Measurement & Monitoring: 22nd Quarterly Literature Update

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

Accumulation of Organochlorine Pesticides by Semipermeable Membrane Devices Using Composite Complex
Liao, Long B. and Xian M. Xiaoa, Chinese Academy of Sciences, Guangzhou, China.
Chemosphere, Vol 64 No 9, p 1592-1600, Aug 2006

Semipermeable membrane devices have been developed for passive in situ monitoring of organochlorine pesticides in aqueous solution. The device consists of a thin film of neutral lipid triolein enclosed in thin-walled tubing made of composite cellulose acetate (CA) membrane supported by linear low-density polyethylene (LLDPE), and is referred to as a CAPE. Test results indicate that the triolein-CAPE (TCAPE) could accumulate hydrophobic pesticides quickly and efficiently in water. In the lab, uptake equilibrium is reached within 20 h. Some mathematical relationships of TCAPE/water partition coefficient, triolein/water partition coefficient, and octanol/water partition coefficient were developed under laboratory conditions. The device was also tested under field conditions, where the average concentration of pesticides in surface water could be estimated by measuring pesticides concentrations in the device.

An Accurate, Precise, and Cost-Effective Method for Measuring Mercury in Production Gas Streams: Method 40 CFR Part 75 App. K
Brunette, Robert, Frontier GeoSciences Inc., Seattle, WA.
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

The author describes a rugged, accurate, precise and inexpensive sampling and analytical method for measuring mercury in process gas streams. The method has been around for nearly a decade and has undergone several validations for measuring mercury in coal utility flue gas (including a US EPA 301h validation process). The method is now codified in 40 CFR Part 75, Appendix K. The Frontier Sorbent Total Mercury (FSTM) method involves a highly efficient, specially designed, solid sorbent trap which in turn is digested and analyzed via a modern analysis technique (same principles as US EPA 1631) yielding a detection limit of 0.005 ug Hg/m3. Details of the technique, validation data, and applications to process gas streams are presented.

Analysis of Bioavailable Phenols from Natural Samples by Recombinant Luminescent Bacterial Sensors
Leedjarv, A. and A. Ivaska (National Inst. of Chemical Physics and Biophysics, Tallinn, Estonia); M. Virta (Univ. of Helsinki); A. Kahru (National Inst. of Chemical Physics and Biophysics).
Chemosphere, Vol 64 No 11, p 1910-1919, Sep 2006

A whole-cell recombinant bacterial sensor for the detection of phenolic compounds was constructed and used for the analysis of bioavailable phenols in natural samples. The sensor Pseudomonas fluorescens OS8(pDNdmpRlux) contains luxCDABE operon as a reporter under the control of phenol-inducible Po promoter from Pseudomonas sp. CF600. The production of bioluminescence is controlled by the transcriptional activator DmpR, which initiates transcription in the presence of phenolic compounds. The sensor bacteria detection limits for different phenols varied from 0.03 mg/L (2-methylphenol) to 42.7 mg/L (5-methylresorcinol). The detection limit for phenol, the most abundant phenolic contaminant in the environment, was 0.08 mg/L. Different phenolic compounds had an additive effect on the inducibility of the sensor. The constructed sensor bacteria were applied on groundwaters and semicoke leachates to estimate the bioavailable fraction of phenols. This sensor could be used to estimate the natural biodegradation potential of phenolic compounds in complex environmental mixtures and matrices.

Analysis of Hydrologic Data to Evaluate Phytoremediation System Performance
Schneider, W.H. (Roy F. Weston, Inc., Albuquerque, NM); S.R. Hirsh (U.S. EPA, Philadelphia, PA); H.R. Compton (U.S. EPA, Edison, NJ); A.E. Burgess and J.G. Wrobel (U.S. Army, Aberdeen Proving Ground, MD).
Remediation of Chlorinated and Recalcitrant Compounds: The Third International Conference. Battelle Press, 7 pp, 2002

A long-term environmental monitoring program is providing hydrologic data that demonstrates poplar trees are influencing groundwater flow at the J-Field site, Aberdeen Proving Ground, MD. Advanced data collection and analysis techniques have enabled researchers to construct a water budget for the study area and to estimate the amount of groundwater the trees are transpiring on a daily and annual basis. Continuous monitoring of the aquifer indicates that the trees transpire enough groundwater to produce daily fluctuations of the shallow water table. Hydrologic analyses demonstrate that the trees are intercepting a significant component of groundwater flow during the summer and early fall and are thereby limiting the discharge of contaminated groundwater to the marsh during this period. Tree tissue and transpiration gas sampling confirm the poplar trees are withdrawing contaminant mass from the aquifer. Based on the favorable results of the pilot study, 600 additional trees are being planted to improve the capacity of the phytoremediation system to provide hydraulic containment of a plume.
http://www.westonsolutions.com/about/news_pubs/Tech_Papers/SchneiderBattelle.pdf

Analysis of Pesticides in Water and Sediment Under Different Storage Conditions Using Gas Chromatography
Lyytikainen, M., J.V. K. Kukkonen, and M.J. Lydy.
Archives of Environmental Contamination and Toxicology, Vol 44 No 4, p 437-444, May 2003

A simple, low-solvent method was tested for simultaneously extracting five classes of pesticides (triazines, organophosphates, organochlorines, pyrethroids, and carbamates) from reconstituted water and sediment, and later with pond water and soil samples. The method uses solid phase extraction (SPE) and sonication in combination with gas chromatography. Pesticide recoveries ranged from 60 to 120%, with the exception of carbaryl, dicofol, and methoxychlor, which had higher recoveries. Pesticide recoveries from soil were comparable with those from sediments, while in pond water, organochlorine recoveries exceeded 100%. To determine sample storage time ranges and conditions, pesticide recoveries in water and sediment were monitored for 28 days. Water samples were most stable when extracted immediately and stored in SPEs in the freezer, where they remained stable for up to six weeks. Sediment samples were stored for a month without significant decrease in pesticide concentrations.

Ant Colony Optimization and Bayesian Analysis for Long-Term Groundwater Monitoring
Li, Yuanhai, Ph.D. dissertation, Florida State University, 120 pp, 2006

Though groundwater longterm monitoring (LTM) is required to assess human health and environmental risk of residual contaminants after active groundwater remediation activities are completed, LTM can be costly because of the large number of sampling locations and frequencies that exist at a site from previous site characterization and remediation activities. Two LTM spatial sampling optimization methods based on an ant colony optimization (ACO) algorithm were developed to identify optimal sampling networks that minimize the cost of LTM by reducing the number of monitoring locations with minimum overall data loss. The first method, the primal ACO-LTM algorithm, minimizes the number of remaining wells given the constraint on data loss quality, and it is implemented by binary decision variables. The second method, the dual ACO-LTM algorithm, is inspired by primal algorithm. The role of the number of remaining wells is reversed from objective function to constraint, and this algorithm minimizes data loss, given a fixed number of remaining wells. Comparisons among the primal and dual ACO-LTM, the GA, and complete enumeration indicate that the dual ACO-LTM algorithm shows the best performance and identifies global optimal solutions. A statistical guideline for the LTM temporal redundancy problem is proposed. Instead of relying on pollutant transport simulation models, this method is a data-driven analysis approach based on a Bayesian statistics-based methodology to optimize the scheduling of groundwater LTM. The technique combines information from different sets of observations over multiple sampling periods with spatial sampling optimization by the ACO algorithm to provide probability distribution for a future sampling schedule. The output of this method is not binary results (0/1) but fuzzy probabilistic scale (0 1) for a future monitoring schedule for each well. The results from a medium-size site were compared with those from other LTM design methods, including MAROS, CES, and a 3-tiered approach. Similar but outperforming results with other methods verified that this method is a promising approach for the LTM temporal problem.
http://etd.lib.fsu.edu/theses/available/etd-07102006-143028/unrestricted/DissertationYuanhai.Li.pdf

The Application of Bioassays as Indicators of Petroleum-Contaminated Soil Remediation
Plaza, G. (Inst. for Ecology of Industrial Areas, Katowice, Poland); G. Nałęcz-Jawecki (Medical Univ. of Warsaw, Poland); K. Ulfig (Inst. for Ecology of Industrial Areas); R.L. Brigmon (Savannah River National Lab, Aiken, SC).
Chemosphere, Vol 59 No 2, p 289-296, Apr 2005

The bioassays Spirotox, Microtox(r), Ostracodtoxkit F(tm), umu-test with S-9 activation, and plant assays were applied and compared to evaluate bioremediation processes in soils heavily contaminated with petroleum. Six higher plant species were used for bioassay tests based on seed germination and root elongation. The ecotoxicological analyses were made in DMSO/H2O and DCM/DMSO soil extracts. Soils were tested from two biopiles at the Czechowice oil refinery (Poland) that had been subjected to different bioremediation applications. In biopile 1, the active or engineered bioremediation process lasted four years, while biopile 2 was treated passively for eight months. Soil hydrocarbon concentrations had decreased an average of 81% in biopile 1 and only 30% in biopile 2. The bioassays provided sensitive indications of soil quality suitable for evaluating the quality of bioremediated soil. The study underlines the need to combine the bioassays with chemical monitoring for evaluation of bioremediation effectiveness.

Application of Hydrocyanic Acid Vapor Generation via Focused Microwave Radiation to the Preparation of Industrial Effluent Samples Prior to Free and Total Cyanide Determinations by Spectrophotometric Flow Injection Analysis

Quaresma, M.C., M.D. de Carvalho, F.A. Meirelles, V.M. Santiago, and R.E. Santelli, Univ. Federal Fluminense, Niteroi, RJ, Brazil.
Analytical and Bioanalytical Chemisty, [e-pub 2006]

Researchers have developed a sample preparation procedure for the quantitative determination of free and total cyanides in industrial effluents that involves hydrocyanic acid vapor generation via focused microwave radiation. Hydrocyanic acid vapor was generated from free cyanides using only 5 minutes of irradiation time (90 W power) and 5 minutes of purge time. The HCN generated was absorbed into an accepting NaOH solution using a simple glassware apparatus appropriate for the microwave oven cavity. The cyanide concentration was determined within 90 seconds using a spectrophotometric flow injection analysis system. Total cyanide analysis required 15 minutes irradiation time, as well as chemical conditions such as the presence of EDTA-acetate buffer solution or ascorbic acid, depending on the effluent to be analyzed (petroleum refinery or electroplating effluents, respectively). The detection limit was 0.018 mg CN/L, and the measured RSD was better than 8% for 10 independent analyses of effluent samples. The sample preparation procedure takes only 10 minutes for free and 20 minutes for total cyanide.

Application of Remote-Sensing and Ground-Truth Techniques in Determining the Effects of Coalbed-Methane Discharge Waters on Soils and Vegetation

Micale, David C. and Ronald W. Marrs, Univ. of Wyoming, Laramie.
Rocky Mountain Geology, Vol 41 No 1, p 29-43, June 2006

The authors used Landsat Enhanced Thematic Mapper (ETM) data and field observations for change analysis in a region of coalbed methane (CBM) production along a creek in northeast Wyoming. They investigated whether plant biomass increases with the addition of saline and/or sodic CBM waters and whether CBM waters increase soil salinity, sodicity, and pH. Results indicate the application of CBM waters at the study site has initially increased plant biomass in areas of CBM activity; however, the waters are high in salinity and sodicity, and the soil chemistry is affected such that pH, salinity, and sodicity levels have changed to the point of making the soils slightly sodic. These levels are within the tolerance limits for most of the plants in the region at present but could increase with continued discharge of CBM waters.

Application of Solar FTIR Spectroscopy for Quantifying Gas Emissions
Kihlman, Manne, thesis, Chalmers Univ. of Technology, Gothenburg, Sweden. Technical report No. 4L, 115 pp, 2005

The Solar Occultation Flux (SOF) method is a relatively new method to measure gas emission rates. The method is based on recording broadband infrared spectra of the sun with an FTIR spectrometer connected to a solar tracker, which is a mirror device that tracks the sun and reflects the light into the spectrometer independent of its position. From the solar spectra, it is possible to retrieve the line-integrated concentration (molecules/cm2) between the sun and the spectrometer. To obtain the gas emission from a source, the instrument is placed in a car. The car is driven to position the instrument in such a way that the detected solar light cuts through the emission plume. To calculate the gas emission, the wind direction and speed is also required. Between 2002 to 2005, a project (KORUS) was run in cooperation with four industries--three refineries and the oil harbor of Goeteborg--to explore the possibilities to measure gas emissions of volatile organic compounds (VOC) with the SOF method. All the industries are located on the west coast of Sweden. The project aimed at achieving commercially competitive performance for the method by increasing reliability and automatization. Simultaneously with this work, an extensive program was conducted to test the method at full scale test to demonstrate its capacity for routine measurements. This thesis provides an overview of the SOF method and describes the technical challenges that have been overcome to make the method more operative. General conclusions from the measurements are presented with a detailed error analysis of the method.
http://www.fluxsense.se/reports/SOF%20Licenciate%20thesis%20Kihlman%202005.pdf

Application of the Lugeon Test in Landfill Hydrologic Studies
Sanchez, M.A., A. Foyo, and C. Tomillo, Univ. of Cantabria, Santander, Spain.
Environmental and Engineering Geoscience, Vol 12 No 2, p 125-136, May 2006

The Lugeon test is a single-hole in situ test of formation permeability performed by measuring the volume of water taken in a section of test hole when the interval is pressurized at 10 bars (150 psi). The test is used primarily in variably permeable formations under evaluation for grouting and is a good method to determine the relative hydraulic conductivity of fractured bedrock. The authors report on an adaptation of the test for landfill sites and propose a rock mass classification based on water-take criteria. The study is based on 27 tests for inert and municipal solid waste carried out in three landfills located in northern Spain.

Applications of Integrated Geophysical Survey in Mapping Subsurface to a Depth of 80 ft at a Landfill in Salina, Kansas
Xia, J. and R.D. Miller.
Kansas Geological Survey, Open-file Report no 2005-21, 31 pp, Sep 2005

Subsidence was observed at several places on the Salina Municipal Golf Course in areas known to be built over a landfill in Salina, KS. High-resolution magnetic survey (57,900 ft2), multi-channel electrical resistivity profiling (three 504-ft lines), and microgravity profiling (23 gravity-station values) were performed on a subsidence site (Green 16) to evaluate the effectiveness of the geophysical methods in determining boundaries and density deficiency of the landfill in the vicinity of the subsidence. Horizontal boundaries of the landfill were confidently defined by both magnetic anomalies and the pseudo-vertical gradient of magnetic anomalies. The

pseudo-vertical gradient of magnetic anomalies presented a unique anomaly at the surface of Green 16, which provided a criterion for predicting other spots with subsidence potential using the same gradient property. Results of multi-channel electrical resistivity profiling (ERP) suggested a bottom limit of the landfill at Green 16 was around 70 ft below ground surface based on the vertical gradient of electric resistivity and a priori information on the depth of the landfill. ERP results also outlined several possible landfill bodies based on their low resistivity values. Microgravity results suggested a -0.14 g/cm3 density deficiency at Green 16 that could equate to future surface subsidence of as much as 5 ft due to gradual compaction.
http://www.kgs.ku.edu/Geophysics/OFR/2005/21/index.html

Assessment of In Situ Biodegradation Potential of MTBE Using 13C-Labeled MTBE and Bio-Sep(r) Beads
Sublette, K., J. Busch-Harris, K. Roberts, and E. Jennings (Univ. of Tulsa); A. Peacock (Univ of Tennessee); D.C. White (Univ. of Tulsa); G. Davis (Microbial Insights, Inc.); W. Holmes (Univ. of Michigan); A. Kolhatkar (Atlantic Richfield Co.); X. Yang (Microbial Insights).
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

The strategy for implementing an intrinsic bioremediation-based management plan for sites contaminated with methyl tert-butyl ether (MTBE) requires documentation that contaminant reduction is linked to aquifer microbial activity, and for abiotic losses to be distinguished from microbial biodegradation. To demonstrate anaerobic, in situ biodegradation of MTBE and to investigate the responsible microorganisms, two field studies were completed in an MTBE-contaminated aquifer in Illinois. Bio-traps containing Bio-Sep(r) beads were preloaded with 13C-labeled MTBE and deployed in a groundwater monitoring well where methanogenic conditions were indicated. After 30 days, the bio-traps were retrieved and analyzed for mass loss of MTBE, microbial biomass, and for 13C-enrichment in polar lipids extracted from the Bio-Sep(r) beads. The residual pool of MTBE in the beads was extracted and analyzed by GC-MS. MTBE concentrations decreased by 90%. Phospholipid fatty acid analysis and CG-cIR-MS analysis of fatty acid methyl esters were used to assess microbial biomass, community structure, and incorporation of 13C. Both a significant increase in biomass as well as biological incorporation of the 13C isotope were detected. These data suggested anaerobic biodegradation of the target compound and incorporation of the heavier isotope into the biomass.

Assessment of Mercury(II) Species Bioavailability Using a Bioluminescent Bacterial Biosensor
Barrocas, Paulo Rubens Guimaraes, Ph.D. dissertation, Florida State Univ., 197 pp, 2004

The objective of this research was to investigate the bioavailability of various Hg(II) species in laboratory and natural solutions using a mercury bioluminescent bacterial biosensor. An E.coli strain was genetically altered to produce firefly luciferase in proportion to its exposure to bioavailable Hg(II). Computer modeling of the Hg(II) solution speciation was used to interpret the observed Hg(II) uptake by the biosensor. The feasibility of using the Hg biosensor approach to determine the bioavailable Hg(II) concentrations in natural samples was assessed by analysis of environmental samples from two Florida lakes and the Everglades. The experiments were successful, showing a dose-response relationship between Hg(II) added to the natural samples and the light produced by the biosensor. In the natural samples tested, the response to added

Hg(II) seemed to be controlled by natural organic ligand complexation; however, the results also reinforced the need for careful chemical characterization of the samples and the use of a constitutive control strain to avoid bias in the results. The developed model uses the biosensor response to Hg(II) additions to calculate the total concentration of natural ligands that can bind Hg(II) and the apparent equilibrium constant for the Hg(II)-ligand complexation. In the second phase of the research, Hg(II) speciation was manipulated by the addition of inorganic and organic ligands, and the bioavailabilities of the species formed were assessed. The chloride titration results suggested that neutral Hg(II) chloride complexes were more bioavailable than anionic Hg(II) chloride complexes. These data agree with other studies performed with a different mercury biosensor and support the hypothesis that neutral Hg(II) species may play an important role in bacterial Hg(II) uptake in the environment. The addition of EDTA decreased the biosensor's response in both synthetic solutions and natural samples proportionally to the total EDTA concentration, suggesting that the HgEDTA complexes had lower bioavailability.
http://etd.lib.fsu.edu/theses/available/etd-12242003-031109/unrestricted/BarrocasPhD.pdf

Automated Analysis of Chromium(VI), Hanford Site, Washington
Burge, S.R. (Burge Environmental, Inc.) and R. Venedam.
The Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, (Monterey, CA; May 2006): Book of Abstracts. Battelle Press, Columbus, OH. Poster presentation, 2006

A "universal platform" interfaced with a colorimetric method of detection for chromium was deployed at the 100-D Area of the Hanford Site to collect data on subsurface hexavalent chromium concentrations at more frequent intervals than was possible with previous sampling and analysis methods employed at Hanford. The automated universal sampling/ calibration/ analytical system was developed for mounting analytical sensors in the well or adjacent to the well. The system allows a sensor to directly analyze the analyte in the water sample or to analyze the analyte in the headspace above the water sample. The system can perform up to 500 analyses without changing solutions or other maintenance. The limit of detection of the monitoring system is .5 ppb. Data are presented from field trials at a site in the state of Washington where a chromium(VI) groundwater plume is suspected of discharging into the Columbia River.

An Automated Rotating Lysimeter System for Greenhouse Evapotranspiration Studies
Lazarovitch, N. (Hebrew Univ. of Jerusalem, Rehovot, Israel); A. Ben-Gal (Agricultural Research Organization, Gilat Research Center, Israel); U. Shania (Hebrew Univ. of Jerusalem).
Vadose Zone Journal, Vol 5 No 2, p 801-804, 2006

Lysimeters are important tools in soil/plant/atmosphere research because they allow direct measurements of evapotranspiration and facilitate studies of water, nutrient, and solute balances. The authors present a rotating structure that significantly enhances uniformity in environmental conditions between individual free-standing lysimeters placed on the structure. The system contains automatic irrigation (water and fertilizer) delivery and drainage collection devices. The system was tested in evaporation and plant growth experiments. A dual carousel setup was used to measure evaporation from containers placed on the soil surface of the lysimeters, as well as yield of lettuce plants growing in the lysimeters. Half of each carousel was covered with netting to reduce solar radiation by 50%. One carousel rotated throughout the experiment, while the other one remained stationary. Variability in measured data was reduced as a result of rotation. The CV of measured evaporation from the rotating system (3.3%) was significantly lower than that of the stationary system (16.2%), and the CV of relative lettuce yields of the rotating system was 11.9% compared with 20.9% for the stationary system. The proposed apparatus provides a research tool for measuring plant physiological processes, flow and transport in soils, and plant response to management or environmental variables.

Benefits of Partial DNAPL Source Removal: Measuring Contaminant Flux Change
Annable, M.D. (Univ. of Florida), K. Hatfield, J. Cho, M.C. Brooks, A.L. Wood, C.G. Enfield, C. Holbert, and K. Gorder.
The Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, (Monterey, CA; May 2006): Book of Abstracts. Battelle Press, Columbus, OH. Poster presentation, 2006

At Hill AFB, two innovative methods for measuring water and contaminant mass flux at a DNAPL site were evaluated after the implementation of surfactant flushing. Ten monitoring wells on approximately 10-ft centers were placed downgradient from the DNAPL source zone. In one technique, a transect of passive flux meters (PFMs) was used to measure TCE mass flux passing through the PFMs before and after the surfactant flood. The meters indicated a reduction in TCE flux of approximately 90%. With the other technique--the integral pumping test method--water was subsequently extracted from the same series of wells, and contaminant concentration/time series was measured in each pumping well effluent. These methods were also compared to mass flux calculated using water quality data from the transect of fully screened wells. The three independent measurement techniques provided comparable results, showing significant contaminant mass flux reduction following remediation.

BIO-SEP(r) Bio-Trap Stable Isotope Probing: a New Tool for Characterizing Biodegradation Potential and the Associated Microbial Ecology
Busch-Harris, J.L., K.L. Sublette, E. Jennings, & K.P. Roberts (Univ. of Tulsa); G. Davis & D. Ogles (Microbial Insights, Inc.); D.C. White & A. Peacock (Univ. of Tennessee); W.E. Holmes (Univ. of Michigan); X. Yang & A. Kolhatkar (Atlantic Richfield).
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

The taxonomic identity of the microorganisms involved in consortia processes often is largely unknown. Coupling molecular biological methods with stable-isotope abundance in biomarkers can provide a cultivation-independent method for linking the identity of bacteria with their function in the environment. Stable carbon isotope analysis can be performed using Bio-Sep(r) bio-traps containing labeled target compound as a means to investigate microorganisms involved in the biodegradation of hazardous materials, as well as degradation rates. The bio-traps attract indigenous microorganisms by providing a carbon source to a microbial community that is preadapted to in situ biodegradation of the specific target compound. Specific microbial populations will metabolize the isotopically labeled substrates, and 13C-enriched biomarkers will allow the target group of microorganisms to be characterized taxonomically, functionally and for metabolic status. 13C-DNA from microorganisms involved in the biodegradation can be separated by density-gradient centrifugation. The target group of microorganisms can thus be characterized through gene probing and sequence analysis. Phospholipid fatty acids can also be efficiently extracted from Bio-Sep(r) beads to provide a means for discerning viable biomass, community composition, and metabolic status of the community involved in biodegradation. Isotopically enriched fatty acids produced during the growth of metabolically distinct microbial groups on a 13C-enriched carbon source can be resolved from the 12C pool through the use of GC-c-IRMS. Stable-isotope probing offers a new technique for identifying microbial communities actively involved in specific metabolic processes in the contaminated subsurface.

Biological Test Method: Reference Method for Determining the Toxicity of Sediment Using Luminescent Bacteria in a Solid-Phase Test
Environment Canada, Ottawa, ON. EPS 1/RM/42E, 83 pp, 2002

A reference method for measuring the toxicity of samples of whole sediment under controlled and defined laboratory conditions is described in this report. It uses luminescent bacteria (Vibrio fischeri) as the test organism and inhibition of light production by the bacteria in a solid-phase test as the biological endpoint. This reference method follows and is built upon the generic (multipurpose) biological test method previously published as "Toxicity Test Using Luminescent Bacteria (Photobacterium phosphoreum)," (1992, EPS 1/RM/24).
http://www.ec.gc.ca/publications/index.cfm?screen=PubDetail&PubID=537&CategoryID=22&lang=e

Bioluminescent Biosensors Based on Genetically Engineered Living Cells in Environmental and Food Analysis
Michelini, E., M. Guardigli, M. Magliulo, M. Mirasoli, A. Roda, P. Simoni, M. Baraldini, Univ. of Bologna, Bologna, Italy.
Analytical Letters, Vol 39, Number 8, p 1503-1515, 2006

Whole-cell biosensors have shown the potential to complement both laboratory and field analytical methods for the detection of general stress conditions, cyto- and genotoxic compounds, organic xenobiotics and metals, and endocrine-disrupting compounds. Complex pretreatment of the environmental sample is generally unnecessary for biosensor measurements, and the sensitive and rapid detection of biochemiluminescence, combined with the specificity or selectivity of gene regulation in living cells, offers significant advantages over conventional analytical methods, providing data on the bioavailability and biological activity of contaminants.

Biosensor for Direct Determination of Fenitrothion and EPN Using Recombinant Pseudomonas putida JS444 with Surface Expressed Organophosphorus Hydrolase. 1. Modified Clark Oxygen Electrode
Lei, Y. (Nanyang Technological Univ., Singapore); P. Mulchandani, W. Chen, and A. Mulchandani (Univ. of California, Riverside).
Sensors, Vol 6 No 4, p 466-472, Apr 2006

The authors report a microbial biosensor for rapid and cost-effective determination of the organophosphorus pesticides, fenitrothion and EPN. The biosensor consists of recombinant PNP-degrading/oxidizing bacteria Pseudomonas putida JS444 anchoring and displaying organophosphorus hydrolase (OPH) on its cell surface as a biological sensing element and a

dissolved oxygen electrode as the transducer. Surface-expressed OPH catalyzed the hydrolysis of fenitrothion and EPN to release 3-methyl-4-nitrophenol and p-nitrophenol, respectively, which Pseudomonas putida JS444 oxidized to carbon dioxide while consuming oxygen, which was measured and correlated to the concentration of organophosphates. Under optimum operating conditions, the biosensor can measure as low as 277 ppb of fenitrothion and 1.6 ppm of EPN without interference from phenolic compounds and other commonly used pesticides, such as carbamate pesticides, triazine herbicides, and organophosphate pesticides without nitrophenyl substituent. The applicability of the biosensor was demonstrated in lake water.
http://www.mdpi.org/sensors/list06.htm

Bottom-Material Samples
Radtke, Dean B.
U.S. Geological Survey TWRI Book 9, National Field Manual for the Collection of Water-Quality Data, Chapter A8, 60 pp, 2005

Chapter A8 on bottom-material samples includes procedures and guidelines for selection of sampling sites, selection and decontamination of equipment, and the collection, processing, packaging, and shipping of samples.
http://pubs.usgs.gov/twri/

Calibration of Polyurethane Foam (PUF) Disk Passive Air Samplers for Quantitative Measurement of Polychlorinated Biphenyls (PCBs) and Polybrominated Diphenyl Ethers (PBDEs): Factors Influencing Sampling Rates
Hazrati, Sadegh and Stuart Harrad, Univ. of Birmingham, Birmingham, UK.
Chemosphere, [in publication] 2006

A calibration experiment was conducted to examine the use of PUF disk air samplers as quantitative sampling devices. Time-integrated indoor air concentrations of PCBs and PBDEs were obtained from a low-volume air sampler operated over a 50-day period alongside PUF disk samplers in the same office microenvironment. Passive sampling rates for the fully sheltered sampler design were determined for the 51 PCB and 7 PBDE congeners detected in all calibration samples. The values were appreciably lower than those reported elsewhere for different PUF disk sampler designs employed under different conditions, such as in outdoor air, and derived using different calibration experiment configurations. Analysis of wipe samples taken from the inside of the sampler housing indicated that the housing surface scavenges particle-bound PBDEs.

A Case Study of Indirect Geochemical Indicators
Jacobs, J.A. (Environmental Bio-Systems Inc.); D.G. McEdwards (The McEdwards Group).
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Although enhanced aerobic bioremediation is a slow process, it can reduce site closure schedules from decades for natural attenuation in an anaerobic environment to a few years with the addition of dissolved oxygen. The iSOC gas infusion system allows oxygen to dissolve slowly at about 15 cc/min or 0.77 cubic feet per day per monitoring well. For in situ enhanced bioremediation of petroleum hydrocarbons, direct contaminant concentrations are useful to monitor the success of the project; however, as water levels rise and fall over the complete hydrologic cycle, confirmatory data for microbial activity and changes in geochemical conditions can be provided by other indirect indicators, such as dissolved oxygen, heterotrophic plate count, specific aerobic degraders, macronutrients ammonia nitrogen and ortho-phosphate, total inorganic carbon, total organic carbon, total dissolved solids, speciated alkalinity, pH, oxygen reduction potential, chemical oxygen demand, biological oxygen demand, ferrous iron, sulfate, and nitrate. A gas infusion case study using the iSOC technology in Maple Shade, NJ, was evaluated for indirect indicators to verify that enhanced bioremediation was responsible for the hydrocarbon degradation of benzene (>96%), MTBE (89%), and TBA (54%) that occurred over a 6-month period. The data showed that the degradation was related to the iSOC treatment rather than to seasonal changes in the hydrologic contaminant cycle.

Chalmers Researchers Measure Environmental Pollutants in Texas
Chalmers University of Technology News Release, 13 October 2006

The enormous petroleum plants and refineries in Texas are leaking. The question is how much and where. A research group from Chalmers is using a unique optical remote sensing method to pinpoint refinery emissions directly. The team has been in Houston, TX, where it has assisted the environmental authorities in the task of estimating emissions of gaseous environmental pollutants (hydrocarbons, nitric oxide, and sulphur oxide) from refineries and petrochemical plants. The project is part of a campaign in which American researchers are attempting to find ways of reducing the photochemical smog that often occurs in Texas. Previous measurements from the air made by researchers from the American Meteorological Institute, NOAA, showed that industrial emissions of volatile hydrocarbons in Texas appear to be 20 to 50 times higher than the industry reports. The method employed by the Chalmers group, Solar Occultation Flux (SOF), can estimate directly how much gas is leaking and causing emissions in the complex environments of the large Texas plants. SOF makes use of light and optical sensing. Many other remote sensing methods can be used to measure air pollutants, but only SOF uses solar light instead of laser beams. Solar spectra are measured and from them an estimate is made of how much gas lies along the path of the solar light. The measurements are made using a vehicle that is driven around the facility, thus allowing the movement of gases in and out to be monitored. The research group has already used the same principle in tests on volcano warning systems and for measurements in major cities, including Mexico City. For further information: Project Manager Johan Mellqvist, Optical Remote Sensing, Department of Radio and Space Science, Chalmers University of Technology. Tel. +46 (0)31-772 48 55, +46 (0)703-08 87 77, johan.mellqvist@chalmers.se
http://chalmersnyheter.chalmers.se/chalmers03/english/Article.jsp?article=7982

Characterisation of Acid Mine Drainage Using a Combination of Hydrometric, Chemical and Isotopic Analyses, Mary Murphy Mine, Colorado
Hazen, J.M. and M.W. Williams (Univ. of Colorado, Boulder); B. Stover (Colorado Dept. of Natural Resources); M. Wireman (U.S. EPA Region 8).
Environmental Geochemistry and Health, Vol 24, p 1-22, 2002

A study was conducted to identify and test new tools to identify sources of metal pollution within a mine and to identify low-cost treatment alternatives through the use of these tools. Source waters and flowpaths within the Mary Murphy Mine (a source of gold, silver, copper, lead, and zinc) were characterized using analysis of hydrogen and oxygen isotopes of water in combination with solute analysis and hydrometric techniques. Hydrometric measurements showed that while discharge from a central level portal increased from 0.7 to 7.2 L/s during snowmelt runoff, Zn concentrations increased from 3,100 to 28 320 ug/L. Water isotopes were used as conservative tracers to represent baseflow and snowmelt inputs in a hydrologic mixing model analysis. The results showed that within the mine, ~71% of the high-flow Zn loading was caused by a single internal stream characterized by extremely high Zn concentrations and low pH (3.4). Hydrologic mixing models using water isotopes showed that new water contributed up to 79% of flow in this high-Zn source during the melt season. Diversion of this high-Zn source within the mine resulted in a decrease in Zn concentrations at the portal by 91% to 2,510 ug/L. These results suggest that the characterization techniques demonstrated in the study can be used to identify problem areas and divert or isolate contaminated flows.
http://snobear.colorado.edu/Markw/Research/hazen_2002.pdf

Characterization of Tetrachloroethene DNAPL in Low-Permeability Coastal Plain Sediments, North Carolina
Holzmer, F.J., V. Dwarakanath, J.E. Ewing, M. Jin, and J.T. Londergan, Intera Inc., Austin, TX.
Environmental and Engineering Geoscience, Vol 11 No 3, p 197-208, Aug 2005

The geosystem approach to source-zone characterization was used at a dry cleaners contaminated with tetrachloroethene (PCE) as a dense nonaqueous-phase liquid (DNAPL) within a shallow, low-permeability aquifer. The DNAPL zone beneath and adjacent to the dry cleaning building is bounded below by a clay aquitard that serves as an effective capillary barrier to downward DNAPL migration. A partitioning interwell tracer test (PITT) measured approximately 81 +/- 7 gallons (280 to 330 L) of DNAPL in the test zone, with the majority of DNAPL located near the building and decreasing northward away from the building. Postremediation soil core analyses indicate that low permeability at depth was a limiting factor in the detection of all the DNAPL within the targeted zone using the PITT; the partitioning interwell tracer test successfully detected DNAPL in the more sandy portions of the aquifer, while not detecting an estimated 23 +/- 5 gallons (87 +/- 19 L) of DNAPL in the clayey silts below 17.8 ft below ground surface.

Characterizing the Microbial Community in SABRE Microcosm Studies

Dworatzek, S. and J. Roberts (SiREM, Guelph, ON); et al.

The Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, (Monterey, CA; May 2006): Book of Abstracts. Battelle Press, Columbus, OH. Poster presentation, 2006

The goal of the SABRE (Source Area BioREmediation) project is to determine if enhanced anaerobic bioremediation can result in effective and quantifiable treatment of chlorinated solvent DNAPL source areas. Prior to field implementation, a large-scale, multi-laboratory microcosm study is being performed to determine the optimal electron donor, supplemental nutrient, and bioaugmentation combination to support reductive dechlorination of TCE in site soil and groundwater. In a microcosm study, performance was assessed based on the chemical concentrations of TCE and dechlorination products. In addition, the microbial community was characterized using three techniques: quantitive polymerase chain reaction (qPCR) for enumeration of Dehalococcoides organisms, qPCR for the vinyl chloride reductase (vcr) gene, and phospholipid fatty acid analysis (PFLA). Initial samples from the field site were positive for Dehalococcoides organisms.

Cleaning of Equipment for Water Sampling

Wilde, Franceska D. (ed.).

U.S. Geological Survey TWRI Book 9, National Field Manual for the Collection of Water-Quality Data, Chapter A3, 83 pp, 2004

The National Field Manual for the Collection of Water-Quality Data describes protocols and provides guidelines for U.S. Geological Survey personnel who collect data used to assess the quality of the Nation's surface-water and groundwater resources. Chapter A3 describes procedures for cleaning the equipment used to collect and process samples of surface water and groundwater and procedures for assessing the efficacy of the equipment-cleaning process.
http://pubs.usgs.gov/twri/

Closing the Mass Balance on Sources, Donors, Competing Reactions, and Attenuation Processes at Chlorinated Solvent Sites

Kamath, R. and C. Newell (Groundwater Services, Inc.); B. Looney and K.M. Vangelas (Savannah River National Lab); D. Adamson (Groundwater Services, Inc.).

NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

The mass balance paradigm is an important new approach to evaluating monitored natural attenuation (MNA) at chlorinated solvent sites. The BIOBALANCE Toolkit, a spreadsheet-based application, has been developed to help site managers determine whether the assimilative capacity of a particular system can manage the mass flux of chlorinated solvents emitted from a source zone. BIOBALANCE uses hydrogeologic, geochemical, and contaminant data that are typically generated from MNA projects at chlorinated solvent sites to simulate the long-term behavior of sources at these sites. By using detailed mass balance, the toolkit can provide valuable insight on which processes contribute to the overall assimilative capacity, how the source term might change over the long-term lifetime of the source, to what degree competing reactions interfere with solvent biodegradation processes, and how sustainable biodegradation is likely to be over the long term. The toolkit comprises a source module, competition module, donor module, plume module, and final mass balance. The source module uses simple mass balance models to provide estimates of the reduction in remediation time frame for a given amount of source depletion. Both vadose zone and submerged sources can be modeled. The competition module calculates how mass flux of competing electron acceptors into the source zone translates into lost electron donor capacity. With the donor module, users can estimate the sustainability of a source zone based on either NAPL composition data or dissolved constituent data. The plume module helps predict the benefit of remediation strategies on plume length and mass flux using an analytical groundwater model. The relative contribution of NA processes--dispersion, sorption, degradation, and source decay to mass flux--are presented graphically. With the final mass balance module, key mass balances on solvents, donors, and competing electron acceptors over the lifetime of the source are integrated and presented.

Collection of Undisturbed Surface Sediments: Sampler Design and Initial Evaluation Testing
Capri, J., B.A. Schumacher, and J.H. Zimmerman, U.S. EPA, Las Vegas, NV.
EPA 600-R-05-076, 2005

EPA's National Exposure Research Laboratory has designed a new sediment sampler designed to collect undisturbed surface sediment samples that can be sliced to represent depth in the sediment column. The new undisturbed surface sediment (USS) sampler consists of a core tube housed within a stand that provides isolated, mechanical support in a sediment bed. The tension on the deployment line is slowly released once the sampler has touched the bottom so that the core tube gently descends into the sediment. A weight spindle then descends and pushes the core tube farther into the sediment, collecting the sample. Upon retrieval of the sampler, the sample is maintained undisturbed inside the tube until it is removed for subsampling. To subsample, a slicer block is set over the top of the core tube, the sediment is pushed up into the slicer block until the desired sample thickness is obtained, and the slicer block cuts the sediment column into increments as thin as 1 centimeter. In the laboratory, the USS sampler was compared against a grab sampler, dredge sampler, and core sampler. Evaluation of video and turbidity measurements collected during testing in a 450-gallon tank demonstrated that disturbance of surface sediments was reduced during collection events with the USS sampler when compared to the other samplers. In the field at Sylvan Lake in Pontiac, MI, the USS sampler was compared against the best performer of the other sampling devices from laboratory tank testing. Video data collected during colocated sampling events demonstrated that the USS sampler offered significantly improved sample collection with minimal disturbance to the surface sediment. Samples collected by the USS sampler exhibited significantly less variability from location to location in particle-size distribution indicating that a consistent depth of sampling was obtained using the USS sampler. The undisturbed surface sediment sampler will undergo modification and robustness testing in FY06 at several more sites.

Comparison of Active and Passive Sampling for the Determination of Persistent Organic Pollutants (POPs) in Sewage Treatment Plants
Katsoyiannis, A. and C. Samara, Aristotle Univ. of Thessaloniki, Thessaloniki, Greece.
Chemosphere -- Available online 30 November 2006

Samples of wastewater obtained with semipermeable membrane devices (SPMDs) and conventional active sampling methods from the wastewater treatment plant of Thessaloniki in northern Greece revealed (by both sampling methods) the presence of 22 POPs, primarily heptachlor-exo-epoxide and PCBs-52, -101, and -180. Concentrations of POPs detected by active sampling and those estimated by the SPMDs matched very well in some cases, but significant mismatches were also observed. The data suggest that active and passive sampling are complementary approaches.

Comparison of Bioassays by Testing Whole Soil and Their Water Extract from Contaminated Sites
Leitgib, L., J. Kalman, and K. Gruiz, Budapest Univ. of Technology and Economics, Budapest, Hungary.
Chemosphere, Vol 66 No 3, p 428-434, Jan 2007

A study was conducted to assess the applicability and reliability of several environmental toxicity tests, comparing the result of whole soils and water extracts. Real soils were taken from three different sites contaminated with organic and inorganic pollutants. The measured endpoints were the bioluminescence inhibition of Vibrio fischeri (a bacterium), the dehydrogenase activity inhibition of Azomonas agilis (a bacterium), the reproduction inhibition of Tetrahymena pyriformis (a protozoon) and Panagrellus redivivus (a nematode), the mortality of Folsomia candida (a springtail), the root and shoot elongation inhibition of the white mustard plant, and the nitrification activity inhibition of an uncontaminated garden soil. New direct-contact ecotoxicity tests have been developed and introduced that, due to their interactive nature, are useful for risk characterization of contaminated soils. In most cases in this study, the interactive ecotoxicity tests indicated a greater harmful effect from the contaminated soil than the tests using soil extracts. The direct-contact environmental toxicity tests were found to meet the requirements of environmental toxicology: reliability, sensibility, reproducibility, rapidity, and low cost.

