Measurement & Monitoring: 18th Quarterly Literature Update

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24-Hour Diffusive Sampling of 1,3-Butadiene in Air onto Carbopack X Solid Adsorbent Followed by Thermal Desorption/GC/MS Analysis: Feasibility Study
McClenny, W.A., D.A. Whitaker, K.D. Oliver, H.H. Jacumin Jr., and E.H. Daughtrey Jr.
Symposium on Air Quality Measurement Methods and Technology, Research Triangle Park, NC, April 20-22, 2004 [EPA 600-04-062; NTIS PB2004-106812]

Diffusive sampling of 1,3-butadiene for 24 hr onto the graphitic adsorbent Carbopack X packed in a stainless steel tube badge (6.3 mm o.d., 5 mm i.d., and 90 mm in length) with analysis by thermal desorption/gas chromatography (GC)/mass spectrometry (MS) has been evaluated in controlled tests. A test matrix of 42 trace-level volatile organic compounds (VOCs) in humidified zero air was established by dynamic dilution of compressed gas standards flowing through an environmental chamber. Conditions for both automated thermal desorption of the badge, including pre-desorption dry purging, and GC/MS analyses (column flow rate and temperature programming profile) were optimized for specificity, precision, and sensitivity of response. Analytical system responses for sets of tubes exposed to a given 1,3-butadiene concentration were typically precise, e.g., a % RSD < 10% at 1.1 ug/m3 (0.5 ppbv), and system response was approximately linear with concentration over the range 0-9 ug/m3. No significant systematic variations of response were observed for changes in sample humidity and temperature (35% and 75% RH at 16, 20, and 29 degrees C). Loss of 1,3-butadiene from the tube badge due to reverse diffusion into clean air over 12 hr after an initial 12-hr exposure at 9 ug/m3 gave an 11% response decrease. Adding 100 ppbv (~200 ug/m3) of ozone during the second 12 hr caused no additional response change.

24-Hour Diffusive Sampling of Toxic VOCs in Air onto Carbopack X Solid Adsorbent Followed by Thermal Desorption/GC/MS Analysis: Laboratory Studies
McClenny, W.A., K. Oliver, H. Jacumin, H. Daughtrey, and D.A. Whitaker.
Journal of Environmental Monitoring, Vol 7, p 248-256, 2005

The laboratory evaluation of diffusive sampling of a mixture of 42 VOCs in air onto the solid adsorbent Carbopack X included variations in sample air temperature, relative humidity, and ozone concentration. Afterward, 27 VOCs were selected for quantitative monitoring in the concentration range from approximately 0.1 to 4 ppbv. Comparison of analytical results for active and diffusive samples taken over 24 hours under the same simulated ambient conditions at a constant 2 ppbv were interpreted to estimate the effective diffusive sampling rates (ml/min) and their uncertainty, and to calculate the corresponding diffusive uptake rates (ng/ppmv/min).

Airborne LIDAR for Remediation of Abandoned Mine Lands
Jackson, Russell, BLM, National Science and Technology Center.
Bureau of Land Management Resource Note No. 68, May 2004

Acid mine drainage is a known concern in the upper Arkansas River near Leadville, CO. The Lake Fork tributary of the Arkansas River is 4 miles west of Leadville. This stream flows south out of Turquoise Lake for about 4 miles to its confluence with the Arkansas River. Below

the Sugarloaf Dam on Turquoise Lake, many turn-of-the-20th-century silver mines exist, with tailing piles leaching heavy metals into the Lake Fork tributary. To aid in the restoration of the Lake Fork watershed, high-resolution, highly accurate terrain data must be obtained. Traditionally, Bureau of Land Management (BLM) crews on the ground perform surveys of the site to capture the terrain data needed for the restoration process. Other technologies are being evaluated that may provide the same accuracies and point density necessary for the remediation process. Though conventional photogrammetric practices can provide products that meet the requirements, recent advances with airborne Light Detection and Ranging (LIDAR) imaging systems may also satisfy the requirements in a more timely and efficient way than traditional photogrammetry. Products from both systems were evaluated in early 2003, including bare-earth and vegetation models, digital orthoimages utilizing the terrain data during orthorectification, and intensity data generated from the LIDAR sensor in vegetation identification. Though the overall cost of acquiring the LIDAR products is presently higher than the cost of products obtained from conventional photogrammetry, the future cost of photogrammetric work will exceed that of LIDAR. Total photogrammetric costs are presently 94% of the total LIDAR costs. Costs of the LIDAR products were $6.40 per acre, whereas photogrammetric costs are $6.00 per acre. It should be noted that these costs are for this study only and should not be used to project costs of other studies. The photogrammetric products cover only the Dinero Dump, whereas the LIDAR products cover the entire project area. In addition to the costs for photogrammetric products, costs associated with reclaiming the dumps, producing volume calculations and cut–fill estimates, and additional survey costs for each dump must be considered.
http://www.blm.gov/nstc/resourcenotes/rn68.html

Air Modeling Overestimates Contaminant Levels at Former Navy Installation NAS Moffett Field
RPM News, p 8-10, Spring 2005

The Installation Restoration Program team at Naval Air Station Moffett Field recently found that the air model used in the investigation of trichloroethene (TCE) vapors might overestimate contaminant levels. The team used the draft U.S. EPA Vapor Intrusion (VI) Guidance model to predict concentrations of TCE in indoor air. The model consistently overestimated the amount of TCE in indoor air, based on follow-up air sampling and analysis. According to Wilson Doctor, Remedial Project Manager for the site, "The overestimates may be due to the complex site lithology, the uncertainty of the source of TCE contaminations detected in a background residential unit and whether subtracting this result from measured indoor air results accurately adjusts for background, and/or a result of the low concentrations detected in the residential units." A comparison of measured indoor air concentrations to concentrations predicted using the EPA VI guidance generally shows that the model may overestimate the amount of TCE in indoor air. Understanding that site-specific factors could cause modeling results to vary should allow project managers to work these factors into their investigations.
http://enviro.nfesc.navy.mil/erb/erb_a/outreach/newsltr/rpmnews/2005sp.pdf

Amperometric Microbial Biosensor for p-Nitrophenol Using Moraxella sp.-Modified Carbon Paste Electrode
Mulchandani, Priti, Carlos Hangtarer, Yu Lei, Wilfred Chen, and Ashok Mulchandani.
Biosensors and Bioelectronics, Vol 21, p 523-527, 2005

An amperometric microbial biosensor recently developed for highly specific, sensitive, and rapid quantitative determination of p-nitrophenol takes advantage of the ability of Moraxella sp. to specifically degrade p-nitrophenol to hydroquinone, a more electroactive compound than p-nitrophenol. The electrochemical oxidation current of hydroquinone formed in biodegradation of p-nitrophenol was measured at Moraxella sp.-modified carbon paste electrode and correlated to p-phenol concentrations. At optimum conditions, the biosensor had excellent selectivity against phenol derivatives and was able to measure as low as 20 nM (2.78 ppb) p-nitrophenol with very good accuracy and reproducibility. When stored at 4 degrees C, the biosensor remained stable for approximately 3 weeks. The biosensor was tested by measurement of p-nitrophenol in lake water.
http://www.engr.ucr.edu/~wilfred/PNP%20Biosensor%2005.pdf

Analysis of Mercury Wet-Deposition Data Collected with a Newly Designed Sampler, Boston, Massachusetts Metropolitan Area, 2002-04
Chalmers, Ann, Mark A. Nilles, David P. Krabbenhoft, and Eric Prestbo.
U.S. Geological Survey Open-File Report 2005-1368, 27 pp, 2005

Atmospheric mercury wet-deposition rates were determined by the use of a newly designed wet-deposition sampler at four sites around the Boston, MA, metropolitan area. The new sampler design was evaluated to determine reliability and capture efficiency. Capture efficiency was lowest during cold and (or) windy winter storms when accumulated ice and (or) snow either overflowed or blew out of the funnel. High capture efficiency (median values of 0.95 and 1.01) occurred with the top-loading type of N-Con sampler, likely reflecting the enhanced collection efficiency of the optical infrared precipitation sensor during light precipitation, and the improved temperature distribution in the top-loading model. Wet-deposition samples collected from January 2002 to August 2004 were analyzed for total mercury (HgT), and a subset of samples from September 2003 to August 2004 were analyzed for methyl mercury (MeHg). MeHg concentrations at all four sites were below the detection level of 0.04 ng/L. Precipitation-weighted HgT concentrations during the study were 7.81 to 8.31 ng/L at the more urban sites, and 6.87 ng/L at the regional-reference site. Annual HgT deposition was 8.11 to 9.98 micrograms per square meter per year (g/m2/yr) at urban sites, and 6.56 g/m2/yr at the regional-reference site. Precipitation-weighted HgT concentrations were 2 times higher in the summer than the winter, and the HgT deposition rate was 3 times higher in the spring and (or) summer than in the winter in the Boston metropolitan area.
http://pubs.usgs.gov/of/2005/1368/

Analysis of Selected Pyrethroid Pesticides Using Reverse Phase High Pressure Liquid Chromatography/UV
Morrison, C.N., J. Starr, and E.M. Ulrich.
Society of Environmental Toxicology & Chemistry (SETAC), Kennesaw, GA, March 25-27, 2004.

This research was conducted in cooperation with EPA Region 4 in Athens, GA to develop a method to analyze selected pyrethroid pesticides using reverse-phase high pressure liquid chromatography (HPLC). This HPLC method will aid researchers in separating and identifying these pyrethroids. The method was developed for Type I pyrethroids without a cyano group (allethrin, permethrin, resmethrin) and Type II pyrethroids with a cyano group (cypermethrin and fenvalerate). The pyrethroids were separated on a Hewlett Packard model 1090 using a Phenomenex C-18 100 x 2.0 mm SYNERGI 4u Hydro-RP 80A column. The flow rate was set at 0.5 mL/min. at 35 degrees C using two mobile phases consisting of acetonitrile-distilled water (1:1, v/v) and methanol-acetonitrile-distilled water (0.5:0.5:1, v/v) with 10 uL injections. The ratios of aqueous to organic mobile phase evaluated ranged from 10:90 to 60:40. Mobile phase conditions of 20% water and 80% acetonitrile separated allethrin (2.207 minutes), resmethrin isomers (7.997, 8.414 minutes), and permethrin isomers (9.631, 11.326 minutes), respectively. Analysis of the pyrethroids separately allows the hypothesis that, in an unknown sample, complete separation occurs.

Analysis of Soil and Environmental Processes on Hyperspectral Infrared Signatures of Landmines
Cathcart, J.M., R.D. Bock, R. Campbell, Georgia Inst. of Technology, Atlanta.
Proceedings for the Army Science Conference (24th), 29 November - 2 December 2004, Orlando, Florida. NTIS: ADA432578, 8 pp, Dec 2004

Georgia Tech is in the second year of a multi-university research initiative designed to study the impact of environmental processes on optical signatures. This program is conducting phenomenological studies on hyperspectral and polarimetric signatures of various target classes in the visible and infrared wavebands. Initial research studies have focused on landmines and the impact of various environmental factors and processes (e.g., subsurface processes) on the resultant spectral infrared signatures. A variety of approaches to gain a better understanding of the impact of the environment on the spectral and polarimetric characteristics of soil and landmine signatures have been employed in this research, i.e., theoretical analyses, physics-based signature modeling, field measurements, and laboratory studies. The authors present results from their research into the use of a physics-based, hyperspectral signature model as an analysis tool for landmine-related phenomenology studies. Results from these studies will be presented that underscore the importance of incorporating the subsurface processes into the signature analyses and the impact of these processes on detection algorithm development. The results of these analyses have been propagated to algorithm developers to permit the creation of more robust processing techniques based on these physical analyses and models.
http://handle.dtic.mil/100.2/ADA432578

Application of Artificial Neural Networks in Multitouch-Sensitive Systems for the Detection of Nitrohydrocarbons in the Air
Kalach, Andrew V., Inst. of Ministry of Internal Affairs, Voronezh, Russia.
Sensors, Vol 5 No 1-2, p 85-96, Jan/Feb 2005

Touch-sensitive electronic-nose systems include nonselective sensors and methods of analytical signal processing based on modern artificial intelligence development. The multitouch-sensitive approach allows simultaneous qualitative and quantitative analysis of complex mixtures. Artificial neural networks (ANNs) can be developed to measure information coming from separate or combined sensors (the multitouch-sensitive system). This paper evaluates ANNs used as sensor calibration means with electronic nose-generated analytical signals. Piezoelectric quartz sensors array in addition to the ANN data allow recognition of aliphatic nitrohydrocarbons C1 to C3.
http://www.mdpi.net/sensors/list05.htm

Application of a Dialysis Sampler to Monitor Phytoremediation Processes
Jackson, W.A. (Texas Tech Univ., Lubbock); L. Martino; S. Hirsh; J. Wrobel; J.H. Pardue.
Environmental Monitoring and Assessment, Vol 107 No 1-3, p 155-171, 2005

A cylindrical dialysis sampler (1.2 m x 5 cm) was used to sample small-scale phytoremediation processes in the root zone of trees in a plantation of hybrid poplars located above a chlorinated solvent plume containing 1,1,2,2-tetrachloroethane (1,1,2,2-TeCA), trichloroethene (TCE), and daughter products at Aberdeen Proving Ground, MD. The trees were planted in 1996. Two dialysis samplers were installed: one directly in the poplar grove (approximately 0.3 m from the trunk of a mature tree) and the other outside the grove but in the plume. The dialysis sampler monitoring data showed that concentrations of VOCs were similar across the vertical profile, but where the sampler was located near roots, a highly variable profile (at the centimeter scale) suggested VOC rhizosphere biodegradation and uptake near the active roots.

Application of PIXE Analysis to the Study of Electrokinetic Removal of Cesium from Soil
Oguri, Y.; K. Miyake; H. Fukuda; J. Kaneko; J. Hasagawa; M. Ogawa (Tokyo Inst. of Technology, Tokyo, Japan); M. Shiho (JAERI, Naka, Ibaraki, Japan).
20th Symposium on PIXE in Japan; 11th Annual Meeting of Japan Society for Particle Induced X-ray Emission (PIXE) Research, 15-17 Sep 2003, Kochi, Japan.
International Journal of PIXE, Vol 14 No 1-2, p 49-56, 2004 [OSTI: DE20623712]

In a study of electrokinetic soil remediation, radioactive soil contamination was simulated by mixing a salt of stable cesium, Cs-137, with soil samples. The soil samples were subjected to electrolysis for up to 36 hours with a field gradient of ~1-3 V/cm. After electrolysis, the distribution of Cs concentration in the soil along the electrolysis cell was measured by PIXE analysis. Cs concentrations in the drain water sampled from the cathode well were also measured. The migration of Cs from the anode to the cathode was clearly apparent after electrolysis. Water supply in the anode well enhanced the removal rate. The observed migration of Cs in this study was attributed to electroosmotic flow in the soil samples, rather than electrophoretic migration. The minimum detectable concentration of Cs by PIXE analysis was limited to approximately 800 ppm due to spectral interference by metallic elements in the soil.

Application of Quantitative Fluorescence and Absorption-Edge Computed Microtomography to Image Metal Compartmentalization in Alyssum murale
McNear, D.H., Jr., E. Peltier, and J. Everhart (Univ. of Delaware, Newark); R.L. Chaney (USDA-ARS, Beltsville, MD); S. Sutton, M. Newville, and M. Rivers (Univ. of Chicago, Chicago, IL); D.L. Sparks (Univ. of Delaware, Newark).
Environmental Science & Technology, Vol 39 No 7, p 2210-2218, 2005

Synchrotron-based fluorescence and absorption-edge computed microtomographies (CMT) were used to determine the compartmentalization and concentration of metals in hyperaccumulating plant tissues. Fluorescence CMT of intact leaf, stem, and root samples revealed that Ni was concentrated in stem and leaf dermal tissues and, together with Mn, in regions associated with the Ca-rich trichomes on the leaf surface of Alyssum murale, a nickel hyperaccumulator. Absorption-edge CMT showed the 3-D distribution of the highest metal concentrations and verified that epidermal localization and Ni and Mn co-localization at the trichome base occurred throughout the entire leaf, possibly contributing to metal detoxification and storage.
http://ag.udel.edu/SoilChem/McNear05EST.pdf

Application of Supercritical Fluid Extraction (SFE) to Predict Bioremediation Efficacy of Long-Term Composting of PAH-Contaminated Soil
Cajthaml, T. and V. Sasek, Academy of Sciences of the Czech Republic, Prague.
Environmental Science & Technology, Vol 39 No 21, p 8448-8452, 2005 [OSTI: DE20681280]

Researchers used supercritical fluid extraction (SFE) with pure carbon dioxide to obtain desorption curves of polynuclear aromatic hydrocarbons (PAHs) from four contaminated industrial soils. Total PAH concentrations ranged from 1495 to 2439 mg/kg. After composting and consequent long-term maturation, the residual PAH contaminations ranged from 4 to 36% of the original values, which variation may be due to the different bioavailability of the pollutants. In a simple two-site model used to determine the rapidly released fraction (F) representing bioavailability of PAHs, the F values showed good agreement with degradation efficiencies. The results indicate that SFE could be a rapid test to predict bioremediation results of composting of PAH-contaminated soils.

Applications of TDR Technology for Closure Monitoring
K. O'Connor, GeoTDR, Inc., Westerville, OH.
2003 Annual SME Meeting.
Society for Mining, Metallurgy, and Exploration (SME), Littleton, CO.

Time Domain Reflectometry (TDR) is a pulse testing technique developed by the telecommunications and power industry for use in locating breaks in cables. This paper focuses on applications of TDR technology in mining, including remote continuous monitoring of landfill cover performance, densification of mine tailings, contaminant transport, fluid level monitoring, impoundment slope movement, and abandoned mine subsidence.

An Approach to the Rapid Control of Oil Spill Bioremediation by Bioluminescent Method of Intracellular ATP Determination
Efremenko, E.N.; R.E. Azizov; A.A. Raeva; V.M. Abbasov; S.D. Varfolomeyev, Moscow State Univ., Moscow, Russian Federation.
International Biodeterioration and Biodegradation, Vol 56 No 2, p 94-100, Sep 2005

The bioluminescence method of intracellular ATP determination was used to enumerate hydrocarbon-oxidizing bacteria in soil containing various concentrations of oil (up to 60% oil w/w) and cells. Investigation of the growth kinetics of Rhodococcus ruber and Pseudomonas putida in the oil-contaminated soil demonstrated the dependence of specific growth rate on the initial pollutant concentration. The results of the bioluminescence method correlated with levels of oil biodegradation determined gravimetrically. The bioluminescence method of intracellular ATP determination could be widely used to estimate the efficacy of application of hydrocarbon-oxidizing bacteria during bioremediation.

Aqueous Mobility of Metals Released from a Hydrothermally Altered Terrain: Case Study in the Lake Creek Watershed, Colorado
Bird, D. and M. Sares (Colorado Geological Survey, Denver); P. Hauff (Spectral International, Arvada, CO); D. Peters (Peters Geosciences, Golden, CO).
2004 Annual SME Meeting, 23-25 February, Denver, Colorado.
Society for Mining, Metallurgy, and Exploration (SME), Littleton, CO.

The Colorado Geological Survey is conducting a NASA-funded study in Colorado's Lake Creek and Arkansas River watersheds to determine the ability of hyperspectral remote sensing to map mineralogy related to water quality within a hydrothermally altered watershed, and to identify the relative contributions of natural and anthropogenic sources of metals contamination to that drainage. Phase 1, the Lake Creek watershed, was completed in 2002. Phase 2, the Arkansas River, was completed in 2003. Water chemistry combined with streamflow data provides a detailed picture of metals transport and solubility in the two watersheds. Metals concentrations and loadings vary both spatially and temporally along the watersheds, primarily following pH fluctuations.

Aquatic Passive Sampling of Herbicides on Naked Particle Loaded Membranes: Accelerated Measurement and Empirical Estimation of Kinetic Parameters
Stephens, B. Scott (Univ. of Queensland, Coopers Plains, Queensland, Australia), Anita Kapernick, Geoff Eaglesham (Queensland Health Scientific Services, Cooper Plains, Queensland, Australia), and Jochen Mueller.
Environmental Science & Technology, Vol 39 No 22, p 8891-8897, 2005

Water-sampler equilibrium partitioning coefficients and aqueous boundary layer mass transfer coefficients for atrazine, diuron, hexazionone, and fluometuron onto C18 and SDB-RPS Empore disk-based aquatic passive samplers have been determined experimentally under a laminar flow regime that involved accelerating the time to equilibrium of the samplers by exposing them to three water concentrations, decreasing stepwise to 50% and then 25% of the original concentration. A method of estimating mass transfer coefficients using the dimensionless Sherwood correlation developed for laminar flow over a flat plate was also applied. For trace concentrations at these flow conditions, the naked Empore disk performed well

as an integrative sampler over short deployments (up to 7 days) for the compounds investigated. The SDB-RPS disk allows a longer integrative period than the C18 disk due to its higher sorbent mass and/or its more polar sorbent chemistry.

Assessment of the Toxicity of Mine Waste Piles in Russell Gulch, Gilpin County, Colorado
Wildeman, T., N. Heflin, and A. Bazin (Colorado School of Mines, Golden); R. Abel (Colorado Dept. of Public Health, Denver).
2004 Annual SME Meeting, 23-25 February, Denver, Colorado.
Society for Mining, Metallurgy, and Exploration (SME), Littleton, CO.

Russell Gulch, which is in the Idaho Springs/Central City Superfund Site in Colorado, exhibits ephemeral drainage of water in the heart of the Central City mining district, the site of over 100 abandoned mine waste piles. To help make decisions on which waste rock piles should be remediated first, a simple decision tree was developed. The decision tree uses physical and chemical criteria to assess the potential toxicity to aquatic organisms of runoff from a mine waste pile. The chemical leachate tests give a good estimate of the water chemistry that pile runoff would have during annual recharge and storm events. Using the decision tree to rate 29 of the most significant mine waste piles showed that some posed physical risks but not strong chemical risks to the environment; conversely, some of the piles that exhibited severe toxicity in the waters leached from the waste pile samples did not appear to be severe physical threats.

Automated Ground-Water Sampling and Analysis of Hexavalent Chromium Using a "Universal" Sampling/Analysis System
Burge, S.R. and D.A. Hoffman (Burge Environmental, Tempe, AZ); M.J. Hartman (Pacific Northwest Laboratory, Richland, WA); and R.J. Venedam (Bechtel Nevada, Las Vegas).
Sensors, Vol 5 No 1-2, p 38-50, Jan/Feb 2005

A "universal platform" for the deployment of analytical sensors in the field for long-term monitoring of environmental contaminants has been used previously to monitor trichloroethene in monitoring wells and at groundwater treatment systems. The platform was interfaced with analytical systems for Cr(VI) and conductivity to monitor shallow wells installed adjacent to the Columbia River at the 100-D Area of the Hanford reservation, WA. A groundwater plume of hexavalent chromium is discharging into the Columbia River through the gravel beds used by spawning salmon. The sampling/analytical platform was deployed for the purpose of collecting data on subsurface hexavalent chromium concentrations at more frequent intervals than was possible with the previous sampling and analysis methods employed a the site.
http://www.mdpi.net/sensors/list05.htm

Beach Company Develops Low-Cost Chemical Detection Device
Connolly, Allison.
The Virginian-Pilot, 31 Oct 2005

When members of the Virginia Beach Fire Department's hazardous materials team approached a railcar spewing white smoke in an exercise drill, they wore strapped to their forearms an armband called the Chameleon that could tell them by changing color what kind of gas they were being exposed to. Before acquiring the arm bands, they would have to consult

books and other devices to determine what the gas was. The rugged, 2-ounce armband sensors have been used by crews cleaning up New Orleans after Hurricane Katrina and by Marines looking for toxic chemicals in Iraq. The U.S. Drug Enforcement Administration has used them to detect the presence of ammonia, an ingredient in the drug methamphetamine. They may even be attached to unmanned aerial vehicles to detect the use of biochemical warfare on a battlefield. The Chameleon is made by Virginia Beach-based Morphix Technologies, formerly K&M Environmental. A Small Business Innovation Research grant in 2002 helped the company to develop a low-cost, disposable chemical detection product for the Marines. The result was the Chameleon. In January 2005, Morphix won a $2 million contract from the Defense Threat Reduction Agency to develop a wireless communications device that detects chemical and biological warfare. The Chameleon is easy to use, waterproof, disposable and cheap; the armband device costs $30 and the disposable sensors are $3 each.

Behavioral Monitoring of Trained Insects for Chemical Detection
Rains, Glen C., Samuel L. Utley, and W. Joe Lewis, Univ. of Georgia and USDA-ARS, Tifton.
Biotechnology Progress, Vol 22 No 1, p 2-8, 2006

Parasitic wasps optimize their ability to locate food and host insect resources by learning and subsequently using associated chemical and visual cues. Agricultural Research Service scientists at Tifton and the University of Georgia together are working with others to explore whether the remarkable olfactory and learning abilities of these organisms can be harnessed for agricultural and military intelligence and detection purposes, such as monitoring for food safety. The parasitic wasp, Microplitis croceipes (Cresson) (Hymenoptera: Braconidae), can be trained to respond to target odors by allowing them to encounter the odors in association with food or hosts. One such response to a target odor is known as "area restricted searching," whereby trained wasps exhibit crowding within the same area where the target odor is detected. A portable, handheld, computer-vision device, dubbed the "Wasp Hound, " was developed for using the wasps as detectors. Trained wasps, containerized in the device, provided distinct measurable responses to air samples containing low concentrations of the test chemical, 3-octanone, a common fungal volatile chemical. The development and initial demonstration of this methodology greatly advances the feasibility of this important detection and monitoring technology and accelerates it prospects for transfer into practical application. The Wasp Hound, with conditioned wasps, was able to detect 0.5 mg of 3-octanone within a 240 mL glass container filled with feed corn (2.6 x 10-5 mol/L). The Wasp Hound response to the control (corn alone) and a different chemical placed in the corn (0.5 mg of myrcene) was significantly different than the response to the 3-octanone.

Benzene Sensing Using Thin Films of Titanium Dioxide Operating at Room Temperature
Mabrook, Mohammed (Univ. of Durham, Durham, UK); Peter Hawkins (Univ. of the West of England, Bristol, UK).
Sensors, Vol 2 No 9, p 374-382, Sep 2002

Thin films of titanium dioxide dispersed in poly(vinylidenfluoride) are sensitive to benzene at room temperature and have potential applications in benzene monitors. The authors present a detailed study into the direct current electrical characteristics of the films when exposed to benzene. The current (I) through the films increases linearly with applied voltage (V), at low

applied voltages and at higher voltages. The results are consistent with the films being p-type semiconductors and, at higher voltages, the conduction is dominated by a space charge-limited process caused by negative traps with an average energy of 0.1 eV. The films are sensitive to benzene only at the higher voltages. The proposed mechanism is that benzene molecules on the surface of the films reduce the concentration of holes. The relative resistance of the films increases linearly (r = 0.92) with benzene concentrations sensitivity of 0.042%/ppm and a detection limit of 10 ppm. The films have response times to increasing and decreasing concentrations of benzene of about 1 and 5 minutes, respectively.
http://www.mdpi.org/sensors/list02.htm

Best Available Technology 2004 Conference Report, Anchorage, Alaska
Alaska Dept. of Environmental Conservation, Division of Spill Prevention and Response, Industry Preparedness Program, Anchorage. 219 pp, Apr 2005

Title 18 of the Alaska Administrative Code Chapter 75.425 requires the Alaska Department of Environmental Conservation to sponsor a Best Available Technology (BAT) Conference every five years to gain knowledge of new equipment and methods to increase the efficiency of oil spill prevention and response. The 2004 meeting is the first BAT Conference to be held since this requirement was established. Conference organizers determined that additional information was needed regarding the best available technologies in the following six categories: leak detection for crude oil transmission pipelines; secondary containment liners for oil storage tanks; fast water booming; viscous oil pumping systems; well capping; and source control technologies. Five methodologies representing two technologies were presented for pipeline leak detection: ATMOS(TM) Pipe; duoThane(TM); LeakNet(TM); WaveAlert(R); and Sonilocate(R)/Ultrasonic Flowmeters. A total of 18 technology providers presented technologies at the BAT Conference. Each of the 18 technologies was reviewed and evaluated, and this report documents the findings.
http://www.circac.org/documents/pdf/props/report.draft_bat.adec.pdf

Biosensor for Rapid Detection of Organophosphate Insecticides: A Potentially Portable and Simple Way to Detect Compounds Such as Parathion
Booth, Barbara.
ES&T Technology News, 12 Oct 2005

A simple, reusable, and portable biosensor with a fast response can detect less than 1 part per billion (ppb) of some commonly used organophosphate insecticides. The biosensor can selectively detect organophosphate insecticides, such as parathion, methyl parathion, and ethyl parathion. Current analytical methods for these organophosphates are less selective, less sensitive, or require extensive sample preparation. The new biosensor uses whole-cell Pseudomonas putida, engineered to produce on its surface a key enzyme that breaks down organophosphates. Along with another naturally-occurring enzyme on the surface, these organophosphates are converted into a detectable, electrochemically active intermediate. Having the two enzymes expressed extracellularly decreases the response time and increases sensitivity. Each analysis takes less than 5 minutes, and the same sensor can be used up to 20 times by merely rinsing it in between measurements. It is a one-step assay system. Because the biosensor only measures one class of organophosphate insecticides, it may be most effective when

combined with an initial screening assay, such as cholinesterase inhibition assays, which are used to screen for a broad spectrum of agents that damage the nervous system but are unable identify specific chemicals.

