to 3 and a significant reduction at station 4 in both blood and hepatic cells. This increase could be due to the presence of oxidated reactive species between stations 3 and 4 that are partially captivated by the living forms present in the wetland, reducing the genotoxic potential of the effluent. The results suggest that the treatment is efficient at removing toxicity and reducing genotoxicity, but further improvements are required.

Tree Coring to Assess Subsurface Volatile Organic Compounds
U.S. EPA, Technology Innovation Program. CLU-IN Webinar Archive, 25 Sep 2008

Analysis of the VOC content of tree cores is an inexpensive, rapid, simple approach to examining the distribution of subsurface volatile organic compound contaminants. The method has been shown to detect several volatile petroleum hydrocarbons and chlorinated aliphatic compounds associated with vapor intrusion and groundwater contamination. Tree cores are obtained by using an increment borer. The cores are placed in vials and sealed. After a period of equilibration, the cores can be analyzed by headspace analysis gas chromatography. Don Vroblesky of the U.S. Geological Survey discusses the 2008 "User's Guide to the Collection and Analysis of Tree Cores to Assess the Distribution of Subsurface Volatile Organic Compounds," which describes the method. The guide helps environmental professionals unfamiliar with the tools and methods of tree coring and contributes understanding to the relevant underlying tree physiology. http://www.clu-in.org/conf/tio/treecores_092508/

Triad Month Session 1: Introduction to Triad
U.S. EPA, Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 4 Aug 2009

This session, the first in a series of seven sessions on implementing the Triad approach to site characterization, introduces students to the basic elements of the Triad approach and process. Primarily intended for managers and non-technical staff, this seminar describes processes for improving the performance of a project during setup, site characterization, and remediation/reuse and provides numerous "how to" examples of Triad processes. Robert Howe with Tetra Tech EMI and Kym Takasaki with the U.S. Army Corps of Engineers are the instructors for this session. http://www.clu-in.org/conf/tio/triad1_080409/

Triad Month Session 2: Triad Communications and Systematic Planning
U.S. EPA Technology Innovation and Field Services Division, CLU-IN Webinar Archive, 6 Aug 2009

This session, the second in a series of seven sessions on implementing the Triad approach to site characterization, examines the use of Triad in communications and systematic planning. The first presentation by Thomas Palaia, CH2M Hill, prescribes a data management and decision support system as a critical success factor to sustain the long-term viability of Triad via incorporation of Triad data into overall site management decision making. The purpose of the presentation is to demonstrate that integration of this toolset can fulfill the data management needs of a Triad project as well as serve a long-term use as a full life-cycle environmental remediation database and decision support system. The second offering by Robert Howe of Tetra Tech EMI discusses work products and strategies for building consensus visions at sites. Lessons learned and examples of what has worked and not worked at sites in various stages of the planning and implementation process are presented. Methods for bringing consensus vision with stakeholders during project design are discussed in the context of real-world examples from U.S. EPA's brownfields, Superfund, and RCRA technical support programs. http://www.clu-in.org/conf/tio/triad2_080609/

Triad Month Session 3: Triad During RD/RA
U.S. EPA Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 11 Aug 2009

This session, the third in a series of seven sessions on implementing the Triad approach to site characterization, looks to dispel the common perception that Triad is simply a tool used during characterization using two of the selected presentations from the June 2008 conference on this topic. The first is a case study involving Seymour Johnson AFB in North Carolina, where future first planning, Triad techniques, and performance-based contracting strategies were employed to accelerate site closure. The second is a demonstration of one of the many useful tools in the Triad toolbox--Spatial Analysis and Decision Assistance (SADA). In addition to learning more about SADA, the instructor uses a removal action to demonstrate implementation of this Triad technique. http://www.clu-in.org/conf/tio/triad3_081109/

Triad Month Session 4: Triad Measurement Techniques
U.S. EPA Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 13 Aug 2009

This session, the fourth in a series of seven sessions on implementing the Triad approach to site characterization, examines the use of Triad measurement techniques. The first presentation by Seth Pitkin of Stone Environmental, "High Resolution Groundwater Characterization Methods and the Triad Approach," examines the principle of reducing sampling uncertainty as an essential element in reducing the uncertainty associated with key site management decisions. The second offering by Dr. Mark Kram of Groundswell Technologies, Inc., "Hydraulic Parameter and Mass Flux Distribution Using the High-Resolution Piezocone and GMS," illustrates the use of the high-resolution piezocone direct-push sensor probe to determine direction and rate of ground water flow in three dimensions.
http://www.clu-in.org/conf/tio/triad4_081309/

Triad Month Session 5: Triad Implementation
U.S. EPA Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 18 Aug 2009

This session, the fifth in a series of seven sessions on using the Triad approach to site characterization, examines the implementation of Triad principles and processes. The first presentation by Nick Nigro of ECCS Nationwide Mobile Laboratories, "Programmatic Implementation of the Triad Approach within a State Reimbursement Program" discusses the successful experience of the Wisconsin Department of Agriculture, Trade and Consumer Protection program to remediate local agricultural supply dealerships using the Triad approach. Sharon Budney of CDM makes the second presentation, "Effective Funding Management Approaches for Triad Investigations," which describes successful funding and budget management approaches used to implement the Triad approach during the remedial investigation at the Emmell's Septic Landfill Superfund Site, Galloway Township, New Jersey.
http://www.clu-in.org/conf/tio/triad5_081809/

Triad Month Session 6: Triad Case Studies
U.S. EPA Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 20 Aug 2009

In this session, the sixth in a series of seven sessions on using the Triad approach to site characterization, two Triad practitioners present case studies of the Triad approach. In the first case study, "Characterizing a Complex TCE Groundwater Plume, Eliminating Suspected Source Areas, and Reducing Investigation Costs for a RCRA RFI at Shaw AFB, SC," Jonathan Shireman of Shaw Environmental & Infrastructure, shows how the Triad approach was successfully used to complete a RCRA Facility Investigation in a complex geologic setting with highly sensitive land use at Shaw Air Force Base. For the second case study, Kym Takasaki with the U.S Army Corp of Engineers, presents a case study on "Using Environmental Visualization System (EVS) Modeling to Develop Remediation Alternatives." http://www.clu-in.org/conf/tio/triad6_082009/

Triad Month Session 7: Dynamic Work Strategies
U.S. EPA, Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 25 Aug 2009

