Measurement & Monitoring: $21M^2$
12^{th} Literature Update

Airborne Detection and Mapping of Oil Spills
Environment Canada.
Environmental Solutions Through Technology Innovation and Partnerships, p 27, 2003.

Timely and accurate detection, identification, and mapping of oil spills in the environment has been enhanced by technology developed at Environment Canada's Environmental Technology Centre (ETC). In remote sensing, it can be difficult to distinguish oil from other materials, such as rocks and vegetation. A state-of-the-art Scanning Laser Environmental Airborne Fluorosensor prototype has been installed in ETC's DC-3 aircraft. The aircraft-mounted system is designed to unequivocally detect and classify the type of oil in a marine or terrestrial environment. Work continues on the development of an airborne laser-ultrasonic sensor for the remote measurement of oil slick thickness. Research and development partners include Barringer Research, Optech Toronto, Imperial Oil, U.S. Minerals Management Services, National Research Council of Canada, Transport Canada, and Environment Canada's Environmental Technology Centre.

Behaviour of Uranium in Iron-Bearing Permeable Reactive Barriers: Investigation with ^{237}U as a Radioindicator
Simon, Franz-Georg; C. Segebade; M. Hedrich, Fed. Inst. for Mat. Res. and Testing BAM Div. of Waste Treatm./Remedial Eng., Berlin, Germany. Science of the Total Environment, Vol 307 No 1-3, p 231-238, 20 May 2003

In a study of the long-term performance of elemental iron as reactive material for the removal of uranium in passive ground-water remediation systems, scientists used U-237 as a radioindicator to track the movement of the contamination front through a test column without taking samples or dismantling the apparatus. When combined with other site-specific factors, such data enable the calculation of an ideal lifetime for an iron permeable reactive barrier to remove uranium.

Biosensors for Direct Monitoring of Environmental Pollutants in Field
Nikolelis, Dimitrios P. (ed.), et al.
Kluwer Academic Publishers, Boston. ISBN: 0792348672. NATO ASI series. Partnership sub-series 2, Environment: Vol 38, 381 pp, 1997

In the Proceedings of the NATO Advanced Research Workshop on Biosensors for Direct Monitoring of Environmental Pollutants in Field held in Smolenice, Slovakia, the presented papers indicate that biosensors offer clear and distinct advantages over standard analytical methods for the direct monitoring of environmental pollutants in the field. The chief advantage is real-time detection with minimum sample preparation and handling. The book presents recent trends in analytical methodology for the determination of indoor and outdoor pollutants; advances in DNA, biological, and recognition-based sensors; examples of biosensors for use in field and water analysis; biosensors based on non-aqueous systems; and recent advances in the miniaturization and micromachining of biosensors.

Use of a Moss Culture as Bioaccumulator for the Biomonitoring of Metal Contamination in Continental Waters
Ah-Peng, C. (Museum National d'Histoire Naturelle, Paris, France); C. Rausch de Traubenberg (Tauw Environnement, Douai, France); F.-O. Denayer (Univ. de Lille 2, Lille, France). XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 25-28, May 2003

Aquatic bryophytes that accumulate pollutants can provide information about past and present pollution events, and they are often used to assess trace metal contamination in continental waters. Standardizing the method using a cultured transplanted moss will improve this technique and ensure the comparability and repeatability of the results. The researchers have cultured a moss strain of the species *Fontinalis antipyretica Hedw*. successfully for 2 years in the laboratory, but it has been difficult to obtain biomass with sufficient speed to identify the parameters that influence the moss growth. Current work involves making different calibrations to improve the diagnostic tool for assess metal contamination in continental waters.

Bismuth Film Microelectrodes for Heavy Metals Monitoring by Anodic Stripping Voltammetry
Baldo, M.A.; S. Daniele; C. Bragato, Univ. of Venice, Venice, Italy. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 103-106, May 2003

This paper discusses the preparation of bismuth film microelectrodes (BiFuE), and their subsequent application to heavy metal analysis by the anodic stripping voltammetric (ASV) technique. The BiFuE are prepared by electrodeposition of a Bi film onto carbon and platinum disk microelectrodes, by applying both ex and in situ electroplating procedures. The authors evaluated the analytical performance of such systems in stripping analysis on synthetic solutions containing Cd2+ and Pb2+ as target ions. The results indicate that both carbon and platinum microdisks are suitable substrates for Bi-film formation, and the BiFuEs obtained with both the deposition procedures are effective for heavy metal deposition. The BiFuEs prepared by the in situ procedure on graphite performed best in terms of data reproducibility and linear range of the calibration curves. Performance tests of such BiFuEs for trace metal analysis in food products had good results.

Chromium Speciation by Different Methods of Practical Use for Routine In Situ Measurement
Barakat, S. and L. Giusti, Univ. of the West of England, Bristol, UK. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 111-114, May 2003

Simple, sensitive, low-cost, and relatively rapid methods for the detection of Cr(III) and Cr(VI) species in natural waters are needed for monitoring. Because conventional acidification and storage of filtered samples can be a major cause of chromium losses from the dissolved phase, in situ monitoring is desirable. The practical usefulness of selected chromium speciation methods was assessed in the laboratory and in the field. The authors found significant discrepancies in the Cr(VI) detection efficiency by a selective ion meter based on the diphenylcarbazide method when compared with conventional Zeeman graphite fumace AAS. The efficiency of the DGT (diffusion gradients in thin films) method, based on the deployment in situ of gel/resin units capable of separating labile species of Cr (III) and Cr (VI), looks promising, but is limited by cost considerations and by potential complications in the presence of complexing substances. Use of Sephadex DEAE A-25 ion exchange resins has proved effective in the separation of Cr species, though the method requires on-site facilities, is relatively time-consuming and is potentially affected by complexing substances.

Coupled Biosensor, Biomimetic and Chemometrics Strategies for Analysis of the Metals in Complex Environmental Matrices
Bhand, S.G. (Birla Inst. of Technology and Science, Pilani (Rajastan), Pin, India); E. Yilmaz (Lund Inst. of Technology, Lund Sweden); B. Danielsson (Lund Univ., Lund, Sweden). XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 169-172, May 2003

In an analytical strategy to determine metals in environmental samples contaminated with both organophosphate pesticides and metals, parathion and arsenate were determined separately in the first step. Inhibition of the enzyme butyrylcholinesterase was quantified employing an enzyme thermistor and also with a CCD camera. After parathion mixed with arsenate was measured, a molecularly imprinted polymer catalyst was introduced as a pre-column to degrade OPs. The catalytic MIP enabled the measurement of metal from the mixture containing OPs. Hydrolysis of parathion, ethyl paraoxon, O-Ethyl-O-(4-nitrophenyl)-phenylphosphonothioate EPN and dichlorvos were monitored by using catalytic MIPs in the enzyme thermistor. Inhibition patterns of parathion and arsenate were obtained employing multivariate analysis. The patterns generated after eliminating the OPs at the end of the process can be used for monitoring and mapping of metals in various environmental matrices.

Detection of Heavy Metals Released at the Sediment/Water Interface by Combining Anodic Stripping Voltammetry (ASV) and Scanning Electrochemical Microscopy (SECM) Measurements
Daniele, S.; I. Ciani; C. Bragato; M.A. Baldo, University of Venice, Venice, Italy. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 353-356, May 2003

For the detection of heavy metal ions at the solid/solution interface of a sediment sample, the investigators examined hemisphere mercury microelectrodes in combined anodic stripping voltammetry (ASV) and scanning electrochemical microscopy (SECM) experiments. Relatively large anodic stripping peaks due to lead were monitored at m distances from the solid particles, while, under the same experimental conditions, no or lower ASV peaks were found in the bulk solution. The method offers a new means for investigating spatial differences of immobilization and remobilization processes of heavy metals at sediment/water interfaces.

Mapping Heavy Metal Distribution by Measuring the Magnetic Susceptibility of Soils
Hanesch, M.; G. Maier; R. Scholger, Inst. of Geophysics, Univ. of Leoben, Austria. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France.
Journal De Physique IV (Proceedings), Vol 107 No 5, p 605-608, May 2003

Researchers tested the potential of measurements of magnetic susceptibility of heavy metals in soil in a regional study and in the city of Vienna using dense grids of measurement points. Magnetic susceptibility mapping proved to be a reliable method for the delineation of polluted areas. Sampling points for more detailed chemical analyses can be chosen with the help of susceptibility maps, which reduces the costs of heavy metal mapping and at the same time yields high resolution information.

Electrochemical Metal Speciation Using Self-Assembled Monolayers

Mandler, D.; R. Gal-Oz; D. Burshtain; I. Turyan, Hebrew Univ. of Jerusalem, Jerusalem, Israel. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 801-804, May 2003

Self-assembled monolayers (SAMs) can be applied to achieve speciation in heavy metal electrochemical determination. SAMs are monomolecular organic layers that can be chemically attached onto different electrode materials and used for the selective extraction of heavy metals. The selectivity is achieved by assembling monolayers that have pendant ligands, which interact selectively with the analytes in the solution. For example, the formation of a monolayer comprising a pyridine group was used to selectively extract Cr(VI) from aqueous solutions, whereas the selective determination of Fe(II) was accomplished using a covalently bound terpyridine monolayer. The authors discuss two methods for determining the binding constants of heavy metal ions by SAMs.

Trace Metals Dynamics in Surface Sediments Investigated by DGT Micro-Scale Measurements

Motelica-Heino, M. (BRGM, Orleans, France); W. Davison (Lancaster Univ., Lancaster, UK). XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 899-902, May 2003

DGT (diffusion gradients in thin films) is a dynamic probe that measures the kinetically available fraction of metals or sulphide. In surface sediments, metal mobility is controlled by the recruitment and turnover of organic matter, whereas sulphide is thought to control the concentration of metals in sediment pore water by removing them from the solution. DGT uses a probe the size of a credit card inserted into the sediment to obtain a snapshot of the metal distribution in the sediment, which can be uncovered by spectrochemical analytical techniques. In situ vertical profiles and horizontal maps of trace metals at high (mm scale) and ultra-high resolution (100 m) together with Fe, Mn, and sulphide were generated from DGT probes deployed in surface sediments. Besides showing vertical gradients associated with the depletion of oxygen with depth and the degradation of organic matter by a succession of electron acceptors, the probe showed that small-scale remobilization of metals associated with sediment heterogeneity took place.

Complexing Gel Integrated Microelectrode Arrays for Direct Detection of Free Metal Ion Concentrations in Natural Waters

Noel, S.; M.-L. Tercier-Waeber; L. Lin; J. Buffle, CABE, Univ. of Geneva, Geneva, Switzerland. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 965-968, May 2003

The authors report the development of a novel Complexing Gel Integrated Microelectrode (CGIME) for direct measurements of free metal ion concentrations in natural waters. The detector is prepared by successive deposition of a chelating resin, antifouling agarose gel, and the Hg layers on an 100-interconnected Ir-based microelectrode array. The CGIME sensor has been applied to Cu and Pb free metal concentration measurements in sea-water samples with results comparable with those of free metal ion concentration measurements performed using Hollow Fiber Permeation Liquid Membrane (HF-PLM). Similar concentration values were found for both metals with both techniques.

The Use of Sequential Extraction to Evaluate the Remediation Potential of Heavy Metals from Contaminated Harbour Sediment
Nystrom, G.M.; L.M. Ottosen; A. Villumsen, Technical Univ. of Denmark, Lyngby, Denmark. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 975-978, May 2003

Sequential extraction has been performed with harbor sediments (with the original sediments and after the sediments were treated with acid) to evaluate their electrodialytic remediation potential. Sequential extraction results show that 75% Zn and Pb and about 50% Cu are found in the most mobile phases in the original sediment, and more than 90% Zn and Pb and 75% Cu are found in the most mobile phase in the sediment treated with acid. Electrodialytic remediation uses a low direct current as cleaning agent, removing the heavy metals towards the anode and cathode according to the charge of the heavy metals in the electric field. Sampling after electrodialytic experiments shows that up to 50% Cu, 85% Zn, and 60% Pb can be removed by day 20. There is potential for higher removal with some changes in the experimental setup and a longer remediation time. The experiments demonstrate that sequential extraction can be used to predict the electrodialytic remediation potential for harbor sediments.

The Use of Permeation Liquid Membrane (PLM) As an Analytical Tool for Trace Metal Speciation Studies in Natural Waters
Parthasarathy, N.; M. Pelletier; J. Buffle, Univ. of Geneva, Geneva, Switzerland. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 1021-1024, May 2003

A permeation liquid membrane (PLM) comprising didecyl 1, 10 diaza crown etherlauric acid in phenylhexane/toluene has been developed for measuring free metal ions (e.g. Cu, Pb, Cd, and Zn) concentration under natural water conditions. The capability of PLM for making speciation studies has been demonstrated using synthetic and natural ligands. The authors report on the application of in situ preconcentration of trace metals in diverse waters using specially designed hollow fiber PLMs.

In Situ Determination and Laboratory Measurements of Cu Fluxes in Two Dam Sediments Using DGT
Roulier, J.-L. and B. Motte, Cemagref, Lyon, France. XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 1161-1164, May 2003

The technique of diffusion gradients in thin films (DGT) accumulates labile metals on a chelex resin after their diffusive transport through a hydrogel. DGT can measure in situ fluxes of metals in sediments under induced perturbation. Porewater concentration is lowered, but depending on the sediment, metal sorbed to particulate matter can either exchange with solution to maintain its concentration or not. The researchers measured Cu fluxes in the sediments of two dams both in the field with an on-site DGT insertion technique and in the laboratory. Some experiments also were performed to measure directly fluxes in their porewaters after extraction. Results of experiments and calculations using the DIFS model allowed discrimination between both aquatic systems in their ability to sustain metal concentration in porewaters.

Multi Physical-Chemical Profiler for Real-Time Automated in Situ Monitoring of Specific Fractions of Trace Metals and Master Variables

Tercier-Waeber, M.-L. (Univ. of Geneva, Geneva, Switzerland); F. Confalonieri, G. Riccardi, A. Sina, and F. Graziottin (Idronaut Sri, Brugherio (MI), Italy); J. Buffle (Univ. of Geneva, Geneva, Switzerland). XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 1297-1300, May 2003

A novel Multi Physical-Chemical profiler (MPCP system) has been developed for simultaneous, autonomous, in situ measurements of three environmentally relevant specific fractions of trace metals, as well as master variables in natural waters. It has been designed using advanced voltammetric microsensors, microprocessor, and telemetry technology. This paper provides a detailed description of the system and examples of environmental applications for in situ measurements in sea water. The results indicate that the system is reliable and that in situ measurements of the three specific fractions of trace metals can be achieved down to concentrations at the ppt level using Square Wave Anodic Stripping Voltammetry (SWASV).

Microelectrodes for In Situ Voltammetric Determination of Pollutants
Paux, T. and G. Billon (Univ. des Sciences et Technologies de Lille 1, Villeneuve-d'Ascq cedex, France); L. Pieta (Ruer Boskovi Inst., Zagreb, Croatia); B. Ouddane1, J.C. Fischer, and M. Wartel (Univ. des Sciences et Technologies de Lille 1, Villeneuve-d'Ascq cedex, France). XIIth International Conference on Heavy Metals in the Environment, 26-30 May 2003, Grenoble, France. Journal De Physique IV (Proceedings), Vol 107 No 5, p 1413-1416, May 2003

The toxicity of sediments is often closely bound to the labile toxic elements contents. In porewaters, metal concentrations are generally measured after separation from the solid material by means of pressure or centrifugation. In recent developments, in situ metal measurements by microsensors do not require any pretreatment of the sediment and hence avoid some possible artifacts such as oxygen penetration in anoxic sediment and/or temperature modification. This paper describes the preparation of microelectrodes based on a thin solid silver (diameter: 30 m) or iridium (diameter: 75 m) wire, covered at the tip with a fine layer of mercury. Then an analytical procedure (based on cathodic voltammetry) is presented to measure Mn(II), Fe(II) and S(-II) concentrations, which play a relevant role in the metal pollutant cycle in sediments. By anodic stripping voltammetry, such microsensors are able to detect trace heavy metals such as Cd(II) or Pb(II) at relatively low concentration levels (~1 g.dm -3) with 5 minutes accumulation time. The goal is to install the microelectrodes in natural media and monitor metal pollution over a long period of time.

The Use of Remote Sensing to Evaluate Environmental Impacts of Mining in the Central Rand
Mphephu, N.F,; M.J. Viljoen; H.J. Annegarn, Univ. of the Witwatersrand. Sudbury 2003: Mining and the Environment, 25-28 May 2003, Sudbury, Canada. [PowerPoint presentation]

Research objectives: rapid assessment of environmental damage and status of mining at a regional scale including an inventory of polluted areas, definition of areas susceptible to pollution, identification of pollution pathways, and classification of mine tailings. Remote sensing data involve the Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER), the Modis Airborne Simulator (MAS), and color aerial photographs from 1996. ASTER and MAS data were collected in 2000 as part of SAFARI 2000, which is an air pollution study in Southern Africa. The work has produced classification of tailings from rehabilitated dumps (dry and living vegetation), unrehabilitated dumps, active mine tailings, and rehabilitated and unrehabilitated footprints. It also has identified sources of pollution (areas of spillages and exposed areas), classifies and prioritized dumps for rehabilitation by

government because of public pressure, and identified oxide and sulphate minerals.
http://www.sudbury2007.ca/English/defaultEnglish.html

Using Isotopic Composition of Reduced Sulfur Species in Sulfidic Mine Tailings as Signatures of Bacterial Sulfate Reduction
Praharaj, Tanmay and Danielle Fortin, Dept. Earth Sciences, Univ. of Ottawa. Sudbury 2003: Mining and the Environment, 25-28 May 2003, Sudbury, Canada. [PowerPoint presentation]

Sulfate reducing bacteria (SRB) occur in high temperature environments (like geothermal areas and hot springs) as well as low temperature environments like natural soils and sediments (freshwater, marine, lacustrine etc.). They also can be found in extreme environments like acidic mine tailings. In anoxic environments (or micro-environments), they can survive over a range of temperature (summer and winter) and pH (2 to 9.5), but prefer near-neutral pH and large metal concentrations. The role of SRB in mine tailings is to reduce the oxidized forms of sulfur (viz. sulfates or S0) to produce hydrogen sulfide (H2S), and to form metal sulfides (commonly FeS-owing to high Fe in tailings), which are relatively insoluble and precipitated as solid sulfide minerals. The extraction method for Fe-sulfides includes Acid Volatile Sulfide [AVS (H2S + FeS)], Chromium Reducible Sulfide [CRS (FeS2 + S0)], and reactive Fe (HCl extractable). FeS is known to be diagenetic. Microbial sulfate reduction leads to fractionation of S-isotopes between SO42- and S2- during bacterial SR. SRB prefer and metabolize 32S more readily than 34S. Sulfate is enriched in 34S while sulfide is enriched in 32S. The natural abundance of 32S is 95.02 %; and 34S is 4.21%. FeS and FeS2 formed during bacterial SR become depleted in 34S while the sulfate left behind is enriched in 34S. Fe-sulfides are expected to bear this signature. Isotopic composition of Fe-sulfides could indicate SRB activity.
http://www.sudbury2007.ca/English/defaultEnglish.html

Integrating LiDAR Altimetry and Hyperspectral Data for Monitoring Mine Wastes
Wallace, Julie and Phil Howarth (Univ. of Waterloo); Bill Morris (McMaster Univ.). Sudbury 2003: Mining and the Environment, 25-28 May 2003, Sudbury, Canada. [23 pp PowerPoint presentation]

This presentation describes LiDAR (Light Detection and Ranging) altimetry and the use of hyperspectral data for remote monitoring and discusses its application to mine sites in the Sudbury area.
http://www.sudbury2007.ca/English/Presentations/Wallace_Julie.pdf

Automated Flow Through Electrode Liquid Monitoring System
Battelle Technologies Available for Licensing, No. 11985

Flow through electrodes are used extensively for monitoring industrial processes, as well as geochemical conditions of surface water or ground water. To ensure accurate measurements, these electrodes require routine calibration that typically calls for manual disconnection of the monitoring system from the sample flow. These sampling interruptions and the labor costs associated with the manual calibrations significantly drive up the operational costs of such monitoring. This patented technology is an automated flow through electrode monitoring system consisting of a self-contained calibration system. The technology is ideally suited for applications that require extensive or continuous monitoring at remote locations. Based on U.S. Patent No. 6,438,501, 9 pp, Aug 2002.
http://availabletechnologies.pnl.gov/envirnuclear/us06438501__.pdf

Automated Sampling Instrument for Low Yield Wells
Battelle Technologies Available for Licensing, No. 12161, Sep 2003

This technology provides an automated, field-deployable, sample collection apparatus and method for collecting a fluid sample from a low yield well. The automated feature of this device avoids the time, effort, and cost of having an operator make several trips to a well site to purge and obtain sufficient sample volume from low yield aquifers. The device is suitable for ground-water monitoring and reliably collects and stores samples without contamination from external sources. Based on U.S. Patent No. 6,547,004.
http://availabletechnologies.pnl.gov/envirnuclear/us6547004.pdf

Biofilm Coupon for Microbial Characterization
Battelle Technologies Available for Licensing, No. 10932-E

Microbial characterization in ground water is typically done by sampling the groundwater at desired locations; however, it has been shown that the number of microorganisms collected free-floating in a water sample bears little relationship to the size of the population adhered to the subsurface strata. Existing methods for getting around this problem are expensive and time consuming. This technology, the biofilm coupon, is a device for accurately measuring, in situ, the population and growth rate of biofilm-forming microorganisms in water, particularly in the subsurface. The device consists of a cylinder with porous walls and end caps. The cylinder is packed with a material such as glass beads upon which the biofilm microorganisms are permitted to grow. After a period of time, the biofilm coupon can be withdrawn and the microbial growth measured. One use of the device is to monitor bioremediation progress in ground water by monitoring the status of the microbial population in the water. Based on U.S. Patent No. 5,641,642. Contact: Connie Mitzel-Faulk, Battelle Licensing Staff, 509-375-6401, Fax 509-375-6731, or technology@pnl.gov.