Bomb-Sniffing Bugs
Ross, Karen.
Analytical Chemistry, Vol 77 No 23, p 453A, 1 Dec 2005

Insects, which have exquisitely sensitive olfactory systems and can learn to respond to almost any chemical, are being assessed for their ability to identify explosives in systems designed to creatively meld natural insect ability with modern technology. Jerry Bromenshenk is leading a multi-institutional effort to use honeybees to find buried landmines. Bromenshenk and colleagues at the University of Montana, Montana State University, and the National Oceanic and Atmospheric Administration's Environmental Technology Laboratory fed bees sugar syrup while exposing them to 2,4-dinitrotoluene (DNT), which is often found in landmines. The bees quickly learned to associate the smell of the explosive with food. When they were released over a test minefield, they hovered longer over spots that emitted explosives-tinged vapors. By scanning the field with light detection and ranging (LIDAR), a laser-based technique similar to radar, the researchers created a "bee density map." The areas of high bee density matched the spots where chemical measurements indicated that landmines were buried. Unfortunately, LIDAR cannot distinguish between bees and other obstacles, so the research team was forced to conduct the test on a flat, neatly mowed field, a type of environment that does not correspond to the real-world terrain of abandoned land mines. Problems with the resolution and specificity of LIDAR seem to be the major obstacles restricting the usefulness of the bee system. To address the problem of nonspecific detection, Bromenshenk and his group have developed a modified laser-based sensor that has been successful at picking out the bees from the background. This article also discusses the work other research in progress, such as that of Kevin Daly at West Virginia University and his colleagues in testing an explosives sensing device that is part machine and part moth, as well as work by the University of Georgia and the USDA with wasps trained to detect explosives, plant pathogens, illegal drugs, and buried bodies.
http://pubs.acs.org/subscribe/journals/ancham-a/77/i23/pdf/1205government1.pdf?sessid=6006l3

Can Geoelectrical Methods Be Used to Monitor Non-Aqueous Phase Liquid Remediation Efforts?
Werkema, D. Dale, U.S. EPA ORD/NERL/ESD.
EPA Science Forum 2005: Collaborative Science for Environmental Solutions, 16-18 May 2005, Washington, DC.

U.S. EPA's Strategic Plan includes the research and development of improved methods for evaluating the long-term performance of monitored natural attenuation. This groundwater research need is part of Government Performance Results Act (GPRA) Goal 3, sub-objective 3.3.2 for Superfund and Oil Program Research Priorities, which includes research and development for all nonaqueous phase liquid (NAPL) remediation. Geophysical techniques show promise as part of this research effort through the evaluation of NAPL remediation. Specifically, geoelectrical methods can detect changes in the conductivity of the subsurface as related to these remediation activities. This poster presents findings demonstrating that the electrical properties

of remediated zones are altered due to remediation activities, and these changes are measurable by direct current geoelectrical methods. The electrical conductivity variation due to biodegradation of a light NAPL (LNAPL) and the electrical conductivity changes that occur during surfactant flushing of a dense NAPL (DNAPL) are presented. Results from lab and field investigations of the biodegradation of diesel and of surfactant flushing of perchloroethene (PCE) are presented. These studies suggest that, once implemented and validated at sites, analytical chemistry costs may be reduced, hazardous waste products from analyses may be reduced, and the capability to remotely and passively monitor the remediation process and protect our groundwater and soil resources are possible. This research is the result of partnerships with Western Michigan University, University of Missouri-Rolla, and the National Exposure Research Laboratory, Environmental Sciences Division in Las Vegas, NV. The results from this work are expected to be used to efficiently and effectively monitor and characterize the remediation of LNAPL- and/or DNAPL-impacted sites.
http://www.epa.gov/nerl/news/forum2005.html

Characterization of Waste Rock Associated with Acid Drainage at the Penn Mine, CA, by Ground-Based Visible to Short-Wave IR Reflectance Spectroscopy Assisted by Digital Mapping
Montero, I.C., G.H. Brimhall, C.N. Alpers, and G.A. Swayze.
Chemical Geology, Vol 215 No 1-4, p 453-472, 2005

Prior to remediation at the abandoned copper/zinc Penn Mine in the massive sulfide belt of the Sierra Nevada foothills, acid mine drainage (AMD) was created, in part, by the subaerial oxidation of sulfides exposed on several waste piles. To support remediation efforts, a mineralogical study of the waste piles was undertaken by acquiring reflectance spectra measured in the visible to short-wave infrared range of light (0.35 to 2.5 um) using a portable, digitally integrated pen tablet PC mapping system with differential global positioning system and laser rangefinder support. Analysis of the spectral data made use of a continuum removal and band-shape comparison method, as well as reference spectral libraries of end-member minerals and mineral mixtures. Analysis of reflectance spectra of characterized rock samples from the mine helped in gauging the spectral response to particle size and mixtures. The mineral map patterns represent the evolution of acid solutions discharged from the pyritic waste piles and the subsequent accumulation of secondary precipitates by hydrolysis reactions. The results highlight the high capacity of the pyritic waste to release further acid mine drainage into the environment, as well as the effectiveness of the mapping method to detect subtle changes in surface mineralogy and to produce maps useful to agencies responsible for cleaning up the site.

Characterizing Mineral Alteration Using Airborne Visible-Infrared Imaging Spectrometer Data at Questa, New Mexico
Livo, K. Eric and Roger N. Clark, U. S. Geological Survey, Lakewood, CO.
AVIRIS Proceedings 2002, Jet Propulsion Laboratory (JPL), NASA.

A baseline and pre-mining ground-water quality study of the Red River Basin in New Mexico is being undertaken by the U.S. Geological Survey. As part of this study, Airborne Visible-Infrared Imaging Spectrometer (AVIRIS) data were analyzed to characterize mined and non-mined ground along the Red River between the towns of Questa and Red River, New Mexico. This area has zones of intensely mineralized and altered ground that effect the water

quality of Red River. Analysis of the reflectance data has identified mineral assemblages that can affect water quality by lowering the pH and introducing metals, salts, and sediments.
ftp://popo.jpl.nasa.gov/pub/docs/workshops/02_docs/toc.html

Chemical Detection in Liquid Media with a Refractometric Sensor Based on a Multimode Optical Fibre
Cherif, K., S. Hleli, and A. Abdelghani (IPEST, Tunis, Tunisia); N. Jaffrezic-Renault (IFOS, Ecole Centrale de Lyon, Ecully, France); V. Matejec (Acad. of Sciences of the Czech Republic, Prague).
Sensors, Vol 2 No 6, p 195-204, June 2002

The physical basis for the design of an optical fiber sensor that is based on the excitation of an evanescent wave at the core/cladding interface is suited for an aqueous medium as well as the gaseous phase. Detection is based on the refractive index changes (between 1.41 and 1.45) of the infinite dielectric medium, which can be an electrolyte or a sol-gel polymer deposited on the uncladded part of the fiber. Refractive indices of absorbent and volatile compounds, such as fuel and unleaded gas, were determined. Toluene detection in water was performed using a xerogel sensing layer as optical cladding. The observed sensitivity is linear and the detection limit is 1% (in volume) toluene in water.
http://www.mdpi.org/sensors/list02.htm

Chemical Weapons Convention Chemicals Analysis: Sample Collection, Preparation and Analytical Methods
Mesilaakso, Markku (ed.), Finnish Inst. for Verification of the Chemical Weapons Convention (VERIFIN), Univ. of Helsinki, Finland.
Wiley, New York. ISBN: 0-470-84756-5, 426 pp, 2005

The Chemical Weapons Convention (CWC) on the prohibition of the development, production, stockpiling, and use of chemical weapons and of their destruction was signed on January 13, 1993, and entered into force on April 29, 1997. The CWC Verification Annex, which by length occupies the majority of the document, is written in 11 parts. This text discusses sample collection, sample preparation, and analysis, and concentrates on verification that takes place on site, analyses done off site, and methods and procedures used. The first part of the book discusses the mobile laboratory of the Organization for the Prohibition of Chemical Weapons (OPCW) and instrumentation and software used therein, as well as other on-site analytical equipment, procedures, and strategies. The OPCW gas chromatograph/mass spectrometer for on-site analysis is described, and an introduction to Automated Mass Spectrometry Deconvolution and Identification System (AMDIS) software is given. Various monitoring methods of hazardous substances are reviewed, and a comprehensive review of 10 OPCW proficiency tests is provided. The second part of the book begins with a discussion of the analysis strategy employed in an OPCW-designated laboratory, continues with a discussion on sample preparation methods in an off-site laboratory, and concludes with discussion of the various analytical techniques used for analysis of CWC-related chemicals in (designated) laboratories worldwide. i.e., gas chromatography (GC), gas chromatography/mass spectrometry (GC/MS), liquid chromatography/mass spectrometry (LC/MS), nuclear magnetic resonance (NMR) spectroscopy, gas chromatography/Fourier transform infrared spectroscopy (GC/FTIR), and capillary

electrophoresis (CE). The methods included in this part provide the best off-site performance for unambiguous identification of CWC-related chemicals. In the third section, methods are discussed for retrospective detection of exposure to toxic scheduled chemicals using mass spectrometric and immunochemical analysis methods applied to human samples. It describes the procedures for collection of samples, sample preparation, and analysis of CWC-related chemicals. It deals with analytical procedures that can be followed in off-site labs, as well as on-site analytical procedures that OPCW inspectors use in sample collection and preliminary analysis of the samples in field conditions.

Chemometric Classification of Herb Orthosiphon stamineus According to Its Geographical Origin Using Virtual Chemical Sensor Based upon Fast GC
Sim, C.O., M.N. Ahmad, Z. Ismail, A.R. Othman, N.A.M. Noor, and E.M. Zaihidee, Univ. Sains Malaysia, Penang, Malaysia.
Sensors, Vol 3 No 10, p 458-471, Oct 2003

An analytical method was developed for the analysis of a volatile organic compound from samples of Orthosiphon stamineus using an electronic nose instrument. This new chemical sensor is based on fast gas chromatography and a surface acoustic wave (SAW) detector. A chromatographic fingerprint obtained from headspace analysis of O. stamineus samples was used as a guideline for optimum selection of a sensor array. Qualitative analysis was carried out based on the responses of each sensor array to distinguish the geographical origin of the cultivated sample. Though similarities of the main components from all five samples were observed, the analytical results showed variances of volatile chemical compounds among the samples, which enabled determination of their geographical origin using pattern recognition chemometric approaches, such as principal component analysis, linear discriminant analysis, and cluster analysis for processing instrumental data.
http://www.mdpi.org/sensors/list03.htm

Circuit and Noise Analysis of Odorant Gas Sensors in an E-Nose
Tian, F. (Chongqing Univ., Chongqing, P.R. China); S.X. Yang and K. Dong (Univ. of Guelph, Guelph, ON, Canada).
Sensors, Vol 5 No 1-2, p 85-96, Jan/Feb 2005

The response of all sensors in an electronic nose (e-nose) together constitutes a unique profile that "fingerprints" an odor. The noises from a sensor array consisting of several odorant gas sensors may result in inaccurate cluster analysis of the tested material. The noise of gas sensors cannot be ignored. In the worst case, the noise magnitude could become up to 20% of the signal magnitude of some sensors. The authors analyze the relationship between typical circuit structures of gas sensor circuits and their output noise by using averaged segmenting periodical graph and improved histogram estimation methods to estimate the noise power spectra and optimal probability distribution functions.
http://www.mdpi.net/sensors/list05.htm

Collecting and Interpreting Soil Gas Samples from the Vadose Zone: A Practical Strategy for Assessing the Subsurface Vapor-to-Indoor Air Migration Pathway at Petroleum Hydrocarbon Sites
American Petroleum Institute, API 4741, 106 pp, Nov 2005

This API publication discusses soil gas transport with emphasis on petroleum hydrocarbon vapors, as well as the expected soil gas profiles based on empirical analysis of existing data; the conceptual vapor-migration model; sampling locations, depths, and frequency; monitoring installations and sample collection procedures; methods of soil gas analysis; and interpretation of soil gas data. Appendices include a site information checklist, worksheets for three typical scenarios that can be used for planning sampling locations, supporting information on analytical methods, and tools for data evaluation.
http://www.api.org/groundwater

Comparison of Immunoassay and Gas Chromatography/Mass Spectrometry for Measurement of Polycyclic Aromatic Hydrocarbons in Contaminated Soil.
Chuang, J.C., Y.L. Chou, N. Junod, J.K. Finegold, N.K. Wilson, and J.M. Van Emon.
Analytica Chimica Acta, Vol 486 No 1, p 31-39, 2003

A commercial enzyme-linked immunosorbent assay (ELISA), was evaluated as a screening method for monitoring polycyclic aromatic hydrocarbons (PAHs) at contaminated sites. The ELISA was a Carcinogenic PAH (C-PAH) RaPID assay testing kit that cross-reacts with several PAHs and utilizes benzo[a]pyrene (BaP) as a calibrator. Soil samples were extracted with 50% acetone in dichloromethane (DCM) for analysis by ELISA and gas chromatography/mass spectrometry (GC/MS). The ELISA results were compared to GC/MS summation results for the total 19 target PAHs as well as for the subset of the 7 B2-PAH compounds. For all soil samples, the PAH concentrations derived from ELISA were greater than the sum of B2 PAH concentrations obtained by GC/MS; however, results of paired tests show that though the PAH data from ELISA and GC/MS methods are significantly different ($p < 0.001$), they are also highly correlated. The ELISA data had a strong positive relationship with the GC/MS summation data for the B2 PAHs as well as for the 19 PAHs targeted by the GC/MS method. Results indicate that the ELISA may be useful as a broad screen for monitoring PAHs in environmental samples.

Comparison of Immunoassay and Gas Chromatography/Mass Spectrometry Methods for Measuring 3,5,6-Trichloro-2-pyridinol in Multiple Sample Media
Chuang, J.C., J.M. Van Emon, A.W. Reed, and N. Junod.
Analytica Chimica Acta, Vol 517 Nos 1-2, p 177-185, 2004

Two enzyme-linked immunosorbent assay (ELISA) methods were evaluated for the determination of the pesticide 3,5,6-trichloro-2-pyridinol (3,5,6-TCP) in multiple sample media (dust, soil, food, and urine). The dust and soil samples were analyzed by a commercial RaPID immunoassay testing kit. The food and urine samples were analyzed by a laboratory-based 96-microwell plate immunoassay format. Methanol was used as the extraction solvent for the preparation of the dust and soil samples for analysis by both the ELISA and gas chromatography/mass spectrometry (GC/MS) procedures. Chlorobutane was used for extraction of the urine samples for each method. The food samples were extracted with methanol for GC/MS and with

acidic methanol for ELISA. The percent difference of the duplicate RaPID assays ranged from 0 to 43.4% for dust and from 0 to 47.9% for soil. Quantitative recoveries of 3,5,6-TCP were obtained for the spiked dust, soil, food and urine samples by ELISA ranging from 71 to 102%. Quantitative recoveries (>90%) of 3,5,6-TCP were also obtained for these samples by the GC/MS procedure. The immunoassay and GC/MS data were highly correlated, with correlation coefficients of 0.98 for dust, 0.98 for soil, 0.93 for food and 0.98 for urine. Both ELISA methods can be used as quantitative monitoring tools for 3,5,6-TCP concentrations in dust, soil, food, and urine samples.

Comparison of Two Non-Invasive Methodologies to Monitor Diffuse Biogas Emissions From MSW Landfills Soil: a Case Study
Raco, B., A. Scozzari, M. Guidi, and M. Lelli (CNR, Pisa, Italy); G. Lippo (P&C Srl, Peccioli Pisa, Italy).
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 8 pp, 2005

Biogas is a mixture of CH4 (55 to 60%), CO2 (40 to 45%), and other organic compounds present as trace gases. Mapping the superficial distribution of biogas emissions is a necessary step for planning any upgrade in biogas collection and landfill coverage, as well as for checking the efficiency of both. The gas flux coming from the landfill surface can be measured directly with an accumulation chamber. This paper draws upon field experience at MSW landfills, using a geostatistical data processing approach and measurement techniques to build emission maps useful for site management. During a flux measurement survey, images of the landfill were taken with a longwave infrared radiometer, both hand-held and airborne. The correlation between infrared thermography images and biogas flux maps is discussed, including the possibility of using radiometric information as guidance for local flux measurements.

Congener-Specific Detection of Dioxins Using Jet-Rempi
Oser, H., K. Copic, M.J. Coggiola, G.W. Faris, and D.R. Crosley.
Chemosphere, Vol 43 No 4, p 469-478, 2001

Though 210 chemically different polychlorinated dibenzo-p-dioxin and dibenzofuran congeners can be produced during combustion, perhaps fewer than 20 are toxic enough to warrant monitoring. A continuous emissions monitor has been developed to study the emission levels of the most toxic dioxins and thereby to improve understanding of the formation of these molecules and means of monitoring and control. The authors report first results of performing congener-specific detection for two dichloro dibenzo-p-dioxins present in low ppt concentrations in a mixture using the supersonic jet/resonantly enhanced multiphoton ionization time-of-flight mass spectrometer technique. Preliminary data are presented on the detection of chlorinated aromatic compounds using a two-color REMPI scheme with the same instrument.

Conventional Analytical Methods for Chemical Warfare Agents
Hill, Herbert H., Jr. and Stephen J. Martin, Washington State Univ., Pullman.
Pure and Applied Chemistry, Vol 74 No 12, p 2281-2291, 2002

The authors review methods currently used for the detection and identification of chemical warfare agents and classify them by the number of dimensions of information they provide. Single-dimensional sensors target specific compounds or classes of compounds, and although they can be less expensive and more portable than multidimensional sensors, multidimensional sensors detect a broader threat spectrum with greater precision and accuracy. The authors recommend the use of simple 2-D analytical methods such as gas chromatography or ion mobility spectrometry for on-site screening of CW agents for analytical field verification during inspections under the Chemical Weapons Convention, or even to fully equip a modern, mobile analytical laboratory located in an airplane for rapid mobility in moving from site to site and providing high-quality analytical data on site.
http://www.iupac.org/publications/pac/2002/pdf/7412x2281.pdf

Design of a Wireless Sensor Network for Long-Term, In-Situ Monitoring of an Aqueous Environment
Yang, X. (Pennsylvania State Univ., University Park); K.G. Ong and W.R. Dreschel (SenTech Corporation, State College, PA); K. Zeng, C.S. Mungle, and C.A. Grimes (Pennsylvania State Univ.).
Sensors, Vol 2 No 11, p 455-472, Nov 2002

A new aqueous sensor network consists of an array of sensor nodes that can be randomly distributed throughout a lake or drinking water reservoir. The data of an individual node are transmitted to the host node via acoustic waves using intermediate nodes as relays. Each node of the sensor network serves as a data router and contains physical, biological, or chemical sensors, thus allowing long-term, wide-area, in situ, multi-parameter monitoring. This paper describes the application of the aqueous sensor network to pH measurement using magnetoelastic sensors. Beyond monitoring drinking water, possible applications for the aqueous sensor network include advanced industrial process control and monitoring aquatic biological communities or waste-stream effluents.
http://www.mdpi.org/sensors/list02.htm

Detecting Pesticide Residue by Using Modulating Temperature Over a Single SnO(2)-Based Gas Sensor
Huang, X., J. Liu, Z. Pi, and Z. Yu, Chinese Academy of Sciences, Hefei, China.
Sensors, Vol 3 No 9, p 361-370, Sep 2003

The authors report on a new rapid detection method ("dynamic measurements") to detect and distinguish the presence of two pesticide gases in ambient atmosphere. The method employs only a single SnO2-based gas sensor in a rectangular temperature mode to perform the qualitative analysis of a binary gas mixture (acephate and trichlorphon) in air. In tests, the sensor showed high selectivity in the range of 250 to 300 degrees C and modulating frequency 20mHz, allowing easy observation of the qualitative difference in response to pure acephate and pure trichlorphon gases of the same concentration, as well as to a gas mixture. The concentration of the pesticide gases can be obtained based on the changes of polar plots.
http://www.mdpi.org/sensors/list03.htm

Detection of Acetylene Gas Using Optical Correlation Spectroscopy
Cheung, A., W. Johnstone, and D. Moodie
OFS 2005: 17th International Conference on Optical Fibre Sensors, 23-27 May 2005, Bruges, Belgium.

This paper presents a novel variation in optical correlation spectroscopy in which a semiconductor optical amplifier is employed as the light source and an optical fiber delay line is used to achieve the 180 degree phase shift between the reference and measurement signals. The system was tested using acetylene gas. Absorption data from the HITRAN database were used to model the theoretical response of the system. Experimental results for the detection of various acetylene gas concentrations were obtained and compared with theory.
http://cmp.eee.strath.ac.uk/OFS-17%20AC.pdf

Detection of Heavy Metal Ions in Drinking Water Using a High-Resolution Differential Surface Plasmon Resonance Sensor
Forzani, Erica S., Haiqian Q. Zhang, Wilfred Chen, and Nongjian Tao.
Environmental Science & Technology, Vol 39, p 1257-1262, 2005

The authors have built a high-resolution differential surface plasmon resonance (SPR) sensor for heavy-metal ion detection. The sensor surface is divided into a reference and sensing areas, and the difference in the SPR angles from the two areas is detected with a quadrant cell photodetector as a differential signal. In the presence of metal ions, the differential signal changes due to specific binding of the metal ions onto the sensing area coated with properly selected peptides, which provides an accurate real-time measurement and quantification of the metal ions. Selective detection of copper and nickel in the ppt or ppb range was achieved by coating the sensing surface with the peptides NH2-Gly-Gly-His-COOH and NH2-(His)6-COOH. The sensor was tested on copper in drinking water.
http://www.engr.ucr.edu/~wilfred/EST%20NJ.pdf

Detection of Hydrocarbon Fuel Spills Using a Distributed Fibre Optic Sensor
Maclean, A., C. Moran, W. Johnstone, B. Culshaw, D. Marsh and P. Parker.
Sensors & Actuators: A. Physical, Vol 109 No 1-2, p 60-67, 2003

This paper describes a fiber-optic sensor capable of distributed detection of multiple hydrocarbon fuel and solvent spills. The sensor incorporates liquid-swelling polymers that when activated convert the swelling into a microbend force on an optical fiber. Sensor interrogation is conducted using a standard optical time domain reflectometry (OTDR) technique. Typical sensor response time after exposure to the fuel is 30 seconds using the current design. Sensors capable of locating 1-meter-long spill events with a location accuracy of 2.5 meters over a range of 2 km are reported. A brief description of the underlying technology and material evaluation tests is followed by initial sensor evaluation results. Lab and field trials demonstrating repeatability and the simultaneous location of multiple fuel spills are summarized, and the potential applications for this type of sensor technology are outlined.
http://cmp.eee.strath.ac.uk/detection%20hydrocarbon%20fuel%20spills.pdf

Detection of Solvents Using a Distributed Fibre Optic Sensor
MacLean, A., C. Moran, W. Johnstone, B. Culshaw, D. Marsh and P. Parker.
Electronics letters, Vol 39 No 17, p 1237-1238, 2003

The authors report on an optical fiber sensor capable of making fully distributed measurements of a wide range of solvents. The sensor incorporates optical fiber components that are readily available in the optical communications industry and a swelling polymer that responds on contact with liquid solvents, typically within 30 seconds of exposure. A conventional optical time domain reflectometry technique provides for sensor interrogation and location of multiple spill events over a range of 20 km. The sensor uses a low-power laser source to perform the sensing function. The swelling characteristics of the polymer material in a range of solvents and experimental test results of prototype sensors are presented.
http://cmp.eee.strath.ac.uk/distributed%20fibre%20sensor.pdf

Determination of the Vapor Pressures of Select Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans at 75-275 [degrees] C
Ryan, S., B.K. Gullett, D.G. Tabor, L. Oudejans, and A. Touati.
Chemical Engineering Science, Vol 60 No 3, p 787-796, 2005

This paper discusses the determination of vapor pressures for several polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) at 75 to 275 degrees C, extending the available literature data to more relevant temperature regions and providing the first experimental data for 2,3,7-trichlorodibenzo-p-dioxin (2,3,7-TriCD). A modification of the effusion technique, based upon controlling the diffusion of the target compound and subsequent high resolution gas chromatography/low resolution mass spectrometry analysis, compared well to other accepted methods for determining the vapor pressures of semi-volatile organic compounds. The use of the method to deliver reproducible trace concentrations (ppb and ppt) of targets was applied to the calibration of the jet-REMPI/TOFMS as an online detector for low chlorinated PCDDs/Fs.

Development of a Convenient Method of Monitoring Carbon Dioxide in Ambient Air at Landfill Sites Using a Portable Open Path Type Analyzer
Tanikawa, N., T. Furuichi, and K. Ishii, Hokkaido Univ., Sapporo, Japan.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy.

Carbon dioxide (CO2) is one of the main gases emitted from landfill sites. A portable open-pass CO2 analyzer (POCA) was developed from improvements to a natural gas leak tester to develop a convenient method of monitoring CO2 in ambient air. The POCA measurements were compared with those from a nondispersive infrared absorption (NDIR) CO2 analyzer and showed strong correlation between the respective measured values. The measured values of CO2 from the POCA had good repeatability. The developed method keeps a distance of 10 m between the POCA and the special reflector for using the POCA. CO2 and CH4 in ambient air at landfill sites were conveniently measured using the portable open-path analyzers.

Development of a Fiber Optic Chemical Sensor for Detection of Toxic Vapors
Bansal, Lalitkumar, Ph.D. thesis, Drexel University, 152 pp, Sep 2004

This thesis presents the development of a fiber-optic chemical sensor for detection of the organophosphorous nerve agent sarin precursor, dimethyl-methylphosphonate (DMMP). The developed optical fiber sensor is based on a modified cladding approach using the conducting polymer polypyrrole as a chemo-chromic material. Polypyrrole was synthesized by chemical oxidation and characterized by FTIR and Raman spectroscopy. To characterize the electrical and optical property changes that come about in polypyrrole upon exposure to DMMP, four probe techniques, ellipsometry, and thin-film transmission were used. The polypyrrole coating was applied to un-cladded fiber core using two different coating techniques: in situ deposition and monomer vapor-phase deposition. Preliminary results show an intensity decrease of 2.1% when the sensing element is exposed to 134 ppm of DMMP. Three different dopant anions -- napthalene disulphonic acid, anthraquenone sulfonic acid, and hydrochloric acid -- were added to improve the sensor sensitivity. The device was tested for DMMP sensitivity optimizations in terms of substrate nature, Cu2+ dopant, waveguide geometry, and light source intensity. The sensitivity optimization has resulted in a 25.75% sensor response and a detection of 26 ppm of DMMP concentration. Selectivity and environmental stability of the developed device were investigated. Mechanical property and adhesion were investigated using the nanoindentation and ASTM D-4541 pull-off test method. The influence of these adhesion enhancements on the sensor response were investigated.
http://dspace.library.drexel.edu/handle/1860/372

Development of a Surface Acoustic Wave Sensor for In-Situ Monitoring of Volatile Organic Compounds
Ho, C.K. (Sandia National Labs, Albuquerque, NM); E.R. Lindgren; K.S. Rawlinson; L.K. McGrath; J.L. Wright.
Sensors, Vol 3 No 7, p 236-247, July 2003

This paper describes the development of a surface-acoustic-wave (SAW) sensor that is designed to be operated continuously and in situ to detect volatile organic compounds. A ruggedized stainless-steel package that encases the SAW device and integrated circuit board allows the sensor to be deployed in air, soil, and even water. Polymers were optimized and chosen based on their response to chlorinated aliphatic hydrocarbons (e.g., trichloroethene), which are common groundwater contaminants. Initial testing indicates that a running-average data-logging algorithm can reduce the noise and increase the sensitivity of the in situ sensor.
http://www.mdpi.org/sensors/list03.htm

Development of a Systematic Approach to Accurately Measure Trace Levels of Volatile Organic Compounds and Semi-Volatile Organic Compounds in Soil and Sediment with High Moisture Content

Zimmerman, John H. and Brian A. Schumacher, U.S. EPA/ORD/NERL/ESD/CMB.

EPA Science Forum 2005: Collaborative Science for Environmental Solutions, 16-18 May 2005, Washington, DC.