Comparison of Multi-Objective Evolutionary Algorithms for Long-Term Monitoring Design
Kollat, Joshua B. and Patrick M. Reed.
EWRI 2005: Impacts of Global Climate Change.
American Society of Civil Engineers, Reston, VA. ISBN: 0-7844-0792-4, 2005

In long-term groundwater monitoring (LTM) design, prior studies have shown that evolutionary multi-objective optimization (EMO) tools can aid decision makers by providing rapid assessments of the tradeoffs between conflicting design objectives, such as minimizing sampling costs while minimizing uncertainty. This work compares the performance of several EMO algorithms (the NSGAII, the epsilon-NSGAII, and the MOEA) for supporting LTM design. The EMO algorithms are used to quantify tradeoffs for a four-objective LTM test case. A 25-well LTM test case has been enumerated to provide a reference Pareto-optimal solution set to facilitate rigorous testing of the EMO algorithms. Results of the analysis indicate that the epsilon-NSGAII performs the most reliably and ultimately attains the highest performance on this application.

Comparisons of Structural Fe Reduction in Smectites by Bacteria and Dithionite: An Infrared Spectroscopic Study

Lee, Kangwon, J.E. Kostka, and J.W. Stucki (Univ. of Illinois at Urbana-Champaign).

Clays and Clay Minerals, Vol 54 No 2, p 195-208, Apr 2006

Bacteria are probably the principal agent for mediating redox processes in natural soils and sediments, and further study is needed to ascertain the differences between biotic and abiotic reduction processes. The authors conducted a study to compare the effects of dithionite (abiotic) and bacteria (biotic) reduction of structural Fe in three reference smectites on the clay structure as observed by infrared spectroscopy. After treatment, the spectra from bacteria-treated samples were compared with dithionite-treated samples having a similar Fe(II) content. The changes observed in all three spectral regions (OH stretching, M2-O-H deformation, and Si-O stretching) for bacteria-reduced smectite were similar to results obtained at a comparable level of reduction by dithionite. In general, the shift of the structural OH vibration and the Si-O vibration and the loss of intensity of OH groups indicate that the bonding and/or symmetry properties in the octahedral and tetrahedral sheets change as Fe(III) reduces to Fe(II). Upon reoxidation, peak positions and intensities of the reduced smectites were largely restored to the unaltered condition, with some minor exceptions. These observations are interpreted to mean that bacterial reduction of Fe modifies the crystal structures of Fe-bearing smectites, but the overall effects are modest and of about the same extent as dithionite at similar levels of reduction. No extensive changes in clay structure were observed under conditions present in the model system.

Concentration and Fate of Persistent Organochlorine Pesticides in Estuarine Sediments Using Headspace Solid-Phase Microextraction

Chang, Sue-Min (National Chiao Tung Univ., Hsinchu, Taiwan, ROC); Ruey-An Doong (National Tsing Hua Univ., Hsinchu, Taiwan, ROC).

Chemosphere, Vol 62 No 11, p 1869-1878, Mar 2006

The concentration and fate of persistent organochlorine pesticides (OCPs) in estuarine surface sediments was investigated using a headspace solid-phase microextraction (HSSPME) method to evaluate the pollution potential and guidelines for OCP concentrations. The HSSPME method exhibits a good analytical performance with low detection limits for OCP determination in sediment. The results obtained with the developed method agreed well with those obtained using Soxhlet extraction in a certified sample. The developed analytical method was further applied to the determination of concentrations of OCP residues in surface sediments from the estuaries of selected rivers in Taiwan. HCHs and DDTs were abundant in the estuarine sediments from the selected rivers.

CORONA: Confidence in Forecasting of Natural Attenuation as a Risk-Based Groundwater Remediation Strategy
Lerner, D.N., P. Bjerg, J. Datel, A. Gargini, P. Gratwohl, C. Holliger, P. Morgan, T. Ptak, R. Schotting, H. Slenders, and S.F. Thornton.
Final report of the EU research project EVK1-2001-00087. University of Sheffield, UK. 32 pp, Oct 2005

Monitored natural attenuation is a potentially valuable risk-based remediation strategy for contaminated ground water; however, its wider exploitation in the EU is currently limited by lack of confidence in its application and management, and uncertainty in predicting its performance at many sites. The most important mass-removal process for natural attenuation is biodegradation. The CORONA project hypothesizes that a common pattern of biodegradation activity can be found in most groundwater pollution plumes. Certain zones will have better conditions for biodegradation, and these zones will have more rapid degradation and make a significant contribution to the overall rate of mass loss for the entire plume. Two basic scenarios are postulated: (1) an active, oxidizing fringe to a plume, mainly controlled by dispersion, and (2) an anaerobic core controlled by the interplay between pollutants, environmental conditions, and microorganisms. High resolution data were collected from six varied field sites to support the development of three mathematical models for estimating the length of pollution plumes. The mathematical models were built into an easy-to-use spreadsheet called CoronaScreen, which is accompanied by manuals for the software and a guidance document to explain how natural attenuation can be assessed in the field and quantified with the new models. These simple but robust engineering tools were tested by practitioners outside the project before being made available for free download from the project website at
http://www.corona.group.shef.ac.uk/download.htm
The CORONA research project has been funded principally by the European Union within the 5th Framework Programme.
http://www.corona.group.shef.ac.uk/mainproject/Public_dissemination/D1/CORONA_final_publishable_report.pdf

Construction and Use of Specific Luminescent Recombinant Bacterial Sensors for the Assessment of Bioavailable Fraction of Cadmium, Zinc, Mercury and Chromium in the Soil
Ivask, A. (National Inst. of Chemical Physics and Biophysics, Tallinn, Estonia); M. Virta (Univ. of Turku, Finland); A. Kahru (National Inst. of Chemical Physics and Biophysics).
Soil Biology and Biochemistry, Vol 34 No 10, p 1439-1447, Oct 2002

Recombinant luminescent bacterial sensors were constructed for the detection of zinc and chromate. The sensors carry firefly luciferase gene as a reporter under the control of zinc-inducible regulatory unit from Zn resistance system in chromosomal DNA of Escherichia coli or chromate-inducible unit from Ralstonia metallidurans CH34 megaplasmid pMOL28. The detection limit of the zinc sensor was 40 uM (2.6 mg/L Zn) and that of chromate sensor for dichromate was 30 nM (1.6 ug/L Cr) and for chromate 50 nM (2.6 ug/L Cr). The zinc and mercury sensors were not completely specific to the target metals; the zinc sensor was co-inducible with cadmium and mercury and the mercury sensor with cadmium. The chromate sensor was inducible not only by chromate but also with Cr3+.

Contribution of the Diffusive Exchange Method to the Characterization of Pore-Water in Consolidated Argillaceous Rocks

Savoye, S. (IRSN, SARG/LETS, Fontenay-Aux-Roses, France); J.-L. Michelot (UMR IDES CNRS-Univ. Paris-Sud, Orsay, France); C. Wittebroodt and M.V. Altinier (IRSN).

Journal of Contaminant Hydrology, Vol 86 Nos 1-2, p 87-104, 30 June 2006

Consolidated argillaceous display particular properties (low water content, very small pore size) that require specific methods for the characterization of their porewater. The diffusive exchange method was applied to the claystone of Tournemire by taking into account the effect of swelling or micro-cracks induced by drilling. The good agreement of diffusion parameters with those obtained from the through-diffusion method showed that the extent of this disturbance was low. This method provided stable isotope content values in porewater in good agreement with those measured in the fracture fluids located in the vicinity, validating the method.

Critique of Thermal Decomposition Analysis of Hydrocarbons for Hg Using a Commercially Available System

Hensman, C.E., C. Choice, B.D. McIntosh, D.L. Cussen, and T.R. Baker, Frontier GeoSciences Inc., Seattle, WA.

IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

Fast, on-site analysis of Hg concentrations in crude oil and natural-gas condensate has been a goal of the petroleum industry, but the analysis is often hampered by the complex hydrocarbon matrix, low Hg concentrations, and non-optimal equipment. The typical on-site instrument uses simple thermal decomposition of the sample, pre-concentration of the emitted Hg and re-emission of the Hg into an atomic absorption detector. The equipment is broadly scoped for many types of matrix, from fish tissues to soils, and is not optimized for Hg in hydrocarbons. It is also designed to be turnkey and fully automated for multiple samples, though only a single Hg sample event may occur per day. This presentation examines the practical optimum conditions for Hg analysis in crude oil using a dedicated commercial analyzer, its limitations, and how the measurement statistics define whether a result is usable without excessive QA/QC. A much simpler and potentially more suitable approach is proposed and compared, with a discussion of the method's potential to indicate the form of the Hg (i.e., as cinnabar or associated to the hydrocarbons).

Cyanide in Water and Soil: Chemistry, Risk, and Management

Dzombak, David A., Rajat Ghosh, and George Wong-Chong.

CRC Press, Boca Raton, FL. ISBN: 1566706661, 616 pp, 2005

This text provides a comprehensive review of the literature on the fate, transport, toxicity, and treatment of different chemical forms of cyanide released into the environment. Owing to the complexity of its chemistry and speciation, cyanide cannot be considered a single entity in regulations and engineering investigations related to water and wastewater treatment and contaminated site remediation. The importance of the natural cyanide cycle in the environment and how anthropogenically released cyanide is influenced by the natural cyanide cycle is discussed. The book also summarizes the analytical methods available for measurement of cyanide species in water, soil, and solid/semi-solid materials and offers an in-depth examination of control and treatment technologies and of management approaches available for cyanide-contaminated water and soil.

Delineating Subsurface Features with the MASW Method at Maxwell AFB in Montgomery, Alabama
Xia, J.
Kansas Geological Survey, Open-file Report no 2006-1, 37 pp, June 2006

A recently developed technique--Multichannel Analysis of Surface Waves (MASW)--was used to detect shallow geological features (< 150 ft) at Maxwell AFB in Montgomery, AL. The MASW method with the standard common depth point (CDP) roll-along acquisition format was employed to acquire surface-wave data along eight lines with a total length of 7,712 ft. S-wave velocity and residual velocity sections were generated. Notable changes in shear (S)-wave velocities reveal a possible buried channel and interfaces between different rocks. S-wave velocities inverted from the MASW method normally possess 10 to 15% error compared to direct borehole measurements. In addition, the vertical and horizontal resolution of the results is limited by the geophone spread and the layered earth model used in the inversion. Interpreters of the S-wave velocity and residual velocity sections should be aware of the uncertainty and these limitations.
http://www.kgs.ku.edu/Geophysics/OFR/2006/OFR06_01/index.html July 2006

Detecting Estrogenic Activity in Water Samples with Estrogen-Sensitive Yeast Cells Using Spectrophotometry and Fluorescence Microscopy
Wozei, E. and H-Y.N. Holman (Lawrence Berkeley National Lab, Berkeley, CA); S.W. Hermanowicz (Univ. of California, Berkeley); S. Borglin (LBNL).
SDW Symposium, 16-17 March 2006, 19 pp, 2006 [LBNL-59880]

Environmental estrogens are environmental contaminants that can mimic the biological activities of the female hormone estrogen in the endocrine system, i.e., they act as endocrine disrupters in the human body. Several substances are reported to have estrogen-like activity or estrogenic activity, such as steroid hormones, synthetic estrogens (xenoestrogens), environmental pollutants, and phytoestrogens (plant estrogens). Using the chromogenic substrate ortho-nitrophenyl-beta-D-galactopyranoside (ONPG), the authors show that an estrogen-sensitive yeast strain RMY/ER-ERE, with human estrogen receptor (hERalpha) gene and the lacZ gene which encodes the enzyme beta-galactosidase, is able to detect estrogenic activity in water samples over a wide range of spiked concentrations of the hormonal estrogen 17beta-estradiol (E2). Ortho-nitrophenol (ONP), the yellow product of this assay, can be detected using spectrophotometry but requires cell lysis to release the enzyme and allow product formation. This aspect was improved in a fluorogenic assay by use of fluorescein di-beta-D-galactopyranoside (FDG) as a substrate. The product was visualized using fluorescence microscopy without the need to kill, fix, or lyse the cells. In live yeast cells, the uptake of E2 and the subsequent production of beta-galactosidase enzyme occur quite rapidly, with maximum enzyme-catalyzed fluorescent product formation evident after about 30 minutes of exposure to E2. The fluorogenic assay was applied to a selection of estrogenic compounds and the synchrotron-based Fourier transform infrared (SR-FTIR) spectra of the cells obtained to better understand the yeast whole cell response to the compounds. The fluorogenic assay is most sensitive to E2, but the SR-FTIR spectra suggest that

the cells respond to all the estrogenic compounds tested even when no fluorescent response was detected. These findings may shorten the duration of environmental water screening and monitoring regimes using yeast-based estrogen assays, as well as the development of biosensors for environmental estrogens designed to complement quantification methods.
http://repositories.cdlib.org/lbnl/LBNL-59880/

Detecting Hydrothermal Pyritic Zones Along Bald Eagle Ridge Using Induced Polarization
Moret, Geoff, David P. Gold, and Arthur W. Rose, Pennsylvania State Univ., University Park.
Environmental and Engineering Geoscience, Vol 12 No 4, p 377-384, Nov 2006

Acid rock drainage (ARD) occurs when iron sulfides, most commonly pyrite, oxidize to form sulfuric acid. This weathering reaction typically occurs slowly in undisturbed pyritic rock. When this rock is excavated, however, the greater surface area and availability of oxygen enable iron-oxidizing bacteria to flourish, increasing the reaction rate by many orders of magnitude. Although the majority of ARD problems are due to coal mining, ARD can also be caused by highway construction. Induced polarization (IP) is a geophysical method that can be used to detect pyritic zones before excavation. IP is an electrical geophysical method developed by the mining industry to prospect for disseminated sulfide deposits. IP measures chargeability, the ability of a material to retain electrical charge. In general, rocks with pyrite contents of approximately 1% or greater have elevated chargeabilities. This paper reports the results of IP surveys of hydrothermal pyrite veins in the sandstones and shales of the Appalachians.

Detection and Analysis of Volatile Organic Chemicals in Waste Water Using an Electronic Nose
Staples, E.J. (Electronic Sensor Technology, Newbury Park); S. Viswanathan (National Univ., La Jolla).
Water Pollution VIII: Modelling, Monitoring and Management. WIT Press, Wessex Institute of Technology, UK. ISBN: 1-84564-042-X, Transactions on Ecology and the Environment Vol 95, p 401-409, 2006

This paper describes use of the zNose(r), a new type of electronic nose developed to measure volatile organic compounds in water. Based upon ultra-fast gas chromatography, the zNose(r) is able to perform analytical measurements of volatile organic vapors in near real time with part-per-billion sensitivity. Separation and quantification of the individual chemicals within water samples is performed in seconds. Using a patented, solid-state, mass-sensitive detector, the device achieves picogram sensitivity, universal non-polar selectivity, and electronically variable sensitivity. An integrated vapor pre-concentrator coupled with the electronically variable detector allows the instrument to measure VOC concentrations spanning 6+ orders of magnitude. An on-site procedure is described that uses the electronic nose for measuring the concentration of VOCs in water based on headspace analysis. Measurement of volatile chemicals in water headspace vapors is correlated with water standards using Henry's Law. Use of this instrument and a procedure for aniline- and nitrobenzene-contaminated water is described. The real-time measurement technique has been used to measure concentrations of aniline and nitrobenzene in river water resulting from an explosion at a petrochemical plant.

Detection and Delineation of Deicing Materials in an Unconfined Aquifer via EC Measurements

Kelley, Shawn P., Ph.D., Univ. Of Massachusetts, Amherst. Sep 2003

A low-cost prototype detection system has been developed for the Massachusetts Highway Department to measure in situ electrical conductivity (EC) of groundwater. The system, termed "permanent conductivity points" (PCP), comprises conductivity cells individually consisting of two-array electrodes attached to a rigid pipe. This system acts as a "long conductivity meter" when permanently installed into the ground and used to measure electrical conductivity at specific points in the aquifer. To assist in delineating contaminants, low-flow sampling ports (WSP) were placed on the rigid plastic pipe adjacent to the PCP monitoring points. The obtained samples were analyzed in the laboratory for chemical composition. This prototype detection system was useful in detecting the presence of deicing materials in an unconfined sandy aquifer and beneficial in delineating the shape and extent of the contaminant plume. The ease of construction, installation, and monitoring make this system valuable for long-term monitoring of a contaminant plume. Extensive data can be quickly obtained in a single vertical profile, which makes this system appealing for detecting and delineating contaminants that elevate ambient groundwater electrical conductivity at the site. The possible cost savings using PCP technology for long-term monitoring may be substantial compared to the installation cost, material cost, and personnel sampling time needed for standard groundwater monitoring wells. This prototype detection system provides a low cost/high benefit technology for long-term groundwater quality monitoring.

http://geotech.ecs.umass.edu/spkelley/spkresearch.htm

Detection of Organomercurials with Sensor Bacteria

Ivask, A., K. Hakkila, and M. Virta, Univ. of Turku, Turku, Finland.
Analytical Chemistry, Vol 73 No 21, p 5168-5171, 2001

The authors have developed a whole-cell bacterial sensor for organomercurial detection. The sensor uses firefly luciferase as a gene reporter under the broad spectrum mer operon from pDU1358. A gene coding for merB was coexpressed in the sensor strain. The sensitivity of the sensor was assessed in the presence of environmentally prevalent organomercurials. In the case of methylmercury chloride, phenylmercury acetate, and dimethylmercury, the lowest detectable concentrations were 0.2 nM, 1 nM, and 10 uM respectively. With such a sensor, it should be possible to characterized mercurials in the environment.

Determination of Chlordecone in Soils by GC/MS

Amalric, L. (BRGM Metrology, Orleans, France), B. Henry, and A. Berrehouc.
International Journal of Environmental Analytical Chemistry, Vol 86 Nos 1-2, p 15-24, Jan/Feb 2006

A study was undertaken to develop and characterize an extraction method for chlordecone determination in soils. An accelerated solvent extractor was found to be suitable for extracting the pesticide from soils, but a cleanup step was necessary to recover chlordecone from the hexane solution. The method was found to be repeatable and reproducible, and a quantification limit of 1 mg/kg was attained.

Determination of Elements in Natural-Water, Biota, Sediment, and Soil Samples Using Collision/Reaction Cell Inductively Coupled Plasma/Mass Spectrometry
Garbarino, John R., Leslie K. Kanagy, and Mark E. Cree.
U.S. Geological Survey Techniques and Methods, Book 5, Section B, Chapter 1, 88 pp, 2006

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

Determination of Naturally Occurring MTBE Biodegradation by Analysing Metabolites and Biodegradation By-Products
Martienssen, M., H. Fabritius, S. Kukla, and G.U. Balcke (UFZ Centre for Environmental Research Leipzig-Halle, Halle/Saale, Germany); E. Hasselwander (G.U.T. mbH Gerichtsrain, Merseburg, Germany); M. Schirmer (UFZ Centre).
Journal of Contaminant Hydrology, Vol 87 Nos 1-2, p 37-53, 10 Sep 2006

Significant MTBE degradation was observed at a contaminated site in eastern Germany. Because the extent of the plume had remained constant over a 5-year period, an extended study was performed to elucidate the degradation processes, with close attention to the production, accumulation, and degradation of metabolites and byproducts. Groundwater samples from 105 monitoring wells were used to measure 20 different substances. MTBE degradation apparently occurred at the site under microaerobic conditions, with no evidence for anaerobic MTBE degradation. Among the degradation products, TBA was found to be a useful intermediate to identify MTBE degradation under microaerobic conditions. TBA accumulation was strongly correlated to MTBE degradation according to the kinetic properties of both degradation processes. Since maximum degradation rates and km values were higher for MTBE than for TBA, TBA accumulated significantly as an intermediate byproduct.

Determination of Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in Solids by Gas Chromatography/Mass Spectrometry
Zaugg, S.D., M.R. Burkhardt, T.L. Burbank, M.C. Olson, J.L. Iverson, and M.P. Schroeder.
U.S. Geological Survey Techniques and Methods, Book 5, Section B, Chapter 3, 54 pp, 2006

A method for the determination of 38 polycyclic aromatic hydrocarbons (PAHs) and semivolatile organic compounds in solid samples (e.g., sediments) is described. Samples are extracted using a pressurized solvent extraction system. The compounds of interest are extracted

from the solid sample twice at 13,800 kilopascals; first at 120 degrees C using a water/isopropyl alcohol mixture (50:50, volume-to-volume ratio), and then the sample is extracted at 200 degrees C using a water/isopropyl alcohol mixture (80:20, volume-to-volume ratio). The compounds are isolated using disposable solid-phase extraction (SPE) cartridges containing divinylbenzene-vinylpyrrolidone copolymer resin. The cartridges are dried with nitrogen gas, and then sorbed compounds are eluted from the SPE material using a dichloromethane/diethyl ether mixture (80:20, volume-to-volume ratio) and passed through a sodium sulfate/Florisil SPE cartridge to remove residual water and to further clean up the extract. The concentrated extract is solvent exchanged into ethyl acetate and the solvent volume reduced to 0.5 milliliter. Internal standard compounds are added prior to analysis by capillary-column GC/MS. Comparisons of PAH data for 28 sediment samples extracted by Soxhlet and the accelerated solvent extraction (ASE) method described in this report produced similar results. Extraction of PAH compounds from standard reference material using this method also compared favorably with Soxhlet extraction. The recoveries of PAHs less than molecular weight 202 (pyrene or fluoranthene) are higher by up to 20% using this ASE method, whereas the recoveries of PAHs greater than or equal to molecular weight 202 are equivalent. This ASE method of sample extraction of solids has advantages over conventional Soxhlet extraction by increasing automation of the extraction process, reducing extraction time, and using less solvent. Extract cleanup also is greatly simplified because SPE replaces commonly used gel permeation chromatography.
http://pubs.usgs.gov/tm/2006/tm5b3/

Determination of Wastewater Compounds in Sediment and Soil by Pressurized Solvent Extraction, Solid-Phase Extraction, and Capillary-Column Gas Chromatography/ Mass Spectrometry
Burkhardt, M.R., S.D. Zaugg, S.G. Smith, and R.C. ReVello.
U.S. Geological Survey Techniques and Methods, Book 5, Section B, Chapter 2, 42 pp, 2006

A method for the determination of 61 compounds in environmental sediment and soil samples was developed in response to increasing concern over the effects of endocrine-disrupting chemicals in wastewater and wastewater-impacted sediment on aquatic organisms. This method also may be used to evaluate the effects of combined sanitary and storm-sewer overflow on the water and sediment quality of urban streams. Method development focused on the determination of compounds chosen on the basis of their endocrine-disrupting potential or toxicity. These compounds include the alkylphenol ethoxylate nonionic surfactants and their degradates, food additives, fragrances, antioxidants, flame retardants, plasticizers, industrial solvents, disinfectants, fecal sterols, polycyclic aromatic hydrocarbons, and high-use domestic pesticides. Sediment and soil samples are extracted using a pressurized solvent extraction system. The compounds of interest are extracted from interfering matrix components by high-pressure water/isopropyl alcohol extraction. The compounds were isolated using disposable solid-phase extraction (SPE) cartridges containing chemically modified polystyrene-divinylbenzene resin. The cartridges were dried with nitrogen gas, and then sorbed compounds were eluted with methylene chloride (80%)-diethyl ether (20%) through Florisil/sodium sulfate SPE cartridge, and then determined by capillary-column gas chromatography/mass spectrometry.
http://pubs.usgs.gov/tm/2006/tm5b2/

Determination of Trace of Methyl tert-Butyl Ether in Water Using Liquid Drop Headspace Sampling and GC
Yazdi, A.S. and H. Assadi, Ferdowsi Univ. of Mashhad, Iran.
Chromatographia, Vol 60 Nos 11-12, p 699-702, Dec 2004

The application of headspace microextraction into a single drop of solvent (benzyl alcohol) for the determination of MTBE in aqueous solutions is described. The calibration range for MTBE was 0.01 to 10 ppm and the detection limit 7 ppb. The relative standard deviation for 0.1 ppm MTBE in water was 5.5%.

Determining Active Oxidant Species Reacting with Organophosphate Pesticides in Chlorinated Drinking Water
Duirk, S.E. (U.S. EPA, Athens, GA); D.P. Cherney; C.J. Tarr; T.W. Collette.
EPA 600-R-06-103, 83 pp, Sep 2006

Chlorpyrifos (CP) is an organophosphate (OP) pesticide that was used as a model compound to investigate the transformation of OP pesticides at low pH and in the presence of bromide and natural organic matter under drinking water treatment conditions. Raman spectroscopy was used to determine which active chlorine species was responsible for the rapid oxidation of CP below neutral pH.
http://www.epa.gov/athens/publications/reports/DuirkEPA600R06103DeterminingActiveOxidant.pdf

Determining In Situ Degradation Rates for Various Electron Acceptors via Bio-Trap(tm) Samples and Push-Pull Tests: A Case Study at a Petroleum Distribution Facility
Raes, E.J. and A.V. Callaghan (Engineering and Land Planning Associates, Inc., Clinton, NJ); K. Sublette, J. Busch-Harris, and E. Jennings (Univ. of Tulsa, OK); J. Istok (Oregon State Univ., Corvallis); A. Peacock (Univ. of Tennessee, Knoxville); G. Davis (Microbial Insights, Inc.).
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

When applied together, BioTrap(tm) samplers and push-pull tests can be used to assess the biological component of natural attenuation in situ. The biodegradation kinetic data generated from this combined approach can provide key information for assessing the feasibility of monitored natural attenuation as a stand-alone remedy versus a biostimulation strategy. A case study utilizing this approach at a large petroleum distribution facility in New Jersey is presented. Using baited BioTraps(tm), microbial responses to a suite of electron acceptors (nitrate, sulfate, and dissolved oxygen) were measured in 3 monitoring wells with different geochemical environments. Each BioTrap(tm) was amended with a different electron acceptor and a mixture of 12C-benzene and 13C-labeled benzene. Control BioTraps(tm) were included, amended only with benzene. Total benzene loss and incorporation of 13C into microbial biomass were measured for each BioTrap(tm) condition. The relative biodegradation rates under amended conditions (based on total benzene loss) were compared to the relative degradation rates in the unamended controls to determine whether biodegradation is enhanced under certain terminal electron-accepting conditions. Push-pull tests were conducted to verify the preliminary BioTrap(tm) data and to segregate biodegradation from abiotic processes, such as dilution. Using the results of the push-pull tests, the plume behavior was modeled to predict the plume's migration and persistence due to abiotic processes, unamended conditions, and biostimulated conditions. Collectively, these techniques were used to calculate mass reduction per dollar rate estimates for natural attenuation (unamended conditions) versus biostimulation (amended conditions) to develop the most cost-effective and successful remedial strategy.

Determining the Source of PAHs in Sediment
Emsbo-Mattingly, S.D. (NewFields Environmental Forensics Practice LLC, Rockland, MA), A. Uhler, S. Stout, G. Douglas, K. McCarthy, and A. Coleman.
Land Contamination and Reclamation, Vol 14 No 2, p 403-411, 2006

The evaluation of tar impacts at manufactured gas plant (MGP) sites often requires a clear understanding of polycyclic aromatic hydrocarbon (PAH) origins to address issues of source control, nature and extent of contamination, and potential risk to biological receptors. The PAH signatures of many natural, point, and non-point PAH sources are similar, and multiple lines of evidence, including the innovative use of alternative measurement techniques, may be required to identify individual PAH source signatures in complex environmental media. The authors use data from a demonstration project and several field samples to illustrate the effective application of environmental forensics for assisting risk assessments and limiting MGP cleanup expenditures. Alkylated PAHs (GC/MS), saturated hydrocarbons (GC/MS), radiogenically dated sediment cores, and organic petrology are the featured analytical methods, and chemical fingerprinting and source-specific diagnostic ratios are the interpretive techniques.

Developing Sensors to Detect Mercury
Homer, M.L., H. Zhou, A.D. Jewell, C.J. Taylor, A.V. Shevade, A.K. Kisor, M.A. Ryan, S.-P.S. Yen, M. Blanco, and W.A. Goddard, III, California Inst. of Technology, Pasadena.
210th Electrochemical Society Meeting, ECS Abstract 2120, 2006

An electronic nose that uses an array of polymer-carbon composite sensors is under development at the Jet Propulsion Laboratory, with future use planned as an event monitor for human habitats in spacecraft. This sensor array will be able to identify and quantify 10 to 15 organic and inorganic species in air. Previous JPL E-Noses have consisted of 32 polymer-carbon black composite sensors. The array under development will have 32 sensors, but additional materials are under consideration for the detection of inorganic compounds, including mercury at 3 to 30 ppb. Using molecular modeling techniques, the interaction energy between Hg and polymer functional groups has been calculated and certain polymers were selected as potential Hg sensors. The literature describes many Hg sensors based on the amalgamation of Hg with gold. Gold-based materials (nanowires and polymer composites) were also selected as potential Hg sensors. This paper describes the experimental and modeling results.

Development and Demonstration of a Bidirectional Advective Flux Meter for Sediment-Water Interface
Lien, Bob K., U.S. EPA, Cincinnati, OH.
EPA 600-R-06-122, 94 pp, Nov 2006

A bidirectional advective flux meter for measuring water transport across the sediment-water interface has been successfully developed and field tested. The flow sensor employs a heat-pulse technique combined with a flow-collection funnel for the flow measurement. Because the direction of flow is initially unknown, the heater is located in the center of the flow tube. Two thermocouples are placed symmetrically to both sides of the heater for temperature monitoring. For each measurement cycle, the heater generates and injects a heat pulse to the center of the flow tube, the water flow inside the flow tube carries the heat pulse downgradient, and the temperature is monitored at each thermocouple over time. In theory, the heat-pulse arrival time is inversely proportional to the flow rate. The bidirectional feature of the flux meter is realized through the temperature measuring capability on either side of the flow tube. The system has automatic data acquisition, real-time data display, and signal display/analysis capability. The instrument has undergone several calibrations to establish empirical relations between flow rate and heat-pulse travel time. Flow rate can be derived as a function of peak temperature arrival time or as a function of first temporal moment of the heat pulse. In field operation, the flow across a sediment/water interface is funneled through a dome to the flow tube, and the rate of water flowing through the flow tube is measured. The advective flux through the sediment/water interface, in terms of vertical Darcy velocity, is calculated by dividing the flow rate by the dome area. The dome serves as an amplifier to bring the generally low Darcy flow within a measurable range by the flow sensor. The larger the dome area, the smaller the flow it can detect. The flux meter has undergone three field tests, for which the results are described. http://www.epa.gov/ORD/NRMRL/pubs/600r06122/600r06122.htm

Development of a Fiber Optic Enzymatic Biosensor for 1,2-Dichloroethane
Campbell, Derek W., Cord Mueller, and Kenneth F. Reardon, Colorado State Univ., Fort Collins.
Biotechnology Letters, Vol 28 No 12, p 883-887, June 2006

The authors have constructed and tested small fiber-optic biosensors for measurement of 1,2-dichloroethane (DCA) in aqueous solutions. The biocomponent is the haloalkane dehalogenase, DhlA, in whole cells of Xanthobacter autotrophicus GJ10. These cells were immobilized in calcium alginate on the tip of a fiber-optic fluoresceinamine-based pH optode. The resulting biosensor could quantify DCA at 11 mg/L and had a linear response up to at least 65 mg/L. Total signal change was reached in 8 to 10 minutes, and measurements were reproducible (SE <9%). The sensor's potential for remote operation and low cost make it of interest for further development.

Development of an In-Fiber Nanocavity Towards Detection of Volatile Organic Gases
Elosua, C., I.R. Matias, C. Bariain, and F.J. Arregui, Univ. Publica de Navarra, Pamplona, Spain.
Sensors, Vol 6 No 6, p 578-592, June 2006

An optical fiber nanosensor has been developed doping an interferometry Fabry-Perot based nanocavity constructed following the ESA method with a novel vapochromic material. The deposition method is automated, so a high reproducibility is guaranteed. Using a cleaved end multimode fiber, the complete implementation process takes only one day. The fabricated sensor head is able to distinguish among some VOCs and also can determinate different concentrations individually. The response of the sensor has been evaluated for five different VOCs, and a deeper study has been made for vapors of three different alcohols. Changes up to 1.44 dB in the reflected optical power are registered in less than two minutes. The response registered from the

sensor in terms of time response and dynamic range for different VOCs and different concentrations meets the conditions required to conform a sensor array system.
http://www.mdpi.org/sensors/list06.htm

Digital Spectral Reflectance Data of Fe-Oxide, Fe-Hydroxide, and Fe-Sulfate-Hydrate Minerals Associated with Sulfide-Bearing Mine Wastes
Crowley, J.K. (U.S. Geological Survey, Reston, VA); D.E. Williams (U.S. EPA, Research Triangle Park, Raleigh, NC); J.M. Hammarstrom, N. Piatak, J.C., Mars, and I-Ming Chou (USGS, Reston, VA).
Geochemistry: Exploration, Environment, Analysis, Vol 3 No 3, p 219-228, 2003

Fifteen Fe-oxide, Fe-hydroxide, and Fe-sulphate-hydrate mineral species commonly associated with sulphide bearing mine wastes were characterized using X-ray powder diffraction and scanning electron microscope methods. Diffuse reflectance spectra of the samples show diagnostic absorption features related to electronic processes involving ferric and/or ferrous iron, and to vibrational processes involving water and hydroxyl ions. Such spectral features enable field and remote sensing based studies of the mineral distributions. Because secondary minerals are sensitive indicators of pH, Eh, relative humidity, and other environmental conditions, spectral mapping of these minerals promises to have important applications to mine waste remediation studies. A full description of the samples and associated spectral features is provided.

Direct Detection of V-Type Nerve Agents Using a Carbon Nanotubes and OPH Modified Amperometric Enzyme Electrode
Joshi, K.A., M. Prouza, M. Kum, J. Wang, R. Haddon, W. Chen, and A. Mulchandani.
Analytical Chemistry, Vol 78 No 1, p 331-336, 2006

A biosensor for the detection of V-type nerve agents, VX and R-VX, is based on the enzyme-catalyzed hydrolysis of the nerve agents and amperometric detection of the thiol-containing hydrolysis products at carbon nanotube-modified, screen-printed electrodes. The large surface area and the hydrophobicity of the carbon nanotubes was used to immobilize an organophosphorus hydrolase mutant with improved catalytic activity for the hydrolysis of the P-S bond of phosphothiolester neurotoxins (including VX and R-VX nerve gases) to develop a mediator-free, membrane-free biosensor for V-type nerve agents. This paper describes the construction and testing of the biosensor for direct, rapid, and selective detection of V-type nerve agents.
http://www.engr.ucr.edu/~wilfred/

Dissolved Organic Matter in Pore Water of Freshwater Sediments: Effects of Separation Procedure on Quantity, Quality and Functionality
Akkanen, J., M. Lyytikainen, A. Tuikka, and J.V.K. Kukkonen, Univ. of Joensuu, Joensuu, Finland.
Chemosphere, Vol 60 No 11, p 1608-1615, Sep 2005

Porewater was separated either with or without water extraction prior to centrifugation to investigate the effects of the separation procedure on the amount and properties of dissolved organic matter (DOM) in three freshwater sediments. DOM in the samples was quantified by total organic carbon measurement and characterized by specific UV-absorption and high-performance size-exclusion chromatography analyses. Sorption of pyrene was used as a measure for DOM functionality. Both water extraction and centrifugation speed were shown to affect the properties of DOM; however, the effects were sediment dependent. Water extraction increased the amount of DOM separated from the two sediments that had humic character. The separation procedure had also an effect on the functionality of DOM; in some of the water-extracted samples, the sorption of pyrene was higher than in the corresponding samples separated without water extraction. Centrifugation speed generally had smaller effects on the properties of DOM than water extraction.

Documentation of In-Situ Microbial Oxidation of 13C-Labeled Benzene Coupled to Denitrification-Based Bioremediation Using Bio-Trap(tm) Samplers
Hince, E. (Geovation Consultants, Inc., Florida, NY); G. Davis (Microbial Insights, Inc., Rockford, TN); K. Sublette, J. Busch-Harris, and E. Jennnings (Univ. of Tulsa, Tulsa, OK).
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

An in situ denitrification-based bioremediation (DBB) program was implemented in the fall of 2004 to treat a gasoline-contaminated shallow aquifer at a DoD-owned gasoline service station site in Maine. Sampling of smear zone aquifer media documented up to two orders of magnitude reduction in the sorbed-phase concentrations of gasoline hydrocarbons in response to DBB treatment. Several molecular, culture-independent methods were used to characterize the denitrifying, gasoline-degrading microbial consortia stimulated by the DBB treatments, including denaturing gradient gel electrophoresis (DGGE), real-time polymerase chain reaction (qPCR) and multi-color fluorescence in situ hybridization (mFISH). Bio-Trap(tm) samplers containing Bio-Sep(r) beads loaded with 13C-labeled benzene were deployed in two keys wells to evaluate the intrinsic ability of the DBB-stimulated microbial consortia to degrade benzene in-situ. Floats supported the Bio-Traps(tm) at a fixed distance beneath the water table and within the zone of highest hydrocarbon contamination. The traps were installed three months after the last DBB treatment event for about one month. About 78% and 43%, respectively, of the 13C-labeled benzene was degraded in the Bio-Traps(tm) installed in wells DP-13 and DB-04 over the one-month period. The results of this study documented the in situ anaerobic oxidation and microbial assimilation of 13C-labeled benzene.

Electrical Conductivity of a Failed Septic System Soil Absorption Field
Lee, B.D. and B.J. Jenkinson (Purdue Univ., West Lafayette, IN); J.A. Doolittle (USDA-NRCS-NSSC, Newton Square, PA); R.S. Taylor (Dualem Inc., Milton, ON); J.W. Tuttle (USDA-NRCS-NSSC, Wilkesboro, NC).
Vadose Zone Journal, Vol 5 No 2, p 757-763, 2006

A study was conducted to determine the effectiveness of noninvasive electromagnetic induction (EMI) for locating a failed septic system in fine-textured glacial-till-derived soils. Components of a failed septic system were located with a push probe, georeferenced with a theodolite, and surveyed with a dual receiver EMI sensor (DUALEM-2) in both wet and dry soil moisture conditions. Results from this study suggest that electromagnetic induction is a promising technique to identify the location of septic system components, failed septic systems, and their associated effluent plumes.

Electrochemical and Optical Bioassays of Nerve Agents Based on the Organophosphorus-Hydrolase Mediated Growth of Cupric Ferrocyanide Nanoparticles
Arribas, A.S., T. Vazquez, J. Wang, and A. Mulchandani (Arizona State Univ., Tempe); W. Chen (Univ. of California, Riverside).
Electrochemistry Communications, Vol 7, p 1371-1374, 2005

A new biometallization route for detecting low levels of organophosphorus nerve agents is based on organophosphorus-hydrolase (OPH)-stimulated formation of cupric-ferrocyanide (CuFeCN) nanoparticles. The growth and accumulation of these nanoparticles onto the surface of carbon paste electrodes, coupled with their favorable redox activity, allows the amplified electrochemical detection of nerve agents. The biocatalytic formation and surface preconcentration of CuFeCN nanoparticles provides a new and attractive bioamplification route with potential for monitoring of a wide range of biocatalytic transformations.
http://www.engr.ucr.edu/~wilfred/

Electrochemical Detection of Tricresyl Phosphates
Vertelov, G. W. Gale, and A. Simonian.
210th Electrochemical Society Meeting, ECS Abstract #2102, 2006

Most of the detection and environmental research concerning organophosphates (OPs) has focused on agricultural pesticides and chemical warfare agents. Much less attention is paid to other toxic tri-aryl OPs, like tricresyl phosphate (TCP), which is heavily used in industrial applications. The most common used method for the detection of TCP includes highly sensitive gas chromatography with a nitrogen-phosphorus sensitive detector, a flame photometric detector or mass spectrometeric recognition, high-performance liquid chromatography, and thin-layer chromatography. These systems are expensive, bulky, and unsuitable for continuous on-site monitoring and also require special supplements and well-trained personnel. TCP itself is chemically very stabile and electrochemically inactive, and usually is a mixture of isomers containing different cresols residues (o-cresol, p-cresol, or m-cresol). One approach to TCP detection involves its chemical disruption into more active compounds. For example, TCP can be hydrolyzed prior to detection onto dicresyl phosphate and cresol. At room temperature, this is a slow process, achieving 90% conversion within 50 min with stirring. Irradiation of the mixture in a microwave oven obtains hydrolosis about 200 times faster (within 15 seconds) without stirring. Linear sweep voltammetry was performed with glassy carbon or carbon paste electrodes, a silver/silver chloride reference electrode, and platinum auxiliary electrode. The oxidation peak for cresols was observed at 0.778 V (vs. Ag/AgCl) in acetic buffer with pH 4.80. The sensitivity thus achieved is 10-5 M of TCP in water solution, with future sensitivity improvement anticipated.