Chemometric Characterization and Classification of Unknown Vapors
Battelle Technologies Available for Licensing, No. 12193

A method for taking the data generated from an array of responses from a multichannel chemical sensor instrument can help determine the characteristics of a chemical in the sample without the necessity of calibrating or training the instrument with known samples containing the same chemical. The characteristics determined by this method are then used to classify and identify the chemical in the sample. This method can also be used to quantify the concentration of the chemical in the sample. This chemometric approach represents a synthesis of chemometric methods with knowledge of the response mechanisms of the sensors. Given knowledge of the sensor materials and their interactions with vapors, it is possible to extract information about those vapors from the array. Once an array has been suitably calibrated on known vapors, the array response to an unknown vapor can be converted to several descriptors of the detected vapor, even if the vapor was not included in the original training. This method has been fully elaborated and demonstrated via simulations. Details have been published in “A Method for Chemometric Classification of Unknown Vapors from the Responses of an Array of Volume-Transducing Sensors,” J.W. Grate, et al., Analytical Chemistry, 73(10), 2239 -2244, 2001, and in “Methods for Characterizing, Classifying, and Identifying Unknowns in Samples,” U.S. Patent No. 2001/0029774 A1 (Appl. No. 09/797,162). U.S. and foreign patents pending. Contact: Licensing, Technology Commercialization, 509-375-6401 or technology@pnl.gov, 902 Battelle Boulevard, P.O. Box 999, MSIN: K9-89, Richland, Washington 99352.

Enhanced Photoacoustic Detection Including that of Optically Dense Samples
Battelle Technologies Available for Licensing, Nos. 11714, 11715, 11846, 11847

Photoacoustic spectroscopy is a versatile and highly sensitive pulsed-light absorption-spectroscopic technique for analytic, kinetic, and calorimetric analyses. Photoacoustic spectroscopy involves the absorption of a pulse of light energy by a molecule and the subsequent detection of a pressure wave generated by heat energy released by the molecule upon its return to the ground state. Photoacoustic spectroscopy analysis is nondestructive, real-time, and 10 to 1000 times more sensitive than conventional UV-Vis spectroscopy. A suite of photoacoustic sensor technologies developed at the Pacific Northwest National Laboratory significantly improves the real world applicability of existing photoacoustic spectroscopy technologies in the following ways: (1) it allows analysis of suspensions, as well as dilute or optically dense solutions; (2) provides for nondestructive, real-time chemical monitoring of complex mixtures; (3) enables microliter and nanoliter sample volumes with wide range of wavelengths; (4) enables the design of low cost, small and rugged instruments; (5) permits continuous monitoring of constituents in solutions without the need to dilute samples, thus allowing analysis of mixtures in situ, under real-life conditions, and if needed, in line; (6) extends the range of concentrations that can be analyzed while retaining sensitivity at concentrations considerably lower than conventional UV-Vis and IR spectroscopy; and (7) reduces the time needed for handling samples (there is often no need for extractions or dilutions), and therefore the cost of routine analysis. Based on U.S. Patents 6,244,101, 6,236,455, 6348,968, and pending.

Rapid Measurement of Volatile Compounds in an Aqueous Solution
Battelle Technologies Available for Licensing, No. 11632, Sep 2003

Analysis of a volatile compound in an aqueous solution is well known, typically involving a sample of the volatile compound-laden aqueous solution placed in a container with a head space filled with a gas and a vapor sensor. The disadvantage of this approach is the large amount of time for the gas in the headspace to reach equilibrium with the solution to enable an accurate measurement. This patented technology significantly reduces the time needed to reach equilibrium by the incorporation of a gas or liquid sparger within the container. Based on U.S. Patent No. 6,420,187, July 2002.
http://availabletechnologies.pnl.gov/envirnuclear/us06420187__.pdf

Microsparger Monitoring Probe
Gilmore, Tyler; Kirk Cantrell, Pacific Northwest National Laboratory, Mar 2002

The Microsparger is an in-well probe designed to detect volatile compounds such as TCE and BTEX in the ground water. The probe is lowered inside a ground-water well where a water sample is drawn into the sample vessel. The water is then aerated and the vapor captured for analysis at the surface by commercially available gas analyzers, such as a photo-ionizing detector (PID), gas chromatograph (GC) or an infrared photoacoustic spectro-photometer. The concentration of the vapor is used to calculate the equivalent concentration in the dissolved phase using Henry's Law. This method allows in situ measurements of volatiles with immediate results. The Microsparger represents a time and cost improvement over the conventional laboratory method of measuring volatiles using gas chromatography. With this system, measurements of volatile concentration can be obtained in less than 10 minutes compared to the 1 to 6 weeks for the results with the conventional laboratory submitted sample. This speed is particularly useful for rapid site characterization efforts (e.g., Hydropunch or geoprobe investigations) and ground-water remediation systems where volatile concentrations are needed to optimize equipment operations. There is also a significant cost savings because no waste is generated, the accuracy and precision should compare well to conventional methods, and the labor hours for sampling and analysis are significantly reduced in comparison to conventional methods. Future deployments of Microsparger may include the use of the system as a dedicated probe deployment in monitoring wells for continuous or periodic remote monitoring of ground-water contaminant concentrations. A patent is pending. Contact: Tyler Gilmore, 509-376-2370, tyler.gilmore@pnl.gov.

Field Technique for Automated Dithionite Analysis to Support In Situ Redox Manipulation
Battelle Technologies Available for Licensing, No. 11926, Sep 2003

When deploying in situ redox manipulation techniques for ground-water remediation, accurate measurement of the dithionite concentration is needed in laboratory and field experiments to assess the reduction of the sediment and ultimately the effectiveness of the in situ redox manipulation technique. Once dithionite is put in aqueous solution, it will degrade to different sulfur-containing compounds over several hours, so accurate measurement of only the dithionite concentration needs to be accomplished as soon as possible. While dithionite can be accurately measured in the laboratory with several techniques (direct titration, liquid chromatography, or gas chromatography-mass spectrometry), these rely on relatively expensive ($40K to $70K) equipment and additional laboratory resources, including an anaerobic chamber to provide an oxygen-free environment during sample processing. These techniques are not practical for remote field locations. The technique described in this invention report was developed over several years of laboratory and field experiments based on the necessity for fast and accurate measurement of dithionite concentration at remote field locations. Novel aspects of this invention include (1) a novel fluid analysis system for performing automated fluid analysis over a widely varying concentration range, (2) a novel fluid analysis system for performing automated ground-water analysis during a remediation injection, especially for injection of dithionite, and (3) an ability to monitor levels of soil chemicals following a remediation injection. Based on Patent Application No. 2002/0132351A1, 16 pp, Sep 2002.
http://availabletechnologies.pnl.gov/envirnuclear/us22132351a1.pdf

Low-Cost Gated System for Monitoring Phosphorescence Lifetimes
Kostov, Yordan; Govind Rao. Review of Scientific Instruments, Vol 74 No 9, p 4129-4133, Sep 2003

The authors present a low-cost, gated system for measurements of phosphorescence lifetimes with an extensive description of system operating principles and metrological characteristics. The system operates without optical filtering of the light-emitting diode excitation source and could find wide application in environmental fields because it effectively suppresses high-level background fluorescence and scattered light.

Real-Time Atomic Absorption Mercury Continuous Emission Monitor
Zamzow, D.S.; S.J. Bajic; D.E. Eckels; D.P. Baldwin; C. Winterrowd; R. Keeney. Review of Scientific Instruments, Vol 74 No 8, p 3774-3783, Aug 2003

A continuous emission monitor (CEM) for mercury (Hg) in combustion flue gas streams has been designed and tested for the detection of Hg by optical absorption. The CEM incorporates a sampling system that allows continuous introduction of stack gas for the sequential analysis of elemental and total Hg. A key component of the CEM is a laboratory-designed and -assembled echelle spectrometer that provides simultaneous detection of all of the emission lines from a Hg pen lamp, which is used as the light source for the optical absorption measurement. This feature allows for online spectroscopic correction for interferent gases such as sulfur dioxide and nitrogen dioxide. The authors provide a detailed description of the CEM system, the characteristics and performance of the CEM, and the results of field tests performed at EPA's rotary kiln in Research Triangle Park, NC.

Capillary-Discharge-Based Portable Detector for Chemical Vapor Monitoring
Duan, Yixiang; Yongxuan Su; Zhe Jin. Review of Scientific Instruments, Vol 74 No 5, p 2811-2816, May 2003

This paper describes a portable detector of simple design and with very low power needs that also is sensitive, powerful, and rugged. The detector is based on a dry-cell battery powered, capillary-discharge based microplasma source with optical emission detection. It is possible for the plasma source to be powered with a small dry-cell battery because the microscale plasma source has low thermal temperature and very low power needs. A very small amount of inert gas can be used as sample carrier and plasma supporting gas. Inert gases possess high excitation potentials and produce high-energy metastable particles in the plasma. These particles provide sufficient energy to excite chemical species through Penning ionization and/or energy transfer from metastable species. A molecular emission spectrum can be collected with a palm-sized spectrometer through a collimated optical fiber and the spectrum displayed on a notebook computer. The new portable detector provides high sensitivity for organic chemical species. It also is easy to operate.

An Ion Beam Reflectron/Single-photon Infrared Emission Spectrometer for the Study of Gas-Phase Polycyclic Aromatic Hydrocarbon Ions: Testing Proposed Carriers of the Unidentified Infrared Emission Bands
Kim, Hack-Sung; Richard J. Saykally. Review of Scientific Instruments, Vol 74 No 4, p 2488-2494, Apr 2003

The authors describe the design and performance of an electron-impact ion beam reflectron system coupled to a single-photon infrared emission spectrometer for measurement of infrared emission from excited gas-phase polycyclic aromatic hydrocarbon (PAH) cations.

Development and Testing of a Frequency-Agile Optical Parametric Oscillator System for Differential Absorption Lidar
Weibring, P.; J.N. Smith; H. Edner; S. Svanberg. Review of Scientific Instruments, Vol 74 No 10, p 4478-4484, Oct 2003

An all-solid-state fast-tuning lidar transmitter for range- and temporally resolved atmospheric gas concentration measurements is based on a commercial optical parametric oscillator (OPO) laser system that has been redesigned with piezoelectric transducers mounted on the wavelength-tuning mirror and on the crystal angle tuning element in the OPO. The construction allows the system to be tuned to any wavelength, in any order, in the range of the piezoelectric transducers on a shot-to-shot basis. This extends the measurement capabilities far beyond the two-wavelength differential absorption lidar method and enables simultaneous measurements of several gases. Absorption cell measurements of methane and mercury have shown that the system achieves stable wavelength and linewidth during rapid scans in the mid-IR and UV regions.

Leaching from CCA-Treated Wood into Soils: Preliminary PIXE Studies
Kelly, R.F.; I.I. Kravchenko; J.C. Kuharik; H.A. Van Rinsvelt; F.E. Dunnam; J. Huffman. AIP Conference Proceedings, Vol 680 No 1, p 428-430, 26 Aug 2003

This paper compares the results of PIXE (particle induced X-ray emission) laboratory studies of CCA-contaminated soil samples with previous analyses of As, Cu, Cr, and other heavy-elemental content, with some variability in diffusion rates. The advantages of PIXE--rapid analysis, quick sample turnover, possible lower cost--suggest its application to this area of interest.

PIXE and RBS Elemental Analyses of Tree Rings from Mexico Basin Forests as a Record of Pollution
Miranda, J.; G. Calva-Vasquez; C. Solis; L. Huerta. AIP Conference Proceedings, Vol 680 No 1, p 444-447, 26 Aug 2003

Investigators performed particle induced X-ray emission (PIXE) and Rutherford backscattering (RBS) elemental analyses of tree rings and soils from forests around the Mexico City Metropolitan Area (MCMA) to estimate the impact of pollution on the forests. Differences were observed in samples from the different forests, showing higher values in the areas closest to the MCMA. A correlation of several elements with ring width was found using cluster analysis.

Photonuclear-Based Explosive Detection System Optimizations
Yoon, W.Y.; J.L. Jones; K.J. Haskell; D.R. Norman. AIP Conference Proceedings, Vol 680 No 1, p 909-912, 26 Aug 2003

Idaho National Engineering and Environmental Laboratory (INEEL) has developed a photoneutron-based nondestructive evaluation (NDE) technique that uses a pulsed, high energy (2- to 12-MeV) electron accelerator and a customized high-purity germanium-based gamma-ray spectroscopy system. This NDE technique is being applied to the detection of nitrogen-containing explosives. Each pulse of electrons produces highly penetrating bremsstrahlung photons. Interrogating neutrons are generated by the bremsstrahlung photons interacting within a photoneutron source. The interaction of these interrogating neutrons with an object of interest generates elemental characteristic gamma rays. Spectrometry is performed between accelerator pulses by analyzing these neutron-capture gamma rays.

The DIAMINE Landmine Detection System
Viesti, G., et al. AIP Conference Proceedings, Vol 680 No 1, p 924-927, 26 Aug 2003

The DIAMINE sensor makes use of the neutron backscattering techniques (NBT). Due to the hydrogen content of the explosive and of the plastic case of the mine, the presence of a buried land-mine causes a localized strong increase of the yield of low energy neutrons. In some conditions, the hit distribution could provide an "image" of the hidden object. Coupling of the NBT sensor with a metal detector will provide the operator with a compact device, reducing the false alarm rate of the single sensors. The laboratory tests of the DIAMINE system demonstrate the possibility to detect small APM up to 10 cm deep in sand.

Bremsstrahlung-Based Imaging and Assays of Radioactive, Mixed and Hazardous Waste
Kwofie, J.; D.P. Wells; F.A. Selim; F. Harmon; S.P. Duttagupta; J.L. Jones; T. White; T. Roney. AIP Conference Proceedings Vol 680 No 1, p 943-946, 26 Aug 2003

A new nondestructive accelerator based x-ray fluorescence (AXRF) approach has been developed to identify heavy metals in large volume samples. Distributions of heavy metal impurities in mining and milling process and waste samples can range from homogeneous to highly inhomogeneous, and non-destructive assays and imaging that can address both are urgently needed. The approach uses high energy, pulsed bremsstrahlung beams (3-6.5 MeV) from small electron accelerators to produce K-shell atomic fluorescence x-rays. The excellent penetrability of the beams allows assays and images for soil-like samples at least 15 g/cm2 thick, with elemental impurities of atomic number greater than ~50. The paper reports actual and potential detection limits of heavy metal impurities in a soil matrix for a variety of samples and discusses the potential for imaging with AXRF and related probes.

DUNBLAD, the Delft University Neutron Backscatter LAnd-mine Detector, a Status Report
Bom, Victor R.; Cor P. Datema; Carel W. E. van Eijk. AIP Conference Proceedings, Vol 680 No 1, p 935-938, 26 Aug 2003

A novel, ergonomic detector system has been constructed to apply the neutron backscattering technique to search for non-metallic land mines in relatively dry sandy soils. Tests with real land mines in a realistic environment show that anti-tank mines can be found reliably, but anti-personnel mines might escape detection. One approach is to use an array of position-sensitive 3He detectors placed close to the soil. With a pulsed neutron generator, further improvement could be reached by applying a time window on the neutron transit time. Researchers investigated the possibilities of neutron backscattering imaging systems using Monte Carlo simulations with GEANT-4. A neutron backscattering imaging device with a 2D sensitive detection plane currently is under development.

Gamma Resonance Technology for Detection of Explosives, Revisited
Wielopolski, L.; P. Thieberger; J. Alessi; J. Brondo; D. Vartsky; J. Sredniawski. AIP Conference Proceedings, Vol 680 No 1, p 919-923, 26 Aug 2003

Gamma resonance technology provides the combined capability of absorption and fluorescence in the simultaneous detection and imaging of multiple elements for identification of contraband and total density for imaging of contents. This paper discusses recent advances in the production of gamma resonance beams that justify revisiting gamma resonance technology as a viable tool for explosives and drug interception in large cargo containers.

Detection of Hidden Explosives Using Resonant Gamma Rays From In-Flight Annihilation of Fast Positrons
Guardala, Noel A.; J. Paul Farrell; Vadim Dudnikov; George Merkel. AIP Conference Proceedings, Vol 680 No 1, p 905-908, 26 Aug 2003

Gamma rays with tunable energies can be produced by the in-flight annihilation of fast positrons. The kinetic energy of the positron beam determines the gamma-ray energy of annihilation photons emitted in a narrow cone in the forward direction. These photons can be used for nuclear resonant fluorescence determination of explosive materials rich in N-14 selecting gamma rays with energies that match excited states in N-14, and then observing the emitted nuclear fluorescence.

The Integrated Detection of Hazardous Materials
Koltick, David S, Purdue Univ., West Lafayette, IN. AIP Conference Proceedings, Vol 680 No 1, p

835-839, 26 Aug 2003

Research is under way to combine various detection techniques together to identify hazardous materials. These techniques include (1) elemental analysis for hazardous materials using neutron interrogation and gamma ray spectrum analysis techniques, as well as associated particle-imaging techniques, (2) ion mobility using new miniaturized instrumentation in simple ion trap instruments, (3) point-of-need chemical analysis systems for analyses in aqueous systems using antibody arrays on micro-chips, and (4) micro-sensors using advanced scanning probe microscope technique on gold and silicon surfaces coated with antibodies and antigen in both dry and aqueous environments. Combining several of these techniques into a single decision process gives broad response capability with a reduction in false signals.
http://koltick.physics.purdue.edu/papers/Hazard_detect.pdf

Photothermal Trace Detection in Capillary Electrophoresis for Biomedical Diagnostics and Toxic Materials
Faubel, Werner; Stefan Heissler; Ute Pyell; Natalia Ragozina. Review of Scientific Instruments, Vol 74 No 1, p 491-494, Jan 2003

This paper presents two applications of a near-field thermal lens capillary electrophoresis detector in the deep ultraviolet region (pump beam 257 nm wavelength). In the determination of (nonfluorescent) nitroaromatic explosives in contaminated soil, the compounds are detected with the laboratory-built thermal lens detector after their separation by micellar electrokinetic chromatography. This type of detection makes it possible to obtain limits of detection 1to 2 orders of magnitude lower than those obtained with classical absorption spectrometric detection. In capillary electrophoretic determination of the pharmaceuticals Tramadol, Verapamil, and Papaverin, direct separation techniques were used for the different classes of substances with characteristic absorbance spectra.

Photoacoustic Sensor System for the Quantification of Soot Aerosols
Haisch, C.; H. Beck; R. Niessner. Review of Scientific Instruments, Vol 74 No 1, p 509 [abstract only], Jan 2003

The authors present two similar photoacoustic sensor systems optimized for a highly sensitive and fast online and in situ quantification of soot. The system consists of two photoacoustic cells operated in a differential mode to avoid cross sensitivities. The cells are built as acoustical resonators to increase sensitivity. A diode laser with a wavelength of 810 nm and an output power of 1.1 W provides excitation when its collimated beam passes first through the reference cell and then through the measurement cell. To avoid condensation of water, the cells are heated to 50°C. One unit contained in a rugged 19-inch rack is designed for field applications to withstand external acoustic noise, temperature fluctuations, and dust contaminations in routine use at an engine test site. A second system is designed for the detection of very low concentrations of atmospheric soot in a remote area at high altitude in an observatory on top of a mountain.

An Intelligent Radiation Detector System for Remote Monitoring
Latner, Norman; Norman Chiu; Colin G. Sanderson, Environmental Measurements Lab., New York, NY. AIP Conference Proceedings, Vol 632 No 1, p 182-189, 10 Oct 2002

DOE's Environmental Measurements Laboratory has developed a unique real-time gamma radiation

detector and spectroscopic analyzer specifically designed for a Homeland Security radiological network. The sensitivity and rapid sampling cycle of the Intelligent Radiation Detector (IRD) assure up-to-the minute radiological data, which will indicate fast changes in atmospheric radioactivity. An immediate alert will occur within seconds to signal rapid changes in activity or levels elevated beyond a preset, which feature is particularly valuable to detect radioactivity from moving vehicles. The IRD also supplies spectral data, which allows the associated network computer to identify the specific radionuclides detected and to distinguish between natural and manmade radioactivity. The IRD uses readily available off-the-shelf components combined with an inexpensive, unique detector housing made of PVC plastic pipe. A prototype unit has been in continuous, reliable, automatic, and unattended operation since November 27, 2001.
http://www.eml.doe.gov/homeland/921J_reprint.pdf

NEWNet: Web-Based Unattended Monitoring in the Public Domain
McNaughton, Michael W.; Allen Treadaway; Kevin Anderson; M. William Johnson. AIP Conference Proceedings, Vol 632 No 1, p 244-251, 10 Oct 2002

The Neighborhood Environmental Watch Network, NEWNet, is a system of environmental radiation monitors near Los Alamos National Laboratory and other sites that provides data at 15-minute intervals on the Internet. Scientist are testing extensions of the NEWNet system to include environmental alpha detectors. This paper provides a status report on recent improvements in sensitivity and enhancements of capabilities and discusses possible future applications of the enhanced technology.
http://newnet.lanl.gov

Low Cost Autonomous Field-Deployable Environment Sensors
Kremens, Robert L.; Andrew J. Gallagher; Adolph Seema, Rochester Inst. of Technology, Rochester, NY. AIP Conference Proceedings, Vol 632 No 1, p 190-199, 10 Oct 2002

The described Autonomous Environmental Sensor (AES) is a miniature electronic package combining position location capability using the Global Positioning System (GPS)), communications (packet or voice-synthesized radio), and environmental detection capability (thermal, gas, radiation, optical emissions) into a small, inexpensive, deployable package. AESs can now be made with commercial off-the-shelf components. The AES package operates as a data logger (recording data locally) or as a sentry (transmitting data real-time). An AES can operate for a number of weeks on a simple dry battery pack. With current low power radio communication technology, it can be designed to have a transmitting range of several kilometers. Inexpensive portable repeaters can be used to extend the range of the AES and to coordinate many probes into an autonomous network. The authors discuss the design goals and engineering restrictions of an AES, and show a design for a forest fire sentry.
http://www.cis.rit.edu/~rlkpci/urssra_Kremens.pdf

Diffraction Based Optical Particle Sizer for On-Line Monitoring in Hostile Environments of Low Concentration Particle Laden Flows
Golinelli, E.; P. Martinelli; S. Musazzi; U. Perini; F. Trespidi; E. Paganini. Review of Scientific Instruments, Vol 72 No 6, p 2796-2803, June 2001

An optical particle sizer conceived for the on-line analysis of low concentration particle-laden flows belongs to the wide class of instruments based on the detection of the light scattered at small angle in the forward direction. Innovative solutions have been adopted both in the optical configuration and in the detection scheme that enable the instrument to operate at very low concentration regimes (i.e., at extinction values as small as 10^{-5}) in hostile environments. Preliminary measurements have been carried out in a coal fired power plant on a flue duct downgradient from the electrostatic precipitators.