Risk assessment is a crucial component of the site remediation decision-making process. Some current U.S. EPA methods do not have detection limits low enough for risk assessment of many volatile organic compounds (VOCs) (e.g., U.S. EPA Region 3 Risk-Based Concentration levels, U.S. EPA Region 9 Preliminary Remediation Goals, state-specified concentration levels). The magnitude of this problem was described in a paper recently presented at a University of Massachusetts Remediation Conference with the conclusion that the resolution of this issue is critical for valid human health and ecological risk assessments. Likewise, the difficulty of obtaining complete extraction of water-soluble VOCs and semivolatile organic compounds (SVOCs) makes the generation of reliable and reproducible data a serious concern in site characterization and risk assessment programs. This poster presents findings of the development of an analytical method that uses thermal desorption combined with dual gas chromatography/ mass spectrometry to extract and accurately measure low levels of VOCs and SVOCs in soil and sediment samples with medium to high moisture content. Thermal extraction was selected for examination because the technique is simpler and more efficient than the present U.S. EPA purge-and-trap methods, and all water-soluble compounds are amenable to the procedure. Efforts were made to modify commonly used instrumentation (e.g., the Archon™ autosampler) and quality control compounds (e.g., internal standards, surrogates) in the present U.S. EPA methods so that the proposed method can be easily adopted by routine analytical laboratories. This project is a Regional Applied Research Effort involving U.S. EPA Region 1 scientists, U.S. EPA/ORD/NERL/ESD/CMB scientists, and a cooperative research and development agreement with EST Analytical. The development of a U.S. EPA method capable of accurately measuring trace VOCs, water-soluble VOCs, and SVOCs is important for accurate risk assessment at Superfund, RCRA, and brownfield site redevelopment programs, as well as ongoing state site remediation projects.

http://www.epa.gov/nerl/news/forum2005.html

Development of Fibre Laser Systems for Ring-Down and Intra-Cavity Gas Spectroscopy in the Near-IR

Stewart, G., P. Shields, and B. Culshaw.

Measurement Science and Technology, Vol 15, p 1621-1628, 2004

The authors describe progress in the investigation of intracavity systems based on an erbium-fiber loop laser operating in the near-IR. Refinement of the ring-down system has extended the ring-down duration from approximately 100 us to above 10 ms, with digital signal processing to extract ring-down signals in the presence of relaxation oscillations and to provide a display of the attenuation history of the ring-down loop. Use of intracavity laser absorption spectroscopy avoids the need for an external input pulse, and a path-length enhancement factor of almost three orders of magnitude should be possible.

http://cmp.eee.strath.ac.uk/development%20fibre%20laser%20systems.pdf

Dibenzocyclamnickel(II) as Ionophore in PVC-Matrix for Ni(2+-) Selective Sensor
Gupta, Vinod K., Rajendra Prasad, and Azad Kumar, Indian Inst. of Technology, Roorkee, India.
Sensors, Vol 2 No 10, p 384-396, Oct 2002

A tetramethyldibenzocyclam derivative was synthesized, characterized, and used for the fabrication of a potentiometric sensor for Ni2+ metal ions. With a fast response time of 12 seconds, the sensor works well in the pH range of 2.0 to 7.6 and can be satisfactorily used in the presence of 40% (v/v) methanol, ethanol, or acetone. The sensor is highly selective for Ni2+ over a large number of mono-, bi-, and trivalent cations and has been successfully used as indicator electrode in the potentiometric titration of Ni2+ against EDTA. The practical utility of the sensor was tested by applying it for the estimation of Ni2+ in an electroplating waste and spent iron-chromium catalyst. The results indicate that the sensor can be successfully employed for the estimation of Ni2+ in real samples. The practical utility of the proposed sensor was also successfully demonstrated for the quantitative determination of Ni2+ in some Indian-brand chocolates.
http://www.mdpi.org/sensors/list02.htm

Diffusive Gradients in Thin-films (DGT): A Technique for Determining Bioavailable Metal Concentrations
International Network for Acid Prevention, 145 pp, Mar 2002

The International Network for Acid Prevention (INAP) commissioned Lorax Environmental Services Ltd. to conduct a two-phase study to establish the current state-of-knowledge of DGT technology (Phase 1) and to conduct further validation work on DGT (Phase 2). Phase one of the study consisted of a comprehensive literature survey to review the latest developments in DGT techniques and assess the applicability of DGT to mining-related environmental studies. Over 250 papers were reviewed and approximately 200 are cited in Part I of this report. Recognizing the limitations of conventional methods for estimating water quality, which are typically restricted to partitioning metals between total and "dissolved" phases, a variety of analytical and test methods have been used to quantify metal toxicity and speciation in natural waters and effluents. Virtually all of the techniques suffer inadequacies that limit their general use. For example, most existing speciation and toxicity techniques must be carried out in a laboratory, rather than in situ, resulting in the potential for changes in metal speciation and therefore toxicity. Electrochemical in situ speciation techniques require expensive instrumentation that must be used by highly trained operators, making such techniques onerous and nonroutine. DGT represents a relatively new approach for in situ determinations of labile metal species in aquatic systems. The DGT device passively accumulates labile species from solution while deployed in situ and therefore contamination problems associated with conventional water collection and filtration procedures are eliminated. Since DGT affords an operationally defined measure of the labile, or "bioavailable" fraction, inferences can be made with respect to metal toxicity. The theory behind DGT is based on the diffusional characteristics of metals in a hydrogel and on the ion exchange properties of a metal-binding resin. Specifically, the technique utilizes a hydrogel layer to control the diffusive transport of metals in solution to a cation-exchange resin. Because the resin used in DGT (Chelex) is selective for free or weakly complexed species, it provides a proxy for the labile fraction of metals in solution. DGT utilizes a three-layer system consisting of a resin-impregnated hydrogel layer, a hydrogel diffusion-layer,

and a filter membrane. The innermost two gel layers are fabricated from a polyacrylamide hydrogel. The filter membrane isolates the polyacrylamide surface from particles in the water. Labile metal ions in solution diffuse across the filter and gel layers and are pre-concentrated on the resin. Based on the laws of diffusion and the established characteristics of the diffusive path in the DGT sampler, the concentration of labile metals in solution can be calculated using the measured metal ion inventory on the resin, the sampler exposure time and the temperature-corrected molecular diffusion coefficient for the metal of interest. A qualification of the method is that the calculated labile-metal concentration depends on the diffusion coefficient D adopted for the hydrogel. Ionic strength, pH, and solution composition can influence the rate of diffusion, for example by affecting the behavior of functional groups on the polyacrylamide, which may become ionized.
http://www.inap.com.au/public_downloads/Research_Projects/Diffusive_Gradients_in_Thin-films.pdf

Direct Determination of p-Nitrophenyl Substituent Organophosphorus Nerve Agents Using Recombinant Pseudomonas putida JS444-Modified Clark Oxygen Electrode
Lei, Yu, Priti Mulchandani, Wilfred Chen, and Ashok Mulchandani.
Journal of Agricultural and Food Chemistry, Vol 53, p 524-527, 2005

This paper reports the development of a microbial biosensor for rapid, sensitive, selective, and cost-effective determination of the total content of organophosphorus nerve agents with p-nitrophenyl substituent. The biosensor consists of genetically engineered PNP-degrader Pseudomonas putida JS444 expressing organophosphorus hydrolase (OPH) on its cell surface immobilized on a dissolved oxygen electrode. When operated at optimized conditions, the biosensor measured as low as 55 ppb of paraoxon, 53 ppb of methyl parathion, and 58 ppb of parathion without interference from most phenolic compounds and other commonly used pesticides, such as atrazine, coumaphos, sutan, sevin, and diazinon. The operational life of the microbial biosensor was about 5 days when stored in the operating buffer at 4 degrees C.
http://www.engr.ucr.edu/~wilfred/J%20Ag.%20Chem.pdf

DNAPL Site Characterization for Waste Management at Manufactured Gas Plant (MGP) Sites
Electric Power Research Institute (EPRI), Palo Alto, CA. Report No: 1011170, Dec 2004

Determining the optimal waste management strategy at manufactured gas plant (MGP) sites requires adequate site characterization to provide data for remediation decisions, a task that is particularly challenging when dense nonaqueous phase liquids (DNAPLs) are present. This report discusses the development of an appropriate characterization strategy for manufactured gas plant (MGP) sites contaminated with dense nonaqueous phase liquids (DNAPLs), including parameters that should be characterized, tools for characterization, and the relation between characterization goals, a developing site conceptual model, and characterization design. The text was compiled from published reports, emphasizing reported results from MGP site characterizations. Essential information is provided in as brief a form as possible, and links are provided to more extensive articles, emphasizing online sources. Light nonaqueous phase liquids (LNAPLs) and dissolved-phase plume characterization are briefly described, as characterization methods for them are well established. Site characterization should include determining permeability, thickness, continuity, and general structure of hydrogeological units.

Groundwater flow regimes should be determined from measurements of hydraulic head distribution. Characterizing contamination usually begins with establishing the presence of contamination, which due to past practices at MGP sites is generally already known. Once the presence of contamination is established, the limits of contamination generally must be determined. This phase of characterization may be made more efficient using rapid analytical methods allowing dynamic modification of the sampling plan based on interim results. The probable existence of DNAPL, typically indicated by high concentrations in the aqueous phase or high concentrations in soil samples, leads to additional characterization requirements since the distribution of DNAPL will be quite different from the distribution of dissolved-phase contamination. The objectives of a characterization effort must be explicitly defined to determine the level of characterization required. Although conventional drilling-based methods provide high-quality data, extensive data requirements for DNAPL characterization suggest that alternative, less expensive methods such as push-in tools, field analytical methods, and geophysical methods should be used when possible. Geophysical techniques have proven capabilities in site characterization, but have had limited success in direct detection of DNAPL.

Elements of Quality Assurance in Monitoring Volatile Organic Compounds at Trace Levels
McClenny, W.A.
14th Annual Quality Assurance Conference, Dallas, TX, October 18-22, 2004.

Monitoring for air toxic VOCs at sub-ppbv concentrations has been demonstrated in the TO-15 Supplement recently published by the EPA. While this approach uses specially prepared canisters for sampling and storage of the air samples, the use of solid adsorbents has now been investigated for the same purpose. Examples of the results obtained with both canisters and solid adsorbents are given along with a discussion of the quality assurance guidelines in both cases.
http://www.epa.gov/Arkansas/6pd/qa/co4-p3.pdf

Energy-Dispersive X-Ray Fluorescence Systems as Analytical Tool for Assessment of Contaminated Soils
Vanhoof, C., V. Corthouts, and K. Tirez.
Journal of Environmental Monitoring, Vol 6 No 4, p 344-350, 2004

Demand is increasing for analyses that can be performed in the field with immediate feedback of the analytical results. For this purpose, the authors evaluated four types of ED-XRF systems, ranging from portable to high-performance laboratory equipment. The evaluation criteria are based on performance characteristics such as limit of detection, accuracy, and the measurement uncertainty, as well as the influence of sample pretreatment on the obtained results. The study showed that a field-portable system and a mobilized bench-top system (e.g., placed in a mobile van) can be applied as field techniques to achieve semi-quantitative analytical results. The bench-top system produced more accurate results and reduced measurement uncertainty. The selection of a field system should be based on the required detection level and accuracy of results.

Environmental Studies with the Sensor Web: Principles and Practice
Delin, K.A., S.P. Jackson, D.W. Johnson, S.C. Burleigh, R.R. Woodrow, and J.M. McAuley (NASA/Jet Propulsion Laboratory, Pasadena, CA); J.M. Dohm, F. Ip, T.P.A. Ferre, D.F. Rucker, and V.R. Baker (Univ. of Arizona,Tucson).
Sensors, Vol 5 No 1-2, p 103-117, Jan/Feb 2005

The Sensor Web was conceived at the NASA/Jet Propulsion Laboratory (JPL) in 1997 to take advantage of increasingly inexpensive, yet sophisticated, mass consumer-market chips for the computer and telecommunication industries and use them to create platforms that share information among themselves and act in concert as a single instrument. This instrument would be embedded into an environment to monitor and even control it. The Sensor Web's purpose is to extract knowledge from the data it collects and to use this information to react and adapt to its surroundings. It links a remote end-user's cognizance with the observed environment. This paper examines not only current progress in the Sensor Web technology, but also its recent application to problems in hydrology to illustrate the general concepts involved.
http://www.mdpi.net/sensors/list05.htm

An Enzyme-Linked Immunosorbent Assay (ELISA) for Determining Dioxins in Sediment and Soil Samples
Van Emon, J.M., J.C. Chuang, B. Lordo, M. Nichkova, S.J. Gee, and B. Hammock.
EPA Science Forum 2005: Collaborative Science for Environmental Solutions, 16-18 May 2005, Washington, DC.

The dioxins comprise a family of compounds chemically referred to as polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). The most toxic of these compounds is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a known human carcinogen. Dioxins are formed mainly as byproducts of industrial processes (e.g., waste incineration) and can also be produced from natural processes (e.g., volcanic eruption or forest fire). Exposure to dioxins has been linked to various adverse health effects such as severe skin disease (chloracne), birth defects, and an increased risk of cancer. Non-occupational routes of exposure to dioxins include inhalation of contaminated air, ingestion of contaminated food and non-food items, and dermal contact. Conventional analytical methods for determining dioxins rely on sophisticated instrumentation, such as gas chromatographs and high resolution mass spectrometers. These methods are typically time consuming and costly, severely limiting the number of samples that can be processed. Low-cost field screening methods and efficient high-capacity laboratory methods are needed to support large-scale environmental monitoring and human exposure assessment studies. Immunoassays, such as the enzyme-linked immunosorbent assay (ELISA), use antibodies to analyze samples rapidly and cost effectively. An ELISA has been developed at the University of California, Davis, for the detection of various dioxins. More than 80 sediment and soil samples from a U.S. EPA Superfund site were analyzed by the ELISA and compared with an instrumental method. The findings suggest that the ELISA method can be used as a quantitative monitoring tool for determining dioxin levels in monitoring studies and to determine dioxin toxic equivalent values in environmental samples.
http://www.epa.gov/nerl/news/forum2005.html

Evaluating Presence of TCE Below a Semi-Confining Layer in a DNAPL Source Zone
Yoon, S.W-S., A.R. Gavaskar, J. Sminchak, C. Perry, and E. Drescher (Battelle); J.W. Quinn (NASA, Cape Canaveral Air Station, FL); T. Holdsworth (U.S. EPA, Cincinnati, OH). Proceedings of the Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2002). Battelle Press, Columbus, OH. ISBN 1-57477-132-9, Paper 1E-05, 9 pp, 2002

Three dual-stage monitoring wells were installed in a DNAPL source zone at Launch Complex 34, Cape Canaveral Air Station, FL, to determine the presence of DNAPL or dissolved-phase TCE contamination below a relatively thin aquitard. The monitoring wells were installed with a telescopic dual-stage method to isolate the DNAPL in the surficial aquifer and prevent any vertical DNAPL migration into the deep aquifer. A mud-rotary drilling rig was used to isolate the DNAPL, while a continuous outer casing was keyed into a semi-confining clay unit above the lower (deep) aquifer. The aquitard was determined to be a semi-confining layer with approximately 3 ft in thickness. After the outer surface casing was set and grouted, a continuous smaller inner casing was installed within the outer casing to isolate any DNAPL in the upper aquifer. The inner stainless steel casing penetrated the semi-confining unit to the deep aquifer, with the screen depths at 55 to 60 feet below ground surface (bgs) level. During the well installation, the drilling mud was screened for volatile organic compounds (VOCs) with a photoionization detector (PID) to evaluate any potential drag-down of DNAPL or dissolved-phase contamination from near the bottom of the surficial aquifer to the deep aquifer. At no time did the PID detect VOCs in the drilling mud, indicating that no significant contamination was entering the borehole and migrating downward as the drilling advanced. Soil samples were collected continuously beginning a few feet above the semi-confining clay layer to a few feet below this clay unit into the deep aquifer. These soil samples, as well as groundwater sampling from the completed monitoring wells, indicated that TCE was present in the clay, as well as in the deep aquifer below the clay layer at some locations. The wells were also used to determine the hydrologic properties of the deep aquifer. The well installation technique provided an effective way of monitoring the deep aquifer in the DNAPL source zone for the presence of contamination.
http://www.rr-inc.com/Frame%20Pages/Case%20Studies/lc34/1E-05.pdf

Evaluating the Sensitivity of Screening-Level Vapor Intrusion Models
Weaver, Jim (U.S. EPA, ORD/NERL/ERD); Fred Tillman (NRC).
EPA 2004 Science Forum, 1-3 June 2004, Washington, DC. Poster presentation.

A screening-level model may be employed to determine if a potential indoor inhalation exposure pathway exists, and if such a pathway is present, whether long-term exposure increases the occupants' risk for cancer or other toxic effects to an unacceptable level. A popular screening-level algorithm for making such determinations is the Johnson and Ettinger (J&E) model. EPA's Office of Emergency and Remedial Response issues several spreadsheet variations of the basic J&E model through their website at
http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm
Though the J&E model is appealing because of its simple nature, there are unanswered scientific questions concerning its application: (1) Does the model consistently produce the "conservative" results necessary in deciding upon further action? (2) How important are the choices of various input parameters? (3) Would changes in basic assumptions significantly change model outputs?

To answer these questions, a web-based version of the model is being developed (http://www.epa.gov/athens/onsite) so that the sensitivities and uncertainties of this model can be assessed. A new decision-tree structure drives the model input process, requesting information from the user and selecting subsequent data and models based on user response. This approach to using the model is designed not only to answer the scientific questions by providing best estimates of indoor air concentration, but also to provide upper and lower concentration bounds based upon the ranges of possible inputs. Where multiple conceptual formulations of the model can be used, the analysis also evaluates the sensitivities introduced by the choice of model itself. These results are expected to provide an improved basis for the use of models in a risk screening protocol.
http://www.epa.gov/nerl/news/forum2004.html

Evaluation of Geophysical Methods for the Detection of Subsurface Tetrachloroethylene in Controlled Spill Experiments
Mazzella, Aldo (U.S. EPA ORD/NERL/ESD/CMB); Ernest L. Majer (Lawrence Berkeley National Laboratory, Berkeley, CA).
EPA Science Forum 2005: Collaborative Science for Environmental Solutions, 16-18 May 2005, Washington, DC.

Tetrachloroethene (PCE), typically used as a dry cleaning solvent, is a predominant contaminant in the subsurface at Superfund sites. PCE is a dense non-aqueous phase liquid (DNAPL) that migrates downward into the earth, leaving behind areas of residual saturation and free product pools on areas of low permeability. These residues can act as long-term sources of drinking water contamination. The purpose of the described research is to evaluate the use of geophysical methods to detect this PCE. A series of controlled spill experiments have been conducted in which measurements with various geophysical methods were made before, during, and after the injection of PCE into the subsurface. These results clearly identified any geophysical anomaly associated with the PCE. The experiments were conducted at the Canadian Forces Base Borden with the University of Waterloo and at the Oregon Graduate Institute with the U.S. Geological Survey. Different geophysical methods were tested in each of these experiments with good success; however, the presence of steel walls and tanks to contain the migration of the PCE prevented the evaluation of some of the geophysical methods. To evaluate these other methods, an experiment was conducted with the Lawrence Berkeley National Laboratory in a nonmetallic fiberglass tank at the University of California, Berkeley. In May 2004, an experiment was conducted in which 85 liters of PCE was injected into the subsurface of a constructed sand and sand/clay formation. Ten different geophysical methods were used to monitor the subsurface properties before, during, and after the injection. Preliminary results show significant changes in the responses of most of the geophysical methods with the presence of the PCE. The results are undergoing analysis to provide PCE detection limits of the various geophysical methods. The research results will be published in the peer-reviewed literature and incorporated into a revised version of the Geophysics Advisor Expert computer program, which has been widely used by EPA remedial project managers and other hazardous waste site investigators. The results will provide better guidance on the use of geophysical methods for the subsurface detection of DNAPLs at hazardous waste sites.
http://www.epa.gov/nerl/news/forum2005.html

Evaluation of the Hydraulic Performance of a Full-Scale Permeable Reactive Barrier by a Tracer Study
Lai, K.C.K. (Hong Kong Univ. of Science & Technology, Kowloon); P. Kjeldsen (Technical Univ. of Denmark, Lyngby); I.M.C. Lo (Hong Kong Univ. of Science & Technology). Permeable Reactive Barriers (Proceedings of the International Symposium held at Belfast, Northern Ireland, March 2004). IAHS Publ. 298, p 144-153, 2005

At the Vapokon site in Denmark, an investigation of the hydraulic performance of a funnel-and-gate permeable reactive barrier (PRB) packed with zero-valent iron was conducted with a natural gradient tracer study. The investigators sought to evaluate the flow pattern and determine the seepage velocity (vx) of groundwater through the PRB. After collecting and analyzing about 13,000 groundwater samples over a period of 10 months, the moving path of the tracer (i.e. lithium, Li+) was identified in which the Li+ plume was observed passing through the PRB. A preferential path was discovered inside the PRB, probably owing to clogging caused by mineral precipitates. Comparison of the water table contour in the Vapokon site obtained in March 2000 and January 2003 showed formation of a low permeability zone within the barrier, which further verified mineral precipitates clogging. Based upon the results of first moment analysis, a vx of 99.5 m/year within the PRB was calculated; however, the vx just upgradient of the reactive barrier was only about 6.86 m/year, likely owing to the effect of disturbance exerted by the clogged upgradient interface of the upper part of the PRB.

Evaluation of Xenon Gas Detection as a Means for Identifying Buried Transuranic Waste at the Radioactive Waste Management Complex, Idaho National Environmental and Engineering Laboratory
Dresel, P. and S.R. Waichler, Pacific Northwest National Laboratory, Richland, WA. PNNL-14617, 42 pp, Apr 2004

Xenon, an inert rare gas, is produced as a fission product in nuclear reactors and through spontaneous fission of some transuranic (TRU) isotopes. Xenon gas will be released from buried TRU waste. This document describes and evaluates the potential for analyzing xenon isotopes in soil gas to detect TRU waste in the subsurface at the Idaho National Environmental and Engineering Laboratory's Radioactive Waste Management Complex. Two complementary methods for xenon isotope measurements are evaluated: radiometric analysis of short-lived radioxenon isotopes and mass spectrometry for detection of stable xenon isotopes. The radioxenon analysis has greater sensitivity due to the lower background concentrations than the stable isotopes. Stable isotope ratios can be used to distinguish irradiated fuel sources from pure spontaneous fission sources. Numerical modeling indicates that, under generalized burial-ground conditions, the radioxenon isotopes will diffuse away from the waste and be found in the cap and adjacent to the burial ground at levels many orders of magnitude above the instrumental detection limit. The greatest unknown in the evaluation is the release rate of xenon from the waste forms. The release rate will be dependent on the type of waste and container integrity. Due to their short half lives, the radioxenon isotopes will be most affected by slow release rates. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14617.pdf

An Experimental Dielectric System Using Flexible Integrating Probe for Waste Water Content Measurement
Bouye, J.-M. (Cemagref, Antony, France); M. Chanet (Cemagref, Aubiere, France); C. Heckmann and S. Moreau (Cemagref, Antony, France).
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy.

A laboratory experiment was carried out to study the feasibility of estimating the water content of waste via the insertion of simple and economical equipment, i.e., flexible, coated time-domain transmission (TDT) probes. In a 1-cubic-meter waste tank, several flexible probes were set at different levels. Beginning with dry waste, water levels were gradually generated to obtain saturated and drained waste to establish an experimental calibration relationship TDT signal to water content. The method results appear to be reproducible. Means of development are suggested to increase the operational character of the system, particularly for volume of measurement, and potential industrial applications for landfills are proposed.

Fibre Laser Systems for Intra-Cavity Gas Spectroscopy in the Near-IR
Stewart, G., P. Shields, and B. Culshaw.
Photon '04: Optics and Photonics 2004, 6-9 September, Glasgow, 2004. [abstract only]

A micro-optic open-path gas cell can be incorporated within the lasing cavity (intra-cavity cell) of a fiber laser. Continuing development has extended the range of operation over 1480 to 1620nm, encompassing the near-IR absorption lines of numerous gases. Progress is described in the development of two methods--ring-down cavity and intra-cavity laser absorption spectroscopy--to achieve multiple circulation of light within a fiber laser cavity for path-length enhancement. Ring-down times have been extended out to several milliseconds and Labview environment has been introduced with digital band-pass filtering to extract ring-down signals in the presence of relaxation oscillations and to display the attenuation history of the ring-down loop. A detailed analysis has been performed on the relaxation oscillations induced during transient operation of the laser to measure upper state lifetimes and build-up times, with the aim of capturing mode evolution spectra in the presence of intra-cavity absorbers.

Fibre Lasers for Near-IR Gas Spectroscopy
Stewart, G., G. Whitenett, J. Marshall, and B. Culshaw.
Second European Workshop on Optical Fibre Sensors, 9-11 June 2004, Santander, Spain.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 5502, p 329-333, 2004

To take advantage of the potential of fiber lasers as sources for gas sensors in the near infrared, challenges need to be met, particularly in regard to stable tuning, application of high sensitivity detection techniques, and operation over an extended range of wavelength. Some problems may be addressed through an alternative configuration using a short, polarization-maintaining cavity and a Faraday rotator mirror (the sigma fiber laser). Initial experiments conducted on the sigma fiber laser have investigated the gain that can be achieved through double pass operation as compared with the prediction of a theoretical model that takes into account the effects of amplified spontaneous emission. The authors propose several fiber laser

designs for potential application to gas spectroscopy systems. Their goal is to realize a range of gas sensors capable of multi-point and multi-gas sensing at an acceptable cost.
http://cmp.eee.strath.ac.uk/EWOFS_04GS.pdf

Field-Effect Enzyme Sensor for the Detection of Pesticides
Thust, M., A. Mulchandani, J. Wang, M. Arzdorf, P. Mulchandani, W. Chen, and M.J. Schoning.
Technisches Messen, Vol 70, p 561-564, 2003

Toxic organophosphorus compounds are often used as pesticides, insecticides, and nerve agents. The authors propose a field-effect enzyme sensor that is fast, selective, reversible, easy to produce, and highly stable in the long term.

Field Method Comparison Between Passive Air Samplers and Continuous Monitors for Volatile Organic Compounds and NO2 in El Paso, Texas, USA
Mukerjee, S., L. Smith, G.A. Norris, M.T. Morandi, M. Gonzales, C.A. Noble, L. Neas, and A.H. Ozkaynak.
Journal of Air & Waste Management Association, Vol 54 No 3, p 307-319, 2004

The authors evaluated the performance of Model 3300 Ogawa(TM) Passive NO2 Samplers and 3M(TM) 3520 Organic Vapor Monitors (OVMs) by comparing the integrated passive sampling concentrations to averaged hourly NO2 and VOC measurements made at two continuous air monitoring stations (CAMS) operated by the Texas Commission on Environmental Quality (TCEQ) in the U.S.-Mexico border city of El Paso, TX. Passive samplers were deployed over three time intervals (3 day weekend, 4 day weekday, and 7 day weekly) for three consecutive weeks in November/December 1999. Highly precise results (< 5 % relative standard deviation, RSD) were found for NO2 measurements from collocated Ogawa samplers. Reproducibility was lower from duplicate OVMs for the BTEX (benzene, toluene, ethylbenzene, and xylene isomers) VOC species (≥ 7 % RSD for 2 day samples) with better precision for longer sampling periods. Comparison of Ogawa NO2 samplers with chemiluminescence measurements averaged over the same time period suggested potential calibration problems with the chemiluminescence analyzer at the sites, though further evaluation of the Ogawa sampler with continuous measurements was considered necessary. For the BTEX species compared, generally good agreement was obtained between OVMs and auto-GC measurements. The OVMs successfully tracked increasing levels of organic pollutants recorded by the continuous monitors. Except for toluene, the OVM BTEX measurements generally exceeded their continuous counterparts with a mean bias ranging from 5 to 10 %. Though the interpretation of the study results was limited due to small sample sizes, diffusion barrier influences due to the design of the shelters, used to house the OVMs and differences in sampling heights between OVMs and the auto-GC inlet may explain the over-estimation. This study demonstrates the need to perform additional evaluation of collocated passive samplers/with continuous monitors and/or other pumped sampling methods to further evaluate the precision and sampling rate.
http://www.ogawausa.com/techpapers/fieldmethod.pdf

Final Technical Report for the Airborne, Optical Remote Sensing of Methane and Ethane for Natural Gas Pipeline Leak Detection
Myers, J., Ophir Corporation, Littleton, CO.
NTIS: DE00841423, 122 pp, Apr 2005

Ophir Corporation was awarded a contract by DOE's National Energy Technology Laboratory under the Project Title, "Airborne, Optical Remote Sensing of Methane and Ethane for Natural Gas Pipeline Leak Detection," on October 14, 2002. The scope of work involved designing and developing an airborne, optical remote sensor capable of sensing methane and, if possible, ethane for the detection of natural gas pipeline leaks. Flight testing using a custom dual-wavelength, high-power fiber amplifier was initiated in February 2005. Ophir successfully demonstrated the airborne system, showing that it was capable of discerning small amounts of methane from a simulated pipeline leak. The duoThane(R) sensor successfully detected a simulated pipeline leak from an airborne platform 500 feet above ground level traveling at a speed of 100 miles per hour. Leak rates as low as 150 standard cubic feet per hour (scf/h) were detected by the airborne sensor. The company plans to ruggedize the instrument before introducing the sensor to the market. Combining visual airborne surveys with remote sensing surveys can alleviate the need for walking or driving surveys, particularly in areas with challenging terrain.
http://www.osti.gov/bridge/servlets/purl/841423-nz6Phj/native/841423.pdf

Flame Ionisation Detector and Linear Kriging Method for Landfill Cap Leakage Detection
Awono, S., C. Collart, A. Kheffi, R. Fafchamps, and P. Dengis, Inst. Scientifique de Service Public (ISSeP), Liege, Belgium.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 2005

A linear kriging method was used in combination with a flame ionization detector (FID) for methane emission detection and localization in a landfill capping system. A time evolution assessment of top cover leakages can also be assessed. The FID is used for methane semi-quantitative measurement and data are processed with the linear kriging method to plot methane emission zones at the landfill surface. The method is easy to implement. This paper illustrates an application of the method at the Cour-au-Bois site. Methane emission monitoring on five landfill cells equipped with a final or provisional capping system showed little or no emission from the cells covered with a final cap and zones of degassing methane from the provisional ones.