Electromagnetic Imaging and Subsurface Pollution: An Alternative Approach
Rollins, Paul, Willowstick Technologies LLC.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

To characterize the migration of trichloroethene and other solvents in groundwater at Lawrence Livermore National Laboratory (LLNL), investigators opted to employ a minimally invasive electromagnetic water mapping technology. This paper details the theoretical science driving this advancement in site characterization technology and analyzes the lessons learned from its application at LLNL. Implementation begins with the strategic placement of electrodes into the subject groundwater system. The electrodes charge the water with a low-voltage, low-amperage audio-frequency electrical current. As the current forges a path through the features of the network, it emits a magnetic field that is characteristic of those features. That field can be captured and analyzed at the surface by a specially tuned receiver. The magnetic field data are processed, contoured, and correlated to other hydrogeologic data, resulting in enhanced definition of the groundwater system. At LLNL, this procedure was used to characterize the contaminated site and identify the plume's preferential flow paths. The procedure has the capacity to characterize sites at significant depths (beyond 1 km) and over large areas (1,000 acres).

Estimating Remediation Timeframes with and without Source Remediation
Newell, C. J. and David Adamson, Groundwater Services, Inc.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

At this time, there are no widely-used process-based models of source zones for estimating remediation timeframes (RTFs), largely because of the complexity of fate and transport processes that control source zone behavior. Source zone decay and the response of source zones to remediation are affected by a variety of overlapping fate and transport processes, such as dissolution of NAPL fingers, dissolution of NAPL pools, linear desorption, dual-equilibrium desorption, dispersion, and back diffusion from fine-grained materials. Planning-level concentration vs. time models can be a useful tool for estimating RTFs and/or the benefits that can be realized from source zone remediation. The authors present four simple concentration vs. time models: a compound model, first order decay, linear decay, and step function. RTF equations are presented for each model, as well as simple design charts and equations to show the reduction in RTF as a function of reduction in source mass and reduction in mass flux.

Environmental Technology Verification Report: QTL Biosystems LLC, QTL Biosensor
Schrock, M., R. James, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 45 pp, Sep 2006

The QTL Biosensor is a handheld device similar to standard immunomagnetic sandwich assays and is capable of detecting anthrax spores and ricin toxins in samples. The sample is added to the QTL Biosensor cartridge, which contains sensing reagents. The sensing reagents are composed of a magnetic component and a fluorescent component. Receptors for the biological agent(s) of interest are contained in both sensing reagents. Upon mixing the sample with the reagents, the magnetic and fluorescent components form a complex with the biological agent(s)

for which they are specific. A magnetic field is then applied that separates all magnetic materials (including any complexes containing the biological agent) from the solution, which contains excess fluorophore. A wash is performed to remove all excess reagents materials from the sample chamber. An excitation wavelength of light is then exposed to the magnetic pellet comprising the biological agent complexes, and the resulting fluorescence indicates the presence of the biological agent. The QTL Biosensor contains both positive and negative controls to ensure the validity of results and proper functioning of the QTL Biosensor. Both liquid and solid samples can be analyzed. Results are displayed as a millivolt (mV) and percent of full scale (%FS) reading. The red/green warning lights can be set to a pre-determined mV threshold reading to indicate a positive/negative response. A green light indicates no toxin below the mV threshold, and a red light indicates the presence of a toxin above the mV threshold. The biosensor has an integrated bar code reader (use is optional), and a starter kit comes with 20 test cartridges. The cartridge is single-use, self-contained, and self-sealing, and includes all necessary reagents. The QTL Biosensor is 11 inches long by 10 inches wide by 5 inches high and weighs 6 pounds. Its battery life is 16 hours of continuous operation, and it has a recharge cycle of 2 to 4 hours. Results can be uploaded electronically to a laptop computer. Sensor pricing starts at $11,500, and each cartridge costs $21. This report describes the ability of the QTL Biosensor to detect various concentrations of anthrax and ricin as evaluated by analyzing performance test and drinking water matrix samples.
http://www.epa.gov/etv/pdfs/vrvs/600etv06093/600etv06093.pdf

Environmental Technology Verification Report: Bioveris Bioverify(tm) Botulinum Toxin A and Ricin Test Kits and M-Series(r) M1M Analyzer
Schrock, M., R. James, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 44 pp, Sep 2006

BioVerify(tm) Test Kits detect biological agents such as bacteria, viruses, and toxins in various matrices, including food and environmental samples. The test kits use proprietary BioVeris Technology(tm) based on a process that uses labels designed to emit light when electrochemically stimulated. The tests use two antibodies specific for the antigen of interest in a single-tube lyophilized reagent format. One antibody is immobilized on paramagnetic microparticles, and the other is labeled with the BioVeris BV-TAG(tm) label. When the antigen of interest is present in the sample, both antibodies bind to the antigen, effectively linking the microparticle, the antigen, and the BVTAG(tm) label. The electrode stimulates the labels bound (via the antibodies and antigen) to the microparticles, and the emitted light is measured. If the antigen of interest is not present in the sample, the microparticle and the label are not linked, and no signal is generated. Sample analysis tubes are arranged in a 96-well format, and tests tubes containing reagents for specific target analytes are color coded. The analyzer provides real-time data acquisition using preset test protocols and includes both audible and visual warnings in the event a positive sample is encountered. The system allows storage and retrieval of all plate, sample, and quality control data in Microsoft Excel format. All reagent information is entered into the system through a barcode, and reagent usage is monitored electronically. The total weight of the analyzer, computer, transport case, and accessories is 36.4 kilograms (80 pounds). The analyzer requires a power source or use of a battery backup. Required reagents as well as waste are contained in a second transport case to segregate liquids and electronics during

transport. A BioVerify(tm) test kit containing 96 tests and the controls to run them is $1,440. The M-SERIES(r) M1M analyzer is $69,500.
http://www.epa.gov/etv/pdfs/vrvs/600etv06091/600etv06091.pdf

Environmental Technology Verification Report: PharmaLeads EzyBot(r) A and EzyBot(r) B Test Kits
Schrock, M., R. James, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 48 pp, Sep 2006

EzyBot(r) test kits provide a means for detecting botulinum toxins A (EzyBot(r) A) and B (EzyBot(r) B) in water. The technology is based on internal collision fluorescence quenching technology. A fluorogenic substance and a quenching substance in the substrate bracket an amino-acid sequence that, in the presence of botulinum toxin A or B, is cleaved, generating an intense fluorescence. This fluorescence is measured using either a laboratory or a field fluorimeter. A laboratory fluorimeter is not provided by PharmaLeads with the EzyBot(r) kit, though a field fluorimeter is available for purchase as part of the field case. The type of fluorimeter used for detection can affect the sensitivity of the analysis obtained with the EzyBot(r) test kit. The fluorescence generated by the EzyBot(r) test kit increases in intensity with time and with botulinum toxin concentration. EzyBot(r) A and B are available individually in kits of 50 ready-to-use cuvettes containing freeze-dried reagents, which can be used in the laboratory or in the field. The PharmaLeads field case provides a field incubator which can be plugged into the auxiliary power outlet of a car to perform the 1-hour incubation at 37 degrees C in the field. The price of an EzyBot(r) kit depends on the quantity ordered. For large quantities, unit price is approximately $30 per ready-to-use cuvette. Cost for the field case, including the field fluorimeter, the portable incubator, and 100 cuvettes, is less than $12,500.
http://www.epa.gov/etv/pdfs/vrvs/600etv06092/600etv06092.pdf

Environmental Technology Verification Report: Abraxis LLC, Organophosphate/Carbamate Screen Kit
Buehler, S., R. Mangaraj, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 49 pp, Sep 2006

The Organophosphate/Carbamate Screen Kit is an in vitro enzymatic test used to detect a wide range of organophosphates (including thiophosphate) and carbamates in water and other environmental matrices. The test is a qualitative, colorimetric assay (modification of the Ellman method) based on organophosphates and carbamates inhibition of the enzyme acetyl cholinesterase (ACh-E). ACh-E hydrolyzes acetylthiocholine (ATC), which reacts with 5, 5'-dithio-bis(2-nitrobenzoic acid) (DTNB) to produce a yellow color that is read at 405 or 450 nanometers. Depending on their concentrations, OP or C compounds present in a sample will inhibit ACh-E and therefore color formation will be reduced or absent. The OP/C Screen Kit is supplied with freeze-dried ACh-E and ATC in dropper bottles. Both are reconstituted with diluents supplied in the OP/C Screen Kit. The oxidizer solution is prepared by taking 200 microliters of the oxidizer and placing it into the dropper bottle containing the oxidizer diluent. All other reagents are ready to use and supplied in color-coded dropper bottles. A 5-minute incubation follows the oxidation of controls and samples. After adding neutralizer and Ach-E, an incubation of 15 to 30 minutes is required, and after adding the ATC (substrate) and DTNB

(chromagen), a 30-minute incubation is required. Color development is curtailed by adding stop solution. The tubes are read in a colorimeter at 405 or 450 nanometers. Not supplied is a colorimeter capable of reading 405 or 450 nanometers; however, samples can also be read by visually comparing the sample to the negative control. The OP/C Screen Kit contains 20 tubes with assay buffer, two test tubes (one to be used for the negative control and ATC diluent and the other for the ACh-E diluent). Dropper bottles with color-coded caps contain the freeze-dried ATC and Ach-E and ready-to-use solutions of oxidizer diluent, neutralizer, chromagen (DTNB), and stopper solution. Also included are two 4-milliliter amber vials that contain the oxidizer and positive control (5 ppm diazinon in deionized water). Two 3-mL transfer pipettes and 22 exact-volume 100-uL disposable pipettes are included in the kit. The assay incubations are performed at 70+/-20 degrees F. The price of the OP/C Screening Kit (20 tests) is $180, not including the colorimeter. The OP/C Screen Kit results for this verification test for samples containing VX, GB, GD, aldicarb, and dicrotophos are presented in this report in tabular form.
http://www.epa.gov/etv/pdfs/vrvs/600etv06066/600etv06066.pdf

Environmental Technology Verification Report: Aqua Survey, Inc., NEURO-IQ Tox Test Kit(tm)
Buehler, S., R. Mangaraj, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 47 pp, Sep 2006

The Neuro-IQ Tox Test Kit(tm) is used to test water supplies for the presence of contaminants in drinking water in sufficient concentrations to cause harm to humans. The Neuro-IQ-Tox Test Kit(tm) is acetocholine/cholinesterase based and detects contaminants of interest by interrupting an enzymatic reaction. The presence or absence of contaminants at significant concentrations is predicted by adding two reagents to water samples and measuring the drop in pH after three minutes. This test is generally performed in replicates of up to four. A test sample pH higher ($\geq$ 0.2 pH units) than the control water sample's 3-minute pH reading indicates the possible presence of a significant threat contaminant concentration. The test can be conducted by a technician with basic laboratory skills. Data are recorded on a scorecard provided with the kit. Enough reagent is provided with the kit to assay up to 400 test water samples. The Neuro-IQ-Tox Test Kit(tm) retails for $300. The results for this verification test for samples containing VX, GB, GD, aldicarb, and dicrotophos are presented in tabular form. Results include qualitative responses for each set of sample replicates, as well as accuracy, false negatives and positives, and precision. The performance factors apply across all contaminants.
http://www.epa.gov/etv/pdfs/vrvs/600etv06067/600etv06067.pdf

Environmental Technology Verification Report: Protein-Biosensor, OP-Stick Sensor
Mangaraj, R., S. Buehler, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 48 pp, Sep 2006

The OP-Stick Sensor is an enzymatic colorimetric assay designed for detecting organophosphate (including thiophosphate) and carbamate (OP/C) pesticide residues in water, soil, and food. This technology had not been used to test for chemical warfare agents (CWA) prior to this verification test. The assay is a field diagnostic test that measures acetylcholinesterase (AChE) activity and is based on an enzyme engineered for increased sensitivity to OP and C pesticides. When not in the presence of inhibiting pesticides, AChE

hydrolyzes acetylthiocholine to thiocholine, which reacts with a colorimetric substrate on a test stick to produce a brown color. In the presence of OP/Cs (which are oxidized during the test to an 'oxon' form), AChE is irreversibly inhibited and color formation is reduced or absent depending on the pesticide concentration. The intensity of the brown color is inversely proportional to OP/C concentration. Detection limits for the various OP/Cs differ depending on their ability to inhibit the enzyme. Combinations of various OP/Cs will have an additive effect on the inhibition assay. The test allows screening without any laboratory. Positive tests would need confirmation by further analysis for qualitative and quantitative assay. One OP-Stick Sensor kit is composed of three tubes each labeled with a colored sticker and one test stick. Tube 1 (labeled yellow) contains an oxidizing agent for phosphorothioate activation in an oxon form. Tube 2 (labeled blue) contains a neutralizing agent to avoid denaturation of AChE by the reagent from Tube 1. Tube 3 (labeled red) contains the chromogen reagent. The price of this small kit, which can be used for one test, is approximately $20. This verification test evaluated the ability of the OP-Stick Sensor to detect chemical agents, carbamate pesticides, and OP pesticides in drinking water and specifically assessed the performance of the OP-Stick Sensor relative to accuracy, false positive and negative rates, precision, potential matrix and interference effects, and operational factors (operator observations, ease of use, and sample throughput).
http://www.epa.gov/etv/pdfs/vrvs/600etv06068/600etv06068.pdf

Environmental Technology Verification Report: Severn Trent Services, Eclox(tm)-Pesticide Strips
Mangaraj, R., S. Buehler, A. Dindal, Z. Willenberg, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 48 pp, Sep 2006

The Eclox(tm)-Pesticide Strips are designed to give a qualitative (i.e., yes/no) indication for the presence of OP, thiophosphate, and carbamate pesticides. The technology is based on the inhibition of the enzyme acetylcholinesterase. Each strip contains a smaller white disk and a larger pink disk covered with foil. After removing the strip from the packaging, the operator exposes the white disk only and dips it into the sample for one minute. Next, the operator removes the strip from the sample and removes the foil cover to expose the pink disk. The operator folds the strip at the perforation and presses the disks together. The disks are held together for three minutes to expose the pink disk to the suspect test water sample. After the 3-min holding time, the operator visually reads the color of the smaller disk. Two results are possible: a blue color indicates the absence of a pesticide and white indicates the presence of a pesticide. The Eclox(tm)-Pesticide Strips are part of the Eclox(tm) portable field water quality assessment system, which detects intentional or accidental contamination of water. The Eclox(tm) system uses a luminometer to determine water toxicity and can be used to test for various contaminants in water. A package of 25 Eclox(tm)-Pesticide Strips can be purchased separately (from the Eclox(tm) system) for $510.00. The objective of this verification test was to evaluate the ability of the strips to detect chemical agents, carbamate pesticides, and OP pesticides in drinking water relative to accuracy, false positive and negative rates, precision, potential matrix and interference effects, and operational factors (operator observations, ease of use, and sample throughput).
http://www.epa.gov/etv/pdfs/vrvs/600etv06069/600etv06069.pdf

Environmental Technology Verification Report: TraceDetect SafeGuard Trace Metal Analyzer
Gregg, A., T. Kelly, Z. Willenberg, A. Dindal, and K. Riggs, Battelle.
U.S. EPA, Environmental Technology Verification Program, 52 pp, Aug 2006

TraceDetect's SafeGuard is designed to automatically measure total arsenic (As) concentrations in drinking water samples (both raw and treated water) over a range from 1 part per billion (ppb) to over 100 ppb. Once the operator has introduced the sample vial and selected 'measure' on the control computer, all calibrations, dilutions, reductions, standard additions, and measurements are performed by the SafeGuard, with the results displayed and logged in a data file. The software program is designed with a basic mode of operation and an administrator mode of operation and hence can be operated by either a technical or non-technical user. The SafeGuard consists of three main components: the expert system, the fluidics system, and TraceDetect's patented NanoBand(tm) sensor and potentiostat. Each of these components has a part in the measurement process, from controlling the pumps, to adding chemicals, to making measurements and interpreting the results. The SafeGuard uses anodic stripping voltammetry (ASV) and the method of standard addition to make metals measurements. ASV is an electro-analytical method that detects ions in a solution by the potential at which they oxidize and strip away from the surface of an electrode. The device is able to measure As(III) and reduce As(V) to As(III) to measure total arsenic. It can also be configured to analyze copper, lead, zinc, cadmium, and mercury in water. The unit stores data for every measurement and operation. The TraceDetect SafeGuard as configured for measuring arsenic during this verification test was priced at $35,000, excluding options that the customer might require for unique sample preparation (e.g., copper removal from samples, filters for high turbidity samples).
http://www.epa.gov/etv/pdfs/vrvs/600etv06060/600etv06060.pdf

Evaluating an Electrokinetically Driven Extraction Method for Measuring Heavy Metal Soil Contamination
Deng, Xiaolin and Aaron A. Jennings, Case Western Reserve Univ., Cleveland, OH.
Journal of Environmental Engineering, Vol 132 No 4, p 527-537, Apr 2006

The authors compared results for an extraction based on the electrokinetic mobilization of "old" metals to the results of established single analyte and sequential extraction methods. Accomplishing extractions electrokinetically offers promise for simplifying processes and for evaluating the electrokinetic remediation potential of weathered contaminated soils. On the brownfield soils tested, electrokinetic extraction identified an average of 82% of the soil's Cr, Cu, Pb, and Zn burden relative to EPA Method 3050B extractions; however, neither of the methods was successful at extracting all of the sequestered (residual) fraction of heavy metals and thus the total contamination burden of the soil was underestimated.

Evaluation and Optimization of Extraction and Clean-up Methods for the Analysis of Polycyclic Aromatic Hydrocarbons in Peat Samples
Dreyer, Annekatrin and Michael Radke, Univ. of Bayreuth, Bayreuth, Germany.
International Journal of Environmental Analytical Chemistry, Vol 85 No 7, p 423-432, 15 June 2005

The analysis of polycyclic aromatic hydrocarbons (PAHs) in peat samples is complicated by peat's high organic matter content, which affects both extraction efficiency and analytical quality. Investigators evaluated the efficiencies of three extraction methods--accelerated solvent extraction (ASE), fluidized bed extraction, ultrasonic extraction--and several cleanup techniques to find the best set of methods. ASE proved to be the best extraction method. For cleanup, a procedure using aluminium oxide and silica gel showed the highest efficiency. Using the optimized extraction and cleanup procedure, the investigators analyzed 170 samples from Canadian bogs for PAH. The optimized method was found to be well suited for the analysis of PAH in peat samples.

Evaluation of a Method for Identification of Host Physico-Chemical Phases for Trace Metals and Measurement of Their Solid-Phase Partitioning in Soil Samples by Nitric Acid Extraction and Chemometric Mixture Resolution
Cave, M.R., A.E. Milodowski, and E.N. Friel, British Geological Survey, Keyworth, Nottingham, UK.
Geochemistry: Exploration, Environment, Analysis, Vol 4 No 1, p 71-86, Feb 2004

A sequential extraction methodology designed to measure the solid-phase partitioning of metals in soils and sediments uses centrifugation to pass increasing concentrations of nitric acid through the sample, followed by ICP-AES analysis of major and trace elements of the extracts. A data-processing algorithm is used to identify the number of physico-chemical components extracted, their composition, and the proportion of each in each extract. The algorithm has been successfully tested on a synthetic data set, and the combined extraction methodology and data-processing algorithm have been tested on a standard contaminated soil sample.

Evaluation of Diffusive Gradients in Thin Film (DGT) Samplers for Measuring Contaminants in the Antarctic Marine Environment
Larner, Bronwyn L. and Andrew J. Seen (Univ. of Tasmania, Launceston, Tasmania, Australia); Ian Snape (Australian Antarctic Division, Kingston, Tasmania, Australia).
Chemosphere, Vol 65 No 5, p 811-820, Oct 2006

Diffusive gradients in thin film (DGT) samplers were used to measure metals in water and sediment porewater in the Antarctic environment. Although DGT water sampling was restricted to quantification of Cd, Fe, and Ni, preconcentration using Empore chelating disks provided results for an additional nine elements (Sn, Pb, Al, Cr, Mn, Co, Cu, Zn, As). Heavy-metal concentrations in the impacted Brown Bay were found to be comparable with the non-impacted O'Brien Bay. Although sediment porewater sampling using DGT indicated little difference between Brown Bay and O'Brien Bay for many metals (Cd, Al, Cr, Co, Ni, Cu), greater amounts of Pb, Mn, Fe, and As were accumulated in DGT probes deployed in Brown Bay than in O'Brien Bay. Comparison of DGT-derived porewater concentrations with actual porewater concentrations showed limited resupply of Cd, Pb, Al, Cr, Mn, Co, Ni, Cu, Zn, and As from the solid phase to porewater, with these metals appearing to be strongly bound to the sediment; however, resupply of Fe and Sn was apparent. The authors conclude that Sn, and to a lesser extent Pb, are critical contaminants.

Evaluation of Geophysical Methods for the Detection of Subsurface Tetrachloroethyene in Controlled Spill Experiments
Mazzella, Aldo (U.S. EPA); Ernest L. Majer (Lawrence Berkeley National Laboratory).
SEG/New Orleans 2006 Annual Meeting, p 1466-1470, 2006 [LBNL-60407]

A controlled tetrachloroethene (PCE) spill experiment was conducted in a multi-layer formation consisting of sand and clay/sand layers. The purpose of the work was to determine the detection limits and capability of various geophysical methods. Measurements were made with 10 different geophysical techniques before, during, and after the PCE release. This experiment provided a clear identification of any geophysical anomalies associated with the presence of the PCE. During the injection period, all the techniques indicated anomalies associated with the PCE. To quantify the results and provide an indication of the PCE detection limits of the various geophysical methods, the tank was subsequently excavated and samples of the various layers were analyzed for residual PCE concentration with gas chromatography. This paper presents some of the results of five of the techniques: cross-borehole complex resistivity (aka spectral induced polarization), cross-borehole high resolution seismic, borehole self potential, surface ground penetration radar, and borehole video.
http://repositories.cdlib.org/lbnl/LBNL-60407/

Evaluation of Vapor Intrusion from Subsurface Diesel Plume Using Multiple Lines of Evidence
Connor, J.A., T.E. McHugh, and F. Ahmad, Groundwater Services, Inc., Houston, TX.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

A series of investigations have been conducted near a railway facility in Mandan, ND, to investigate alleged vapor intrusion impacts from a subsurface diesel plume. The results of these investigations demonstrate how multiple lines of evidence can be employed to distinguish between background indoor air quality and volatile organic vapors associated with actual subsurface vapor intrusion. For a building overlying soil or groundwater containing volatile organic chemicals (VOCs), the measured concentration of a VOC in indoor air is the sum of the background indoor air concentration and the VOC contribution from subsurface vapor intrusion. To distinguish vapor intrusion impacts from background indoor air sources, the authors review data management procedures and multivariate statistical methodologies for comparing the organic vapor composition of indoor air, ambient air, and subsurface vapors; evaluating the temporal effect of soil vapor extraction operations on organic vapors in the subsurface and in indoor air; and measuring and interpreting vertical vapor concentration profiles within vadose zone soils. Evaluation of these multiple lines of evidence at the Mandan site showed that indoor vapor sources were the likely cause of the VOCs measured in indoor air, with no contribution observed by subsurface vapor intrusion from the underlying diesel plume.

Existing and Potential Standoff Explosives Detection Techniques
National Research Council, Committee on the Review of Existing and Potential Standoff Explosives Detection Techniques.
National Academy Press, Washington, DC. ISBN: 0309091306, 148 pp, 2004

To assist the Defense Advanced Research Projects Agency (DARPA) in its efforts to develop more effective and flexible explosive and bomb detection systems, the NRC has

examined the scientific techniques currently used as the basis for explosives detection and attempted to identify other techniques that might provide promising research avenues with possible pathways to new detection protocols.
http://books.nap.edu/catalog/10998.html

The Extraction and Analysis of 1,4-Dioxane from Water Using Solid-Phase Microextraction Coupled with Gas Chromatography and Gas Chromatography-Mass Spectrometry
Shirey, R.E. and C.M. Linton, Supelco, Inc., Bellefonte, PA.
Journal of Chromatographic Science, Vol 44 No 7, p 444-450, Aug 2006

Two methods were developed for the extraction of 1,4-dioxane from water using 80-um carboxen-polydimethylsiloxane solid-phase microextraction fibers followed by either gas chromatography/flame ionization detection (GC/FID) or GC-mass spectrometry (MS). With GC/FID, the lower limit of detection for 1,4-dioxane was 2.5 ug/L (ppb) with a linear range of 5 to 10,000 ug/L, obtained by immersing the fiber in the sample for 20 min with agitation. Using GC/MS, the lower limit of quantitation is 0.5 ug/L, and the LOD is 0.25 ug/L. The upper linear range limit is 100 ug/L. Samples are extracted in 20 min using either heated headspace with agitation or direct immersion with agitation.

Fibre-Optic Bacterial Biosensors and Their Application for the Analysis of Bioavailable Hg and As in Soils and Sediments from Aznalcollar Mining Area in Spain
Angela Ivask, A. (National Inst. of Chemical Physics and Biophysics, Tallinn, Estonia), T. Green, B. Polyak, A. Mor, A. Kahru, M. Virtad, and R. Marks.
Biosensors and Bioelectronics, [available as e-print], 2006

Fiber-optic biosensors for mercury and arsenic were developed by attaching alginate-immobilized recombinant luminescent Hg- and As-sensor bacteria onto optical fibers. The optimized biosensors enabled quantification of the target analytes at 2.6 ug/L Hg(II) and 141 ug/L As(V) or 18 ug/L As(III). Best sensitivity was obtained when the fiber tips were stored in calcium chloride solution at -80 degrees C. This paper details the application of the fiber-optic biosensors to soil and sediment samples from Aznalcollar mining area in comparison with non-immobilized sensors. Approximately 20-fold more Hg and 4-fold more As was available to non-immobilized sensor bacteria, which indicates the importance of direct cell contact (possible only for non-immobilized cells) for enhanced bioavailability of these metals in solid samples.

Fiber Optic Biosensors for Contaminant Monitoring
Environmental Security Technology Certification Program, ESTCP Project CU-0115, 79 pp + 3 separate appendices, Dec 2005

Colorado State University (CSU) has developed fiber optic biosensors that are ideally suited for monitoring ground-water contaminants in the field. Generally, a biosensor is a device that utilizes a biological recognition element (typically enzymes or antibodies) to sense the presence of an analyte and create a response that is converted by a transducer to an electrical or optical signal. The primary issue regarding the use of biosensors is reliability (i.e., are biosensor results comparable to laboratory analyses?). The end user needs to know whether the biosensor results are comparable to laboratory analyses and also whether conditions exist that affect the

reliability of biosensor performance. Biosensor ease of use and calibration are also important so that reproducible results can be obtained by different users. The demonstration conducted at the Naval Submarine Base (SUBASE Bangor) in Kipsap County, WA, was designed to address these issues. The target analyte was 1,2-dichloroethane (1,2-DCA). The overall objective of the demonstration was to provide a basis to justify the use of biosensors to augment or replace conventional analytical methods for measuring selected compounds in groundwater. The investigators found that at the present level of development, the biosensors would most appropriately be used to provide semi-quantitative data regarding 1,2-DCA concentrations in ground water when used for flow-through cell and down-hole measurements. When used in the vial measurement mode, the biosensors can be used to collect quantitative data. Further investigation into development and testing of the biosensors is required for them to be reliable field instruments for all of the applications originally intended. Appendices 1, 2, and 3 are available individually on line at http://www.estcp.org/technology/ER-Site-Characterization.cfm
http://www.estcp.org/Technology/upload/ER_0115_FR.pdf

Field Data and Modeling MTBE Remediation by SVE: Case Study in Southern California
Umstot, T.G., N. Sweetland, B. Casadevall, and D.B. Stephens (Daniel B. Stephens & Associates); M.J. Huggins and D.E. Potts (Wayne Perry Inc.).
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Analytical and numerical models often fall short of accurately predicting the time a remedial approach will require to reach the cleanup goals. Under-prediction of cleanup times is due in part to insufficient site data obtained during characterization to support the formation of a solid site conceptual model. This paper presents a case study of an MTBE cleanup by soil vapor extraction (SVE) at a site in southern California. Detailed investigations were conducted at this site to develop a comprehensive understanding of the nature and extent of subsurface contamination, an estimation of the size and timing of the gasoline release, and a detailed description of the site stratigraphy and aquifer characteristics. A numerical model of the site and SVE system was built using independently derived source parameters and model framework. The model was used to predict the SVE removal curves for MTBE, benzene, and other gasoline constituents. The predictions were compared to the actual measured volatile organics data collected from individual SVE wells and from the combined effluent data for each gasoline constituent studied. This comparison illustrates how precisely cleanup times can be estimated for a comprehensively characterized site.

Field Demonstration and Validation of a New Device for Measuring Water and Solute Fluxes, NASA LC-34 SITE
Environmental Security Technology Certification Program (ESTCP), 172 pp, Feb 2006

The use of contaminant flux and contaminant mass discharge as robust metrics for assessment of risks at contaminated sites and for evaluating the performance of site remediation efforts has gained increasing acceptance within the scientific, regulatory and user communities. The Passive Flux Meter (PFM) is a new technology that directly addresses DoD's need for cost-effective long-term monitoring by using flux measurements for process control, remedial action performance assessments, and compliance purposes. The use of innovative technologies, such as the PFM, can be slow to gain acceptance in the environmental community without successful

demonstration of the technology in the field. ESTCP project No ER-0114 is supporting the demonstration and validation of the PFM is demonstrated at several locations, including Hill AFB in Layton, UT and NASA Launch Complex 34 (LC 34) in Cape Canaveral, FL. These projects are intended to evaluate the flux meter as an innovative technology for direct in situ measurement of cumulative water and contaminant flux for DNAPLs and for compiling field data to transition the technology from the innovative testing phase to regulatory/end user acceptance and stimulated commercialization. The focus of the NASA site was to demonstrate and validate the PFM for measuring simultaneously the ground-water and contaminant fluxes in contaminated aquifers at LC 34, where NASA was demonstrating bioaugmentation to enhance the removal of trichloroethene.
Report at http://www.estcp.org/Technology/upload/ER-0114-FR-NASA.pdf

Field Measurement of LNAPL Mobility and Soil Properties through Parametric Analysis of Product Baildown Tests
Lundy, Don A., PG, Environmental Systems & Technologies.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

American Petroleum Institute guidance provides two different methods of analyzing baildown test data for estimating the oil conductivity (Ko) of a mobile light nonaqueous phase liquid (LNAPL) layer in the subsurface. These methods are based on different assumptions about how oil head changes are represented in the solution method, which can lead to significantly different results in which Ko values may differ by a factor of 10. Parametric analysis of the baildown test results may help resolve the issue of which is more suitable to site conditions, while offering a way to estimate site-specific soil properties. The parametric analysis recalculates the Ko value from either method with a set of parametric equations for oil saturations and relative permeabilities, while holding measured or assumed fluid properties constant and treating capillarity parameters and residual water as functions of the hydraulic conductivity within the LNAPL zone. Soil parameter values are estimated using an optimization routine for one of two database-defined functions, depending on which solution is most consistent with other site-specific information. The optimum set of soil parameter values is then used to calculate the specific oil volume and inherent oil mobility at the test well location.

Field Measurements
U.S. Geological Survey TWRI Book 9, National Field Manual for the Collection of Water-Quality Data, Chapter A6, 7 sections, 2005/2006

The National Field Manual for the Collection of Water-Quality Data provides protocols, standard procedures, and guidance for U.S. Geological Survey personnel who collect data used to assess the quality of the Nation's surface-water and groundwater resources. Chapter A6 presents general information and guidelines for performing field measurements (section 6.0) and specific requirements and guidance for collecting data for water temperature (section 6.1), dissolved oxygen concentrations (section 6.2), specific electrical conductance (section 6.3), pH (section 6.4), reduction-oxidation potential (section 6.5), alkalinity (section 6.6), and turbidity (section 6.7). Each of these sections is revised periodically and published separately.
http://pubs.usgs.gov/twri/

Field Methodology for the Stabilization of Arsenic Species in AMD
Sarmiento, A., D. Sanchez-Rodas, V. Oliveira, J.M. Nieto, & J.L. Gomez-Ariza.
Mine Water 2005 -- Mine Closure. University of Oviedo. p 569-573, 2005

Different methodologies for the arsenic species preservation in acid mine drainage samples were examined by using different containers (clear or brown), temperatures, acids (EDTA, hydrochloric acid, and acetic acid), and a cationic exchange resin to preserve the samples until analysis. The best result was obtained with filtration of the samples to 0.2 um pore size, acidification with HCl, and in situ cleanup with a cationic exchange resin. The use of opaque containers and refrigeration is necessary. This method should preserve sample integrity for analysis of As speciation for at least 48 h.
http://www.imwa.info/docs/imwa_2005/IMWA2005_081_Sarmiento.pdf

Field Methods for Geologists and Hydrogeologists
Assaad, Fakhry, Philip E. LaMoreaux and Travis H Hughes
Springer Verlag, ISBN: 3540408827, 378 pp, 2004

The authors describe project performance, methods for field study of rocks, soils, and outcrops and how to evaluate impacts of air pollution and water resources systems. Furthermore, they develop guidelines for graphic and text presentation of results of studies and describe superficial rock characteristics and subsurface geological mapping techniques. The text covers hydrogeologic methods, groundwater monitoring systems, contamination, and waste management and discusses groundwater flow in fractured and granular aquifers, including a special reference to karstic aquifers. International waste management rules and regulations are listed. A glossary lists geological and hydrogeological terms, as well as a standard terminology for soils, rocks, and contained fluids.

Field Push-Pull Test Protocol for Aerobic Cometabolism of Chlorinated Aliphatic Hydrocarbons
Kim, Y., M. Azizian, J. Istok, and L. Semprini, Oregon State Univ., Corvallis.
Environmental Security Technology Certification Program, 83 pp, 2005

This protocol describes a newly developed field technology--the single-well push-pull test--for evaluating the feasibility of using in situ aerobic cometabolic processes to treat ground water contaminated with chlorinated solvent mixtures. Push-pull tests have been used to obtain quantitative information on a variety of aquifer physical, chemical, and microbiological characteristics, but have not previously been used to investigate aerobic cometabolic processes. This protocol describes how push-pull tests can be used to evaluate the potential for aerobic cometabolism of chlorinated aliphatic hydrocarbons using gaseous cometabolic substrates (e.g., propane) and soluble substrates (e.g., toluene). The protocol introduces the field test methodology, describes how field push-pull tests are performed, explains how to prepare test solutions, and summarizes the analytical methods used to measure tracer, nutrient, substrate, and chlorinated solvent/transformation product concentrations in field samples collected during the tests. Case studies of field work conducted at McClellan AFB, CA, and Fort Lewis, WA, are provided to illustrate additional details about the push-pull test methodology.
http://www.estcp.org/Technology/upload/CU-9921%20PR-01.pdf

Fingerprint Analysis of Contaminant Data: A Forensic Tool for Evaluating Environmental Contamination
Plumb, Russell H., Jr., Lockheed Martin Environmental Services, Las Vegas, NV.
EPA 600-5-04-054, 27 pp, 2004

Several studies have been conducted on behalf of U.S. EPA to identify detection monitoring parameters for specific industries. One outcome of these studies was the evolution of an empirical multi-variant contaminant fingerprinting process. This process, Fingerprint Analysis of Leachate Contaminants (FALCON), was developed through the EPA's Technical Support Center in response to the need for identifying the source of contaminant plumes. FALCON combines data for several contaminants to develop a distinctive graphical fingerprint or multi-parameter chemical signature. These fingerprint patterns can be used to characterize the source of a contaminant plume, differentiate the contaminant plume from background conditions at the source, and monitor the migration of leachate into the environment. It can be applied to both organic and inorganic contaminants and is effective over a wide range of contaminant concentrations. This data evaluation process is analogous to using fingerprints to identify individuals; however, rather than using the size and location of ridges and swirls on the fingertip, the relative abundance of selected constituents is used to develop distinctive chemical signatures. The objective of this paper is to demonstrate that FALCON is a quantitative, defensible fingerprinting process. Examples and case studies are presented to illustrate the range of situations in which fingerprinting can be applied to characterize the occurrence and distribution of environmental contaminants. These examples were developed using routine monitoring data obtained from a variety of ongoing site characterization and monitoring programs.
http://www.epa.gov/esd/tsc/images/fingerprint.pdf

Flare Testing Using the SOF Method at Borealis Polyethylene in the Summer of 2000
Mellqvist, Johan, Chalmers Univ. of Technology Goteborg.
Public Works and Government Services Canada, Request No 1694120, 29 pp, 3 October 2001

A study of flaring efficiency at the Borealis Polyethylene low-pressure plant in Stenungsund was conducted using a new patented method called Solar Occultation Flux (SOF), in combination with a new type of direct measurement of flow rate and ethylene concentration in the flare stack. The SOF method is based on the measurement of hydrocarbon concentrations over a cross-section of the emission plume. Multiplied by wind speed, this gives the flux of gas through the cross-section, i.e., the source emission in kg/s. The sun was used as the measurement light source. An infrared FTIR spectrometer linked to a sun tracker was placed on top of a van, which was driven in such a way that the sunlight shone through a cross-section of the plume being measured. From the size of the molecular fingerprints in the infrared solar spectra, the concentration of ethylene and other constituents can be calculated. The results show that the flare studied has a good combustion efficiency of about 98% at high loads (>1100 kg/h), but that at low loads (which are the normal operating conditions most of the time) it has a significantly lower efficiency (50 to 90%). Emissions thus appear to vary between 20 and 50 kg/h irrespective of load, a result consistent with other long-term FTIR measurements taken outside the plant. Similar emission results were also obtained during the course of the project from a newly installed flare, which indicates that the problem does not appear to be specific to the study flare. From the measurements in this study, it seems that a major contributing factor to poor efficiency is an overdose of steam at low operating loads as a result of trying to avoid soot formation by optimizing flare combustion at high loads. The problem can presumably be solved by

introducing some form of dynamic steam metering linked to combustion load, or by eliminating the presence of ethylene at low operating loads. The direct flare stack measurements show that the heating value is generally low, and theoretically, poorer efficiency levels could occur, though it was not possible to demonstrate it unambiguously because the steam and ethylene levels were generally covariant.
http://www.fluxsense.se/reports/flarepaperfinal%201004.pdf

A Flexible Water Content Probe for Unsaturated Soil Column Experiments
E. D. Mattson, K.E. Baker, C.D. Palmer, C.R. Breckenridge, and J.M. Svoboda (Idaho National Lab., Idaho Falls, ID); R.W. Smith (Univ. of Idaho, Idaho Falls, ID).
Vadose Zone Journal, Vol 5 No 2, p 805-808, 2006

A commercially available soil moisture probe was modified by replacing rigid electrode waveguides with flexible electrode traces that can be attached to the interior of soil column walls. This new design minimizes soil packing difficulties and potential bias in water and solute flow pathways commonly associated with rigid probe installations in column experiments. Tests demonstrated that the modified flexible electrode design maintains a voltage response proportional to the electrode trace length, reduced by approximately one-half when only one side of the electrode trace is in contact with the soil media. The replacement of the rigid electrode with a flexible electrode offers an improved method of measuring the water content in solute transport experiments while minimizing sensor intrusion into laboratory soil columns.

Flow-Through Bulk Optode for Spectrophotometric Determination of Thiocyanate and Its Application to Water and Saliva Analysis
Garcia, M.S., J.A. Ortuno, C. Sanchez-Pedreno, M.I. Albero, and M.J. Fernandez, Univ of Murcia, Murcia, Spain,
Sensors, Vol 6 No 9, Sep 2006

This paper describes a flow-through spectrophotometric bulk optode for the flow-injection determination of thiocyanate. As active constituents, the optode incorporates the lipophilized pH indicator 5-octadecanoyloxy-2-(4-nitrophenylazo)phenol and methyltridodecyl ammonium chloride, dissolved in a plasticized poly(vinyl)chloride membrane entrapped in a cellulose support. The optode is applied, in conjunction with the flow injection technique, to the determination of thiocyanate at pH 7.5. The sensor is readily regenerated with a 10-2 M NaOH carrier solution. The analytical characteristics of this optode with respect to thiocyanate response time, dynamic measurement range, reproducibility and selectivity are discussed.
http://www.mdpi.org/sensors/list06.htm

Fluorescence and DOC Contents of Estuarine Pore Waters from Colonized and Non-Colonized Sediments: Effects of Sampling Preservation
Otero, M., A. Mendonca, M. Valega, E.B.H. Santos, E. Pereira, V.I. Esteves, and A. Duarte, Univ. of Aveiro, Aveiro, Portugal.
Chemosphere, [in press] 2006

The influence of the colonization of salt marsh sediments with sea purslane (Halimione portulacoides), an evergreen shrub, was evaluated by analyzing the fluorescent dissolved organic matter (FDOM) in sediment pore waters from a salt marsh at different depths. Cores of sediments at colonized and non-colonized sites were collected from a coastal lagoon. The DOC content of extracted pore waters was determined and characterized by synchronous molecular fluorescence and UV-visible spectroscopies. The authors present a disscusion of the freezing (for preservation) of extracted and filtered pore water and the methodology's effect on the properties of pore waters. Two types of fluorescent substances were found in the porewater's spectra, one corresponding to humic-like substances and another one resembling proteins. Major differences were noted in the spectra of pore waters depending on both depth at which the sample was taken and the presence or absence of vegetation colonization.