A New Device for Dynamic Sampling of Radon in Air
Lozano, J.C.; V. Gomez Escobar; F. Vera Tome. Review of Scientific Instruments, Vol 71 No 8, p 3065-3071, Aug 2000

The authors propose a new system for the active sampling of radon in air based on the property of activated charcoal to retain radon. Two identical carbon-activated cartridges arranged in series remove the radon from the air being sampled. The air passes first through a desiccant cell and then the carbon cartridges for short sampling times using a low-flow pump. The alpha activity for each cartridge is determined by a liquid scintillation counting system. The cartridge is placed in a holder into a vial that also contains the appropriate amount of scintillation cocktail, avoiding direct contact between cocktail and charcoal. Once dynamic equilibrium between the phases has been reached, the vials can be counted. When applied to environmental samples, the method provides good results for very different levels of activity.

On the Use of the Thermal Wave Resonator Cavity Sensor for Monitoring Hydrocarbon Vapors
Lima, J.A.P.; E. Marin; M.G. da Silva; M.S. Sthel; S.L. Cardoso; D.F. Takeuti; C. Gatts; H. Vargas; C.E. Rezende; L.C.M. Miranda. Review of Scientific Instruments, Vol 71 No 7, p 2928-2932, July 2000

A gas sensing device based on a thermal wave resonator cavity has been tested for monitoring the presence of several hydrocarbon vapors in air via the measurement of the thermal diffusivity. The characteristic response time is linearly correlated to the thermal diffusivity value of the mixture, and the time-dependent response can be used to follow the diffusion of vapor. The authors discuss future development of a practical sensing device.

Development of a Compact, Handheld Raman Instrument with No Moving Parts for Use in Field Analysis
Cullum, Brian M.; J. Mobley; Z. Chi; D.L. Stokes; G.H. Miller; T. Vo-Dinh. Review of Scientific Instruments, Vol 71 No 4, p 1602-1607, Apr 2000

A lightweight, self-contained, field-portable Raman instrument has been developed for rapid on-site determination of primary mixture components. The instrument consists of a helium neon (HeNe) laser for excitation, an acousto-optic tunable filter (AOTF) for wavelength discrimination, and an avalanche photodiode for detection. The AOTF is the primary component of this system and has been selected based on its spectral range (600 to 900 nm) and its high resolution, ~7.5 cm^{-1}. The authors compare the spectral resolution, sensitivity, and data acquisition speed for certain environmentally important compounds with those obtained using a conventional laboratory Raman system consisting of a grating-based spectrograph and a charge-coupled device.

Design and Development of a Highly Sensitive, Field Portable Plasma Source Instrument for On-Line Liquid Stream Monitoring and Real-Time Sample Analysis
Duan, Yixiang; Yongxuan Su; Zhe Jin; Stephen P. Abeln, Los Alamos National Lab. Review of

Scientific Instruments, Vol 71 No 3, p 1557-1563, Mar 2000

System sensitivity and portability, plasma source, sample introduction, desolvation system, power supply, and instrument configuration were considered carefully in the design of a highly sensitive, field-portable, low-powered instrument for on-site, real-time liquid waste stream monitoring. A newly designed miniature modified microwave plasma source was selected as the emission source for spectroscopy measurement, and an integrated small spectrometer with a charge-coupled device detector was installed for signal processing and detection. An innovative beam collection system with optical fibers was designed and used for emission signal collection. Microwave plasma can be sustained with various gases at relatively low power, and it possesses high detection capabilities for both metal and nonmetal pollutants, making it desirable to use for on-site, real-time liquid waste-stream monitoring. An effective in situ sampling system was coupled with a high efficiency desolvation device for direct-sampling liquid samples into the plasma. A portable computer control system is used for data processing. The new, integrated instrument can be used easily for on-site, real-time monitoring in the field.
http://www.lanl.gov/partnerships/pdf/license/mpt-aes.pdf

Long-Path Monitoring of Atmospheric Aerosol Extinction with an Automated Laser Positioning System
Widada, W.; H. Kuze; Y. Xue; K. Maeda; N. Takeuchi. Review of Scientific Instruments, Vol 71 No 2, p 546-550, Feb 2000

An automated laser-beam positioning system has been developed and applied to long-path (700 m) monitoring of atmospheric aerosols. The system is based on a piezoelectric-driven mirror mount whose vertical and horizontal positioning is precisely controlled to maximize the return beam intensity. By optimizing the direction of the transmitted beam every 5 to 10 minutes, the change in aerosol extinction can be measured accurately without interference from beam displacement due to temperature change. The positioning method allows the use of relatively small detectors and optical components.

A Charge-Coupled Device-Based Laser Photofragment Fluorescence Spectrometer for Detection of Mercury Compounds
Tong, X.; R.B. Barat; A.T. Poulos. Review of Scientific Instruments, Vol 70 No 11, p 4180-4184, Nov 1999

A charge-coupled device (CCD) camera for the detection of mercuric bromide (HgBr2) vapor at low concentrations by laser photofragment fluorescence (PFF) spectroscopy offers reasonable sensitivity plus spectral information, enhancing PFF as a technique for the environmental monitoring of airborne mercury compounds. In tests detailed in this paper, the detection limit for the PMT system was 10 ppb without signal averaging, but the linear dynamic range ended at 0.7 ppm.

Real Time Chemical Vapor Detection and Enhancement Utilizing Aerosol Adsorption
Novick, V.J.; S.A. Johnson; H.A. Hisgen; V.J. Reyes. Review of Scientific Instruments, Vol 70 No 3, p 1829-1834, Mar 1999

A new trace gas detection system uses the high surface area properties of an aerosol to adsorb specific gas species and the high sensitivity and near real-time capabilities of the infrared aerosol analyzer. The authors describe a new technique that allows certain chemical vapor species to be detected in time frames on the order of 2 minutes. The technique uses aerosols of selected materials to adsorb the vapor from an air sample, concentrating the vapor onto the surface of the aerosol, then depositing the particles onto a substrate for infrared analysis. Preliminary results indicate that the measured absorbance is a monotonic function of the quantity of the trace gas injected, which gives encouraging evidence that a quantitative determination of the amounts of trace gases present in the atmosphere can be made in many cases. Trace gas detection is dependent upon the aerosol material chosen as the absorbent.

Spectroscopic Diagnostics of an Atmospheric Microwave Plasma for Monitoring Metals Pollution
Woskov, P.P.; K. Hadidi; M.C. Borras; P. Thomas; K. Green; G.J. Flores, MIT, Cambridge, MA.
Review of Scientific Instruments, Vol 70 No 1, p 489-492, Jan 1999

DOE/EPA testing has shown a 1.5 kW, 2.45 GHz microwave sustained plasma in a flowing sample of stack exhaust gas to be an accurate monitor of trace hazardous metals in the ppb range, such as lead, chromium, and beryllium. Optical-ultraviolet spectroscopic studies are being carried out to better understand this particular atmospheric pressure plasma torch. An experimental device has been modified with extra visible access for radial and axial profile measurements. Diffraction limited fiber optic plasma views and high-resolution grating spectrometer instrumentation for molecular rotational and atomic excitation temperature measurements are being used for plasma studies.
http://www.psfc.mit.edu/library/98ja/98ja026/98ja026_full.pdf

A Pulsed Photoacoustic Instrument for the Detection of Crude Oil Concentrations in Produced Water
Freeborn, S.S.; J. Hannigan; F. Greig; R.A. Suttie; H.A. MacKenzie. Review of Scientific Instruments, Vol 69 No 11, p 3948-3952, Nov 1998

A pulsed photoacoustic instrument for the detection of crude oil concentrations in produced water utilizes fiber-optic delivery of pulsed diode laser sources to an in-line sensor head and incorporates a gradient-index lens for optical delivery into the flow line and a piezoelectric transducer for acoustic detection. Tests indicate a crude oil concentration detection range of 5 to 8000 ppm in water.

Development of a Portable Time-of-Flight Membrane Inlet Mass Spectrometer for Environmental Analysis
White, A.J.; M.G. Blamire; C.A. Corlett; B.W. Griffiths; D.M. Martin; S.B. Spencer; S.J. Mullock.
Review of Scientific Instruments, Vol 69 No 2, p 565-571, Feb 1998

This paper describes a transportable time-of-flight (TOF) mass spectrometer based upon a converging, annular TOF (CAT) arrangement. The instrument, the portable CAT or T-CAT, is battery powered and self-contained. The vacuum chamber is never vented and is kept at a very low pressure, even during analysis. Sample gases are admitted to the mass spectrometer via a membrane inlet system. Data are recorded and analyzed on a portable PC. The T-CAT is capable of detection limits approaching those of more conventional, nonportable design and shows reasonable linearity over wide concentration ranges.

A CdS Photoconductivity Gas Sensor as an Analytical Tool for Detection and Analysis of Hazardous Gases in the Environment
Miremadi, Bijan K.; Konrad Colbow; Yutaka Harima. Review of Scientific Instruments, Vol 68 No 10, p 3898-3903, Oct 1997

A highly sensitive gas sensor for detection and analytical identification of hazardous gases has been developed by depositing partially crystalline powder from an aqueous suspension of CdS powder on an alumina substrate. When the deposited layers are promoted with catalysts from Pt-group metals, they exhibit high sensitivity to different gas molecules upon modulation with light of certain frequency, depending on catalyst and impurity concentration. Dark resistance and photosensitivity of the sensors are monitored against gas concentration, sensor temperature, and frequency of the modulating light. Depending on the gas and its concentration, a change of up to 100% in sensor response is observed. The display of different slopes for different molecules likely comes about by different interactions of gas molecules with surface recombination centers, depending on the nature of physisorption and/or chemisorption on the surface. Not only does the sensor detect gases, the variation of slope with light frequency allows the sensor to be used as an analytical tool.

Development of a Hand-Held Forensic-Lidar for Standoff Detection of Chemicals
Thomson, Grant; David Batchelder. Review of Scientific Instruments, Vol 73 No 12, p 4326-4328, Dec 2002

The design of a compact, hand-held forensic-lidar instrument enables a single operator to perform the spectral identification of a labeled object at 5 m distance using, low-power excitation (1 mW) and short sampling times (under 2 s) from a sample less than 100-µm thick. The system integrates a modified single-lens-reflex (SLR) telephoto camera with an optical-fiber coupled Raman probe head. Spectral analysis is achieved using an optical-fiber coupled spectrograph employing a volume-phase holographic grating, charge-coupled device array detection, and visible excitation Spectra can be acquired from objects encased in transparent packaging or behind glass windows. A modified SLR camera supports accurate sample alignment using the visible spectrum and collection of surface-enhanced resonance Raman scattered flux through the SLR camera lens using epi-illumination. A single operator can acquire fingerprint recognition of a material with a single hand-held unit and spectrum-matching software.

On the Use of Photothermal Techniques for Monitoring Constructed Wetlands
Gatts, C.E.N.; R.T. Faria, Jr.; H. Vargas; L.S. Lannes; G.T. Aragon; A.R.C. Ovalle. Review of Scientific Instruments, Vol 74 No 1, p 510-512, Jan 2003

Constructed wetlands for wastewater treatment (reed-bed systems) can act as a source for greenhouse gases through the emission of sediment-produced methane (CH4) to atmosphere. The authors discuss the potential use of photothermal techniques for monitoring gaseous emissions in wetlands.

Dynamic High Throughput Screening of Chemical Libraries Using Acoustic-Wave Sensor System
Potyrailo, Radislav A.; Ralph J. May. Review of Scientific Instruments, Vol 73 No 3, p 1277-1283, Mar 2002

The measurement method for a novel sensor-based high throughput screening (HTS) system for identification and quantitation of volatile substances in combinatorial chemical libraries employs a combination of a periodic introduction of a minute amount of a liquid sample into the HTS system, rapid evaporation of volatile components in the sample at room temperature, and dynamic measurement of a generated vapor pulse. These measurements are performed using an array of four 10 MHz acoustic-wave thickness-shear mode sensors coated with different chemically sensitive films. Depending on the gas flow rate, quantitative measurements are performed 10 to 150 seconds after the sample introduction and provide significant throughput advantage over gas-chromatographic instruments. Determinations of mixtures of analytes in a variety of solvents are performed using multivariate locally weighted regression. This method of dynamic sensor-based measurements allows for instrument miniaturization and increases the usefulness of the instrument in space-limited applications. The operation of multiple sensors in parallel makes possible the effective analysis of dense combinatorial libraries of materials.

Preconcentration Techniques for Natural and Treated Waters
Crompton, T.R.
Spon Press, London. ISBN: 0415268117, 736 pp, 2002

Equipment used for the analysis of water is frequently insufficiently sensitive to be able to detect low concentrations of organic and inorganic substances present in samples. Applying preconcentration to the sample prior to analysis means the results gained are more accurate and can be used to report trends more effectively. Each chapter of this text discusses a different method of preconcentration and its application to cations, anions, organic substances, and organometallic compounds. Drawing upon recent literature on the subject, this book provides detailed discussion of the need for reducing detection limits in analytical chemistry and ways of achieving this aim. This book will be useful to biologists, chemists, agriculturalists, toxicologists, oceanographers and environmentalists dealing with the analysis of water.

Determination of Anions in Natural and Treated Waters
Crompton, T.R.
Spon Press, London. ISBN: 0415258006, 880 pp, 2002

The concentration of anion components in natural and treated waters can have profound effects on the ecosystem. Through the process of bioaccumulation, their presence can affect all organisms from invertebrates, fish, crops, and livestock to, ultimately, humans. This book draws upon recent literature to present in a systematic fashion the latest available analytical techniques for detecting anions in non-saline, saline, and treated waters. This volume is intended for environmental analytical chemists, toxicologists, the medical community and public health sector, and the water, agrochemistry, fisheries, and waste management industries.

Determination of Metals and Anions in Soils, Sediments and Sludges
Crompton, T.R.
Spon Press, London. ISBN: 041523882X, 776 pp, 2001

Here is the first volume to comprehensively discuss the range of methods available for the analysis of metal and anions in soils, river and marine sediments, and industrial sludges. A special feature is its coverage of solid sewage, which is increasingly being applied to land as fertilizer. The reader is presented with details of the methods of analysis available, their applicability in certain environments, advantages and disadvantages of one method against another, likely causes of interference, and the sensitivity of methods and detection limits.

Determination of Organic Compounds in Soils, Sediments and Sludges
Crompton, T.R.
Spon Press, London. ISBN: 0419252703, 520 pp, 2000

This book discusses the range of methods available for the analysis of organic compounds in soils, river and marine sediments, and industrial sludges. The reader is presented with details of the methods of analysis available, their applicability in certain environments, advantages and disadvantages of one method against another, likely causes of interference, and the sensitivity of methods and detection limits. The various chapters address hydrocarbons; surface-active agents; compounds containing oxygen, halogen, nitrogen, phosphorous, or sulphur; insecticides, herbicides, growth regulators, and fungicides; miscellaneous organic compounds; mixtures of organic compounds; non-metals and metalloids; organometallic compounds; sampling procedures; accumulation processes in sediments; and disposal of wastes to land.

Determination of Organic Compounds in Natural and Treated Waters
Crompton, T.R.
Spon Press, London. ISBN: 0419243607, 928 pp, 1999

This book draws together and systemizes the vast body of information available on the occurrence and determination of organic substances, providing a comprehensive description of organic compounds in all types of non-saline and saline natural and treated waters. This book is intended for analytical chemists working in industry in the water utilities, those working in government and non-government organizations and regulatory agencies, chemical companies producing aqueous effluents, and environmental and analytical consultants.

Field Detection and Identification of a Bioaerosol Suite by Pyrolysis-Gas Chromatography-Ion Mobility Spectrometry
Snyder, A.P. (U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD); A. Tripathi and W.M. Maswadeh (Geo-Centers, Inc., Gunpowder Branch, Aberdeen Proving Ground, MD); J. Ho and M. Spence (Defence Research Establishment Suffield, CFB Suffield, Ralston, Alberta, Canada). Field Analytical Chemistry & Technology, Vol 5 No 4, p 190-204, 2001 ** Special Issue: Papers from ICFAC III Rapid Field Detection and Identification of Biological Agents **

Improvements made to a pyrolysis-gas chromatography-ion mobility spectrometry (Py-GC-IMS) stand-alone biodetector have provided more pyrolyzate compound information to the IMS detector module. Air carrier gas flowing continuously through the pyrolysis tube, the rate of air flow, and pyrolysis rate have improved the relative quality and quantity of pyrolyzate compounds detected by the IMS detector compared to earlier work. The airflow improvement allowed more biomarker compounds to be observed in the GC-IMS data domain for aerosols of gram-negative *Erwinia herbicola* and ovalbumin protein as compared to previous studies. Previous outdoor aerosol trials have shown the Py-GC-IMS device to be a credible detector with respect to determining the presence of a biological aerosol. The series of outdoor trials described in this paper has provided a platform to show that the Py-GC-IMS can provide information more specific than a biological or non-biological analysis to an aerosol when the time of dissemination is unknown to the operator. The Py-GC-IMS can discriminate between aerosols of a gram-positive spore (BG), a gram-negative bacterium (EH), and a protein (ovalbumin).

Continuous Bioaerosol Monitoring Using UV Excitation Fluorescence: Outdoor Test Results
Eversole, J.D.; W.K. Cary Jr.; C.S. Scotto; R. Pierson; M. Spence; A.J. Campillo, Naval Research Lab., Washington, DC. Field Analytical Chemistry & Technology, Vol 5 No 4, p 205-212, 2001 ** Special

Issue: Papers from ICFAC III Rapid Field Detection and Identification of Biological Agents **

This report describes procedures and results of recent outdoor tests in evaluating a prototype single particle fluorescence analyzer (SPFA), an instrument that is being developed to simultaneously monitor ambient concentrations of both biological and nonbiological aerosols using optical techniques. Recent modifications to the SPFA are noted and discussed. During recent outdoor tests, aerosols were generated containing four different types of biological material: ova albumin, MS-2 phage, *Erwinia herbicola* vegetative cells and *Bacillus subtilis* spores. Analysis of the SPFA results indicates that a probability of detection of at least 87% was achieved for target aerosol concentrations as low as a few (1-5) particles/liter. Comparisons with different reference instruments indicate that the SPFA can achieve absolute quantitative detection efficiencies for individual biological aerosols of at least 70%, assuming appropriate alignment and threshold settings are made. During some of the outdoor tests, different nonbiological aerosols also were released that generally did not generate any significant fluorescent signals. Though official test scores have not yet been distributed, the SPFA results for each of the aerosol releases made during the test are provided. Analysis of the relative fluorescent intensities in the visible and UV spectral bands suggests that these data can be used in the future to provide an indication of the type of biological aerosol being released as well.

Biological Agent Detection and Identification by the Block II Chemical Biological Mass Spectrometer
Griest, W.H.; M.B. Wise; K.J. Hart; S.A. Lammert; C.V. Thompson; A.A. Vass, Oak Ridge National Laboratory, Oak Ridge, TN. Field Analytical Chemistry & Technology, Vol 5 No 4, p 177-184, 2001
** Special Issue: Papers from ICFAC III Rapid Field Detection and Identification of Biological Agents **

The Block II Chemical Biological Mass Spectrometer (CBMS) detects and identifies both chemical and biological warfare agents. Biodetection is based upon respirable particle collection by an opposed-jet virtual impactor, liberation of derivatized biomarkers by thermolysis-methylation and their analysis by direct-sampling ion trap mass spectrometry in the full-scan chemical ionization mode. Results from laboratory and field trials demonstrate the capability of the Block II CBMS for biodetection and identification.

Detection of Volatile Vapors Emitted from Explosives with a Handheld Ion Mobility Spectrometer
Ewing, R.G.; C.J. Miller, Idaho National Engineering and Environmental Lab., Idaho Falls, ID.
Field Analytical Chemistry & Technology, Vol 5 No 5, p 215-221, 2001

Vapor detection of plastic explosives is difficult because of the low vapor pressures of explosive components (i.e., RDX and PETN) present in the complex elastomeric matrix. To facilitate vapor detection of plastic explosives, detection agents (taggants) with higher vapor pressures can be added to bulk explosives during manufacture. This paper investigates the detection of two of these taggants, ethyleneglycol dinitrate (EGDN) and 2,3-dimethyl-2,3-dinitrobutane (DMNB), using a handheld ion mobility spectrometer. These two taggants were detected both from neat vapor sources as well as from bulk explosives. EGDN was detected from NG-dynamite as EGDN·NO3- at a reduced mobility value of 1.45 cm2 V/s, with detection limits estimated to be about 10 ppbv. DMNB was identified from tagged C-4 as both negative and positive ions with reduced mobility values of 1.33 cm2/Vs for DMNB·NO2- and 1.44 cm2/Vs for DMNB·NH4+. Positive ions for cyclohexanone were also apparent in the spectra from tagged C-4, producing three additional peaks.