Fluorescent Sensors for Detecting Mercury in Aqueous Media
Nolan, Elizabeth M. and Stephen Lippard, Massachusetts Institute of Technology, Cambridge.
226th American Chemical Society National Meeting, 7-11 September 2003, New York, NY

In a first step toward the development of fluorescent tools for mercury detection in water and biological samples, the authors have created several water-soluble fluorescent sensors for Hg(II) detection. These probes contain a fluorescein reporting group and exhibit selective fluorescence enhancement upon addition of Hg(II). The syntheses and photophysical properties of these compounds are described.

Gas Detection Using Open Path Micro-Optic Cells and Spectroscopic Techniques
Duffin, K.
PREP 2004, 5-7 April 2004, Univ. of Hertfordshire, UK. 2 pp.

When waste has been left to decompose on a landfill site for over a year, it begins to emit a methane-rich biogas that can be harnessed and used as an energy source. CO2, O2, and N2 are also present in raw landfill gas. For optimum use of the resource, quantitative and discriminate measurements of concentration must be available all over the site. Because methane is explosive when above LEL1, constant high-speed measurements of methane are essential to prevent the recurrence of such unfortunate events as the Piper Alfa disaster in 1988. This paper documents the progress made on a multi-point environmental gas analyzer.
http://cmp.eee.strath.ac.uk/duffin%20k.pdf

Geophysical Techniques Help Monitor Microbial Remediation
Petkewich, Rachel.
ES&T Technology News, 17 Aug 2005

Scientists at Lawrence Berkeley National Laboratory and the University of California, Berkeley, have demonstrated how researchers can use two complementary geophysical techniques to monitor microbes that remediate metals in contaminated aquifers, without putting equipment into the ground. Their work showed that 20 days after biostimulation, acoustic wave signatures began to deviate from their baselines. The spectral changes suggest that the metals are precipitating and being sequestered as the result of microbial action. Microbes reduce sulfate to sulfide, and then precipitate metals as metal/sulfide minerals. In the past 20 years, environmental scientists have used complex resistivity and acoustic waves at the surface to locate underground pollutant plumes or to characterize source points. Now they are using both techniques to monitor changes brought about by microbial processes. Specifically, the researchers examine how the geophysical signatures change as sulfate-reducing microbes process metals and form mineral precipitates. These techniques can be run at the surface and have been modified for a high degree of resolution in field tests to a depth of 10 meters. Complex resistivity, also known as induced polarization, measures how currents change as they pass through sediments. The acoustic wave technique measures changes in velocity and amplitude of sound waves. Mineral products of microbial reactions alter the way both current and mechanical waves move through sediments. For example, the sulfate-reducing bacterium, Desulfovibrio vulgaris, contained in a sand column, was stimulated to degrade iron and zinc compounds. The researchers monitored changes in the column with the nondestructive techniques and identified the mineral products by chemical testing. By analyzing the current and wave data collected over time from the test column, they could create visual representations of the microbes' progress.
http://pubs.acs.org/subscribe/journals/esthag-w/2005/aug/tech/rp_microbes.html

Groundwater Remediation Engineering: Study on the Flow Distribution of Air Sparging Using Acetylene
Zheng, Yan-Mei; Y. Zhang; G.-Q. Huang; B. Jiang; X.-G. Li, Tianjin Univ., Tianjin, China.
Journal of Environmental Sciences, Vol 17 No 3, p 437-439, 2005

Air sparging performance to remove VOCs from saturated soils and groundwater depends greatly on the air distribution resulting in the aquifer. A 2-D experimental chamber was designed and installed to study gas flow characterization, with acetylene used as a tracer to directly image the gas distribution results of the air sparging process. Experiments were later performed with different injected gas flow rates, and the gas flow patterns were found to depend significantly on the injected gas flow rate. The characterization of gas flow distributions in porous media was very different from the acetylene tracing study. Lower and higher gas flow rates generally showed more irregularity in shape and less effective gas distributions.

Hazardous Gas Detection with an Integrating Sphere in the Near-Infrared
Hawe, Eamonn (Univ. of Limerick, Limerick, Ireland), Elfed Lewis, and Colin Fitzpatrick.
Journal of Physics: Conference Series, Sensors & Their Applications XIII, Vol 15, p 250-255, 2005

This paper describes an optical fiber near-infrared carbon dioxide sensor. In an integrating sphere test cell, multiple reflections within the sphere increase the path length. When light from a C + L band ASE source is transmitted through the sphere, any absorption is detected using a near-IR spectrometer. A change in optical intensity was observed at a wavelength of 1.59 um when carbon dioxide was present, from which the carbon dioxide concentration can be determined.
http://ej.iop.org/links/q87/u7ncYgAjLDbPbC0MjQCbRw/jpconf5_15_042.pdf

Helium Tracer Tests for Assessing Air Recovery and Air Distribution During In Situ Air Sparging
Johnson, R.L., P.C. Johnson, T.L. Johnson, and A. Leeson, Battelle, Columbus, OH.
AFRL-ML-TYTP-2000-4580, NTIS: ADA406353, 22 pp, 2001

Helium tracer tests are used as an alternative to soil-gas pressure measurements to assess the effectiveness of soil vapor extraction (SVE) systems for capturing contaminant vapors liberated by in situ air sparging (IAS). The tracer approach is simple to conduct and provides more direct and reliable measures than the soil-gas pressure approach. The tracer test described here can be used to both determine SVE system capture efficiency and to evaluate air distribution during IAS pilot tests. The tests can also be conducted on operating, full-scale systems to confirm system performance. In addition, tests can be easily repeated, which allows system parameters to be modified and the impact of those modifications to be quickly assessed. Whether used alone or in conjunction with other diagnostic tools, helium tracer tests provide an important measure of IAS system performance.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA406353&Location=U2&doc=GetTRDoc.pdf

Highly Sensitive and Selective Amperometric Microbial Biosensor for Direct Determination of p-Nitrophenyl Substituted Organophosphate Nerve Agents
Lei, Yu, Priti Mulchandani, Wilfred Chen, and Ashok Mulchandani.
Environmental Science & Technology, Vol 39 No 22, p 8853-8857, 2005

A whole-cell-based amperometric biosensor has been developed for single-step, selective, sensitive, direct, rapid, and cost-effective determination of organophosphate pesticides with a p-nitrophenyl substituent. The biosensor contains a p-nitrophenol degrader, Pseudomonas putida JS444, which has been genetically engineered to express organophosphorus hydrolase (OPH) on the cell surface immobilized on the carbon paste electrode. The best sensitivity and response time were obtained using a sensor constructed with 0.086 mg dry weight of cells operating at 600 mV applied potential (vs Ag/AgCl reference) in 50 mM citratephosphate pH 7.5 buffer with 50 IM CoCl2 at room temperature. Under optimum operating conditions the biosensor measured as low as 0.28 ppb of paraoxon, 0.26 ppb of methyl parathion, and 0.29 ppb parathion, which are comparable to the detection limits achieved by cholinesterase inhibition-based biosensors. The service life of the microbial amperometric biosensor was 5 days when stored in the operating buffer at 4 degrees C.
http://www.engr.ucr.edu/~wilfred/EST%20Whole%20Amper%2005.pdf

How to Measure the Effectiveness of Different Soil Treatments for Improving Pollutant Availability Using a Differential Availability Factor
Poggi-Varaldo, H.M.; S. Caffarel-Mendez; N. Rinderknecht-Seijas; I. Sastre-Conde, CINVESTAV-IPN, Mexico D. F., Mexico.
Remediation of Contaminated Sediments 2003: Proceedings of the Second International Conference on Remediation of Contaminated Sediments. Battelle Press, Columbus, OH. ISBN: 1574771434, 2004

The authors discuss an availability enhancement factor (AEF) and its usefulness for determining the effectiveness of desorption treatments of pollutants from soils and sediments. The AEF is defined as the ratio of the slope of the desorption curve of a given pollutant, with a surfactant or solvent treatment, to the slope of the corresponding desorption curves, with distilled water. Simple algebraic equations were developed for finding the values of the AEF based on the coefficient of hysteresis or in terms of the desorption parameters for the most common desorption isotherm. The AEF is useful as a semi-empirical tool for in vitro tests of adsorption irreversibility and the availability of a pollutant.

Hydrodynamic Modelling for Coupled Free and Porous Domains While Designing Permeable Reactive Barriers
Das, Diganta Bhusan, Oxford University, Oxford, UK.
Permeable Reactive Barriers (Proceedings of the International Symposium held at Belfast, Northern Ireland, March 2004). IAHS Publication 298, p 136-143, 2005

Groundwater flow through permeable reactive barriers (PRBs) may often involve coupled non-porous (free) and porous sections. To model the fluid mobility efficiently in such situations and to design an effective subsurface remediation scheme, the free and porous flow zones should be studied together. The flow phenomena in the conjugate regions must also be scaled up from the local scale to the field scale. This paper focuses on analyzing the hydrodynamic conditions in

combined free and porous domains as an aid for designing PRBs. The paper does not address the issues related to scaling the flow processes up to a larger scale.

Hyperspectral Image Analysis for Oil Spill Detection
Salem, F. and M. Kafatos (George Mason Univ., Fairfax, VA); T. El-Ghazawi (George Washington Univ., Washington, DC); R. Gomez and R. Yang (George Mason Univ.).
AVIRIS Proceedings 2002, Jet Propulsion Laboratory (JPL), NASA.

This research addresses remote sensing, especially hyperspectral image analysis applicable to the Chesapeake Bay. This case study is a prototype of oil spill leaks in the Patuxent River in Maryland and the associated image analysis for detecting oil spills using hyperspectral imagery and determining the effect of oil contaminants on soil, water quality, wetland, and vegetation. Hyperspectral sensing can record over 200 selected wavelengths of reflected and emitted energy. This spectral information can be used to exploit the spectral signature of oil and distinguish between different concentrations of crude oil dispersant. HSI observations with high spectral and spatial resolution can be used to detect oil using spectral signature matching to identify oil spectra based on chemical composition. Oil signatures can be extracted to identify the level of oil contamination of polluted areas, which is necessary for selecting appropriate cleanup processes. Some of the problems of the conventional visual techniques can be minimized when using more advanced methodology based on spectral signature matching to identify oil spills. New techniques such as HSI should be used to make the proper distinctions between oil spills and to properly identify natural phenomena. Preliminary results of this research show that with HSI spectral information, the signature of oil can be used to detect minute concentrations of hydrocarbon (crude oil) on the sea and to distinguish between different levels of oil dispersant on water. The first part of this study examined the monitoring of oil slicks movements, dispersion in water, and identification of spills on the shoreline. The second part examines oil contamination in wetland, soil, vegetation, and grass in the Patuxent River basin. Various remote sensing systems are available (e.g., side-looking airborne radar, laser fluorescence, microwave radiometer, infrared-ultraviolet line scanner, SAR, ERS 1, 2 and LANDSAT satellite systems). Though remote sensing data can be a valuable tool in the response effort, results from different sensors can vary widely. After oil spends even a short time floating on the ocean surface, it starts to change its physical characteristics due to various physical, biological, and chemical processes.
ftp://popo.jpl.nasa.gov/pub/docs/workshops/02_docs/toc.html

Hyperspectral Remote Sensing Analysis for ARD in Central Colorado
Hauff, P. (Spectral International, Inc., Arvada, CO); M. Sares (Colorado Geological Survey); D. Peters (Peters Geosciences, Golden,CO); D. Coulter (Overhill Imaging and Cartography, Golden, CO); D. Bird (Colorado Geological Survey); E. Prosh (Spectral International,Inc., Arvada, CO); F. Henderson (HENDCO Services, Nathrop, CO).
2004 Annual SME Meeting, 23-25 February, Denver, Colorado.
Society for Mining, Metallurgy, and Exploration (SME), Littleton, CO.

NASA has funded the Colorado Geological Survey and a team of remote sensing experts from industry in an application of hyperspectral technology to the characterization, mapping, and monitoring of watersheds affected by acid rock drainage in part of the upper Arkansas River basin of central Colorado. Image maps have been produced that show the source and type of the

oxidizing hydrothermal minerals that produce acid rock drainage (ARD) and aid in tracking the drainages of the iron sulfate, iron oxyhydroxide, and aluminum hydroxide precipitates from the drainage. These minerals are identifiers for changing pH conditions and therefore can be used to predict and map the extent of impact from ARD.

Identification and Quantification of Pesticides in Environmental Waters with Solid Phase Microextraction and Analysis Using Field-Portable Gas Chromatography-Mass Spectrometry
Nack, Michael J., Master's thesis, Uniformed Services Univ. of the Health Sciences, Bethesda MD. DTIC: ADA434815, 88 pp, June 2004

A solid-phase microextraction (SPME) and gas-chromatography-mass spectrometry (GC-MS) sampling and analysis method was developed for 1-Naphthyl methylcarbamate (Carbaryl) and gamma-benzenehexachloride (gamma-BHC) in water. A 15 minute sampling time of 40 degrees centigrade with a carbowax/divinylbenzene-coated SPME fiber for carbaryl and a polydimethylsiloxane-coated SPME fiber for lindane was employed. This allowed detection of carbaryl at concentrations in environmental water sources that included modeled ground water, simulated post-production water, and raw surface water while using the MS detector in full scan mode. The method was also successfully used with a field-portable GC-MS instrument using a low thermal mass, resistively heated column (LTM/RHC). Total analysis time using the field-portable GC-MS system was 30 minutes. The method avoids the use of complex sample preparation steps and enhances analyst safety through the elimination of the need to handle solvents in the field.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA434815&Location=U2&doc=GetTRDoc.pdf

Identifying the Potential Loss of Monitoring Wells Using an Uncertainty Analysis
Freedman, V.L., S.R. Waichler, C.R. Cole, V.R. Vermeul, and M.P. Bergeron.
Ground Water, Vol 43 No 6, p 916-925, 2005

To identify monitoring wells that will need replacement at DOE's Hanford site, a methodology has been developed using a first-order uncertainty analysis with UCODE, a nonlinear parameter estimation code. Using a 3-D, finite-element groundwater flow code, key parameters were identified by calibrating to historical hydraulic head data. Results from the calibration period were then used to check model predictions by comparing monitoring wells' wet/dry status with field data. A nonphysically based trend model was also used for comparison as a predictor of well wet/dry status. Though the numerical model outperformed the trend model, the central value of the intervals was a better predictor of wet well status for both models, with the prediction interval exhibiting greater success at identifying dry wells. Predictions made through the year 2048 indicated that 46% of the wells in the monitoring well network are likely to go dry in areas near the river and where the groundwater mound is dissipating.

Immunochemical Determination of Dioxins in Sediment and Serum Samples
Nichkova, M., E. Park, M.E. Koivunen, S.G. Kamita, S.J. Gee, J.C. Chuang, J.M. Van Emon, and B.D. Hammock.
Talanta, Vol 63 No 5, p 1213-1223, 2004

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are considered highly toxic contaminants. Immunoassays can be used as screening methods for rapid and low-cost analysis. The authors describe the application of an immunoassay that uses 2,3,7-trichloro-8-methyldibenzo-p-dioxin (TMDD) as a surrogate standard for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) for sediment and human serum samples. Sample extraction and preparation methods were developed to establish simple, cost-effective, and efficient removal of the matrix interferences in the enzyme-linked immunosorbent assay (ELISA). The overall method for sediments is based on a hexane extraction, cleanup by a multilayered silica gel column and an activated carbon column, an organic solvent exchange with DMSO-Triton X-100, and ELISA measurement. The gas chromatography/high resolution mass spectrometry (GC/HRMS) validation studies (n=13) revealed that the method is suitable for the TEQ (toxic equivalents) screening of dioxin in sediments with a method detection limit of about 100 pg/g dry sediment with a precision of 13 to 33% RSD. The analysis of a large number of samples originating from different sources would be required to establish more precisely the screening level, as well as the number of false positives and negatives of dioxin TEQ by the immunoassay for sediments. The immunoassay method for sediment analysis offers improvement in speed, sample throughput, and cost in comparison to GC/HRMS. Dioxins were determined in serum samples after a simple liquid/liquid extraction and solvent exchange into DMSO-Triton X-100 without further dilution. The current method (approximate method LOQ of 200 pg/mL serum) is not sufficiently sensitive for the determination of dioxins in serum to measure an acceptable exposure limit.

Immunochemical Determination of Dioxins in Sediment Samples
Nichkova, M., M. Chow, M.E. Koivunen, Kamita, S.G., S.J. Gee, J.C. Chuang, J.M. Van Emon, and B.D. Hammock.
EPA EnviroExpo: Moving Toward Balance, 9 December 2004, Las Vegas, NV.

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are considered highly toxic contaminants. In environmental monitoring, immunoassay procedures such as the enzyme-linked immunosorbent assay (ELISA) may be useful as screening methods for rapid and low-cost analysis of these compounds. The authors describe the application of an immunoassay for the screening of PCDDs and PCDFs in sediments. Sample extraction and preparation methods were developed with the aim to establish the simplest, most cost-effective and efficient removal of matrix interferences for the ELISA. The overall method is based on a hexane extraction, cleanup by a multilayered (H2SO4/NaOH) silica gel column followed by an activated carbon column, and an organic solvent exchange with DMSO-0.01% Triton X-100, with the final step being ELISA measurement. The less toxic 2,3,7-trichloro-8-methyldibenzo-p-dioxin (TMDD) was used as a surrogate standard for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The estimated theoretical method detection limit for the determination of PCDDs/PCDFs was about 20 pg TMDD equivalents per g of dry sediment. The accuracy (60 to 113%) and the precision (13 to 33% RSD) of the ELISA method were evaluated through the analysis of spiked sediment samples. Gas chromatography/high-resolution mass

spectrometry (GC/HRMS) validation studies were performed using13 samples. The validation revealed that the method is suitable for Toxic Equivalent Quantity (TEQ) screening of dioxins in sediments with a method detection limit of about 100 pg TMDD/g sediment. The study indicated that the immunoassay screening method offers improvement in speed, sample throughput, and cost in comparison to GC/HRMS analysis.

Improved Quantification of Methane Oxidation in Landfill Cover Soils by Numerical Modeling of Stable Isotope Fractionation
Mahieu, K., A. De Visscher, P.A. Vanrolleghem, and O. Van Cleemput, Ghent Univ., Ghent, Belgium.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy.

For the quantification of methane oxidation in landfill cover soils with isotope fractionation, usually only fractionation by oxidation is taken into account. De Visscher et al. (2004) showed that neglecting the fractionation by diffusion results in an underestimation of methane oxidation. The authors developed a simulation model that describes gas transport and methane oxidation in landfill cover soils, including fractionation by diffusion and oxidation. To evaluate the model, the simulations were compared with column experiment results from earlier studies. The predicted concentration profiles and isotopic profiles match the measured ones with good agreement and the comparison shows that overall, a model-based isotope approach for the determination of methane oxidation efficiencies is feasible and superior to existing isotope methods.

In-Situ LIF Analysis of Biological and Petroleum-Based Hydraulic Oils on Soil
Lemke, M., R. Fernandez-Trujillo, and H.-G. Lohmannsroben, Univ. of Potsdam, Potsdam-Golm, Germany.
Sensors, Vol 5 No 1-2, 61-49, Jan/Feb 2005

The absorption and fluorescence properties of 4 hydraulic oils (three biological and one petroleum-based) were investigated using in situ laser-induced fluorescence (LIF) analysis. With calibration, quantitative detection of the oils on a sandy loam soil was achieved, with the estimated limits of detection below 500 mg/kg for the petroleum-based oil and 2000 mg/kg for one biological oil. The authors propose a semi-quantitative classification scheme for monitoring the biological oils. This approach was used to investigate the migration of a biological oil in a soil column and a soil bed.
http://www.mdpi.net/sensors/list05.htm

Indirect Measurement of Biological Activity to Monitor Natural Attenuation
Werkema, D. Dale, ORD, NERL-LV, CMB.
EPA 2004 Science Forum, 1-3 June 2004, Washington, DC. Poster presentation.

The elimination of groundwater contamination by natural attenuation, specifically via biodegradation, requires continual monitoring. This research is aimed at improving methods for evaluating the long-term performance of monitored natural attenuation (MNA), particularly

changes in the biogeochemical environment due to the biologically mediated breakdown of the contaminant. Basic research is presented on the bulk ground electrical conductivity response to the biogeochemical dynamics occurring during the biologically mediated breakdown of non-aqueous phase liquids (NAPLs). Investigations into the geoelectrical response that results from the biodegradation of NAPLs include a 5-year field study, 45-day lab slurry experiment, and a 2-year lab column study performed by a multidisciplinary group of scientists, including several universities and the U.S. EPA. Metabolic byproducts of the microbial degradation of NAPLs react with the subsurface sediments and increase the geoelectrical conductivity of the contaminated zone undergoing biodegradation. The measurement of the geoelectrical conductivity is a very simple, inexpensive geophysical technique that can be applied and measured automatically and/or remotely. EPA expects these findings to provide a new scientific understanding and scientific tool. This research has demonstrated a potential to improve monitoring for evaluating MNA long-term performance. With this research providing the link between measurable physical changes and the biological breakdown of contaminants, the risks to human health and the environment that these contaminants pose can be more effectively controlled at contaminated sites. It is hoped that these findings will reduce analytical chemistry costs, reduce hazardous waste products from analysis, provide the capability to passively monitor the biodegradation process, and provide data for the development of a conceptual site model.
http://www.epa.gov/nerl/news/forum2004.html

Innovative Technology Detects Pipeline Defects
CenterViews, Vol 10 No 1, Spring 2004

An innovative technology was used to inspect a JP-8 jet fuel pipeline system for leaks and corrosion at Tonopah Test Range, NV, a 625 square-mile area run by Nellis AFB. The process used is called the Guided Wave Ultrasonic Technique, or GWUT, which uses a low frequency ultrasound wave to give inspectors a "picture" of a pipe's interior surface. The wave is emitted by a probe ring connected to a computer and other electronic equipment. The ring is placed around a clean and accessible area of a pipe and when activated sends a sound wave running through the pipeline. GWUT then produces a pictorial representation of the pipe's interior in the form of a graph that displays the curves and frequencies along the piping system. If an anomaly is spotted, the pipe is dug up for a visual inspection and inspectors then determine what corrective action to take based on what the problem is. According to officials, inspection ranges can be achieved 15 to 150 feet along the pipe in both directions from a single probe position. The Tonopah inspection, conducted by AFCEE contractor TolTest, Inc., included the evaluation of about 17,300 linear feet of fuel transfer pipeline and other procedures. One hundred percent of the pipeline was covered at 35 locations. The work also included pipe excavations at 25 locations and diggings at 10 other sites. At each location, the crews shot both ways to obtain overlapping data at the extreme range of their machines. The average distance between inspection points was approximately 150 feet, making each shot about 100 feet. The purpose of the project was to develop a comprehensive historical record of the entire pipeline, identify any potential areas of concern, and make recommendations for repair. The AFCEE project team was able to detect both internal and external corrosion and physical anomalies to the pipeline and to make recommendations to test range officials to repair the pipeline before leaks or failure could occur. GWUT was developed specifically to prevent leaks and failures caused by corrosion,

which is a major problem in both insulated and non-insulated pipe systems. According to an industry study, about 60% of hydrocarbon release incidents result from pipe work failures. AFCEE officials said that GWUT is an invaluable tool for long-term pipeline maintenance. For more information, contact AFCEE team chief Damian Sandoval at DSN 240-5238 or 210-536-5238.
http://www.afcee.brooks.af.mil/ms/msp/center/vol10No1/7.asp

Interpreting DNAPL Saturations in a Laboratory-Scale Injection with GPR Data and Direct Core Measurements
Johnson, R.H. (USGS, Denver, CO); E.P. Poeter (Colorado School of Mines, Golden).
U.S. Geological Survey Open-File Report 03-349, 40 pp, 2003

Ground penetrating radar (GPR) is used to track a dense non-aqueous phase liquid (DNAPL) injection in a laboratory sand tank. Before data reduction, GPR data provide a qualitative measure of DNAPL saturation and movement. One-dimensional (1D) GPR modeling provides a quantitative interpretation of DNAPL volume within a given thickness during and after the injection. With geologic conditions that are suitable for GPR surveys (i.e., shallow depths and low electrical conductivities), the procedures in this laboratory study can be adapted to a field site to identify DNAPL source zones after a release has occurred.
http://pubs.usgs.gov/of/2003/ofr-03-349/

Investigation of a Tuneable Mode-Locked Fibre Laser for Application to Multi-Point Gas Spectroscopy
Whitenett, G., G. Stewart, H. Yu and B. Culshaw.
IEEE Journal of Lightwave Technology, Vol. 22, No. 3, 2004, pp. 813–819.

This paper reports on an initial investigation into the operation of a mode-locked fiber laser system for application in gas spectroscopy as a multipoint multi-gas sensor. Wavelength selection is performed by use of multiple chirped gratings and fine tuning by using the dispersion properties of the chirped gratings. A tuning rate of 0.014 nm per kHz change in mode-lock frequency (at the third harmonic) has been shown to be suitable for scanning across gas absorption lines. The authors discuss key issues that have an important bearing on tuning, including gain flattening and polarization drift. A method of multiplexing the sensor cells with the mode-locked system is investigated, and preliminary results for a two cavity system are presented to verify the principles of the technique. A key problem that causes instability in operation arises from the polarization dependence of the modulator due to the effects of polarization drift on both the extinction ratio and the cavity loss. The problem can be solved by use of either a polarization-independent modulator or a polarization maintaining fiber laser system. The researchers are currently investigating a "sigma" fiber laser design.
http://cmp.eee.strath.ac.uk/investigation%20tuneable%20fibre%20laser.pdf

Investigation of Water Flow in a Bioreactor Landfill Using Geoelectrical Imagining Techniques
Rosqvist, H. (Swedish Geotechnical Inst., Malmo, Sweden); T. Dahlin (Lund Univ., Lund, Sweden); C. Lindhe (Novaplan AB, Malmo, Sweden).
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 9 pp, 2005

This paper describes field investigations of leachate recirculation at a bioreactor landfill using electrical resistivity, a geoelectrical imagining technique. The researchers evaluated the electrical resistivity technique and investigated the increase in moisture content as a result of the start of leachate recirculation. Electrical resistivity was useful for showing moisture migration through the bioreactor landfill, as well as for biogas detection.
http://lthtg.tg.lth.se/~tda/docs/Sardinia2005_Electrical_imaging_of_water_flow_in_waste.pdf

Landfill Gas Characterization Over Time: the 9-Phase-Model
Rettenberger, G., FH Trier, Trier, Germany.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 12 pp, 2005

This paper discusses investigations and conclusions concerning the characterization of the composition of landfill gas over the life of a landfill. Landfill gas is a biogas, i.e., a mixture produced during anaerobic processes, consisting mainly of methane and carbon dioxide in a ratio by volume of ~2 to 1. Landfill gas must be collected and disposed of safely. Measurements of landfill gas collection show that the composition of the gas phase in the landfill can vary considerably. The need exists for a means to characterize the current gas phase in a landfill, the gas formation process in the landfill body, and the condition of the gas phase with reference to the kind of gas collection employed. A 9-phase model of investigations in two areas with different operational lifetimes in a full-scale landfill has been carried out. The model was developed considering the following aspects: the gas phases in different stages of the landfill, the gas phase in the upper part of the uncovered landfill where mixing of landfill gas and ambient air may occur, gas emissions into the atmosphere because of changing gas phase behavior, and changes occurring in the gas phase during gas collection using pumping systems. The results of these investigations should enable landfill operators to choose strategies for optimized landfill operation.

Landfill MSW Hydraulic Conductivity Estimation Using in Situ Moisture Sensors
N.G. Gawande, D.R. Reinhart (University of Central Florida, Orlando); A.L.G. Cortazar (University of Cantabria, Torrelavega, Spain).
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 2005

Prediction of leachate routing in a landfill is challenging due to the heterogeneity of solid waste and preferential flow paths. This paper describes a method to estimate the saturated-hydraulic conductivity using in situ moisture sensor measurements. The flow conditions of a cluster of leachate injection wells in a bioreactor landfill were simulated using a finite-element

saturated/unsaturated flow model. The time of travel for the moisture front to reach the sensor locations was used to determine the value of hydraulic conductivity. The distribution of hydraulic conductivity can be obtained via this method, which can be valuable for modeling leachate routing in bioreactor landfills.