Flux-Based Assessment at a Manufacturing Site Contaminated with Trichloroethylene
Basu, N.B., P.S.C. Rao, and I.C. Poyer (Purdue Univ., West Lafayette, IN); M.D. Annable and K. Hatfield (Univ. of Florida, Gainesville).
Journal of Contaminant Hydrology, Vol 86 Nos 1-2, p 105-127, 30 June 2006

Groundwater and contaminant fluxes were measured with the passive flux meter (PFM) technique in wells along a longitudinal transect passing approximately through the centerline of a trichloroethene (TCE) plume at a former manufacturing plant. Two distinct zones of hydraulic conductivity were identified from the measured groundwater fluxes that would significantly affect any remediation technology used at the site. The flux-averaged TCE concentrations estimated from the PFM results compared well with existing groundwater monitoring data. At least 800 kg of TCE was estimated to be present in the source zone. The TCE mass discharge across the source control plane was used to estimate the source strength (365 g/day), while mass discharges across multiple downgradient control planes were used to estimate the plume-averaged TCE degradation rate constant (0.52/year). The mass discharge approach provides a more robust and representative estimate than the centerline approach; the latter uses only data from wells along the plume centerline while the former uses all wells in the plume.

Freely Dissolved Pore Water Concentrations and Sorption Coefficients of PAHs in Spiked, Aged, and Field-Contaminated Soils
ter Laak, T.L., A. Barendregt, and J.L. Hermens, Utrecht Univ., Utrecht, The Netherlands.
Environmental Science & Technology, Vol 40 No 7, p 2184-2190, 1 Apr 2006

A depletive partitioning-based sampling technique was validated and applied to measure free concentrations of polycyclic aromatic hydrocarbons (PAHs) in spiked, aged, and field-contaminated soils. Detailed kinetic studies were performed to select appropriate equilibration times. Freely dissolved aqueous concentrations in the porewater were compared to total concentrations, and sorption coefficients were calculated. Equilibrium partition models can predict sorption coefficients of freshly spiked and lab-aged soils fairly accurately; however, freely dissolved porewater concentrations of field-contaminated soils were found to be orders of magnitude lower than model predictions. Application of the simple and sensitive partitioning-based sampling technique used in this study could improve the site-specific risk assessment of field-contaminated soils.

Fugitive VOC-Emissions Measured at Oil Refineries in the Province of Västra Götaland in South West Sweden - A Success Story Development and Results 1986–2001.
Frisch, L.
County Administration of Västra Götaland, Report No. 2003:56.

This report descibes the results of several years of open path monitoring with a DIAL system at refineries in Sweden. The system is able to quantitate fugitive emissions fluxes and provide a realistic estimate of actual releases at the facilities as well as identify bad actors. There is a consistent 10 to 20 percent underestimation of releases at the plants when emissions factors are used to calculate them instead of direct measurement. http://www.clu-in.org/programs/21m2/projects/rapport200356-Final_VOC.pdf

Functionalized Nanoelectrode Arrays In-Situ Identification and Quantification of Regulated Chemicals in Water
Yelton, W.G., M.P. Siegal, and K.B. Pfeifer.
EWRI 2005: Impacts of Global Climate Change.
American Society of Civil Engineers, Reston, VA. ISBN: 0-7844-0792-4, 2005

The development of nanoelectrode arrays for in situ identification and quantification of chemicals in water has progressed in four major directions. Three nanoelectrode array designs have been developed and engineered to operate in a portable field mode or as a distributed sensor network for water systems. Field-ready sampling heads that combine the arrays with a high-speed potentiostat have been designed and engineered to replace the fragile glass electrochemical cells used in the lab. To utilize these arrays in a portable system, a light-weight, high-speed potentiostat with pulse widths from 2 sec to 100 msec or greater has been developed. The parameters for an analytical method in low-conductivity solutions for Pb(II) detection have also been developed, with initial studies of As(III) and As(V) analysis in natural water sources.

Geochemical and Geophysical Techniques Application to Characterize a Mining Silt Pond from Cartagena-Union (Murcia): Potential Pollution Pathways
Faz, A., E. Aracil, P. Martinez-Pagan, J.A. Acosta, S. Martinez-Martinez, U. Maruri, and M.A. Martinez-Segura.
Mine Water 2005 -- Mine Closure. University of Oviedo, p 295-302, 2005

The results obtained from geochemical and geophysical techniques implemented in the characterization of a mining silt pond are presented. The aim of the study is to establish the potential contamination pathways. The data show that 2D and 3D electric tomography is an effective technique to cube the volume of the mining silt pond and to visualize areas that show high concentrations of heavy metals (Pb, Zn, Cu, Cd) and sulfates. The results have been corroborated and/or complemented by physical/chemical analysis, particularly in those areas that show low values of resistibility through geophysics (~2-4 ohm-m). Both techniques allow characterization of the silt pond and estimation of the potential mobility of heavy metals through the determination of soluble heavy metals.
http://www.imwa.info/publications/congress_2005.htm

Geophysical Investigations at an Abandoned Mine Site Subjected to Reclamation Using a Fixated Scrubber Sludge Cap
Spindler, Kevin M. and Greg A. Olyphant, Indiana Univ., Bloomington.
Environmental and Engineering Geoscience, Vol 10 No 3, p 243-251, Aug 2004

Geophysical investigations were undertaken to evaluate relationships between sources and areas of groundwater contamination and the effects of reclamation on groundwater quality in part of an abandoned mine site in the coal-mining district of Indiana. Prior to reclamation, acidic groundwater drained from a deposit of coarse refuse that was the main source of contaminated water leaving the site. Fixated scrubber sludge (FSS) was used as a capping material to isolate the pyritic refuse from further recharge, and the FSS was in turn capped by a layer of soil. The buried refuse and associated plume of acidic groundwater could be seen as a low-resistivity layer when an electrode spacing of 16 m was deployed in an Offset Wenner configuration. An electromagnetic terrain conductivity survey was undertaken in conjunction with a magnetometry survey to identify the areas of high metal (pyrite) content and acidic groundwater. The work has show that the FSS layer is a zone of no moisture change, which indicates that the layer is serving as an effective barrier to further recharge of the aquifer in the buried refuse.

Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings
Hers, Ian and Jeanette Southwood, Golder Associates Ltd.
Science Advisory Board for Contaminated Sites in British Columbia.
Canada Ministry of Environment, 104 pp, Feb 2006

The purpose of this guidance is to describe the framework, approach, and methods for sampling, chemical analysis, and data interpretation that should be considered when undertaking site characterization programs at contaminated sites where information obtained is used to evaluate potential human health risk from inhalation of soil vapor migrating into indoor air. The guidance begins with an overview of the conceptual site model for soil vapor intrusion into buildings, followed by approaches and methods for sampling and analysis of soil vapor and indoor air. While the focus of the guidance is characterization of soil vapor and indoor air, the sampling and analysis of soil and groundwater media and collection of ancillary data in the context of vapor intrusion studies are also addressed. The guidance concludes with recommendations for data interpretation and analysis, including consideration of quality assurance/quality control issues.
http://www.sabcs.chem.uvic.ca/GUIDANCE%20ON%20SITE%20CHARACTERIZATION%20FOR%20EVALUATION%20OF%20SOIL%20VAPOUR%20INTRUSION%20INTO%20BUILDINGS.pdf

Headspace Solid-Phase Microextraction Gas Chromatography Tandem Mass Spectrometry for the Determination of Brominated Flame Retardants in Environmental Solid Samples
Salgado-Petinal, C., M. Garcia-Chao, M. Llompart, C. Garcia-Jares, and R. Cela, Univ. de Santiago de Compostela, Spain.
Analytical and Bioanalytical Chemistry, Vol 385 No 3, p 637-644, June 2006

A headspace solid-phase microextraction gas chromatography coupled with tandem mass spectrometry (HSSPME-GC-MS-MS) methodology is presented for the determination of brominated flame retardants in sediment and soil samples. Analyses were performed on 0.5-g solid samples moistened with 2 mL water by employing a polydimethylsiloxane (PDMS) fiber coating exposed to the headspace at 100 degree C for 60 min. Several types of environmental solid samples were examined in this study. The extraction efficiency was observed to be related to the organic matter content of the sample. The obtained detection limits were in the sub-ng/g for all the target analytes in both samples. The proposed procedure was applied to several marine and river sediments and soils, some of which were found to contain polybrominated diphenyl ethers (PBDEs) at concentrations in the ng/g level. BDE-47, BDE-100, and BDE-99 were the major congeners detected.

Heat as a Ground Water Tracer
Anderson, M.P., Univ. of Wisconsin-Madison.
Ground Water, Vol 43 No 6, p 951-968, Nov/Dec 2005

The fundamentals of using heat as a groundwater tracer were published in the 1960s, but recent work has expanded its application to a variety of hydrogeological settings. For example, temperature is used to delineate flows in the hyporheic zone, to estimate submarine groundwater discharge and depth to the saltwater/fresh water interface, and to estimate the parameters in coupled groundwater and heat/flow models. The purpose of this review is to provide a critical synthesis of the large body of work on this topic found in the hydrogeological literature and to show that groundwater temperature data and associated analytical tools are currently underused and have not yet realized their full potential.

Identification of a Reactive Degradation Zone at a Landfill Leachate Plume Fringe Using High Resolution Sampling and Incubation Techniques
Tuxen, N., H.J. Albrechtsen, and P.L. Bjerg, Technical Univ. of Denmark, Lyngby, Denmark.
Journal of Contaminant Hydrology, Vol 85 Nos 3-4, p 179-94, 2006

Phenoxy acid herbicide degradation across a landfill leachate plume fringe was studied in laboratory degradation experiments. Sediment cores were collected in the aquifer, and the sediment and porewater were used for microcosm experiments and for determination of solid organic carbon, solid-water partitioning coefficients, specific phenoxy acid degraders, and porewater chemistry. Results from a multi-level sampler installed next to the cores provided information on the plume position and oxygen concentration in the groundwater. Oxygen concentration was controlled individually in each microcosm to mimic the conditions at their corresponding depths. Increased degradation potential governed by the presence of phenoxy acids and oxygen existed at the narrow plume fringe, resulting in the proliferation of a microbial population of specific phenoxy acid degraders, which furthered the degradation potential for phenoxy acids at the fringe. The results illustrate the importance of fringe degradation processes in contaminant plumes and highlight the relevance of using high-resolution sampling techniques, as well as controlled microcosm experiments, in the assessment of the natural attenuation capacity of contaminant plumes in groundwater.

The Impact of Sampling Techniques on Soil Pore Water Carbon Measurements of an Icelandic Histic Andosol
Sigfusson, B., G.I. Paton, and S.R. Gislason, Univ. of Iceland, Reykjavik, Iceland.
Science of the Total Environment, Vol 369 Nos 1-3, p 203-219, 1 Oct 2006

The carbon in soil porewater from a Histic Andosol from Western Iceland was studied in the field, in undisturbed outdoor mesocosms, and in laboratory repacked microcosms. Porewater was extracted using suction cup lysimeters and hollow-fiber tube sampler devices (Rhizon samplers). Significant differences were observed in all measured variables--dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and pH values--between the scales of the experiment. Gaseous constituents of soil solution and pH were more susceptible to changes in scale and the type of sampling devices used. Dissolved inorganic carbon concentrations did not differ significantly between field and mesocosm solutions but where up to 14 times lower in microcosms compared to mesocosms solutions. Rhizon samplers yielded solutions with up to 4.7 times higher DIC concentrations than porous cup lysimeters. Differences in DOC concentration was evident between sampling methods (up to 8 times higher in suction cups than rhizon samplers) above 50 cm depth. The comparison of results between field and lab sampling indicates that rapid carbon experiments can be conducted with confidence in micro- and mesocosms.

Improved Efficiency in Contaminated Groundwater Site Characterization: A Minimally Invasive Approach
Rollins, Paul, Willowstick Technologies LLC, Draper, UT.
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. University of Tulsa, Oklahoma. [Abstract only]

The subsurface mapping technique detailed in this paper requires relatively little drilling and therefore generates groundwater images much more rapidly than other methods. This technique begins with the strategic placement of electrodes into the groundwater system. The electrodes then charge the water with a low-voltage, low-amperage audiofrequency electrical current. As the current forges a path through the features of the network, it emits a magnetic field characteristic of those features that can be captured and analyzed at the surface by a specially tuned receiver. This minimally invasive technology has the potential not only to provide accurate images of the subsurface water systems, but also to detect changing levels of total dissolved solids. Case studies are presented to explore the promise and implications of this technology.

In-Stack and In-Plume Characterization of Particulate Metals Emitted from a Copper Smelter
Wong, H.K.T., C.M. Banic, S. Robert, Z. Nejedly, and J.L. Campell.
Geochemistry: Exploration, Environment, Analysis, Vol 6 Nos 2&3, p 131-137, 2006

A research aircraft was flown seven times in the plume of the Horne Copper Smelter in Rouyn-Noranda, Quebec, during winter and summer of 2000. During each flight, smelter staff performed in-stack sampling for metals while the aircraft instruments characterized in situ chemical and microphysical properties of the particles in the plume over distances of 2 to 27 km. The estimated dilution factors for the samples collected in the plume ranged from 2,000 to 50,000 compared with in-stack samples. The ratios of As/Cu, Pb/Cu and Zn/Cu for the stack and in-plume samples show good correspondence. The relative fraction of As, Cu, Pb, and Zn in the size bins <2 um, 2 to 8 um and >8 um aerodynamic diameter were established using a cascade impactor in the plume. The As, Cu, and Pb were found in larger fraction in the <2 um size bin, with Zn more equally distributed between the <2 and >8 um bins. These data provide the input needed to initialize models to predict emissions deposition and transport.

Indoor Air as a Source of VOC Contamination in Shallow Soils Below Buildings
McHugh, T.E., P.C. De Blanc, and R.J. Pokluda, Groundwater Services, Inc.
Soil & Sediment Contamination, Vol 15 No 1, p 103-122, 2006

When volatile organic compounds (VOCs) are detected below building foundation, the potential for VOC migration from the subsurface is assumed, and further investigation is needed to determine the extent of any VOC impact; however, VOCs detected in below-foundation vapor samples can also originate from indoor sources, migrating down through the slab by diffusion or advection. Commonly referenced conceptual models for vapor intrusion address VOC migration from the subsurface into buildings but do not consider the potential for VOC migration from buildings into the subsurface. The advective and diffusive forces that lead to the migration of VOCs from the subsurface into buildings can also result in the migration of VOCs from buildings into the subsurface when pressure or concentration gradients support such migration. The authors present pressure gradient measurements indicating bidirectional advective flow across building foundations, simple modeling indicating that indoor sources of VOCs may cause subsurface impacts through advection across the building foundation, and field data from a site where indoor sources were the source of VOCs detected in below-foundation vapor samples.
http://www.gsi-net.com/Publications/Mchugh_soilsed06.pdf

Influence of Soil Type and Extraction Conditions on Perchlorate Analysis by Ion Chromatography
MacMillan, D.K., S.R. Dalton, A.J. Bednar, S.A. Waisner, and P.N. Arora.
Chemosphere, [in press] 2006

For determination of perchlorate in soil, samples typically are extracted with water prior to analysis. In an evaluation of perchlorate extraction efficiency from soil, five soil types were each prepared in 30% (w/w) slurries and equilibrated under either oxic or anoxic conditions prior to spiking with a stock solution of sodium perchlorate. After each slurry had been maintained for a specified period of time (one week or one month), the slurries were centrifuged and separated into aqueous and soil phases. After phase separation, the soil was washed first with deionized water and then with 50 mM sodium hydroxide, producing second and third aqueous phases, respectively. Perchlorate concentrations in the three aqueous phases were determined using ion chromatography. The results suggest that matrix interference and signal suppression due to high conductivity have greater effects upon perchlorate concentrations by ion chromatography than does perchlorate interaction with soil. The authors conclude that a single water extraction is sufficient for quantitative determination of perchlorate in soil.

Integration of Field Measurements and Reactive Transport Modelling to Evaluate Contaminant Transport at a Sulfide Mine Tailings Impoundment
Brookfield, A.E. and D.W. Blowes (Univ. of Waterloo, Waterloo, ON); K.U. Mayer (Univ. of British Columbia, Vancouver, BC).
Journal of Contaminant Hydrology, Vol 88 Nos 1-2, p 1-22, 20 Nov 2006

An integration and quantitative assessment of the mineralogical and hydrological data set of the P-area of Inco's tailings impoundment (Copper Cliff, ON) was done with reactive transport modeling. Though the results of the reactive transport simulations generally agreed with the field observations, many factors contributed to discrepancies between the field observations and simulation results, such as geochemical and hydrogeological complexities and necessary model simplifications. Despite the discrepancies, integrating field observations with numerical modelling of the P-area tailings impoundment allowed for a more complete understanding of what affects the complex geochemical reactions.

An Ion-selective Electrode for Anion Perchlorate in Thick-Film Technology
Segui, M.J., J. Lizondo-Sabater, R. Martinez-Manez, F. Sancenon, J. Soto, E. Garcia-Breijo, and L. Gil, Univ. Politecnica de Valencia, Valencia, Spain.
Sensors, Vol 6 No 5, p 489-491, May 2006

The ionophore 1,4,7,10,13-penta(n-octyl)-1,4,7,10,13-pentaazacyclopentadecane (L1) was used for the development of miniaturized perchlorate-selective electrodes in thick-film technology. Different PVC membranes containing L1 and the plasticizers o-nitrophenyl octyl ether (NPOE), dibutyl phthalate (DBP), bis(2-ethylhexyl)sebacate (DOS), and dibutyl sebacate (DBS) were prepared and placed on a graphite working electrode manufactured using thick-film serigraphic technology. The different plasticizers in the perchlorate-selective electrodes exhibited the following perchlorate concentration ranges: DBS, from 1 x 10-4 to 1 x 10-1 M, with a detection limit of 5 x 10-5 M; DBP, from 6.3 x 10-5 to 1 x 10-1 M; and NPOE 7.4 x 10-5 to 1 x 10-1 M. The detection limit for DBP and NPOE was ~2.2 x 10-5 M. All three electrodes demonstrated a response time of ~5 seconds. The prepared electrodes showed no appreciable decay of the slope for at least 25 days.
http://www.mdpi.org/sensors/list06.htm

Ionic Liquid-Containing Semipermeable Membrane Devices for Monitoring the Polycyclic Aromatic Hydrocarbons in Water
Zhao, W. (Inner Mongolia Univ., Hohhot, China); M. Han, S. Dai, J. Xu, and P. Wang (NanKai Univ., Tianjin, China).
Chemosphere, Vol 62 No 10, p 1623-1629, Mar 2006

Ionic liquid-containing semipermeable membrane devices (IL-SPMDs) were developed to monitor polycyclic aromatic hydrocarbons (PAHs) in water. Uptake kinetics of naphthalene, 1-methylnaphthalene, phenanthrene, pyrene, chrysene by lay-flat, low-density polyethylene tubing filled with 0.5 ml 1-butyl-3-methylimidazolium hexafluorophosphate ionic liquid were studied in a continuous-flow system over a 16-day period. The device concentration factors ranged from 830 to 7,800 for the studied PAHs. The kinetic parameters of IL/water partition coefficients, analyte uptake rate constants, and sampling rates were estimated using mathematical models. These parameters were used in field experiments to estimate the concentrations of the PAHs in river water, and the results were compared against those obtained by triolein-SPMD.

Iron Mineralogy of Mine-Drainage Precipitates as Environmental Indicators: Review of Current Concepts and a Case Study from the Sokolov Basin, Czech Republic
Murad, E. (Bayerisches Landesamt for Umwelt, Marktredwitz, Germany); P. Rojk (Sokolovska uhelna, Sokolov, Czech Republic).
Clay Minerals, Vol 40 No 4, p 427-440, Dec 2005

Sampling and analysis of mine-drainage waters and associated precipitates from several active and abandoned lignite mines and mine dumps in the Sokolov Basin, northwestern Czech Republic, showed considerable variations of effluent composition and pH, which were thought to be related to differences in the local microenvironments and to seasonal fluctuations of precipitation. A wide range of precipitates was noted, principally one or several of the ferric minerals: jarosite, schwertmannite, goethite, ferrihydrite, and lepidocrocite. This paper presents a short review of the genesis and properties of the named minerals and a study of mine-drainage precipitates formed under different local conditions in various lignite mines and mine dumps of the Sokolov mining district. Variations in mine-drainage precipitate mineralogy, such as the presence or absence of specific minerals, can serve as indicators for factors such as pH and sulfate concentration and, to some extent, the genetic environment during precipitate formation. The variations in composition can be reflected in various ways, such as in the precipitate color, and can be used for identification and classification of regions potentially prone to acid mine drainage.

Joint Inversion of Geophysical and Hydrological Data for Improved Subsurface Characterization
Kowalsky, M.B., J. Chen, and S.S. Hubbard, Lawrence Berkeley National Lab., Berkeley, CA.
The Leading Edge, Vol 25 No 6, p 730-734, June 2006

Understanding fluid distribution and movement in the subsurface is critical for many subsurface applications, such as remediation of environmental contaminants, sequestration of nuclear waste and CO2, intrusion of saline water into fresh water aquifers, and the production of oil and gas. It is well recognized that characterizing the properties that control fluids in the subsurface with the accuracy and spatial coverage needed to parameterize flow and transport models is challenging using conventional borehole data alone. Integration of conventional borehole data with more spatially extensive geophysical data (obtained from the surface, between boreholes, and from surface to boreholes) shows promise for providing quantitative information about subsurface properties and processes. Typically, estimation of subsurface properties involves a two-step procedure in which geophysical data are first inverted and then integrated with direct measurements and petrophysical relationship information to estimate hydrological parameters; however, errors inherent to geophysical data acquisition and inversion approaches and errors associated with petrophysical relationships can decrease the value of geophysical data in the estimation procedure. The authors illustrate using examples from studies at DOE's Hanford facility and Oak Ridge National Lab how joint inversion approaches, or simultaneous inversion of geophysical and hydrological data, have the potential to overcome some of these limitations.
http://repositories.cdlib.org/lbnl/LBNL-59995/

Laser-Induced Breakdown Spectroscopy (LIBS): an Emerging Field-Portable Sensor Technology for Real-Time, In-Situ Geochemical and Environmental Analysis
Harmon, R.S. (U.S. Army Research Office, RTP, NC); F.C. De Lucia, A.W. Miziolek, and K.L. McNesby (U.S. Army Research Lab, Aberdeen Proving Ground, MD); R.A. Walters (Ocean Optics Inc., Winter Park, FL); P.D. French (ADA Technologies, Inc., Littleton, CO).
Geochemistry: Exploration, Environment, Analysis, Vol 5 No 1, p 21-28, Feb 2005

Laser-induced breakdown spectroscopy (LIBS) is a simple spark spectrochemical sensor technology in which a laser beam is directed at a sample to create a high-temperature microplasma. A spectrometer/array detector disperses the light emission and detects its intensity at specific wavelengths. The commercial launching of a small, high-resolution spectrometer has greatly expanded the utility of of the technology and resulted in a new potential for field-portable, broadband LIBS. The technique is now sensitive simultaneously to all chemical elements due to detector response in the 200 to 980 nm range with 0.1 nm spectral resolution. These small, light, rugged devices are capable of in situ analysis in real time with no sample preparation required. LIBS can be used for either point sensing or standoff detection and can analyze target samples by identifying all constituent elements and determining either their relative or absolute abundances.

Lead and Cu in Contaminated Urban Soils: Extraction with Chemical Reagents and Bioluminescent Bacteria and Yeast
Peltola, P. (Kalmar Univ., Kalmar, Sweden); A. Ivask; M. Astroem; M. Virta.
Science of The Total Environment, Vol 350 Nos 1-3, p 194-203, 1 Nov 2005

Twenty urban soil samples contaminated with a wide range of concentrations of lead and copper were used to compare the operational speciation of a 5-step sequential leach, with bioavailability determined using bioluminescent Pb (RN4220(pTOO24))- and Cu (MC1061 (pSLcueR/pDNPcopAluc))-specific bacterial biosensors and a Cu-specific yeast sensor. With the yeast sensor, 12 of 20 samples were below detection; however, the yeast sensor was capable of detecting all high Cu concentrations, whereas the biosensors tested were not capable of detecting the natural soil concentrations of Pb and Cu in the studied area.

Linking Tailings Seepage Geochemistry to the Performance of Cover System Field Trials for a Tailings Storage Facility at Peak Gold Mine Operations
Meiers, P. G., S. Shaw, N. Overdevest, & M. O'Kane
Mine Water 2005 -- Mine Closure. University of Oviedo. p 317-329, 2005

The Goldcorp Inc. Peak Gold Mining Operation is an underground gold operation located near Cobar in New South Wales, Australia. Two cover system field trials were constructed in 2002 to evaluate the hydraulic performance of alternate cover system designs for closure of the Peak Gold Mine tailings storage facility. The cover system field trials utilize the moisture store-and-release concept to limit the infiltration of meteoric waters to the underlying tailings as a means of controlling acid rock drainage and contaminant release from the tailings storage facility. The first and second field trials consisted of a nominal layer of oxidized waste rock material, 1.5 m and 2.0 m thick, respectively. To assess the field performance of the field trials in

all seasons, lysimeter collection and monitoring systems are automatically recording the quantity of net percolation through each of the cover system field trials. Monitoring data indicate that the 2.0 m cover system has been most successful in limiting the migration of dissolved elements within the tailings storage facility.
http://www.imwa.info/publications/congress_2005.htm

Literature Review and Report: Surface-Sediment Sampling Technologies
U.S. EPA, Las Vegas, NV.
EPA 600-R-03-115, NTIS: PB2004-101011, 21 pp, July 2003

A literature review was conducted to identify available surface sediment sampling technologies with an ability to collect undisturbed sediments to depths of up to 1 meter below the water sediment interface. For each piece of sampling equipment or sampling tool identified during the literature search, the following information was collected: general description of the equipment or tool, including its size, shape, weight, and composition; manufacturer's name, address, phone number, and email; a picture of the equipment or tool; the general mechanism of operation; sample volume collected; chemical and physical compatibility concerns; labor requirements; cost; and other requirements such as electrical power or specialized training. Sampling methodologies included in this investigation are grab or core types of sampling devices, as these types are most typically used in collecting surface sediments. In this review, 40 samplers were identified--13 grab samplers and 27 core samplers. The grab samplers include the Ponar, Birge-Ekman, Van Veen, Peterson, Mud Snapper, Scoopfish, Shipek, Smith-McIntyre, and others. The core samplers include the piston, splitcore, box, Vibracore, Mackereth, Ballchek, Craib, Gomex, Phleger, and others. Some of the technologies found in this review were identified through contacts with centers of contaminated sediments expertise. Vendors were solicited to provide required information for the report. All information collected in the literature search phase is maintained in a Microsoft Access database. Pictures of equipment are maintained in digital PDF or JPEG file formats in a sediment sampler picture file directory associated with the database. For additional information, contact Brian Schumacher, U.S. EPA, Las Vegas, NV. 702-798-2242, schumacher.brian@epa.gov
http://www.epa.gov/nerlesd1/cmb/research/bs123.pdf

Little Effect of Excessive Biofouling on the Uptake of Organic Contaminants by Semipermeable Membrane Devices
Booij, K., R. van Bommel, A. Mets, and R. Dekker, Royal Netherlands Inst. for Sea Research, Texel, The Netherlands.
Chemosphere, Vol 65 No 11, p 2485-2492, Dec 2006

The effects of water flow rate and antifouling agents on the extent of biofouling and on the uptake of nonpolar organic contaminants by semipermeable membrane devices (SPMDs) were studied during four field experiments in the Western Wadden Sea. The antifouling agents Irgarol and capsaicin (33 mg per ml triolein) had no noticeable effect on the extent of fouling and caused only a 5 to 10% increase in the absorbed amounts. Enhanced flow rates had only a minimal effect on the amount of biofouling but caused the water sampling rates to increase by a factor of 1.2 to 2. The authors reached the following conclusions: extreme biofouling does not always result in reduced sampling rates, nor does it preclude the existence of flow effects on the sampling rates, and differences in uptake rates are quantitatively reflected by the dissipation rates of performance reference compounds.

Long-Term Groundwater Monitoring Optimization: Improving Performance and Reducing Costs Associated with Natural Attenuation and Other In Situ Treatments
Minsker, Barbara S., Univ. of Illinois, Urbana.
Bioremediation Journal, Vol 8 Nos 3-4, p 87-88, July-Dec 2004

Abstract not available.

Long-Term Monitoring Network Optimization Evaluation for Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site, Idaho
U.S. EPA, Office of Solid Waste and Emergency Response.
EPA 542-R-06-005, 126 pp, Jan 2006

This report presents a description and evaluation of the groundwater and surface-water monitoring program associated with the Bunker Hill Mining and Metallurgical Complex Superfund Site Operable Unit (OU) 2. A monitoring network consisting of 77 groundwater monitoring wells and 18 surface-water stations was evaluated to assess its overall effectiveness at achieving the OU2-specific monitoring objectives, and to identify (1) potential opportunities to streamline monitoring activities while still maintaining an effective monitoring program and (2) data gaps that may require the addition of additional monitoring points. A three-tiered approach, consisting of a qualitative evaluation, a statistical evaluation of temporal trends in contaminant concentrations, and a spatial statistical analysis (groundwater only), assessed the degree to which the monitoring network addresses the objectives of the monitoring program, as well as other important considerations. The results of the three evaluations were combined and used to assess the optimal frequency of monitoring and the spatial distribution of the components of the monitoring network. The results of the analysis were then used to develop recommendations for optimizing the monitoring program at OU2.
http://www.cluin.org/download/remed/hyopt/application/bunker_hill.pdf

Long-Term Monitoring Network Optimization Evaluation for Wash King Laundry Superfund Site, Lake County, Michigan
U.S. EPA, Office of Solid Waste and Emergency Response.
EPA 542-R-06-004, 84 pp, June 2006

This report presents a description and evaluation of the groundwater monitoring program associated with the Wash King Superfund Site located in Pleasant Plains Township, Lake County, MI. A monitoring network consisting of 44 groundwater monitoring wells and five groundwater extraction wells was evaluated to identify potential opportunities to streamline monitoring activities while still maintaining an effective monitoring program.
http://www.cluin.org/download/remed/hyopt/application/wash_king.pdf

Long-Term Monitoring Optimization Guide, Version 1.2
Air Force Center for Environmental Excellence, Brooks City-Base, TX. 64 pp, 2006

The purpose of this guide is to assist DoD installation managers in the optimization of their long-term monitoring (LTM) programs by identifying and applying the appropriate strategies and optimization tools. These strategies and tools should assure compliance with data quality objectives (DQOs) and quality assurance (QA) requirements to improve overall effectiveness while minimizing cost. The guide has been updated and revised in 2006. This update has been prompted primarily by the development of two LTM optimization tools--the Monitoring and Remediation Optimization System (MAROS) and Geostatistical Temporal/Spatial (GTS) optimization algorithm software packages. These computer-based programs are available at no cost and can be downloaded from the AFCEE website (www.afcee.brooks.af.mil/products/rpo/ltm.asp).
http://www.afcee.brooks.af.mil/products/rpo/docs/LTM06Guidance1212.pdf

Luminescent Yeast Cells Entrapped in Hydrogels for Estrogenic Endocrine Disrupting Chemical Biodetection
Fine, T. (Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel); P. Leskinen; T. Isobe, H. Shiraishi, and M. Morita; R.S. Marks; M. Virta.
Biosensors and Bioelectronics, Vol 21 No 12, p 2263-2269, 15 June 2006

In the construction of luminescent yeast-cell-based fiber-optic biosensors, a novel approach is presented for estrogenic endocrine disrupting chemical (EDC) biodetection by entrapping genetically modified Saccharomyces cerevisiae cells. The cells contain the estrogen receptor alpha-mediated expression of the luc reporter gene in hydrogel matrices based on calcium alginate or PVA. The biocompatible alginate beads, which were characterized by a detection limit of 0.08 [ug/L] and an EC50 of 0.64 [ug/L] for beta-E2, still retained their viability for luminescence measurements after 1 month of storage at -80 degrees C (slow freeze condition). An alternative immobilization method, based on room-temperature partial drying of polyvinyl alcohol solution and cell suspension mix, was investigated with a slightly lower detection limit for beta-E2 than was reported with alginate beads. The trend of detected estrogenic activities with alginate beads roughly correlated with LC/MS/MS analytical results, which suggests that alginate yeast-based hydrogels may be applicable to the analysis of environmental water samples.

Mass Flux Toolkit to Evaluate Groundwater Impacts, Attenuation, and Remediation Alternatives: User's Manual, Version 1.0
Farhat, S.K. and C.J. Newell (Groundwater Services, Inc., Houston, TX); E.M. Nichols (LFR Levine-Fricke, Newfields, NH).
Environmental Security Technology Certification Program (ESTCP), 135 pp, Mar 2006

Traditional site investigations have focused on collecting both chemical concentrations and subsurface flow characteristics. These data have typically been analyzed separately, such as when chemical concentrations are compared to regulatory standards. When the two types of data are combined, it is typically for use in solute transport models. There has been recent interest in combining chemical and flow data into a single metric to provide estimates of contaminant mass flux. This flux is the rate that a contaminant passes through a defined cross

section in units of mass per time. Although the strict definition of mass flux is mass discharge per unit area (in units of mass per time per area), many researchers and practitioners use the term mass flux to denote the rate of "mass discharge" or "total mass discharge." This document will use "mass flux" to represent data in units of mass per time passing by a plume transect perpendicular to ground-water flow. To help site managers and site consultants estimate mass flux and understand the uncertainty in those estimates, DoD's ESTCP has funded the development of a computerized Mass Flux Toolkit, an easy-to-use, free software tool that gives site personnel the capability to compare different mass flux approaches, calculate mass flux from transect data, and apply mass flux to manage ground-water plumes. The toolkit spreadsheet and associated documentation are available on line.
http://www.gsi-net.com/Software/massfluxtoolkit.htm

Measurements of VOCs at Refineries Using the Solar Occultation Flux Technique
Fransson, Karin and Johan Mellqvist, Chalmers Univ. of Technology, Gothenburg, Sweden.
Preem Environmental Foundation, 22 pp, 2002

The Solar Occultation Flux technique (SOF) has been developed and demonstrated for the quantification of emissions of volatile organic compounds from the oil industry. The measurements are based on the recording of infrared solar spectra using an FTIR (Fourier Transform Infrared) spectrometer coupled to a solar tracker. From these spectra, the average concentration of gaseous hydrocarbons in the path of the solar light can be retrieved. The instrument is placed on a car, which as it travels, enables the instrument to measure solar light traversing a cross section of the studied emission plume. By multiplying the measured values with the wind speed, the flux in mass unit of alkanes per time unit is obtained. The flux can then be interpreted in terms of emission source strength using available geographical and meteorological information. During the development of of the SOF instrument and a meteorological system, the researchers conducted spectroscopic and error source studies aimed at optimizing the concentration measurements. In August 2001, SOF measurements were carried out in Göteborg, at the Preem refinery, and at Port of Göteborg to investigate various measurement schemes for different emission source areas and to demonstrate the method.
http://www.fluxsense.se/reports/SOF%20refinery%20report%202002%20high%20res.pdf

Measuring Methods for Groundwater/Surface Water Interactions: a Review
Kalbus, E., F. Reinstorf, and M. Schirmer, UFZ: Centre for Environmental Research Leipzig-Halle, Leipzig, Germany.
Hydrology and Earth System Sciences, Vol 10, p 873-887, 2006

This paper provides an overview of methods currently applied and described in the literature for estimating fluxes at the groundwater/surface water interface. Considerations for choosing appropriate methods include spatial and temporal scales, uncertainties, and limitations in application. A multi-scale approach combining multiple measuring methods can be used to refine estimates of fluxes between groundwater and surface water.
http://www.hydrol-earth-syst-sci.net/10/873/2006/hess-10-873-2006.pdf

Microbial Biosensors: A Review
Lei, Yu, Wilfred Chen, and Ashok Mulchandani.
Analytica Chimica Acta, Vol 568, p 200-210, 2006

Recently, genetically engineered microorganisms based on fusing of the lux, gfp, or lacZ gene reporters to an inducible gene promoter have been widely applied to assay toxicity and bioavailability. This review identifies recent trends in the development and application of microbial biosensors. Current advances and prospective future directions in developing microbial biosensors also are discussed.
http://www.engr.ucr.edu/~wilfred/microbial%20sensor%2006.pdf

Microbial Biosensor for Direct Determination of Nitrophenyl Substituted Organophosphates Using Recombinant Moraxella sp.
Priti Mulchandani, Wilfred Chen, and Ashok Mulchandani.
Analytica Chimica Acta, Vol 568, 217-221, 2006

A microbial biosensor has been developed that consists of a dissolved oxygen electrode modified with the genetically engineered PNP-degrader Moraxella sp. The biosensor displays organophosphorus hydrolase (OPH) on the cell surface for sensitive, selective, rapid, and direct determination of p-nitrophenyl (PNP)-substituted organophosphates (OPs). Surface-expressed OPH works in tandem with the PNP oxidation machinery of the Moraxella sp. to degrade PNP-substituted OPs and PNP simultaneously while consuming oxygen in proportion to the analyte concentration. The optimum performance was obtained by electrodes constructed using 0.35 mg dry weight of cell and operating at pH 7.5. Under optimum conditions, the biosensor was able to measure paraoxon at levels as low as 0.1 uM (27.5 ppb) and had excellent selectivity against triazines, carbamates, and OPs without PNP substitutent. The biosensor was stable for a week when stored at 4 degrees C. The biosensor was applied to the measurement of OPs in lake water.
http://www.engr.ucr.edu/~wilfred/mora%20biosensor%2006.pdf

Microdroplets for Integrated High-Sensitivity Biosensors
Tanyeri, Melikhan and Ian M. Kennedy, Univ. of California/Davis.
BioMEMS and Nanotechnology. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5275, p 133-140, 2004

The detection of single bacterial cells and novel absorbing labels has been demonstrated through optical resonances in microdroplets. A microdroplet acts as an optical cavity that supports morphology-dependent resonances (MDRs) at wavelengths where the droplet circumference is an integer multiple of the emission wavelength. The setup enables high throughput detection of single Escherichia coli (E. Coli) cells without direct labeling. Rhodamine 6G (R6G) is used as the signal transduction mechanism. The cells inside the droplet have a direct effect on the fluorescence lasing spectrum of R6G fluorescence by means of scattering and local refractive index change. The change in the lasing spectrum can be observed at the concentrations where each droplet has as little as one cell. C60 fluorescence quenching has also been demonstrated in microdroplets. R6G in ethanol (10uM) was used for the fluorescence spectrum measurements.

Monitoring Arthrobacter Protophormiae RKJ100 in a 'Tag And Chase' Method During p-Nitrophenol Bioremediation in Soil Microcosms
Pandey, G., J. Pandey, and R.K. Jain, Inst. of Microbial Technology, Chandigarh, India.
Applied Microbiology and Biotechnology, Vol 70 No 6, p 757-760, May 2006

Monitoring of microorganisms released deliberately into the environment is essential to assess their movement during the bioremediation process. This paper reports molecular methods used to monitor a p-nitrophenol (PNP)-degrading organism, Arthrobacter protophormiae RKJ100, during PNP degradation in soil microcosms. Cells were tagged with a transposon-based foreign DNA sequence prior to their introduction into PNP-contaminated microcosms. Later, the artificially introduced DNA sequence was polymerase chain reaction-amplified to distinguish the bioaugmented organism from the indigenous microflora during PNP bioremediation.

Monitoring Biodegradation of Diesel Fuel in Bioventing Processes Using In Situ Respiration Rate
Lee, T.H. (Andong National Univ., South Korea); I.G. Byun; Y.O. Kim; I.S. Hwang; T.J. Park.
Water Science and Technology, Vol 53 Nos 4-5, p 263-272, 2006

During a laboratory application of bioventing to diesel-contaminated soil, a system to measure the respiration rate in situ was tested for biodegradation monitoring. One soil column was operated in continuous venting mode and the other in intermittent venting mode. For a five-month period, an on-line gas measuring system was used to measure O2 utilization and CO2 production during biodegradation of diesel. The biodegradation rate of TPH was calculated from the respiration rate measured by the on-line gas measuring system. No apparent differences were observed between calculated biodegradation rates from the columns operated in different venting modes. The variations in biodegradation rate corresponded with the trend of the remaining TPH concentrations as compared using other biodegradation indicators. The study results indicate that the respiration-rate measuring system has potential for application in measuring biodegradation rate and in determining the feasibility of bioventing for bioremediation of an oil-contaminated soil.

Monitoring Microbial Community in a Subsurface Soil Contaminated with Hydrocarbons by Quinone Profile
Song, D. (Kiso-Jiban Consultants Co., Ltd., Tokyo, Japan); A. Katayama (Nagoya Univ., Chikusa, Nagoya, Japan).
Chemosphere, Vol 59 No 3, p 305-314, Apr 2005

A natural attenuation experiment was carried out in a lysimeter containing hydrocarbon (HC)-spiked soil for 308 days. Changes in the structures of the microbial community in the contaminated subsoil were monitored by quinone profile analysis. HC residues were observed for 217 days in the subsoil after application of the contaminants. The amount of total quinones, an indicator of microbial biomass, increased significantly in the contaminated subsoil for 217 days when compared against the background subsoil or the uncontaminated subsoil. The major quinone species and the quinone composition, indicators of community structure, were significantly different between the HC-contaminated soil and the background soil. No significant difference was seen in the diversity of the quinone species, an indicator of taxonomic diversity of the microbial community. When the HCs in the subsoil disappeared after 308 days, the total quinones returned to the level of the background soil, and no significant difference in quinone composition were observed between the HC-contaminated soil and the background soil. The results suggest that respiratory quinones are effective biomarkers for characterizing the temporal changes in a microbial community in HC-contaminated soil.

