WHAT WE HAVE LEARNED IN THE PAST DECADE AND WHAT THE FUTURE HOLDS.

Fractured rock is arguably the most challenging geologic environment to characterize and remediate. Historically, it has been perceived that these sites are so complex that even after spending considerable dollars, a great deal of uncertainty remains. As the science and technologies develop we are gaining a better understanding as to the physical and chemical nature of the systems and the fate and transport of contaminants in fractured rock. The conference is a cooperative effort by the U.S. Environmental Protection Agency and the National Ground Water Association to identify the current state of remediating contaminated ground water in fractured rock settings and make future remediation efforts more effective. Invited plenary lectures will serve as reviews of our existing understanding as well as looking at directions for the future. A perspective will be given on technical impracticability and other regulatory issues at contaminated fractured rock sites. “Performance Assessment” will be an open-microphone discussion with the panel of invited speakers on how to measure success of remediation. Each registrant will receive a full proceedings on CD-ROM. The conference is an international consortium of engineers, scientists, regulators, responsible parties, researchers, and students gathering to understand the science of classical and innovative remediation technologies. Case studies include federal, state, and industrial sites contaminated by DNAPLs, other organics, metals, and radionuclides. The conference will feature an industry display area, platform and poster sessions, reception, workshops, a luncheon, and a field trip.
Monday, September 13, 2004
9:05–9:30 am  Keynote Address
9:30–9:50 am  DNAPL Behavior in Fractured Rock — Bernard Kueper, Ph.D., Queen’s University
9:50–10:10 am Geophysical Characterization of Fractured Rock Aquifers: Accounting for Scale Effects and Putting Hydrology into the Geophysics
Fred Paillet, Ph.D., University of Maine
10:10–11:00 am  NGWA Distinguished Darcy Lecture
Recent Advances in Characterizing Ground Water Flow and Chemical Transport in Fractured Rock: From Cores to Kilometers
Allen Shapiro, Ph.D., U.S. Geological Survey

Tuesday, September 14, 2004
8:30–8:50 am Oil Field Techniques for Characterizing Fractured Reservoirs — Roberto Aguilera, Ph.D., Servipetrol Ltd.
8:50–9:10 am Utility of Rock Core for Characterizing Contamination in Fractured Sedimentary Rocks — Beth Parker, Ph.D., University of Waterloo
9:10–9:30 am Blast Fracturing and Application for Permeable Reactive Barriers in Bedrock
Vince Dick, Haley and Aldrich Inc.

Wednesday, September 15, 2004
8:30–8:50 am Successful Use of a Horizontal/Vertical Well Couplet in Fractured Bedrock Remediation — Dana Carlisle, GeoEngineers
8:50–9:10 am Using Tracers to Understand Advection, Dispersion, and Diffusion in Fractured Rock — Matthew W. Becker, University at Buffalo, State University of New York
9:10–9:30 am Innovation Approach for Hydraulic Containment of PCB Contamination in Fractured Bedrock
Jack Guswa, Ph.D., GeoTrans

Photo courtesy of Maine Office of Tourism
Special Events

Tuesday, September 14, 2004
Peak’s Island “Down East Lobster Bake”
4:45–9:00 pm

Buses leave at 4:45 and 5:15 pm for the waterfront. Guests will board the boat and enjoy a scenic, 20-minute ride to Peak’s Island where they will enjoy an authentic “Down East Lobster Bake” with all the trimmings at the Lion’s Club theatre, which was built in 1866. Guests can substitute steak, chicken, or vegetarian lasagna for lobster. A cash bar will be available along with volleyball, beach combing, and plenty of fun. A boat leaves for the shore at 8:30 pm, and guests will be back at the hotel by 9:00 pm. Enjoy the fun that Maine offers!
Cost: $60

Thursday, September 16, 2004
Field Trip to Bedrock Bioremediation Center
8:00 am – 5:00 pm

Characterization Methods for Contaminated Fractured Rock
Members of national organizations, federal agencies, universities, and private industry are collaborating to provide field demonstrations of methods to characterize fracture patterns, hydraulic properties, the potential for bioremediation, and ground water flow in a contaminated fractured-rock aquifer. Field demonstrations will include drilling techniques; hydraulic testing and discrete-interval monitoring; methods to sample microbes and monitor bioremediation; and borehole imaging, flowmeter, and fluid-property logging. Data collection and the results of related ongoing site-specific research will be discussed in terms of the challenges and the complexities of characterizing contaminant transport and remediation with a particular focus on fractured-rock aquifers.
Lunch will be provided. Registrations will be taken on a first come, first served basis and NGWA reserves the right to limit the number of participants.