Laser Diffraction Method: Two New Sediment Sensors
Agrawal, Yogesh C. and Henry C. Pottsmith, Sequoia Scientific, Inc., Bellevue, WA.
Proceedings of the Federal Interagency Sediment Monitoring Instrument and Analysis Research Workshop, 9-11 September 2003, Flagstaff, Arizona. 6 pp, 2005

Laser diffraction offers a fundamentally superior basis for measuring suspended particles as it, unlike older and simpler optical or acoustic methods, does not suffer a change in calibration with changing sediment color, composition, or size. The diffraction based LISST series instruments have, in this manner, opened new scientific vistas into particle dynamics, their settling velocities measured in situ, and to a lesser extent, floc dynamics. The first new system, the LISST-SL, which employs isokinetic sampling, is now in development for the needs of the USGS. Current frontiers in research deal with particle shape effects. New data firmly point to the need for distinguishing spheres from natural, random shapes. The second new system delivers suspended sediment concentration and a true mean size (vs. Sauter Mean Diameter provided by LISST-25s). This results from newly invented shapes of comet detectors.
http://water.usgs.gov/osw/techniques/sediment/sedsurrogate2003workshop/agrawal.pdf

Laser Water Detection, Treatment and Notification Systems and Methods
Baca, Anthony Michael, Luis M. Ortiz, Thomas A. Crow, and Donald W. Wichers (Inventors); Saltech Corporation (Assignee).
U.S. Patent and Trademark Office, Washington, DC. U.S. Patent 6919019, 19 July 2005

A water-borne hazard detection and water treatment system includes sensors (e.g., flow rate, microorganism detectors, and chemical detectors) and can be microprocessor controlled. Microorganisms and/or chemicals are detected within a water distribution system. Treatment areas can be deployed at various stages along a water distribution system. Water entering/passing through a "treatment area" are subjected to light emanating from an ultraviolet laser. UV-treated water is provided to its intended point of use after treatment. Filtration can be deployed around input and/or output locations of a system. The system is networkable for communication to remote monitoring agencies (e.g., command and control units) through wired and/or wireless network communications and devices. Networked monitoring and assessment enables rapid deployment of counter measures within affected water distribution systems and populated communities. Emergency distribution shut-off through the distribution network can be based on input from distributed sensors. Multiple treatment systems can be staged.

Lessons Learned from 10 Years of Leak Detection Surveys on Geomembranes
Forget, B., A.L. Rollin, and T. Jacquelin, Solmers Inc., Varennes, Quebec, Canada.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy. 9 pp, 2005

The authors present statistics obtained from geoelectric leak detection surveys performed on more than 89 projects. This work identifies leak densities on geomembranes (exposed and covered) with respect to their thicknesses, the application or absence of a Construction Quality Assurance (CQA) program, and a water puddle leak-detection survey on exposed geomembrane prior to the placement of a covering material. Their investigations have shown that the average leak density on exposed geomembranes (many types and thicknesses) installed under a rigorous CQA program is approximately 4 leaks per hectare. Conversely, the statistics show a sharp climb, to 22 leaks per hectare, in the absence of such a CQA program. A similar situation is found with covered geomembranes: a negligible leak density (0.5 leaks/ha) is found on geomembranes installed under a strict CQA program and a prior water puddle leak-detection survey on the exposed geomembrane, whereas in the absence of both a CQA program and the water puddle leak detection survey the density climbs to 16 leaks/ha.
http://www.solmers.ca/francais/publications/img/lessons_learned%20.pdf

Liquid Chromatography/Mass Spectrometry, MS/MS and Time of Flight MS: Analysis of Emerging Contaminants
Ferrer, Imma and E.M. Thurman, eds.
Oxford University Press, Cary, NC. ISBN: 0-8412-3825-1, American Chemical Society (ACS) symposium series no 850, 431 pp, 2003

This volume explores state-of-the-art mass spectrometric techniques. It focuses on liquid chromatography/mass spectrometry/mass spectrometry and time-of-flight/mass spectrometry to determine emerging contaminants, such as pharmaceuticals, hormones, pesticides, surfactants and unknown natural products.

Liquid-Sheath-Flow Electrospray Ionization Feasibility Study of Direct Water Analysis with the Use of High-Resolution Ion-Mobility Spectrometry
Matz, L.M., B.H. Clowers, W.E. Steiner, W.F. Siems, and H.H. Hill, Jr., Washington State Univ., Pullman.
Field Analytical Chemistry and Technology 5(1–2):91–96, 2001

Electrospray ionization (ESI) sources have been demonstrated as a viable ionization source with ion-mobility spectrometry (IMS) instruments, enabling the analysis of many nonvolatile compounds. Introduction of a liquid-sheath-flow ESI source enabled the direct analysis of water samples. The ESI source was built with relatively simple, lightweight components for use in field applications. A comparison between traditional ESI solvent conditions (water plus organic solvent) and the liquid-sheath-flow concept shows the new source to be able to spray water samples directly without prior sample preparation. The system was tested on two unfiltered water samples, one from a snow sample and the other from a local stream. In both cases, 1 ppm of Terbutryn (a widely used herbicide) was easily detected.
http://www.wsu.edu/~hillh/PDF%20Web%20Files/LSF%20ESI-IMMS%20feasi%20stud,%202001.pdf

Mapping Groundwater Flowpaths Using AquaTrack (Controlled Source Audio Frequency Magnetics)
R. Fry, Willowstick Technology, Draper, UT.
2005 SME Annual Meeting & Exhibit, February 28 - March 2, Salt Lake City, Utah.

Groundwater flow in the subsurface follows preferential flow paths influenced by geologic structures and heterogeneous strata. It is vital to understand the location of the preferential flow paths, whether to avoid them in underground mining, intersect them in wells, or account for them in remedial strategies for groundwater contamination zones. AquaTrack (Controlled Source Audio Frequency Magnetics) is a technology that enables the identification of preferred groundwater flow paths. This paper presents a study in which the technology was applied to map the preferred groundwater flow paths that allowed groundwater to intersect mine workings at a depth of 1,000 m.

Mapping of Heavy Metals Accumulated in Plants Using Submilli-PIXE Camera
Watanabe, R.; J. Hara; C. Inoue; T. Chida; T.S. Amartaivan; S. Matsuyama; H. Yamazaki; K. Ishii, Tohoku Univ., Sendai, Miyagi, Japan.
20th Symposium on PIXE in Japan; 11th Annual Meeting of Japan Society for Particle Induced X-ray Emission (PIXE) Research, 15-17 Sep 2003, Kochi, Japan.
International Journal of PIXE, Vol 14 No 1-2, p 35-41, 2004 [OSTI: DE20623710]

Scientists analyzed plant and soil samples from a shooting range using a submilli-PIXE camera. Some of the heavy metals were rapidly and easily detected in these samples. Element dot-maps of the plants show Cu and Pb accumulated in the epidermis of subterranean stems and the venation of leaves. Submilli-PIXE analysis allows the distribution of heavy metals to be mapped and detailed in the plant, providing an effective tool for phytoremediation research.

Mapping Weathering and Alteration Minerals in Virginia City, Nevada with AVIRIS and HyperSpecTIR
Vaughan, R.G. and Wendy M. Calvin, Univ. of Nevada Reno.
AVIRIS Proceedings 2004, Jet Propulsion Laboratory (JPL), NASA.

As a historic mining district with over 100 years of activity, much of the surface area in Virginia City (approximately 0.85 km2) is covered with mine dumps. Mine dumps and tailings piles are composed of minerals like quartz, pyrite, and various clay minerals, and often contain anomalous concentrations of accessory elements, such as Hg, As, Cd, Co, Cu, Mo, Ni, Pb, Zn, Se, and Sb. Iron sulfides, most commonly pyrite, exposed at the surface readily oxidize to form secondary Fe-bearing minerals, which are indicative of the chemical conditions under which they form. Pyrite oxidation is a complex biogeochemical process involving hydration, oxidation, and microbial catalysis that results in the formation of acidic water. Acidic surface water, and water that percolates through the porous rock pile, contain dissolved heavy metals and travel away from the acid-generating source. Chemical reactions with other rocks and minerals partially neutralize the pH of the water, which leads to the precipitation of Fe-sulfates (e.g., jarosite, schwertmannite, or copiapite), Fe-oxyhydroxides (e.g., goethite), and Fe-oxides (e.g., hematite) that sometimes forms a spatial pattern around points of actively oxidizing sulfides. The occurrence of water-soluble sulfates on mine dumps is also indicative of acidic surface conditions. These sulfate salts can contain high concentrations of heavy metals within their

crystal structure that can be rapidly released during increased water flow shortly after rainfall. With a wide range of exposed weathering and alteration minerals, Virginia City has been the focus of numerous hyperspectral imaging spectroscopy studies. This study introduces a new hyperspectral imaging spectrometer to the family of sensors that have imaged the area. The SpecTIR Corporation's airborne hyperspectral imager, HyperSpecTIR (HST) has been designed to acquire images with a very high spatial resolution without significant loss of signal over noise. This study represents the first geological analysis of the new HST data and presents mineral mapping results of one of the highest spatial resolution hyperspectral data sets acquired over Virginia City. This study used both AVIRIS and HST data to map weathering and alteration minerals in the Comstock region and relate the mineral maps to local geology and chemical conditions on the mine dumps.
ftp://popo.jpl.nasa.gov/pub/docs/workshops/04_docs/toc.html

Measurement of Gaseous Fluxes for Mine Waste Management
Kabwe, Louis K. and Ward Wilson, UBC.
Mining Rocks! Toronto 2005, Mining Industry Conference and Exhibition, 24-27 April. Canadian Institute of Mining, Metallurgy and Petroleum.

Field methods to monitor the exchange and/or diffusion of gases such O2 and CO2 across the soil/atmosphere boundary of a waste-rock or tailing surface are of interest to the mining regulators and geotechnical engineers in the design of soil cover system and to determine geochemical reactions rates in the waste-rock profile below the surface. This paper summarizes the results of field application of chamber-based techniques to quantify the spatial variation in the CO2 flux from a mine waste-rock pile. Results showed that the chamber-based methods can provided useful information for characterizing spatial CO2 flux variability as well as providing information regarding local-scale processes.

Measurement of Protein-Like Fluorescence in River and Waste Water Using a Handheld Spectrophotometer
Baker, A., D. Ward, S.H. Lieten, R. Periera, E.C. Simpson, and M. Slater, Univ. of Birmingham, Birmingham, UK.
Water Research, Vol 38 No 12, p 2934-2938, July 2004

A portable luminescence spectrophotometer was used to investigate if the technology could be used to provide field scientists with a rapid pollution monitoring tool and process control engineers with a portable wastewater monitoring device. The investigators measured river and wastewater tryptophan-like fluorescence from a range of rivers in NE England and from effluents from within two wastewater treatment plants. The portable spectrophotometer demonstrated that wastewaters and sewage effluents had the highest tryptophan-like fluorescence intensity, urban streams had an intermediate tryptophan-like fluorescence intensity, and the upstream river samples of good water quality the lowest tryptophan-like fluorescence intensity. Replicate samples demonstrated that fluorescence intensity is reproducible to +/- 20% for low fluorescence, 'clean' river water samples and +/- 5% for urban water and waste waters.

Measuring Trace Gases in Plumes from Hyperspectral Remotely Sensed Data
Marion, R., R. Michel, and C. Faye.
AVIRIS Proceedings 2003, Jet Propulsion Laboratory (JPL), NASA.

Characterizing surface and atmospheric properties from hyperspectral imaging spectrometry has been successfully applied to geological, aquatic, ecological, and atmospheric research. Hyperspectral sensors (e.g., AVIRIS, HyMap, Hyperion) are passive earth-looking systems providing radiance images in the solar reflected portion of the electromagnetic radiation spectrum. Generally, they cover a spectral range included in the 400 to 2500 nm window with a few hundred contiguous bands about 10 nm wide. The nominal pixel size is about 20 m. Typical signal-to-noise ratios (SNR) are a few hundred. For example, the AVIRIS spectral range is 400 to 2500 nm, the number of bands is 224, the spectral bands are about 10 nm wide, the spatial resolution is about 20 m, and the SNR is between 300 and 800 for the year 1995. The images depend on sun irradiance, atmospheric conditions, ground conditions, and on the system's transfer function in a complex way (scattering, absorption, reflection, averaging), leading to a strongly non-linear pixel equation. The authors propose an enhanced method, Joint Reflectance and Gas Estimator (JRGE), to measure trace gases within a plume corresponding to variations relative to a given standard atmosphere model. This method is based on a cubic smoothing spline-like surface reflectance estimator and non-linear radiative transfer calculations. When JRGE was applied to simulated data to yield preliminary results (assuming an aerosol-free atmosphere (Rayleigh atmosphere) and standard ground temperatures), the method yielded an enhancement factor equal to 2.5 in H20 retrieval accuracy compared with conventional methods.
ftp://popo.jpl.nasa.gov/pub/docs/workshops/03_docs/toc.html

Methods for Speciation of Metals in Soils: A Review
D'Amore, J.J., S.R. Al-Abed, K.G. Scheckel, and J.A. Ryan, U.S. EPA, Cincinnati, OH.
Journal of Environmental Quality, Vol 34, p 1707-1745, 2005

The inability to determine metal species in soils hampers efforts to understand the mobility, bioavailability, and fate of contaminant metals in environmental systems, to assess health risks posed by them, and to develop methods to remediate metal contaminated sites. This paper highlights a selection of the available analytical methods offering the greatest promise, briefly describes the fundamental processes involved, examines their limitations, points to how they have been used in the environmental and geochemical literature, and offers suggestions for further research.
http://www.esd.ornl.gov/research/earth_sciences/images/meta_speciation_review_ryan_jeq_2005.pdf

Microarrays Monitor Environmental Contaminants
Christen, Kris.
ES&T Technology News, 11 Aug 2004

Researchers at Pacific Northwest National Laboratory (PNNL) are developing a process based on chip technology to scan tiny gnat-like insects called midges for genes that respond to specific pollutants. This biomonitoring array can survey for many contaminants as well as their sources. Midges, which have aquatic larval stages, are common in rivers and streams throughout the northern hemisphere. They tend to become relatively more abundant as streams become more

contaminated, which indicates that either they are able to detoxify certain pollutants, such as organic compounds, or they are able to limit their exposure. With a microarray system, Charles Brandt, an ecologist at PNNL, and colleagues hope to use midges as sentinels to find out what contaminants are in a particular water body, assess exposure levels, and determine how the pollutants affect the insects. In this way, researchers could detect pollutants before they become a problem. There currently is no midge genome map, so the researchers have been substituting that of the thoroughly mapped fruit fly Drosophila to do the exploratory work of finding environmental biomarkers, aiming to eventually produce a midge-specific array. In the laboratory, the PNNL researchers exposed the midges to various chemicals, extracted their messenger RNA, and tagged it with a fluorescent molecule. After flooding the Drosophila array with this RNA mixture, they obtained gene expression patterns specific to certain toxicants, in particular for the endocrine disruptor ethynylestradiol and the radionuclide strontium-90. They hope ultimately to catalog gene expression patterns that match all major classes of pollutants, including heavy metals, PAHs, and pesticides.
http://pubs.acs.org/subscribe/journals/esthag-w/2004/aug/tech/kc_microarrays.html

Microbial Characterization of Sulfate-Reducing Columns Remediating Acid Mine Drainage
Pruden, A. (Colorado State Univ., Fort Collins), H.-S. Hong, L.Y. Inman, M.V. Logan, C. Sans, D. Ahmann, L.A. Figueroa, and K.F. Reardon.
2005 National Meeting of the American Society of Mining and Reclamation, 19-23 June 2005, Breckenridge CO: Book of Abstracts. ASMR, Lexington, KY. p 77, 2005

Sulfate-reducing permeable reactive zones (PRZs) for passively remediating mine drainage can be constructed in the form of anaerobic wetlands, sulfate-reducing bioreactors, or permeable reactive barriers. Unfortunately, maintenance difficulties, such as variation of sulfate-reducing activity, are not yet well understood. DNA-based techniques provide a powerful means of characterizing the microbial composition of PRZs. The authors developed a suite of methods specific to PRZ communities and analyzed samples from columns simulating PRZs. The objective was to determine the differences in microbial community structure between highly active columns, columns with reduced activity, inactive columns, and columns operated for over one year. Denaturing gel gradient electrophoresis (DGGE) and single-stranded conformation polymorphism (SSCP) were performed to compare the microbial community structures of the columns with different activity levels and operation times. Sequencing results from DGGE and SSCP suggested that gram-positive microorganisms belonging to the Clostridium group were dominant in all columns. This group includes cellulose degraders, fermenters, and sulfate reducers, which are all critical to PRZ function. To target sulfate-reducing groups directly, quantitative real-time PCR (Q-PCR) methods were developed for three genera: Desulfobacterium, Desulfotomaculum, and Desulfovibrio. Quantification of all three groups demonstrated that a decline in sulfate-reducing activity does not necessarily indicate a decline in sulfate reducing bacteria populations. The developed methods will provide diagnostic tools for PRZs in the field and may assist in developing optimized PRZ inocula.

Microbiological Methods for Assessing Soil Quality
Bloem, J., D.W. Hopkins, and A. Benedetti, eds.
Oxford University Press, Cary, NC. ISBN: 0-85199-005-3, 272 pp, 2005

This book provides a selection of microbiological methods that are already applied in regional or national soil quality monitoring programs. Part One provides an overview of approaches to monitoring, evaluating, and managing soil quality. Part Two provides a selection of methods, which are described in sufficient detail to use the book as a practical handbook in the laboratory. The methods are described in chapters on soil microbial biomass and numbers, soil microbial activity, soil microbial diversity and community composition, and plant/microbe interactions and soil quality. The results of a census of the main methods used in over 30 European laboratories is given.

Microchip Enzymatic Assay of Organophosphate Nerve Agents
Wang, J., G. Chen, A. Muck Jr., M.P. Chatrathi, A. Mulchandani, and W. Chen.
Analytica Chimica Acta, Vol 505, p 183-187, 2004

The authors describe an on-chip enzymatic assay for screening organophosphate (OP) nerve agents, based on a pre-column reaction of organophosphorus hydrolase (OPH), electrophoretic separation of the phosphonic acid products, and their contactless-conductivity detection. The complete bioassay requires 1 min of the OPH reaction, along with 1 to 2 min for the separation and detection of the reaction products. The response is linear, with detection limits of 5 and 3 mg/l for paraoxon and methyl parathion, respectively. The OPH-biochip can differentiate between the individual OP substrates and shows great promise for field screening of OP pesticides and nerve agents.
http://www.engr.ucr.edu/~wilfred/Microchip%20ACA04.pdf

Microfabricated Differential Mobility Spectrometry with Pyrolysis Gas Chromatography for Chemical Characterization of Bacteria
Schmidt, H., F. Tadjimukhamedov, I.V. Mohrenz, G.B. Smith, and G.A. Eiceman, New Mexico State Univ.
Analytical Chemistry, Vol 76 No 17, p 5208-5217, 1 Sep 2004

This paper describes how a microfabricated drift tube for differential mobility spectrometry (DMS) was used with pyrolysis-gas chromatography (py-GC) to chemically characterize bacteria through 3-D plots of ion intensity, compensation voltage from differential mobility spectra, and chromatographic retention time. The DMS analyzer provided chemical information for positive and negative ions simultaneously from chemical reactions between pyrolysis products in the GC effluent and reactant ions of H+(H2O)n and O2-(H2O)n in air at ambient pressure. The minimum number of total bacteria (cell-forming units) detected was 6,000, though detection limits and resolution could be varied by the magnitude of the separation voltage in the differential mobility spectrometer.

Microfluidic System for the Chemiluminescence Optical Detection of Pollutants Using Magnetic Beads

Varsamis, Dimitrios D. and D.C. Cullen, Cranfield Univ. at Silsoe, UK.

Presentations by Britain's Younger Engineers at the House of Commons, London, 14 December 2004. Presentation No 88, 2004

A novel biosensing instrument is being designed and applied for large-scale screening and monitoring of herbicides in industrial and urban effluents and ground and irrigation waters. Photosynthetic herbicides act by binding to Photosystem II (PS II), a chlorophyll/protein complex in plants that plays a vital role in photosynthesis. The inhibition of PS II by herbicides causes a reduced photoinduced production of hydrogen peroxide, which can be measured with chemiluminescence. The novel sensing device combines the production and detection of hydrogen peroxide in a single flow assay by combining all the individual steps in a compact, portable device that utilizes micro-fluidic components. In the flow channel, regions of appropriate reagents are temporarily immobilized using engineered magnetic beads by switching magnetic fields on/off, thereby addressing issues of reagent stability and regeneration. The detection of herbicides using the chemiluminescence method has been successful in levels close to those set by the EU. Their incorporation in the microfluidic system has been successful, albeit with a loss of sensitivity, which is being optimized. The device will respond to a range of pollutants and be used for rapid, low-cost screening of large numbers of samples to identify samples that will require more detailed analysis.

Mineralogical Analysis of Rock Piles and Acid-Generating Source Rocks Using Hyperspectral Remote Sensing

Hauff, P. (Spectral International Inc., Arvada, CO); D. Peters (Peters Geosciences, Golden, CO); D. Coulter (Overhill Imaging and Cartography, Golden, CO); E. Prosh (Spectral International Inc., Arvada, CO).

2005 SME Annual Meeting & Exhibit, 28 February - 2 March, Salt Lake City, Utah.
Society for Mining Metallurgy and Exploration (SME), Littleton, CO.

Hyperspectral remote sensing is used to analyze the mineralogy of the Questa (NM) mine rock pile surfaces and surrounding altered and unaltered bedrock. These remote sensing data are collected by analyzing samples with a portable spectrometer. Knowing the distribution of minerals at the surface of the piles provides a tie between surface conditions and subsurface variation within the piles. The piles are also being sampled and analyzed with traditional mineralogical analysis methods. Of special interest in this study are acid-sulfate minerals, particularly jarosite, that indicate areas of acid generation in the piles, and clays that can be altered through reaction with acidic solutions.

Model Uncertainty Analysis, Field Data Collection, and Analysis of Contaminated Vapor Intrusion into Buildings
Tillman, F.D. (National Research Council); J.W. Weaver, D. Spidle, and S.L. Bird (U.S. EPA ORD/NERL/ERD/RSB).
EPA Science Forum 2005: Collaborative Science for Environmental Solutions, 16-18 May 2005, Washington, DC.

Vapor intrusion is the term used to describe the migration of volatile chemicals from the subsurface into overlying buildings. Volatile organic compounds (VOCs) are frequently associated with contamination from leaking fuel storage tanks and releases from dry cleaners and industrial facilities. When these contaminants are present in soil or groundwater, they may volatilize and enter homes or businesses through cracks in basement floors or slabs. To address uncertainty associated with the evaluation of these problems, the authors are working with the Georgia Environmental Facilities Authority (GEFA) on a 3-part strategy that includes (1) evaluation of uncertainty in model-based assessments, (2) collection of field data, and (3) assessment of sites using U.S. EPA and state protocols. The GEFA manages underground storage tanks provided by the State of Georgia to the highway patrol, department of transportation, forestry department, welcome centers, and university facilities. The conventional approach to assessing vapor intrusion sites is to use a simplified model (the "Johnson-Ettinger" model) with only a few site-specific parameters. Through the EPA's provision of software for automated uncertainty analysis of the model (http://www.epa.gov/athens/onsite), users of the model can determine the significance of input parameters for themselves. To test the results of the uncertainty analysis, the authors are beginning to use various sampling techniques, such as trained vapor-detecting dogs (http://www.epa.gov/athens/research/regsupport/Detection_Dogs.html) at GEFA sites. They have also constructed a dedicated facility for soil and vapor intrusion testing (http://www.epa.gov/athens/research/regsupport/vi.html). Use of data from the GEFA and research sites in an assessment according to established protocols is anticipated to provide an evaluation of the overall approach to vapor intrusion and insight on the role of the simplified transport models for state agencies.
http://www.epa.gov/nerl/news/forum2005.html

Molecular Beacon: A Multitask Probe
Goel, Gunjan, Ashwani Kumar, A.K. Puniya, Wilfred Chen, and Kishan Singh.
Journal of Applied Microbiology, Vol 99, p 435-442, 2005

Among stem loop oligonucleotides, molecular beacons have been recently used as probes for biomolecular recognition reactions. Molecular beacon-based assays are inexpensive, simple, fast, and allow real-time monitoring of nucleic acid reactions both in vivo and in vitro. The authors have provided a review designed to enhance understanding of the different aspects of molecular beacons with respect to structure, design, and applications in real-time monitoring of nucleic acid amplification, detection of pathogens, nucleic acid/protein interaction, genetic analysis, and array technology.
http://www.engr.ucr.edu/~wilfred/Beacon%20review%2005.pdf

Molecular Monitoring of SRB Community Structure and Dynamics in Batch Experiments to Examine the Applicability of In Situ Precipitation of Heavy Metals for Groundwater Remediation

Geets, J.; B. Borremans; J. Vangronsveld; L. Diels; D. van der Lelie, Brookhaven National Laboratory, Upton, NY.

Journal of Soils and Sediments, Vol 5 No 3, p 149-163, 2005

The capacity of sulfate-reducing bacteria (SRB) to reduce and precipitate heavy metals as metal sulfides can be used to create an in situ reactive zone for the treatment of metal-contaminated groundwater via in situ metal precipitation (ISMP). Batch experiments were conducted to investigate the feasibility of ISMP as a groundwater remediation strategy for an industrial site contaminated with elevated levels of Zn, Cd, Co, and Ni. The researchers explored the potential of different types of carbon source/electron donor (lactate, acetate, methanol, ethanol, Hydrogen Release Compound(R), molasses) to stimulate the sulfate reduction and metal precipitation activity of the SRB community, as well as the effect of amending vitamin B12 and yeast extract. The ISMP process was monitored by combining analytical analyses of process parameters (e.g., metal concentrations, pH) with molecular tools such as SRB subgroup and genus-specific PCR, denaturing gradient gel electrophoresis, and phylogenetic analysis of clone sequences, based on either the 16S rRNA or the dissimilatory sulfite reductase gene. The batch experiments demonstrated that the SRB communities were present and that their activities could be used to obtain efficient in situ precipitation of the contaminating heavy metals. In future work, an on-site pilot test for ISMP will allow the searchers to define optimal ISMP process conditions and to test its long-term efficacy and sustainability before going into an on-site bioremediation application.

Monitoring and Analysis of Volatile Organic Compounds Around an Oil Refinery

Gariazzo, C., A. Pelliccioni, P. Di Filippo, and F. Sallusti (Italian Inst. for Occupational Safety and Health); A. Cecinato (IIA-CNR, Monterotondo Scalo RM, Italy).

Water, Air, & Soil Pollution, Vol 167 Nos 1-4, p 17-38, Oct 2005

During the summer, volatile organic compounds (VOCs) including benzene, toluene and xylenes were sampled and analyzed at two different sites in an industrial area. Strong modulation of VOC concentrations was observed between daylight and darkness. The alkane fraction was found to be the most abundant group, indicating the oil refinery as the major source of atmospheric hydrocarbons. Surface turbulence and upper air sonic detection and ranging (SODAR) data were processed to investigate the relationships between meteorology and VOC levels and patterns. Atmospheric turbulence was found to be responsible for the daily modulation of VOC. The highest BTX pollution episode observed after dark was correlated with strong atmospheric stability and a surface-based inversion layer. The analysis of BTX ratios allowed recognition of the relationship between the pollutants and their co-variance, as well as the dispersion and reaction patterns occurring during transport across the two sites.

Monitoring at Chemical Agent Disposal Facilities
National Research Council, Committee on Monitoring at Chemical Agent Disposal Facilities. National Academies Press, Washington, DC. ISBN: 0-309-09732-0, 104 pp, 2005

The report presents an assessment of current monitoring systems used for airborne agent detection at the U.S. Army's Chemical Materials Agency (CMA) facilities and of the applicability and availability of innovative new technologies for trace gas detection (e.g., Fourier transform infrared (FT-IR) spectroscopy, employed in either an open-path or a folded multipass gas cell configuration; surface-enhanced Raman scattering (SERS); and chemical ionization mass spectrometry (CIMS)). It also provides a review of how new regulatory requirements would affect the CMA's current agent-monitoring procedures, and whether new measurement technologies are available and could be effectively incorporated into the CMA's overall chemical agent monitoring strategies.
Can be read on line at http://www.nap.edu/catalog/11431.html

Monitoring Dioxin Levels in Maine Rivers with Semipermeable Membrane Devices
Shoven, Heather A., Master's thesis, University of Maine, 310 pp, 2001

Recent state law in Maine (38 M.RS.A. $420-A) mandates that by December 31, 2002, the dioxin concentrations in fish downstream of a bleached Kraft pulp and paper mill are not to exceed the concentrations in fish upstream of the mill. This thesis project was undertaken to develop an alternate method for determining Kraft mill compliance with the dioxin law. The use of semipermeable membrane devices (SPMDs) circumvents many of the concerns generated by the upstream/downstream fish test. An important advantage is that the SPMDs sample current dioxin concentrations at fixed sites. Over the course of two field seasons, the feasibility of using SPMDs to monitor dioxin concentrations in Maine rivers was assessed. The 1999 field season focused on developing viable field and laboratory SPMD methods. Field methods included design of the vertical deployment apparatus for the SPMDs and determination of which environmental conditions to monitor. In the laboratory, the final SPMD extraction and cleanup methods included extraction by dialysis of the entire SPMD into hexane, followed by two cleanup methods: acidified silica gel slurry to remove residual lipids and gel permeation chromatography to remove interference through size exclusion. The final laboratory analysis involved EPA Method 16 13B and high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS). In 2000, the developed methods were applied to assess the effects of varying environmental conditions on SPMD sampling and to test two pairs of upstream-downstream sites. A preliminary investigation of the effect of varying environmental conditions on SPMD dioxin concentrations indicated positive temperature correlation and negative water velocity correlation with SPMD dioxin concentrations. The effects of environmental conditions on SPMD dioxin concentrations need to be further studied with experimental designs that allow for additional statistical tests; otherwise, a permeability reference compound for dioxin should be identified to correct SPMD concentrations for varying environmental conditions at the sites during a deployment.
http://library.umaine.edu/theses/pdf/ShovenHA2001.pdf

Monitoring of Anaerobic Processes in the Landfill Body
Wens, P. (Pollux Consulting); W. Verstraete (LabMET, Gent).
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 9 pp, 2005

Both a lack and a surplus of water within a landfill can inhibit the level of anaerobic degradation. Geo-electric sounding was found to give good insight in the overall status of a waste body in relation to anaerobic digestion.