In this seventh (and last) 2-hour seminar in a series of sessions on Triad practices, two practitioners present case studies of the Triad approach. In the first case study, "Real Time CSM Visualization and Feedback," John Sohl of Columbia Technologies demonstrates concepts and case studies for processing large data sets as well as incorporating them into an evolving CSM, visually, so that both onsite and offsite project stakeholders can "see" the current investigation status. The second case study takes those concepts up a notch in terms of volume of data to manage and the duration of the program of interest. Between these two presentations, viewers will gain a better understanding of how to manage data onsite and convert empirical 2-D results into more useable formats. http://www.clu-in.org/conf/tio/triad7_082509/

Triad Used to Conduct Indoor Air Assessments at Active Installations
Moore, S.L. (U.S. Army Corps of Engineers); K. Lynch (U.S. EPA).
Joint Services Environmental Management Training Conference & Exposition, 5-8 May 2008, Denver, Colorado. Abstract ID 8199, 2008

The Triad approach was used to design and conduct indoor air studies for residential areas at the Fort Lewis Army Base and at Fairchild Air Force Base in Washington State in 2007. The subject indoor air studies were conducted as additional lines of evidence to confirm previous conclusions and address regulatory concerns. Both subject sites are active military installations with occupied residences overlying solvent plumes. Systematic project planning used existing conceptual site models to identify project uncertainties and potential actions based on study outcomes. The project objectives were defined as phases: Phase 1 to determine if contaminants of concern are present in indoor air, and if needed, Phase 2 to determine if the source of contamination is the underlying groundwater plume. Samples from unoccupied homes and upwind ambient air locations were collected and analyzed by onsite analysis of grab samples collected in Tedlar bags and by offsite fixed laboratory analysis for 24-hrs summa canister samples. Both project results indicated low level concentrations of groundwater contaminants present in housing units. This presentation describes the systematic planning, study methods correlations, results interpretation, and subsequent installation response actions.

Uptake Rates of Alkylphenols, PAHs and Carbazoles in Semipermeable Membrane Devices (SPMDs) and Polar Organic Chemical Integrative Samplers (POCIS)
Harman, C., K.-E. Tollefsen, O. Boyum, K. Thomas, and M. Grung.
Chemosphere, Vol 72 No 10, p 1510-1516, Aug 2008

Uptake of a range of alkylated phenols (APs), PAHs, and carbazoles was determined for semipermeable membrane devices (SPMDs) and polar organic chemical integrative samplers (POCIS) using a flow-through exposure system. Sampling rates ranged from 0.02 to 0.26 L/d for POCIS and 0.02 to 13.83 L/d for SPMDs. Observed SPMD uptake was also compared to that predicted by an empirical model that included the use of performance reference compounds (PRCs). Predicted sampling rates did not differ by more than a factor of 1.3 from experimental values for PAHs, providing further evidence that the PRC approach can be used successfully to determine in situ sampling rates for these compounds. Experimental sampling rates for APs in SPMDs, however, were much lower than predicted. This discrepancy was too large to be explained by small uncertainties in the calibration system or in the calculations. Based on the data, the authors conclude that while hydrophobic APs are accumulated by SPMDs, their partitioning cannot be predicted from their log Kow using current methods. Due to this lower-than-expected uptake, sampling rates were higher in SPMDs than in POCIS only in the range of log Kow>5.0. Simultaneous deployment of both sampler types allows the study of compounds with a broad range of physicochemical properties.

Use of Fe3O4 Nanoparticles for Enhancement of Biosensor Response to the Herbicide 2,4-Dichlorophenoxyacetic Acid
Loh, K.-S., Y.H. Lee, A. Musa, A.A. Salmah, and I. Zamri.
Sensors, Vol 8 No 9, p 5775-5791, 2008

Magnetic nanoparticles of Fe3O4 were synthesized and characterized using transmission electron microscopy and X-ray diffraction. The Fe3O4 nanoparticles were found to have an average diameter of 5.48 +/- 1.37 nm. An electrochemical biosensor based on immobilized alkaline phosphatase (ALP) and Fe3O4 nanoparticles was based on the reaction of ALP with the substrate ascorbic acid 2-phosphate (AA2P). The incorporation of the Fe3O4 nanoparticles together with ALP into a sol gel/chitosan biosensor membrane enhanced the biosensor response, with an improved linear response range to the substrate AA2P (5-120 uM) and increased sensitivity. Using the inhibition property of the ALP, the biosensor was applied to the determination of the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D). The use of Fe3O4 nanoparticles yields a 2-fold improvement in the sensitivity toward 2,4-D, with a linear response range of 0.5 to 30 ug/L. Exposure of the biosensor to other toxicants, such as heavy metals, demonstrated only slight interference from metals, such as Hg2+, Cu2+, Ag2+ and Pb2+. Even though the analysis was performed in water samples with a complex matrix, the biosensor achieved determination of 2,4-D with a recovery of 95 to 100%. The results from the analysis of 2,4-D in water samples using the biosensor correlated well with an HPLC method.
http://www.mdpi.com/1424-8220/8/9

Use of Field-Portable XRF Analyzers for Rapid Screening of Toxic Elements in FDA-Regulated Products

Palmer, P.T., R. Jacobs, P.E. Baker, K. Ferguson, and S. Webber.

Journal of Agricultural and Food Chemistry, Vol 57 No 7, p 2605-2613, 8 Apr 2009

Field-portable X-ray fluorescence (XRF) analyzers can fill a very important niche and are becoming increasingly popular for a wide variety of elemental analysis applications. These analyzers already are used routinely for environmental applications (lead in paint and soil, metal particulates in air samples collected onto filters), geology studies (ore and soil analysis, precious metal identification), and recycling industries (alloy identification). This paper opens with a brief review of the theory of XRF to highlight the underlying principle, instrumentation, and spectra. It includes a discussion of various analytical figures of merit of XRF to illustrate its strengths and limitations compared to existing methods, such as ICP-MS. It concludes with a discussion of a number of different FDA applications and case studies in which XRF has been used to screen, identify, and in some cases quantify toxic elements in various products. This work clearly demonstrates that XRF analyzers are an exceedingly valuable tool for routine and nonroutine elemental analysis investigations, both in the laboratory and in the field. Both field-portable and laboratory-grade XRF analyzers likely will see more widespread use in the future for investigational and forensic-type applications of food and other regulated consumer products.