Monitoring of Effluent DOM Biodegradation Using Fluorescence, UV and DOC Measurements
Saadi, I. (Newe Ya'ar Research Center, Ramat Yishay, Israel); M. Borisover (Volcani Center, Bet Dagan, Israel); R. Armon (Technion-Israel Inst. of Technology, Haifa); Y. Laor (Newe Ya'ar Research Center).
Chemosphere, Vol 63 No 3, p 530-539, Apr 2006

The potential of effluent dissolved organic matter (DOM) to undergo microbial degradation was assessed in batch experiments. Reservoir and wastewater effluent samples were incubated either with effluent or previous soil microorganisms for a period of 2 to 4 months and characterized by dissolved organic carbon (DOC) content, UV254 absorbance, and fluorescence excitation/emission matrices. Overall, about 50% of the total DOM was found to be readily degradable such that residual resistant DOC levels were between 8 and 10 mg/L.

Monitoring of Organochlorine Pesticides Using PFU Systems in Yunnan Lakes and Rivers, China
Yang, J. (Chinese Acad. of Sciences, Wuhan, PR China); W. Zhang (China Univ. of Geosciences, Wuhan, PR China); Y. Shen and W. Feng (Chinese Acad. of Sciences); X. Wang (Huazhong Univ. of Science and Technology, Wuhan, PR China).
Chemosphere, Vol 66 No 2, p 219-225, Jan 2007

Polyurethane foam unit (PFU) systems were collected from 11 lakes and three rivers in the Yunnan Plateau, China, and the PFU extrusion liquids were analyzed for organochlorine pesticides (OCPs) by gas chromatography with electron capture detection (GC/ECD). The investigators found that that HCHs are the predominant contaminants and some point sources of HCHs may still exist in the study area. The pollution levels in Yunnan were compared with other studies, suggesting the PFU method is suitable for long-term, on-line monitoring of trace OCPs in aquatic ecosystems.

Monitoring of VOC Emissions from Refineries and Storage Depots Using the Solar Occultation Flux Method
Kihlman, M., J. Mellqvist, and J. Samuelsson, Chalmers Univ. of Technology, Gothenburg, Sweden.
RR Report (Goeteborg) No 1, 102 pp, 2005

Solar Occultation Flux (SOF), a new remote sensing method, has been under development since 1997 for identifying and quantifying fugitive industrial hydrocarbon emissions. The method is based on measuring infrared intensity spectra of the sun from a moving platform, such as a vehicle or ship. To obtain the flux from a particular emission source, the vehicle is driven in such as way that the detected solar light traverses across the emission plume. The flux is obtained as the integrated sum of the retrieved path averaged concentrations, multiplied by wind speed. With SOF, it is possible to scan an industrial facility quickly and

detect leaks in real time, in addition to estimating the total emissions. The retrieval code has been tested and compared to other published codes for alkanes, HCl, and SO2, with generally good agreement. Results from a validation experiment utilizing SF6 trace gas shows that if averaging enough data (10 traverses), accuracies of ±10 to 20% are obtained from simple emissions sources. This report describes the results of a measurement project KORUS (Kolvatematning vid raffinaderier utnyttjande SOF) conducted between 2002 and 2005 with the aim of quantifying the emission of volatile organic compounds from four industrial facilities.
http://www.fluxsense.se/reports/SOF%20Refinery%20report-%20KORUS%20%202005%20%20high%20res.pdf

Monitoring of VOC Emissions from Refineries in Sweden Using the Solar Occultation Flux Method
Kihlman, M., J. Mellqvist, and J. Samuelsson (Chalmers Univ. of Technology, Goeteborg, Sweden); L. Tang and D. Chen (Gothenburg Univ., Sweden).
Paper A, 20 pp, 2002

A new spectroscopic technique for mobile gas flux measurements of VOCs, the Solar Occultation Flux (SOF) method, has been further developed and successfully tested for its capability of conducting large scale monitoring of fugitive gas emissions from industries. During 2002 to 2004, three refineries and an oil terminal harbour in Sweden were monitored. The measurement errors were, at good conditions, estimated to be around 25%, caused mainly by uncertainties of the wind field. The SOF instrument was tuned to detect alkanes, which contribute to the dominant fraction of the VOCs emitted from a refinery. Complementary measurements were conducted to assess the emissions of the aromatic species, typically 5 to 10% by mass of the alkanes. Each industry was divided into smaller sectors, and the emission from each sector was determined, as well as the total emission. With SOF, it is possible to scan a facility in real time to detect leaks. For a typical refinery, 0.06% of the mass of the crude oil is lost due to vaporization. Of the emitted gas, 26% originates from the process, 31% from crude-oil tanks, 32% from product tanks, 8% from the water treatment facility, and 2% from transport-related activities.
http://www.fluxsense.se/reports/paper%202%20final%20lic.pdf

Monitoring the Progress of Remedial Technologies Using a Rate-limiting NAPL Dissolution Model
Benni, William C. and Mary Ann Parcher, Environmental Systems & Technology.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Application of a rate-limiting nonaqueous phase (NAPL) dissolution model has successfully monitored the progress and effectiveness of remedial activities on NAPL sources. The approach relies on the principles of NAPL dissolution, measured groundwater concentration data, and estimates of the mass removal from each phase. When a multi-component NAPL mixture dissolves, higher soluble constituents are preferentially removed, which results in noticeable and predictable changes in the NAPL's composition. The equations for the rate-limiting mechanisms have been developed through review of laboratory studies and application of the model to several sites. The model uses the observed recovery data to calibrate an initial effective NAPL mass to the same level of certainty as the recovery data. The model estimates the amount of source mass remaining and provides real-time monitoring of the remedy's progress toward achieving the remedial objectives. The model's use of data that are readily available and frequently obtained makes it applicable to a wide range of remedial technologies and sites. Case studies for a recovery system and an innovative technology are presented to show the modeling approach for monitoring the progress of these remedial activities.

Mound Plant SW-17 & SW-19 Old Cave Facilities Advanced Trupro(r) Subsurface Sampling
Aggarwal, S., G. Charters, and J. Gill, New Millennium Nuclear Technologies.
ICEM'05: 10th International Conference on Environmental Remediation and Radioactive Waste Management, 4-8 September 2005, Glasgow, Scotland

TRUPRO(r), a concrete and subsurface profiling technology, was deployed to sample the subsurface materials beneath rooms SW-17 and SW-19 at the Old Cave, Mound Plant, OH. The subsurface profiling technology penetrated many locations and layers of materials to depths of nine feet, obtaining 97 separate samples, including powdered concrete and metal fine shaving samples. Sampling was in the vertical direction downward into the floors and subsurface building structures to acquire representative samples of buried subsurface metal objects, such as cave shielding doors, sections of the cave structure, cave structure concrete footer base, and subsurface bedrocks and soils. Some sampling was at angles from a perpendicular orientation to a wall or floor surface to obtain samples from inaccessible depths within the structure. Drill guides and mounting equipment were used to achieve these sampling angles. All the retrieved powdered samples were initially assessed semi-quantitatively by hand-held probe and then measured quantitatively using ISOCS for specific radionuclides of interest, specifically radium-226, actinium-227, radon and daughters, potassium-40, and thorium-228, 229, 230. TRUPRO(r) has four major components: a drill with a specialized concrete/metal cutting and sampling head, drill bits, a sample collection unit, and a vacuum pump. The drill head is used under hammer action to penetrate hard surfaces, causing the bulk material to be pulverized as the drill travels through the radioactive media, efficiently transmitting to the sampling unit a representative sample of powdered bulk material that prevents cross-contamination of the clean retrieved samples

Multi-Metal Contaminated Stream Sediment in the Mansfeld Mining District: Metal Provenance and Source Detection
Schreck, P. (Univ. of Leipzig, Leipzig, Germany); M. Schubert, K. Freyer, H.-C. Treutler, and H. Weiss (UFZ Centre for Environmental Research Leipzig-Halle, Leipzig, Germany).
Geochemistry: Exploration, Environment, Analysis, Vol 5 No 1, p 51-57, Feb 2005

In metal mining districts, element and radionuclide patterns in contaminated stream sediment can be used as tracers to detect and track the sources of pollution and to distinguish geogenic from anthropogenic input. An example is provided from the Mansfeld mining district in central Germany, where a study was conducted to identify the metal sources in the mining district and to assess the range of pollutant migration. In combining conventional geochemistry, mineralogy, and radiometry, most of the multimetal pollution in the Mansfeld mining district was shown to be of anthropogenic origin. The major sources of metals are low-grade ore, metalliferous flue dust, and slag. Conventional geochemistry provided information on the spread of contamination in the rivers of the mining district. Mineralogy and microchemistry added data on the composition of the source material and pointed to potential sources of contamination. The fraction of these sources as pollutants was estimated by gamma spectroscopy.

Nanoporous Zeolite Thin Film-Based Fiber Intrinsic Fabry-Perot Interferometric Sensor for Detection of Dissolved Organics in Water
Liu, N., J. Hui, and C. Sun (New Mexico Inst. of Mining and Technology, Socorro); J. Dong; L. Zhang; H. Xiao.
Sensors, Vol 6 No 8, p 835-847, Aug 2006

A fiber optic intrinsic Fabry-Perot interferometric (IFPI) chemical sensor was developed by fine-polishing a thin layer of polycrystalline nanoporous MFI zeolite synthesized on the cleaved endface of a single mode fiber. The sensor operates by monitoring the optical thickness changes of the zeolite thin film caused by the adsorption of organic molecules into the zeolite channels. The optical thickness of the zeolite thin film is measured by white light interferometry. The zeolite IPFI sensor demonstrated detection of dissolved organics (methanol, 2-propanol, and toluene) in water with high sensitivity.
http://www.mdpi.org/sensors/list06.htm

Nanowire-Based Electrochemical Biosensor
Wanekaya, Adam K., Wilfred Chen, Nosang V. Myung, and Ashok Mulchandani,
Electroanalysis, Vol 18 No 6, 533-550, 2006

Recent advances and advantages and disadvantages of biosensors based on 1-D nanostructure field-effect transistors (FET) are reviewed, with discussions of fabrication, functionalization, assembly/alignment, and sensing applications. The biosensors have been used for the detection of various biological molecules, and these devices have achieved high sensitivity and selectivity with low detection limits. Challenges researchers face in the 1-D nanostructures research arena are identified, with suggestions for the areas toward which future research efforts in this technology might be directed.
http://www.engr.ucr.edu/~wilfred/

NDCEE Validates HVOC Field Screening Technology for Groundwater Applications
NDCEE Newsletter, p 1 & 6, Winter 2006

In 2005, the National Defense Center for Environmental Excellence (NDCEE) performed two field evaluations of a halogenated volatile organic compound (HVOC) field-screening technology. Evaluations were performed in California at North Island Naval Air Station and Edwards Air Force Base. The X-Wand(tm) field-portable monitor can both detect and quantify HVOC concentrations in soil and groundwater samples. In accordance with federal regulations, HVOCs must be measured before, during, and after a site is remediated. As part of the demonstrations, the NDCEE evaluated and then modified the associated methodology that forms the basis for a November 2005 ASTM standard for analysis of trichloroethene (TCE) in soil and ground water; a method for analysis of TCE and HVOC in ground water is now in ASTM review. The HVOC field-screening technology is based on a refrigerant leak detector technology modified to provide a numerical output and operate as an organic vapor analysis tool. A key element is the use of a heated diode. After collection of soil or water samples, the X-Wand is used to analyze the headspace of the sample container above the soil or water media. These detectors do not respond to nonhalogenated VOCs, and humidity does not interfere with or degrade the detectors. A break-even analysis was performed to determine the potential economic benefit of the X-Wand in comparison to traditional laboratory testing. Preliminary results indicate that the X-Wand may offer a cost savings when used for 33 or more samples during site assessments and 16 samples during remediation. Most of the savings result from being able to analyze samples in the field, but the X-Wand also requires fewer samples--up to 25 to 50% less, depending on the type of sampling undertaken. Under traditional methods, a typical site assessment could require approximately 100 samples and a typical site remediation could require hundreds of samples. Final results of the assessment should be available for DoD use in early 2006. The NDCEE is assisting the HVOC screening technology developer with enhancing and commercializing the instrument to make it more available and cost-effective. The instrument is expected to be commercially available in 2006. For more information on the HVOC field-screening technology demonstrations, contact Hany Zaghloul, ODASA (I&E) - ESOH, 703-602-5526, hany.h.zaghloul@erdc.usace.army.mil; Tom Ivory, NDCEE/CTC, 703-414-5862, ivoryt@ctc.com.

New Applications of Organic Polymers in Chemical Gas Sensors
Harbeck, Mika, Ph.D. dissertation, Eberhard-Karls-Universitat Tubingen, Germany. 183 pp, 2005

In spite of the large number of sensing layers already available for chemical gas sensors and the existing technology, new materials need to be tested for special applications as new sensors are developed. This thesis is focused on the development of ammonia-sensitive layers for future use in a suspended-gate field-effect transistor (SGFET). Microsensors, including the gas-sensitive field-effect transistor (GasFET), can be used in principle with many available gas-sensitive materials, polymeric, inorganic, or metallic. The main advantage of polymer-sensitive layers over metal oxides is their operation at room temperature, as they do not require heating. This is in line with the low-power goal of microsensors. They are thus very suitable for use in GasFETs and are the material of choice in this work. The SGFET and the GasFET in general rely on potential changes upon gas exposure of a sensitive material deposited on the gate electrode. This potential change can be measured with the Kelvin probe (KP). The KP served in this work as a test tool to determine the gas responses of the self-made samples, which are made of a polymer film on a conducting substrate. Several polymer/substrate combinations were tested and characterized in their gas-sensing performance with the KP. Polymers were preferred over metal oxides as sensitive layers to make low-temperature operation of the SGFET possible. For future use in the GasFET, the morphology of the layers was checked and optimized in a series of deposition experiments with a spraying nozzle. This work describes in detail the layer preparation, morphology characterization, and results of the gas sensing experiments with the KP and additionally with QMB sensors and the IR technique. In this new field, few data are available on KP measurement of substrates coated with thin films of non-conducting polymers as used in this work, and no explanation of the observed phenomena was found. At this early stage, the focus is on the investigation of this new sensing principle rather than detailed performance characterization and optimization. The QMB and IR experiments were carried out to gather additional data for the explanation of the sensing mechanism. The obtained database allows a

first modeling of the sensing mechanism, and a basic model is presented. The experiments are expected to provide enough data to be able to choose the best sensing layer at present for the detection of ammonia with the GasFET and to provide a prognosis of performance.
http://deposit.ddb.de/cgi-bin/dokserv?idn=977834832&dok_var=d1&dok_ext=pdf&filename=977834832.pdf

New Hydrodynamic Electrochemical Arrangement for Cadmium Ions Detection Using Thick-Film Chemical Sensor Electrodes
Prasek, J., M. Adamek, and J. Hubalek (Brno Univ. of Technology, Czech Republic); V. Adam (Mendel Univ. of Agriculture and Forestry, Brno, Czech Republic); L. Trnkova (Masaryk Univ., Brno, Czech Republic); R. Kizek (Mendel Univ. of Agriculture and Forestry).
Sensors, Vol 6 No 11, p 1498-1515, Nov 2006

Due to the sensitivity and low experimental deviations of the thick-film transistor (TFT) sensor, researchers worked to optimize the best conditions for fabrication of a TFT chemical sensor. A new electrochemical analytical device was developed to ensure certain known mass transport to the electrodes, which is the most limiting process to influence response quality of the sensor. The device consists of a rotating conic vessel for sample measurement and a stick-in thick-film sensor. The sensor responses were tested for trace analysis of cadmium.
http://www.mdpi.org/sensors/list06.htm

Nonlinear Complex-Resistivity Survey for DNAPL at the Savannah River Site A-014 Outfall
Grimm, R.E. (Blackhawk GeoServices, Inc., Golden, CO); G.R. Olhoeft; K. McKinley; J. Rossabi; B. Riha.
Journal of Environmental & Engineering Geophysics, Vol 10, p 351-364, Dec 2005

Nonlinear complex-resistivity (NLCR) cross-hole imaging of the vadose zone was performed at the A-014 Outfall at the Savannah River Site, Aiken, SC. The experiment was conducted to field-test the method for the detection of dense nonaqueous phase liquid (DNAPL), specifically tetrachloroethene (PCE), which is known to contaminate the area. Five vertical electrode arrays were installed with 15-ft separations in and around the suspected source zone to depths of 72 ft, and measurements were carried out at seven nearest-neighbor panels. Amplitude and phase data were edited for quality and then inverted to form 3-D images. Lab analysis of nearby soil contaminated in situ indicated that the NLCR response to the PCE/clay reaction is maximized near 50 mHz. Variations in PCE content were independently detailed at three drilling locations within the NLCR survey area using direct penetration-based soil-collection tools. Approximately 400 soil samples were collected and analyzed for chlorinated solvent mass composition at 1-ft vertical intervals to compare with the NLCR-predicted distribution of DNAPL. The optimum performance for 1,000 mg/kg PCE was 80% detection (true positives) with 30% false alarms (false positives) at an effective resolution of 4 ft, or 1/4 of the interwell separation. When smoothed to 12-ft resolution, detection was 100% with just 12% false alarms. NLCR successfully predicted the general distribution of PCE at parts-per-thousand soil-mass fractions, specifically widespread near-surface contamination and a zone of discontinuous stringers and pods below the source.

A Novel Biosensor for Mercuric Ions Based on Motor Proteins
Martinez-Neira, R., M. Kekic, D. Nicolau, and C.G. Dos Remedios.
Biosensors and Bioelectronics, Vol 20 No 7, p 1428-1432, 15 Jan 2005

The authors explored the potential of the contractile proteins, actin and myosin, as biosensors of solutions containing mercury ions. This paper describes the biochemical, biophysical, and nanotechnological basis of what may prove to be a useful nano-device.

Novel Organic Membrane-Based Thin-Film Microsensors for the Determination of Heavy Metal Cations
Arida, H.A. (Atomic Energy Authority, Cairo, Egypt); J.P. Kloock and M.J. Schoening (Aachen Univ. of Applied Sciences Julich Campus/Research Centre Julich GmbH, Julich, Germany).
Sensors, Vol 6 No 4, p 435-444, Apr 2006

A novel type of thin-film chemical microsensor for some divalent metal cations (Hg2+, Cu2+, Pb2+, and Cd2+) has been developed by the methods of silicon planar technology using PVC-based organic membranes. These metal-contact (Pt & Au) microsensors, which are based on a set of commercially available and recently synthesized ionophores for the tested cations, were independently prepared and electrochemically evaluated. Results showed that the response characteristics of the organic membrane-based thin-film microsensors are comparable with those obtained by conventional membrane-based electrodes, as well as of those obtained by coated Ag wire-based electrodes. The lifetime of the proposed microsensors is relatively short (one working day), but they can be reactivated easily every day using a stock solution of a cocktail coating mixture prepared for this purpose.
http://www.mdpi.org/sensors/list06.htm

Oil Spill Detection System: Results from Field Trials, October 2004
Gangeskar, R. and E. Nost, Miros AS, Norway.
Environmental Problems in Coastal Regions VI, Including Oil and Chemical Spill Studies. WIT Press, Wessex Institute of Technology, UK. ISBN: 1-84564-167-1, Transactions on Ecology and the Environment Vol 88, p 377-386, 2006

The oil spill detection system discussed in this paper consists of the hardware and software modules of the Wavex system, plus new software modules developed specifically for oil detection. Wavex is a system for monitoring scaled directional wave spectra and sea surface currents from X-band radar images. The principle of measurement is based on the fact that areas covered by an oil spill reflect less microwave power due to the dampening of the sea surface capillary waves. The detection system was tested in a field trial carried out in October 2004 off the west coast of Norway as arranged by the Norwegian Clean Seas Association for Operating Companies. Six small releases of oil equivalents were discharged so they could be detected and followed by the system in various wind and wave conditions. Images providing an average of the back-scattered intensity from various parts of the sea surface helped to guide the system operator. The system is particularly useful for continuous surveillance of spill areas during the hours of darkness. These data were later reprocessed with a new and completely automatic oil detection algorithm using methods of image segmentation and object classification for automatic detection of the oil. The algorithm is now implemented in the real-time system. The system would benefit from further operation during marginal conditions, such as low wind speeds with non-optimal directions of sight and rougher sea states.

Optimisation of a Microbial Bioassay for Contaminated Soil Monitoring: Bacterial Inoculum Standardisation and Comparison with Microtox(r) Assay
Abbondanzi, F., A. Cachada, and T. Campisi (Montecatini Environmental Research Centre); R. Guerra (Univ. of Bologna, Ravenna, Italy); M. Raccagni and A. Iacondini (Montecatini Environmental Research Centre, Ravenna, Italy).
Chemosphere, Vol 53 No 8, p 889-897, Dec 2003

Three different techniques were employed to standardize a microbial inoculum as the basis for a microbial bioassay based on the dehydrogenase activity (DHase) inhibition in Pseudomonas fluorescens bacterial strain ATCC 13525. Triphenyl tetrazolium chloride (TTC) was used as electron acceptor; its reduction produces Triphenyl formazane. The P. fluorescens DHase inhibition bioassay was investigated for being a reliable and rapid method for assessing toxicity. Optimization of the operating conditions resulted in a repeatable bioassay. Two different toxicity assessment protocols--Microtox(r) and a dehydrogenase (DHase) activity inhibition test--were compared. P. fluorescens and Vibrio fischeri sensitivity were first compared by testing Zn++, one of the reference compounds for Microtox(r) test. Ni++, Cd++, Cu++, and phenol were also tested with both bioassays. A high statistical significance of data was obtained with the logistic curve. The work has demonstrated that P. fluorescens is as sensitive as Microtox(r) culture (V. fischeri) for some of the metal ions; however, the lower sensitivity of P. fluorescens to phenol makes its use difficult in organics samples.

Optimization of a Pressurization Methodology for Extracting Pore-Water
Lopes, I. and R. Ribeiro, Univ. de Coimbra, Coimbra, Portugal.
Chemosphere, Vol 61 No 10, p 1505-1511, Dec 2005

Several methods have been developed for sampling porewater. Centrifugation and pressurization methods are recommended when large volumes of porewater are required to perform toxicity assays; however, these methods involve sediment transportation and storage in laboratory, which can alter sediment toxicity. Researchers aimed to optimize and evaluate an existing portable, easy-to-operate sediment pressurizing device with low construction costs. The device presents minimal chemical reactivity, which is achieved by lining the device interior with Teflon, using large pore filters (50 um), and using an inert gas (nitrogen). Porewater extraction efficiency and the toxicities of porewater samples obtained by pressurization and by refrigerated centrifugation were compared. An artificial sediment spiked with phenol, SDS surfactant, copper, and parathion and a natural sediment contaminated with acid mine drainage were assayed for toxicity with Microtox assays. Sediment pressurization was found to be adequate for field use--as efficient as centrifugation for extracting porewater, but more cost effective.

Optimization of the Sampling Technique for the Determination of Dissolved Hydrogen in Groundwater
Heimann, A., S. Marczinek, K. Kloos, and S. Peiffer, Univ. Bayreuth, Bayreuth, Germany.
Acta Hydrochimica Hydrobiologica, Vol 31 No 6, 491-500, 2003

A field-sampling technique for dissolved hydrogen (H2) in groundwater enables the transport of gaseous samples to the lab for further analysis. The method consists of transferring

the headspace trapped in a gas-sampling bulb continuously purged by groundwater into previously evacuated vials using a gas-tight syringe. Three transfer steps with preceding evacuation of the vial achieved 100% H2 recovery in lab experiments. The method was applied to determine H2 concentrations in an aquifer contaminated with chlorinated solvents. Tests concerning the effect of different pumping techniques on H2 concentrations revealed that the most reliable values were obtained with a bladder pump, while an electrically driven submersible pump generated considerable amounts of hydrogen due to electrochemical interactions with the sampled water. In a study of the effect of two tubing materials (PVC and polyamide) on H2 losses, PVC tubing allowed transfer of H2-enriched water over 25 m without significant losses, whereas PA tubing was not suitable for H2 sampling.
http://www.environmental-expert.com/articles/article3087/article3087.pdf

A Passive, No-Flow Sampler for Quantitative Groundwater Monitoring
Jarski, Paul B., Randy W. St. Germain, and Jennifer L. Kuschel, Dakota Technologies, Inc.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Dakota Technologies, Inc., is developing an innovative subsurface passive sampling system--the patented Twin Reservoir Equilibrated Water (TREW(tm)) Sampler--which is designed for collection of both volatile and semi-volatile organic compounds from the vadose and saturated zones by either conventional or direct-push deployment techniques. The TREW sampler consists of a pair of membrane reservoirs inside a rigid cage. Once implanted, clean water (alternatively, a gas can be used for soil gas monitoring) is introduced into the first reservoir until the interior volume of the cage is filled. Organic compounds in the surrounding groundwater formation diffuse through the membrane material into the inner water. After a period of time (hours to days, depending on analytes being monitored) the inner water sample comes to equilibrium with the water outside the membrane yielding a representative sample of the groundwater concentration. To collect the sample, clean water is introduced into the second reservoir, which simultaneously forces the equilibrated sample to collection/storage vials at the surface and recharges the sampler for the next sampling round. The passive nature of the TREW samplers means that the groundwater is not perturbed by the sampling efforts. The absence of bulk flow of groundwater toward the sampler eliminates drawdown and virtually eliminates microbial growth and fouling of the sampler. Laboratory and field studies of the TREW sampler are summarized for MTBE, BTEX, and chlorinated solvents contamination.

Photoacoustic Spectroscopy with Quantum Cascade Lasers for Trace Gas Detection
Elia, A., C. Di Franco, P.M. Lugara, and G. Scamarcio, Univ. of Bari, Bari, Italy.
Sensors, Vol 6 No 10, p 1411-1419, Oct 2006

Single-mode, distributed-feedback quantum-cascade lasers (QCLs) are attractive spectroscopic sources because of characteristics of narrow linewidth, average power, and room temperature operation. In combination with these laser sources, photoacoustic spectroscopy offers the advantage of high sensitivity and selectivity, compact sensor platform, fast response, and user-friendly operation. This paper reports recent developments on QCL-based photoacoustic spectroscopy for trace gas detection and assesses different applications of a photoacoustic trace gas sensor employing a longitudinal resonant cell with a detection limit on the order of a hundred ppb of ozone and ammonia. Two QCL-based photoacoustic sensors are evaluated for the detection of nitric oxide, environmental pollution monitoring, medical diagnostics, and hexamethyldisilazane sensing for application in semiconductor manufacturing. http://www.mdpi.org/sensors/list06.htm

Plant Tissue Extraction Method for Complexed and Free Cyanide
Bushey, J.T. (Syracuse Univ.); S.D. Ebbs (Southern Illinois Univ.); D.A. Dzombak (Carnegie Mellon Univ.).
Water, Air, & Soil Pollution, Vol 157 Nos 1-4, p 281-293, Sep 2004

A method for free cyanide and strongly-complexed cyanide measurement within plant tissue was developed to study uptake and movement of cyanide species separately from cyanide metabolism and metabolite movement by a willow plant. Spike recoveries from solutions with and without plant tissue, using various solvent combinations and background control tissue contributions were investigated to obtain an accurate and precise extraction method for measurement of complexed and free cyanide concentrations within plant tissue. The optimum extraction technique involved the freezing of plant tissue with liquid nitrogen to facilitate homogenization prior to extraction. Filtration was not used in the process due to increased cyanide loss, and analysis of control tissue showed minimal release of cyanide or interference of plant tissue with the cyanide analytical method. Tissue cyanide concentrations from hydroponically-exposed tissue using the optimal extraction method agreed with tissue cyanide stable isotope (15N) results.

Predicting Organic Contaminant Concentrations in Sediment Porewater Using Solid-Phase Microextraction
Yanga, Ze-Yu (Graduate School of the Chinese Academy of Sciences, Beijing); E.Y. Zeng (Chinese Academy of Sciences, Guangzhou, Guangdong); K.A. Maruy (Southern California Coastal Water Research Project, Westminster, CA); B.-X. Mai and Y. Ran (Chinese Academy of Sciences, Guangzhou, Guangdong).
Chemosphere, Vol 66 No 8, p 1408-1414, Jan 2007

To develop a predictive modeling framework to address the effect of key parameters on solid-phase microextraction (SPME) performance in assessing the bioavailable fraction of hydrophobic organic contaminants (HOCs) in sediment porewater, the authors derived two governing equations to predict (1) the minimum sediment volume and (2) dissolved-phase HOC porewater concentrations (Cpw) as functions of HOC- and sediment-specific characteristics in a conceptual 3-compartment system. The resulting model predicted that the MathML source was independent of HOC concentrations in both sediment and porewater, but did vary with hydrophobicity, the fraction of sediment porewater, and the volume of the SPME sorbent phase. The study results suggest that relatively small sediment volumes participate in exchange equilibria among sediment, porewater, and the SPME fiber and that large sediment HOC reservoirs are not needed to improve the detection sensitivity of SPME-based porewater samplers.

Quantification of Aqueous Cyanogen Chloride and Cyanogen Bromide in Environmental Samples by MIMS
Yang, X. and C. Shang, Hong Kong Univ. of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.
Water Research, Vol 39 No 9, p 1709-1718, May 2005

Membrane-introduction mass spectrometry (MIMS) was developed and verified for the direct quantification of cyanogen chloride (CNCl) and cyanogen bromide (CNBr) in environmental samples without any sample workup. The MIMS method provided linear responses for three orders of magnitude of concentrations. The instrument detection limits of CNCl and CNBr were 1.2 and 3.8 ug/L, respectively, and the method detection limits of CNCl and CNBr were both 1.7 ug/L. A pH ranging from 3 to 10 did not affect quantification. Average recoveries of CNCl and CNBr in the water matrixes tested were 98.5% and 92.7%, respectively. The use of MIMS in on-line monitoring of the formation of cyanogen halide was demonstrated in chlorination of aqueous solutions containing glycine and bromide ions. The results highlighted the important role of bromide ions in cyanogen halide speciation.

Quantification of Ecotoxicological Tests Based on Bioluminescence Using Polaroid Film
Tamminen, Manu V. and Marko P.J. Virta, Univ. of Helsinki, Finland.
Chemosphere, Vol 66 No 7, p 1329-1335, Jan 2007

It is possible to use common Polaroid film for the detection of the luminescence of BioTox(tm), a Vibrio fischeri-based toxicity test, and a specific recombinant bacterial strain for arsenic determination. The exposed films can be used for visual or computer-assisted quantification of the signal. Qualitative visual comparison to standards can provide rapid and relatively accurate estimation of toxicity or pollutant concentration. The computer-assisted method significantly improved the accuracy, and the quantification of the results agreed well with the values obtained with a luminometer.

Quantifying Fugitive Emission of VOCs Using the Solar Occultation Flux Technique (SOF)
Mellqvist, Johan, Chalmers Univ., Goteborg.
Complement to Fransson and Mellqvist 2002, 2 July 2004, 23 pp, [Fransson, K and Mellqvist, J., Measurements of VOCs at Refineries Using the Solar Occultation Flux Technique, Report to Preem Environmental foundation, Goteborg, 2002]

The Solar Occultation Flux (SOF) remote sensing method is based on measuring infrared intensity spectra of the sun from a moving vehicle in combination with mobile point measurements with a parallel infrared system coupled to a White cell (the cell is used to estimate the plume height). SOF measurements have been made at most Swedish refineries and the largest petrochemical industries. Detection limits down to 0.5 mg/m2 can be achieved, which corresponds to measuring a point source of 0.5 kg/h at a distance of 50 m with a precision better than 3%. Trace gas experiments show that an accuracy of 3 to 5% can be obtained under favorable conditions with emissions from a single point at an open field upon the averaging of 10 to 20 measurements. Individual measurements are usually within 20% but may deviate as much as 50% from the correct value. The SOF technique is used today at most of the Swedish refineries to estimate their annual emissions in place of the DIAL technology that was used for

almost 10 years. In comparison to the DIAL technique the SOF method is more cost effective since considerably cheaper hardware and less manpower is required.
http://www.fluxsense.se/reports/The%20Solar%20Occultation%20Flux%20technique,%20overview%202005%20(Flare).pdf

Quantifying Stream-Aquifer Interactions Through the Analysis of Remotely Sensed Thermographic Profiles and In Situ Temperature Histories
Loheide, S.P. II and S.M. Gorelick, Stanford Univ., Stanford, CA
Environmental Science & Technology, Vol 40 No 10, p 3336-3341, 15 May 2006

During warm periods, groundwater/surface water interactions have two primary effects on stream temperature: (1) cool groundwater discharging as baseflow lowers stream temperature and (2) hyporheic exchange buffers diurnal stream temperature variations. The authors discuss how high-resolution, remotely sensed, forward-looking infrared (FLIR) images and instream temperature data can be used to quantify detailed spatial patterns of groundwater discharge to a stream.

Quantifying Uncertainty in Estimating DNAPL Source Mass Using High Resolution Site Characterization
Wealthall, Gary P., Mike R. Lelliott, and Mark R. Cave, British Geological Survey.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

At present, no single technique is available that adequately characterizes DNAPL source zone architecture in heterogeneous geologies. This paper describes work in progress at the Source Area BioREmediation (SABRE) research site in the UK. A major four-year international research program is focused on quantifying the performance of in situ accelerated bioremediation for chlorinated solvent source zones. The combined lines of evidence from high-resolution site characterization indicate that the DNAPL source zone is highly residualized, with only limited evidence to indicate pooling of free-phase liquid. The predicted source architecture is used to estimate DNAPL mass based on a non-wetting phase bulk retention capacity approximation method. The results indicate the presence of nine individual DNAPL zones. The authors present detailed 3-D reconstruction and visualisation of the site data and examine a novel method to quantity uncertainty in DNAPL mass distribution.

Quantitative Determination of 1,4-Dioxane and Tetrahydrofuran in Groundwater by Solid Phase Extraction GC/MS/MS.
Isaacson, C. (Oregon State Univ., Corvallis), T.K. Mohr, and J.A. Field.
Environmental Science & Technology, Vol 40 No 23, p 7305-7311, 1 Dec 2006

Groundwater contamination by cyclic ethers, 1,4-dioxane, and tetrahydrofuran (THF) are a growing concern. The high water solubility of the readily transported cyclic ethers coupled with low Henry's law constants and octanol-water partition coefficients make their removal from groundwater problematic for both remedial and analytical purposes. A solid-phase extraction (SPE) method based on activated carbon disks was developed for the quantitative determination of 1,4-dioxane and THF, with average recoveries of 98% and 95%, respectively. The method requires 80 mL samples and a total of 1.2 mL of solvent (acetone). The number of steps is minimized due to the "in-vial" elution of the disks. The method quantitation limits are 0.31 ug/L for 1,4-dioxane and 3.1 ug/L for THF. During a single sampling campaign at a trichloroethane (TCA)-impacted site, use of the SPE method demonstrated that the concentrations and areal extent of 1,4-dioxane in groundwater were greater than those of either TCA or THF.

Quantitative Techniques to Discriminate Petroleum Oils Using LED-Induced Fluorescence
Rostampour, V. and M.J. Lynch, Curtin Univ. of Technology, Australia,
Water Pollution VIII: Modelling, Monitoring and Management. WIT Press, Wessex Institute of Technology, UK. ISBN: 1-84564-042-X, Transactions on Ecology and the Environment Vol 95, p 255-262, 2006

In situ LED-induced fluorescence analysis of oil on water was performed by examining the fluorescence spectrum of various Australian crude oils and some refined oil products. Crude oils and refined oil were discriminated using non-contact fluorescence-based techniques. The spectral distribution of the fluorescence emission has been used as a quantitative technique to differentiate oil products, taking advantage of key factors such as spectral shape, the wavelength of maximum intensity, and fluorescence spectral width. In tests, oil slicks on water were exposed to two different excitation illumination wavelengths. All oil samples were illuminated by several UV and visible excitation sources. The four crude oils and other petroleum products were easily differentiated by applying the ratio of two fluorescence spectral bands excited by 528 nm and 405 nm; however, the selected excitation wavelength range was not the optimum wavelength for fluorescence of crude oil, and more studies should be performed at shorter excitation wavelengths.

Rapid Analysis of Tile Industry Gaseous Emissions by Ion Mobility Spectrometry and Comparison with Solid Phase Micro-Extraction/Gas Chromatography/Mass Spectrometry
Pozzi, R., P. Bocchini, F. Pinelli, and G.C. Galletti, Univ. of Bologna, Bologna, Italy.
Journal of Environmental Monitoring, Vol 8 No 12, p 1219-1226, Dec 2006

A rapid method for the analysis of gaseous emissions from ceramic industry uses ion mobility spectrometry (IMS) to provide on-site monitoring of volatile organic compounds (VOCs) produced during tile baking. IMS was calibrated with a set of reference compounds (i.e., ethyl acetate, ethanol, ethylene glycol, diethylene glycol, acetaldehyde, formaldehyde, 2-methyl-1,3-dioxolane, 2,2-dimethyl-1,3-dioxolane, 1,3-dioxolane, 1,4-dioxane, benzene, toluene, cyclohexane, acetone, acetic acid) via air-flow permeation. The technique was tested on a laboratory-scale kiln and then was applied to emissions from two industrial facilities in the Modena (Italy) ceramic area. When the experimental results were compared against those obtained by solid phase micro-extraction/gas chromatography/mass spectrometry (SPME/GC/MS), IMS showed potential as a real-time monitoring device for ceramic industry emissions. The advantages and limitations of both techniques are discussed.

A Rapid and Robust Method for the Organic Mercury Determination in Hg Mine Waters
Fernandez-Martinez, R., M. Galan Pilar, M.D. Petit-Dominguez, A. Ordonez, J. Loredo, & M.I. Rucandio.
Mine Water 2005 -- Mine Closure. University of Oviedo. p 655-660, 2005

A rapid, simple and robust method for the organic mercury determination in Hg mine waters has been developed. Organic mercury species were extracted in dichloromethane as bromide derivatives in a single step and aliquots of the organic phase were evaporated, retaining organic mercury in a N-acetyl-L-cysteine solution. Organic mercury was determined by using the direct mercury analyzer DMA-80. The suitability of the proposed method was evaluated in methylmercury recovery studies in spiked waters from an abandoned mining area in Asturias. Recoveries higher than 92% were achieved for all the tested matrices, with no influence of iron and sulfate observed. Preparation of spiked samples and analysis of an acceptable number of replicates could be carried out in the same day.
http://www.imwa.info/publications/congress_2005.htm

A Real-Time Aromatic Specific Instrument for Vapor Intrusion Monitoring
Jarski, Paul B. and Jennifer L. Kuschel, Dakota Technologies, Inc.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

The Aromatic Specific Laser Ionization Detector (ARSLID(tm)-100) Monitor is a portable instrument that directly detects airborne total aromatic concentrations in real-time. ARSLID is based on resonance-enhanced multi-photon ionization, which greatly increases the specificity and sensitivity of the system for detection of aromatic versus non-aromatic compounds. The Monitor is unaffected by changing environmental conditions such as humidity, temperature, or dust particulates. System response is stable over several days, allowing for unattended operation for week-long periods. This presentation describes the technology and its application at several sites. The potential for application of the ARSLID technology for fenceline monitoring and subsurface characterization of dissolved-phase plumes (e.g., benzene, toluene, xylenes, and polycyclic aromatic hydrocarbons) is also discussed.

Recombinant Luminescent Bacterial Sensors for the Measurement of Bioavailability of Cadmium and Lead in Soils Polluted by Metal Smelters
Ivask, A. (National Inst. of Chemical Physics and Biophysics, Tallinn, Estonia); M. Francois; A. Kahru; H.-C. Dubourguier; M. Virta; F. Douay.
Chemosphere, Vol 55 No 2, p 147-156, Apr 2004

Two recombinant bacterial sensors, one responding specifically to cadmium and the other to lead and cadmium by increase of luminescence (firefly luciferase as a reporter), were used to determine the bioavailability of these metals in soil/water suspensions (a contact assay) and respective particle-free extracts. Both chemical and sensor analysis applied to 50 agricultural soils sampled near zinc and lead smelters showed that only ug/L levels of metals were extracted from the soil into the water phase; however, 115-fold more Cd and 40-fold more Pb proved bioavailable when the sensor bacteria were incubated in soil suspensions (i.e., in the contact assay). The bioavailability of metals in different soils varied (depending probably on soil type), ranging from 0.5% to 56% for cadmium and from 0.2% to 8.6% for lead.

Reevaluation of VOC Contamination in Ground Water Prompted by Indoor Air Results
Palmer, J.L., D.S. Oliver, & S.J. Steinmacher (MWH Americas); B.L. Hall & J.D. Case (Hill AFB).
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

In residential areas surrounding Hill Air Force Base, UT, analysis of indoor air sample results collected from over 400 houses indicated the unexpected presence of trichloroethene (TCE) and 1,2-dichloroethane (1,2-DCA) in several homes. Previous groundwater investigations and monitoring well sampling in the area had led investigators to conclude that these residences did not overlie contaminated groundwater. The finding of contaminant presence prompted an additional cone penetration testing and direct-push groundwater sampling investigation that focused on shallow groundwater, which had not been sampled during previous investigations due to slow recharge. Results from the investigation confirmed the presence of TCE above the federal maximum contaminant level, as well as other site contaminants in a shallow lens underlying the homes. Contaminated groundwater was not identified previously in this area due to the highly stratified nature of contamination within the site and the presence of contamination at deeper intervals elsewhere at the site. This case study demonstrates how the presence of site contaminants in homes believed not to overlie contaminated groundwater may indicate the need for further investigation, even at sites where the extent of groundwater contamination is thought to be well understood.