MTBE and Gasoline Hydrocarbons in Ground Water of the United States
Moran, M.J., J.S. Zogorski, and P.J. Squillace, U.S. Geological Survey, Rapid City, SD.
Ground Water, Vol 43 No 4, p 615-627, July/Aug 2005

The occurrence of methyl tert-butyl ether (MTBE) and gasoline hydrocarbons in U.S. groundwater was examined by the U.S. Geological Survey through major aquifer surveys, urban land-use studies, and agricultural land-use studies. Only 13 groundwater samples from all study types (0.3%) had concentrations of MTBE that exceeded the lower limit of U.S. EPA's Drinking-Water Advisory. The detection frequency of MTBE was highest in monitoring wells located in urban areas and in public supply wells. The probability of detecting MTBE in groundwater was strongly associated with population density, use of MTBE in gasoline, and recharge. The probability of detecting MTBE in ground water was weakly associated with the density of leaking underground storage tanks, soil permeability, and aquifer consolidation, and only concentrations of MTBE >0.5 ug/L were associated with dissolved oxygen.

A Multidisciplinary Approach to Assess History, Environmental Risks, and Remediation Feasability of Soils Contaminated by Metallurgical Activities. Part B: Direct Metal Speciation in the Solid Phase
Venditti, D., S. Durecu, and J. Berthelin.
Archives of Environmental Contamination and Toxicology, Vol 38 No 4, p 421-427, 2000

Three soils contaminated by industrial smelting activities were examined with a complementary mineralogical approach: X-ray diffraction to identify the main mineral components, and scanning electron microscopy coupled with energy dispersive x-ray microanalysis, which showed that carbonates and oxides contained low amounts of heavy metals. Microanalysis also revealed peculiar minor mineral forms that were highly informative about the history of soil contamination. These approaches allowed completion and confirmation of the conclusions achieved after chemical and physical investigations, providing accurate information about the history, environmental risks, and remediation feasibility of this contaminated soil.

New Device Monitors Metal Content in Stack Emissions at Tooele
Finney, Dana, ERDC/CERL.
Public Works Digest, Vol 16 No 4, p 27, July/Aug 2004

A multi-metal continuous emission monitor tested at Tooele Army Depot, UT, could decrease the burden and cost of complying with the 1990 Clean Air Act Amendments. Developed by the Engineer Research and Development Center (ERDC) in partnership with

Cooper Environmental Services, Beaverton, OR, the device uses X-ray fluorescence to simultaneously check for up to 19 different hazardous metals as emissions exit the stack. The new device is called XCEM, for X-Ray Fluorescence-Based Multi-Metal Continuous Emission Monitor. ERDC's Construction Engineering Research Laboratory (CERL) installed the prototype in FY02 on Tooele's conventional munitions furnace, which is the only one currently operating in the U.S. Current sampling procedures are not only cumbersome, but also expensive, with $600,000 spent every two years to do trial burns, which take two months to complete. The X-ray fluorescence component of XCEM is the analytical tool, while an automated sampling system provides extractive batch sampling onto a resin-impregnated filter tape. When the tape is spent, it can be removed and analyzed to verify that the monitor was working properly. XCEM samples the emissions every 20 minutes, and a computer interface notifies the furnace operator if the level of any contaminant is approaching limits set by EPA's National Emissions Standard for Hazardous Air Pollutants. If it does, the operator can immediately invoke measures to control it, such as slowing the feed rate. The monitor is interfaced with easy-to-use software that provides sensor integration automation, quality assurance routines, automatic calibration, and report generation. XCEM is commercially available at about $200K per unit. In addition to demilitarization furnaces, XCEM could have application at any other industrial plant that emits hazardous metals, such as cement manufacturers or coal-fired boilers. A spin-off technology called XCMM, which continuously monitors mercury levels, was evaluated in an EPA-sponsored test during summer 2003. For more information about these monitors, contact Dr. K. James Hay at CERL, 217-373-3485, Kent.J.Hay@erdc.usace.army.mil.
http://www.hq.usace.army.mil/isd/PUBS/DIGEST/PWD_Jul_Aug_2004.pdf

New Fluorescent Probes for the Detection of Mixed Sodium and Potassium Metal Ions
Xu, Xiaohe, Hao Xu, and Hai-Feng Ji, Louisiana Tech Univ., Ruston.
Chemical Communication, Vol 20, p 2092-2093, 21 Oct 2001

A new fluorescent probe 2 has been developed that is capable of measuring the concentration of a mixture of sodium and potassium ions in solution. This probe contains a fluorophore that is utilized in two ways, depending on the pH of the solution.
http://www2.latech.edu/~hji/papers/commun2001.pdf

A New Framework for Adaptive Sampling and Analysis During Long-Term Monitoring and Remedial Action Management
Minsker, Barbara, Univ. of Illinois, Urbana-Champaign.
Report No: EMSP-87023-2005, 2005 [OSTI: DE00859257]

This research note describes the latest work on a multi-year DOE-funded project. Yonas Demissie, a research assistant supported by the project, has successfully created artificial data and assimilated it into coupled Modflow and artificial neural network models. His initial findings show that the neural networks help correct errors in the Modflow models. Abhishek Singh has used test cases from the literature to show that performing model calibration with an interactive genetic algorithm results in significantly improved parameter values. Meghna Babbar, the third research assistant supported by the project, has found similar results when applying an interactive genetic algorithms to long-term monitoring design. She has also developed new types of interactive genetic algorithms that significantly improve performance. Gayathri

Gopalakrishnan, who is partially supported by the project, has shown that sampling branches of trees used for phytoremediation is an accurate approach to estimating soil and groundwater contaminations in areas surrounding the trees at the Argonne 317/319 site.

Novel Approach to Measurement of Rhizosphere Effect in Phytoremediation
Thoma, G., P. Hsu, T. Lam, S. Ziegler, and D. Wolf. Univ. of Arkansas, Fayetteville.
The AIChE 2005 Annual Meeting, 30 October - 4 November, Cincinnati, OH. 23 pp [PowerPoint presentation], 2005

Plant roots and plant-produced compounds or root exudates provide a local environment rich in nutrients and enzymes for enhanced microbial population and activity in the rhizosphere, the soil zone near the root surface. Mathematical modeling suggests that the spatial extent of the rhizosphere is an important parameter in the degradation of immobile constituents in petroleum-contaminated soil by phytoremediation based on rhizodegradation. In work to develop an accurate and non-destructive approach to quantify the rhizosphere spatial extent in phytoremediation experiments, the rhizosphere extent is calculated from a digitized high-resolution image of the root zone during phytoremediation of a fluorescent pyrene or phenanthrene thin film. This calculation is based upon differentiating the luminescent intensity between the rhizosphere zone and bulk soil zone. Images show the rhizosphere effect and provide a quantifiable measure of the extent of the rhizosphere volume. Quantitation of the luminescent intensity also provides for direct measurement of the contaminant mass in the rhizosphere as a function of time, providing information for estimation of rhizodegradation rate constants. The results of this work should lead to a more accurate model that can be used to improve phytoremediation management.
http://www.envdiv.seas.ucla.edu/publications/Publications/2%20Thoma.pdf

A Novel Technique for Detecting Hydrocarbons in Soils
Armendartz, Al, Southern Methodist Univ., Dallas, TX.
14th Annual Quality Assurance Conference, Dallas, TX, October 18-22, 2004.

Detector tubes are commonly used in occupational settings to determine the concentration of oxygen or potentially hazardous gases in the workplace. They are designed for use with a hand pump that draws in a small, fixed quantity of air (100 mL - 1 L). Detector tubes are available for many gases, such as oxygen, ozone, formaldehyde, benzene, alkanes, vinyl chloride, total hydrocarbons, and many others. The hydrocarbon tubes contain a chemical that changes color during reactions with incoming hydrocarbons. The tubes are designed and marked to provide measurements of concentration from 100 ppb to %. These are airborne concentrations. For many petroleum hydrocarbons, the majority of mass will be in the condensed phase at equilibrium. Researchers at Southern Methodist University have been able to detect vapors in soils with at least a few hundred ppm contamination using these devices in experiments. They are trying to improve the limit of detection by getting a larger amount of mass into the detector tube. Thus far, they have achieved a technique that provides at least a yes/no response to whether soil contains at least 50 ppm gasoline contamination. The goal is to develop a technique that is at least semi-quantitative, to give order or magnitude or better estimates of the amount of contamination. The researchers are aiming for a technique that will provide results at ~$20 per sample and detect contamination levels of 50 ppm or more.
http://www.epa.gov/Arkansas/6pd/qa/co4-p14.pdf

On-Site Mercury Analysis of Soil at Hazardous Waste Sites by Immunoassay and ASV
Gerlach, R.W., M.S. Gustin, and J.M. Van Emon.
Applied Geochemistry, Vol 16 No 3, p 281-290, 2001

Two field methods for achieving quick on-site results at hazardous waste sites were evaluated for mercury: immunoassay and anodic stripping voltammetry (ASV). Each method was applied to samples containing high levels of Hg, and the results were compared to those obtained from two laboratory methods: cold vapor atomic fluorescence spectrometry (CVAFS) and inductively coupled plasma-mass spectrometry (ICP-MS). The immunoassay was found to be accurate for high and low Hg concentrations compared to the 5 and 15 ug/g soil sample standards provided with it. Despite poor agreement between immunoassay and confirmatory analysis results at concentrations near the comparison standards, the immunoassay could be used as an effective screening method, provided care is taken in identifying an operational screening level. The ASV method had an analytical range of 1to 50 ug/g, with a CV of 15%, with results were comparable to CVAFS and more precise than ICP-MS.

Optical Fibre Instrumentation for Environmental Monitoring Applications
Whitenett, G., G. Stewart, K. Atherton, B. Culshaw and W. Johnstone.
IoP Journal of Optics A: Pure and Applied Optics, Vol 5 No 5, p S140-S145, 2003

This paper reports the operation of a 64-point fiber-optic methane sensor installed on a landfill site in Glasgow, UK. Though the environmental conditions are harsh, the sensor has performed satisfactorily, detecting methane in the range of ~50 ppm to 100% methane. The authors also discuss the application of erbium-doped fiber lasers and amplifiers in gas spectroscopy, the mode-locked operation of fiber lasers, and techniques for extending fiber laser systems to form multi-point, multi-species gas sensors.
http://cmp.eee.strath.ac.uk/Optical%20fibre%20Instrumentation%20for%20environmental%20monitoring%20applications.pdf

Optical Fibre Sensors and Networks for Environmental Monitoring
Stewart, G., B. Culshaw, W. Johnstone, G. Whitenett, K. Atherton and A. McLean.
Management of Environmental Quality: An International Journal, Vol 14 No 2-3, p 181-190, 2003

Fiber sensors and networks have been developed for monitoring trace gases such as methane, acetylene, carbon dioxide, carbon monoxide, and hydrogen sulfide, as well as for detection of spills of gasoline, diesel, and organic solvents. The authors illustrate this use of technology by describing a 45-point fiber optic sensor network installed at a landfill to assess the distribution of methane generation across the site. System operation is based on near-IR absorption and is currently being extended to monitor other gases, such as carbon dioxide and hydrogen sulfide. Based on other principles, such as periodic micro-bending loss effects, detection of hydrocarbon fuel spills has been demonstrated at multiple locations along the length of a specially designed fiber optic cable using standard optical time domain reflectometry measurements.

Optimisation of Sorbent Trapping and Thermal Desorption-Gas Chromatography-Mass Spectrometric Conditions for Sampling and Analysis of Hydrogen Cyanide in Air
Juillet, Yannick, Sophie Le Moullec, Arlette Begos, and Bruno Bellier.
Analyst, Vol 130 No 6, p 977-982, 2005

Hydrogen cyanide (HCN) is present in numerous old chemical weapons that are stockpiled awaiting destruction in Northeastern France, and sampling on stockpile area and subsequent verification of HCN levels is vital to ensure worker safety. Several commercial sorbents were evaluated for their ability to trap hydrogen cyanide at various concentration levels and in various humidity conditions, and thermal desorption of the corresponding samples, followed by analysis by gas chromatography-mass spectrometry, was optimized. Carbosieve S-III, a molecular sieve possessing a very high specific area, proved the most efficient sorbent for HCN sampling in all conditions tested; however, the results showed that Tenax, which is generally considered a reference sorbent for air monitoring and analysis of chemical warfare agents, is not suitable for HCN trapping.

Optimizing the Analysis of Polybrominated Diphenyl Ethers
Wylie, Philip L., Agilent Technologies Inc., Wilmington, DE.
14th Annual Quality Assurance Conference, Dallas, TX, October 18-22, 2004.

PBDEs are the most widely used class of brominated flame retardants. These compounds have 10 possible Br substitution sites and 209 possible congeners depending on number and location of Br substitutions, and they are numbered (1 through 209), like PCBs. There are three commercial PBDE products: Penta, Octa, and Deca. All are mixtures of related congeners. Penta is used in foam products, mattresses, furniture. etc. Octa is used in computer and other business machine housings and keyboards. Deca is used in electrical and electronic equipment, automotive equipment, construction materials, and textiles. PBDEs are not covalently bound and are therefore easily released into environment. In analysis, Penta and Octa chromatograph easily, but Deca is labile, with a high boiling point, and is difficult to recover. Typical chromatographic recoveries for Deca range from ~0 to 20%. Discusses PBDE analysis in sediments and sludges. To achieve acceptable recovery for Deca, very short retention times are necessary, ideally 10-12 minutes, with GC oven temperatures of 300 degrees C or less. It can be optimized by using very short, thin-film columns and high carrier gas linear velocity, resulting in very high flows. Most GC-MS cannot tolerate high carrier gas flow (>4-5 ml/min), but short columns cannot resolve all critical congeners. This presentation describes how the use of ICP-MS can resolve some of the analytical challenges.
http://www.epa.gov/Arkansas/6pd/qa/co4-p25.pdf

Ormosil Encapsulated Pyrroloquinoline Quinone-Modified Electrochemical Sensor for Thiols
Joshi, Kanchan A., Prem C. Pandey, Wilfred Chen, and Ashok Mulchandani.
Electroanalysis, Vol 16, p 1938-1943, 2004

This paper presents an organically modified sol-gel glass (ORMOSIL) encapsulating pyrroloquinoline quinone (PQQ)-modified electrode for the rapid, sensitive, and simple determination of thiol-containing compounds, such as cysteine and glutathione. The electrode retained 95% of the original response for 7 days when stored at 48 degrees C. The ORMOSIL-encapsulated PQQ was also characterized by spectrophotometry.
http://www.engr.ucr.edu/~wilfred/Ormoil%20electroanal%2004.pdf

Overview of Sensors and Needs for Environmental Monitoring
Ho, Clifford K., Alex Robinson, David R. Miller, and Mary J. Davis, Sandia National Laboratories, Albuquerque, NM.
Sensors, Vol 5 No 1-2, p 4-37, Jan/Feb 2005

The authors review the sensor market and needs associated with environmental monitoring and long-term environmental stewardship. Emerging sensor technologies are reviewed to identify compatible technologies for various environmental monitoring applications. The contaminants that are considered in this report are grouped into the following categories: metals, radioisotopes, volatile organic compounds, and biological contaminants. United States regulatory drivers are evaluated for different applications (e.g., drinking water, storm water, pretreatment, and air emissions), and sensor requirements are derived from these regulatory metrics. Sensor capabilities are then summarized according to contaminant type, and the applicability of the different sensors to various environmental monitoring applications is discussed.
http://www.mdpi.net/sensors/list05.htm

Phytochelatin Modified Electrode Surface as a Sensitive Heavy-Metal Ion Biosensor
Adam, V., J. Zehnalek, J. Petrlova, and D. Potesil (Mendel Univ., Czech Republic); B. Sures (Univ. Karlsruhe, Germany); L. Trnkova (Masaryk Univ., Brno, Czech Republic); F. Jelen (Acad. of Sciences of the Czech Republic, Brno); J. Vitecek and R. Kizek (Mendel Univ.).
Sensors, Vol 5 No 1-2, p 70-84, Jan-Feb 2005

A new heavy-metal biosensor is proposed based on the interaction of heavy metal ions (Cd2+ and Zn2+) with phytochelatin, which is adsorbed on the surface of a hanging mercury drop electrode using adsorptive transfer stripping differential pulse voltammetry. The technique was tested for the determination of heavy metals in a biological sample of human urine and platinum in a pharmaceutical drug. The results indicate that the proposed technique offers simple, rapid, and low-cost detection of heavy metals in environmental, biological, and medical samples.
http://www.mdpi.net/sensors/list05.htm

Pipeline Integrity Management: Safely Managing the Life Cycle of Pipelines -- Session 15: Emerging Technologies
Anderson, R., D. Driscoll, R. Baker, and K. Leewis.
Southern Gas Association, 45 pp, 2005

This presentation addresses the operational reliability and integrity of the natural gas infrastructure, including transmission and distribution networks and the innovative and developing technologies that allow them to be monitored effectively.
http://homepage.mac.com/fraserfarmer/SGA/Session_15.pdf

A Porphyrin Based Potentiometric Sensor for Zn(2+) Determination
Gupta, V.K., D.K. Chauhan, V.K. Saini, and Shiva Agarwal (Indian Inst. of Technology, Roorkee (Uttaranchal) India); M.M. Antonijevic (Univ. of Belgrade, Bor, Serbia); H. Lang (Technical Univ. Chemnitz, Chemnitz, Germany).
Sensors, Vol 3 No 7, p 223-235, July 2003

The authors describe the preparation and construction of PVC-based membranes for the determination of Zn(II). The useful pH range of the sensor is 3.0 to 7.4, beyond which a drift in potential is observed. The response time of the sensor is 10 seconds, and the lifetime is about 2 months, during which time it can be used without any measurable divergence. It has good stability and reproducibility. The membrane works satisfactorily in a non-aqueous medium up to 40% (v/v) non-aqueous content. The electrode was used as an indicator electrode to determine the endpoint in the potentiometric titration of Zn2+ with EDTA.
http://www.mdpi.org/sensors/list03.htm

Prediction of [3-SUP14C]Phenyldodecane Biodegradation in Cable Insulating Oil-Spiked Soil Using Selected Extraction Techniques
Dew, N.M., G.I. Paton, and K.T. Semple, Lancaster University, Lancaster, UK
Environmental Pollution, Vol 138 No 2, p 316-323, 2005

Phenyldodecane represents a major constituent of cable-insulating oil. The authors investigated the use of an aqueous hydroxypropyl-beta-cyclodextrin (HPCD) shake extraction in predicting microbial mineralization and total loss of [3-SUP14C]phenyldodecane-associated activity in soils spiked with cable insulating oil. Direct comparisons were made between freshly spiked and aged soils, and following composting. The results indicate that an aqueous HPCD extraction may be a useful tool in assessing the microbial availability of phenyldodecane in both aged and freshly contaminated soils.

Problems of Analysis of Naturally Occurring Dioxin in Minerals
Moll, W., Oil-Dri Corp., Vernon Hills, IL.
2005 SME Annual Meeting & Exhibit, 28 February - 2 March, Salt Lake City, Utah.
Society for Mining, Metallurgy, and Exploration (SME), Littleton, CO.

Analysis of naturally occurring dioxin in minerals poses challenges with respect to methods of extraction, effects of possible catalysis during extraction, and cases of non-recovery of analytical spikes from minerals. The relevance of the determined values to the actual uses of the minerals and estimation of the actual exposures these uses may pose is also a problem. This

paper explores these questions, presents possible explanations for their origin and strategies to accommodate them, and discusses methods to determine mineral products that pose no danger to the user.

Proceedings of the Federal Interagency Sediment Monitoring Instrument and Analysis Research Workshop, 9-11 September 2003, Flagstaff, Arizona
Gray, John R., ed.
U.S. Geological Survey Circular 1276, ISBN 0-607-96322-1, 50 pp, 2005

The Advisory Committee on Water Information's Subcommittee on Sedimentation sponsored the Federal Interagency Sediment Monitoring Instrument and Analysis Research Workshop on September 9-11, 2003, at the U.S. Geological Survey Flagstaff Field Center in Arizona. The workshop brought together a diverse group representing most federal agencies whose mission includes fluvial-sediment issues. The workshop emphasized technological and theoretical advances related to measurements of suspended sediment, bedload, bed material and bed topography, and data analyses. This report provides a description of the salient attributes of the workshop and related information, major deliberations and findings, and principal recommendations. Extended abstracts available on line.
http://pubs.usgs.gov/circ/2005/1276/

Quantification of the Effects of Pore Clogging in Potential PRB Substrates Using Image Analysis
Wantanaphong, J., S.J. Mooney, and E.H. Bailey, Univ. of Nottingham, Nottingham, UK.
Permeable Reactive Barriers (Proceedings of the International Symposium held at Belfast, Northern Ireland, March 2004). IAHS Publ. 298, p 154-160, 2005

Of major concern in the use of PRBs to address groundwater contamination is the deterioration of barrier material performance due to mineral precipitation and pore clogging. Scientists sought to quantify the effect of pore clogging on the alteration of the physical architecture of clinoptilolite and calcified seaweed using image analysis. After treatment with contaminated water for 1 to 10 months, the investigators identified a decrease in porosity from 22% to 15% for calcified seaweed and from 22% to 18% for clinoptilolite. The mean pore size of both materials was also decreased after the treatment. An increase in irregularly shaped pores was also observed in both materials after the treatment, particularly in the bottom of columns where the contaminated water first interacted with the barrier materials. The distribution of pores within an image derived from the distance transform indicated morphological differences in material between the bottom and the top of calcified seaweed columns, which is likely to affect their performance as barrier materials.
http://www.nottingham.ac.uk/biosciences/ah/posters/pdf/image%20analysis.pdf

Rare Earth Element Patterns: a Tool for Understanding Processes in Remediation of Acid Mine Drainage
Merten D. (Friedrich-Schiller Univ., Jena, Germany); J. Geletneky; H. Bergmann; G. Haferburg; E. Kothe; and G. Buchel.
Chemie der Erde, Vol 65 Supl 1, p 97-114, 19 Sep 2005

The distribution of rare earth elements (REE) was applied to study processes in remediation of acid mine drainage (AMD). The studied AMD REE patterns were thought to be representative of the seepage location, which means they might be used to identify waste rock sources of contamination for valley sediments; however, results from percolation experiments and LA-ICP-MS measurements show that REE patterns of seepage water samples do not reflect the total REE pattern of the source rocks, but are preferentially eluted from Silurian "Ockerkalk." Due to co-precipitation with Fe phases, REEs decrease in concentration and fractionate along the path of a creek. The REE patterns can also be used to identify the potential for sorption/uptake of heavy metals by biomass; a strain with high potential for remediation purposes could be identified by incubating microbial strains isolated from the investigation area directly in AMD. The authors also used the REE patterns to study the transfer of heavy metals from soil to plants.

Reductive Dechlorination of the Vinyl Chloride Surrogate Chlorofluoroethene in TCE-Contaminated Groundwater
Ennis E.; R. Reed; M. Dolan; L. Semprini; J. Istok; J. Field, Oregon State Univ., Corvallis
Environmental Science & Technology, Vol 39 No 17, p 6777-6785, 1 Sep 2005

At many trichloroethene (TCE)-contaminated sites, microbial transformation of TCE results in the accumulation of vinyl chloride (VC). Quantitative tools are needed to determine the rates of VC transformation to ethene in contaminated groundwater. E-/Z-chlorofluoroethene (E-/Z-CFE) was evaluated as a surrogate for VC in laboratory microcosm and field push-pull tests. At a TCE-contaminated field site, E-/Z-CFE was injected and the formation of fluoroethene (equivalent to VC transformation to ethene) was monitored over a period of up to 80 days. The results of the study indicate the viability of E-CFE as a potential surrogate for estimating the in situ rates of VC transformation.

Refinement of Weak Acid Dissociable (WAD) Method for Measuring Weak Metal Cyanide Complexes in Aqueous Samples
Ghosh, R.S. (The RETEC Group, Inc., Monroeville, PA); I.P. Murarka (Ish Inc., Raleigh, NC); D.V. Nakles (RETEC); E.F. Neuhauser (Niagara Mohawk Power Corp., Syracuse, NY).
Environmental Engineering Science, Vol 22 No 5, p 543-556, Sep 2005

The deficiencies in a weak acid dissociable (WAD) cyanide analytical method became apparent when the method was applied to groundwater and surface water samples dominated by iron/cyanide complexes at >50% of the total cyanide content. The method is fine for determining WAD cyanide in any aqueous sample where weak metal cyanide complexes and free cyanide ions dominate the cyanide speciation (i.e., iron/cyanide complexes are <50% of the total cyanide content). Correcting the deficiency depends upon which iron/cyanide complex is present. For the samples dominated by the ferri- and ferrocyanide complexes, addition of the prescribed amount of zinc acetate under mildly acidic conditions was sufficient to remove these complexes from solution via formation of an iron cyanide precipitate; however, the high-temperature distillation

step of the analytical method destabilized the iron/cyanide precipitate thus formed, resulting in the recovery of some of this strong acid dissociable cyanide complex as WAD cyanide. An intermediate filtration step using a 0.45-micron filter was introduced to remove the precipitate before distillation is performed. When the iron/cyanide complexes were dominated by the iron/pentacyano methylamino complex, it was necessary to add 3 times the prescribed amount of zinc acetate to remove the complex from the solution and to use a smaller filter size (0.2 micron) to remove the precipitate before distillation.

Relationship Between OVA Readings and Air Toxic Emissions from Soil Vapor Extraction Remediation Systems
Barringer, J.H.M. and L.M. Haselbach, Fuss and O'Neill, Inc., Columbia, SC.
Proceedings of the 2004 World Water and Environmental Resources Congress: Critical Transitions in Water and Environmental Resources Management, 27 June - 1 July 2004, Salt Lake City, UT. ASCE, Reston, VA. ISBN: 0784407371, 2004

An estimation of the relationship between organic vapor analyzer (OVA) readings and air toxic emissions from soil vapor extraction remediation systems resulted in a recommendation of a detailed examination of site-specific variables to find the relationship between OVA readings and air toxic concentrations. A standard regression analysis was performed on each of the findings associated with contaminants and OVA. It is important to implement a standard operating procedure for the use of OVA meters when sampling is being carried out.

Research Report on Development of a Standard Test Method for Screening Trichloroethylene (TCE)-Contaminated Soil Using a Heated Diode Sensor
Sorini, S.S., J.F. Schabron, J.F. Rovani, Jr., and T.M. Bomstad.
ASTM International, West Conshohocken, PA. Research Report RR:D34-1017, Nov 2005

ASTM Method D 7203-05, "Standard Test Method for Screening Trichloroethylene (TCE)-Contaminated Soil Using a Heated Diode Sensor," provides a procedure for screening soil known to contain the halogenated volatile organic compound (VOC), TCE, by measuring the TCE concentration in the headspace above a sample of the soil using a heated diode sensor device and calculating an estimated concentration of TCE in the soil. This method can also be used for screening the headspace above a soil suspected of containing halogenated VOC contamination to indicate the presence or absence of such contamination in the soil. This report describes experimental work that was performed to develop the screening method. After the method was developed, a field validation study, which is also described in this report, was conducted to evaluate the performance of the method to screen soil collected at a TCE-contaminated site. The data generated in the study show that the method performs well for screening TCE-contaminated soil samples to give an estimated TCE concentration in the samples. The screening method gave no false negative or false positive results and provided estimated TCE concentrations that correlate well with laboratory data. The data generated in the study also show the usefulness of the screening method for indicating the presence or absence of halogenated VOCs in soil.