The Use of Flow-Injection Analysis with Chemiluminescence Detection of Aqueous Ferrous Iron in Waters Containing High Concentrations of Organic Compounds

Borman, C.J., B.P. Sullivan, C.M. Eggleston, and P.J.S. Colberg.

Sensors, Vol 9 No 6, p 4390-4406, 2009

An evaluation of flow-injection analysis with chemiluminescence detection (FIA-CL) was performed to quantify Fe2+(aq) in fresh waters. Iron-coordinating and/or iron-reducing compounds, dissolved organic matter (DOM), and samples from two natural water systems were used to amend standard solutions of Fe2+(aq). Slopes of the response curves from ferrous iron standards (1 to 100 nM) were compared to the response curves of iron standards containing the amendments. Results suggest that FIA-CL is not suitable for systems containing ascorbate, hydroxylamine, cysteine, or DOM, but little or no change in sensitivity occurred in solutions of oxalate and glycine or in natural waters with little organic matter.

http://www.mdpi.com/1424-8220/9/6

Using Geophysical Methods to Characterize an Abandoned Uranium Mining Site, Portugal

Ramalho, E., J. Carvalho, S. Barbosa, and F.A. Monteiro Santos.

Journal of Applied Geophysics, Vol 67 No 1, p 14-33, 1 Jan 2009

The possible negative environmental impacts of using old open pits from abandoned uranium mining sites as potential waste disposal sites is being assessed using geophysical methods and geological outcrop studies in several critical areas, such as the abandoned Quinta do Bispo uranium mine. This old open pit, chosen as one of the sites to be used in the near future for waste containment deposit, must be characterized at depth to prevent any possible negative environmental impacts. Thus, acquisition, processing, and interpretation of electromagnetic, electrical, and both seismic refraction and reflection data have been carried out. Two-dimensional schematic models have been constructed, showing alteration and faults zones at depth. These fault zones control groundwater circulation and their mapping should allow prediction and prevention of future water circulation problems with negative environmental impact.

Using High-Resolution Piezocone to Determine Hydraulic Parameters and Mass Flux Distribution

U.S. EPA Technology Innovation Program. CLU-IN Webinar Archive, 27 Aug 2008

This 1.5-hour seminar covers the results of a demonstration of the use of the high-resolution piezocone direct-push sensor probe to determine direction and rate of ground water flow in three dimensions. The demonstration was funded by ESTCP (www.estcp.org). Field hydraulic measurements can be used to determine seepage velocity distributions through interpolation methods recently incorporated into a groundwater modeling system. Probe data comprising soil type and co-located hydraulic information are particularly amenable to innovative data fusion-based interpolations available through the modeling platform. Following chemical concentration data collection, these innovative data processing approaches allow for the determination of flux distributions at resolutions and spatial configurations never before available. Field-scale data collection, interpolation, and modeling results are presented and discussed. The 2008 final technical report for the ESTCP demonstration, "Detailed Hydraulic Assessment Using a High-Resolution Piezocone Coupled to the GeoVIS," is available at http://www.estcp.org/Technology/upload/ER-0421-FR.pdf.
http://www.clu-in.org/conf/tio/piezocone_082708/

Using Membrane Interface Probes for Diesel Hydrocarbon Detection in Soil

Schafstall, T., USACHPPM.
Joint Services Environmental Management Training Conference & Exposition, 5-8 May 2008, Denver, Colorado. Abstract ID 8005, 2008

A membrane interface probe (MIP) equipped with an electron capture detector, photoionization detector, and flame ionization detector is commonly used in subsurface-soil investigations to provide qualitative data for the presence of gasoline-range organics, aviation fuels, or halogenated compounds typical of solvents such as TCE. The MIP probe also can provide qualitative data on diesel-range organics if the concentration is high. The effectiveness of the MIP to detect lesser concentrations of diesel-range organics is unclear. A MIP mounted on a direct-push hydraulic sampling vehicle was used to determine if diesel-range petroleum hydrocarbons were present in subsurface soils at a former aboveground storage tank and fuel-dispensing site at a California Army facility. Nine test borings were conducted to a depth of 21 to 25 feet in a 70-foot by 30-foot area at an 15-foot spacing. MIP data then were correlated with quantitative data from previously collected subsurface-soil samples. MIP (photoionization probe) data indicate petroleum hydrocarbon contamination is not ubiquitous at the site. When correlated with quantitative data from subsurface-soil samples, the MIP data confirm that the distribution of petroleum hydrocarbons in the subsurface is limited in areal and vertical extent. Use of the MIP proved to be an effective method to reduce the need for quantitative subsurface-soil samples and thereby reduce project costs and field time.

Validation of Sampling Protocol and the Promulgation of Method Modifications for the Characterization of Energetic Residues on Military Training Ranges
Environmental Security Technology Certification Program (ESTCP), Project ER-0628, 62 pp, Apr 2009

The objectives of this demonstration/validation project were to promote scientifically defendable sampling and sample-processing protocols for the characterization of energetic residues on military training ranges. The principal mechanism for meeting this objective has been to inform potential users of the sampling and sample processing protocols developed under SERDP projects ER-1155 and ER-1418. These objectives were promoted by posting U.S. EPA Method 8330B on the Web (2006), performing two field demonstrations, and developing guidance for implementing Method 8330B (www.navylabs.navy.mil/Archive/Final%208330B%20Implementation%20Guide%20070708.pdf) Workshops have been held to promote the attributes of MULTI INCREMENT(r) sampling (MIS) and highlight the laboratory modifications required for representative subsampling and analysis, and commercial laboratories have been actively assisted to prepare for certification in Method 8330B.
http://www.estcp.org/Technology/upload/ER-0628-C&P.pdf

Vapor Intrusion Assessment: Former Naval Ammunition Depot, Hastings, Nebraska
Perwak, J.H. and J. Barker, Shaw Environmental, Inc.
JSEM 2008: 2008 Joint Services Environmental Management Training Conference and Exhibition, 5-8 May 2008, Denver, Colorado: Abstracts. Abstract 8321. 2008