A Compact Optical System for Multi-Determination of Biochemical Oxygen Demand Using Disposable Strips
Yoshida, Nobuyuki, S.J. McNiven, A. Yoshida, T. Morita (Akebono R&D Center, Ltd., Saitama, Japan); H. Nakamura and I. Karube (Univ. of Tokyo, Tokyo, Japan). Field Analytical Chemistry & Technology, Vol 5 No 5, p 222-227, 2001

A compact optical device and disposable strips for the simultaneous determination of the biochemical oxygen demand (BOD) of multiple samples is constructed using three pairs of light emitting diodes (LEDs) and silicon photodiodes (Si-PDs). The disposable strips are fabricated using inexpensive, transparent polycarbonate plates. *Pseudomonas fluorescens* bacteria were immobilized in a layer at the bottom of each reaction cell on the sensor strip using a photocrosslinkable resin (ENT-2000). Using the redox electron acceptor 2,6-dichlorophenolindophenol sodium salt as the chromophore, a linear relationship was observed between the response of the Si-PDs and the BOD value of synthetic wastewater. In spite of the sensor response decreasing to approximately half its initial value after 2 weeks, the correlation coefficients (r2) of calibration curves remained above 0.9 upon storage of the strips in 0.1 M NaCl solution at 4˚C for up to 6 weeks. This compact, transportable, and easy to operate system is suitable for rapid, on-site measurements.

On-Site Gas Chromatographic Determination of Explosives in Soils
Hewitt, A.D. and T.F. Jenkins (U.S. Army Cold Regions R&E Lab., Hanover, NH); T.A. Ranney (Science and Technology Corp., Hanover, NH). Field Analytical Chemistry & Technology, Vol 5 No 5, p 228-238, 2001

On-site determination of nitroaromatic and nitramine residues in soils was performed using a field-portable gas chromatograph (GC) equipped with a thermionic ionization detector selective for compounds with nitro functional groups. Soil samples were extracted with acetone. A 1-liter volume of the filtered extract was manually injected into the GC, allowing for the rapid determination of the suite of explosives that often coexist in explosives-contaminated soils at military training facilities and other defense-related sites. Results from examination of concentrations of several explosives by this method agreed well with results obtained with either high-performance liquid chromatography (Method 8330) or GC electron capture (Method 8095) analysis. Comparisons were performed for sample extracts and for soil subsample replicates distributed for on-site analysis during a field verification test performed under EPA's Environmental Technology Verification Program. This on-site GC method for the determination of explosives residues in soils is well suited for dynamic site characterization activities.

Small-Size Sensors for the In-Field Stripping Voltammetric Analysis of Water
Brainina, K.Z., I.V. Kubysheva, E.G. Miroshnikova, and S.I. Parshakov (Ural State Univ. of Economy, Ekaterinburg, Russia); Y.G. Maksimov and A.E. Volkonsky (All-Russian Federal Nuclear Centre of Technical Physics, Snezhinsk, Russia). Field Analytical Chemistry & Technology, Vol 5 No 6, p 260-271, 2001

Sensors based on thick-film graphite and screen-printed electrodes open up a new era in stripping voltammetry. The use of modified thick-film graphite and screen-printed electrodes can resolve the main problems of the method, i.e., toxicity of mercury and mechanical regeneration of the solid electrode surface. One problem with the stripping voltammetric method--the interference of organic compounds--cannot be solved without sample pretreatment. This paper describes new four-electrode sensors based on thick-film graphite and screen-printed carbon electrodes for analysis of natural and waste waters. The analysis is performed in three steps: sample pretreatment, accumulation of the analyte on the electrode surface, and measurement. The measuring cells have a small volume (e.g., 0.2-0.8 ml) sufficient for uniform mixing of the test solution and introduction (if required) of standard additions. A solid electrolyte can be placed in the cell. The sensors were used for determination of Cu, Pb, and Cd concentrations.

Enhanced Biosensor Performance for On-Site Field Analysis of Explosives in Water Using Solid-Phase Extraction Membranes
Charles, P.T. and B.M. Dingle (Naval Research Lab, Washington, DC); S. Van Bergen (George Mason Univ., Fairfax, VA); P.R. Gauger (Geo-Centers, Inc., Rockville, MD); C.H. Patterson Jr. and A.W. Kusterbeck (Naval Research Lab, Washington, DC). Field Analytical Chemistry & Technology, Vol 5 No 6, p 272-280, 2001

A promising biosensor developed utilizing a displacement immunoassay format has been designed to detect TNT and RDX. The fundamental principle of the biosensor relies on the specificity of the recognition element (e.g., antibody) to recognize and bind the explosive molecule, with subsequent release and fluorescence signal response by a cyanine-5 labeled reporter complex. In recent analytical tests performed on environmental samples, erroneous signal responses and inaccurate quantitative measurements were obtained with the biosensor due to interference components present in the environmental matrices. The authors investigated the use of solid-phase extraction (SPE) membranes for their efficiency to extract TNT and RDX in water samples to improve quantitative measurements conducted with the biosensor. Three SPE membranes were evaluated: (1) styrenedivinylbenzene-extra clean (SDB-XC) copolymer, (2) styrenedivinylbenzene-reverse phase sulfonated (SDB-RPS) copolymer, and (3) C-18 octadecyl bonded silica (C18).

On-Site Analysis of World War II Cylinders and Barrels with Unknown Contents
Davoli, E., L. Cappellini, and R. Fanelli (Mario Negri Pharmacological Research Inst., Milano, Italy); M. Bonsignore and M. Gavinelli (Ambiente S.p.A., Milanese, Italy). Field Analytical Chemistry & Technology, Vol 5 No 6, p 313-319, 2001

Some barrels and one cylinder, contents unknown, were found underground. They were suspected to contain chemical warfare agents, but neither the class of compounds nor their physical state (solid, liquid, or gas) was known. The condition of the containers did not allow transport to a laboratory. A direct sampling system was installed on site to minimize sample handling risks. A small commercial bench-top quadrupole was adapted to sample the gas phase directly, possibly at high pressure. Mass spectrometry was employed to analyze the vapors inside the barrels. The system allowed the operators to open the barrels and the cylinder and to analyze and dispose of the contents safely on site. Mass spectra indicated that most of the containers were empty, a few contained water and hydrocarbons, and one had phosgene gas.

A Forensic Approach to Evaluation of Co-mingled Aircraft Deicing Fluids and Jet Fuel
Cherry, E.M. (Hull & Associates, Inc., Dublin, OH); H. Pruess (Cleveland Hopkins International Airport); L. Snider (Hull & Associates, Inc.); K.C. Valentine (CHMM, Parsons Corp.).
The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst.
Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Soil, water, and air samples were collected from areas at a municipal airport potentially affected by deicing fluids and releases of jet fuel, with subsequent analysis for VOCs, SVOCs, ammonia, aldehydes, glycols, and sulfur compounds. Analyses were conducted using USEPA or ASTM methods with tentatively identified compounds. A total of 164 different compounds were detected in one or more of the sample media. Chemical constituents from the source materials tended to be present in relatively low concentrations; however, a wide range of daughter products were detected. A comparison of chemical concentrations to promulgated standards or risk-based target concentrations suggests that the greater proportion of allocation of risk is due to non-target list daughter compounds relative to the parent compounds evaluated by the standard target list approach. The forensic evaluation of the distribution of constituents can be used to estimate the relative contribution of various parent products to the final mixture of chemicals identified in impacted areas.

Surface Water Sheen Source Investigation at a Petroleum Product Terminal
Sueker, J.K. (Blasland, Bouck & Lee, Inc., Denver, CO); C. Koll; R. Countway; P. Hughes; P.L. Kasbohm; H. Costa; B. McCune. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

An investigation was undertaken to identify the source of a sheen emanating at low tide from a petroleum product terminal bulkhead into a tidally-influenced river. Molecular and isotopic composition analyses and fuel fluorescence detection (FFD) soil screening were applied to develop a contaminant forensic profile. Product samples were collected from a monitoring well approximately 200 feet upgradient from the bulkhead and an oil-water separator located further inland. These NAPL samples appeared to be a mixture of gasoline and middle distillate hydrocarbons such as diesel/fuel oil #2. C8 to C23 carbon ranges were identified for petroleum hydrocarbons in the soils. Sheen samples collected from the river during low tide featured an unresolved complex mixture in the C15 to C28 range. Although this carbon range overlapped with that of the NAPL samples, the absence of lighter hydrocarbons in the sheen and the absence of heavier hydrocarbons in the soils suggested that upgradient NAPL and residual petroleum hydrocarbons in sampled soils are not sheen sources. Compound-specific carbon isotopic analyses of select NAPL, soil, and sheen samples are currently underway to provide further characterization of potential source materials and sheen.

Forensic Electronic File Review
Blye, D.R. (CEAC, Environmental Standards, Inc., Valley Forge, PA); R.J. Vitale; R.L. Forman. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Some data users assume that laboratory-reported results are absolute, accurate, and reliable. This assumption has proven time and time again to be a costly mistake. Though data validation can determine if an analysis conforms to client, method, and regulatory agency specification and contains results usable for their intended purpose, data validation is dependent upon the hard copy data package provided. Labs use software to process electronic data output from instrumentation and to prepare hard copy data packages. If a lab has manipulated its electronic data files so that the data conform to specifications prior to the lab's preparation of the hard copy data package for data validation, the data validator would have no way of knowing that electronic data manipulation had occurred. A forensic electronic file review allows the auditor to assess issues such as the integrity of manual integrations, qualitative identification, accuracy of results, and presence and identification of non-target compounds. Using the same type of software that the lab uses allows data reviewers to take the original organic electronic data files, reprocess them, and compare the lab's final result records to the reprocessed results. An independent reviewer can determine if the electronic data files have been manipulated or altered. This paper presents examples of how examination of organic electronic data files can benefit data review.

Distinguishing PAH Background and MGP Residues in a Freshwater Creek
Costa, H.J. (Blasland, Bouck & Lee, Inc., New Bedford, MA); K.A. White; J.J. Ruspantini. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Due to the proximity of many former manufactured gas plant (MGP) sites to streams, delineating the extent of polycyclic aromatic hydrocarbons (PAHs) in sediments is a common component of many MGP remedial investigations. It is often difficult to accurately determine the local PAH background in sediments in aquatic systems near these sites because of the compositional similarity of weathered or degraded MGP residues to background PAHs. In the context of a remedial investigation, uncontrolled background sources constitute a potential for post-remedial recontamination, limiting the feasibility of some remedial options. The authors present a case study in which relatively simple interpretative techniques were applied to PAH delineation data generated using conventional analytical methods, after which PAH fingerprinting was performed on selected samples to confirm source identifications and refine the conceptual site model.

Diamondoid Hydrocarbons: Application in the Chemical Fingerprinting of Gas Condensate and Gasoline
Stout, S.A; E.M. Healey; G.S. Douglas, Battelle Memorial Inst., Duxbury, MA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Diamondoids are a class of saturated hydrocarbons that consist of three or more fused cyclohexane rings, which results in a 'cage-like' structure. The diamondoids that can be found in light petroleum liquids (e.g., natural gas condensates), intermediate petroleum distillates (e.g., naphthas), and finished petroleum products (e.g., automotive gasoline) include adamantane and diamantane and their various substituted equivalents. These naturally occurring compounds are thermodynamically stable and extremely resistant to weathering, which means their distribution and relative abundance in environmental samples can be useful in the chemical fingerprinting of light petroleum and gasoline. The authors discuss and demonstrate the chromatographic and mass spectral characteristics of diamondoids in various petroleum products.

Bioindicators: Essential Tools for Realistic Site Assessment and Remediation Cost Control
Zillioux, E.J. (Florida Power & Light Co., Juno Beach, FL); J.R. Newman (Pandion Systems, Gainesville, FL). The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Contamination Assessment Reports (CARs) typically are developed from the results of sampling and chemical analysis of soil, ground water, surface water, sediments, and/or free product, accompanied by an evaluation of the spatial extent of contamination and model predictions of potential temporal changes from the current condition. Rarely considered are the bioaccessibility or bioavailability of contaminants of concern, which must affect the accuracy of human or ecological risk characterization. Sampling physical factors alone generally assumes continuous exposure. Though adverse effects due to synergistic interactions of multiple stressors can be missed (false negatives), more often the common practice of comparing discrete physical parameters to regulatory "bright lines" leads to the overprediction of site hazards (false positives).

EPA-STAR Grants for Research on Environmental Bioindicators

Lasat, M.M., U.S EPA, Washington, DC. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

EPA is seeking effective and cost-efficient techniques to assess the impact of environmental stressors on the human health and the ecosystem, and to monitor the effect of remedial activities. The use of biosensors emerges as a powerful new approach for environmental monitoring. In addition to an internal research and development program, EPA supports the advancement of biosensor-related science and technology through Science To Achieve Results (STAR), a competitive extramural research grants program. Through the STAR program, EPA is funding research on the application of biosensors for the assessment of exposure and toxicity in humans and ecosystem, and for the monitoring of remediation progress. The presentation focuses on the development of biosensors for site characterization and monitoring, biomarkers for the assessment of exposure and toxicity, and ecological indicators. This paper describes STAR research results and EPA research priorities in this emerging area.

Ultra-Fast Field Gas Chromatography for Site Characterization and Field Monitoring

Marando, M.A., GEI Consultants, Inc., Winchester, MA; mmarando@geiconsultants.com. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

The zNose™ Model 4200 analyzer manufactured by Electronic Sensor Technology of Newbury Park, CA, is a field gas chromatograph (GC) capable of analyzing VOCs and SVOCs to part-per-billion (ppb) levels in less than two minutes. The analyzer and has a surface acoustic wave (SAW) detector that can detect and quantify the mass of VOC and SVOC compounds to picogram (10-12 gram) levels. The zNose™ can be used to perform rapid soil gas surveys to delineate the extent of contamination at a site, to test the effectiveness of remedial technologies in the field, and to reduce the need for off-site analysis. It also has the capability to produce VaporPrints™, a visual representation of the constituents in the sample that allows for identification of complex mixtures of chemicals, such as diesel and gasoline, to assist in environmental forensics.

A Comparison of Commonly Used Cyanide Analytical Methodologies for MGP Site Applications

Occhialini, J.F., J.C. Todaro, J. Clements, & E. Dayne (Alpha Analytical Labs, Westborough, MA); M. Rostkowski (Global Environmental Strategies, LLC); W.R. Swanson & T. Burke (Camp Dresser &

McKee Inc.).
The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst.
Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Two ground-water samples collected from a manufactured gas plant (MGP) site were analyzed in triplicate using a series of cyanide analytical methodologies and compared against a laboratory reference sample. The ground-water samples were representative of site conditions and contained differing concentrations of total cyanide. The reference sample was prepared by adding a known concentration of potassium cyanide and ferric ferrocyanide to laboratory reagent water. The two samples and the reference sample were analyzed in triplicate for total cyanide, cyanide amenable to chlorination, weak acid dissociable cyanide, physiologically available cyanide, and free cyanide. The results, observations, and interpretations are presented with emphasis on the usefulness of the data to MGP site investigations.

Passive Diffusion Sampling for Metals
Tunks, John and J. Hicks (Parsons, Denver, CO); R. Vazquez (AFCEE/ERT, Brooks City-Base, TX)
The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst.
Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

This paper presents the results of a field-scale demonstration using passive diffusion samplers (PDSs) for inorganics at Grissom Air Reserve Base, IN. Details include a general description of the work performed, a summary of how PDS and conventional results compared, and a comparative cost analysis of the two sampling approaches.

Innovative Continuous On-Line Monitoring of Mercury and Arsenic
Gurleyuk, H., C. Hensman, & P. Kilner (Frontier Geosciences, Seattle, WA); W.T. Dietze (TraceDetect, Seattle, WA). The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Frontier Geosciences has developed an innovative continuous mercury monitoring system with online sample preparation involving chemical, thermal, and UV digestion and detection achieved by cold vapour atomic florescence spectrometry (CV-AFS). Run using either EPA method 1631 or 245.7 to achieve a detection range of sub-ppt to 100 ppb levels, the system is capable of measuring mercury concentration at 5-minute intervals, which can be increased as needed. It can run matrices ranging from drinking water to petroleum hydrocarbon, and organic-rich process water from a natural gas plant. The online monitoring instrument for arsenic incorporates a similar sample treatment system with a different chemistry suitable for As. Sub-ppb detection limits are achieved using Anodic Stripping Voltammetry with the patented NanoBand Electrodes in a novel flowcell. This paper presents details of the method and the results of field studies.

Arsenic in Soil and CCA Treated Wood by Field Portable X-Ray Fluorescence
Mercuro, David, Debbie Schatzlein, and Volker Thomsen, NITON LLC, Billerica, MA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003,

Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

X-ray Fluorescence (XRF) has been a widely accepted means of analyzing the preservative content of wood by treatment plants for many years. Chromated copper arsenate (CCA) is the most widely used wood preservative for decks, playgrounds, and exterior housing structures, and its analysis in wood is straightforward by XRF. Monitoring data have shown that field-portable XRF (FPXRF) has the ability to analyze low levels (ppm) of arsenic in soil very well. It can be used to monitor proper treatment of wood, sort treated and untreated wood at a construction and demolition landfill, and screen for arsenic leaching in soil.

Does Low-Flow Sampling Produce Representative Groundwater Samples?
Doherty, James D., Pennoni Associates, Inc., Hopkinton MA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Low-flow sampling can produce sample results that are significantly different than values obtained with bailer-collected samples, which are more representative of average concentrations along the well screen. EPA has demonstrated that the results of low-flow sampling can produce ground-water contaminant concentrations that vary by over a factor of 10, depending on where the sample is collected within a screened interval. The variability in sample results introduced by using low-flow sampling methods must be accounted for when interpreting the sample results.

Passive Vapor Diffusion Sampling for Volatile Organic Compounds in a Bayou
Dragoo, Tom, J. Hicks, J. Tunks (Parsons, Denver, CO); R. Vazquea (AFCEE/ERT, Brooks City-Base, TX); Joy Lozano (Booz, Allen & Hamilton, San Antonio, TX). The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

At the former England Air Force Base in Louisiana, polyethylene-membrane passive vapor diffusion samplers (PVDSs) were buried in the bottom sediment of a bayou to assess whether ground water contaminated with chlorinated aliphatic hydrocarbons was discharging to the bayou. A horizontal contaminant profile was developed by analyzing the resulting vapor samples for VOCs. Details of this project include a cost analysis and insights gained into ground-water/surface water interactions at the study site.

Use of Innovative Packer Sampling and Geophysical Techniques for Groundwater and Bedrock Characterization
Huddleston, Roger E. (CH2M HILL, Chicago, IL); Dakon Brodmerkel (CH2M HILL, Philadelphia, PA); Andrew Judd (CH2M HILL, Parsippany, NJ). The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

At a former chemical company site in Paterson, NJ, the fractured bedrock aquifer site was characterized in 2002 using traditional rock coring and logging techniques, as well as more innovative packer sampling and geophysical tools. Ground-water samples were collected at approximately 20-foot intervals from 100 to 400 feet bgs using a custom-built triple-packer and transducer assembly. The top and bottom packers of the packer assembly inflated simultaneously, while the middle packer could be independently inflated. By initially inflating the top and bottom packers, evacuating water from the sealed zone, inflating the middle packer, then initiating ground-water purging and sampling from the zone between the middle and bottom packers, the effects of leakage around the packers due to the high hydraulic head at depth was reduced, with resultingly greater confidence in ground-water quality results. Geologic formation characteristics were logged using natural gamma, fluid temperature, fluid resistivity, heat pulse flow meter (for vertical borehole flow measurements), high resolution acoustic televiewer, and optical televiewer tools. A Model 40 GeoFlow horizontal heat pulse flow meter was used to characterize horizontal gradient flow directions. Results were used to select additional well locations and depths, which subsequently verified the gradient data indicated by the geophysical techniques.

Increasing the Accuracy of LNAPL Volume Determinations in the Subsurface
Kirkman, Andrew J., The RETEC Group, Inc., St. Paul, MN. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

LNAPL observed in the subsurface is frequently thought of as a entirely separate fluid layer, detached from the groundwater. A conceptual model with a shape like a pancake is often thought of where there is some saturation that is constant over the thickness of LNAPL measured in the well (bo); however, the average LNAPL saturation occurs far below 100%. In the absence of significant smearing, LNAPL often starts at low saturations of 5 to 28% at the oil/water interface, then peaking at 30 to 50% at the oil/air interface and declining back to a residual oil saturation again of 5 to 28%. Below the oil/air interface, total fluids are close to 100%, though some air might be trapped below. Analyzing representative core plugs for capillary pressure yields the actual oil saturation profile in the subsurface and a more realistic original-oil-in-place (OOIP) value can be obtained. Three cross sections of monitoring wells in the subsurface are presented to illustrate the actual distribution of an LNAPL in the modeled subsurface.

Increased Accuracy of Site Assessment using Passive Soil Gas Technology
Whetzel, James E., W. L. Gore and Associates, Inc., Elkton, MD. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

An alternate contamination assessment approach relies on the analysis of organic compounds in the vapor phase using passive soil gas technology. A passive soil gas survey allows a denser profiling of a site, resulting in a more accurate site characterization. A comprehensive soil gas survey can shift subsequent matrix sampling programs from assessment to confirmation. This poster presentation illustrates this innovative and cost-effective approach with case studies.