Response Characteristics of an Aquatic Biomonitor Used for Rapid Toxicity Detection
van der Schalie, W.H., T.R. Shedd, M.W. Widder, and L.M. Brennan, U.S. Army Center for Environmental Health Research, Fort Detrick, MD.
Journal of Applied Toxicology, Vol 24 No 5, p 387-394, Sep-Oct 2004

The response characteristics of an aquatic biomonitor that detects toxicity by monitoring changes in bluegill fish ventilatory and movement patterns were evaluated in single chemical laboratory studies at concentrations near the 96-h LC(50) concentration. Baseline data collected prior to exposure allows each fish to serve as its own control. When at least 70% of exposed fish exhibit ventilatory or movement parameters significantly different from baseline observations, a group alarm is declared. In the lab, the aquatic biomonitor responded to the majority of chemicals at the 96-h LC(50) within an hour or less, though with higher response times for malathion and pentachlorophenol. All four monitored parameters (ventilatory rate, cough rate, ventilatory depth, and movement) contributed to identification of first alarms at acutely toxic levels. Study of these response patterns can be useful for applications such as surface water monitoring for watershed protection, wastewater treatment plant effluent monitoring, or source water monitoring for drinking water protection.

Results of Performance Evaluation Testing of Electrical Leak-Detection Methods at the Hanford Mock Tank Site, FY 2002-2003
Barnett DB, GW Gee, MD Sweeney, MD Johnson, VF Medina, DP Mendoza, BG Fritz, F Khan, WD Daily, JB Fink, MT Levitt, and AM Binley, Pacific Northwest National Lab, Richland, WA.
PNNL-14192, 423 pp, 2003

Pacific Northwest National Laboratory (PNNL) evaluated electrical geophysical methods for tank leak-detection performance parameters during a 110-day blind test staged at the Hanford Mock Tank Site in 2002. Thirteen releases of sodium thiosulfate solution (waste simulant) totaling ~53,000 L (~14,000 gal) were injected into the soil beneath the Mock Tank to simulate a single-shell tank leak. The performance evaluation (PE) test was designed to determine the minimum leak volume that would trigger a detection response by the geophysical methods and how accurately the methods quantify the leak volumes, both with respect to background signal levels and signal levels from later periods, after leaking began (i.e., determining change in sensitivity of methods over time). The methods evaluated during the PE test included electrical resistivity tomography (ERT) with variations of the method termed the point-electrode technique (PET) and the long-electrode technique (LET). PET used eight vertical arrays of electrodes to perform tomographic (3-D) inversion analysis of both the volume of a leak and its approximate location. LET used eight fused vertical arrays, simulating steel casings, to provide a 2-D tomograph of the leak. Data from both techniques were used to devise a statistical tool to provide a leak-no leak determination. The second method, the high-resolution-resistivity steel casing resistivity technique (HRRSCRT), employed 4 variations of the technique to determine the most effective configurations of the measurement system. These sub-techniques involved different combinations of electrodes, including direct connection to the leaking solution (excitation of mass) to dynamically detect changes in the grounding characteristics of the tank due the presence or absence of leaking solution. Results for the ERT-LET were mixed. Leak-detection results for the HRR-SCRT provided reasonable volume estimates (within 30%) of the solution injected into the subsurface, as well as relatively accurate leak rates in real-time.
http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14192.pdf

Results Report for the Demonstration of No-Purge Groundwater Sampling Devices at Former McClellan Air Force Base, CA.
U.S. Army Corps of Engineers Omaha District, Air Force Center for Environmental Excellence, and Air Force Real Property Agency. 79 pp, Oct 2005

This publication reports the results of a field demonstration of six "no-purge" groundwater sampling devices. Analyses of VOCs, metals, anions, and 1,4-dioxane levels in samples from four diffusion and two grab-type samplers were compared to those from conventional low-flow and three-well-volume purge samples. The study was conducted at the former McClellan Air Force Base, Sacramento, CA. The two grab-type samplers delivered results that were typically more similar than the diffusion-based samplers to the conservative (i.e., higher concentration) results from the conventional sampling methods. Of the two grab-type samplers, the HydraSleeve(R) was substantially less expensive based on the assumptions used in the cost analysis, though both methods were less expensive than the conventional approaches. The HydraSleeve was simpler to deploy and retrieve, and permits a larger volume of water to be collected. Of the six no-purge devices tested, the HydraSleeve was also the only one that delivered viable samples for all of the analytes tested. The report concludes that the HydraSleeve appears to be a technically viable method for monitoring all the compounds included in this demonstration. Note: the appendices are in separate files from the 79-page main report.
http://www.geoinsightonline.com/resources/mcclellan_report_excerpt.html

A Review of Field Technologies for Long-Term Monitoring of Ordnance-Related Compounds in Groundwater
MacMillan, Denise K. and David E. Splichal, U.S. Army Engineer Research and Development Center, Omaha, NE.
ERDC/EL TR-05-14, 60 pp, Sep 2005

This document identifies and describes proven and promising sampling devices and onsite analytical instrumentation that potentially could be used now for long-term monitoring (LTM) of ordnance-related compounds in groundwater. Instrumentation for LTM must provide rigorous qualitative as well as quantitative identifications. The following general categories of field analytical technologies applicable to volatile organic chemicals and organic ordnance-related chemicals are included in the report: water quality monitors associated with low-flow purge techniques, discrete interval samplers, immunoassay for detection of explosives, gas chromatography with liquid compatible inlets, mass spectrometry with liquid compatible inlets, ion mobility spectrometry with liquid compatible inlets, chemical sensors, and colorimetric technologies.
http://el.erdc.usace.army.mil/elpubs/pdf/trel05-14.pdf

Saline Tracer Visualized with Three-Dimensional Electrical Resistivity Tomography: Field-Scale Spatial Moment Analysis
Singha, K. and S.M. Gorelick, Stanford Univ., Stanford, CA.
Water Resources Research, Vol 41 No 5, 2005

Cross-well electrical resistivity tomography (ERT) was used to monitor the migration of a saline tracer in a 2-well pumping injection experiment. After injecting 2200 mg/L of sodium chloride for 9 hours, ERT data sets were collected from four wells every 6 hours for 20 days.

Each ERT data set was inverted to produce a sequence of 3-D snapshot maps that track the plume. A pumping test and an infiltration test were also conducted to estimate horizontal and vertical hydraulic conductivity values. Though the tomograms provide valuable insights into field-scale tracer migration behavior and aquifer heterogeneity, standard tomographic inversion and application of Archie's law to convert electrical conductivities to solute concentration results in underestimation of tracer mass due to (1) reduced measurement sensitivity to electrical conductivity values with distance from the electrodes and (2) spatial smoothing (regularization) from tomographic inversion.

Satellite Monitoring of Inland and Coastal Water: Quality Retrospection, Introspection, Future Directions
Bukata, Robert P., National Water Research Inst., Burlington, ON, Canada.
CRC Press, Boca Raton, FL. ISBN: 0849333563, 300 pp, 2005

The author reviews how aquatic optics models convert remote determinations of water color into accurate assessments of water quality. This conversion generates products of value for environmental monitoring of optically complex inland and coastal waters. The author emphasizes how terrestrial, aquatic, and wetland remote sensing are underutilized tools due to a lack of influential end-usership. He reviews this lack of interest and examines why it exists, how it can be abated, and the synergies that need to be activated among technologists, scientists, entrepreneurs, policy-makers, and water quality professionals to promote the use of unfamiliar technologies.

Screening Method for Linear Alkylbenzene Sulfonates in Sediments Based on Water Soxhlet Extraction Assisted by Focused Microwaves with On-Line Preconcentration/Derivatization/Detection
Morales-Munoz, S., J.L. Luque-Garcia, and L. de Castro, Univ. of Cordoba, Cordoba, Spain.
J Chromatogr A. Vol 1026 Nos 1-2, p 41-46, 13 Feb 2004
A screening method for linear alkylbenzene sulfonates (LAS) in sediments has been developed. Soxhlet extraction with water assisted by focused microwaves provides recoveries better (>90%) than obtained by conventional Soxhlet extraction (70-80%). Coupling of the extractor with an on-line preconcentration/derivatization/detection manifold through a flow injection (FI) interface allows a fully automated screening approach. A yes/no answer can be obtained in less than 2 h (for the whole analytical process), a short time compared with the at least 24 h of Soxhlet extraction (without final detection). Due to the use of water as leaching agent, the proposed method is environmentally friendly

Sensing Environmental Estrogens with Glowing Yeast
Thacker, Paul D.
ES&T Technology News, 27 July 2005

John Sanseverino, a research assistant professor in the center for environmental biotechnology at the University of Tennessee, has engineered a speedy detection device for endocrine-disrupting chemicals: yeast that glows in the presence of estrogens. The sensor provides results in 2 to 6 hours. The current EPA system takes 3 to 5 days and relies on

mammalian cell lines grown in a medium that changes color as the cells respond to estrogens. Sanseverino's system relies on human and bacterial genes introduced into yeast cells. If an estrogenic chemical enters a modified yeast strain, then the compound will bind to an estrogen receptor protein expressed by the added human gene. This receptor-protein complex then binds to a small section of DNA, and this turns on the production of "reporter" bacterial lux genes, which produce a luminescent protein. Elaine Francis, the national director for the EPA's pesticide and toxic research program, says that once a chemical has been found to bind with hormone receptors, EPA then plans to put the substance through a second tier of testing to uncover any actual endocrine-disrupting effects. Sanseverino is now engineering a separate yeast line that contains a human androgen receptor to test for chemicals that mimic male hormones, such as testosterone. He is also evaluating whether the amount of light emitted by the yeast correlates with the strength of endocrine activity, so that a test can also quantify the effect. He aims to create an online endocrine-sensing system by coupling the glowing yeast with a photodetector hooked to the Internet to allow remote sensing of the presence of hormone-like chemicals in wastewater treatment plants or distant lakes and streams.

Sensor Technologies Used During Site Remediation Activities: Selected Experiences
U.S. EPA, Technology Innovation and Field Services Division, Washington, DC.
EPA 542-R-05-007, 110 pp, Sep 2005

EPA prepared this report to provide an overview of several types of sensor technologies and a summary of selected experiences in using the technologies during site remediation activities. The report highlights the applications, implementation, strengths and limitations, and lessons learned from actual projects that have used one or more sensor technologies as part of an overall site remediation strategy. Appendices one through seven provide case studies for specific sites that have used sensor technologies during site remediation activities.
http://www.clu-in.org/download/remed/542r05007.pdf

Shining Light on Metals in the Environment
McNear, David H., Jr., Ryan Tappero, and Donald L. Sparks, Univ. of Delaware, Newark.
Elements, Vol 1, p 209-216, Aug 2005

Elucidating the speciation of heavy metals in the environment is essential to understanding their potential mobility and bioavailability. Scientists have often used total metal concentrations or chemical extraction techniques (e.g., sequential extraction methods) to provide some insight into metal speciation and bioavailability; however, total concentration measurements do not take into account that not all of the metal is labile or available for uptake by plants and other organisms. Sequential extraction methods attempt to overcome this ambiguity by employing multiple chemical extractants, each progressively more aggressive, to remove specific physically or chemically sorbed and/or occluded metal ions (e.g., exchangeable, associated with carbonates, oxides, etc.). The accuracy of the metal/solid phase associations derived from sequential extractions is strongly dependent on the type of extracting reagent used and thus is prone to misinterpretation. Cutting-edge synchrotron-based techniques such as microfocused X-ray absorption fine structure (XAFS) and X-ray fluorescence (XRF) spectroscopy and microtomography have revolutionized the way metal reactions and processes in natural systems are studied. The authors have applied these intense-light tools to decipher

metal forms (species) and associations in contaminated soils and metal-hyperaccumulating plants.
http://ag.udel.edu/SoilChem/211-218%20McNear.pdf

A Simple Field Leach Test to Assess Potential Leaching of Soluble Constituents from Mine Wastes, Soils, and Other Geologic Materials
Hageman, P.L., U.S. Geological Survey, Denver, CO.
U.S. Geological Survey Fact Sheet 2005-3100, 4 pp, Sep 2005

Rainwater- or snowmelt-induced leaching of major elements, trace elements, and acid from mine wastes or naturally mineralized areas and the effects of the resulting runoff on adjacent streams are common environmental concerns. Another concern is the direct or indirect uptake of potentially toxic metals from these leachates into the food chain. Many other geogenic materials (e.g., soils, mineralized rocks, dusts, volcanic ash, and forest-fire ash) can also react chemically with water to produce leachates with increased concentrations of major and trace elements and altered pH. Traditionally, laboratory leach studies have been a useful way to assess the potential effects from the leaching of materials; however, the leach tests most commonly used are complicated and time-consuming and require specialized equipment. USGS has developed a fast (5-minute), relatively simple, and cost-effective leach test to aid in quantifying the leachability of geologically derived material and the chemical reactions that can occur when the material comes into contact with water. The USGS Field Leach Test (FLT) can easily be performed in the laboratory or on site to effectively simulate the chemical reactions that occur when geologic materials are leached by water.
http://pubs.usgs.gov/fs/2005/3100/

A Simple Method for Calculating Growth Rates of Petroleum Hydrocarbon Plumes
Bekins, Barbara A., Isabelle M. Cozzarelli, and Gary P. Curtis.
Ground Water, Vol 43 No 6, p 817-826, Nov 2005

Data from two research sites contaminated with petroleum hydrocarbons show that toluene and xylenes degrade under methanogenic conditions, but the benzene and ethylbenzene plumes grow as aquifer Fe(III) supplies are depleted. It is possible to derive a simple expression for the growth rate of a benzene plume by considering a 1-D reaction front in a constant unidirectional flow field. The method balances the mass flux of benzene with the Fe(III) content of the aquifer, assuming that the biodegradation reaction is instantaneous. The resulting expression shows that the benzene front migration is retarded relative to the groundwater velocity by a factor that depends on the concentrations of hydrocarbon and bioavailable Fe(III). Although it was developed for BTEX constituents, the growth-rate estimation method may have applications to contaminant plumes from other persistent contaminant sources.

Simplified Method for Detecting Tritium Contamination in Plants and Soil
Andraski, B.J., M.W. Sandstrom, R.L. Michel, J.C. Radyk, D.A. Stonestrom, M.J. Johnson, and C.J. Mayers.
Journal of Environmental Quality, Vol 32 No 3, p 988-995, 2003

In an effort to identify the presence and distribution of tritium near radioactive waste disposal and other contaminated sites, the authors undertook a study to develop a simplified sample preparation method for determining tritium contamination in plants and also to determine if plant data could be used as an indicator of soil contamination. Plant water from foliage was collected and subjected to solar distillation, followed by filtration and adsorption of scintillation-interfering constituents on a graphite-based, solid-phase extraction (SPE) column. The method was evaluated using samples of creosote bush, an evergreen shrub, near a radioactive disposal area in the Mojave Desert. A 2-g SPE column was determined to be necessary and sufficient for accurate determination of known tritium concentrations in plant water. Comparisons of tritium concentrations in plant water determined with the solar distillation/SPE method and the standard (and more laborious) toluene-extraction method showed no significant difference between method results. Tritium concentrations in plant water and in water vapor of root-zone soil also showed no significant difference in method results. The solar distillation/SPE method provides a simple and cost-effective way to identify plant and soil contamination with sufficient accuracy to facilitate collection of plume-scale data and optimize placement of more sophisticated and costly monitoring equipment at contaminated sites of the type described in this paper.

Single-Channel Microchip for Fast Screening and Detailed Identification of Nitroaromatic Explosives and Organophosphate Nerve Agents
Wang, J., M. Pumera, M.P. Chatrathi, A. Escarpa, M. Musameh, G.E. Collins, A. Mulchandani, Y. Lin, and K. Olsen, New Mexico State Univ., Las Cruces.
Analytical Chemistry, Vol 74 No 5, p 1187-1191, 1 Mar 2002

A single-channel chip-based analytical microsystem allows rapid flow injection measurements of the total content of organic explosive or nerve agent compounds, as well as detailed micellar chromatographic identification of the individual ones. The protocol involves repetitive rapid flow injection (screening) assays, switching to the separation (fingerprint identification) mode only when harmful compounds are detected. While micellar electrokinetic chromatography, in the presence of sodium dodecyl sulfate (SDS), is used for separating the neutral nitroaromatic explosive and nerve agent compounds, an operation without SDS leads to high-speed measurements of the total explosives or nerve agent content. The researchers aim to develop a field-deployable microanalyzer that will enable transporting the forensic laboratory to the sample source.

A Small-Diameter Sample Pump for Collection of Depth-Dependent Samples from Production Wells Under Pumping Conditions
Izbicki, John A.
U.S. Geological Survey Fact Sheet 2004-3096, 2 pp, 2004

The U.S. Geological Survey, in cooperation with the manufacturer (Besst, Inc.), has modified a commercially available gas-displacement sample pump to collect water at selected depths within production wells under pumping conditions. The modified pump is about 6 inches

long, less than 1 inch in diameter, and is operated through repeated application and release of compressed gas. The pump is intended for use in production wells having limited access that prevents the use of traditional geophysical tools, such as wire-line bailers, used to collect depth-dependent water samples. In most cases, the production pump does not have to be removed or the well modified for insertion of the sample pump. Data collected at different depths within the production well reflect water quality at those depths under actual pumping conditions. If well-bore flow velocities are known, the quality of water in the aquifer between sample depths can be estimated. This small-diameter pump enables more efficient collection of depth-dependent samples from production wells of limited access by increasing the ease with which water samples are collected (thereby reducing the time and cost) through eliminating the need to retrieve the sample pump from the well after each sample is collected.
http://pubs.usgs.gov/fs/2004/3096/

Soils and Mosses for the Monitoring of Trace Elements in Three Landfills
Cenci, R.M. (European Commission DG JRC Inst for Environment and Sustainability, Ispra, Italy); N. Simonazzi; E. Meglioli; P.R. Trincherini; L. Canovi; V. Guberti.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy. 17 pp, 2005

Bioindicators (transplanted mosses, Scleropodium purum species) and surficial soils were used to monitor heavy metals in three landfills in Italy. All the landfills are positioned on exhausted clay mines. One landfill began this monitoring in 1999, and other two in April 2002. Monitoring ended in April 2004. The researchers sought to estimate the concentrations of Al, As, Bi, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Ti, Tl, V, Zn, Pt, and Rh in 15 stations over the course of two years, as well as the flows of element depositions (gram element/hectare area/year). The origin of the element depositions was also identified, discriminating between anthropogenic origin and soil-substrate origins. No significant increase of heavy metal concentrations was observed during the monitoring period. The results obtained for the elements investigated did not emphasize any specific anomalies. The concentration values present a situation of absolute normality, similar to natural areas with limited human presence.

Spatial and Temporal Dynamics in Arsenic Speciation Across the Ground Water-Surface Water Transition Zone at a Contaminated Site
Ford, R.G., R.T. Wilkin, F. Beck Jr., and P. Clark (U.S. EPA, Ada, OK); J. Creed and P. Creed (U.S. EPA, Cincinnati, OH).
The 230th ACS National Meeting, Washington, DC, Aug 28-Sept 1, 2005. GEOC 143.

A ground-water plume discharging to a small lake contains elevated levels of arsenic and hydrocarbon contaminants resulting from historical disposal of process wastes from upgradient industrial activities. The chemical speciation of arsenic and iron in ground/surface water, suspended solids, and sediments was assessed using macroscopic and spectroscopic techniques to determine the fate of arsenic derived from groundwater discharge. Patterns in the chemistry of redox-sensitive elements point to both the direct and indirect influence of microbial processes on arsenic speciation and transport. Dramatic changes in chemical speciation were observed over

spatial distances of meters or less, which illustrates the need to tailor monitoring efforts to address site-specific characteristics.

The Stability of Chlorofluorocarbons (CFCs) in Ground-Water Samples Archived in Borosilicate Ampoules
Shapiro, Stephanie Dunkle, Eurybiades Busenberg, and L. Niel Plummer.
U.S. Geological Survey Open-File Report 2004-1392, 36 pp, 2005

The U.S. Geological Survey Chlorofluorocarbon (CFC) Laboratory in Reston, VA, has been measuring concentrations of CFCs in groundwater samples since 1989 to estimate the year that a water sample was recharged to a groundwater flow system. The water samples have been collected in flame-sealed borosilicate ampoules. Typically for each site, three samples were analyzed within days to a few months after collection, and additional samples were archived for extended periods of time (up to four years). The stability of CFC concentrations in the archived water samples from the USGS CFC Laboratory was investigated by analyzing the CFC concentrations in archived water samples and comparing them with the CFC concentrations that were obtained soon after the samples were collected. The archived samples selected for analysis were chosen from sites with a wide variety of hydrogeologic and geochemical conditions. For CFC-11 and CFC-12 concentrations, approximately 14% and 10.5%, respectively, of the archived samples were statistically different (both higher and lower) from the concentrations obtained from analyses conducted soon after the sample collection. Most of the extraneous values were attributed to natural variability of CFC concentrations originally in the water discharged from wells, rather than to microbial degradation within the ampoule on storage.
http://pubs.usgs.gov/of/2004/1392/

Steam Injection Pilot Study in a Contaminated Fractured Limestone (Maine, USA): Modeling and Analysis of Borehole Radar Reflection Data
Gregoire, C., J.W.J. Lane, and P.K. Joesten.
Proceedings of the 3rd International Workshop on Advanced Ground Penetrating Radar, Delft, The Netherlands, May 2-4, 2005

Borehole radar tomography and reflection techniques were used to monitor steam-enhanced remediation of a fractured limestone aquifer contaminated with chlorinated hydrocarbons at the former Loring Air Force Base in Limestone, ME. The borehole radar results were used to estimate the extent and degree of steam invasion within the aquifer in the vicinity of the radar monitoring wells. The study was supported by the U.S. Geological Survey and the KULeuven (University of Leuven, Belgium), and funded by U.S. USEPA's Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation and by the USGS Toxic Substances Hydrology Program. The presentation is in PowerPoint.
http://www.gap2005.uni-muenchen.de/presentations/cg.ppt

A Study of Managing Uncertainties Using the Triad Approach
Petroleum Release Compensation Fund (PRCF).
South Dakota Department of Revenue and Regulation, 258 pp, June 2005

In the fall of 2004, the South Dakota Petroleum Release Compensation Fund (PRCF) conducted a study to evaluate and report on the effectiveness of using the Triad Approach to manage decision uncertainties as they pertain to characterizing petroleum release sites across South Dakota. Three active gas stations, one closed gas station, and a railroad fueling site were chosen for the study. These locations are considered "legacy" sites because the petroleum releases were discovered some time ago, yet none of the sites were moving toward regulatory closure. Some of the sites had been in the assessment process for over a decade, with no remediation to date. The principles of the Triad approach were applied to rapidly characterize the sites, develop accurate conceptual site models, establish clear cleanup goals, and move the languishing sites toward regulatory closure as rapidly as possible. The study was funded by the PRCF, plus a $50,000 grant from U.S. EPA. The study results suggest that the Triad approach reduced the overall data collection costs by increasing the amount of data for every dollar spent. In addition, the approach expedited work schedules by allowing stakeholders to establish goals and objectives prior to work initiation and allowed for flexible work plans based on the data collected on site. The data gathered in this study are intended to aid in the way site investigations are conducted both from private and public sector perspectives, to determine if this type of approach is technically feasible in South Dakota, and to help eliminate backlogs that often occur in cleanup programs. The report does not detail the Triad process but only the results of the study. For more information regarding the Triad approach, visit the Triad website at http://www.triadcentral.org/
http://www.state.sd.us/drr2/reg/prcf/Triad_Pathology.htm

Subsurface Sediment Contamination During Borehole Drilling with an Air-Actuated Down-Hole Hammer
Malard, F., T. Datry, and J. Gibert, UMR CNRS, Univ. Claude Bernard, Villeurbanne, France.
Journal of Contaminant Hydrology, Vol 79 Nos 3-4, p 156-164, Oct 2005

Because of their fast drilling rate, air-actuated hammers are increasingly used for the installation of groundwater monitoring wells in unconsolidated sediments; however, oil entrained in the air stream to lubricate the hammer-actuating device can contaminate subsurface sediments. The authors measured concentrations of total hydrocarbons, heavy metals (Cu, Ni, Cr, Zn, Pb, and Cd), and nutrients in continuous sediment cores recovered during the completion of a 26-m deep borehole drilled with a down-hole hammer in glaciofluvial deposits. Total hydrocarbons, Cu, Ni, Cr, and particulate organic carbon (POC) were measured at concentrations far exceeding background levels in most sediment cores. Because the penetration of contaminated air into the formation is unpreventable when using air percussion drilling, the representativeness of groundwater samples collected may be questionable.

Supplement to EPA Compendium Method TO-15: Reduction of Method Detection Limits to Meet Vapor Intrusion Monitoring Needs
Daughtrey, E.H., Jr., K.D. Oliver, H.H. Jacumin Jr., and W.A. Mcclenny.
Symposium on Air Quality Measurement Methods and Technology, Research Triangle Park, NC, April 20-22, 2004. [EPA 600-A-04-061; NTIS PB2004-106810]

The Supplement to EPA Compendium Method TO-15 provides guidance for reducing the method detection limit (MDL) for the compound 1,1-dichloroethene (1,1-DCE) and for other volatile organic compounds (VOCs) from 0.5 ppbv, as cited in Method TO-15, to much lower concentrations. Revisions to the original wording of Method TO-15 were made where the original language proved limiting to the goal of extending Method TO-15 to low pptv levels or where minor omissions were observed. Recommendations in the form of additions were made on aspects of laboratory procedure deemed critical to low-pptv-level analysis. The MDL for 1,1-DCE was determined to be 6 pptv. During this effort, a capability for preparing 1,1-DCE sample concentrations of 30 pptv and 60 pptv in ambient air was developed. Using this capability and the capability to prepare samples of humidified zero air, samples were prepared in canisters and sent to three contract laboratories as unknowns. Subsequent comparison of results indicated close agreement among the laboratories while maintaining the performance standards for replicate precision (25%) and audit accuracy (30%) originally specified in Method TO-15. The following compounds were also detected at low levels in canisters filled with spiked ambient air: chloroethene, dichloromethane, cis-1,2-dichloroethene, trichloromethane, 1,2-dichloroethane, benzene, 1,1,1-trichloroethane, trichloroethene, and tetrachloroethene. The different laboratories employ different analytical procedures, hence the use of a performance-based method appears justified.

System Uses Lasers to Find Contamination
CenterViews, p 22-23, Fall 2004

A new laser system was used in the summer of 2004 to define soil and groundwater contamination at several sites at the Air Force station at King Salmon, AK. The laser was deployed in conjunction with a Geoprobe(R), which uses direct push technology to drive the sensors into the ground so that drilling is not required. For the Alaska project, the Geoprobe(R) was mounted on a track-driven undercarriage, and an all-terrain vehicle carried the laser system. The laser light is sent through a fiber optic cable into the probe rods. The cable ends near the bottom of the rods, at a sapphire window. The laser light goes through the window and into the soil. If fuel is present the soil will fluoresce. The greater the fuel concentration, the greater the fluorescence. A second fiber optic cable takes in the fluorescent light and transmits it to the surface, where it is processed and plotted on a computer screen. Before the laser light system was developed, the Geoprobe(R) used a mercury lamp as a light source inside the rods, but the mercury lamp was fragile, making it difficult to use the Geoprobe(R) in hard soils, where the probe needs to operate in a hammer mode. The work in Alaska was the first use of the new laser-induced fluorescence Geoprobe(R) system configuration. The data obtained using the device will be compared with data gathered two years ago to evaluate how well bioventing systems at King Salmon sites are destroying the fuel contamination there.
http://www.afcee.brooks.af.mil/ms/msp/center/vol10No3/FALL-041.pdf

Technical Review of Leak Detection Technologies, Volume I: Crude Oil Transmission Pipelines
Oasis Environmental.
Alaska Department of Environmental Conservation, 31 pp, 1999

The State of Alaska seeks to identify strengths and weaknesses in industry crude oil pipeline leak detection operations and gain enough information for strategic implementation of the State's best available technology (BAT) regulations. This manual is to be used as a guidance document by the Alaska Department of Environmental Conservation (ADEC), oil industry representatives, and the public. The document presents detailed discussions of the various types of leak detection systems available today. Individual evaluations for each leak detection technology are presented by vendor name under "Leak Detection System Evaluations." Ideally leak detection vendors could state exactly how their systems would perform on a given pipeline configuration prior to installation. In practice, predicting performance is often difficult due to variability in product characteristics (density, viscosity), pipeline parameters (diameter, length, elevation profile), and process instrumentation variables (flow, temperature, pressure). The focus of this manual is to identify the various types of leak detection systems (LDSs), define a set of criteria for evaluating the performance of these systems that can be adapted to a wide range of operating pipeline systems, and provide a general evaluation of each leak detection technology to facilitate both choosing the appropriate system and evaluating the system according to BAT regulations.
http://www.dec.state.ak.us/spar/ipp/docs/ldetect1.pdf

Technical Review of Leak Detection Technologies, Volume II: Aboveground Bulk Fuel Storage Tanks
Oasis Environmental.
Alaska Department of Environmental Conservation, 23 pp, 1999

The focus of this manual is to identify the various types of leak detection systems (LDS) for aboveground bulk fuel tanks, define a set of criteria for evaluating the performance of these systems, and provide a general evaluation of each leak detection technology. AST leak detection technology can be classified into four broad categories: volumetric/mass methods, acoustic sensing, soil vapor/liquid monitoring, and inventory control. An extensive Internet search and subsequent responses received from questionnaires revealed 15 vendors with representative technologies for review. Detailed evaluations for each vendor's technology are presented under the tab "Leak Detection System Evaluations." It should be noted that the leak detection technology assessments presented in this document are compiled for the purpose of providing technical justification for replacing outmoded technologies and to serve as reference materials for ADEC staff, industry representatives, and the interested public. These technologies do not replace a sound maintenance program and aggressive controller/operator training.
http://www.dec.state.ak.us/spar/ipp/docs/ldetect2.pdf

Techniques for Assessing the Performance of In Situ Bioreduction and Immobilization of Metals and Radionuclides in Contaminated Subsurface Environments
Jardine, P.M. and D.B. Watson (Oak Ridge National Laboratory), et al.
Long-Term Performance Monitoring of Metals and Radionclides in the Subsurface: Strategies, Tools and Case Studies, Reston, VA, April 2004. Paper No: LBNL-56657, 21 pp, 2004

This manuscript describes recent technical developments for assessing the performance of in situ bioremediation and immobilization of subsurface metals and radionuclides. Researchers within DOE's NABIR and EMSP programs have been investigating the possibility of using subsurface microorganisms to convert redox-sensitive toxic metals and radionuclides (e.g. Cr, U, Tc, Co) into a less soluble, less mobile forms. Much of the research is motivated by the likelihood that subsurface metal-reducing bacteria can be stimulated to effectively alter the redox state of metals and radionuclides so that they are immobilized in situ for long time periods. The approach is difficult, however, since subsurface media and waste constituents are complex, with competing electron acceptors and hydrogeological conditions making biostimulation a challenge. Performance assessment of in situ biostimulation strategies is also difficult and typically requires detailed monitoring of coupled hydrological, geochemical/geophysical, and microbial processes. The authors discuss (1) contaminant fate and transport problems in humid regimes, (2) efforts to immobilize metals and radionuclides in situ via bioremediation, and (3) state-of-the-art techniques for assessing the performance of in situ bioreduction and immobilization of metals and radionuclides. These techniques are in situ solution and solid phase monitoring, in situ and laboratory microbial community analysis, noninvasive geophysical methods, and solid-phase speciation via high-resolution spectroscopy.
http://repositories.cdlib.org/cgi/viewcontent.cgi?article=3361&context=lbnl

Temperature Gradient Effect on Gas Discrimination Power of a Metal-Oxide Thin-Film Sensor Microarray
Sysoev, V.V. (Saratov State Technical Univ., Saratov, Russia); I. Kiselev, M. Frietsch, and J. Goschnick (Forschungszentrum Karlsruhe, Eggenstein-Leopoldshafen, Germany).
Sensors, Vol 4 No 4, p 37-46, Apr 2004

A microsystem electronic nose, the KAMINA, was developed at the Karlsruhe Research Center. It utilizes a single metal-oxide thin film segmented by electrodes to create a gas sensor microarray. The KAMINA employs two different techniques, a temperature gradient and surface filters to modify the properties of the sensor segments in a controlled fashion. This sensor-array design perfectly meets the mentioned requirements for low-cost, high-volume production in combination with high gas analytical performance. This paper describes a study of the effect of the spatial variation of the operating temperature applied across the segmented metal-oxide thin film to improve the gas discrimination power of the KAMINA system. The investigation was based on the signal patterns obtained for ammonia, ethanol, acetone, and propanol.