A screening evaluation was conducted for the former Naval Ammunition Depot (NAD) using existing information to determine whether indoor air impacts were likely as a result of vapor intrusion. Beginning in 1987, site investigations identified 8 source areas and 2 distinct plume areas encompassing over 6 square miles of groundwater contamination, including VOCs and explosives. In the vapor intrusion evaluation, maximum concentrations of VOCs over the last five years were used for screening purposes to estimate indoor air concentrations. Even though residential use is very limited at the site, modeling was conducted assuming a theoretical residential structure. Site-specific information on groundwater depth, temperature, and soil characteristics were used in the modeling. The potential contribution to indoor air from vadose zone soils was evaluated using site soil gas data from a former source area. Indoor air concentrations and risks were estimated using EPA's version of the Johnson and Ettinger model for groundwater and soil gas. The screening evaluation showed that estimated risk to theoretical residents from indoor air exposures did not exceed the risk endpoints for any chemical, nor did the cumulative risk. Risk screening endpoints identified by the USACE Task Summary were an estimated excess cancer risk of 10(-5) and a hazard quotient of 1.0 for non-cancer risk. A relatively simple approach was used in this study to screen existing site data for the potential significance of vapor intrusion. Using conservative assumptions and site data, the contractor was able to show that potential indoor air exposures were unlikely to be significant, thus avoiding more costly data collection and evaluation.

Vapor Intrusion at Military Sites: An ATSDR Overview
Burk, T. and G. Zarus, ATSDR.
JSEM 2008: 2008 Joint Services Environmental Management Training Conference and Exhibition, 5-8 May 2008, Denver, Colorado: Abstracts. Abstract 8049, 2008

ATSDR has considered many sources of vapor intrusion at military facilities, including landfills, fuel stations, dry cleaners, and vehicle maintenance shops. ATSDR developed a Landfill Gas Primer (2001, www.atsdr.cdc.gov/HAC/landfill/html/toc.html) to guide scientists while they consider exposures near landfills. Petroleum spill evaluations have generally followed a rule of thumb that focuses on tracking the attenuation of four constituent chemicals. If these chemicals degrade, then the spill is less toxic. Unfortunately, chlorinated volatile organic contaminants do not degrade as readily as petroleum. Additionally, some of the degradation byproducts are more volatile and toxic than their parent compounds. ATSDR has adopted an evaluation policy based on multiple lines of evidence. Case studies at military facilities illustrate the use of multiple lines of evidence to evaluate the vapor intrusion pathway.

Very-High-Resolution Seismic and Magnetic Investigations of a Chemical Munition Dumpsite in the Baltic Sea
Missiaen, T. and P. Feller.
Journal of Applied Geophysics, Vol 65 Nos 3-4, p 142-154, 2008

Very high resolution (VHR) seismic and magnetic investigations were carried out over a chemical munition dumpsite in the Bornholm Basin, south-western Baltic Sea. The main goal of the VHR investigations was to image the shallow internal structure of the dumpsite and map the lateral and vertical distribution of the dumped war material. The shallow geology was imaged in great detail on the seismic data. Seven seismic/stratigraphic units were identified, related to different stages in the Holocene and late-glacial history. A large number of diapir-like features were observed that likely represent fluid expulsion phenomena. Seismic and magnetic data indicate the presence of a large number of buried objects, with good correlation in most cases between the seismic and magnetic data sets. The data confirm the wide variety of dumped war material ranging from bombs and shells to encasements and containers. The distribution of the buried objects seems heterogeneous, with locally high object concentrations surrounded by areas of lower object density. The results of this case study demonstrate the benefit of complementary, concurrent geophysical investigations for munition dumpsite research.

Water Quality in Orbit: U of Utah Tests H20 Disinfection on Space Station
University of Utah News Release, 14 Sep 2009

University of Utah chemists have developed a 2-minute water-quality monitoring method that is undergoing 6 months of testing aboard the International Space Station. The new method involves sampling the water with syringes, forcing the water through a chemical-imbued disk-shaped membrane, and then reading the color of the membrane with a commercially available, handheld color sensor normally used to measure the color and glossiness of automobile paint. The sensor detects if the drinking water contains enough iodine (used on U.S. spacecraft) or silver (used by the Russians) to kill any microbes. The International Space Station has both kinds of water purification systems. Each handheld device--two are in the kit taken to the space station--weighs 1.1 pounds, runs on four AA batteries, has a readout screen, and measures 7 inches by

3.7 inches by 3.2 inches. To test for iodine, the disk is impregnated with PVP (polyvinylpyrrolidone), a nontoxic chemical in contact lens cleaning solutions. The PVP reacts with iodine, and the intensity of the resulting yellow color reveals the concentration of iodine in the water. To test for silver in water, the disk is imbued with DMABR, which is short for 5-(dimethylaminobenzylidene)rhodanine. A yellowish color indicates silver is absent, while flesh to brighter pink reveals how much silver is present. The whole analysis can be done in about two minutes on the ground or in space. The researchers' focus was to develop a small, simple, low-cost testing system implemented in a handheld device that doesn't consume materials or generate waste, takes minimal astronaut time, is safe, and works in microgravity. The method is a general one that can be used on the ground for testing all kinds of water contaminants, and the device is being modified so it can quickly and inexpensively check water for the level of arsenic and other pollutants, such as chromium, cadmium, nickel, and other heavy metals. The present water-monitoring system was launched August 28 on space shuttle Discovery bound for the International Space Station. The project is funded by NASA, the Utah Science, Technology and Research (USTAR) economic development initiative, and Arizona State and Iowa State universities. The project team now includes NASA, USTAR, the University of Utah, Iowa State University, and Wyle Laboratories. http://www.unews.utah.edu/p/?r=090209-1

A "Weight of Evidence" Approach for the Integration of Environmental "Triad" Data to Assess Ecological Risk and Biological Vulnerability
Dagnino, A., S. Sforzini, F. Dondero, S. Fenoglio, E. Bona, J. Jensen, and A. Viarengo.
Integrated Environmental Assessment and Management, Vol 4 No 3, p 314-326, 2008