Dust Buckets and Passive Samplers: Simple Nuisance Dust Collection Methods to Address Complex Problems

Schlaegle, Steven; April Snyder; David Williams; Stephen Kennedy, RJ Lee Group, Inc., Monroeville, PA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Collection of fine airborne particulate is difficult and requires rather sophisticated sampling equipment. A dustfall collection monitor (i.e., dust bucket) and a passive sampler of glue-covered acetate paper can be deployed to collect continuous and/or event depositions. Gravimetric analysis of these samples can be used as a first analytical step that indicates temporal trends, or it can be combined with meteorological data to indicate the direction of potential sources. Optical analysis of the larger particulate at least may be sufficient to identify source(s). Bulk methods of XRD and/or XRF can be used to identify mineral or elemental composition. Scanning electron microscopy, either in manual or automated mode, can be used to more completely characterize the composition, size and shape of particulate further refining the ability to identify potential sources.

New Strategies for the Development of Environmental Biosensors

Laing, Lance G. and Stephen S. Koenigsberg, Regenesis, Belmont, MA and San Clemente, CA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Biosensors at their most fundamental level are small-scale binding reactions between a sensor molecule and the target analyte. ‘Bio’ refers to the fact that the sensor molecule is a DNA-protein complex that can react with the target analyte. The reaction chemistries are coupled to special detection and signaling platforms. Regenesis has completed proof-of-concept work that shows it is possible to detect inorganic species (e.g., arsenic) at very low levels with minimal interference and with an output measured in a few minutes. This presentation contains a discussion of basic binding, specific detection, and signaling interactions.

Direct Mercury Analysis of Soil, Sediments and Waste Waters using Method 7473

Mensh, Mikhail, Milestone, Inc., Monroe, CT. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Compliant with U.S. EPA Method 7473, the DMA-80 Direct Mercury Analyzer from Milestone Inc. uses thermal decomposition, gold amalgamation, and atomic absorption spectroscopy to obtain an accurate result in 5 minutes. This procedure needs no sample preparation, uses no chemicals, and generates no waste. This presentation reviews the savings in time and cost and compares it to the traditional cold vapor EPA Method 7473.

Project Play-Safe: A Survey of City of Boston Tot-Lots Using a Field-Portable XRF

Ross, Leah, D. Brabander, and R. Beattie, Environmental Studies Program, UMass-Boston, MA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst.

Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

A tot-lot is a playground with equipment suitable for children between the ages of three and five. Concentrations of arsenic, lead, and other heavy metals in Boston tot-lots were assessed with field-portable x-ray fluorescence (FP-XRF). The method allows users to prospect for “hot-spots” and analyze a large number of samples. The Niton XL700 provides detection limits appropriate to permit comparison with Massachusetts Department of Environmental Protection (MA-DEP) action levels for most of the heavy metals of interest. This survey is expected to analyze >1000 soil samples.

Monitoring Changes in Microbial Ecology during Sulfate Amendment of a BTEX-Contaminated Aquifer using Bio-Sep Traps
Sublette, K. (Univ. of Tulsa, Tulsa, OK); A. Peacock (Univ. of Tennessee, Knoxville, TN); R. Kolhatkar; D. Beckman; D. Cook; D. White; T. Mathew; C. Mehta; G. Davis. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Bio-Sep® consists of 3-4 mm diameter spherical beads engineered from a composite of 25% aramid polymer (Nomex) and 75% powdered activated carbon (PAC). The bulk density is about 0.16 g/cm3 with a porosity of 74%. Beads are surrounded by an ultrafiltration-like membrane with pores of 1-10 microns. The beads are very effective in collecting biofilms, which are believed to be more indicative of in situ microbial ecology than planktonic organisms from ground-water samples. At a site in Washington state, a gasoline-contaminated aquifer has been under remediation since 1999. A field trial is currently underway to enhance natural attenuation of hydrocarbons at the site by amending the aquifer with sulfate. Prior to initiation of the field trial, two types of Bio-Sep® traps were installed in each of five ground-water monitoring wells to predict the effect of the sulfate amendment on subsurface microbial ecology. The first trap contained non-baited Bio-Sep® beads, and the second trap held both non-baited beads and beads containing Na2SO4. The baited beads provided a source of slow-release sulfate in the trap to mimic the effect of sulfate amendment of the aquifer. The trap biofilms were analyzed after 30 days of incubation, and the biofilms from the two types of traps exhibited different community structures. Sulfate-baited traps were more likely to contain lipid anaerobic biomarkers, biomarkers for sulfate-reducing bacteria, and specifically identified anaerobes like *Geobacter* sp. The aquifer is being monitored using non-baited Bio-Sep® traps to determine whether the predicted shifts in the subsurface microbial ecology are observed as the sulfate amendment is introduced.

Identifying and Dating Creosote Releases in the Environment
Emsbo-Mattingly, Stephen; Scott Stout; Allen Uhler; Kevin McCarthy, Battelle Memorial Inst., Duxbury, MA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Distinguishing the origin of PAH from multiple sources in the environment can be difficult, because the chemical signatures of natural, point, and non-point PAH sources can be very similar. Source determination becomes an important issue when cleanup levels specify moderate to low PAH concentrations. The effects of environmental weathering and matrix interferences in environmental media often confound the signature of various proximate sources. Several emerging environmental forensic methodologies have been reviewed and tested for identifying the sources of PAH materials in the environment generated by the manufacture of treated wood, gas, coke, and tar products in the presence of urban background and atmospheric fallout. The analytical methods include measurement of copper naphthenate, pentachlorophenol, alkylated PAHs and biomarkers by GC/MS, applications of organic petrology, and selective use of compound-specific isotope ratio mass spectrometry (GC/IRMS). Interpretive techniques include chemical fingerprinting, diagnostic ratios, and organic petrography.

Speciation as an Important Tool for Environmental Scientists
Gurleyuk, Hakan, Frontier Geosciences, Seattle, WA. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

Speciation analysis is defined as the separation and quantification of different oxidation states or chemical forms of a particular element. While there are no available speciation methods for elements such as Mo, Mn, B, Se; the available methods for As and Cr either are not selective enough or do not provide sufficiently low detection limits. The most sophisticated analytical method for the determination of an element's speciation is useless if it cannot be assured that the species distribution in the sample remains unchanged between collection and analysis. Frontier Geosciences has developed methods for the speciation analysis of various elements (i.e., As, Se, Cr, Mo, Mn, B, I, and cyanides). These methods combine chromatographic separations with the detection power of ICP-MS to achieve detection limits between 1 and 10 ng/L (ppt) for most species. The presentation includes cases where these methods were used to make educated decisions for various environmental problems.

Characterization of Soot Carbon and PAH Bioavailability in Aquatic Sediments at MGP Sites
Neuhauser, E.F. (Niagara Mohawk Power Corp., Syracuse, NY); J.P. Kreitinger (The RETEC Group, Inc., Ithaca, NY); D.V. Nakles (The RETEC Group, Inc., Monroeville, PA); S.B. Hawthorne (Univ. of North Dakota, Grand Forks); F.G. Doherty (AquaTOX Research, Inc., Syracuse, NY); C.A. Menzie (Menzie Cura & Associates, Inc., Chelmsford, MA). The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

The authors hypothesize that at former gas manufacturing plants (MGPs), soot, coke, and coal particulates can dominate the speciation of PAHs in aquatic sediments, lowering the bioavailability of PAHs to aquatic life. In tests, the bioavailability of PAHs was measured by exposing the aquatic oligochaete (worm), *Lumbriculus variegatus*, in laboratory bioassays to five freshwater sediments collected from an MGP site. The measured concentration of total PAHs in worms was 80% lower in some samples than predicted using default equilibrium partitioning theory. A survey of PAH bioavailability and the carbon characteristics of sediments at multiple MGP sites is on-going and the data available from that effort will also be presented and discussed.

Molecular Characterization of Biogenic Hydrocarbons in Terrestrial Soils
Uhler, R.M.; L.G. Roberts; B. Murphy; S.A. Stout, Battelle Memorial Inst., Duxbury MA.
The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, Univ. of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst. CD-ROM, 2003

The presence of some biogenics can be confused with or attributed to anthropogenic contaminants (e.g., TPH or EPH). Avoiding such confusion is critical in remedial investigations of terrestrial soils. The molecular character of alumina-cleaned solvent extracts from (1) live deciduous leaves, (2) live herbaceous leaves, (3) dead mixed-leaf litter, and (4) soils containing these plant materials from a variety of terrestrial habitats was investigated. The alumina-cleaned extracts (combined aliphatic and aromatic hydrocarbon fractions) for 1000s of samples were analyzed by gas chromatography-flame ionization detection (GC/FID) and the extractable TPH (i.e., EPHtotal) concentrations determined according to EPA Method 8105. This paper reports the statistics for large (>1000) populations of extractable TPH data from each group of materials analyzed. The chromatographic “fingerprints” commonly contain the expected odd-carbon dominated n-alkanes in the C25 to C33 range that are attributed to terrestrial plant leaf waxes; however, many other biogenics hydrocarbons also were recognized. Analysis by gas chromatography/mass spectrometry (GC/MS) operated in the full scan mode for molecular characterization of the biogenics hydrocarbons revealed a variety of iso- and anteiso-alkanes, unsaturated aliphatic hydrocarbons and aromatic hydrocarbons with sesqui- and triterpene skeletons.

Abandoned Mine Lands Preliminary Assessment Handbook
California Environmental Protection Agency, Department of Toxic Substances Control. May 1998 (Revised June 2001)

A 2-page fact sheet about the handbook is available at the URL shown below. It explains how to obtain a copy of the handbook from the California DTSC. Part I contains general, nontechnical information outlining the purpose and limitations of the text, an overview of the mineral industry, and discussion of physical and chemical hazards that can be encountered on AML sites. Part II provides general technical information on conducting an AML investigation, sample collection and analysis methods, human health screening procedures, and environmental screening procedures. Part III contains a suggested report format. The appendices offer detailed supplemental technical information on mineral deposits, mineral deposit interaction with the environment, typical mineral processing methods, specific sampling strategy of mine wastes, augering and trenching issues, surface water evaluations, acid generating potential, health and safety, public participation, Waste Extraction Test, Voluntary Cleanup Agreements, and a list of selected state and federal agencies.
http://www.dtsc.ca.gov/SiteCleanup/FS_SMP_MINE.pdf

Advisory – Active Soil Gas Investigations
California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) and Department of Toxic Substances Control (DTSC). 25 pp, Jan 2003

Active soil gas investigations are useful to obtain vapor phase data at sites potentially affected by volatile organic compounds (VOCs), including chlorinated and aromatic hydrocarbons. Active soil gas investigations also may be used to investigate sites potentially affected by methane and hydrogen sulfide, and to measure fixed and biogenic gasses (e.g., oxygen, carbon dioxide, or carbon monoxide). Among other things, the data can be used to identify the source and determine the spatial distribution of VOC contamination at a site, or to estimate indoor air concentrations for risk assessment purposes.
For site characterization, the Agency encourages both soil gas and soil matrix sampling. Typically, soil gas data are more representative of actual site conditions in coarse-grained soil formations, while soil matrix data are more representative of actual site conditions in fine-grained soil formations. For evaluating the risk associated with vapor intrusion to indoor air, soil gas data are the preferred contaminant data set, where practicable. Flux chamber and passive sampling methods are not discussed

in this Advisory. Any sites where such sampling methods are necessary will be addressed separately. http://www.dtsc.ca.gov/PolicyAndProcedures/SiteCleanup/SMBR_ADV_activesoilgasinvst.pdf

Aircraft Monitors BPI Ammonia Leak
Koehler, Mike. Sioux City Journal, 19 Nov 2003

The EPA's Emergency Response and Removal Superfund Division and a crew from Airborne Imaging Inc. of Midlothian, TX, have used a high-tech aircraft to scan the Beef Products Inc. site in South Sioux City to monitor the release of ammonia. The survey found very small quantities of ammonia coming off the scene, definitely below any amount of concern. After an ammonia line leak was discovered at the plant, the Aero Commander 680 twin-engine aircraft arrived and began using infrared scanning equipment to determine the extent and location of the plume of ammonia resulting from the leak. One tool aboard the aircraft to monitor the chemical plumes in the air is a high-speed infrared spectrometer. Through the use of computers, the device measures the infrared energy from a gas. Analysts can look at that energy on a computer screen and make chemical determinations. The second device is an infrared line scanner. As the aircraft moves forward, it scans the ground in narrow lines and combines them into an image. These images of the heat signature of the ground can then be interpreted much like a photograph. Airborne chemical plumes can be mapped and nearby population centers alerted for possible evacuation. The aircraft can drop a laptop computer in a hard case by parachute to emergency response personnel on the ground. The aircraft that visited Siouxland is the only deployed aircraft of its type. The federal government is providing assistance to states, counties and local governments. In times of terror threats of chemical weapons, the plane is a tool that could someday be deployed around the country. Airborne Imaging Inc. also has responded to the California wildfires and mobilized in Louisiana during the space shuttle Columbia disaster to monitor chemical plumes after the explosion.

AOTF Raman Spectrometer for Remote Detection of Explosives
Gupta, N.; R. Dahmani, Army Research Lab, Adelphi, MD. Spectrochimica Acta A: Molecular Biomolecular Spectroscopy, Vol 56A No 8, p 1453-1456, Jul 2000

A spectrometer based on acousto-optic tunable filters has been developed for use in measuring Raman spectra as part of a detection system. The low-cost, reliable, field-portable system is coupled with a fiber optic bundle to carry the excitation laser light to the sample and to collect the Raman scattered light. Spectra of the explosives TNT, RDX, HMX, and nitroguanidine (NQ) were obtained in very short times and agree well with those taken with conventional Fourier transform Raman spectrometers. Spectra of mixed explosives show no overlap of their characteristic Raman bands.

Application of UV Raman Scattering to Non-Traditional Stand-Off Chemical Detection
Arthur J. Sedlacek, III§ and Ming Wu, Brookhaven National Lab., Upton, NY.
Report No: BNL-69387, 44 pp, Aug 2002 [Submitted for publication in Trends in Applied Spectroscopy]

The current generation of chemical sensors available to Haz/Mat professionals and First Responders (police and firemen) require either sample acquisition (followed by sample preparation) or bringing the detector/sensor in close proximity to the unknown spill prior to knowing the identity of the substance in question. In response to this problem, the authors have reviewed and evaluated the efficacy of short-range Raman lidar (light detection and ranging) towards the detection and identification of

ground contamination and liquid chemical spills. The paper contains a historical summary of the Raman lidar technique and an introduction of Raman spectroscopy. Raman spectra of CCl4 and C2Cl4 are presented to illustrate pre-resonance and resonance effects. Examples of two Raman lidar sensor platforms deployed for Haz/Mat responders are detailed with the data acquisition techniques and experimental results.
http://www.ecd.bnl.gov/pubs/BNL69387.pdf

Assessing Aquatic Ecosystems Using Pore Waters and Sediment Chemistry
Burton, G. Allen Jr., Wright State Univ., Dayton, OH.
Aquatic Effects Technology Evaluation (AETE) Program, Natural Resources Canada, CANMET, Ottowa, 119 pp, Dec 1998

Pore (or interstitial) water toxicity and sediment chemistry are important components of assessments to determine the bioavailability of contaminants in waterways receiving mining discharges. This technical evaluation provides an extensive review of the literature concerning the methods and approaches used in pore water toxicity and sediment chemistry evaluations, with subsequent recommendations. Depositional sediments usually are the primary sediments of concern as they are generally the sites of highest contamination. Predicting what fraction of the total metal concentration is bioavailable is a challenge, since metals complex to varying degrees with so many different entities and their toxicity rapidly changes with speciation and complexation; however, bioavailability can be determined and sound conclusions derived if proper methods and quality assurance protocols are used. This technical evaluation resulted in the following conclusions: 1) pore water toxicity testing provides a useful supplement to whole sediment testing; 2) pore water metal concentrations may be the best sediment chemistry indicator of bioavailability; 3) pore water toxicity testing must be done using carefully controlled collection, extraction, and testing conditions to ensure reliable results; 4) in situ peeper collection of pore waters is the most accurate method, reducing sampling artifacts for chemical analysis and toxicity tests that can be conducted with small sample volumes; 5) in situ sample collection and/or testing is preferable to laboratory extraction and/or testing; 6) efforts must be made to reduce sampling related artifacts, such as oxidation and mixing of vertical gradients; 7) toxicity testing should commence as soon as possible following extraction; 8) Centrifugation (10,000 x g, 30 min., 40 degrees C) without filtration is the preferred pore water extraction method if in situ collection methods are not feasible; 9) total metal concentrations in sediments are most reliable in situations where gross contamination exists; 10) easily extractable fractions might be useful on a site-specific basis but are still considered to be in the realm of research; 11) the AVS/SEM approach shows promise with some metals in anaerobic sediments, such as Cd and Ni; 12) Dissolved organic C is likely a primary control factor for Cu availability; and 13) an integrated assessment approach is most accurate, combining toxicity testing, biological community characterization, habitat characterization, and physicochemical characterization in a tiered testing approach.
http://www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/reports/322afin.pdf

ASTM WK2791: Standard Test Method for Determination of Metal Cyanide Complexes in Wastewater, Surface Water, Groundwater and Drinking Water using Anion Exchange Chromatography with UV Detection [Draft under development by ASTM Subcommittee D19.05]. ASTM International, 2003

This test method under development covers the determination of the metal cyanide complexes of iron, cobalt, silver, gold, copper, and nickel in ground water, surface water, drinking water, and wastewater by anion exchange chromatography and UV detection. The use of alkaline sample preservation conditions ensures that all metal cyanide complexes are solubilized and recovered in the analysis.

Case Study of the Environmental Signature of a Recently Abandoned, Carbonate-Hosted Replacement Deposit: The Clayton Mine, Idaho
Hammarstrom, J.M.; R.G. Eppinger; B.S. Van Gosen; P.H. Briggs; A.L. Meier.
U.S. Geological Survey Open-File Report 02-010, 44 pp, 2002

Data presented in this report, along with data collected by EPA and BLM in developing a site mitigation plan, provide baseline data on the post-mining, pre-reclamation environmental signature of a carbonate-hosted polymetallic base-metal replacement deposit mined in modern times. These types of deposits are significant sources of lead, zinc, and silver. Waters associated with such replacement deposits tend to be nearly neutral and contain relatively low concentrations of base metals compared to waters associated with many other types of mineral deposits. Erosion of solid mine wastes and mill tailings associated with carbonate-hosted polymetallic base metal replacement deposits can contribute sediment and airborne particles that affect aquatic and terrestrial ecosystems negatively and pose potential human health threats.
http://pubs.usgs.gov/of/of02-010/of02-010.pdf

Characterization and Monitoring of Agricultural Contaminant Transport Using Ground Penetrating Radar and Electrical Data
Senechal, P. (Univ.of Pau (UPPA), Pau, France); H. Perroud; D. Rousset; J.-B. Daban; M. Kedziorek.
Geophysical Research Abstracts, Vol 5, #05392, 2003

A combination of multi-offset Ground Penetrating Radar (GPR) and electrical surveys were used in a corn field to characterize the physico-chemical properties of soil, in particular those concerning lithology variations, water content, porosity, and water ionic conductivity in agricultural zones. The investigations were completed by independent chemical analyses of soil and water, rain fall, and fertilizer application data. The study monitored the variations of water content and water ionic conductivity in the corn field over a 12-month period, including seasonal variations. GPR and electrical data have been complemented by a seismic reflection profile. Velocity analysis of multioffset GPR data were used to estimate lateral and vertical ground-water fluctuations, and the combination of radar velocities and electrical conductivities permit to deduce the water ionic conductivity variations. The paper presents the GPR, electrical and seismic data, water content, and water ionic conductivity obtained for each data set and a comparison of these results with the chemical analyses. This study demonstrates the potential of non-destructive geophysical methods for providing information on hydric and solute transfer in the ground and monitoring soil contamination.

Characterization and Quantification of Geochemical Reaction Rates in Mine Waste Piles Using Unsaturated Zone Gases
Birkham, T. (Univ. of Saskatchewan, Canada); J. Hendry; R. Kirkland; S. Bradley; C. Mendoza; L. Wassenaar. Geophysical Research Abstracts, Vol. 5, Poster No 00607, 2003

From 1997 to the present, 240 gas probes have been installed at a maximum depth of 43 m in unsaturated waste rock, overburden, and tailings piles at a uranium mine in northern Saskatchewan and an oil sands mine in northern Alberta. Depth profiles of pore-gas concentrations, temperature, and moisture content were measured in the field and used to characterize and quantify in situ geochemical reaction rates. An innovative field-portable GC system has been developed to monitor pore-gas concentrations. At most sites, gas migration has been attributed to diffusion. At sites where advective transport might be important, subsurface total pressure measurements have been used to assess the contribution of advection to gas migration. At the uranium mine, gas modeling depth profiles were used to identify an alternative mechanism of O2 consumption and CO2 production in mine waste-rock piles. At the oil sands mine, a complex and unique system involving O2, CO2, and CH4 fluxes in the unsaturated zone and across the capillary fringe is being modeled.

Chromatography of Natural, Treated and Waste Waters
Crompton, T.R.
Spon Press, London. ISBN: 0415280044, 520 pp, 2003

This is the first book to bring together information of a range of chromatographic techniques in all types of water, from precipitation to sewage effluents. Organic and inorganic compounds, cations, anions, and elements are discussed. Particular attention is paid to multi-compound analysis of water and the analysis of minute traces of pollutants. Gas chromatography, high performance liquid chromatography, and mass spectrometry are included, with extensive references.