Reflectance Spectra of Three Liquid Hydrocarbons on a Common Sand Type
Allen, C.S. and M.B. Satterwhite.
Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII. Proceedings of SPIE--The International Society for Optical Engineering, Vol 6233, May 2006

Three liquid hydrocarbons of different volatilities--gasoline, diesel fuel, and motor oil--were incrementally applied to a quartz sand substrate. The reflectance spectra of the hydrocarbon/sand samples varied directly with the amount (weight) of liquid on the sand. Liquid-saturated sand samples left to age in ambient outdoor conditions were re-measured at regular intervals for the residual liquid and the associated change in sample reflectance. The results outlined temporal windows of opportunity for detecting these products on the sand substrate, ranging from less than 24 hours to more than a week, depending on liquid volatility. Each hydrocarbon darkened the sand and produced hydrocarbon absorption features near 1.70 and 2.31 um and a hydrocarbon plateau at 2.28 to 2.45 um. These features were used to differentiate the liquid/sand samples. A normalized difference index metric based on one of these features and a spectral continuum band described the reflectance/weight loss and reflectance/time relations. The normalized difference hydrocarbon index (NDHI) using the 1.60 and 2.31 um bands characterized the samples best.

Regarding Methodology of Electromagnetic Investigation for Early Warning of Soil Pollution by Oil Products
Tursunmetov, R.A., N.G. Mavlyanov, and Sh. H. Abdullaev (GIDROINGEO, Tashkent, Uzbekistan); M.F. Rahmatullaeva (Inst. of Information and Computer Technologies, Tashkent, Uzbekistan).
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

Experimental field investigations were carried out in loess soil, where an oil product percolation process was studied in a small pit (50x50x50cm). The migration process was studied by both electromagnetic investigations and chemical sample analyses. The tests were carried out in both naturally moist and saturated loess soils. During oil product migration in natural loess, successive spreading of light and then heavy fractions was reflected in a gradual increase of specific electric resistance and environment polarization. This process was characterized by anomalous change of effective resistance curve during frequency sounding. The process of oil product decay due to oxygen influx from precipitation was characterized by a gradual decrease of specific electric resistance and increase of polarization. Oil product migration in saturated loess was characterized by a moderate decrease of the resistance parameter; that upper part of the cross section shows a slight increase due to oil product oxidation in a wet environment. One section of seeming resistance within separate profiles of oil product spreading was reflected in the form of vertical 'pockets' in loess at the expense of anisotropic pore space.

Relations Between Chemical Variables in Acid Mine Drainage Process: An Application of Fuzzy Clustering Algorithms to the Characterization
Grande, J.A., J.M. Andujar, J. Aroba, M.L. de la Torre, A. Jimenez, and R. Beltran.
Mine Water 2005 -- Mine Closure. University of Oviedo. p 21-28, 2005

Acid mine drainage processes in a stream in the Iberian Pyrite Belt, southwest Spain, were characterized by means of clustering techniques based on fuzzy logic. An explanation of pH behavior in context to precipitation indicates that the influence of rainfall inputs on the acidity and on the resulting metal load of a riverbed undergoing acid mine drainage processes is highly dependant on the moment when it occurs. In general, the riverbed dynamic behavior is the response to the sum of instant stimuli produced by isolated rainfall, the seasonal memory (depending on the moment of the target hydrological year), and the inertia of the river basin as a result of accumulations resulting from long-term mining activity.
http://www.imwa.info/publications/congress_2005.htm

Rocket Paste Production Buildings Investigation, Badger Army Ammunition Plant, Baraboo, Wisconsin: Phase 1 Final Report
Environmental Security Technology Certification Program (ESTCP), 2,525 pp, June 2003

There are no full-scale technologies for non-destructive, in situ characterization of hard-to-reach surfaces (e.g., under floors) in explosives-contaminated buildings. With adequate characterization, many buildings could be safely left in place, resulting in substantial cost avoidance and the ability to transfer the properties out of DoD control more quickly. An ESTCP demonstration was conducted at Badger Army Ammunition Plant (BAAP) to evaluate a variety of methods for characterizing the foundations, adjacent areas, and underlying soils without

having to remove the buildings and foundations first. As part of this demonstration, field test methods including Raman spectroscopy, Expray(r) colorimetric indicator, and the Cold Regions Research and Engineering Laboratory Royal Demolition Explosive (RDX) colorimetric field screening method were evaluated to determine the presence and/or concentration of NC or NG in soil samples and concrete slabs. [Note: this report is massive. Recommend saving to hard drive instead of opening in browser.]
http://www.estcp.org/technology/ER-Site-Characterization.cfm

Sample Holding Time Reevaluation
Ainsworth, C.C., V.I. Cullinan, E.A. Crecelius, K.B. Wagnon, and L.A. Niewolny, Battelle Memorial Inst., Richland, WA.
EPA 600-R-05-124, 329 pp, Oct 2005

The stability of selected contaminants in soil/sediment samples was investigated as a function of holding time prior to extraction. Contaminants of interest centered on SVOCs (particularly polyaromatic hydrocarbons (PAHs)), polychlorinated biphenyls (PCBs), pesticides, Cr(VI), and several heavy metals. The project entailed the following contaminant-specific objectives. (1) Determine if selected SVOC contaminant concentrations in soil/sediment changed with time when held in storage beyond their established extraction maximum holding times (MHTs) under current preservation techniques and at -20 degrees C. (2) Determine if Cr(VI) concentrations change when held in storage beyond their established MHTs under current preservation techniques and at -20 degrees C. (3) Determine if extracted Cr(VI) concentrations change when held beyond the analysis MHT (24 h) when held in the dark at room temperature (~20 degrees C) or 4 degrees C. (4) Determine if air-drying soil samples will adversely impact hot acid-extractable heavy metal concentrations. Findings: The investigators found that for the 17 PAH compounds quantified in different soils/sediments, a holding time of 100 days at either 4 degrees C or -20 degrees C would result in no more than a 20% decrease in concentration, though there is considerable variability in the estimated holding times for different compounds and in different soils/sediments. The major consideration in sediment holding time appears, from these studies, to be the number of aromatic rings (or molecular weight) of the PAH of interest. For the three PCB Aroclor mixtures and the seven congeners quantified in different soils/sediments, a holding time of 260 days at 4 degrees C and 281 days at -20 degrees C would result in not more than a 20% decrease in concentration. For the 10 pesticides quantified in different soils/sediments, a holding time of 217 days at 4 degrees C and 299 days at -20 degrees C would result in not more than a 20% decrease in concentration. These holding times are far greater than the current MHT specified in SW-846. The estimated number of days until a 5% decrease in Cr(VI) concentration from the estimated intercept would be observed was greater than 140 days for all sediments/soils tested. In all cases, when the recovery of the matrix spike and control samples was good within acceptable parameters, the stability of Cr(VI) in the sediment/soil and extract solutions appears to be longer than the current MHT specified in SW-486. Extractable metal concentrations were not affected significantly by a holding time of up to 364 days or by air drying. The results suggest that a minimum of 709 days would elapse before the acid-extractable As, Cu, Pb, or Zn concentration decreased by 20%.
http://www.epa.gov/nerlesd1/cmb/research/bs_033cmb06.pdf

Sampling Methods to Determine the Spatial Gradients and Flux of Arsenic at a Groundwater Seepage Zone

Gan, P., R. Yu, B.F. Smets, and A.A. MacKay, Univ. of Connecticut, Storrs.
Environmental Toxicology and Chemistry, Vol 25 No 6, p 1487-1495, June 2006

Sampling techniques with centimeter-scale spatial resolution were applied to investigate biogeochemical processes controlling groundwater arsenic fate across the groundwater/surface water interface at a site characterized by fine sediments. Freeze-core sediment collection gave more detailed and depth-accurate arsenic and iron contaminant and microbial distributions than could be obtained with a hand auger. Selective chemical extractions indicated that >90% of the arsenic was strongly sorbed to the amorphous iron oxyhydroxides that accounted for more than 80% of the total iron in the sediments. Push-point porewater sampling captured large amounts of sediment fines, even with controlled water withdrawal, which necessitated filtration before water quality analysis. Bead columns containing glass media enabled short-term (29 d) characterization of porewater-to-sediment transfer of arsenic and iron. Bead columns indicated quantitative capture of groundwater arsenic and iron during 2003, suggesting that freeze-core inventories corresponded to 2 to 20 years of accumulation, depending on location.

Scanning Lidar: a Means of Characterizing the Noranda-Horne Smelter Plume

Strawbridge, K.B.
Geochemistry: Exploration, Environment, Analysis, Vol 6 Nos 2&3, p 121-129, 2006

The Meteorological Service of Canada has developed a mobile scanning lidar facility (RASCAL: Rapid Acquisition SCanning Aerosol Lidar) capable of fast azimuth and elevation scanning profiles of the lower troposphere. Lidar is a remote sensing technique that provides high temporal and spatial information on atmospheric particulates and is ideally suited for characterizing stack plume dynamics. RASCAL was located predominantly downwind of the Noranda-Horne smelter stack source for two 3-week periods in the winter and summer of 2000. These particular scanning periods allowed the behavior of the plume to be examined in different conditions of humidity and boundary layer dynamics. The scanning speeds were adjusted to allow a complete scanning profile to be collected within 30 to 60 seconds. Along-plume-axis and cross-sectional scans provided an opportunity to directly measure plume dynamics and interaction with the planetary boundary layer, including the ability to detect fumigation events.

Screen-Printed Carbon Electrode Modified with Poly-L-Histidine Applied to Voltammetric Determination of Chromium(VI)

Bergamini, M.F., D.P. dos Santos, and M.V.B. Zanoni, UNESP, Araraquara, SP, Brazil.
210th Electrochemical Society Meeting, ECS Abstract #2110, 2006

An electrode chemically modified with poly-L-histidine (PH) that uses screen-printed carbon electrodes has been fabricated and evaluated for the determination of chromium(VI) in aqueous solution and in treated wastewater collected from the leather-dyeing/tanning industry. The design of the screen-printed carbon electrode (SPCE) is based on an alumina ceramic base with a working, reference, and auxiliary electrode exposed on the surface. All the electrodes are made by carbon conducting ink. A contacting field is connected with the active part of each electrode by internal carbon conducting parts, covered by a dielectric protection layer. Voltammetric measurements were carried out with a microAUTOLAB Type III (EcoChemie) connected to a microcomputer controlled by software (GPES 4.9) for data acquisition and experimental control. The measurements were performed in a conventional electrochemical cell of 10 mL, where the screen-printed carbon electrode (Oxley Developments UK) was coupled. The sensor was connected with a cable to the potentiostat and used without any pretreatment. Leather-dyeing industry wastewater samples spiked to 0.52 mg/L Cr(VI) or Cr(III) were analyzed using the proposed method with 97% of mean recoveries. The method can also be applied to quantify Cr(III) indirectly via oxidation treatment by hydrogen peroxide in alkaline solution. The results obtained indicate a mean of recoveries of around 100% of Cr(III) from wastewater samples using the SPCE/PH applied in 1.0 x 10-5 mol/L of Cr(III) added to each sample.

Sediment Dilution Method to Determine Sorption Coefficients of Hydrophobic Organic Chemicals
Ter Laak, T.L. (Utrecht Univ., Utrecht, The Netherlands), P. Mayer, F.J. Busser, H.J. Klamer, and J.L. Hermens.
Environmental Science & Technology, Vol 39 No 11, p 4220-4225, 1 June 2005

A sediment dilution approach was combined with measurements of freely dissolved concentrations to determine sorption coefficients of five chlorobenzenes and two chloroanilines in spiked sediment and of two unknown chemicals in field-contaminated sediment. A range of sediment suspensions with different sediment/water ratios was made. Freely dissolved concentrations in these suspensions were measured by negligible-depletion solid-phase microextraction (nd-SPME). Sediment/water sorption coefficients were derived from the decrease of the freely dissolved concentrations as a function of the dilution factor (DF = volume water/mass sediment). The determined sorption coefficients were similar to literature values. The experimental setup provides sorption coefficients without the need for total extractions, and the negligible depletion SPME technique does not require phase separation. The proposed method presents a potential alternative to batch equilibrium experiments to determine sorption coefficients.

Semi-Analytical, Homogeneous, Anisotropic Capture Zone Delineation
Fienen, M.N., J. Luo, and P.K. Kitanidis.
Journal of Hydrology, Vol 312 Nos 1-4, p 39-50, 2005

An implementation in MATLAB of an analytical, 2-D, anisotropic capture zone delineation tool called ComCZAR is available on line. Example files are also included. This model is available without warranty or guarantee for public use. Software and instructions are provided.
http://www.stanford.edu/~fienen/software/

Sensors Based on Spectroelectrochemistry: Detection of Metal Ions
Heineman, W.R. and C.J. Seliskar, Univ. of Cincinnati, Cincinnati, OH.
210th Electrochemical Society Meeting, Abstract #2100: ECS Transactions, Vol 3 No 5, 2006

A great improvement in selectivity can be achieved in a sensor by combining electrochemistry, spectroscopy, and selective partitioning into a single device. One configuration of the sensor consists of an optically transparent electrode (OTE) coated with a selective film. Sensing is based on the change in absorbance for attenuated total reflectance (ATR) at the OTE that accompanies electrochemical modulation of the analyte that has partitioned into the film. Alternatively, ATR provides the excitation signal for fluorescence and measures the change in fluorescence intensity that accompanies electrochemical modulation. Selectivity for the analyte relative to other solution components is obtained by choice of film material, electrolysis potential, and wavelength(s) for optical monitoring. The sensor consists of an indium tin oxide OTE that has been coated with a thin film (typically 20 to 500 nm thick) of charge-selective material. Various films have been tested. Representative detection limits are ~10(-8) M for absorbance detection of ferrocyanide and 10(-11) M for fluorescence detection of Ru(bpy)3(2+). Strategies have also been developed for detecting metal ions that lack appropriate spectroscopic properties for sensitive detection. Iron in the ferrous oxidation state can be detected by spectroelectrochemistry even though neither ferrous nor ferric absorb strongly in the visible range. The capability of the sensor has been demonstrated by determining ferrocyanide in a complex sample of nuclear waste from a storage tank containing hundreds of components.

Silver Solid Amalgam Electrodes as Sensors for Chemical Carcinogens
Barek, J. and J. Fischer (UNESCO Lab. of Environmental Electrochemistry, Charles Univ., Prague, Czech Republic); T. Navratil (Academy of Sciences of the Czech Republic, Prague); K. Peckova (Charles Univ.); B. Yosypchuk (Acad. of Sciences of the Czech Republic).
Sensors, Vol 6 No 4, p 445-452, Apr 2006

The applicability of differential pulse voltammetry and adsorptive stripping voltammetry at a non-toxic meniscus-modified silver solid amalgam electrode (m-AgSAE) for the determination of trace amounts of genotoxic substances was demonstrated on the determination of micromolar and submicromolar concentrations of 3-nitrofluoranthene using methanol - 0.01 mol/L NaOH (9:1) mixture as a base electrolyte and on the determination of Ostazine Orange using 0.01 mol/L NaOH as a base electrolyte. The meniscus-modified silver solid amalgam electrode is based on a non-toxic solid amalgam and thus can be applied where work with liquid mercury is undesirable. Its mechanical stability enables its application for in situ measurements. This type of electrode is fully compatible with both centralized and decentralized testing of electrochemically reducible chemical carcinogens and fulfills the requirements of "green" analytical chemistry. The limit of determination is usually one order of magnitude higher than with the hanging mercury drop electrode and in many cases is sufficient for the determination of various electrochemically reducible chemical carcinogens in biological and environmental matrices.
http://www.mdpi.org/sensors/list06.htm

Simulation and Performance Assessment of Partitioning Tracer Tests in Heterogeneous Aquifers
Moreno-Barbero, E. and T.H. Illangasekare, Colorado School of Mines, Golden, CO.
Environmental and Engineering Geoscience, Vol 11 No 4, p 395-404, Nov 2005

The partitioning interwell tracer test (PITT), which evaluates the relative transport of DNAPL-phase partitioning and conservative (i.e., non-partitioning) tracers, has recently been promoted as a way to quantify entrapped DNAPL mass in source zones. Although the technique has been successfully applied to sites where DNAPL is present primarily at residual saturations, the effects of the geologic heterogeneity and DNAPL architecture on the performance and reliability of this technique have not yet been thoroughly examined. A systematic 2-D simulation study was conducted to evaluate the influence of DNAPL vertical distribution, well location, and geologic heterogeneity on the performance of the PITT for a total of 60 stochastic aquifer realizations. For cases where the aquifer is relatively heterogeneous and the DNAPL architecture is complex, PITT estimation efficiency averaged 48% (decreasing to 20% in certain scenarios) as a result of bypass flow and the limited tracer accessibility to lower hydraulic conductivity regions. While other studies have suggested the PITT technique may underestimate DNAPL saturation for these conditions, potential errors of this magnitude have not been reported previously. The results of this work underscore the importance of geological heterogeneity on PITT performance.

Simultaneous High Throughput and Quantitative Analysis of MTBE and BTEX by P&T-GCMS Using a Precept(r) Autosampler
Houghton, S.L. (Research School of Earth Sciences at UCL-Birkbeck, London, UK); S. Hall (Univ. College London).
Mineralogical Magazine, Vol 69 No 5, p 677-686, Oct 2005

The authors describe a simple and reliable method for rapid and combined analysis of MTBE and BTEX compounds. Forty-eight samples can be analyzed in a 24-hour period using the Precept II(r) autosampler in high throughput work. Validation of the sampler experiments is presented in the form of linearity, precision and intra-day repeatability of standards, as well as limits of detection and limits of quantification ranging from 1 to 20 ug/L. This MTBE/BTEX analytical method was used to study the optimization of a modular post-extraction remediation system incorporating air-stripping and granular activated carbon technologies, from which a selection of sample data is presented.
http://www.homepages.ucl.ac.uk/~ucfbshn/sarah/11-Houghton.pdf

Simultaneous Quantification of Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), and Pharmaceuticals and Personal Care Products (PPCPs) in Mississippi River Water, in New Orleans, Louisiana, USA
Zhang, S. (Armstrong Pharmaceuticals, Inc., Canton, MA); Q. Zhang, S. Darisaw, O. Ehie, and G. Wang (Xavier Univ. of Louisiana, New Orleans, LA).
Chemosphere, Vol 66 No 6, p 1057-1069, Jan 2007

In a six-month field study of contaminant concentrations in Mississippi River water, an analytical method for simultaneously determining 16 polycyclic aromatic hydrocarbons (PAHs), 28 polychlorinated biphenyls (PCBs), and 12 pharmaceutical and personal care products (PPCPs) was developed. The method involves the simultaneous extraction of the selected PAHs, PCBs, and PPCPs from the aqueous phase by solid-phase extraction using two-layer disks consisting of C18 and SDB-XC, plus collection of the suspended solid in water samples by 0.2 to 0.6 um filter in a single step. Target compounds adsorbed on the extraction disks were eluted with methanol, acetone, and dichloromethane. The suspended particles retained by the filter were sonically extracted using the same solvents. GC/MS was used for quantification of PAHs and PCBs directly and of PPCPs after derivatization.

Soil Gas Sampling Methods & Approaches for Vapor Intrusion Assessments For Petroleum Hydrocarbon Sites
Hartman, Blayne, H&P Mobile Geochemistry, Solana Beach, CA.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Although soil gas measurements are a common investigatory approach used for vapor intrusion assessments, allowable soil gas risk-based screening concentrations are 1,000 to 10,000 times lower than concentrations typically of concern for routine site assessment applications. Field and analytical techniques previously used for higher concentrations are not suitable for these ultra-low concentrations, and updated sampling and analytical protocols are needed. Sampling issues include where and how often to collect samples, the volume of sample purged and collected, hardware used to collect and store samples, tracer/leak compounds to ensure sample integrity, and available analytical methods (8021, 8260, TO-14, TO-15, TO-17). The primary factors influencing choice of sample location are the location of the source relative to the receptor (below or to the side), depth of the source, and type of contaminant. Various sampling strategies will be discussed for these scenarios, including spatial and vertical profiling, near-slab vs. sub-slab sampling, and strategies to demonstrate bioattenuation.

Soil Vapor Intrusion Investigations at Petroleum Contaminated Sites in Minnesota
Higgins, Tom M. and Sandeep Burman, Minnesota Pollution Control Agency.
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

Vertical soil gas transport into structures has been thoroughly tested through numerous sensitivity analyses; however, subsurface conditions can cause subsurface vapors to migrate beyond the scope of many predictive applications. An active soil gas sampling approach has been adopted by the Minnesota Pollution Control Agency's Petroleum Remediation Program. Development and interpretation of data from of the current Minnesota policy are discussed along with the current PRP pathway approach for establishing vapor intrusion risk.

Soil-Water-Solute Process Characterization: An Integrated Approach
Edited by Javier Alvarez-Benedi and Rafael Munoz-Carpena
CRC Press, Boca Raton, FL. ISBN 1566706572, 816 pp, 2004

This text addresses complicating factors for soil characterization, such as spatial and temporal variability of soil processes, scale issues, soil structure, and the trade-offs between methods. It focuses on advanced methods for the monitoring and modeling of mass transfer processes in soil. Contributors present limitations to well-known methods and alternatives, discussing their practical applications for characterization efforts, evaluating strengths and weaknesses, and focusing on a reduced set of selected techniques. Three in-depth sections cover everything from multidisciplinary approaches for assessing subsurface non-point source pollution to techniques for characterizing water and energy balances at the soil-plant-atmosphere interface, field methods for monitoring soil water status, and computer models for characterizing the effect of chemicals in soil.

Sol-Gel Processed MoO3 and WO3 Thin Films for Use as Selective Chemosensors
Perena Gouma, P. (SUNY/Stony Brook); E. Comini and G. Sberveglieri (INFM and Univ. degli Studi di Brescia, Italy).
BioMEMS and Nanotechnology. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5275, p 68-75, 2004

Molybdic oxide (MoO3) and tungsten trioxide (WO3) have been identified as suitable materials for detecting toxic gases, such as ammonia and carbon monoxide, with high sensitivity. Sol-gel processed thin films of MoO3, WO3, and a MoO3/WO3 composite have been prepared at SUNY Stony Brook by the hydrolysis of metal alkoxide precursors followed by spin coating and deposition on alumina heater/electrode-containing substrates produced by the Brescia group. Tests were carried out in the Brescia state-of-the-art gas-sensor testing facilities, where the electrical resistance of sensor arrays was recorded as a function of gas concentration for various combinations of gases (e.g., ammonia, CO, NO2, methanol, isoprene) at 10% relative humidity and at temperatures ranging from 400 to 500 degrees C. The MoO3/WO3 composite system showed the best stability at the highest testing temperature. The obtained sensing results are correlated with the structural characteristics of the sensing films.

The Solar Occultation Flux (SOF) Method, a New Technique for the Quantification of Fugitive Emissions of VOCs
Mellqvist, J., M. Kihlman, J. Samuelsson, and B. Galle, Chalmers Univ. of Technology, Gothenburg, Sweden.
Proceedings of the A&WMA 98th Annual Conference & Exhibition, Minnepolis, MN.
Paper #1377, 4 pp, 2005

Solar Occultation Flux (SOF) remote sensing measurements have been demonstrated for quite a few hydrocarbon species from many different industrial source areas, such as process areas, storage tanks, water treatment areas, and flares. In addition to measurements at most Swedish refineries and the largest petrochemical industries, the technique has also been applied in Italy and Mexico. Industrial application emission measurements have been conducted for farming areas, volcanoes (Mt. Etna and Popocatepetl), and mega cities (Milano, Mexico City) for species other than volatile organics.
http://www.fluxsense.se/reports/AWMA%202005%20Mellqvist%201377%20.pdf

The Solar Occultation Flux method: a Nouvelle Technique for Quantifying Fugitive Gas Emissions
Mellqvist, J., M. Kihlman, B. Galle, K. Fransson, and J. Samuelsson, Chalmers Univ. of Technology, Gothenburg, Sweden. Paper B, 17 pp, 2002

The Solar Occultation Flux remote sensing method is based on measurements of infrared (2.5-15 um) intensity spectra of the sun taken from a moving platform, vehicle, or ship. The main uncertainty of the method lies in the assessment of the wind field. The retrieval code has been tested and compared to other published codes for alkanes, HCl, and SO2, with generally good agreement. Results from a validation experiment utilizing SF6 trace gas showed that when averaging enough data (10 traverses), accuracies of ±10 to 20% were obtained from simple emissions sources. Another tracer experiment, simulating emission from a crude oil tank, showed

an error of 50% when measuring in the near field where meteorological disturbances are caused by the tanks. The good performance of the method for estimation of ammonia emissions from fertilized land has also been demonstrated. A ship traverse in the Goteborg harbor past one refinery and the oil harbor showed an emission of 900 kg/h of alkanes, with an average carbon number of 4.5.
http://www.fluxsense.se/reports/paper%201%20final%20lic.pdf

The Solar Occultation Flux Method: a New Technique to Quantify Fugitive VOC Emissions
Mellqvist, J., S. Jerker, B. Galle, and M. Kihlman, Chalmers Univ. of Technology, Goeteborg, Sweden.
Proceedings of CEM 2006: 7th International Conference on Emission Monitoring, Paris, Feb 2006. 9 pp, 2006

Solar Occultation Flux measurements have been demonstrated at many industrial areas for alkanes and olefins, as well as for species such as ammonia, carbon monoxide, formaldehyde, hydrogen chloride, hydrogen fluoride, and sulfur dioxide. During 2002 to 2004 an extensive project was carried out in which three refineries and an oil harbor in Sweden were monitored. The results showed that for a typical refinery, 0.06% of the throughput was lost due to vaporization. Of the emitted gas, 26% originated from the process, 31% from crude-oil tanks, 32% from product tanks, 8% from the water treatment facility, and 2% from transport-related activities.
http://www.fluxsense.se/reports/THE%20SOF%20METHOD%20extended%20abstract%20CEM%202006.pdf

Solid-Phase Dynamic Extraction for the Enrichment of Polar Volatile Organic Compounds from Water
Jochmann, M.A., M.P. Kmiecik, and T.C. Schmidt, Eberhard Karls-Univ. Tuebingen, Tuebingen, Germany.
Journal of Chromatography A, Vol 1115 Nos 1-2, p 208-216, 19 May 2006

Headspace solid-phase dynamic extraction coupled to gas chromatography-mass spectrometry (HS-SPDE-GC/MS) was evaluated for the trace determination of polar volatile organic compounds (PVOC) from aqueous matrices. Four SPDE needle coatings with different phase polarities and sorption properties were tested. The effects of extraction temperature, number of extraction cycles, and ionic strength on partitioning of the target compounds were investigated in detail, including the determination of salting-out constants for the investigated compounds. Lowest method detection limits were obtained with the WAX phase and with the PDMS/AC phase. The investigators used 3 ethers and 12 alcohols as target compounds, including MTBE, 1,4-dioxane, 3-methyl-1-pentanol, 1-propanol, 1-hexanol, and ethanol. With either the WAX or PDMS/AC phase, SPDE provided comparable or better sensitivities for the investigated compounds than other enrichment techniques, high sample throughput because of full automation, and short extraction times, as well as a robust extraction phase owing to its protection inside the steel needle. SPDE applicability has been demonstrated for the determination of fusel alcohols in different alcoholic beverages.

Source-Zone Characterization of a Chlorinated-Solvent Contaminated Superfund Site in Tucson, AZ

Brusseau, M.L. (Univ. of Arizona, Tucson, AZ); N.T. Nelson; Z. Zhang; J.E. Blue; J. Rohrer; T. Allen.

Journal of Contaminant Hydrology, Vol 90 Nos 1-2, p 21-40, 20 Feb 2007

An extensive characterization effort was conducted at a large Superfund site affected by chlorinated solvents in Tucson, AZ. The project consisted of traditional site-characterization activities, tracer tests, lab experiments conducted with core material collected from the site, and mathematical modeling. This paper focuses on the analysis of induced-gradient contaminant elution tests conducted in a source zone at the site, investigation of the potential occurrence of immiscible liquid in the saturated zone, characterization of the relationship between mass flux reduction and mass removal, and evaluation of the impact of source-zone management on site remediation. Ultimately, a greater than 90% reduction in mass flux was achieved for a mass removal of approximately 50%. The influence of source-zone management on site remediation was evaluated by conducting two predictive simulations, one for which the source zones were controlled and one for which they were not. A plume-scale model was used to simulate the composite contaminant concentrations associated with groundwater extracted via the pump-and-treat system, which were compared to measured data. The information generated from this study was used to enhance the site conceptual model, to optimize operation of the pump-and-treat system, and to evaluate the utility of source-zone remediation.

Speciation of Cd and Zn in Contaminated Soils Assessed by DGT-DIFS, and WHAM/Model VI in Relation to Uptake by Spinach and Ryegrass

Almas, A.R., P. Lombnaes, T.A. Sogn, and J. Mulder, Norwegian Univ. of Life Sciences, As, Norway.

Chemosphere, Vol 62 No 10, p 1647-1655, Mar 2006

A pot study was carried out to investigate the impact of Cd and Zn extractability in soil, speciation in soil porewater, and metal concentration in a metal sensitive-species (spinach) and a more metal-tolerant species (Italian ryegrass). WHAM/Model VI version 6.0 was used for chemical speciation of Cd and Zn in porewater. The diffusive gradients in thin films (DGT) technique was used to determine the effective concentration (CE) of Cd and Zn in soils. The free ion activity in porewater correlated well with the contents in plants, and a linear relationship was observed between the CE values and the concentration of Cd and Zn in both spinach and ryegrass in the non-toxic range; however, the CE values usually overestimated the plant contents when plants, particularly spinach, were subjected to toxic concentrations in the porewater. Metal uptake decreased in plants affected by toxicity, whereas metal binding to the Chelex resin did not. No linear relationship was found between the CE and metal contents in spinach, whereas a linear relationship was found between CE-Zn and the Zn concentration in ryegrass. This relationship was weak for Cd in ryegrass. The study results indicate that the transport of metals from labile metal pools to the DGT resin is linearly related to plant uptake only when plants are growing well and that the applicability of DGT as an indicator for plant uptake seems species dependent.

Spectrometry: Johns Hopkins Develops Facile Protein ID Tool.
Analytic Separations News, Vol 3 No 1, June 2005

Researchers at the Johns Hopkins Bloomberg School of Public Health (Baltimore, MD) have developed a method for identifying specific proteins in whole cell extracts of microorganisms using traditional peptide mass fingerprinting (PMF). The key to the new method, according to the researchers, is a "shortcut" for preparing samples that makes PMF faster and more economical. By reducing the cost of protein identification, they believe PMF can become an economical tool for monitoring and evaluating the effectiveness of microorganisms used in environmental cleanup. The researchers used a dioxin-eating organism to demonstrate the capabilities of their methodology. PMF typically involves elaborate sample preparation. A protein mixture is spread across a gel and separated into individual proteins, which are scooped out of the gel and cut with protein scissors into predictable, small pieces called peptides. The samples are then analyzed using matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS), which identifies protein fragments based on the time they need to travel a defined distance when being accelerated in a vacuum. In the study, Rolf U. Halden, assistant professor in the Department of Environmental Health Sciences, Bloomberg School of Public Health, and his colleagues demonstrated how PMF and mass spectrometry are used to identify a unique dioxin-degrading enzyme in a soup of hundreds of cell proteins. The technique avoids elaborate conventional sample preparation steps by coaxing the cells into mass production of the protein the researchers wish to analyze. The method increases the signal up front so that it stands out above the background noise. Halden and his colleagues tested their technique using Sphingomonas wittichii strain RW1, the only bacterium known to consume the backbone of toxic polychlorinated dibenzo-p-dioxins and dibenzofurans as a food source. The researchers already knew that feeding dioxins to RW1 would cause an increased enzyme level as the bacterium consumed the model pollutant. Their study shows that this increase can be easily identified by PMF using mass spectrometry. The method represents a new investigative tool in bioremediation. Johns Hopkins University is seeking partners who would like to license this patent-pending methodology. Inquiries can be directed to Deborah Alper at the Johns Hopkins Bloomberg School of Public Health, dalper@jhsph.edu or 443-287-0402. A paper describing the work, "Identification and Phenotypic Characterization of Sphingomonas wittichii Strain RW1 by Peptide Mass Fingerprinting Using Matrix-Assisted Laser Desorption Ionization-Time of Flight Mass Spectrometry," is available on line.
http://aem.asm.org/cgi/reprint/71/5/2442

SRNL Devices for Collecting Airborne Material Receive Patents
Savannah River National Laboratory News Release WSRC-2005-45, 1 Dec 2005

Two devices developed by Savannah River National Laboratory researchers for collecting airborne particles, including chemical agents and microorganisms, have recently been issued patents. Both the Aerosol-to-Liquid Particle Extraction System (ALPES) and the Aerosol Contaminant Extractor (ACE), which collect particles so they can be analyzed, could have wide application in homeland security and law enforcement. The two work in different ways: the ALPES using a liquid to concentrate particles, and the ACE depositing the particles on a charged plate for off-line analysis. Both devices are able to collect aerosols (including chemical agents), radioactive particles, microorganisms (spores, bacteria, and fungi), residual substances

from explosives, and byproducts of manufacturing processes (such as lead in a battery factory). An array of units, deployed throughout a public or private facility, could be a vital part of an antiterrorism alert system, as well as in less exotic uses where it is important to detect and identify unwanted substances in the air. Both devices are briefcase-sized, making them easily portable, and can operate off a 12-volt battery or be adapted to available power sources. Their quiet operations allow them to be used inconspicuously. ALPES is specifically designed for particles in the range of 0.3 to 2 microns. The device uses an electrical charge to attract airborne particles to a collection tube, where it is collected by recirculating liquid. A valved sample loop allows the liquid containing the contaminants to be diverted to an online analyzer or to a sample vial for transport to a laboratory for analysis. The liquid can be customized, depending on what the particulates of interest are. ACE is contained in a box fitted with motor-driven doors that open when the unit is turned on. The device can be mounted on a robot for particle collection in areas too dangerous for a human to enter. ACE has been used to collect bacteria at cooling towers to determine the presence of Legionella, the bacteria associated with Legionnaire's Disease. WSRC seeks contact with companies interested in licensing the devices for manufacture and marketing. The U.S. Patent & Trademark Office issued U.S. Patent No. 6,955,075 for ALPES on Oct. 18, 2005, and
U.S. Patent No. 6,964,189 for ACE on Nov. 15, 2005.

Stable Isotope Analysis in Remediation of Gasoline Oxygenates and Hydrocarbons
Kuder, T., P. Philp, J. Allen, and E. Cortez, Univ. of Oklahoma, Norman.
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

Compound-specific stable isotope analysis (CSIA) has been used to monitor the natural attenuation of MTBE and other gasoline VOCs. This presentation discusses results from microcosm experiments on oxygenate biodegradation, stable isotope analysis of commercial gasolines, and experiments on verification of isotope effects in abiotic attenuation processes. The results of a study of the carbon and hydrogen isotope composition of individual compounds (MTBE, TBA, and aromatics) of various commercial gasolines are presented. These obtained carbon and hydrogen isotope ratios provide a benchmark for identifying isotope fractionation in environmental samples and also demonstrate the forensic potential of the CSIA approach. No reference data on tertiary-butyl alcohol isotope composition are available at the time of this presentation.

Stable Isotopes: An Emerging Tool in Forensic Geochemistry
Philp, R.P., T. Kuder, and J. Allen, Univ. of Oklahoma, Norman.
IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

This paper provides examples to demonstrate the use of combined gas chromatograph/ isotope ratio mass spectrometer (GC/IRMS) systems in a variety of forensic and environmental problems. Wherever possible, the isotope fingerprints are combined with data from GC and GC/MS and other evidence. When looking at individual spills (e.g., toluene), stable isotopes can be used to discriminate an analyte derived from different feedstocks. Products such as gasoline, even if heavily weathered through evaporation, maintain their original isotopic signature in the weathered residue. Although the GC fingerprints of a suspected source and product in the environment may look very different, the isotopic composition of individual compounds in the two samples will be able to show whether or not the samples are related. Engine oil samples from hit and run accident victims would be another application whereby it would be possible to relate oil spots on the victim with oil samples taken from the suspected vehicle through a combination of the isotopes and GC and GC/MS. From an environmental perspective, it is often necessary to determine whether a particular compound has been undergoing biodegradation as a result of natural attenuation. It can be difficult to make this determination because a decrease in concentration may simply represent a dilution effect. The use of isotopic fingerprinting may resolve this difficulty, as work with compounds such as MTBE and various BTEX compounds shows that a decrease in concentration accompanied by an isotopic enrichment for both carbon and hydrogen is overwhelming evidence for the onset of natural attenuation.

Statistical Evaluation of an Analytical IC Method for the Determination of Trace Level Perchlorate
Huang, H. and G.A. Sorial, Univ. of Cincinnati, Cincinnati, OH.
Chemosphere, Vol 64 No 7, p 1150-1156, Aug 2006

In an evaluation of an ion chromatography (IC) method for the analysis of trace levels of perchlorate in water, researchers examined the homoscedasticity (i.e., all random variables in the sequence or vector have the same finite variance) of the IC system within the calibration concentration range, the effect of the system drift on the calibration curve, and the effect of the self-regeneration suppressor (SRS) current on the detection limit. The detection limits were obtained in two ways, through the method detection limit (MDL) and through the detection limit from the calibration curve (DTC). MDL yielded a lower but less reliable detection limit than DTC. An acceptable detection limit can be achieved under the lower SRS current (100 mA).

A Structured Approach to the Use of Near-Surface Geophysics in Long-Term Monitoring
Versteeg, R., M. Ankeny, J. Harbour, G. Heath, K. Kostelnik, E. Mattson, K. Moor, and A. Richardson (INEEL, Idaho Falls, ID); Ken Wangerud (U.S. EPA Region 8, Denver, CO).
The Leading Edge, Vol 23 No 7, p 700-703, July 2004

The effective and efficient management of earth systems is dependent on information concerning the temporal and spatial behavior of these systems. This information is typically obtained through long-term monitoring efforts; however, many of these efforts are less than successful. The authors discuss the problems contributing to this lack of success and offer suggestions for improvement.

Sub-Nanoliter Spectroscopic Gas Sensor
Alfeeli, B., G. Pickrell, and A. Wang, Virginia Polytechnic Inst. and State Univ., Blacksburg.
Sensors, Vol 6 No 10, p 1308-1320, Oct 2006

A new type of optical fiber-based chemical sensor, the sub-nanoliter sample cell (SNSC)-based gas sensor, is described and compared to existing sensor designs in the literature. This novel SNSC gas sensor has the capability of gas detection with a cell volume in the sub-nanoliter range. Experimental results are presented that demonstrate the capabilities of the miniature gas

sensor. The sub-nL SC technology currently has not achieved the same sensitivity as available gas sensors, but it provides a simple, real-time, inexpensive, robust, flexible, miniature, chemically inert, and biocompatible sensor for applications that do not require high sensitivity. Future work will pursue an evaluation of the sensor's performance in harsh environments.
http://www.mdpi.org/sensors/list06.htm

Subsurface Exploration Using the Standard Penetration Test and the Cone Penetrometer Test
Rogers, J.D., Univ. of Missouri, Rolla.
Environmental and Engineering Geoscience, Vol 12 No 2, p 161-179, May 2006

The standard penetration test (SPT) and cone penetrometer test (CPT) have become industry standards for subsurface geotechnical investigations using small-diameter borings and soundings. Both procedures have been adopted as ASTM standards. Either procedure can elicit incorrect data under particular subsurface conditions that may be overlooked, depending on the experience of field personnel operating or logging the tests. This paper discusses the operative assumptions employed in both procedures, highlights the various corrections that are commonly employed, and warns the reader of common errors in interpretation. The author concludes by stating that, under most conditions, the joint employment of SPT and CPT together has the greatest potential for characterizing sites correctly.