A new expert decision support system (EDSS) that can integrate Triad data for assessing environmental risk and biological vulnerability at contaminated sites has been developed. Starting with ecosystem relevance, the EDSS assigns different weights to the results obtained from Triad disciplines. The following parameters have been employed: (1) chemical soil analyses (revealing the presence of potentially dangerous substances); (2) ecotoxicological bioassays (utilizing classical endpoints such as survival and reproduction rates); (3) biomarkers (showing sublethal pollutant effects); and (4) ecological parameters (assessing changes in community structure and functions). For each Triad discipline, the EDSS compares the data obtained at the studied field sites with reference values and calculates different 0-to-1 indexes (e.g., chemical, ecotoxicological, and ecological risk). The EDSS output consists of 3 indexes. The environmental risk index (EnvRI) quantifies the levels of biological damage at population-community level. The biological vulnerability index (BVI) assesses the potential threats to biological equilibriums. The genotoxicity index (GTI) screens genotoxicity effects. The EDSS has been applied in the integration of a battery of Triad data obtained during the European Union-funded Life Intervention in the Fraschetta Area (LINFA) project, which has been carried out in to estimate the potential risk from soils of an area in Alessandria, Italy, affected mainly by deposition of atmospheric pollutants. Results obtained during 4 seasonal sampling campaigns (2004 to 2005) show maximum values of EnvRI in sites A and B (characterized by industrial releases) and lower levels in site D (affected by vehicular traffic emissions). All 3 potentially polluted sites have shown high levels of BVI and GTI, suggesting a general change from reference conditions (site C).

X-Ray Fluorescence (XRF)
U.S. EPA Technology Innovation and Field Services Division. CLU-IN Webinar Archive, 4-28 Aug 2008

This 8-part internet seminar series covers material that generally is not presented in XRF presentations or training courses. This is an applications course that describes how a FP-XRF can be used so that its data are highly dependable and defensible. The course covers sampling design and sample handling options for FP-XRF, along with the benefits and limitations of each. Analytical and QC concerns common to using XRF are also discussed. This course should be of interest to staff developing XRF sampling and analysis plans, reviewing the plans for quality assurance, field operators, and users of XRF data for making project decisions. Concepts and practice are illustrated using experiences from actual field projects. The capabilities of newer FP-XRF instruments are described. Each session lasts approximately 2 hours: Session 1--Introduction and Basic XRF Concepts; Session 2--Representativeness, Part 1; Session 3--Representativeness, Part 2; Session 4--Demonstration of Method Applicability; Session 5--Quality Control; Session 6--Dynamic Work Strategies, Part 1; Session 7--Dynamic Work Strategies, Part 2; and Session 8--Q&A and Resources Review.
http://www.clu-in.org/conf/tio/xrf_080408/

SBIR AND OTHER GRANT AWARDS

National Science Foundation

AquaSWARM: Small Wireless Autonomous Robots for Monitoring of Aquatic Environments (NSF 2009 Standard Grant)
NSF Award 0916720
Xiaobo Tan (PI), 517-355-5040, xbtan@msu.edu; Elena Litchman (Co-PI)
Michigan State University, East Lansing
September 1, 2009 - August 31, 2012
$409,999

The goal of the AquaSWARM project is to design and develop small, energy-efficient, autonomous underwater robots as sensor-rich platforms for dynamic, long-duration monitoring of aquatic environments. A novel concept of gliding robotic fish merges the energy-efficient design of underwater glider with the high maneuverability of robotic fish. Gliding motion, enabled by pitch and buoyancy control, is exploited to realize dive/ascent and large-distance horizontal travel. Soft actuation materials-based flexible tail fins are used to achieve maneuvers with high hydrodynamic efficiency. The research is focused on understanding gliding design for small robotic fish, and addressing the energy efficiency issue from a systems perspective. Schools of such autonomous robots are deployed in lakes at the Michigan State University Kellogg Biological Station to detect harmful algal blooms (HABs) and validate models for HAB dynamics. The project is expected to result in cost-effective, underwater robots that can perform uninterrupted, long-duration (several months), long-travel (hundreds of miles) operation in aquatic environments. This result will provide a novel, viable, versatile, cyber-physical infrastructure for aquatic environmental monitoring, with applications ranging from understanding the impact of global warming, to environmental protection, drinking water reservoir safety, and seaport security. Robotic fish-based HAB detection will also be used as a tool to engage communities at local lakes and stimulate their interest in novel technology and environmental issues.

Gallium Nitride Nanowire-Nanocluster Hybrids for Chemical Sensing: Grant Opportunities for Academic Liaison with Industry (GOALI) (NSF 2009 Standard Grant)
NSF Award 0901712
Mulpuri Rao (PI), 703-993-2295, rmulpuri@gmu.edu; John Schreifels (Co-PI); Siddarth Sundaresan (Co-PI); Abhishek Motayed (Co-PI)
George Mason University, Fairfax, VA
August 1, 2009 - July 31, 2012
$330,000

The objective of the research is to develop next-generation ultra-sensitive, low-power, multi-component chemical sensors utilizing gallium nitride (GaN) nanowires. The approach is to realize highly-oriented arrays of GaN nanowires by utilizing dielectrophoresis and functionalize them with metal and metal oxide nanoclusters. After studying the electro-physical interactions of chemical species with these functionalized nanowires, ultra-sensitive, low-power sensors capable of operating in extreme conditions will be realized. Commercial thin film sensors have significant limitations in terms of sensitivity, selectivity, and reliability. The proposed hybrid devices will provide numerous active sites for adsorption of molecules and subsequent catalysis of chemical reactions. By combining the enhanced catalytic properties of the nanoclusters with the sensitive transduction capabilities of the nanowires, an ultra-sensitive and highly selective chemical sensing architecture will be created. Post-growth assembly and functionalization will enable the development of sensor arrays in a single chip for multi-component sensing. Nitride-based highly selective gas/chemical nanosensors will have applications in environmental monitoring, biological detection for clinical purposes, and detection of chemical and biological threats.

Geoenvironmental Influences on Raman Spectroscopic Monitoring of Chlorinated Solvents (NSF 2009 Standard Grant)
NSF Award 0927112
Joseph Sinfield (PI), 765-494-4600, jvs@purdue.edu
Purdue University, West Lafayette, IN
August 1, 2009 - July 31, 2011
$151,308

The technology currently available to assess chlorinated solvents at actionable levels involves costly and sophisticated instruments that can assess only select compounds, provide information over a limited spatial extent, and are available to relatively few. There is great potential to overcome this challenge and transform the state of field monitoring by taking advantage of recent technological advances in lasers, photonics, and telecommunications technology to deploy a distributed chlorinated solvent sensing system based on time-resolved Raman spectroscopy. The objective of this effort is to assess geoenvironmental influences on time-resolved Raman scattering observations of chlorinated solvents under controlled laboratory conditions indicative of those likely to be present in the field. Specifically, the work will build upon a recently developed innovative prototype fiber-coupled, time-resolved, Raman spectroscopy system, to 1) methodically examine the impact of multi-compound backgrounds, fluorophores, and sample turbidity on Raman observations, 2) provide insight into data analysis algorithms required to effectively collect Raman signatures in the presence of fluorophores, and 3) develop recommendations for field use of time-resolved Raman scattering for chlorinated solvent investigations, and optical spectroscopic analyses more generally.