Commercial Biosensors: Applications to Clinical, Bioprocess, and Environmental Samples
Ramsay, Graham (ed.).
Wiley, New York. ISBN: 047158505X. 304 pp, 1998

The book is divided into three sections. The first is devoted to applications of biosensors to clinical samples, such as how biosensors are being used for in-home diabetes monitoring, point-of-care diagnostics, noninvasive sensing, and biomedical research. The second section deals with applications of biosensors in bioprocess control, e.g., measuring glucose, sucrose, glutamate, or choline concentrations during food and beverage production and measuring ethanol concentration during beer fermentation. In the final section, contributors discuss the use of biological oxygen demand (BOD) biosensors for monitoring environmental samples.

Comparative Study of Modern Extraction Techniques for the Determination of Environmental Samples (M14)
Gfrerer, M.; E. Lankmayr, Graz Univ. of Technology, Graz, Austria.
TRISP 2002: Trends in sample preparation 2002, Seggau (Austria), 30 June - 3 July 2002.
Paper No: INIS-AT--0038, p 25, 2002 [OSTI: DE20349102]

The aim of any extraction method in analytical chemistry is to effectively separate the analytes from the matrix. The whole step should be fast and quantitative with minimal solvent and time required. The classical Soxhlet extraction usually requires large volumes (up to 200 ml) of solvent to be refluxed through the solid samples for several hours. Therefore, in the last few decades, alternatives for this extraction method have been presented and investigated by ultrasonic extraction (UE), supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), microwave-assisted extraction (MAE), and fluidized-bed extraction (FBE). The actual choice for analytical application is frequently dictated by the initial capital cost, operating costs, simplicity of operation, amount of organic solvent required, and sample throughput. Since sample preparation is a critical step in the analytical cycle, special care has to be taken for an accurate choice and optimization of extraction techniques and cleanup procedures. MAE and FBE were investigated for their influential extraction parameters, and these parameters were optimized for the extraction of organochlorine biocides, PCBs, and PAHs from environmental matrices like soil, sediment, and sewage sludge. The extraction yields were compared with those obtained by Soxhlet extraction performed following DIN-methods. The optimized modern methods were validated by systematic experiments with certified reference materials.

Complex Electrical Resistivity for Monitoring DNAPL Contamination
Brown, Stephen R. (New England Research, White River Junction, VT); David Lesmes, John Fourkas, and Jason R. Sorenson (Boston College, Chestnut Hill, MA).
U.S. DOE, Office of Scientific and Technical Information. 31 pp, Sep 2003

Researchers are working to bring the field measurement of complex resistivity as a means of dense non-aqueous phase liquids (DNAPL) characterization from the conceptual stage to practice. A specially designed laboratory system includes a sample holder, electrodes, electronics, and data analysis software to measure the complex electrical resistivity properties of soil contaminated with organic solvents and document the capabilities and reliability of this technique. The work has been able to reproduce some key complex resistivity effects quoted in the literature. After numerous attempts to reproduce the seminal results of Olhoeft and Sadowski on the complex resistivity response of toluene-contaminated clay-rich samples, similar responses were obtained for plain clays with brine, but the addition of toluene did not produce the effects previously claimed. The scientists could produce effects of similar magnitude only if they intentionally introduced a large artificial dielectric heterogeneity in the specimen. Laboratory studies were performed to test the sensitivity of the complex resistivity method to toluene and methanol contamination in sands, clays, and rocks, and 4-wire IP inversion measurements in a two-dimensional laboratory 'ant farm' tested the ability of the technique to image materials with both conductivity and dielectric heterogeneities. This work indicates a low sensitivity of the complex electrical resistivity method to organic contamination in rocks and soils, which reduces the short-term prospects of using complex resistivity as an effective technique to directly detect organic contamination. However, as noise suppression techniques improve and further understanding of electrical responses in soils is achieved, the potential of the complex resistivity technique should improve. Certain electrically polarizing materials, some clays for example, have responses large enough compared to sandy and silty soils to be reliably imaged through a detailed field IP survey. Quantifying soil heterogeneity (which may relate to DNAPL distribution and transport) is an immediate potential application of this technique.
http://www.osti.gov/dublincore/gpo/servlets/purl/814942-qyJaSA/native/814942.pdf

Controlled Release, Blind Tests of DNAPL Characterization Using Partitioning Tracers
Brooks M.C.; M.D. Annable (Univ. of Florida, Gainesville); P.S.C. Rao; K. Hatfield; J.W. Jawitz; W.R. Wise; A.L. Wood; C.G. Enfield. Journal of Contaminant Hydrology, Vol 59 No 3-4, p 187-210, 2002

The partitioning tracer technique for dense nonaqueous phase liquid (DNAPL) characterization was evaluated in an isolated test cell in which controlled releases of perchloroethylene (PCE) had occurred. Four partitioning tracer tests were conducted, two using an inverted, double five-spot pumping pattern, and two using vertical circulation wells. Two of the four tests were conducted prior to remedial activities, and two were conducted after. Each test was conducted as a "blind test" where researchers conducting the partitioning tracer tests had no knowledge of the volume, method of release, or resulting spatial distribution of DNAPL. Multiple partitioning tracers were used in each test, and the DNAPL volume estimates varied significantly within each test based on the different partitioning tracers. The tracers with large partitioning coefficients generally predicted a smaller volume of PCE than that expected based on the actual release volume.

A Database of LLNL Sensor Technologies
Twogood, Richard E.; Kevin C. O'Brien, Lawrence Livermore National Lab. Report No: UCRL-ID-154618, 65 pp, July 2003

This document contains the text of a database with one Vugraph or executive summary for most, though not all, of the sensor technologies listed. ACOUSTIC SENSORS: 3-D tomographic system; dynamic focusing of acoustic energy for nondestructive evaluation; and other acoustic sensors. BIOSENSORS: single-fluorescent-molecule confocal microscopy; direct detection of biological activity; broad-base biological assay using liquid-based detection arrays; multiplexed protein detection system; biobriefcase detection trains; sensor development using microdot-array fiber-optic sensors; autonomous pathogen detection system (APDS); DNA purification sensor; applications of carbon-nanotube-based atomic force microscopy. EM SENSORS: electrical resistance tomography (ERT). GAS SENSORS: hand-held gas chromatography (GC) system; portable GC-MS; and hydrocarbon sensors. NUCLEAR SENSORS: a full-volume-imaging gamma-ray detector; nanoscience and nanotechnology in nonproliferation applications. OPTICAL SENSORS: speckle reduction LIDAR using optical phase conjugation high-sensitivity, optically polarized NMR; advanced imaging catheter autonomous on-orbit proximity operations and docking system; MEMS-based sensors for vision sensing; MEMS fiber optic microaccelerometer; optochemical sensors. RF SENSORS: wireless sensor network for seismic monitoring; asset protection sensor; bunker/cave monitoring sensor network; electronic tripwire; flashlight sensor; human presense detector; perimeter sensor; portal sensor; HERMES: a bridge inspection system; ultrawideband communications; LANDMARC radar mine detection. MISC. SENSORS: smart camera system; MEMS-based fuel cells; femtoscope: time microscope using parametric temporal imaging; real-time mass-spectrometric detection and ID of biological aerosols; accelerator analysis for protein research; MEMS-based accelerometers; magnetohydrodynamic sensors.
http://www.llnl.gov/tid/lof/documents/pdf/243875.pdf

Determination of Total-Cyanide by UV Radiation-Ion Chromatographic Method
Nagashima, Shigeru; Yukio Kosaka.
Bulletin of Tokyo Metropolitan Industrial Technology Research Inst., No 2, Dec 1999

An ultraviolet (UV) radiation/ion chromatography method for the determination of total cyanide in water was studied. When a sample solution adjusted at pH of above 12 was irradiated with the UV, metal cyanide complexes in the solution decomposed, and the cyanides oxidized to cyanate, which was determined by the by ion chromatograph as cyanide. Almost all metal cyanide complexes decomposed to form cyanate with a yield above 90%, except for silver and copper cyanide complexes. The silver and copper cyanide complexes in the presence of hydrogen peroxide were decomposed with a yield of 90% by 90 minutes of UV radiation. Each metal cyanide complex in the presence of hydrogen peroxide was decomposed to form cyanate with a yield of 80-98% by 90-120 minutes of UV radiation. The application of the procedure to several wastewater sample solutions gave good results.

Determining the Toxicity Potential of Mine-Waste Piles
Smith, K.S. (U.S. Geological Survey, Denver, CO); T.R. Wildeman (Colorado School of Mines, Golden, CO); L. M. Choate; S.F. Diehl; D.L. Fey; P.L. Hageman; J.F. Ranville; R. Rojas; B.D. Smith.
U.S. Geological Survey Open-File Report 03-210

This report consists of lectures from a workshop presented by scientists from the U.S. Geological Survey, Denver, CO, and the Rocky Mountain Regional Hazardous Substance Research Center, Colorado State University, and the Colorado School of Mines. Topics include mine drainage formation and chemistry, characterization, fate and transport of contaminants, sampling, leaching tests, and acid-base accounting.
http://pubs.usgs.gov/of/2003/ofr-03-210/

Electrical Impedance Tomography at the A-014 Outfall for Detection of DNAPL
Daily, W; A. Ramirez, Lawrence Livermore National Lab., Livermore, CA.
Report No: UCRL-ID-153535, 16 pp, May 2003

Some laboratory studies (e.g., Olheoft, unpublished report 2001) have shown that the low frequency electrical properties of some soil minerals contaminated by dense non-aqueous phase liquid (DNAPL) may be sufficiently unique to make it possible to use electrical impedance tomography (EIT) to differentiate normal electrical heterogeneities of the subsurface from DNAPL contamination. The goal of this work is to determine if electrical impedance measurements of the soil and groundwater at a contaminated site can be used to detect the presence and map the distribution of DNAPL. The strategy for achieving this goal is to predict the presence and location of DNAPL from an appropriately processed data set taken at the A-014 outfall site at Savannah River Site, which is suspected of near-surface contamination, and then to compare those predictions with results of sample analysis from the same region. Complete agreement between the predictions and the sampling data will be strong (but not conclusive) evidence that DNAPL contamination alters the subsurface materials in a way that can be detected and mapped using low frequency electrical methods. A total lack of agreement will be interpreted to mean that electrical methods cannot at this time be used to locate contamination. The results will be used to make funding decisions about continuing development of EIT for DNAPL detection.
http://www.llnl.gov/tid/lof/documents/pdf/243742.pdf

Electrical Resistance Tomography to Monitor Mitigation of Metal-Toxic Acid-Leachates, Ruby Gulch Waste Rock Repository, Gilt Edge Mine Superfund Site, South Dakota USA
Heath, G.; D. Paul; R. Markiewicz; R. Versteeg; K. Wangerud. Heap Leach Closure Workshop, 25-26 March 2003, Elko, Nevada

At a cyanide heap-leach open-pit mine, 15-million cubic yards of acid-generating sulfides were dumped at the head of a steep-walled mountain valley, with 30 in/yr precipitation generating 60-gal/min ARD leachate. Remediation has reshaped the dump to a 70-acre, 3.5:1-sloped geometry, installed drainage benches and runoff diversions, and capped the repository and lined diversions with a polyethylene geomembrane and cover system. Monitoring was needed to evaluate (a) long-term geomembrane integrity, (b) diversion liner integrity and long-term effectiveness, (c) ARD (acid rock drainage) geochemistry, kinetics and pore-gas dynamics within the repository mass, and (d) ground-water interactions. Observation wells were paired with a 600-electrode resistivity survey system. Using near-surface and down-hole electrodes and automated data collection and post-processing, periodic two-

and three-dimensional resistivity images are developed to reflect current conditions and changes in moisture, temperature, geochemical components, and flow-direction analysis. Examination of total resistivity values and time variances between images allows direct observation of liner and cap integrity with precise identification and location of leaks; likewise, if runoff migrates from degraded diversion ditches into the repository zone, there is an accompanying and noticeable change in resistivity values. Used in combination with monitoring wells containing borehole resistivity electrodes (calibrated with direct sampling of dump water/moisture, temperature and pore-gas composition), the resistivity arrays allow at-depth imaging of geochemical conditions within the repository mass. The information provides early indications of progress or deficiencies in de-watering and ARD mitigation. If emerging technologies present opportunities for secondary treatment, deep resistivity images might assist in developing application methods and evaluating the effectiveness of any reagents introduced into the repository mass to further effect changes in oxidation/reduction reactions.
http://www.unr.edu/mines/mlc/agenda.htm

Environmental Monitoring of Uranium Mining Wastes Using Geophysical Techniques, Phase I: A Comparison and Evaluation of Conductivity and Resistivity Methods to Monitor Acid Mine Drainage from Uranium Waste Rock Piles and Tailings Areas
CANMET, Natural Resources Canada, Mine Environment Neutral Drainage (MEND) Program. MEND Report No MA-1, Feb 1996

Electromagnetic instrumentation from two manufacturers, Geonics Limited of Mississauga, Ontario, and Apex Parametrics of Uxbridge, Ontario, was selected to carry out conductivity surveys to detect and trace acidic leachate from the Cluff Lake sites. The equipment manufactured by Geonics and utilized for the surveys was the EM-31 and EM-34 terrain conductivity meters. The Apex Parametrics unit was the Max Min 1-8S. The Geopulse resistivity receiver, combined with a central switching unit and a multicore take-out cable, a system manufactured and marketed by Campus Geophysical Instruments Ltd., enabled the rapid measurement of resistivity profiling and sounding data under the control of a laptop computer.

Environmental Monitoring of Uranium Mining Wastes Using Geophysical Techniques, Phase II: A Comparison and Evaluation of Conductivity, Resistivity, GPR and TDEC Sounding Methods to Monitor Acid Mine Drainage from Uranium Waste Rock Piles and Tailings Areas
Koch, R.R.; M. Simpson; P. Giamou. Atomic Energy Control Board, Ottawa. NTIS: MIC-97-07362INZ [microfiche]. 123 pp, 1997

Monitoring of contaminants from uranium mine waste management facilities is primarily done by drilling test holes and installing piezometers to sample the subsurface soil and the ground water. Protocols using geophysical methods of monitoring the migration of acidic leachate from uranium mine waste rock piles and tailings facilities need to be developed. Shallow surface geophysics that include methods such as electromagnetic (EM) and DC resistivity surveys are less expensive, can locate contaminant plumes both laterally and with depth, and provide an areal "snapshot" of the site at any given time. Cluff Lake Mine, a wholly owned project of Cogema Resources Inc. of Saskatoon was selected as the research demonstration site. To study the effects of acidic mine drainage a multi-year program is envisioned. The first phase involved the testing of various off-the-shelf electromagnetic and resistivity equipment over several site locations. Additional phases are required to monitor temporal changes by carrying out repeat surveys to verify the first phase results. Other methods such as ground penetrating radar may be used to supplement the conductivity and resistivity surveys.

Environmental Technology Verification Report. Ground Water Sampling Technologies, Geoprobe Inc., Mechanical Bladder Pump, MP470
Einfeld, W.; E.N. Koglin. Report No: EPA 600-R-03-086, 58 pp, Aug 2003

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification Program (ETV) to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. At one of seven ETV verification centers, Sandia National Laboratories collaborated with personnel from the U.S. Geological Survey and Tyndall Air Force Base to conduct a verification study of ground-water sampling technologies for deployment in narrow-bore, direct-push wells at contaminated sites with potential ground-water contamination. This verification statement provides a summary of the results from a verification test of the Model MP470 Mechanical Bladder Pump manufactured by Geoprobe Systems Inc.
http://www.epa.gov/etv/pdfs/vrvs/01_vr_geoprobe_mb470.pdf

Environmental Technology Verification Report. Ground Water Sampling Technologies, Geoprobe Inc., Pneumatic Bladder Pump, GW1400 Series
Einfeld, W. (Sandia National Lab., Albuquerque, NM); E.N. Koglin (National Exposure Research Lab., Las Vegas, NV). Report No: EPA 600-R-03-085, 54 pp, Aug 2003

Sandia Labs collaborated with personnel from the U.S. Geological Survey and Tyndall Air Force Base to conduct a verification study of ground-water sampling technologies for deployment in narrow-bore, direct-push wells at contaminated sites with potential ground-water contamination. This report describes the results from a verification test of the GW1400 Series Pneumatic Bladder Pump manufactured by Geoprobe Systems Inc.
http://www.epa.gov/etv/pdfs/vrvs/01_vr_geoprobe_gw1400.pdf

Evaluation of Passive Diffusion Bag Samplers, Dialysis, Samplers, and Nylon-Screen Samplers in Selected Wells at Andersen Air Force Base, Guam, March-April 2002
Vroblesky, D.A. (U.S. Geological Survey, Columbia, SC); Manish Joshi (Earth Tech, San Antonio, TX); Jeff Morrell (EA Engineering, Science, and Technology, Inc, Yigo, Guam); J.E. Peterson (Earth Tech, Alexandria, VA). U.S. Geological Survey Water-Resources Investigation Report 03-4157, 29 pp, Sep 2003

In tests of diffusion samplers at Andersen Air Force Base, Guam, the samplers were deployed in three wells at the Main Base and two wells at Marianas Bonins (MARBO) Annex as potential ground-water monitoring alternatives. Prior to sampler deployment, the wells were tested using a borehole flowmeter to characterize vertical flow within each well. Three types of diffusion samplers were tested: passive diffusion bag (PDB) samplers, dialysis samplers, and nylon-screen samplers. The primary volatile organic compounds (VOCs) tested in ground water at Andersen Air Force Base were trichloroethene (TCE) and tetrachloroethene (PCE). In most comparisons, TCE and PCE concentrations in PDB samples closely matched concentrations in pumped samples except in wells where the pumping or ambient flow produced vertical translocation of water in a chemically stratified aquifer. In these wells, PDB samplers probably would be a viable alternative sampling method if they were placed at appropriate depths. In the remaining three test wells, the TCE or PCE concentrations obtained with the diffusion samplers closely matched the result from pumped sampling. In all of the tests, the regenerated cellulose dialysis samplers produced lower VOC concentrations than the passive diffusion bag samplers

and most of the pumped results. The source of the difference is unknown, but a possible explanation may be the biodegradation of the dialysis membrane during the 22 to 23 days of deployment. Chloride concentrations in nylon-screen samplers were compared with chloride concentrations in dialysis and pumped samples to test inorganic-solute diffusion into the samplers across a range of concentrations. The test showed that the results from nylon-screen samplers might have underestimated chloride concentrations at depths with elevated chloride concentrations. The reason for the discrepancy in this investigation is unknown, but may be related to nylon-screen mesh size, which was smaller than that used in previous investigations.
http://water.usgs.gov/pubs/wri/wri034157/

Fiber-Optic Laser Raman Spectroscopy Sensor
Zeigler, K.E.; R.J. Lascola; L.L. Tovo, Westinghouse Savannah River Company, Aiken, SC. Report No: WSRC-TR-2003-00284, 25 pp, June 2003

The Defense Programs Plant Directed Research and Development Program sponsored the optimization and interface of a fiber-optic Raman sensor as a complementary technique to mass spectrometry currently used in the Tritium Facility for measuring hydrogen isotopes. This sensor will provide real-time feedback while reducing the sample load for off-line gas analysis by the tritium mass spectrometers. The compact Raman system incorporates a 488 nanometer laser system, spectrometer, and detector with a 20-foot fiber-optic probe. The analysis of gas mixtures of protium and deuterium at various compositions and total pressures ranging from 11 to 5000 torr showed good signal-to-noise ratios at very short integration times (15 seconds). The detection limits for protium and deuterium ranged from 0.5 to 0.8%. This probe will be demonstrated in-line in the new HT TCAP (hydrogen/tritium thermal cycling absorption process) cold runs.
http://sti.srs.gov/fulltext/tr2003284/tr2003284.pdf

Field Demonstrations of Chemiresistor and Surface Acoustic Wave Microchemical Sensors at the Nevada Test Site
Ho, Clifford K., J.L. Wright, L.K. Mcgrath, E.R. Lindgren, and K.S. Rawlinson (Sandia National Labs.); C.F. Lohrstorfer (Bechtel Nevada Corp., Las Vegas). Report No: SAND2003-0799, 77 pp, Mar 2003

Two microchemical sensors, the chemiresistor sensor and the surface-acoustic-wave (SAW) sensor, were evaluated in tests at the Nevada Test Site. Both sensors rely on sorption of chemicals onto polymer films to produce a change in an electrical signal that can be recorded and calibrated, but different transduction mechanisms are involved. The primary purpose of the tests was to evaluate the feasibility of using these devices in unattended applications such as long-term monitoring of subsurface contaminants. A complete monitoring system was developed that provided real-time monitoring of the sensors via the Internet. Engineering issues such as sensor packaging, data acquisition, power requirements, and telemetry were addressed during the development and testing of the sensor systems, as well as problems with data processing, noise, and interferences from fluctuating environmental variables. Results showed that both sensors could be operated remotely and continuously for long-term monitoring applications using commercial data-acquisition systems and custom-designed packaging. Both the chemiresistor and SAW sensors experienced drift in the signal and were affected by fluctuations in temperature and humidity; however, results from the chemiresistor showed that exposure to large concentrations of contaminants (e.g., trichloroethene) overwhelmed the fluctuations caused by temperature and humidity variations. Contrary to initial theoretical predictions,

he chemiresistor sensor exhibited better stability and sensitivity than the SAW sensor for the conditions and analytes tested.
http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/2003/030799.pdf

Final Comprehensive Results Report for the Passive Diffusion Bag Sampler Demonstration
Air Force Center for Environmental Excellence Science and Engineering Division (AFCEE/ERS). 205 pp, Aug 2003

This report presents the results of a passive diffusion bag sampling (PDBS) demonstration consisting of ground-water monitoring of volatile organic compounds (VOCs) at 14 DoD installations. The objectives of the PDBS demonstration were to (1) develop vertical profiles of VOC concentrations across the screened intervals of the sampled monitoring wells, (2) assess the effectiveness of the PDBS method by statistically comparing ground-water analytical results for VOCs obtained using the current (conventional) sampling method (i.e., micropurge/sample or 3-casing-volume purge/sample) during regularly scheduled long-term monitoring (LTM) events with results obtained using the PDBS method; and (3) compare the costs of PDB and conventional sampling. A secondary objective of this demonstration was to perform monitoring network optimizations (MNOs) at nine of the 14 demonstration installations. The MNO evaluated the adequacy and appropriateness of a portion of the ground-water monitoring program at selected sites using both qualitative assessments and a geographic information system-based algorithm that performs temporal and spatial statistical analyses of monitoring well information. Based on the results of the MNO activities, recommendations were made for optimizing the groundwater monitoring program. The PDBS method relies on the natural flow of ground water through a well screen. The results obtained from this method will not always be comparable
to results obtained using conventional sampling methods, which induce ground-water flow into a well by creating a hydraulic gradient through well purging.
http://ds.itrcweb.org/Parsons_demo.pdf

Geo-Environmental Site Characterization of Soils Using In-Situ Testing Methods
Campanella, R.G., Univ. of British Columbia, Vancouver, Canada. Asian Institute of Technology 40th Year Conference, New Frontiers & Challenges, 12 pp, 1999

The author discusses the use of the Piezocone to provide detailed stratigraphic information, as well as the piezometric and hydraulic characteristics of the soil. The use of a resistivity module of external electrode rings attached to the piezocone to log and assess the ground-water quality, soil porosity, and saturation also is discussed, together with basic theory and comments. The combination of the economical and rapid BAT ground-water penetration tool with the Resistivity Piezocone to provide 'specific-depth' ground water and gas samples for chemical and biological analysis and correlation with resistivity also is explained. Field data relating to acid generation and drainage at a mining site demonstrate the use of the resistivity piezocone in combination with ground-water sampling provide screening data to locate permanent monitoring well systems or to develop remediation scenarios.
http://technology.infomine.com/hydromine/topics/WQ_Monitoring/Papers/DP.pdf

Geochemical Characterisation of Arsenic in Uranium Tailings Pore Fluids
Moldovan, B.; M.J. Hendry; P. Landine. Proceedings: Uranium 2000, International Symposium on the Process Metallurgy of Uranium, Saskatoon, 9-15 September 2000, Saskatchewan, Canada.