Towards a Capacitive Enzyme Sensor for Direct Determination of Organophosphorus Pesticides: Fundamental Studies and Aspects of Development
Schoning, M.J. (Univ. of Applied Sciences Aachen, Germany); M. Arzdorf, P. Mulchandani, W. Chen, and A. Mulchandani (Univ. of California, Riverside).
Sensors, Vol 3 No 6, p 11-18, June 2003

A miniaturized potentiometric enzyme biosensor utilizes the enzyme organophosphorus hydrolase (OPH) for the direct determination of pesticides. The transducer structure of the sensor chip consists of a pH-sensitive capacitive electrolyte/sensor/semiconductor structure that reacts toward pH changes caused by the OPH-catalyzed hydrolysis of the organophosphate compounds. The biosensor is operated versus a conventional Ag/AgCl reference electrode. Measurements were performed for the pesticides paraoxon and parathion.
http://www.mdpi.org/sensors/list03.htm

Tracking Sludge Disposal Using Electrical Conductivity Mapping
Coleman, M.M. (NB Coal Limited, Minto, NB); K.E. Butler; A. Mersich; Tom A. Al.
2005 National Meeting of the American Society of Mining and Reclamation, 19-23 June 2005, Breckenridge CO: Book of Abstracts. ASMR, Lexington, KY. p 21, 2005

NB Coal had been depositing lime neutralization sludge from its acid mine water treatment plant back onto the waste rock at the backfilled Fire Road strip mine since 1992. Chemical investigations have identified a decrease in the mine water acidity and iron and aluminum concentrations, which may be in part due to the application of the sludge. Electromagnetic (EM) surveys were first used over parts of the Fire Road mine in 2000 to identify subsurface accumulations of acid mine drainage (AMD). One unexpected result was the observation of anomalous electrical conductivities in an area that had previously been used for the disposal of sludge. The possibility of using electrical conductivity as a tracer to track sludge migration within the waste rock motivated NB Coal to sponsor an EM apparent conductivity survey over the entire backfilled pit in 2004. The survey results show that distribution of electrical conductivity over the mine is highly variable. A long, linear conductivity high, located along the high wall of the mine, is attributed to pooling of mine water and higher porosities (higher water contents) in that zone. Other conductivity highs, however, are clearly associated with historical patterns of sludge application and its subsurface migration. The presence of moist, conductive sludge filling a portion (or all) of the void space in the waste rock above the water table may explain this association. If that is the case, apparent conductivity maps may be useful as a management tool to decide which parts of the mine site would benefit most from the application of sludge for purposes of reducing the infiltration of oxygen and production of AMD.

Transport and Fate of Dieldrin in Poplar and Willow Trees Analyzed by SPME
Skaates, S.V., A. Ramaswami, and L.G. Anderson, Univ. of Colorado, Denver.
Chemosphere, Vol 61 No 1, p 85-91, Sep 2005

Experiments were conducted to measure the degree of partitioning of dieldrin, a hydrophobic organochlorine insecticide, to plant tissue and the potential for dieldrin biodegradation in the rhizosphere of trees. Dieldrin was analyzed in water and plant tissue using headspace solid-phase microextraction (SPME) coupled with gas chromatography.

Tunable Diode Laser Spectroscopy over Optical Fibres for Gas Measurements in Harsh Industrial Environments
W. Johnstone, K. Duffin, A. McGettrick, G. Stewart, A. Cheung and D. Moodie
SPIE-COO, International Congress on Optics and Optoelectronics, 28 August - 2 September 2005, Warsaw, Poland.

Near infra-red tuneable diode laser spectroscopy (TDLS) with wavelength modulation spectroscopy (WMS) is a powerful technique for the measurement of gas compositions. It can be used to address multiple sensing points over optical fiber networks; however, compensating for errors arising from pressure fluctuations is a complex process. Measuring pressure requires the extraction of accurate linewidth information from the recovered signals, which is made difficult by the presence of a systematic distortion arising from the laser amplitude modulation. The authors report a simple detection technique to nullify the effects of laser amplitude modulation and recover undistorted signals from which the gas linewidth can be accurately measured. They show how the measurements of accurate gas linewidths and pressure can be made from direct detection TDLS, addressing an atmospheric water absorption line. The method has been used to achieve accurate and simple measurement of acetylene pressure from TDLS/WMS measurements.
http://cmp.eee.strath.ac.uk/SPIE%20TDLS%20-%205952-6.pdf

Tuneable L Band Multi-Wavelength Fibre Laser Using Silicon Wafers
Marshall, J., G. Stewart, G. Whitenett and B. Culshaw.
OFS 2005, 17th International Conference on Optical Fibre Sensors, 23-27 May 2005, Bruges, Belgium.

The authors have demonstrated a simple, low-cost design for a multi-wavelength L-band continuous-wave laser for sensing applications. The device utilizes a Fabry-Perot cavity that provides the multi-wavelength lasing lines with regular wavelength spacing of around 0.9nm. The position of the multiple laser peaks can be tuned by adjustment of the cavity attenuation. This was achieved first by changing the position of the silicon wafers in the micro-optic cell, and then introducing a loss into the cavity using a variable attenuator. The laser can operate over the range 1565nm to 1595nm and has lasing bands corresponding to transmission lines for CO2 and H2S. The methods shown in this paper could be extended by use of a programmable attenuator that would dither the wavelength automatically and finely tune over the transmission lines of gases of interest. In future research, a MEMS type device could replace the silicon wafers. A silicon micro-actuator could be fabricated and the losses within the system controlled through slight adjustment of the position of the silicon wafer.
http://cmp.eee.strath.ac.uk/OFS_05JM.pdf

Uncertainty Based Multi-Objective Optimization of Groundwater Remediation Design
Singh, Abhishek, Masters' thesis, Univ. of Illinois at Urbana-Champaign, 50 pp, 2003

Management of groundwater contamination is a cost-intensive undertaking filled with conflicting objectives and substantial uncertainty. A critical source of this uncertainty in groundwater remediation design problems comes from the hydraulic conductivity values for the aquifer, upon which the prediction of flow and transport of contaminants are dependent. For a remediation solution to be reliable in practice it is important that it is robust over the potential

error in the model predictions. This work focuses on incorporating uncertainty within a state-of-the-art multi-objective optimization approach. Previous research has shown that small amounts of sampling within a single-objective genetic algorithm can produce highly reliable solutions; however, with multiple objectives, the noise can interfere with the basic operations of a multi-objective solver, such as determining non-domination of individuals, diversity preservation, and elitism. This work proposes several approaches to improve the performance of noisy multi-objective solvers for groundwater remediation problems. These include a simple averaging approach, taking samples across the population (which we call extended averaging), and a probabilistic selection approach. All of the approaches are tested on standard multi-objective benchmark problems and a hypothetical groundwater remediation case study. These approaches strike a balance between finding the most optimal and the most reliable solution to the problem, thus giving decision makers and designers a practical and robust optimization tool.
http://cee.uiuc.edu/emsa/documents/asingh-2003-01.pdf

Use of Bioluminescence to Study Reactive Solute Transport and Biofilm Growth and Activity in Porous Media
Sharp, R., A. Cunningham, and R. Gerlach.
2004 AGU Annual Fall Meeting, 13-17 December 2004, San Francisco, California.

Researchers used a meso-scale porous media flat plate reactor to combine a naturally bioluminescent biofilm (V. fischeri) and tracer studies to obtain information on the interactions between biofilms and reactive flow in porous media. The growth and development of the V. fischeri biofilm in a porous media geometry was studied using digital time-lapse images of the bioluminescent signal given off by the developing biofilm. The effect of biofilm development on porous media hydrodynamics was examined using dye tracer studies and image analysis. The natural bioluminescence of the V. fischeri allowed real-time, in situ study of biofilm development in porous media, without destruction of the biofilm. Using bioluminescent imaging, the location of active biomass, as well as the relative degree of biological activity, could be visualized and monitored over time.

The Use of 3D Seismic Imaging in Making Groundwater Management Decisions at Potential DNAPL Sites
Adams, Mary-Linda and Brian Herridge, Resolution Resources, Inc., Ionia, MI.
Groundwater Protection Council, Annual Forum, 20-23 September 1998, Sacramento, California. 10 pp, 1998

Three-dimensional (3D) acoustic imaging is a highly developed technology that has been used to produce a very detailed characterization of the subsurface, at sites where dense nonaqueous phase liquids (DNAPL) may be present. Because DNAPL transport is dependent upon the geologic structure and stratigraphy, rather than on groundwater flow, 3D seismic imaging has been used to provide dense data volume to analyze the pathways and traps. This information has then been used to optimally drill the most permeable control points, or traps, where DNAPL have collected. Evaluation of chemical sampling while drilling has then been used to make informed groundwater management decisions. These decisions center upon whether DNAPL is present, and if so, where it is located. Practical issues of whether the groundwater plume can be contained or remediated can then be addressed. The first 3D seismic

survey over a DNAPL site was performed in 1994 at Naval Air Station North Island in San Diego, CA. The 3D seismic information, followed by confirmatory drilling, significantly changed the site conceptual model. Previously it was believed that a clay layer acted as a confining unit for the DNAPL; instead, the free product had migrated into deep fault zones. A detailed understanding of the subsurface saved time and costs for characterization and remediation. A seismic survey was used to locate the most permeable zones in the source area at a NASA site, where DNAPL was suspected. Confirmatory drilling showed that DNAPL was no longer present and that natural attenuation with monitoring could replace a pump-and-treat system.
http://www.rr-inc.com/Frame%20Pages/papers/gwpc/gwpc.pdf

Use of Environmental Isotopes in Studying Mining Groundwater Issues:
B. Buck, JBR Environmental Consultants, Inc., Sandy, UT and A. Mayo, Mayo and Assoc., LC, Lindon, UT.
2005 SME Annual Meeting & Exhibit, February 28 - March 2, Salt Lake City, Utah.

Stable isotopes, such as deuterium and oxygen-18, can be helpful in studying impacts to groundwater caused by mining operations. When combined with water chemistry data for normal solutes and analytical results for tritium and carbon-14, stable isotope data allow improved understanding of local groundwater flow systems. Unlike reliance on normal groundwater solutes, use of these isotopes can support definitive determinations of whether or not mining facilities have impacted groundwater systems. The authors describe techniques for using environmental isotopes in groundwater investigations at mining facilities with examples from past projects in Utah and neighboring states.

The Use of Pisum Sativum (Snow Pea) to Identify the Bioavailability of Lead in a Phosphate Stabilized Soil
Mark Bricka, Brian S. Baldwin, and Gene Fabian.
The AIChE 2005 Annual Meeting, 30 October - 4 November, Cincinnati, OH.

This paper presents the results of a study to investigate the effect of phosphate additives on lead-contaminated soil. Pisum satirum (Snow Pea) was used to assess the bioavailability of the lead in the untreated and treated soils. The effectiveness of a newly developed laboratory method to determine the treatment effectiveness is discussed. The test results showed that Snow Pea could accumulate over 800 mg/kg of lead on a dry weight basis and indicated that over 80% of the lead available for plant uptake can be reduced via phosphate treatment.

Use of Pressurized Liquid Extraction (PLE)/Gas Chromatography-Electron Capture Detection (GC-ECD) for the Determination of Biodegradation Intermediates of Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX) in Soils
Zhang, B., X. Pan, G.P. Cobb, and T.A. Anderson, Texas Tech. Univ., Lubbock.
Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences, Vol 824 No 1-2, p 277-282, 25 Sep 2005

A rapid, sensitive, and reproducible method was developed for quantitative determination of the explosive RDX and its biodegradation intermediates, MNX, DNX, and TNX, in soils. The

four compounds were extracted from soil by pressurized liquid extraction (PLE), followed by cleanup using florisil. Instrumental analysis was performed using gas chromatography with electron capture detection, which was highly sensitive to the parent explosive and its metabolites. The method detection limits were 0.243, 0.095, 0.138, and 0.057 ng/g for RDX, MNX, DNX, and TNX, respectively. The method gave high recovery (98 to 102%), good precision (0.22 to 5.14%), and reproducibility, and proved to be suitable for real-world sample analysis.

The Use of Semipermeable Membrane Devices (SPMDS) for Monitoring Dioxin Levels in Maine Rivers

Lake, Bjorn Anders, Master's thesis, University of Maine, EES2003-02, 184 pp, 2003

Maine's Department of Environmental Protection (DEP) has been monitoring dioxin and furan levels in Maine rivers using fish tissue analysis since the 1980s. Effective December 31, 2002, pulp and paper mills in Maine must not discharge any toxic congeners of dioxins and furans into local surface water. The test prescribed in the law (38 M.R.S.A. 5420) requires that the concentration of dioxins or furans in fish (or surrogate) collected downstream of a mill cannot exceed fish monitored upstream from a mill. The purpose of this project is to determine if measuring upstream/downstream dioxin levels with SPMDs is more effective than monitoring dioxin levels in fish. Effective analytical and field methods were developed at the Environmental Chemistry Laboratory at the University of Maine to determine dissolved dioxin/furan concentrations in the SPMD sampling matrix. Water temperature, biofouling, and flow velocity are environmental conditions that can affect the uptake kinetics of SPMDs. Assuming isotropic exchange kinetics, a permeability reference compound (PRC) can be spiked into the SPMD prior to deployment to calibrate the rate change of dioxin/furan uptake caused by environmental conditions. Thus, more accurate concentrations can be determined utilizing these passive samplers rather than destructive analysis of fish tissue. The results of this thesis indicate that the levels of most dioxin/furan congeners are consistently at or below the detection limit, and PRCs are effective at correcting for the environmental conditions. 2,3,7,8-TCDF has been quantified in each of three deployments on the Androscoggin River at both the upstream and downstream locations. In 2002, both toxic PeCDFs were quantified along with TCDF, allowing a comparison of the upstream and downstream sites for those three congeners. The rest of the 17 toxic dioxin/furan congeners were not consistently detected. Using the Mann-Whitney U test, a significant difference in concentration ($p=0.05$) was determined between the two sites, with the upstream site greater than the downstream site. There are three possible explanations for the lower trend in furan concentrations downstream: (1) The downstream location is too far from the point of discharge, leading to dilution of the furans. (2) The discharged dioxins/furans are not in dissolved form upon release from the mill. (3) The pulp and paper mill assessed is in compliance with the upstream/downstream law and is not releasing dioxins/furans in excess of the background concentrations based on the SPMD protocol established in this thesis.
http://library.umaine.edu/theses/pdf/LakeBA2003.pdf

Use of Submersible Pressure Transducers in Water-Resources Investigations
Freeman, L.A., M.C. Carpenter, D.O. Rosenberry, J.P. Rousseau, R. Unger, and J.S. McLean.
Chapter A of Book 8, Instrumentation Section A, Instruments for Measurement of Water Level.
U.S. Geological Survey Techniques of Water-Resources Investigations 8-A3, 65 pp, 2004

Submersible pressure transducers, developed in the early 1960s, have made the collection of water-level and pressure data much more convenient than former methods. Submersible pressure transducers, when combined with electronic data recorders have made it possible to collect continuous or nearly continuous water-level or pressure data from wells, piezometers, soil-moisture tensiometers, and surface water gages. These more frequent measurements have led to an improved understanding of the hydraulic processes in streams, soils, and aquifers. This manual describes the operational theory behind submersible pressure transducers and provides information about their use in hydrologic investigations conducted by the U.S. Geological Survey.
http://pubs.usgs.gov/twri/twri8a3/

Using AVIRIS in the NASA BAA Project to Evaluate the Impact of Natural Acid Drainage on Colorado Watersheds
Hauff, P.L. (Spectral International, Inc.); D.W. Coulter; D.C. Peters; M.A. Sares (Colorado Geological Survey); E.C. Prosh; F.B. Henderson III; D. Bird.
AVIRIS Proceedings 2003, Jet Propulsion Laboratory (JPL), NASA.

The Colorado Geological Survey and the co-authors of this paper were awarded one of 15 NASA Broad Agency Announcement (BAA) grants in 2001 to investigate the use of hyperspectral remote sensing to map acid-generating minerals that affect water quality within a watershed, and to identify the relative contributions of natural and anthropogenic sources to that drainage. A further objective is to define the most cost-effective remote sensing instrument configuration for this application. The study area is located in the state of Colorado. Phase I of this project involves the Lake Creek watershed in central Colorado (a major tributary of the upper Arkansas River), which contains extensive, naturally exposed sulfide mineralization that is adversely impacting the water quality of Lake Creek. Phase II will map the upper Arkansas River, which is affected by mine drainage from the Leadville mining district. The two areas will then be compared.
ftp://popo.jpl.nasa.gov/pub/docs/workshops/03_docs/toc.html

Using Canines in Source Detection of Indoor Air Pollutants
Bird, Sandra L., U.S. EPA, ORD/NERL/ERD.
EPA 2004 Science Forum, 1-3 June 2004, Washington, DC. Poster presentation.

Scent detection dogs have been used extensively in law enforcement and military applications to detect narcotics and explosives for over 30 years. Controlled laboratory studies have documented accurate detection by dogs of specific compounds associated with explosives and narcotics at air concentrations below 1 ppb. Relatively few applications have taken advantage of this canine capability in the environmental arena. Dogs can serve as a rapid screen to indicate the presence of a substance in air, soil, or even water. Dogs are capable not only of indicating the presence of a compound, but also of moving upgradient toward the source of the material and discriminating between closely related compounds. Benzene, toluene, ethene, and

xylene, major constituents of gasoline, are frequent culprits related to vapor intrusion into buildings from contaminated groundwater. Because indoor air contamination can also occur from household sources, responsibility is often contested. Canines can provide an effective approach for screening contaminant source location, as well as simply indicating the presence of a contaminant and significantly reducing required sampling costs. This poster illustrates the use of dogs as a tool in vapor intrusion investigations, with an emphasis on evaluating the cost-effectiveness of employing them, developing quality assurance strategies in support of their use, and protecting the dogs from exposure to harmful levels of chemicals. This project is a unique application in the use of scent detection canines in an environmental application.
http://www.epa.gov/nerl/news/forum2004.html

Using Enzyme Bioassays as a Rapid Screen for Metal Toxicity
Blumenstein, E.P. and J.F. Ranville (Colorado School of Mines, Golden); L.M. Choate (USGS); P.E. Ross.
2005 National Meeting of the American Society of Mining and Reclamation, 19-23 June 2005, Breckenridge CO: Book of Abstracts. ASMR, Lexington, KY. p 8, 2005

Traditionally, the metals toxicity of abandoned mine soil piles has been determined by a variety of chemical methods, including the Toxicity Characteristic Leaching Procedure (TCLP) and traditional toxicity tests using organisms such as Ceriodaphnia dubia. Enzymatic bioassays may provide an easier, less costly, and more time-effective toxicity screening procedure for mine tailings and abandoned mine soil leachates. The commercially available MetPLATE(TM) enzymatic toxicity assay test kit uses a modified strain of Escherichia coli bacteria as the test organism. Toxicity is defined by the activity of beta-galactosidase enzyme, which is monitored colorometrically with a 96-well spectrophotometer. This paper reports the results of a MetPLATE(TM) assay study that used water samples collected from mining-influenced water. A benefit to using the MetPLATE™ assay over the TCLP is that it shows actual toxicity of a sample by taking into account the bioavailability of the toxicants, rather than simply measuring the metal concentration present. The MetPLATE™ assay produces results much more quickly (~2 hours) than the C. dubia testing process, with a more continuous variable due to a greater number of organisms present in each sample (100,000+). It also eliminates the need to maintain a culture of organisms at all times.

Using Honey Bees as Monitors of Aromatic Hydrocarbon Pollutants in Rio Riazzone Waste-Landfill (Reggio Emilia, Italy)
Nizzoli, V., I. Negri, M. Pellecchia, L. Pizzetti, and T. Tellini.
Proceedings Sardinia 2005, 10th International Waste Management and Landfill Symposium, S. Margherita de Pula, 3-7 October 2005, Cagliari, Italy.
CISA, Environmental Sanitary Engineering Centre, Italy.

Honey bees are considered bioindicators of chemical pollutants present in the environment, and bee products, such as honey, are used as bioaccumulators of heavy metals, radionuclides, and pesticides. Research was conducted to evaluate if an hypothetic gas leakage from a gas collection system can affect honeybee colonies located on a landfill final cover in the course of restoration, in this case, by causing the concentration of organic pollutants in beeswax to increase. Qualitative gas chromatographic analysis performed on waxes produced in the hives

located on the landfill showed no evidence of VOC accumulation; however, insect mortality rate exceeded the threshold level, suggesting the presence of an abnormal environmental situation. This absence of VOCs in waxes in the study could indicate a brief exposure time (about 3 weeks); in previous research, after four months of exposure, the waxes were found to absorb organic compounds originating from the landfill, as well as from passing automotive traffic.

Variation in Dissolved Gas Content and Microbial Activity in Groundwater During Well Pumping

Kwon, Man Jae, Jungho Park, Matthew F. Kirk, Robert A. Sanford, and Craig M. Bethke, Univ. Illinois, Urbana, IL.

2004 GSA Denver Annual Meeting, 7-10 November 2004. Geological Society of America Abstracts with Programs, Vol 36 No 5, p 574, 2004

To better understand subsurface microbiological processes and to better define groundwater sampling strategies, investigators monitored the chemical and microbiological evolution of water pumped from an unconsolidated confined aquifer. The initial pumping rate of less than 0.5 L/min was increased and maintained at 6 L/min for 5 days. The concentrations of ferrous iron, sulfide, and sulfate attained steady state within 8 hours. The investigators discovered that with increased pumping, H2 was supplied to the wellbore more rapidly than bacteria there could consume it, causing the H2 concentration to rise to a level likely reflecting approximate ambient conditions in the aquifer. Continued pumping increased the flux of substrates toward the well, promoting microbial growth. Biomass was calculated to increase more than 12-fold on the basis of the increase in the rate of hydrogen consumption. After about 30 hours, increasing rates of methanogenesis and potentially other microbial processes drove down the H2 concentration and caused CH4 to accumulate. These results suggest the best time for obtaining a representative groundwater sample is after the initial stabilization phase and before the growth of microorganisms in response to continued pumping. The optimum interval in this study extended from ~8 hours to ~30 hours of rapid pumping.

Voltammetric Determination of Carcinogenic Nitrobiphenyls at a Hanging Mercury Drop Electrode

Stepan, R. and J. Barek (Charles Univ., Prague, Czech Republic); V. Mejstrik (Research Inst. for Organic Syntheses, Czech Republic); J Zima (Charles Univ.).

Sensors, Vol 3 No 3, p 43-60, Mar 2003

Differential pulse voltammetry and adsorptive stripping voltammetry at a hanging mercury drop electrode were used for the determination of trace amounts of carcinogenic 2-nitrobiphenyl, 3-nitrobiphenyl, and 4-nitrobiphenyl. The practical applicability of the newly developed methods was verified using model samples of drinking and river water and liquid-liquid extraction for preliminary separation and preconcentration.

http://www.mdpi.org/sensors/list03.htm

Whole Cell-Enzyme Hybrid Amperometric Biosensor for Organophosphorous Nerve Agents
Lei, Yu, Priti Mulchandani, Wilfred Chen, Joseph Wang, and Ashok Mulchandani.
Biotechnology and Bioengineering, Vol 85, p 706-713, 2004

This paper reports the construction of a hybrid biosensor for direct, highly selective, sensitive, and rapid quantitative determination of organophosphate pesticides with p-nitrophenyl substituent using purified organophosphorus hydrolase (OPH) for the initial hydrolysis and Arthrobacter sp. JS443 for subsequent p-nitrophenol oxidation. The best sensitivity and response time were obtained using a sensor constructed with 0.06 mg dry weight of cell and 965 IU of OPH operating at 400 mV applied potential (vs. Ag/AgCl reference) in 50 mM citratephosphate pH 7.5 buffer at room temperature. Thus optimized, the biosensor measured as low as 2.8 ppb (10 nM) of paraoxon and 5.3 ppb (20 nM) of methyl parathion without interference from phenolic compounds, carbamate pesticides, triazine herbicides, and organophosphate pesticides lacking the p-nitrophenyl substituent. The biosensor had excellent operational lifetime stability with no decrease in response for more than 40 repeated uses over a 12-hour period when stored at room temperature, while its storage life was approximately 2 days when stored in the operating buffer at 4 degrees C.
http://www.engr.ucr.edu/~wilfred/Hybrid%20OP%20Sensor%20BB.pdf

A Wireless, Passive, Magnetically-Soft Harmonic Sensor for Monitoring Sodium Hypochlorite Concentrations in Water
Ong, K.G. and M. Paulose (SenTech Corporation, State College, PA); C.A. Grimes (Pennsylvania State Univ., University Park).
Sensors, Vol 3 No 1, p 11-18, Jan 2003

The authors present a wireless, passive, remote-query sensor for in situ monitoring of sodium hypochlorite (bleach) in water. The sensor is made of a highly permeable, magnetically soft, ribbon-like amorphous ferromagnetic alloy that supports higher-order harmonics in response to a magnetic ac field. The magnetically-soft ferromagnetic ribbon is coated with a layer of polyurethane and alumina and has a large and nonlinear permeability that supports higher-order harmonics in response to a time-varying magnetic field. The hypochlorite ions induce swelling in the coating, with the resultant stress altering the sensor's harmonic signature, from which the sodium hypochlorite concentration can be determined. The wireless, passive nature of the sensor platform enables long-term monitoring of bleach concentrations in the environment. The sensor platform can also be extended to other chemical analytes.
http://www.mdpi.org/sensors/list03.htm

World's First Heavy Metal Detection Biosensor
Medical News Today, 16 Nov 2004

Kansai Electric Power, Tokyo, Japan, in collaboration with the Central Research Institute of Electric Power Industry, has developed innovative antibodies that can identify heavy metals, including cadmium, mercury, and zinc. Using an antibody designed to identify cadmium, the company has developed a biosensor that can easily detect cadmium in soil, as well as in foods. The biosensor enables researchers to detect heavy metals with the naked eye without having to use any special device. It takes 6 to 8 hours to detect a heavy metal, compared to one week using

conventional analyzer-based techniques. The biosensor can be used for heavy metal detection in pharmaceutical and food processing applications as well.