Hand-Held Device for ppb-Level Water Analysis (NSF 2009 SBIR Phase 1)
NSF Award 0945002
Mark Peterman (PI), 650-218-5427, peterman@labrador-research.com
Labrador Research LLC, Jackson, WY
January 1, 2010 - June 30, 2010
$150,000

This SBIR Phase I project will develop a unique lab-on-a-chip for simultaneous detection of several water contaminants down to parts-per-billion levels. The separation method to be used is an innovative microfluidics undulating electro-osmosis technique that uses a capillary tube with a varying diameter. The detector is a surface-enhanced Raman spectrophotometer using embedded metallic nanoparticles. The project team will conduct tests of the instrument using perchlorate and nicotine as the target species for testing. These target species are to be adsorbed onto gold nanoparticles. The proposed project results could lead to the capability of detecting a broad array of contaminants in the natural environment such as emerging pharmaceuticals, arsenic, heavy metals, melanine, and plasticizers. Contaminants of national security risk would be additional targets. Labs-on-a-chip have been developed and commercialized by several companies, but in general they are limited to basic analyses such as pH and conductivity, and/or they can detect specific organic or inorganic compounds only to ppm levels. Being able to go down to ppb levels will be a great benefit for applications such as on-site investigations. Coupling the novel separation technique to the surface-enhanced Raman spectrophotometer may result in a unique technology for detecting and quantifying many chemical species in water.

High Resolution Tunable Receiver for Remote THz Sensing (NSF 2009 SBIR Phase 2)
NSF Award 0923942
Darold Wobschall (PI), 716-837-8719, designer@eesensors.com
Esensors Inc., Buffalo, NY
September 1, 2009 - August 31, 2011
$419,645

This SBIR Phase II research project is aimed at developing devices for the detection of terahertz (THz) signals and a spectrometer based on these devices. The lack of suitable electronic devices has made the THz region of the electromagnetic spectrum inaccessible except by use of large and costly scientific instruments. The aim is to develop a simple, low-cost, low-power receiver that will make this region accessible. The three critical components of the THz heterodyne receiver are an antenna, a microbolometer/mixer, and a quantum cascade laser that functions as a local oscillator. With these novel components, it is possible to develop a portable, field-deployable THz spectrometer capable of monitoring a wide variety of gases in its vicinity. The high-sensitivity spectrometer will allow rapid identification of chemicals and remote sensing of gases for environmental, global warming, and homeland security applications. The broader impacts of this research are that the THz receiver, which has high sensitivity and high spectral resolution not achievable with existing devices, can be used in a much wider variety of non-invasive imaging and screening devices. Explosives and biological agents can be detected and identified even if concealed in clothing and suitcases because the THz radiation is transmitted through clothing and luggage. The proposed receiver also has a potential of providing THz imaging of biological materials and broad-band transmitting of digital signals.

MEMS-Based Preconcentrators with Nano-Structured Adsorbents for Micro Gas Chromatography: Grant Opportunities for Academic Liaison with Industry (GOALI) (NSF 2008 Standard Grant)
NSF Award 0854242
Masoud Agah (PI), 540-231-5281, agah@vt.edu; Gary Rice (Co-PI); James Heflin (Co-PI); Vikas Meka (Co-PI)
Virginia Polytechnic Institute and State University, Blacksburg
August 15, 2009 - July 31, 2012
$349,039

The objective of this work is to employ microelectromechanical systems (MEMS) technology to develop VOC preconcentrator chips with integrated thermal desorption capability and high surface-to-volume ratio and to utilize nanotechnology to coat them with nano-structured adsorbents. Four specific goals are proposed: 1) fabricate low-mass (low-power) preconcentrators with on-chip heaters and temperature sensors using high-aspect-ratio silicon etching techniques and a silicon-on-glass wafer process, 2) deposit ionic self-assembled multilayers (ISAM) or alkane functionalized gold nanoparticles on all surfaces of the MEMS-based preconcentrators with nanometer resolutions, 3) coat MEMS preconcentrators with conventional adsorbents such as OV-1 and Tenax and evaluate their performance against those coated with nano-structured materials in terms of desorption width, breakthrough volume, and temperature profile as well as develop new models to predict the behavior of such preconcentrators, and 4) characterize the performance of microPCs and their corresponding adsorbents for monitoring bioanalytes present in breath and compare the performance of the microchips with conventional industry-standard preconcentrators through collaboration with Convergent Engineering Inc. The concentration and desorption likely will be demonstrated on n-alkanes (C5-C16) and PAHs as well as breath analytes that vary in ring-size by achieving a concentration factor of >200, desorption widths <0.2s, and power consumptions <1W at 50 degrees C/sec temperature ramps. The ability to self-assemble both polar and non-polar adsorbent materials will enable us to have selective concentration of analytes in a wide range of applications, namely environmental monitoring, homeland security, and biomedicine.