This paper reports on sampling and characterization efforts in the Rabbit Lake In-pit Tailings Management Facility (RLITMF). A research project dedicated to geochemical characterization of uranium tailings pore fluids has several objectives, including recovery of pore fluid samples from tailings core samples by centrifugation, hydraulic squeezing, and decantation. Chemistry of these fluids will be compared to fluids obtained from a drive point piezometer. Arsenic speciation will be performed on the pore fluids. The project also aims to characterize the amount of arsenic present as calcium arsenates, the mineralogy of these compounds, and their long-term solubility.

'Glowing' Technique Could Detect River Pollution
Univ. of Newcastle upon Tyne News Release, 8 Oct 2002

New technology used to analyze dissolved organic matter in river water could also help scientists detect and monitor pollution, according to new research by the University of Newcastle, UK. Dissolved organic matter is found in all river water and can produce natural fluorescence visible to spectrophotometers. River waters fluoresce at wavelengths that the naked eye cannot see. Researchers from Newcastle University took samples of the water in the River Ouseburn at Newcastle and found that 70% could be correctly classified to the river's tributaries by measuring the natural fluorescence in the water. Occasions when the scientists were unable to discriminate the tributary waters were due to either pollution or strong seasonal differences in dissolved organic matter. Dr. Andy Baker of the Centre for Land Use and Water Resources, Newcastle University, leads the research team using spectrophotometric techniques to fingerprint dissolved organic matter in rivers. Up until now it has not been possible to separate the dissolved organic matter fractions in river water, but the research results mean that it is now possible to use dissolved organic matter as a natural fingerprint of different water sources, and to monitor and detect organic pollutants. Contact: Dr. Andy Baker, andy.baker@ncl.ac.uk, 44-191-222-5344.

In Situ Measurements and Monitoring for Rock Wastes
Barbour, M.L. and J. Hendry, Univ. of Saskatchewan. Symposium Rouyn-Noranda 2002. Canadian Inst. of Mining, Metallurgy and Petroleum, Montreal, Quebec

Waste rock piles from metal mining operations are often comprised of large surface deposits of unsaturated, coarse grained soil and rock. The unsaturated condition and coarse grained nature of these deposits often make them difficult to monitor or characterize. Some of the key parameters that must be evaluated include volume-mass relationships (e.g. water content, air content, porosity, density, degree of saturation, grain-size), transport properties (e.g. air-permeability, gas diffusion rates, hydraulic conductivity), geochemistry (e.g. solids, gas, and fluid phases), and fluxes (e.g. soil-atmospheric fluxes). A multi-year NSERC-Industry research program has been underway at several waste rock piles in Northern Saskatchewan over the past 5 years to develop practical means of measuring and monitoring some of the parameters outlined above. This presentation briefly describes some of the techniques that have been developed or are currently under development through this research program. Some of the specific measurements and monitoring techniques to be discussed include the following: grain-size; soil suction and air pressure; water content and air-filled porosity; pore-fluid, pore-gas and solids chemistry; evaporative moisture fluxes; and gas fluxes. The methods of measurement are described, installation details are outlined, and preliminary field data are presented and discussed.

An Investigation of Environmental Contamination at the Silvermines Abandoned Mines Site in Ireland Based on the Preliminary Delimitation of Pollution Hot Spots
Aslibekian, Olga; Richard Moles, Centre for Environmental Research, Univ. of Limerick, Ireland.
Mine Water and the Environment, Vol 20 No 2, p 73-80, July 2001

This paper describes a holistic methodology for the investigation of environmental contamination from abandoned mine sites (AMSs), and is based on a case study of the Silvermines AMS. Ground-water modeling, surface water temperature monitoring, and a geographical information system (GIS) were used to undertake a preliminary delimitation of areas where soil, fluvial sediments, and surface and ground water were contaminated. Subsequent soil and water sampling and analysis confirmed the accuracy of these predictions. The methodology described here allows effective and cost-efficient investigation of the environmental impact of AMSs, which in turn provides the basis for site rehabilitation.

Laser Interrogation of Surface Agents (LISA) for Standoff Sensing of Chemical Agents
Chyba, T.H., N.S. Higdon, W.T. Armstrong, C.T. Lobb, D.A. Richter, P.L. Ponsardin, B.P. Kelly, Q. Bui, R. Babnick, and W. Marsh (ITT Industries, Albuquerque, NM); A.J. Sedlacek (Brookhaven National Lab., Upton, NY). 21st International Laser Radar Conference (ILRC), 8-12 July 2002, Quebec, Canada. Paper No: BNL-69444-AB, 5 pp, 2002

Laser Interrogation of Surface Agents (LISA) is a new technique based on short-range Raman lidar that provides standoff detection and identification of surface-deposited chemical agents. ITT Industries, Advanced Engineering and Sciences Division is developing the LISA technology under a cost-sharing arrangement with the U.S. Army Soldier and Biological Chemical Command (SBCCOM) for incorporation on the Army's future reconnaissance vehicles. This paper presents the field-engineered prototype LISA-Recon system, designed to demonstrate single-shot on-the-move measurements of chemical contaminants.
http://www.ecd.bnl.gov/pubs/BNL69444AB.pdf

Method Kelada-01: Kelada Automated Test Methods for Total Cyanide, Acid Dissociable Cyanide, and Thiocyanate, Revision 1.2
U.S. EPA, Office of Water, Washington, DC. EPA 821-B-01-009, 44 pp, Aug 2001

Kelada-01 provides for rapid determination of total cyanide, acid dissociable cyanide, and thiocyanate in drinking water, wastewater, ambient water, industrial wastes, and sludge, with minimal effects from interferences. Kelada-01 was developed by Dr. Nabih Kelada, and represents the culmination of years of cyanide chemistry research. The method uses a combined on-line ultraviolet (UV) irradiation and flash distillation system in place of classical manual cyanide distillation procedures to determine total cyanide. Under irradiation in a glass coil, strongly-bound complex cyanides (excluding thiocyanate) break down into free cyanide, which is separated from the sample matrix by distillation and is detected using a on-line colorimeter By omitting UV-irradiation, acid dissociable cyanide complexes are broken down and determined. By replacing the glass irradiation coil with a quartz coil, thiocyanate can be determined. Kelada-01 has been validated in multiple studies coordinated by the Metropolitan Water Reclamation District of Greater Chicago, the American Society for Testing and Materials (ASTM), and Environment Canada. The method was evaluated under EPA's Alternate Test Procedure (ATP) program.
http://www.lib.ucdavis.edu/govdoc/EPA/kelada.pdf

Mine Tailings Characterization by Piezometer Cone
Jones, G.A.; D. Van Zyl; E. Rust. Proceedings of the ASCE National Convention: Cone Penetration Testing and Experience, St. Louis, 303-24, American Society of Engineers (ASCE).

Piezocone test (CPTU) are cone penetration tests (CPT) with additional measurement of the pore water pressure at one or several locations on the penetrometer surface. Cone penetration testing with pore water pressure measurements gives a more reliable determination of stratification and soil type than standard CPT. In addition, CPTU gives a better basis for interpretation of the results in terms of mechanical soil properties.

Mine Water Tracing -- A Tool for Assessing Flow Paths in Flooded Underground Mines
Wolkersdorfer, Ch. (TU Bergakademie Freiberg, Freiberg/Sachsen, Germany); N. Feldtner (Technische Univ. Clausthal, Clausthal-Zellerfeld, Germany); I. Trebusak (Geolowki Zavod Slovenije, Ljubljana, Slovenia). Mine Water and the Environment, Vol 21 No 1, p 7-14, Apr 2002

This paper reports on the successful application of a tracer test developed for hydrodynamic investigations German underground mines. The objectives of the test were to investigate the kind and rate of flow within a flooded mine. At each sampling point, colored spores were injected using a Lycopodium apparatus. Beginning one day after injection, two samples were collected per weekday at each sampling point with a recovery rate of 2%.

Mini-Raman Lidar
Research note, Brookhaven National Laboratory, Brookhaven, NY.

Brookhaven National Laboratory is developing a short-range tool to screen unknown substances in the field. The mini-Raman lidar system (MRLS), an outgrowth on ongoing research in Raman lidar, can be used to look for chemicals resulting from nuclear, chemical, or biological weapons, narcotics or other illegal drug processing, and accidents involving hazardous materials on any surface (e.g., ground, buildings, clothing, vegetation). Chemicals are identified through analysis of the Raman scattering generated by laser illumination of the target area. Contact: Arthur Sedlacek, Brookhaven National Lab, 516-344-2404, sedlacek@bnl.gov.
http://crgq.com/HTML/lidarfacts.pdf

Mobile Raman Targets Chemical Spills
Photonics Technology World, Feb 2001

Researchers at Brookhaven National Laboratory have developed a mobile Raman spectroscopy system to remotely assess unknown chemical spills in emergency situations. The system uses 266-nm Raman lidar to target samples more than 1700 feet away.
http://www.photonics.com/spectra/tech/XQ/ASP/techid.1015/QX/read.htm

New Technology for Profiling Plumes from Stacks, Flares and Processing Equipment Demonstration
Alberta Research Council, Calgary, Canada. Technology Information Session, 24 June 2003

The Alberta Research Council is currently operating a research project for the PTAC Air Issues Steering Committee to assess the use of Differential Absorption LIDAR (DIAL) for several applications in the natural gas industry. Spectrasyne Ltd., UK, has commercially operated a mobile DIAL unit in Europe for measuring fugitive emissions from industrial facilities for over 15 years. DIAL is a non-intrusive technology that enables measurement of concentration profiles and mass emission rates of various gaseous species. Spectrasyne's mobile unit contains a 'duplex' DIAL system to measure 2 species or species groups simultaneously, e.g., VOCs and benzene or methane and SO2. To date, most of their work has been in the European oil industry, measuring mass emission rates of VOCs and aromatics from refineries, storage areas, terminals and other facilities. The equipment can quickly measure 2D and 3D profiles of components such as SO2 and hydrocarbons in plumes from stacks, flares, and processing facilities to quantify emissions and directly locate and quantify individual sources of emissions.

Nuclear Micro-Probe Analysis of *Arabidopsis thaliana* Leaves
Ager, F.J.; M.D. Ynsa; J.R. Dominguez-Solis; M.C. Lopez-Martin; C. Gotor; L.C. Romero, Centro Nacional de Aceleradores, Sevilla, Spain.
8th International Conference on Nuclear Microprobe Technology, 8-13 September 2002, Takasaki, Japan.
Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms, Vol 210, p 401-406, Sep 2003

Phytoremediation is a cost-effective plant-based approach for remediation of soils and waters that takes advantage of the remarkable ability of some plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues, such as toxic heavy metals and organic pollutants. *Arabidopsis thaliana* plants can be used for basic studies to improve the technology on phytoremediation. The researchers used nuclear microscopy techniques to study leaves of wild type and transgenic *A. thaliana* plants grown in a cadmium-rich environment under different conditions. Micro-PIXE, RBS, and SEM analyses, performed on the scanning proton micro-probe at the CNA in Seville (Spain), prove that cadmium is preferentially sequestered in the central region of epidermal trichome and allow comparison of the effects of genetic modifications.

Occurrence, Species Distribution and Transport Behaviour of Cyanides in the Groundwater of the "Testfeld Sued"
Kunze, N.; M. Isenbeck-Schroter, Inst. of Environmental Geochemistry, Heidelberg, Germany.
Groundwater Research, Rosbjerg et al. (eds.). Balkema, Rotterdam, ISBN: 90-5809-133-3, 2000

The behavior of typical gasworks contaminants in ground water was studied on the Testfeld Sued in order to predict long-term effects due to natural attenuation processes. In addition to a variety of organic contaminants, cyanide compounds related to former gasworks activities occur in ground water at this site. The project involved detailed studies on the occurrence, species distribution, and transport behavior of cyanides as carried out in 60 observation wells.
http://www.rzuser.uni-heidelberg.de/~od4/KUNOSD00.pdf

Optical Properties and Remote Sensing of Multicomponental Water Bodies
Arst, Helgi.
Springer, New York, in association with Praxis Pubs. ISBN: 3-540-00629-X, 2003

This book is a comprehensive study of the use of remote sensing to examine the quality of water in lakes, oceans, and coastal waters. It compares and contrasts results obtained from experiments with both clean and polluted waters, and offers various models that analyze problems connected with the thermal influence of oil on water. The text looks at the variability of optically active substances and their characteristics in turbid and polluted water; shows how to interpret signals received from a satellite by deducing the amount of glint provided by the sun on the water and therefore the degree of pollution; provides interpretation of passive optical remote sensing data for coastal and lake waters, including water bodies with very low transparency; and looks at light regimes at different depths in oceans and lakes to calculate pollution.

Photoinduced Nucleation: a Novel Tool for Detecting Molecules in Air at Ultra-Low Concentrations
Katz, Joseph L.; Heikki Lihavainen; Markus M. Rudek; Brian C. Salter.
Journal of Chemical Physics, Vol 112 No 19, p 8363-8366, 15 May 2000

Photoinduced nucleation is not in itself a nucleation process; rather, supersaturated vapor condenses onto long-lasting clusters formed by chemical reaction of photo-excited molecules. The supersaturated vapor increases the size of these photoproducts by condensation to a size readily detectable by light scattering. The measured nucleation rate variation with illumination wavelength exactly matches the substance's vapor-phase UV light absorption wavelength dependence, which provides species identification. The detection and identification of substances at concentrations as small as a few parts per trillion from ambient air is useful for detecting and monitoring pollutants and explosives such as TNT.

Plume Delineation Using Membrane Interface Probe (MIP), Savannah River Site, Aiken, South Carolina
Vangelas, K.M. Prepared for Westinghouse Savannah River Company, LLC, by Columbia Technologies, LLC, Baltimore, MD. Report No: WSRC-OS-2003-00050, 69 pp, May 2003

In a 2002 investigation of subsurface contamination at the Savannah River Site, Aiken, SC, Membrane Interface Probe (MIP) technology was used to delineate the depth and horizontal extent of contamination in the vadose and saturated zones, and Cone Penetrating Testing (CPT) technology was used to characterize soil types. A second objective was to evaluate the use of the MIP probe as a screening level tool for delineating volatile organic compound (VOC) contamination. The standard characterization screening method involves performing CPT pushes at selected locations to obtain lithology information followed by performing a second push at the same locations to obtain water samples for laboratory analysis. Identifying more efficient methods of performing screening level characterizations is important to increasing productivity while maintaining quality of data. The work involved testing a combined MIP/CPT tool to allow collection of lithology and contaminant profile data with one push at each location. Water samples for VOC analysis were collected for comparison with the MIP results to determine if the MIP tool provided a sufficient level of data quality to eliminate or minimize the amount of water sampling needed during screening level characterization activities.
http://sti.srs.gov/fulltext/os2003050/os2003050.pdf

Probe Sampling and Geophysics Applied to Ground Water Evaluation of Mine Dumps
Malen, F.; R. Wanty; J.H. Viellenave; J.V. Fontana, Colorado School of Mines, Golden, CO. Tailings

and Mine Waste '00: Proceedings of the 7th International Conference, January 2000, Fort Collins, CO. A.A. Balkema, Netherlands. ISBN: 9058091260. p 223-240, 2000

Metals migration into an alpine wetland setting prompted application of Direct Push sampling and installation of nested, multi-level piezometers to evaluate the ground-water flow path through mine dumps near the abandoned Waldorf mine near Georgetown, CO. Access to the site prohibited use of traditional large scale drill rigs, without significant road modification. A Direct Push Strataprobe(TM) was used to hydraulically advance either a push point or a core sampler to bedrock beneath the dumps, with maximum depths up to 40 feet. In several locations, nested piezometers, with thermister, were installed with short screens at multiple depths. This allowed discrete sampling of ground water and the vertical profiling of water temperature and chemistry. In addition, natural gamma logging was performed to evaluate the potential for using the tool to characterize the lithology, while minimizing the number of soil samples taken.

Proceedings of EPA's Optical Remote Sensing (ORS) Workshop, July 29-31, 2002, Research Triangle Park, NC
U.S. EPA web site, Meeting Summary and Presentations, 2002

To promote the regulatory acceptance of new measurement capabilities by state and local pollution control agencies, EPA sponsored a workshop in July 2001 that brought together experts and regulators in this field. The purpose of the workshop was to take the current state-of-the-art optical remote sensing (ORS) technologies developed for regulatory and other applications and to leverage these opportunities into (1) a variety of new applications for multi-media regulatory applications for compliance monitoring, and (2) potential applications to homeland security issues. The web site contains a brief summary of the meeting and some of the presentations have been made available in PowerPoint format. Presentation titles include ‘IR Active-Open Path for Chemical Agents and HAPs’ by R. Kagann.
http://www.epa.gov/ttn/emc/emcopticalsensingwkshp.html

Process and Balance Assessment in Lignite Mining Areas by Multi-Isotope Approach
Strauch, G. (UFZ-Center for Environmental Research, Germany); R. Trettin; K. Knoeller. International Symposium on Isotope Hydrology and Integrated Water Resources Management, 19-23 May 2003, Vienna. Book of Extended Synopses. International Atomic Energy Agency, Vienna Austria. Report No: IAEA-CN-104/P-117, p 209-210, 2003 [OSTI: DE20370060]

A multi-isotope approach with stable isotopes of various light elements can be used to examine chemical processes within aquifers, interactions between ground and surface water, quantification of the balance of water, or dissolved compounds in anthropogenic stressed landscapes. The quality of ground and surface water before and after remediation of mining areas is of particular interest to these authors. Sulfide oxidation and consequent acidification of surface and ground-water systems are common processes that result from lowering the ground-water level. Successful remediation strategies require knowledge of the chemical and physical processes and the ground-water flow dynamic obtaining in dump sites. This paper presents three examples for assessing the sulfate reduction in dump sediments, the water balance of mining lakes, and sulfate input from different sulfur sources.

Processing of Remote Sensing Data
Girard, Michel-Claude and Colette M. Girard.

A.A. Balkema, Netherlands. ISBN: 9058092321, 508 pp, 2003

The first two parts of the book deal with the data sources and their physical interpretation. The third part is devoted to the processing techniques: visual interpretation and automated classifications, textural and structural processing, photogrammetry, etc. The fourth part deals with accuracy assessment, while the fifth describes various applications concerning crops, grasslands, soils, landscapes, mines, coasts, and water bodies.

Quantifying In Situ Metal Contaminant Mobility in Marine Sediments
Hampton, T.W.; D.B. Chadwick.
SSC San Diego Technical Report 1826, 118 pp, June 2000

This report summarizes the work conducted to demonstrate and validate the use of the Benthic Flux Sampling Device (BFSD) for quantifying in situ metal contaminant mobility in marine sediments. Test and demonstration results along with analysis and interpretation are included in the report, as well as performance and cost analysis.
http://www.spawar.navy.mil/sti/publications/pubs/tr/1826/tr1826.pdf

Raman Spectroscopy of Some Complex Arsenate Minerals: Implications for Soil Remediation
Frost, Ray L.; J.T. Kloprogge, Queensland Univ. of Technology, Brisbane, Australia.
Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy, Vol 59 No 12, p 2797-2804, Oct 2003

Minerals of arsenate can form depending upon the availability of specific cations such as calcium and iron. Such minerals include carminite, pharmacosiderite, and talmessite. Each of these arsenate minerals can be identified by its characteristic Raman spectrum, enabling identification.