Surface Water Monitoring in Abandoned Mercury Mine Sites in Asturias (Spain): Comparative Studies
Loredo, J., A. Ordonez, M. Galan Pilar, R. Fernandez-Martinez, R. Alvarez, A. Olay, M.D. Petit-Dominguez, R.M. Fernandez, S, Marin, M. Gonzalez del Mar, and M.I. Rucandio.
Mine Water 2005 -- Mine Closure. University of Oviedo. p 595-601, 2005

Systematic monitoring of surface waters in the area of abandoned mine sites constitutes an essential step in the characterization of pollution from these sites. This paper provides an overview of systematic monitoring of physicochemical data in thirteen selected sampling points of a river catchment near abandoned mercury mines in Central Asturias in northwestern Spain. Arsenic is present in the mercury deposits in the form of As-rich pyrite, realgar, and occasionally arsenopyrite. Multivariate statistical studies reveal important differences between the physicochemical data of the samples taken upstream and downstream along the mine area.
http://www.imwa.info/publications/congress_2005.htm

The Swedish Landfill Methane Emission Project
Samuelsson, J. (Chalmers Univ. of Technology, Goteborg, Sweden); G. Borjesson (Linkoping Univ., Linkoping, Sweden); B. Galle (Chalmers Univ.); B. Svensson (Linkoping Univ.).
Sardinia 2001, 10 pp,

A tracer technique combined with time-resolved downwind plume concentration measurements by FTIR spectroscopy has been applied for estimating total methane emissions from landfills in Sweden. Results from four landfills, constituting a set of different scales and topographies, are presented.
http://www.fluxsense.se/reports/Sardinia2001paper.pdf

Synthesis of a Molecularly Imprinted Polymer for Dioxin
Malitesta, C., R.A. Picca, G. Ciccarella, V. Sgobba, and M. Brattoli, Univ. degli Studi di Lecce, Lecce, Italy.
Sensors, Vol 6 No 8, p 915-924, Aug 2006

A molecularly imprinted polymer for selectively recognizing the dioxin compound 2,3,7,8-tetrachlorodibenzodioxin (TCDD) is made by a new non-covalent method employing a "dummy" template. The proposed method is a simplification of a synthetic scheme proposed for covalent imprinting. Comparison of extraction yields of the novel polymer, a non-imprinted polymer, and an imprinting polymer prepared by the original procedure demonstrates the binding capacity of the proposed polymer, which is in principle applicable to solid-phase extraction (SPE) of dioxin.

http://www.mdpi.org/sensors/list06.htm

A System for Calibrating Seepage Meters Used to Measure Flow Between Ground Water and Surface Water
Rosenberry, D.O. and M.A. Menheer.
U.S. Geological Survey Scientific Investigations Report 2006-5053, 27 p, 2006

A system has been developed for generating controlled rates of seepage across the sediment/water interface, representing flow between groundwater and surface water. The seepage-control system facilitates calibration and testing of seepage measurement devices, commonly called seepage meters. Two slightly different seepage-control systems were evaluated. Both designs make use of a 1.5-m-diameter by 1.5-m-tall polyethylene flux tank partially filled with sand that overlies a pipe manifold and diffuser plate to provide a uniform flux of water through the sand. The flux tank is filled with water to maintain a water depth above the sand bed of about 0.6 m. Flow is generated by routing water through tubing that connects an adjustable-height reservoir to the base of the flux tank, through the diffuser plate and sand, and across the sediment-water interface. Seepage rate is controlled by maintaining a constant water depth in the reservoir while routing flow between the reservoir and the flux tank. The rate of flow is controlled by adjusting the height of the reservoir with a manually operated fork lift. Flow rates as large as +/-55 centimeters per day were generated by adjusting the reservoir to the extremes of the operable range of the fork lift. The minimum seepage velocity that the flowmeter can reliably measure is about 7 centimeters per day. The datalogger records flow, in units of volume per time, as measured by an in-line flowmeter positioned between the base of the flux tank and the reservoir. Seepage flux in units of distance per time is determined by dividing the flowmeter output by the surface area at the sediment-water interface in the flux tank. Spatial heterogeneity in seepage was evident in both flux tanks in spite of attempts to minimize heterogeneity during tank construction. Medium sand was used in both flux tanks and care was taken to homogenize the sand during and after filling of the tanks. Time was provided for release or dissolution of trapped air, and water was circulated to remove fine-grained sediments prior to system use. In spite of these precautions, seepage measured with five to six small 20.25-cm-diameter seepage meters varied by about a factor of two. Use of larger diameter seepage meters, which cover a larger percentage of the sediment surface of the flux tanks, greatly minimized measured seepage heterogeneity. The seepage-control system was used to demonstrate that seepage-meter efficiency is sensitive to the type of seepage-meter bag and that bag-measured seepage rate is sensitive to the duration of the seepage-meter measurement only during very short measurement times. The in-line flowmeter used with this system is incapable of measuring seepage rates below about 7 centimeters per day. Smaller seepage rates can be measured manually. The seepage-control system also can be modified for measuring slower seepage rates with the use of two flowmeters and a slightly different water-routing system, or a fluid-metering pump can be used to control flow through the flux tank instead of an adjustable-height reservoir. http://pubs.usgs.gov/sir/2006/5053/

Testing VOC Emission Measurement Techniques in Wood-Coating Industrial Processes and Developing a Cost-Effective Measurement Methodology
Ojala, S. (Univ. of Oulu, Oulu, Finland); U. Lassi (Central Ostrobothnia Polytechnic, Kokkola, Finland); R.L. Keiskia (Univ. of Oulu, Oulu, Finland).
Chemosphere, Vol 62 No 1, p 113-120, Jan 2006

Numerous methods can be used to measure VOC emissions, but no single method allows sampling of the whole range of volatile organics. The authors discuss the development of an emission measurement procedure used to monitor solvent emissions from coating processes.

Time-Gated Detection of Europium Nanoparticles in a Microchannel-Based Environmental Immunoassay
Chen, Shi-Che, Richard Perron, Dosi Dosev, and Ian M. Kennedy, Univ. of California/Davis.
BioMEMS and Nanotechnology. Proceedings of SPIE--The International Society for Optical Engineering, Vol 5275, p 186-196, 2004

Using MEMs (micro electro mechanical system) fabrication techniques, it is possible make a micro-sized instrument for optical detection of trace amounts of chemical species in aqueous solution. The red-emitting $Eu2O3$ nanoparticle is suitable for a biolabel for such species because of its long fluorescence lifetime and narrow emission bandwidth. The Eu nanoparticles are excited by a laser pulse. Their long-lived emission allows the detected signal to be separated from the laser pulse both spectrally and temporally. The background signal can also be eliminated in this manner. The instrument is assembled with silicon and glass layers with a 200um deep channel. A Nd:YAG pumped optical parametric oscillator is used as the excitation source. The authors discuss the underlying fundamental principles and the micro-fabrication steps for the instrument and compare the measurement sensitivities achieved using two detectors: a photo-multiplier tube and an avalanche photodiode.

Screening Methods for Water Data Information in Support of the Implementation of the Water Framework Directive: A Toolbox of Existing and Emerging Methods for Water Monitoring Under the WFD
Roig, Benoit, Ian J. Allan, and Richard Greenwood (eds.).
Sixth Framework Programme, Germany, 251 pp, 2005

This document provides easy access to the wide range of candidate monitoring methods currently available or under development for supporting the Water Framework Directive (WFD). It is organized with tables containing parameters and pollutants (including many emerging contaminants) that may need to be monitored, and these are linked to tables containing

summaries of the available methods, both biological and physicochemical. While some of these techniques are commercially available, many are at prototype stage. Tools may be based on the collection of spot samples, passive sampling techniques, or continuous in situ monitoring.
http://www.ecologic-events.de/swift-germany/documents/Emerging_tools_manual.pdf

Total and Partial Digestion of Sediments for the Evaluation of Trace Element Environmental Pollution
Perez-Santana, S. (Centro de Estudios Ambientales de Cienfuegos, Cuba); M.P. Alfonso; M.V. Tagle; M.P. Icart; C. Brunori; R. Morabito.
Chemosphere, Vol 66 No 8, p 1545-1553, Jan 2007

Four different sample treatment methods for the determination of trace elements were compared: three standardized methods of fractionation--BCR three-step sequential extraction, U.S. EPA method 3050B, and ISO standard 11466--and a total digestion with HNO3-H2O2-HF using microwaves. The four treatment methods were applied to the determination of copper and nickel in four samples collected in different areas of Cienfuegos Bay, Cuba. The total digestion and BCR three-step procedures were performed with inductively coupled plasma mass spectroscopy, while the EPA and ISO procedures were performed with flame atomic absorption spectroscopy. The results were compared with an estimated anthropic fraction evaluated in each sampling point as the difference between the total concentration and an estimated background concentration level. The BCR three-step method provided the best approximation of the estimated anthropic fraction and so was also applied to the determination of Pb and Cd for further evaluation.

Toxicity of Metals and Organic Chemicals Evaluated with Bioluminescence Assays
Ren, S. (Gradient Corporation, Cambridge, MA); P.D. Frymier (Univ. of Tennessee, TN).
Chemosphere, Vol 58 No 5, p 543-550, Feb 2005

The high level of luminescence of a Pseudomonas spp. strain (PM6) shows potential for the development of a bioluminescent sensor organism for assessing wastewater toxicity. Scientists evaluated the toxicity of 7 metals and 25 organic compounds using assays of the novel PM6 and a previously developed organism (Shk1) in a batch toxicity testing protocol. Results showed good correlation between the toxicity data of the PM6 and the Shk1 assays. Neither assay appeared to be more sensitive to a group of toxicants than the other. These assay results were further compared with the results of the Vibrio fischeri luminescence inhibition assay and activated sludge inhibition assays. The resulting data indicate that PM6 and Shk1 more closely represented activated sludge organisms than V. fischeri.

Tracers as Tools for Design and Evaluation of Injection-Based In Situ Groundwater Remediation Systems
Nelson, D.K. (ARCADIS G&M, Minneapolis, MN); Craig E. Divine (ARCADIS G&M, Highlands Ranch, CO).
Environmental and Engineering Geoscience, Vol 11 No 4, Nov 2005

Three case studies are presented in which tracers were used to evaluate various design and operational components at sites treating contaminants in situ by the direct injection of a reagent solution into the subsurface. Tracers were used to determine groundwater velocity, effective radius of injected fluids, and required frequency of injections, as well as to verify hydraulic connectivity between the injection field and downgradient observation wells and to provide information on hydrogeology and solute-transport behavior within the targeted treatment areas. In two instances, tracers were used in conjunction with reagent delivery for determination of decay half-life coefficients. Tracers can be used as practical tools to aid in designing full-scale systems and evaluating operation and long-term performance of in situ treatment strategies.

Trends in Flow-Based Biosensing Systems for Pesticide Assessment
Prieto-Simon, B. and M. Campas (BIOMEM group, Univ. de Perpignan, Perpignan, France); S. Andreescu (Clarkson Univ., Potsdam, NY); J.-L. Marty (Univ. de Perpignan).
Sensors, Vol 6 No 10, p 1161-1186, Oct 2006

The state of the art of pesticide detection using flow-based biosensing systems for sample screening is reviewed, with the main focus on commonly used enzyme-based biosensors. Of the different detection methods available for integration into flow-injection analysis (FIA) systems, the electrochemical ones are examined in greater detail due to their high sensitivity, simple sample pretreatment, easy operational procedures, and real-time detection. New trends have emerged that lower the detection limits and increase the enzyme stability, sensitivity, and selectivity of the measurements. These approaches are based on the design of novel matrices for enzyme immobilization, new manifold configurations of the FIA system, the use of cholinesterase enzymes either from various commercial sources or genetically modified to be more sensitive, the incorporation of other highly specific enzymes (e.g., organophosphate hydrolase or parathion hydrolase), and the combination of different electrochemical methods of detection. This article addresses the novel strategies, their advantages, and their limitations.
http://www.mdpi.org/sensors/list06.htm

Uncertainty Assessment of Contaminant Plume Length Estimates in Heterogeneous Aquifers
Beyer, C., S. Bauer, and O. Kolditz, Univ. of Tubingen, Tubingen, Germany.
Journal of Contaminant Hydrology, Vol 87 Nos 1-2, p 73-95, 10 Sep 2006

The Virtual Aquifer approach was used to assess the uncertainty involved in the estimation of contaminant plume lengths in heterogeneous aquifers. Contaminant plumes in heterogeneous 2-D conductivity fields and subject to first-order and Michaelis-Menten (MM) degradation kinetics were investigated by the center line method. First order degradation rates and plume lengths are estimated from point information obtained along the plume center line. Plume lengths calculated using the MM parameters were closer to the correct length, as compared to the first-order approximation, and the authors recommend this approach if field data collected along the center line of a plume show evidence of MM kinetics.

Use of Electrical Resistivity Probe for Determination of Hyporheic Flow
Faulkner, B.R., V.A. Murray (Shaw Environmental); S.R. Hobson (Oklahoma State Univ).
Proceedings of the 2005 Annual Water Resources Conference, 7-10 November, Seattle, WA. American Water Resources Association, Middleburg, VA, CD-ROM, TPS--5--3. NRMRL-ADA-05223, 2005

When stream restoration actions are planned, the actual water quality improvements are rarely predicted, yet the Clean Water Act is often the impetus for the actions. It is increasingly apparent that cost/benefit ratios are needed to evaluate benefits of management alternatives for restoration. Efforts to develop simplified methods to characterize the extent and residence time distributions of hyporheic zones have been tested at Tishomingo National Wildlife Refuge, OK.

Use of Passive-Diffusion Bag Samplers to Profile Low-Level Trichloroethene Concentrations in Ground-Water Extraction Wells
Geibel, Nicholas M., U.S. Army Corps of Engineers, Omaha District, Omaha, NE.
Environmental and Engineering Geoscience, Vol 12 No 4, p 361-368, Nov 2006

The passive-diffusion bag (PDB) sampler is deployed in a well or borehole where passive diffusion through the semi-permeable membrane of the sampler allows the water quality in the sampler (typically filled with deionized water) to equilibrate with that in the surrounding aqueous environment. The type of membrane determines which solutes are able to pass into the sampler medium. To obtain representative samples with PDB samplers, groundwater must be able to flow through the well screen in sufficient volume to permit solute equilibration in the sampler medium during the sampler deployment period. After initial equilibration is achieved, sampler medium and ambient groundwater should maintain equilibrium, but because this constant re-equilibration process is not instantaneous, the sampler medium represents a time-averaged solute concentration of groundwater during the preceding days (depending on the rate of equilibration). The rate at which the medium within the PDB sampler equilibrates with ambient groundwater depends on multiple factors, including the type of compound being sampled, groundwater temperature, contaminant distribution, and groundwater flow dynamics. Various compounds more easily diffuse into the sampler medium simply because the molecular sizes of the compounds are smaller than the pore size of the PDB sampler membrane. This study was focused on low levels of dissolved-phase trichloroethene.

Using Helicopter Electromagnetic Surveys to Identify Potential Hazards at Coal Waste Impoundments
Hammack, R.W., V. Kaminskiy, K. Warner, and R.L. Kleinmann.
Mine Water 2005 -- Mine Closure. University of Oviedo. p 125-132, 2005

In July 2003, 14 coal waste impoundments in southern West Virginia were surveyed electromagnetically to detect conditions that could lead to impoundment failure, either by structural failure of the embankment or leakage through adjacent or underlying mine works. The surveys attempted to (1) identify saturated zones within the coal waste, (2) delineate the paths of filtrate flow through the embankment and into adjacent strata or receiving streams, and (3) identify flooded mine workings underlying or adjacent to the waste impoundment. In-phase and quadrature data from the helicopter surveys were inverted using EM1DFM software to generate conductivity/depth images. Conductivity/depth images were then spatially linked to georeferenced air photos or topographic maps for interpretation. The data indicate that helicopter electromagnetic surveys can provide a picture of the hydrologic conditions that exist within the impoundment. A similar approach can likely be used to detect potential problems at tailings dams.
http://www.imwa.info/publications/congress_2005.htm

Utilization of Automated Oil Spill Detection Technology for Clean Water Compliance and Spill Discharge Prevention

Chase, Chris R. and Steven Van Bibber, InterOcean Systems, Inc., San Diego, CA.

IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. Univ. of Tulsa, Oklahoma. 13 pp, 2006

This paper presents the development of an oil spill detection and alarm system that provides industry with a reliable, cost-saving mechanism for containing and/or preventing accidental discharges of hydrocarbon-based pollutants. This automated spill detection system allows hydrocarbon releases to be detected in real time. Early warning and automated response capabilities allow containment of pollution before the environment, wildlife, public waterways, or commercial assets are damaged. This paper details (1) development of a reliable, economical, optical, non-contact, hydrocarbon pollution detection sensor, the "Slick Sleuth," (2) performance results drawn from performance tests and real-world deployments, and (3) a variety of existing applications and deployment opportunities for which this new technology has been found to provide a reliable, easy-to-use tool for regulatory compliance and realization of cost benefits associated with minimizing spill risk(s). Key system attributes include near-zero maintenance, micron-level sensitivity for a comprehensive range of oils (from crude oil to jet A), and sensor/system flexibility and adaptability for a wide range of installation settings and application requirements.

http://ipec.utulsa.edu/Conf2006/Papers/Chase-_24.pdf

Vapor Intrusion: Emerging Guidance, Investigative Methods, and Sampling Issues

Lund, L.

IPEC 2006: 13th Annual International Petroleum Environmental Conference, 17-20 October 2006, San Antonio, TX. [abstract only]

The recommended phases in subsurface vapor intrusion (SVI) investigations include developing a conceptual site model, conducting investigations outside the buildings, and if needed, performing interior building investigations (e.g., sub-slab soil-gas and/or indoor air sampling). Statistically based, external, stratified-grid soil-gas sampling was conducted on 25- to 100-ft grid spacing, which resulted in up to a 100% probability that at least one sample would be collected beneath a future building. Exterior near-slab petroleum hydrocarbon soil gas results were shown to correlate statistically with interior sub-slab results. Exterior soil gas samples analyzed in a mobile lab were comparable (>90% correlation) with samples analyzed by a fixed lab. Case study results and lessons learned are presented to emphasize the importance of considering vapor leak testing, indoor and outdoor air sources, temporal and spatial variability, and future land use during SVI investigations. Recent data and efforts to account for bioattenuation of petroleum hydrocarbons during vapor intrusion investigations are also summarized.

The Vapor Intrusion Pathway and Biodegradation of Gasoline and Benzene Vapors in the Vadose Zone: A Utah Experience
Menatti, John A. (Utah Department of Environmental Quality); Thomas R. Peargin (ChevronTexaco Energy Technology); Todd Creamer (Trihydro Corp.).
NGWA 2006 Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment, and Remediation Conference, 6-7 November 2006

In 2003, U.S. EPA formed the Vapor Intrusion/Petroleum Issues Work Group to gather, compile, and analyze data from the literature to evaluate biodegradation of petroleum vapors in the vadose zone. The evaluation indicated that biodegradation is a vapor attenuation mechanism and that the calculated vapor intrusion-to-indoor air pathway may be incomplete at many sites. Johnson & Ettinger modeling was conducted at six Utah DEQ leaking underground storage tank sites and indicated the potential for unacceptable risks from benzene vapor intrusion. Sub-slab soil gas sampling and nested vapor well sampling were performed, showing that one site had free-product gasoline under the site at 17 feet below grade. The free-product site with the nested vapor wells was sampled in 2003 and 2006 during barometric pressure lows. All of the sampling indicates that biodegradation of petroleum vapors in clean vadose zone soils is a major attenuation process that must be incorporated into vapor intrusion evaluations.

Volatile Organic Compound Optical Fiber Sensors: A Review
Elosua, C., I.R. Matias, C. Bariain, and F.J. Arregui, Univ. Publica de Navarra, Pamplona, Spain.
Sensors, Vol 6 No 11, p 1440-1465, Nov 2006

This paper provides a classification of optical fiber volatile organic compound (VOC) sensors made according to the sensing mechanism and taking into account the sensing materials or the different methods of fabrication. Solutions already implemented for VOC detection using optical fiber sensors are described in detail.
http://www.mdpi.org/sensors/list06.htm

XRF Marks the Spot: the Benefits of X-Ray Fluorescence Are Helping Change the Way People Look at Brownfield Remediation
Martin, James, Innov-X Systems, Inc., Woburn, MA.
Environmental Protection, Vol 17 No 2, Mar 2006

This case study describes the use of portable X-ray fluorescence (XRF) instrumentation in site characterization and corrective remediation for heavy metals and other contaminants, a process that allowed engineers to accelerate remediation efforts as the client prepared for the redevelopment of a commercial 26-acre site in Massachusetts. After an initial in situ XRF survey, the results can be used to identify areas that warrant a more thorough investigation, typically areas of low contaminant concentrations. In these cases, operators often collect samples and prepare them to confirm the in situ findings with laboratory-accurate results. Portable XRF almost always yields better accuracy when samples are prepared as they would be for XRF lab analysis. Collected, prepared samples are ideal for laboratory analysis because they provide a direct comparison with portable XRF results. XRF testing is nondestructive, allowing the same prepared sample (or split) analyzed via portable XRF to be analyzed by a laboratory system as well.
http://www.environmental-expert.com/resulteacharticle4.asp?cid=6082&codi=6701&idproducttype=6&idmainpage=68&level=3

SMALL BUSINESS INNOVATIVE RESEARCH (SBIR) AWARDS AND OTHER GRANTS

DEPARTMENT OF DEFENSE

Active Optical Remote Sensing System for Ground Contamination Detection (Air Force 2003 SBIR Phase 1)
Contract/Grant F29601-03-M-0091
David Ludwig (PI), 714-444-8730, dludwig@irvine-sensors.com
Irvine Sensors Corp., Costa Mesa, CA
$99,999
This effort is to develop/demonstrate an active optical contamination technique for airborne platform. ISC concept is an active system that transmits spectral energy to the target area, and uses the spectral return to identify ground contaminants. The detection mechanism to be considered is DISC. ISC has conducted an analysis using DC 200 with a one-micron film thickness. Active LWIR showed superior performance when analyzing both active and passive concepts. ISC will utilize a SOA OSC, which accounts for background sources, atmospheric transmission, and uses measured material HDR, MR and BRDF to determine the differential radiance when SF96 is placed on surfaces. ISC, with Mundkowsky Consulting, can fulfill the objectives of the SBIR. A system approach is mandatory to ensure that the components to be developed meet the requirements and can be field-tested with GFE in Phase II. For Phase I, ISC will conduct the tasks in Section 2.0. Completion of these tasks will satisfy objectives of Phase I. The program will provide background to develop the airborne contamination detection system heretofore unavailable, benefiting the Air Force and industry. The active sensor system developed under this topic could be applied to a range of planned commercial active remote sensing systems for both commercial, homeland defense, and military applications. Potential commercial applications include remote sensing for various surface contamination, agricultural chemical coverage and mineral exploration purposes.

Active Optical Remote Sensing System for Ground Contamination Detection (DoD DARPA 2005 SBIR Phase 2)
Contract/Grant W31P4Q-05-C-R126
Suresh Subramanian (PI), 714-444-8846, ssubramanian@irvine-sensors.com
Irvine Sensors Corp., Costa Mesa, CA
$749,557.00
The DARPA Phase II proposal addresses the development of an active optical sensing system, materials database to support the development of an instrument for non-contact detection of surface contamination. The ISC team is developing a technique that has the potential for real-time detection and identification. The Phase I effort was to develop and demonstrate a technique that can be applied to an airborne sensor. Successful results from this and related programs provided the firm foundation for the Phase II proposal. The team's envisioned concept is an active optical system that transmits optical radiation to the target area and uses the return energy to detect and identify ground contaminants. The primary detection mechanism is based upon

spectral monostatic bi-directional reflection measurements of clean and contaminated materials. The near-term man-pack instrument will be designed for standoff detection of several meters. ISC, with Y-12, SSI, RAI, and TRA as subcontractors, is positioned to fulfill the objectives of the DARPA effort. To satisfy the objective of Phase II, the team will conduct SOW tasks of Section 2.0, which presents the final products to be provided in Task 5.0 - Laboratory Reflectometer materials measurements, Task 9.0-Fabricate and Deliver Man-Pack Prototype Instrument, and Task 10.0 - Reporting. Completion of the SOW will satisfy the objective of Phase II, "Develop and demonstrate an active optical surface chemical contamination detection technique that can be applied to a man-pack or an airborne capability."

Airborne Fluorescence Lifetime Imaging System for Remote Sensing of Chemical (Army 2005 SBIR Phase 1)
Contract/Grant W9132V-05-C-0012
Edgar A Mendoza (PI), 310-292-7673, emendoza@redondooptics.com
Redondo Optics, Inc., Redondo Beach, CA
$119,214.00
Redondo Optics Inc. (ROI) proposes to develop and demonstrate an airborne fluorescence lifetime imaging (SeePhaseT) system for the remote, real time identification and measurement of chemical and biological fluorescent markers in the battle field that are indicative of potential threats to the war fighter. The fluorescence lifetime of the target fluorophores is measured using the principle of "frequency-domain" or "phase-locked" detection, a method that is totally insensitive to the excitation or fluorescence emission light intensity levels as well as insensitive to any background stray light. The detected lifetime signals are processed using fast software algorithms and displayed in real time in a spatially resolved 3-dimensional fluorescent lifetime image of the battlefield.

Airborne Fluorescence Lifetime Imaging System for Remote Sensing of Chemical (Army 2005 SBIR Phase 2)
Contract/Grant W9132V-06-C-0008
Edgar A. Mendoza (PI), 310-292-7673, emendoza@redondooptics.com
Redondo Optics, Inc., Redondo Beach, CA
$729,570.00
Redondo Optics Inc. (ROI) proposes to develop and demonstrate an airborne fluorescence lifetime imaging (SeePhaseT) system for the remote, real time identification and measurement of chemical and biological fluorescent markers in the battle field that are indicative of potential threats to the war fighter. The fluorescence lifetime of the target fluorophores is measured using the principle of "frequency-domain" or "phase-locked" detection, a method that is totally insensitive to the excitation or fluorescence emission light intensity levels as well as insensitive to any background stray light. The detected lifetime signals are processed using fast software algorithms and displayed in real time in a spatially resolved 3-dimensional fluorescent lifetime image of the battlefield. The SeePhaseT system will readily find applications in the military for the protection of war-fighters as well as in civilian and government institution for first-time responders and civilian protection.

Bioluminescent Detection of Chemical Agent Contamination (Army 2005 SBIR Phase 1)
Contract/Grant W31P4Q-06-C-0067
David Schofield (PI), dschofield@guildassociates.com
Guild Assoc., Inc., Dublin, OH
$98,998.00
Chemical weapons such as organophosphate (OP) nerve agents pose a deadly risk to both military and civilian personnel. In addition, OP pesticide contamination of soils and water supplies is thought to result in 1 to 3 million cases of pesticide poisonings annually worldwide. This proposal will generate a genetically engineered yeast biosensor that can detect and hydrolyze chemical warfare agents such as VX. The yeast biosensor will also be able to detect the subsequent biodegraded products. The yeast Saccharomyces cerevisiae, a robust non-pathogenic microorganism that is resistant to environmental extremes, will be used as a self-contained biosensor. No exogenous substrates or consumables will be required and a simple hand-held illumination device will allow distinct visual detection of the chemical agent contamination and biodegraded products using a dual fluorescent reporter system.

Bioluminescent Detection of Chemical Agent Contamination: A Highly Specific and Sensitive Cell-Based Fluorescent Biosensor for Detection of Nerve Gas Agents (DoD DARPA 2005 SBIR Phase 1)
Contract/Grant W31P4Q-06-C-0036
Sanjay Jayachandran (PI), 626-535-9496, jayachans@hotmail.com
Transmembrane Biosciences, Pasadena, CA
$99,000.00
The objective of the proposal is to create prototype(s) for a microorganism-based fluorescent biosensor for the detection of nerve gas agents. The biosensor is derived from the enzyme organophosphorous hydrolase and the bacterial periplasmic binding proteins. The main sensor units are double fusion constructs with N-terminus and C-terminus linked fluorescent proteins, hence relying on FRET as detection principle. The main goal for this research is creating an efficient reagentless fluorescent biosensor that is economical, yet highly sensitive, highly specific for the detection of nerve gas agents, but convenient and simple to use. Specifically, the goal is to develop a bacterial biosensor that glows red observably by the eye in the presence of nerve gas agents.

Chemical/Biological Agent Non-Intrusive Detection (DoD DTRA 2005 SBIR Phase 1)
Contract/Grant HDTRA1-05-P-0119
Robert K. Brandt (PI), 262-695-6900, KBrandt@BrandtInnovativeTech.com
Brandt Innovative Technologies, Inc., Pewaukee, WI
$99,551.00
Brandt proposes to demonstrate the ability to non-invasively probe the characteristics of material properties using acoustical waves through thermal conversion of a remote laser pulse. The advantages of the proposed system as an inspection and identification technique are: 1) Non-contact: Sensor does not require contact with container; 2) Stand-off: Sensor could be located many meters away from container; 3) Non-intrusive: Sensor measures properties inside a container; 4) Real-time: Sensor and processing system gives results in seconds or less; 5) Robust

Penetration: Sensor able to sense through a variety of container materials including glasses, polymers, ferrous and non-ferrous metals; 6) Robust Identification: Sensor able to identify a wide variety of materials that include solids, liquids, and gases.

CW Indicating Chromophore for Decontamination Operations (DoD CBD 2005 SBIR Phase 2)
Contract/Grant W911NF-05-C-0046
Martin Leuschen (PI) 405-372-9535, mleuschen@nomadics.com
Nomadics, Inc., Stillwater, OK, www.nomadics.com
$729,979.00
In Phase I, Nomadics demonstrated that a novel chemical weapon indicating chromophore (CWIC) developed by Professor Tim Swager at MIT will allow equipment to be quickly and easily examined to show any areas of contamination, making targeted decontamination manageable. When exposed to CW agent simulants, CWICs react to become fluorescent under UV stimulation. In the first phase, a system was implemented employing CWICs to indicate whether an area is contaminated by chemical agents. Tests conducted on military-type assets proved the feasibility of this approach. In Phase II, the research will be extended to enhance sensitivity and to optimize the process to support military operations and to reduce risks to the environment, the public, and allied warfighters. An especially important feature of these chromophores is that they have been shown to be responsive only to chemicals that are in fact hazardous even if they are not typically considered CW agents. Similarly, because the CWICs respond only to reactive materials, they are not subject to interference even from compounds that normally serve as surrogates for CW agents. The proposed work should lead to development of an effective system for assessing CW agent contamination.

Demonstration of a Unique Nanotube-Based Arsenic Detector (Air Force 2005 SBIR Phase 2)
Contract/Grant FA9302-05-C-0004
Russell Davis (PI) 321-631-3550, rwd@mainstream-engr.com
Mainstream Engineering Corp., Rockledge, FL, www.mainstream-engr.com
$744,506.00
Arsenic contamination in water supplies poses a severe health risk to world-wide populations. The US EPA has recently lowered As water standards from 50 ppb to 10 ppb to address this risk. Many states, including California, either have passed or are soon to pass even stricter regulations. Currently available As detection methods suffer from numerous drawbacks including non-real-time, costly, bulky, complicated, and inaccurate. The sensor demonstrated in Phase I overcomes all these obstacles. Carbon nanotubes have found exciting new applications in technologies ranging from batteries to heat transfer, and sensor technologies are now proving to hold equal potential. In Phase I, the feasibility of using ionization-based carbon nanotube sensors for As detection was successfully demonstrated by fabricating carbon sensors and measuring breakdown voltages and the variation of discharge current as a function of concentration. The objective of the Phase II effort is to optimize the carbon nanotube manufacturing process to achieve maximum performance and lower operating voltages, design the extraneous sub-systems, and test the complete sensor. Optional tasks handle prototype system installation and field testing and an investigation of manufacturing quality control. By the end of Phase II, a full prototype sensor will have been developed, fabricated, and tested.

Detection of Contaminants in Petroleum (Army 2005 SBIR Phase 1)
Contract/Grant W56HZV-06-C-0089
David Chenault (PI), 256-562-0087, david@polarissensor.com
Polaris Sensor Technologies, Inc., Huntsville, AL
$68,741.00
Detection of contaminants in petroleum is highly desirable to prevent the devastating effects of sabotage and to prolong the life and enhance the efficiency of engines. Analysis of the chemical composition of a fluid can provide an abundance of information on quality by allowing for the detection of both contaminants and naturally occurring components. Establishing a library of contaminants and normal constituents will allow the user to rapidly establish the properties and quality of the sample. As part of this SBIR, Polaris will develop a portable instrument package that rapidly and accurately detects contaminants in petroleum products, including chemical and biological agents of both naturally occurring and illicit origin. The Phase I will be a study phase to determine the optimum detection capabilities with the minimal complexities and cost. The robust instrumental package that will identify and quantify the dangers of contaminated fuels in the field will be developed in Phase II. The primary development path will consist of a robust yet low cost, broadband spectroscopic device based on a fiber optic spectrometer with no moving parts.

Detection of Contaminants in Petroleum Sources Using Laser-Induced Breakdown Spectroscopy (Army 2005 SBIR Phase 1)
Contract/Grant W56HZV-06-C-0090
Jong Yoo (PI), 408-888-0381, jyoo@appliedspectra.com
Applied Spectra, Walnut Creek, CA
$69,962.00
This SBIR Phase I proposal describes the feasibility of using Laser Induced Breakdown Spectroscopy (LIBS) for detecting contaminants in petroleum sources. Applied Spectra believes that LIBS using a broadband spectrometer/ICCD system can be a compelling platform for developing a highly portable, rugged, and robust detection system. This Phase I project will emphasize the identification of relevant broadband LIBS signatures for different petroleum products of interest to the Army and the ability of LIBS to analyze foreign and naturally occurring contaminants in the fuel. LIBS has been a strong candidate for numerous applications in security, force protection, and detection of hazardous materials, as emphasized by the Army Research Laboratory.

Detection of Molecular and Biomolecular Species by Surface-Enhanced Raman Scattering (Air Force 2003 STTR Phase 1)
Contract/Grant F49620-03-C-0068
Naomi Halas (PI), 713-348-5611, halas@rice.edu
Nanospectra Biosciences, Inc., Houston, TX, partnered with Rice University, Houston, TX
$100,000.00
This Phase I STTR will develop a SERS detection system using nanoshells, a new class of nanoparticles with significant near field enhancement resulting from the ability to design and

manufacture the particle with desired peak plasmon resonance. Preliminary data indicate that nanoshells may reproducibly provide film-based SERS enhancements of up to 10(14). This proposed research will involve (i) the use of modeling techniques for the optimization of nanoshell-based substrates specific to the backscattering collection geometry of the system at 750 nm wavelengths, (ii) the investigation of deposition methods for the manufacturing of nanoshell-based films, and (iii) experimental testing of the resulting nanoshell-based film substrates for Raman sensing. Successful completion of this research will result in the development of a generalizable platform for SERS sensing optimized to near infrared wavelengths in order to reduce background fluorescent "noise" from contaminants in analytes of interest. This reserch will result in a broad-based platform for the extension of SERS research by providing a reliable and consistent level of SERS enhancement for multiple modalities. This platform will be offered for sale to collaborators as a platform to extend their own research as well as offer commercialization opportunities for the detection of small molecules and biomolecules will a high degree of sensitivity and specificity.

Detection of Molecular and Biomolecular Species by Surface-Enhanced Raman Scattering (Air Force 2005 STTR Phase 2)
Contract/Grant FA9550-05-C-0019
Naomi Halas (PI), 713-348-5611, halas@rice.edu
Nanospectra Biosciences, Inc., Houston, TX, partnered with Rice University, Houston, TX
$750,000.00
The goal of this STTR Phase II Proposal is to complete development of the nanoshell-based surface enhanced Raman scattering substrate (NERS) developed in successful Phase I work. This Phase II work will focus on commercialization of the substrate developed in Phase I by (i) refining manufacturing methods, including substrate composition, nanoshell deposition, and detection geometry to increase NERS sensitivity and (ii) developing model assay systems for conjugation of biomolecules onto the substrate for detection of relevant chemical entities. Phase I work demonstrated the following key elements of feasibility: (i) a nanoshell-based substrate can be reproducibly manufactured; (ii) this nanoshell-based substrate is stable under conditions expected in routine use; and (iii) this substrate reproducibly provides significant (>10(10)) SERS enhancements from individual nanoshells, allowing a new level of sensitivity in Raman testing. Phase II work will optimize the sensitivity of the substrate by optimizing anchoring and deposition methods and detection modalities. Additionally, Raman-based assays using periplasmic binding proteins will be developed as capture molecules.

Development of a Person Portable GPS Mounted Internet Ready Explosive Sensor (Army 2005 SBIR Phase 1)
Contract/Grant W15QKN-05-C-1203
Santosh K. Srivastava (PI), 818-957-2421, Srivastava1@aol.com
Science & Technology Corp., Hampton, VA
$69,997.00
An ultra-sensitive, remotely operated, person-portable, GPS-mounted, and Internet-ready explosive detector of novel design is proposed. It will consist of an ion source based on an electro-spray ionization source. This source will be modified to soft-ionize explosive molecules

present in the form of vapors in the ambient air with a very high efficiency. The ions of explosives will then be introduced into a miniature vacuum system through a recently developed device, the "Supersonic Pulsed Jet Separator" (SPJS), in the form of short bursts, thereby reducing the pumping requirements that make mass spectrometer-based instruments bulky, heavy, and power consuming. The ions will be mass analyzed by a recently developed miniature time-of-flight mass spectrometer and detected by a charged particle detector. During the first phase of the proposed work, the following will be accomplished: 1) design, build, and test the electro-spray ionization source, 2) fabricate the SPJS, 3) test the combination for its ability to convert explosive molecules into ions and measure the efficiency of this conversion, and 4) prepare a conceptual design of a person-portable detector that will be fabricated during phase 2 of the proposed work.

Direct Toxin-Specific Biowarfare Detector (Army 2005 STTR Phase 2)
Contract/Grant W911NF-05-C-0119
Anastasia Bogomolova (PI) 727-723-3006, anastasia.bogomolova@verizon.net
Fractal Systems, Inc., Safety Harbor, FL (www.fractalsystemsinc.com) with the University of South Florida, Tampa
$749,995.00
After the successful demonstration of the Phase I approach, Fractal Systems proposes to develop in Phase II a multispecific biowarfare electrochemical sensor for simultaneous detection of 5 toxins and 2 biothreat bacteria (anthrax spores, tularemia bacteria, botulinum toxin A, cholera toxin, staphylococcal enterotoxin B, Shiga toxin and ricin toxin). The sensor will utilize electrochemical aptamer-mediated protein detection on modified ultrathin conducting polymer films. The approach has been tested in Phase I for ricin toxin detection and proved to be advantageous in time and sensitivity compared to peptide-mediated detection, showing detection times under 1 minute and atomole sensitivity. The development of functionalized electrodes, testing, and performance optimization using simulants will be performed at Fractal Systems. Testing of individual electrodes and the multispecific sensor with biowarfare pathogens in complex mixes and spiked environmental samples will be performed at the Biodefense Center (University of South Florida). It is anticipated that by the end of Phase II, a commercially viable multispecific biowarfare protein electrochemical sensor will be developed. The developed sensor will require minimal sample preparation, utilize basic electrochemical equipment, and be portable, robust and user friendly. The commercialization effort will be accomplished through strategic alliances with larger well-established companies in the field.

Dissolved Hydrogen Sensor (Navy 2003 SBIR Phase 1)
Contract/Grant N00014-03-M-0399
Guy Farruggia, farruggia@arete-dc.com
Arete Assoc., Sherman Oaks, CA
$70,000.00
Arete Associates proposes to develop a novel sensor using low-temperature co-fired ceramic (LTCC), thick-film technology, to measure changes of dissolved hydrogen concentration in the ocean environment. A unique layout will be employed of the classic Wheatstone bridge design that uses screened-palladium metal resistors as the transducer. Palladium absorbs hydrogen gas

and changes its electrical resistance in response to the absorption. The sensor has active and inactive bridge branches. Specially selected coatings will make the sensor impervious to resistor metallization surface changes due to wet/dry seawater cycling, and to chemical contamination. For Phase I, Arete will address and resolve critical issues such as diffusion rate, sensitivity, and the effectiveness of a noise cancellation approach. These issues will be verified with modeling and breadboard development. Phase II will see design, development, and testing of a small number of prototype sensors. They will also be tested against an already developed ASW array. There is a need, as is indicated by many papers in the literature, for sensors to measure hydrogen gas that results from reactions or leaks. The need is for reliable, inexpensive, simple, low-power sensors instead of large costly instrumentation such as gas chromatographs or mass spectrometers.

Dissolved Hydrogen Sensor (Navy 2005 SBIR Phase 2)
Contract/Grant N00014-05-C-0010
Guy Farruggia, farruggia@arete-dc.com
Arete Assoc., Sherman Oaks, CA
$606,442.00
Arete Associates proposes to develop a novel sensor using thick-film technology to measure variations in the concentration of dissolved hydrogen in the ocean environment. A unique layout will be employed of the classic Wheatstone bridge design that uses screened-palladium metal resistors as the transducer. Palladium absorbs hydrogen gas and changes its electrical resistance in response to the absorption. The sensor has active and inactive bridge branches. Specially selected coatings will make the sensor impervious to electrode surface changes due to wet/dry seawater cycling, and to chemical contamination. In Phase I, Arete worked with selected vendors to develop a prototype half-bridge sensor using specifically designed palladium inks. This sensor and its associated electronics will be used as a test bed heading into Phase II. Arete has addressed the critical issues of active and passive branch coatings and for Phase II will design, develop, and test a small number of prototype sensors alongside an array of complementary sensors that has already been deployed at sea.

Extending the Life of Biosensors with Dendrimers (Navy 2003 SBIR Phase 1)
Contract/Grant M67854-03-C-6038
Mary Beth Tabacco (PI), 617-443-0066, mtabacco@erols.com
Echo Technologies, Inc., Alexandria, VA
$69,989.00
Echo Technologies, Inc. (ETI) is developing optical biosensors for detection and discrimination of biological warfare agents (BWAs). The sensors incorporate molecular recognition and fluorescent reporter molecules that are chosen to uniquely detect classes of biological material such as bacteria, spores, toxins and viruses. In Phase I, ETI plans to demonstrate the feasibility of using large, globular polymer molecules, known as dendrimers, to enhance sensor performance.