Multi-Modal, Shape-Based Inverse Methods for the Characterization of DNAPL Source Zone Architecture (NSF 2009 Continuing Grant)
NSF Award 0838313
Eric Miller (PI), 617-627-3417, elmiller@ece.tufts.edu; Linda Abriola (Co-PI); C. Andrew Ramsburg (Co-PI)
Tufts University, Medford, MA
February 1, 2009 - January 31, 2010
$135,574

Developing a quantitative understanding of the spatial distribution of DNAPL contamination in the source zone is critical to flux-based remediation and management strategies. Unfortunately, the estimation of the source zone architecture is a very challenging inverse problem. We propose an approach to source zone characterization based on the joint, physics-based inversion of hydrological (down-gradient flux and concentration) and geophysical (electrical impedance tomography) data. Our processing approach addresses the ill-posed nature of this inverse problem by employing a novel representation of the source zone. Rather than using the limited data to recover a fine scale, pixilated representation of the spatial distribution of DNAPL, we parameterize the boundaries separating pools, ganglia, and non-contaminated regions. Algorithms are being developed to estimate this geometry along with the space-varying DNAPL saturation in the contaminated zones. Building on recent work in the image processing and computer vision fields, we employ a new form of parametric active contour models to describe the boundaries of the pool and ganglia regions. These models combine the topological flexibility of traditional level set ideas with the low order parametric representation associated with snakes. The performance of our approach is evaluated using an extensive suite of numerical simulations, as well as a set of laboratory-scale experiments. Simulations and experiments will explore (a) the accuracy and utility of Archie-type mixing rules for mapping geophysical to hydrological variables, and (b) the robustness of the method to un-modeled volumetric heterogeneities in both the electrical and hydrological properties of the subsurface.

A New Method for Quantitative Calibration-Free Chemical Analysis (NSF 2009 SBIR Phase 2)
NSF Award 0924394
Arel Weisberg (PI), 718-608-8788, aweisberg@er-co.com
Energy Research Company, Staten Island, NY
August 15, 2009 - July 31, 2011
$499,998

This SBIR Phase II project seeks to develop an analysis method based on plasma physics with unique advantages for in situ process control in coal-fired power plants and in metal and glass production. Software developed from this program will result in development of process control sensors capable of rapidly measuring the elemental composition of a material solely from the material's analytical laser induced breakdown spectroscopy (LIBS) spectrum. Analyses without calibration curves or standard reference materials (SRMs) would be revolutionary because conditions change and material compositions vary outside their expected range in industrial plants, rendering calibration curves inaccurate. Analytical LIBS could not be developed in the past because of these large uncertainties. This project will verify the algorithms developed are effective when applied to actual industrial materials: coal, aluminum, and glass. Coupling analytical LIBS with a LIBS sensor for coal and patented LIBS probe for molten metals and glass will result in real time monitoring and control, a new and potentially paradigm shifting capability for these industries. Analytical LIBS can also be extended for accurate LIBS analyses of the environment, planetary science, agriculture, and security (e.g., WMD detection). The development of Analytical LIBS for these fields is crucial because no SRMs exist for many of these materials, and hence accurate calibration curves are difficult to construct and will have limited utility.

Photonic Crystal Slot Waveguide Miniature Spectrometer for In-Situ Groundwater Contaminant and Greenhouse Gas Detection and Identification (NSF 2009 SBIR Phase 1)
NSF Award 0945688
Swapnajit Chakravarty (PI), 512-996-8833, swapnajit.chakravarty@omegaoptics.com
Omega Optics, Inc., Austin, TX
January 1, 2010 - June 30, 2010
$150,000

This SBIR Phase I project will develop a 100 micron-long lab-on-a-chip spectrometer to detect benzene, toluene, ethylbenzene, and xylenes (BTEX) and other compounds in contaminated ground water and methane and nitrous oxides in air emissions. The project will develop a photonic crystal slot waveguide device which will combine slow light effect in photonic crystal waveguides with large optical field intensity in a low index slot at the center of the photonic crystal waveguide. This will allow exact identification of analyte through spectroscopic signatures. The broader/commercial impact of the project will be realized with the successful demonstration of this technology that will permit this chip to be adapted to a wide range of contaminants in water and air media to support activities in the environmental field.

Physiologically Coupled Biosensing Approaches for Real-time Monitoring of Environmental Contaminants (NSF 2008 Standard Grant)
NSF Award 0854036
David Porterfield (PI), 765-494-4600, porterf@purdue.edu; Hugo Ochoa-Acuna (Co-PI); Maria Sepulveda (Co-PI)
Purdue University, West Lafayette, IN
September 1, 2009 - August 31, 2012
$397,828

The principal objective of this project is to develop a biotechnology approach and instrumentation platform that enables real-time biomonitoring for environmental protection and remediation. The research tasks include (1) development of a high-throughput, multichannel monitoring system for detection of contaminants by transducing physiological responses of individual fish (Pimephales promelas) and aquatic invertebrate (Daphnia magna) embryos in real-time; (2) validation of this high-throughput monitoring system and iterative optimization of its performance using a wide array of water contaminants; and (3) integrating interdisciplinary programs at Purdue University. Currently, the only real-time biomonitors that utilize whole animals are based on detecting changes in behavior of fish and invertebrates. These systems do not necessarily have the response time needed for real-time monitoring, as physiological systems must first respond to injury to elicit a change in behavior. Preliminary data on monitoring O2 consumption in fathead minnow embryos suggests that this physiological sensing approach is much more sensitive than the best commercial system for real-time broad contaminant detection. By developing an advanced throughput, real-time instrumentation platform, we will be able to monitor statistically reliable numbers of embryos as a biomonitoring system that can be used to detect environmental toxins in surface waters. The physiologically coupled biomonitoring technology will be a dynamic new tool for environmental monitoring that could be deployed to monitor surface waters, effluent from point sources, or remediation efforts. The technology will also be used for toxicology research as a high throughput screening approach for chemicals to develop policy and water quality standards.

Real-Time Monitor to Detect Waterborne Contaminants (NSF 2009 SBIR Phase 1)
NSF Award 0944476
John Merrill (PI), 412-352-5351, jmerrill@quansor.com
QUANSOR Corporation, Richmond, KY
January 1, 2010 - June 30, 2010
$149,703

This SBIR Phase I project will develop a solution to real-time monitoring of contaminants at specific nodes in the water use cycle. The company will employ a proven sensor technology, the quartz crystal microbalance, to detect chemical and biological contaminants. The quartz crystal microbalance uses chemical receptors to bind target contaminants, either individual species or in groups. Quansor has developed chemical receptors for a wide range of inorganic (especially mercury and arsenic) pesticides and nerve agents and biologicals. The system to be developed will use 2 quartz balances operating in a parallel fashion. It will address potential problems of fouling and other interferences. The project will develop the means to overcome that problem and enable monitors to operate in surface and ground waters. The broader/commercial impact of the project will be the removal of contaminants from the water supply. The project will optimize the cost efficiency and other environmental impacts on the effectiveness of treatment options to ensure a high level of contaminant (e.g., arsenic) removal from public water supplies.