Sedimentary Processes: Quantification Using Radionuclides
Carroll, J.; I. Lerche.
Elsevier Science Ltd., ISBN: 0-08-044300-1, 250 pp, 2003

Radionuclide methods in geochronology have revolutionized the understanding of modern sedimentary processes in aquatic systems. This book examines the principles of the method and its use as a quantitative tool in marine geology, with emphasis on the Pb-210 method. The assumptions and consequences of models and their behavior are described, providing the necessary background to assess the advantages and trade-offs involved when choosing a particular model for application. One of the purposes of this work is to disentangle the influences of complicating factors, such as sediment flux variations, post-depositional diffusion of radionuclides, and bio-irrigation of sediments, to arrive at sediment ages and to properly assess the attendant data uncertainty. The text includes relevant examples to demonstrate how dating models are useful for determining sources of contaminants and interpreting their influence on the environment, as well as illustrating the strengths and weaknesses of a given procedure with respect to a data example. Included in an appendix is the computer source code of a new generation of modeling tools based on inverse numerical analysis techniques, along with detailed instructions and examples for its use.

Sensors for Environmental Control: Proceedings of the International Workshop on New Developments, Lecce, Italy, 27-29 May 2002
Siciliano, Pietro (ed.).
World Scientific Pub. Co. Inc., ISBN: 9812383387, 2003

This book contains updated results of both theoretical and applied research in the field of sensors and methods for environmental control, mainly with regard to the detection of pollutant species in gaseous and liquid ambience. The main arguments are related to development of new nanostructured materials as sensing layers and new detection mechanisms, development of micro- and nano-systems and their integration in miniaturized instruments, and application of innovative devices in the detection of contaminant chemical species and their monitoring. Partial contents include the following papers: Ambient Sensors (A D'Amico); Gas Monitoring Unit Realized with a Microsystem Based Approach: Recent Advancements in System Subcomponents and Architecture (S Nicoletti & L Dori); Porous Silicon Microcavities in Bio-Chemical Sensing (P Arcari et al.); Sensing Performances of LB Calyx[4]pyrrole Films in Alcohol Vapours Recognition (S Conoci et al.); Thermal Effects at the Interaction of SnO2 Chemoresistive Sensors with Reducing Gases (A Tomescu et al.); Surface Acoustic Wave Sensing in Liquids: Features, Tendencies, Perspectives (I V Anisimkin & Yu V Gulyaev); Rapid Electrochemical Sensors and Biosensors for Environmental Analysis (I Palchetti et al.); Automated Water Analyser Computer Supported System (AWACSS): An EU-Supported Consortium Developing a Convenient, Quick and Cost-Effective Water Immunosensor (D M Willard & G Gauglitz); Optimisation of an Electrochemical Dissolved Oxygen Microsensor for an Environmental Monitoring System (M E Sandison & J M Cooper); On Site Soil Screening for Volatile Pollutants with an Electronic Nose (M Harms et al.); A Modelling System for Studying the Photochemical Pollution: An Application Over a Mediterranean Area (C Mangia et al.); and Sensor Array for the Monitoring of Contaminant Gases (M Aleixandre et al.).

Short-Range, Non-Contact Detection of Surface Contamination Using Raman Lidar
Sedlacek, Arthur J. III and Mark D. Ray (Brookhaven National Lab, Upton, NY); N.S. Higdon and D.A. Richter (ITT Industries, Albuquerque, NM). Proceedings of SPIE--The International Society for Optical Engineering, Vol 4577, p 95, 2001. Paper No: BNL-69445, 11 pp, Nov 2002

A novel mini-Raman Lidar for standoff detection and identification of chemical spills combines the spectral fingerprinting of solar-blind UV Raman spectroscopy with the principles of lidar to open a new venue of short-range, non-contact detection and identification of unknown substances on surfaces. In addition to detailing experimental results collected with a 'proof-of-principle' system, the authors also discuss a next generation system currently under development.
http://www.ecd.bnl.gov/pubs/BNL69445.pdf

Spectroscopic Determination of Mercury in Streams
Madsen, Sara; Amy Williams; Mark Vogel, Truman State Univ., Kirksville, MO.
The 225th ACS National Meeting, New Orleans, LA, March 23-27, 2003.
American Chemical Society, Abstract INOR 213, 2003

Porphyrins as colorimetric dye molecules are being used to detect mercury metal (and possibly lead) in surface water streams. Meso-tetra (4-sulfonatophenyl) porphyrin is a water soluble non metallic porphyrin that should chelate mercury and lead in a 1:1 ratio in a tetradentate fashion. Metallation of the porphyrin core by mercury can be complicated due to the instability of mercury with water, so ethylenediaminetetraacetic acid has been used to accelerate and stabilize the mercury for the chelation process. Changes upon metallation of the porphyrin and quantitation of the heavy metal can be determined by electronic spectroscopy by using the porphyrinic Q-band region. Electronic spectroscopy has been used to characterize the mercury porphrin complex, and calibration curves have been completed for known amounts of mercury present in solution. Thin layer chromatography has been used to identify number and type of complexes in solution. The hypothesis is that in solution the mercury porphyrin actually exists as a mercury-porphyrin-EDTA complex. Future studies will be to provide a hands-on, field method for determining mercury levels on site.

Stand-Off Detection of Chemicals by UV Raman Spectroscopy
Wu, M.; M. Ray; H. Fung; M.W. Ruckman; D. Harder; A.J. Sedlacek III, Brookhaven National Lab.
Applied Spectroscopy, Vol 54 No 6, p 800-806, 2000

Scientists at Brookhaven National Lab are testing a mobile, stand-alone solar-blind ultraviolet (UV) Raman lidar system for the stand-off detection and identification of liquid and solid targets at ranges of hundreds of meters. The lidar is a coaxial system capable of performing range-resolved measurements of gases and aerosols, as well as solids and liquids. The transmitter is a flash lamp pumped 30 Hz Nd:YAG laser with quadrupled output at 266 nm. The receiver subsystem is comprised of a 40 cm Cassegrain telescope, a holographic UV edge filter for suppressing the elastic channel, a 0.46 m Czerny-Turner spectrometer, and a time gated intensified CCD detector. The rejection of elastic light scattering by the edge filter is better than one part in 105, while the transmittance 500 cm-1 to the red of the laser line is greater than 50%. Raman data are shown for selected solids, neat liquids, and mixtures down to the level of 1% volume ratio. The researchers estimate that a stand-off detection limit of ~500g/m2 for liquid spills of common solvents at the range of one half of a kilometer is possible.

Stand-Off Raman Spectroscopic Detection of Minerals on Planetary Surfaces
Sharma, Shiv K. (Univ. of Hawaii, HIG, Honolulu) P.G. Lucey; Manash Ghosh; H.W. Hubble; K.A. Horton. Spectrochimica Acta Part A, Vol 59, p 2391-2407, 2003

The authors have designed and developed two breadboard versions of stand-off Raman spectroscopic systems for landers based on a 5-in. Maksutov /Cassegrain telescope and a small (4-in. diameter) Newtonian telescope receiver. These systems are capable of measuring the Raman spectra of minerals located at a distance of 4.5 /66 m from the telescope. Both continuous wave (CW) Ar-ion and frequency doubled Nd:YAG (532 nm) pulsed (20 Hz) lasers are used as excitation sources for measuring remote Raman spectra of rocks and minerals. A field-portable remote pulsed Raman spectroscopic system based on the 5-in. telescope and an f /2.2 spectrograph has been developed and tested. A prototype of a combined Raman and laser-induced breakdown spectroscopy (LIBS) system capable of providing major element composition and mineralogical information on both biogenic and inorganic minerals at a distance of 10 m from the receiver has been demonstrated.
http://www.soest.hawaii.edu/lidar/raman_webpage/planetary_raman.pdf

Technical Evaluation of Fish Methods in Environmental Monitoring for the Mining Industry in Canada
EVS Environment Consultants, North Vancouver, BC, Canada.
CANMET, Natural Resources Canada, Aquatic Effects Technology Evaluation (AETE) Program, Ottawa, ON. 104 pp, Feb 1999

Canada’s Aquatic Effects Technology Evaluation (AETE) program was established to review appropriate technologies for assessing the impacts of mine effluents on the aquatic environment. AETE is a cooperative program between the Canadian mining industry, several federal government departments, and a number of provincial governments; it is coordinated by the Canada Centre for Mineral and Energy Technology (CANMET). The program was designed to be of direct benefit to industry and to government. Through technical and field evaluations, it has identified cost-effective technologies to meet environmental monitoring requirements. The program includes three main areas: acute and sublethal toxicity testing, biological monitoring in receiving waters, and water and sediment monitoring. This report reviews available methods for monitoring the effects of metal mining activities on fish in Canada. Potentially applicable monitoring tools for all levels of biological organization (chemical to community level) were initially selected by the AETE Technical Committee based on their successful use in the field and cost effectiveness. These methods are described and critically evaluated for their suitability in a monitoring program for the mining industry based on a review of the literature and several recent case studies. Detailed reviews are provided for the adult fish survey and fish community survey. Metallothionein and histopathological methods are not reviewed in detail in this report because they are the subjects of separate reports prepared for the AETE Technical Committee.
http://www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/reports/aetefinal-223.pdf

Technical Evaluation of Monitoring Methods Using Macrophytes, Phytoplankton and Periphyton to Assess the Impacts of Mine Effluents on the Aquatic Environment
St-Cyr, Louise; Antonella Cattaneo; Raynald Chasse; Christian G.J. Fraikin.
Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada. 218 pp, Nov 1997

This report is a technical evaluation of monitoring methods using macrophytes, phytoplankton, and periphyton to assess the impacts of mine effluents on the aquatic environment based on a wide literature review and evaluation. Macrophytes appear to have an interesting potential as biomonitoring organisms to assess the impacts of mine effluents on the aquatic environment. Many macrophyte species conform very well to many of the criteria listed for an ‘ideal’ biomonitor organism: they are sedentary, visible to the naked eye, easy to collect and to handle, easy to identify in the field, they concentrate metals in their tissues, and reflect the environmental contamination. Metals taken up by rooted submerged macrophyte species represent the bioavailable, free-metal ion concentrations in the sediment interstitial water, as well as metal contamination in the water column, if present. Plant parts to be analyzed, cleaning methods, and methods to deal with the variability of the results are discussed. Although biochemical indicators such as phytochelatins and enzyme induction (peroxidase activity) have not yet been used in the field with macrophytes to assess metal contamination, their possible use as biomonitoring tools is briefly discussed. *Eriocaulon septangulare*, *Eleocharis acicularis*, and *Potamogeton richardsonii* appear to be particularly promising candidates for biomonitoring in the Canadian mining environment. This review has identified several approaches beyond biomass changes and species shifts for phytoplankton biomonitoring that show promise: 1) community canonical analysis, 2) size distribution, 3) pigment analysis, 4) phytochelatin analysis, 5) diatom deformities, 6) tests based on community induced tolerance. The potentials and the limitations of these techniques in view of their integration into a cost-effective monitoring program are discussed. Periphyton is a functional system where autotrophic and heterotrophic processes take place. For studying environmental perturbations from mine effluents, periphyton represents many advantages. Since it is non mobile, it is easy to sample and integrate effects of environmental variables. In addition, periphyton has a rapid response to disturbance which can create modifications of community structure and functioning. The structure of the periphytic community reflects the competitive capacity of the species forming it and can serve as a source of integrated information and a sensitive indicator of metal or acid stress.
http://www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/reports/2_3_2.pdf

Test Methods for Available Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion and Amperometric Detection
Gray, J. and M. Halvorson, OI Analytical, College Station, TX. PITTCON 2003, 9-14 March 2003, Orlando, Florida. Abstract 2130-4

Two cyanide analysis methods incorporating amperometric detection are compared, and a flow injection analysis (FIA) system configured for available cyanide analysis is described. The discussion includes data illustrating the operating range, detection limits, reproducibility, and recoveries of various cyanide-containing compounds.

Testing and Evaluation of Standoff Chemical Agent Detectors
National Research Council, Committee on Testing and Evaluation of Standoff Chemical Agent Detectors.
National Academies Press, Washington, DC. ISBN: 0-309-08687-6, 66 pp, 2003.

The report provides an independent assessment of suitable test protocols that might be useful and reliable for the testing and evaluation of standoff chemical agent detectors. It proposes two testing protocols, one for passive detectors and one for active detectors, to help ensure the reliable detection of a release of chemical warfare agents. The NRC has determined that testing these detectors by release of chemical warfare agents into the atmosphere would not provide additional useful information on the effectiveness of these detectors than would a rigorous testing protocol using chemical agents in the laboratory combined with atmospheric release of simulated chemical warfare agents.

Ultraviolet Mini-Raman Lidar for Stand-off, In Situ Identification of Chemical Surface Contaminants
Ray, Mark D.; Arthur J. Sedlacek; Ming Wu.
Review of Scientific Instruments, Vol 71 No 9, p 3485-3489, Sep 2000

The Mini-Raman Lidar System (MRLS) is a portable chemical sensor that combines the spectral fingerprinting of Raman spectroscopy with the principles of solar-blind ultraviolet lidar for short-range, non-contact detection and identification of unknown substances on surfaces. The MRLS has the potential to detect contaminant films several microns thick at distances of meters and bulk quantities of substances at distances of tens of meters at a signal acquisition time of less than one minute.

Ultraviolet Raman Spectral Signature Acquisition: UV Raman Spectral Fingerprints
Sedlacek III, A.J.; C. Finfrock, Brookhaven National Lab., Upton, NY. Informal Report BNL 69453, 29 pp, Sep 2001

As a member of the science-support part of the ITT-lead LISA development program, BNL is tasked with the acquisition of UV Raman spectral fingerprints and associated scattering cross-sections for those chemicals of interest to the program’s sponsor. In support of this effort, this report contains the first installment of UV Raman spectral fingerprint data on the initial subset of chemicals. Because of the unique nature associated with the acquisition of spectral fingerprints for use in spectral pattern matching algorithms (i.e., CLS, PLS, ANN) great care has been undertaken to maximize the signal-to-noise and to minimize unnecessary spectral subtractions, in an effort to provide the highest quality spectral fingerprints. The report is divided into 4 sections: an Experimental section that outlines how the Raman

spectra are performed and is followed by a section on Sample Handling; the spectral fingerprints are presented in the Results section where the data reduction process is outlined, and a Photographs section concludes the report.
http://www.ecd.bnl.gov/pubs/BNL69453.pdf

Understanding the Behaviour of Metals by Speciation Analysis
Gurleyuk, Hakan, Frontier Geosciences, Inc. Sudbury 2003 Conference Presentations, 25-28 May, Sudbury, Ontario. Centre for Environmental Monitoring, Laurentian Univ., Sudbury, Ontario, Canada. 2003

Speciation analysis determines the separation and quantification of different oxidation states or chemical forms of a particular element. Different forms can have totally different properties. Speciation analysis is essential for predicting and modeling fate, risk, and effects; critical for toxicology, bioavailability, and bioaccumulation; and a must-have for designing custom-tailored treatment strategies. Speciation analysis provides important information but is rarely required under current legislation and few (promulgated) methods are available. It also is more expensive than routine analyses. Frontier Geosciences participated in a joint ASTM and EPA laboratory collaboration to validate IC-based separation of metalcyanide complexes. Total and Weak Acid Dissociable (WAD) cyanide analysis are very common, but these two methods are not very reliable for compliance issues. When determining cyanide speciation by IC-UV, both strong and weak metal cyanide complexes can be determined in the same run. Other complexes can be added to the mix, such as Zn, Cd, and Hg. Free cyanide, cyanate, and thiocyanate cannot be determined with this technique, but other metal complexes can be observed.
http://www.sudbury2007.ca/English/Presentations/Gurleyuk_Hakan.pdf

Use of Design Projects GEM Cables to Detect Dense Non-Aqueous Phase Liquids (DNAPLs) Source Zones at Polluted Sites
Goes, B.J.M.; J.A.C. Meekes; P.A.A. Verhaagen; H. Booi; M. Stolzenburg.
Design Projects Ltd. Website, 2003

It has been demonstrated that electrical resistance tomography (ERT) is able to detect DNAPLs in common Dutch soil types: water-saturated sand, silt, clay, peat, or sand with a small amount of gravel. ERT also functions well at polluted sites with a lot of underground infrastructure (cables, pipes, concrete, cellars, etc). ERT will not perform well in detecting DNAPLs at sites with sediment that has a high electrical resistivity (e.g., gravel) or contain antropogenic objects (e.g., barrels) at the depth of the electrode cables. With a mutual electrode distance of 0.3 m, the resolution varies from ~0.15 m near the boreholes to ~0.5 m in the middle between the boreholes. The outcome of the ERT measurements has proven useful for the planning of the remediation measures at two test sites. According to the expert meeting, of the considered semi-3D techniques, ERT is the only technique that has prospects to be used at a larger scale. This conclusion is based on the high spatial resolution, the relatively short measurement time, and the possibility to reduce the costs of the technique. For shallow pollution (< ~10 m-bs), ERT cannot compete financially with traditional soil studies that aim only to determine the rough extent of pollution. But in the future, comparing the costs for ERT with the achieved reduction in remediation costs can show ERT's usefulness. ERT is particularly valuable at sites where DNAPLs can easily spread vertically, as well as at sites with heterogeneous subsoils. It would be useful to execute more geo-electrical measurements at one time with multi-channel measurements to reduce the ERT measurement time in the field. This techniques measures the potential difference over several electrode

pairs while current is being transmitted into the ground over another pair of electrodes.
http://www.design-projects.com/casestudies/cs03.asp

The Use of Multispectral Remote Sensing to Map Reclaimed Areas at Highland Valley Copper
Richards, D.M. (Highland Valley Copper); G. Borstad and M. Martinez de Saavedra Alvarez (G.A. Borstad Assoc. Ltd.). Mining and the Environment, 4-7 May 2003, Montreal. Canadian Inst. of Mining, Metallurgy and Petroleum, Montreal, Quebec

Highland Valley Copper is a large, open-pit copper mine in the southern interior of British Columbia. Reclamation has been in progress on the site since 1987. The establishment of vegetation and the development of a self-sustaining vegetative cover on 6,300 hectares of land are the central components of the mine's reclamation plan. The present vegetation-monitoring program for the reclaimed area represents a significant commitment of resources and only addresses a small portion of the site each year. In an effort to expand the area surveyed while improving the efficiency of the monitoring, the use of remote sensing is being investigated. Airborne multispectral imagery was acquired in the summer of 2001, and the results of the multispectral classification were compared to ground observations made during the routine 2000 and 2001 monitoring program. A thematic map with 17 vegetation classes was produced. Within the vegetation classes, there was a strong spectral separation between "dry grasses" and "legumes" with further separation according to their density. Green biomass could also be quantified remotely across a wide variety of vegetation types. During summer 2002, further aerial imagery was acquired in combination with a targeted ground-truthing program to determine characteristic vegetation types associated with recognized spectral signatures, which can be used in a supervised classification. It is anticipated that after some fine-tuning, it will be possible to shift the ground-sampling effort from areas where the aerial classification confidence is high to more complex areas.

A User's Guide for Determining the Sources of Contaminants in Sediments. A Demonstration Study: Sources of PAH in Sediments in the Vicinity of the Norfolk Naval Shipyard, Elizabeth River, Norfolk, Virginia
Stout, S.A. (Battelle Memorial Inst.); J.M. Leather (SSC San Diego); W.E. Corl III (NAVFAC EFDLANT). SSC San Diego Technical Report 1907, 97 pp, Sep 2003

The objective of this document is to produce a guide for Navy Remedial Project Managers (RPMs) that will describe and demonstrate the process by which the Navy can defensibly determine the nature, extent, and source(s) of anthropogenic contamination in sediments near existing or former naval facilities. The document is divided into two sections. Section 1 provides a step-by-step description of the investigative process used when considering or designing a study. These steps include (1) evaluation of the site's candidacy for a contaminant source study and development of a Watershed Contaminant Source Document (WCSD), (2) development of a conceptual site model, (3) development of a defensible study design, (4) field sample collection, (5) rapid sediment characterization (RSC) screening, (6) advanced chemical fingerprinting (ACF), and (7) synthesis and presentation of the results. Each of these steps, and the strategy involved in each, are discussed in detail. The cost effectiveness and utility of the step-by-step approach are highlighted in Section 2, which contains a demonstration study aimed at determining the source(s) of polycyclic aromatic hydrocarbons (PAHs) in sediments of the southern branch of the Elizabeth River near the Norfolk Naval Shipyard and surrounding naval properties.
http://www.spawar.navy.mil/sti/publications/pubs/tr/1907/tr1907cond.pdf

UTEK Corporation Acquires License to Chemical Detection Technology, Assigns Rights to Circle Group Holdings, Inc.
UTEK Corporation Press Release, 28 Mar 2003

UTEK (Plant City, FL) has acquired the exclusive license to a chemical detection technology developed by the DOE's Brookhaven National Laboratory. UTEK has assigned the license to Circle Group Holdings, Inc., in a stock transaction. Brookhaven Lab's patent-pending technology, known as Mini-Raman Lidar, is a short-range tool to screen unknown chemical, narcotic, and hazardous substances without having to come in contact with the substances. The tool will give first responders the ability to detect substances on surfaces as well as in bulk quantity from a distance of three to fifteen feet. Arthur Sedlacek III is a co-inventor of the technology and a chemist at Brookhaven Lab. Working in partnership with Circle Group, the scientists look forward to completing the development of the new non-contact detection system. Contact: Brenda Uhlenhopp, UTEK Corp., 813-754-4330, buhlenhopp@utekcorp.com; or Greg Halpern, Circle Group Holdings, Inc., 847-549-6002, greg@justdoit.net; or Mona S. Rowe, Brookhaven National Lab, 631-344-5056, mrowe@bnl.gov.