Extending the Life of Biosensors with Dendrimers (Navy 2005 SBIR Phase 2)
Contract/Grant M67854-05-C-6501
Mary Beth Tabacco (PI), 617-443-0066, mtabacco@erols.com
Echo Technologies, Inc., Alexandria, VA
$585,642.00
Echo Technologies, Inc. (ETI) is developing optical biosensors for detection and discrimination of biological warfare agents (BWAs). The sensors incorporate molecular recognition and fluorescent reporter molecules that are chosen to uniquely detect classes of biological material such as bacteria, spores, toxins and viruses. ETI has recently completed a Phase I program that demonstrated the feasibility of using large, globular polymer molecules, known as dendrimers, to enhance sensor performance. The Phase I results were promising with the following accomplishments: > 4-fold increase in sensor operational lifetime under various conditions > 2-fold increase in sensor storage stability extension of the technology to sensors for monitoring waterborne agents. In Phase II the dendrimer-enhanced biosensors will be more fully characterized and the approach extended to biosensors for other BWAs. The fundamental mechanism responsible for this enhanced performance will be studied to allow rational selection or design of optimum dendrimer molecules for use with the sensors. Sensor improvements will be quantified, and an integrated system demonstrated for the Sponsor.

Heterodyne Detection for Compact Standoff Chem-Bio Sensors (Army 2005 SBIR Phase 1)
Contract/Grant W911SR-05-P-0061
David B. Cohn (PI), 310-378-4961, dbctechnology@earthlink.net
Dbc Technology Corp., Torrance, CA
$99,909.00
CO2 laser-based sensors are poised to enter the next phase of development defined by smaller, lighter systems based on heterodyne detection. This will have significant impact on the Artemis acquisition program, other military deployments, and homeland defense systems. The program Phase I objectives are to perform supporting analysis and develop designs for the critical heterodyne system components, including a rapid grating wavelength tuner and 8 um wavelength shifter.

High Performance Compact Lightweight LWIR Hyperspectral Imager (Army 2005 SBIR Phase 1)
Contract/Grant W15P7T-05-C-F001
Thomas A Mitchell (PI), tmitchell@wavefrontresearch.com
Wavefront Research, Inc., Bethlehem, PA
$119,846.00
The goal of this Phase I effort is to investigate, develop, and characterize a new class of high performance, compact, lightweight, LWIR hyperspectral imaging sensors enabled by an innovative design form and dispersing element technology that are suitable for use on uninhabited aerial vehicles (UAVs). The optical properties of these systems, including light gathering capability, spatial resolution, optical distortion, and other system parameters will be modeled and characterized, and estimates of performance metrics such as NEDT and NESR will be predicted.

High Performance Compact Lightweight LWIR Hyperspectral Imager (Army 2005 SBIR Phase 2)
Contract/Grant W15P7T-06-C-F001
Thomas A Mitchell (PI), 610-974-8977, tmitchell@wavefrontresearch.com
Wavefront Research, Inc., Bethlehem, PA
$729,997.00
The primary goal of this Phase II effort is to design, fabricate, and evaluate a compact, lightweight, demonstration LWIR hyperspectral imaging sensors enabled by an innovative design form and dispersing element technology that is suitable for use on uninhabited aerial vehicles (UAVs). An alignment and test procedure will be developed for the assembly and integration of the spectrometer and imaging fore-optics sub-system components of the demonstration sensor and an operational testbed assembly complete with GUI software applications will be designed and fabricated to facilitate the collection of spectral image data. The optical properties of the demonstration system, including radiometric performance, spatial and spectral MTF, smile and keystone distortion, and other system parameters will be measured and evaluated.

High Sensitivity Standoff LIBS Technology (Army 2005 SBIR Phase 1)
Award ID: 73550, Contract W911NF-05-C-0034
Francis Reininger (PI) 626-578-0626, fmr@spilab.com
Spectral Imaging Laboratory, Pasadena, CA
$118,865.00
The U.S. Army has the need for a compact, laser-induced breakdown spectrometer (LIBS) capable of standoff detection from a range of 100 meters. In a LIBS system, the laser fires at a target to create a micro-plasma emission of radiation that can be analyzed by its spectrometer. The LIBS technique has been used extensively to quantify contaminants in metal alloys, paints, and soils. The Army Research Laboratory (ARL) has been testing LIBS for the detection of chemical warfare agents, bacterial spores, molds, pollens, and proteins. Commercially available LIBS systems use multiple grating spectrometers to reveal the elemental composition of the target from its 0.2 - 1 micron wavelength emission signature. The Spectral Imaging Laboratory (SPILAB) proposes the development of a lower cost system based on a single, high throughput optical module that can also be used for long range, open-path LIBS detection. During Phase 1 SPILAB will design the new optical module, build a novel open-path beam delivery/collection system, and test it with various lasers.

Imaging Sensor Constellation for Tomographic Chemical Plume Mapping (Army 2005 SBIR Phase 1)
Contract/Grant W911S6-05-C-0002
Bogdan R. Cosofret (PI), 978-689-0003, cosofret@psicorp.com
Physical Sciences, Inc., Andover, MA
$119,669.00
In this proposal, Physical Sciences Inc. (PSI) outlines the development of an imaging system which passively tracks and quantifies chemical clouds via computed tomography. The system proposed by PSI will be capable of imaging in the 8-11 micron region with a spectral resolution

of 8-10/cm, and an NESR of 1-2 uW/cm2/sr/um. The system will be capable of detecting the chemical cloud from a standoff distance of 1.5 km, and to beyond 300 m downwind of the plume release point with a spatial resolution of 6 meters per pixel. The estimated lower limit for column density detection is dependent on the temperature differential between the chemical cloud and background of the scene, as well as the absorption coefficient of the chemical species being detected. For a chemical species such as TEP, the proposed sensor will be able to detect as low as 230 mg/m2 column density in conditions where the temperature differential between chemical cloud and background is as low as 3 K. Column density measurements from two or more sensors will be fed into the PSI tomographic algorithm for generation of the three dimensional density distribution of the chemical cloud across the field of view.

Infrared Derivative Spectroscopy for Open Path Sensing (Army 2005 STTR Phase 1)
Contract/Grant W911SR-05-P-0063
Pajo Vujkovic-Cvijin (PI), 781-273-4770, pajo@spectral.com
Spectral Sciences, Inc., Burlington, MA, in partnership with Boston University
$99,993.00
There is a long-standing military, homeland security and industry need for compact, portable sensors to remotely detect, identify and quantify chemical and biological warfare agents and other hazardous species at significant standoff ranges. Current LWIR Fourier transform spectrometers are mechanically complex and sensitive, and susceptible to interference from atmospheric background fluctuations. Spectral Sciences Inc. and Boston University propose the development of a long-path sensor based on a novel derivative multiplexed spectrometer technology that provides high sensitivity, high-speed processing, on-the-fly spectral adaptability, and mechanical stability, all in a rugged package with no macro-scale moving parts. The instrument would operate in two modes, a survey mode for species detection and a pre-processing mode for sensitive measurement. The use of an arbitrarily programmable spectrally selective element makes it suitable for all types of derivative spectroscopy, including novel optically multiplexed approaches, which have the potential for unprecedented sensitivity and background rejection. In Phase I, Spectral Sciences will develop an engineering design for a prototype Phase II system, project its performance, and compare it with conventional devices. In Phase II, a prototype instrument suitable for low-volume production will be constructed.

Low-Cost Portable Lidar Wind Profiler (Army 2005 SBIR Phase 1)
Contract/Grant W911NF-05-C-0029
Scott Shald (PI), 303-604-2000, scott.shald@ctilidar.com
Coherent Technologies, Inc., Louisville, CO
$117,628.00
The Army requires accurate sensing of low-level winds in order to accurately predict the dispersion of chemical or biological agents. Currently, towers equipped with multiple in situ sensors are used for this measurement, but such towers are expensive and difficult to move, and it may not be possible to erect them in urban areas. Coherent Technologies, Inc. (CTI) proposes to solve this problem with a ground based, remote sensing, eye-safe wind lidar, providing 3D range-resolved wind measurements with accuracy and update time matching in-situ sensors. The sensor provides 10 m range resolution at 10 Hz from 10 m up to at least 100 m range, with component wind accuracy on the 10 cm/s level. The proposed sensor draws from CTI's extensive

experience in remote wind sensing, providing a compact, mobile, inexpensive, low-risk solution. The Phase I effort will analyze potential sensor configurations and identify the optimal approach, based upon cost, complexity, and performance. The culmination of the Phase I effort will be a preliminary sensor design. The Phase II effort will develop, test, and demonstrate the prototype sensor based upon the Phase I design.

Micro Gas Analysis System for Detecting CW Agents (DoD DARPA 2005 SBIR Phase 2)
Contract/Grant W31P4Q-05-C-R187
Greg Frye-Mason (PI), 405-372-9535, gfryemason@nomadics.com
Nomadics, Inc., Stillwater, OK
$750,000.00
Attacks using chemical warfare (CW) agents are a principal threat to the US homeland and deployed assets. This proposal focuses on demonstrating key capabilities required to develop a micro-gas analysis (MGA) system that provides orders of magnitude improvement in sensitivity and a very high degree of chemical selectivity to achieve false alarm rates that match laboratory gas chromatographs with mass spectrometer detectors. The proposed innovative ideas have the potential to provide revolutionary advances in analysis speed, sensitivity, and chemical discrimination and will enable MGAs with unprecedented analytical performance and system characteristics. The project team is well equipped to demonstrate prototype components for sample collection, novel two-dimensional chromatography, carrier gas generation, and ultrasensitive and miniature detectors leading to a novel MGA system design. [Note: Phase 1 work was conducted under DOE 2002 SBIR award # DE-FG03-02ER83532.]

Novel Material for Capture and Spectral Detection of Hazardous Vapors (Army 2004 STTR Phase 1)
Contract/Grant W911SR-04-P-0084
Bikas Vaidya (PI), 979-693-0017, bikas.vaidya@lynntech.com
Lynntech, Inc., College Station, TX, partnered with Northwestern University, Evanston, IL
$100,000.00
Rapid detection and unambiguous identification of chemical warfare agents is vital for efficient use of military and civil defense resources. While a variety of detection technologies are currently available, field-deployable systems such as the M21 passive IR standoff detector and the CAM/ICAM ion mobility detector are prone to false alarms due to the presence of interfering species. Combining pre-concentration of an analyte with optical spectroscopic techniques that provide spectral fingerprints of the adsorbed compounds presents an attractive and extremely versatile method to unequivocally identify a wide range of airborne hazardous materials. During Phase I, Lynntech proposes to develop a novel high surface area nano-composite material that is transparent in the infrared, exhibits excellent adsorption capacity, and provides surface-enhanced spectroscopic signals. Using these materials, CWA surrogates from air can be detected at very low concentrations.

Novel Material for Capture and Spectral Detection of Hazardous Vapors (Army 2005 STTR Phase 2)
Contract/Grant W911SR-05-C-0046
Bikas Vaidya (PI), 979-693-0017, bikas.vaidya@lynntech.com
Lynntech, Inc., College Station, TX, partnered with Northwestern University, Evanston, IL
$750,000.00

Rapid detection and unambiguous identification of chemical warfare agents is vital for efficient use of military and civil defense resources. While a variety of detection technologies are currently available, field-deployable systems such as the M21 passive IR standoff detector and the CAM/ICAM ion mobility detector are prone to false alarms due to the presence of interfering species. Combining pre-concentration of an analyte with optical spectroscopic techniques that provide spectral fingerprints of the adsorbed compounds presents an attractive and extremely versatile method to unequivocally identify a wide range of airborne hazardous materials. During Phase I, Lynntech has developed a novel high surface area nano-composite material that is transparent in the infrared, exhibits excellent adsorption capacity, and provides surface-enhanced spectroscopic signals. Using these materials, CWA surrogates from air can be detected at very low concentrations. The overall objective of Phase II is to incorporate these materials into an air sampler/filter cartridge and develop a fully integrated air sampler/spectroscopic detector device prototype deliverable to the US Army. The device will be a lightweight, portable system that can be easily mounted on vehicles or military installations to expand the military's existing CWA detection capabilities.

Novel n-Pulse Approach for LIBS Enhancement (Army 2005 SBIR Phase 1)
Contract/Grant W911QX-05-C-0044
Jong Yoo (PI), 408-945-7753, jyoo_us@yahoo.com
Applied Spectra, Walnut Creek, CA
$70,000.00

Laser-induced breakdown spectroscopy (LIBS) has been proven as a powerful analytical sensor technology for military and civilian applications. Attributes include real-time measurement response, no sample preparation, high sensitivity, and the ability to detect signatures from chem/bio agents, explosives, toxic compounds and other hazardous materials. Although the capabilities of LIBS have been demonstrated, the performance needs to be improved, especially for field applications. Revolutionary advances are needed to transition LIBS from the laboratory to the field. The basis of this SBIR proposal is to test a new paradigm for LIBS, by using high repetition-rate, low energy laser pulses to significantly extend the plasma lifetime. Importantly, this enhancement approach is all optical (there are no additional power supplies to support secondary plasmas) and gated detection will not be required. The Phase I effort will theoretically establish the enhancement concept, demonstrate and benchmark a test system, and produce design requirements (Phase I Option) for a new LIBS instrument (to be prototyped in Phase II). The Phase I effort will emphasize analysis of Al-based materials of military interest. Such a system will be of immediate use to the Army for applications in chem/bio agents, explosives and other hazardous materials.

Portable Infrared Monitor for In-Field Identification of Chemical Unknowns (Navy 2005 SBIR Phase 1)
Contract/Grant N00164-05-C-6081
Jay Schwartz (PI), 978-694-9991, jschwartz@ssginc.com
SSG, Inc., Wilmington, MA
$69,956.00
SSG Precision Optronics proposes the development of a compact handheld infrared (IR) hyperspectral instrument for detection of chemical and biological threat agents. The proposed system will combine a number of SSGPO's recent developments in compact grating imaging spectrometers and miniature front-end optics for the mid- and long-wave infrared, a new programmable sensor technology developed by Nova Sensors and our extensive heritage with hyperspectral operational hardware. This combination of technologies and experience, will provide the ability to rapidly detect and identify threat agent spectral signatures by programming the sensor to selectively detect in the hyperspectral bands that match those of the threat agent. This can be accomplished at readout rates significantly above typical camera rates (>>60 Hz) with no moving parts. The overall dimensions of a fieldable, battery powered instrument are anticipated to be on the order of 4"x 5" x 2". Phase 1 will develop system level design concepts for the compact, spectrally agile hyperspectral instrument with the base Phase 1 effort defining the system requirements and performing design trades. A Phase 1 option will experimentally confirm the viability of the system concept. Phase 2 will develop and demonstrate a prototype instrument for evaluation.

Raman Bio Identification (RBI) Robot (Army 2005 SBIR Phase 1)
Contract/Grant W81XWH-06-C-0010
Charles Gardner Jr. (PI), 412-241-7335, cgardner@chemimage.com
Chemimage Corp., Pittsburgh, PA
$69,971.00
Chemimage Corp. proposes to demonstrate the feasibility of a government-validated Raman Bio Identification (RBI) reagentless detection system that can be mounted onto a JAUS-compliant UGV and taken directly to the incident area to evaluate soil, water, and surface biowarfare agent contamination. Bringing the sensor to the sample minimizes problems associated with sampling, such as cross-contamination and potential personnel exposure to hazardous chemical or biological materials. Moreover, reagentless, multi-use, broad-spectrum Raman detection offers clear advantages over immunoassay and DNA-based biological detection strategies, especially when configured for use on an unmanned vehicle. The proposed RBI Robot effort combines the unique technology capabilities of organizations that are leaders in their respective fields. The proposed detection system builds upon ChemImage's experience and expertise developing Raman spectroscopic detection technology, which has been validated in several US Government-sponsored test programs. Applied Perception provides the solid foundation of the integration of sensors (camera, laser, sonar, radar, GPS) with sophisticated perception, planning, and control software to provide robust solutions to product-driven problems.

Rapid Cell-Based Toxicity Sensor Using Intergrated Micro Ring-Resonators as Signal Transducer (Army 2005 SBIR Phase 1)
Contract/Grant W81XWH-06-C-0038
Shaopeng Wang (PI), 405-372-9535, swang@nomadics.com
Nomadics, Inc., Stillwater, OK
$70,000.00
The goal of the proposed research is to develop a highly sensitive, portable, vertebrate cell-based sensor for rapid detection of toxic chemicals in water that can be used as a standalone device or can be integrated into the ESB system. The key technological innovation that will be employed is a unique photonic element called a microring resonator (MR) as signal transducer, which undergoes a measurable change in resonant wavelength when light interacts with adsorbed mass, such as a living cell. As cell volume changes rapidly upon exposure to toxic chemicals, by attaching cells to microring resonators, the volumetric change of the cells will cause refractive index changes nearby the ring resonators that can be detected very sensitively by the ring resonators. In Phase I, Nomadics will construct a ring resonator testing system and conduct research on selected cell lines and monitor three different toxic chemicals in water to provide a proof of concept demonstration. This will be achieved by performing the following objectives: 1) Build a bench top microring resonator testing system, 2) Culture selected cell lines and attach these cells to the microring resonators, 3) Test the cell based microring resonator sensing system with three selected toxic chemicals

Rapid Detection of Biological and Chemical Contaminants in Water with Evanescent Field Coherent-Surface-Enhanced Raman Spectroscopy (Army 2005 SBIR Phase 1)
Contract/Grant W56HZV-06-C-0092
Miguel Moreno (PI), 505-891-0034, mmoreno@senspex.com
Senspex, Inc., Rio Rancho, NM
$69,980.00
A novel sensor based upon Coherent-Surface-Enhanced Raman scattering (CSERS) is being proposed for rapid detection of biological and chemical contaminants in water. The main characteristic of this sensor is a periodic array of metal nanoparticles or nanoshells deposited on the surface of an optical fiber waveguide. The nanoparticles/nanoshells will be deposited and immobilized in a periodic array by nanosphere lithography.This single fiber will transport the exciting laser radiation by the total internal reflection. The evanescent field at the interface (fiber/water) will interact with biological and chemical contaminant molecules adsorbed onto or near the surface of the metal nanoparticles producing the Raman shifted signal coherently amplified by the propagating coherent surface plasmons. These CSERS signals will enter the waveguide and be directed to a spectrometer. The sensor will work as an attached device to a normal Raman identification system developed by Senspex. This will turn a normal Raman system into a CSERS system.

Rapid Soil Texture Classification Using the Soil Imaging Penetrometer (Army 2005 SBIR Phase 1)
Contract/Grant W9132V-05-C-0006
Daniel Rooney (PI), 608-334-5460, rooney@earthit.com
Earth Information Technologies Corp., Madison, WI
$67,602.00
Soil texture is a critical soil information input to site suitability, mobility, counter-mine, and engineering models. Traditional methods of obtaining soil information are inefficient, inconsistent, and could require time-consuming and expensive laboratory analyses. In addition, a high level of soil expertise may be required on-site. A soil imaging system could provide a more efficient and consistent means of collecting and delivering soil texture, structure, and composition information, while avoiding expensive laboratory analysis and the need for on-site experts. Funding is requested to improve the existing EarthIT Soil Imaging Penetrometer system so that it could be rapidly deployed in diverse environmental conditions with an ATV-based delivery system, acquire in situ soil imagery using integrated data collection software and electronics, analyze the imagery using advanced image processing techniques, automatically classify the soil to USCS texture categories based on metrics derived from image processing, and deliver texture classification and sample images to soil experts and decision makers via an encrypted network. EarthIT anticipates that the imaging system will be integrated with other environmental information gathering technologies (e.g., GPS, GIS, ground and airborne sensors, predictive models) to create a complete Soil Information System for commercialization in military, agriculture, turf, forestry, construction, and environmental science applications.

Real-Time Process Control Sensor for Measuring Arsenic Concentration in Water (Air Force 2005 SBIR Phase 2)
Contract/Grant FA9302-05-C-0003
Badawi Dweik (PI) 781-529-0520, bdweik@ginerinc.com
Company: Giner, Inc., Newton, MA, www.ginerinc.com
$738,393.00
Arsenic in drinking water is a severe health risk to populations throughout the world. In recognition of this risk, U.S. EPA recently lowered its water standard for arsenic from 50 ppb to 10 ppb. To comply with the new standard, there is an urgent need to develop new, simple, and effective systems to monitor this toxic substance in water. The overall objective of this SBIR project is to develop and demonstrate an easy-to-use reliable, field deployable, and practical real-time sensor device (sensor) that can be used to perform rapid on-site screening and quantitative determination (at ppb levels) of dissolved arsenic in drinking water. The proposed sensor will be accurate, sensitive and specific and be compact. The feasibility to develop an advanced, miniaturized sensor for detecting Arsenic in the sub-ppb was clearly demonstrated in Phase I. During this Phase II, a compact packaged prototype sensor instrument, including the sensor cell and the corresponding electronic circuitry, will be refined, prototyped and tested with real-world samples. The prototype sensor will include an electronics package for electrode potential control, data collection, and display. It is planned to yield sensor design specifications, and base information for establishment of fabrication and QC process protocols.

Real-Time Single Particle Bioaerosol Detector (Army 2005 SBIR Phase 2)
Contract/Grant W912HZ-06-C-0001
Stephen Holler (PI), 650-610-0956, sholler@novawavetech.com
Novawave Technologies, Redwood City, CA
$730,000.00
This Small Business Innovation Research Phase II proposal seeks to build upon the Phase I results and develop a multi-spectral prototype instrument for measuring the angular light scattering patterns from individual flowing aerosol particles. The sensor utilizes sophisticated image processing and multivariate algorithms to discriminate among biological and non-biological particulate matter. The ultimate sensor is envisioned to be a compact, modular instrument that may be incorporated into HVAC systems for continuous monitoring and advanced warning of furtive releases of biological warfare agents. Successful threat detection would initiate isolation protocols and appropriate countermeasures. In addition to developing a multi-spectral light scattering apparatus, Novawave Technologies will assess the feasibility of integrating a fluorescence-based approach, providing an orthogonal measurement to enhance the discrimination capabilities. Laboratory testing of the Phase II prototype will quantify system performance and provide a critical design review that will ultimately result in a Phase III commercialization product. Working with a commercialization partner, the successful prototype sensor will be transitioned to the marketplace for air quality monitoring and building security applications. Novawave Technologies will market the Phase III sensor as a complementary instrument for enhanced discrimination in existing programs such as the Joint Biological Point Detection System (JBPDS), Immune Building, and BioWatch.

Real-Time, Ultrasensitive Water Supply System Biosensor (Army 2004 SBIR Phase 1)
Contract/Grant W9132T-04-C-0005
Stephen Holler (PI), sholler@novawavetech.com
Novawave Technologies, Redwood City, CA
$70,000.00
This Small Business Innovation Research Phase I proposal seeks to develop an ultra-sensitive, low-cost, highly-redundant, and robust sensor for the detection of biological and chemical agents, and toxins in water supply systems. The sensor developed under this effort will incorporate optical micro-cavities on an integrated micro-photonic platform for rapidly and simultaneously detecting multiple classes of biological and chemical threat agents with a high degree of redundancy. The high level of redundancy enables sensitive detection while minimizing the effects of non-specific binding. Target specificity is achieved through highly selective interactions at the micro-cavity surface.

Real-Time, Ultrasensitive Water Supply System Biosensor (Army 2005 SBIR Phase 2)
Contract/Grant W9132T-06-C-0008
Stephen Holler (PI), sholler@novawavetech.com
Novawave Technologies, Redwood City, CA
$730,000.00
This Small Business Innovation Research Phase II proposal seeks to expand on the Phase I results to develop an ultra-sensitive, low-cost, highly-redundant, and robust sensor for the detection of biological and chemical agents, and toxins in water supply systems. The sensor

developed under this effort will incorporate optical micro-cavities on an integrated micro-photonic platform for rapidly and simultaneously detecting multiple classes of biological and chemical threat agents with a high degree of redundancy. The high level of redundancy enables sensitive detection while minimizing the effects of non-specific binding. Target specificity is achieved through highly selective interactions at the micro-cavity surface. The prototype integrated optical sensor will be tested on threat simulants in our laboratories, and real agents at a DoD facility such as the Water Security Research Test Loop. The results of these tests will provide a critical design review that will ultimately result in a Phase III commercialization product. Working with a commercialization partner, the successful prototype sensor will be transitioned to the marketplace for water quality monitoring applications. In addition, Novawave Technologies will target markets for variants of the Phase III sensor in other commercial venues such as clinical diagnostics, molecular diagnostics, environmental monitoring, and analytical chemistry applications.

Sensors for Wide-Area Evaluation of Live/Dead Biowarfare Pathogens (DoD DARPA 2005 SBIR Phase 1)
Contract/Grant W31P4Q-06-C-0085
John Hefti (PI), 650-303-4181, hefti@dvbio.com
DVbio, Inc., Mountain View, CA
$98,456.00
The development of a rapid physiology-based detection and viability evaluation platform for applications in biowarfare defense is proposed. The platform is intended to provide analysis of environmental samples within minutes of capture, and provide near real time data on the log-kill of the pathogen during and after decontamination efforts. The mature platform will be a fully hardened portable unit capable of rapid analysis under harsh conditions, require minimally trained personnel without access to laboratory facilities, and be able to analyze multiple pathogens simultaneously. The platform is based on the correlation of specific dielectric responses of a given environmental sample to a matrix of defined media. Detection is based on stimuli of species-specific physiologic responses, and so is able to directly determine pathogen viability. The detection technology employs newly developed dielectric measurement methods which greatly improve detection sensitivity while significantly reducing cost and complexity of the system, as well as greatly simplifying demands on sample preparation and handling. The detection component is adaptable to most sample handling formats, including micro-arrays and flow cytometric systems. It is capable of being integrated into orthogonal detection platforms for enhanced specificity and sensitivity, as well as being configured for a wide range of applications and conditions.

Soil Texture Classification Imaging System (Army 2005 SBIR Phase 1)
Contract/Grant W9132V-05-C-0007
Sergey Sandomirsky (PI), 310-320-3088, sutama@poc.com
Physical Optics Corp., Torrance, CA
$119,996.00
To meet the U.S. Army need for an innovative technology for automatic precise classification of soil texture types according to the USCS schema, in Phase I, Physical Optics Corporation (POC) seeks to develop a SOil Texture Classification Imaging System (SOTCIS) prototype. The SOTCIS architecture consists of two interconnected subsystems: the prediction level subsystem

(PLS) and the measurement level subsystem (MLS). The PLS determines expected soil texture types and recommends methods of soil properties measurement relevant to the inferred soil landscape. The MLS measures three major soil properties: particle size distribution, plasticity, and organic matter content. Data collected by the MLS at the site along with GPS positioning information will be saved in Army GIS-complaint format.

Soil Texture Classification Imaging System (Army 2005 SBIR Phase 2)
Contract/Grant W9132V-06-C-0009
Sergey Sandomirsky (PI), 310-320-3088, sutama@poc.com
Physical Optics Corp., Torrance, CA
$729,986.00
In Phase I, Physical Optics Corporation (POC) successfully developed a SOil Texture Classification Imaging System (SOTCIS) prototype. Specifically, POC demonstrated that soil texture at a particular observation point can be classified in situ in a few minutes (not hours as in conventional methods) by a minimally trained operator. In addition, repeated measurements can be taken easily under computer control, increasing SOTCIS accuracy and reliability. The SOTCIS architecture consists of two interconnected subsystems: the prediction level subsystem (PLS) and the measurement level subsystem (MLS). The PLS determines expected soil texture types and recommends methods of soil properties measurement relevant to the inferred soil landscape. The MLS measures three major soil properties: particle size distribution, plasticity, and organic matter content. Data collected by the MLS at the site along with GPS positioning information is saved in Army GIS-complaint format. In Phase II, POC will integrate the PLS and MLS with GPS and geophysical devices, and perform field tests of SOTCIS to predict soil textures in accordance with the USCS system.

Standoff LIBS Element Detection Sensor (Army 2005 SBIR Phase 1)
Contract/Grant W911NF-05-C-0032
Russell Kurtz (PI), 310-320-3088, sutama@poc.com
Physical Optics Corp., Torrance, CA
$119,993.00
To address the Army's need to rapidly and autonomously detect and identify chemical and biological warfare (CBW) agents and improvised explosive device (IED) compounds from a 100 m standoff distance, Physical Optics Corporation (POC) proposes to develop a new Standoff Laser Induced Breakdown Spectroscopy (LIBS) Elemental Detection System (SLEDS). SLEDS is based on a compact, highly efficient, eye-safe excitation laser and beam delivery/collection optics with the capability of targeting and tracking the LIBS spark, a miniature 3x2x2-in., 200-1000 nm, 0.1 nm resolution multiplanar spectrometer, and smart control and robust chemical fingerprinting software resulting in a 3 cu. m, 10 kg, 10 W portable system suitable for installation on the Army's current mobile platforms, enabling Army personnel to perform moblie standoff detection and operation. In Phase I, the system design will be developed and its feasibility will be demonstrated by assembling and testing a SLEDS prototype as a proof-of-concept.

Standoff LIBS Element Detection Sensor (Army 2005 SBIR Phase 2)
Contract/Grant W911NF-06-C-0013
Russell Kurtz (PI), 310-320-3088, sutama@poc.com
Physical Optics Corp., Torrance, CA
$729,983.00

To address the Army's need to rapidly and autonomously detect and identify chemical and biological warfare (CBW) agents and improvised explosive device (IED) compounds from a 100 m standoff distance, Physical Optics Corporation (POC) proposes to develop a new Standoff Laser Induced Breakdown Spectroscopy (LIBS) Elemental Detection System (SLEDS). SLEDS is based on a compact, highly efficient, eye-safe excitation laser and beam delivery/collection optics with the capability of targeting and tracking the LIBS spark, a miniature 3x2x2-in., 200-1000 nm, 0.1 nm resolution multiplanar spectrometer, and smart control and robust chemical fingerprinting software resulting in a 3 cu. m, 10 kg, 10 W portable system suitable for installation on the Army's current mobile platforms as well as those to be part of the Future Combat System (FCS). This unique integrated SLEDS design will enable Army personnel to perform standoff detection and operation from mobile platforms. In Phase I, POC developed the system design, and demonstrated feasibility by assembling and testing a SLEDS prototype as a proof-of-concept. In Phase II, POC will construct and test an optimized, fully portable, and rugged SLEDS prototype that will be delivered to the U.S. Army for further testing.

An Underwater Bioluminescence Assessment Tool (U-BAT) (Navy 2005 STTR Phase 1)
Contract/Grant N00014-05-M-0208
Andrew Barnard (PI), 541-929-5650, andrew@wetlabs.com
Western Environmental Tech. Laboratories, Inc., Philomath, OR in partnership with Univ. Calif., Santa Barbara
$70,000.00

The transition of a novel bioluminescence (BL) sensor technology is proposed to develop a commercial general purpose bathyphotometer-based product for biological assessment of natural waters. This proposal directly addresses ONR topic # N05-T026 for the need to transition new and novel BL sensing technologies from the research to the commercial realm to enable a more comprehensive quantification of the spatial and temporal variability of the biogeochemical complexity of coastal oceanic ecosystems. For this purpose, a leading manufacturer of in situ bio-optical instrumentation, WET Labs, has partnered with a renowned group of researchers from the University of California, Santa Barbara (UCSB) to transition in situ bioluminescence (BL) sensing technologies developed at the University into a commercially viable combined bioluminescence and inherent optical properties integrated sensor suite. This Underwater Biological Assessment Tool (U-BAT) will provide unprecedented capabilities for scientists and resource managers to observe and discriminate bulk-phase biological processes in the water column. The envisioned invention will also directly address Naval survey and tactical operations in providing a visibility and vulnerability assessment for deployed assets and potential threats.

Visual Stoichiometry Breaking in Linear Response Chemical Test Strips (Army 2005 SBIR Phase 1)
Contract/Grant W911NF-05-C-0019
Mark T. Spitler (PI), 781-376-9911, spitlem@tiac.net
Chemmotif, Inc., Concord, MA
$119,873.00
In this phase I SBIR contract, novel methods will be developed to enhance the perception by the human eye of signal change in color change test strips that detect chemicals, contaminants, and hazardous materials. Modern concepts of human vision and digital imaging will be combined to create readout images on the test strips so that the user obtains sharp and unambiguous signals from exposed strips. Demonstrations of this technology will be made on different color change test strips that are of importance to first responder community and military personnel exposed to chemical warfare agents and other hazardous materials.

Wide-Area Measurement of CWA/BWA Surface Contamination Using Gaseous Tracers (DoD DARPA 2005 SBIR 2005 Phase 1)
Contract/Grant W31P4Q-06-C-0029
Joseph W. Maresca, Jr. (PI), 509-737-1377, maresca@vistaengr.com
Vista Engineering Technologies, LLC, Kennewick, WA
Contract/Grant Number:W31P4Q-06-C-0029
Vista Engineering Technologies will develop, demonstrate, and commercialize a novel tracer technology to rapidly detect and quantify the concentration of active and inactive CWA/BWA in a building following an attack. One or more interactive and conservative tracers are introduced into a room or the ductwork in a building, and the relative concentration of the sampled interactive and conservative tracers are used to detect and quantify agents present in the rooms, hallways, stairwells, and ductwork of the building. The technology will be faster and more accurate than current approaches. First, the tracer gases will attain better and more complete coverage. The technology has the potential for interrogating the entire building, an entire floor, or one room from a single location, including the furniture, shelving/cabinets, and difficult-to-access areas. Second, the technology has an SNR advantage over other technologies (perhaps, 30 dB), because the noise is controlled, and the interactive tracer, not the threat agent itself, needs to be detected. The technology can be implemented as a contact sensor, a point sensor, and a remote sensor with standoff distances of the dimensions of a room, a floor, or the entire building.

DEPARTMENT OF ENERGY: ENVIRONMENTAL REMEDIATION SCIENCES PROGRAM GRANTS

Isotopic Tracers for Waste Fluid Tracking (DOE 2004 Environmental Remediation Sciences Program Grant)
P. Evan Dresel, PI, Pacific Northwest National Laboratory; 509-376-8341, evan.dresel@pnl.gov
Project Number: 1022415
10/1/2006 - 9/30/2007
$35,000 (2004) $35,000 (2005) $30,000 (2006) $100,000 (Total)

Abstract not available.

Hydrogeophysical Characterization and Monitoring at the FRC (DOE 2005 Environmental Remediation Sciences Program Grant)
Susan Hubbard, Lawrence Berkeley National Laboratory; 510-486-5266, sshubbard@lbl.gov
Project Number: 1027035
10/1/2004 - 9/30/2006
$44,000 (2005) $16,000 (2006) $60,000 (Total)

Abstract not available.

Field-Portable and Automated Immunosensors for Hexavalen Uranium, Other Heavy Metals and Chelators (DOE 2005 Environmental Remediation Sciences Program Grant)
Diane Blake, PI, Tulane Univ., New Orleans, LA. 504-988-2478, blake@tulane.edu
Project Number: 1025388
4/1/2006 - 3/31/2007
Tulane University: $318,000 (2005) $267,000 (2006) $585,000 (Total)
Abstract: In this study, the Blake laboratory at Tulane, in conjunction with Sapidyne Instruments, Inc., will develop an in-line immunosensor with the ability to monitor the removal of hexavalent uranium (or other radionuclides) from a groundwater sample over a period of 4-7 days. This new sensor will have advantages over current methods of detection, which require periodic sampling and analysis off-site. This sensor will operate autonomously and provide data about in situ uranium immobilization in the absence of personnel at the site. The idea for this project was the result of discussions between the P.I. and other scientists performing in situ stabilization experiments at the NABIR Field Research Center (FRC), and this site is proposed for the testing and initial deployment of the sensor. During previous DOE funding, the Blake laboratory developed monoclonal antibodies that recognize hexavalent uranium and incorporated them into a prototype immunosensor that detects uranium at levels of 10 nM (~2.4 ppb). The present project has three major goals: 1) to construct an in-line immunosensor for hexavalent uranium after engineering discussions with the final users; 2) to incorporate the reagents already developed for a handheld immunosensor into this device and test its performance capabilities with hexavalent uranium spiked into buffer and groundwater samples; 3) to test the capabilities of the in-line sensor during the upcoming field tests at the FRC. This project bridges the gap between broad fundamental research and needs-driven applied technology development. Our previous funding allowed us to combine basic studies on antibody binding with instrument design and construction.

Integrated Nucleic Acid System for In-Field Monitoring of Microbial Community Dynamics and Metabolic Activity (DOE 2005 Environmental Remediation Sciences Program Grant)
Eric Roden, PI, Univ. of Alabama, eroden@geology.wisc.edu
Project Number: 1025142
11/15/2004 - 11/14/2005
$77,000

Abstract not available.

Chemically Functionalized Arrays Comprising Micro and Non-Electro-Mechanical Systems for Reliable and Selective Characterization of Tank Waste (DOE 2005 Environmental Remediation Sciences Program Grant)
Michael J. Sepaniak, Univ. of Tennessee, Knoxville; 865-974-8023, msepaniak@utk.edu
Project Number: 1025393
1/1/2005 - 12/31/2005
$35,000

Abstract not available.

Optical and Microcantilever-Based Sensors for Real-Time In Situ Characterization of High-Level Waste (DOE 2005 Environmental Remediation Sciences Program Grant)
Gilbert M. Brown, PI, Oak Ridge National Laboratory, 865-576-2756, browngm1@ornl.gov
Samuel G. Bryan, Co-PI, Pacific Northwest National Laboratory, 509-376-6949, sam.bryan@pnl.gov
Project Number: 94981
Award Year: 2005
10/1/2004 - 9/30/2007
Funding by Institution
ORNL: $320,000 (2005) $340,000 (2006) $660,000 (Total)
PNNL: $75,000 (2005) $0 (2006) $75,000 (Total)
Totals: $395,000 (2005) $340,000 (2006) $735,000 (Total)
(This project was funded under a different project number from 2001 to 2004)

Fundamental research is in progress to develop sensors for cesium and strontium that can be used in real time to characterize high-level waste (HLW) process streams. Two fundamentally different approaches are being pursued, which have in common the dependence on highly selective molecular recognition agents. In one approach, an array of chemically selective sensors with sensitive fluorescent probes to signal the presence of the constituent of interest will be coupled to fiber optics for remote analytical applications. The second approach will employ sensitive microcantilever sensors shown to have unprecedented sensitivity in solution for Cs^+, Hg, and CrO_4^-. Selectivity in microcantilever-based sensors is achieved by modifying the surface of a gold-coated cantilever with a monolayer coating of an alkanethiol derivative of the molecular recognition agent. The microcantilever-based sensors function by converting molecular complexation into surface stress. Molecular recognition with these sensors is achieved using ionophores constructed with the three-dimensional architecture provided by calix[4]arenes, a widely used platform for metal ion complexation. Fluorescent sensors utilize a fluorophore group that responds to metal ion complexation. Anthracene, dansyl, coumarin, and pyrene have been covalently attached to calixarenes and investigated as fluorophores. Upon complexation of the metal ion by the ionophore, the above fluorophores signal complexation by a change in the fluorescence intensity. Calix[4]arenes containing the covalently attached ionophore are substituted with alkanethiols which form a self-assembled monolayer on the gold surface for microcantilever sensing. Current research is focusing on dialkanethiols in which one of the alkane groups is a hydrocarbon filler and the other is attached to the calixarene. Calix[4]arene crown-6-ether ionophores are selective for Cs+ and crown-5-ethers are selective for K+. The development of fluorescent and microcantilever sensors for the detection of TcO4 - is proposed. Sensors for other alkali metal ions, hydroxide, and temperature will be part of the array of sensor elements that will be demonstrated for both the cantilever and fiber optic sensor approaches.

Coupled Geochemical Process Evaluation for Conceptualizing Trichloroethylene Co-Metabolism (DOE 2006 Environmental Remediation Sciences Program Grant)
Project Number: 1027628
Ron L. Crawford, PI, University of Idaho, Moscow; 208-885-6580, crawford@uidaho.edu
3/1/2006 - 5/31/2007
$190,000

Abstract not available.

Coupled Geochemical Process Evaluation for Conceptualizing Trichloroethylene Co-Metabolism (DOE 2006 Environmental Remediation Sciences Program Grant)
Project Number: 1027629
Robert C. Starr, PI. North Wind, Inc., Idaho Falls, ID; 208-557-7878
Award Year: 2006
3/1/2006 - 5/31/2007
$140,000

Abstract not available.

Coupled Biogeochemical Process Evaluation for Conceptualizing Trichloroethylene Co-Metabolism (DOE 2006 Environmental Remediation Sciences Program Grant)
Mark Conrad, Lawrence Berkeley National Laboratory; 510-486-6141, msconrad@lbl.gov
Project Number: 1027672
2/1/2006 - 9/30/2007
$100,000

Abstract not available.

Multiscale Characterization and Prediction of Coupled Subsurface Biogeochemical-Hydrological Processes (DOE 2006 Environmental Remediation Sciences Program Grant)
Susan Hubbard, Lawrence Berkeley National Laboratory; 510-486-5266, sshubbard@lbl.gov
Project Number: 1027674
2/1/2006 - 1/31/2007
$500,000

Abstract not available.

Assessing the Performance of Surface and Subsurface Engineered Barriers (DOE 2006 Environmental Remediation Sciences Program Grant)
Anne Linn, PI, National Academy of Sciences, Washington, DC; alinn@nas.edu
Project Number: 1028074
6/1/2006 - 7/1/2007
$50,000

Abstract not available.