Spectral Photoionization Detector (SPID): Real-Time, In Situ Detection and Identification of Volatile Organic Compounds Using Electron Spectroscopy (NSF 2009 SBIR Phase 1)
NSF Award 0945167
Mark Denning (PI), 973-731-6281, mark@lenterra.com
Lenterra Inc, West Orange, NJ
January 1, 2010 - June 30, 2010
$149,999

This SBIR project proposes to develop a new technology for the detection and identification of volatile organic compounds (VOCs) using a portable instrument. Spectral photoionization detection technology will be used to identify VOCs based on their electron energy spectra. This is a useful application because existing photoionization detectors cannot identify individual VOCs present in a gas stream. The broader/commercial impact of the proposed project will be the ability to detect and identify individual VOCs in the atmosphere or at emission sources. This can be useful in atmospheric monitoring programs, hazardous materials management, and control of fugitive emissions.

Stable Isotope Probing to Assess Bioremediation of LUST Contaminants: Addressing Existing MTBE/BTEX and Probable Future Ethanol/BTEX Contamination (NSF 2008 Standard Grant)
NSF Award 0853249
Alison Cupples (PI), 517-355-5040, cupplesa@msu.edu
Michigan State University, East Lansing
September 1, 2009 - August 31, 2012
$300,000

The principal objective of this proposal is to develop and apply stable isotope probing (STP) methods to identify and to study the microorganisms responsible for the transformation of contaminants from leaking underground storage tanks (LUST) under in situ conditions. Major research tasks are (1) to address the limitations associated with STP and further refining methods accuracy, (2) to apply STP to identify the organisms responsible for the biodegradation of BTEX, MTBE, and TBA, and (3) to determine the impact of in situ conditions on the populations and activity of these microorganisms. The proposed work builds on a strong set of techniques already developed in the PI's laboratory and is in the national interest because of the potential contribution to better understanding and the solution of water pollution by LUST.

Tilting-Insensitive MEMS Scanning Fourier Transform Spectroscopy for Portable Chemical/BioSensors (NSF 2009 Standard Grant)
NSF Award 0901711
Huikai Xie (PI), 352-392-3516, hkxie@ece.ufl.edu; Fan Ren (Co-PI)
University of Florida, Gainsville
June 1, 2009 - May 31, 2012
$373,303

The objective of this research is to develop miniature infrared (IR) spectrometers for portable or handheld chemical/biosensors. The approach is to use novel micro-electro-mechanical system (MEMS) techniques to miniaturize the mirror scanning mechanism and the IR detector. A unique interferometer design is also proposed to compensate mirror tilting. Fourier transform spectroscopy, especially in the infrared range (FTIR), is very powerful in chemical/biosensing, but most FTIR systems are bulky and expensive. MEMS technology has been used to miniaturize FTIR systems, but researchers still face several challenges: low spectral resolution due to small displacements of the MEMS mirrors, tilting of scanning MEMS mirrors, and lack of small-sized uncooled IR detectors for FTIR. This research will address these challenges with several innovative techniques: a new MEMS mirror whose scan range will reach over 1 mm; a single-mirror Michelson interferometer design capable of tilt-insensitive scanning; and a capacitive MEMS uncooled IR detector that is small, inexpensive, and highly sensitive. The proposed integrated technology has a broad range of applications: homeland security, antiterrorism, food safety, and environmental monitoring. Due to their small size and low cost, such devices can be used on site by first responders, so that explosives, chemical weapons, toxic hazards, and biological agents can be identified quickly.

Water and Food Analysis by Non-Uniform Electroosmotic Flow (NSF 2009 SBIR Phase 2)
NSF Award 0924350
Mark Peterman (PI), 650-218-5427, peterman@labrador-research.com
Labrador Research LLC, Jackson, WY
September 15, 2009 - August 31, 2011
$500,000

This SBIR Phase II project will result in a prototype portable instrument for water quality analysis. The Phase I SBIR project was designed to show the feasibility of a new technique for separating uncharged polymers; this objective was met with remarkable quantitative accuracy, setting the stage for this Phase II prototype project. The underlying Phase I effort was based on stochastic mathematical models and molecular dynamics simulations through which the Labrador Research team discovered an electrokinetic approach for the separation of uncharged polymers. The potential of this approach as a generic separation technology became evident as the commercialization approach evolved into addressing the market need for water- and food-quality analysis technologies. This Phase II project will lead to a commercial prototype through iterative design improvements coupled with validation testing. The results obtained during Phase I and the anticipated Phase II results will set the stage for Phase III commercial participation by our financing partners and for rapid deployment of this proprietary chip technology in portable, hand-held analytical instruments.

Zero-Power Radio Frequency Identification (RFID) Sensing Tags (NSF 2009 STTR Phase 2)
NSF Award 0923921
Winston Ho (PI), 562-801-2088, winstonho@maxwellsensors.com; Guann Li (Co-PI)
Maxwell Sensors Inc., Santa Fe Springs, CA in partnership with [not specified]
September 1, 2009 - August 31, 2011
$500,000

This STTR Phase II research project focuses on developing a smart sensor network integrated with Zero-Power Radio Frequency Identification/Sensing Tags (RFID-ST) that combines the technology of a digital microelectronic mechanical system (MEMS) switch and a radiofrequency (RF) antenna for a wide variety of distributed sensor applications. While micro-sensor technologies appear very promising, most existing sensors are energy hungry and have a very short battery life. The RFID-ST, however, requires no dedicated power source; rather, after selective detection of special agents of interest, this tiny, low-cost sensor reports back the signal when it is interrogated by an RF reader/transducer. As the primary project goal, a zero-power RFID sensor tag will be developed with temperature sensors for blood supply applications. The resulting tag will improve transfusion safety by identifying each blood product, virtually eliminating the possibility of mixup. The tag will also be equipped with a temperature sensor to enable continuous monitoring of the cooling chain. The broader impacts of this research will allow the resulting wireless sensors to be strategically deployed virtually anywhere in a variety of monitoring applications for homeland security, border and transportation security efforts, toxic gases, biological threat agents, explosives, and environmental pathogens. Environmental and regulatory uses exist in the detection of chemical leaks, contaminants, and illegal storage of hazardous materials; and RFID-ST technology also would allow industrial users to monitor chemical storage and processing systems.