Information about the site: The Bedrock Bioremediation Center (BBC) Research Site at Former Pease AFB (Site 32) has been the focus of multidisciplined research on bioremediation of organically contaminated bedrock aquifers. This demonstration site is the location of a former industrial shop (known as Building 113 at Site 32). From 1955 to 1968, a 1200-gallon concrete underground storage tank with an overflow pipe received TCE from degreasing operations. It was estimated that 5200 gallons of TCE were released at the site. A contaminant plume of TCE and its degradation products has been identified approximately 0.5 km beyond the identified source area. The plume has migrated with the ground water into the bedrock. It is 55 miles south and about one hour from Portland, Maine.
Transportation to the site: NGWA will provide bus transportation from the conference hotel in Portland, Maine to the site. The bus will depart from Portland at 8:00 am and arrive at the field site at about 9:00. People can opt to meet directly at the field site, but must notify NGWA at time of registration and be ready to start the field trip at 9:00.
Cost: $50
Monday, September 13, 2004

10:30–1:40 pm Day One, Track One: Remediation Technologies for Fractured Rock

Moderator: Kent Sorensen, Northwind Environmental

10:30–10:50 am Field-Scale TCE Oxidation in Sedimentary Bedrock: KMnO₄ and BR’ Tracer Test Results and Extended Pilot Design
Michael J. Gefell, P.G., Blasland, Bouck and Lee; Kenneth L. Sperry, P.E., Expert Design and Diagnostics; James R.Y. Rawson, Ph.D., GE Global Research Center; Edward Kolodziej, P.G., GE Corporate Environmental Programs

10:50–11:10 am Field Testing of Nanoscale Zero-Valent Iron Particle Technology for In Situ Ground Water Treatment in Fractured Bedrock
E Gheorghiu, Golder Associates Inc.; L. Walata, GlassoSmithKline; R. Venkatakrishnan, Golder Associates Inc.; W. Zhang, Lehigh University; R.E. Glazer, Golder Associates Inc.

11:10–11:30 am Steam Injection into Fractured Limestone at Loring Air Force Base
Eva L. Davis, Ph.D., USEPA/ORD/NRML/GWERD; Gorm Heron and Steve Carroll, StreamTech Environmental Services

11:30–1:50 pm Remediation of a Chlorinated Solvent Contaminated Site Using Steam Injection and Extraction – David Parkinson and Norm Brown, Integrated Water Resources Inc.

1:50–2:00 pm Remediation of Tetrachloroethene in Fractured Sandstone: A Case Study in Initial Successes and Long-Term Technological Barriers to Timely and Cost-Effective Closure – Kevin Brehm, Vasanta Kalluri, and Jeanne Tarvin, STS Consultants Ltd.

1:40–5:00 pm Remediation General Session

Moderator: Martin Derby, Contech Construction Products Inc.

1:40–2:00 pm Remediation of a Clay and Fractured Rock Source Area Using Extraction and Bioremediation – Gregory L. Carter, P.G., Earth Tech; Roaann Kryczkowski, CHSP, ITT Industries Night Vision

2:00–2:20 pm Art In-Well Air Stripping Technology: Remediation in Fractured Rocks Completed in Months – Morco M. Odah, P.E., P.E., Enviroomedey International Inc.; Steve Pucke, Cintas Corp.

2:20–2:40 pm LNAPL Recovery Using Two-Phase Extraction from Weathered Granitic Bedrock Base Overlain by Alluvium and Lacustrine Deposits
Joel Sheldon, Earth Tech; Mehmet Pehlivan, Tait Environmental Management Inc.

2:40–3:00 pm Blast-Fractured Enhanced Permeability Remediation System at Modern Landfill, York, Pennsylvania: A Five-Year Update
J.R. Smerakianek, J.J. Esca, and F.Gheorghiu, Golder Associates Inc.; M.C. Pedersen, Republic Services Inc.

3:00–3:20 pm Refreshment break


3:40–4:00 pm Evaluation of Successful MTBE Remediation in the Passaic Formation
Craig A. Kunz, P.E., and Shawn McGane, Geologic Services Corp.

4:00–4:20 pm Remediation Strategies for a MTBE Contaminated Fractured Rock Aquifer in Northern Rhode Island – Thomas B. Boving, Ph.D.; University of Rhode Island; Michael Cote, Rhode Island Department of Environmental Management

4:20–4:40 pm Remedial Strategies Applied to a Fractured Bedrock Contaminant Plume at the University of Connecticut Landfill Study Area


5:00–7:00 pm Poster session and ice breaker reception in the exhibit hall

10:30–1:20 pm Day One, Track Two: Project Management

Moderator: Kenneth J. Goldstein, Malcolm Pirnie Inc.

Technical and Regulatory Challenges Resulting from VOC Matrix Diffusion in a Fractured Shale Bedrock Aquifer – Kenneth J. Goldstein, Andrew R. Vitolinis, and Daria Navon, Malcolm Pirnie Inc.; Grant A. Anderson, and Stephen P. Wood, U.S. Army Corps of Engineers; Beth Parker and John Cherry, University of Waterloo

Technical and Regulatory Considerations for DNAPL Remediation in Complex Hydrogeology – Beth A. Moore, U.S. Department of Energy; Dawn S. Kaback, Concurrent Technologies Corp.


LNAPL Behavior in Fractured Rock: Implications for Characterization and Remediation – Paul E. Hardisty, Konex Environmental Ltd.; John Roher, Imperial College of Science and Technology; Jane Dottridge, Komex Environmental Ltd.


1:20–4:00 pm Day One, Track Two: Hydraulic Conductivity

Moderator: John Williams, U.S. Geological Survey

Fractured Bedrock Aquifer Hydrogeological Characterization for a Bioaugmentation Pilot Study – Veryl Wittig and Paul Jeffers, GeoSystec Consultants; Candace Gibson, County of San Diego

Fractured Rock Transmissivity Estimates from Oscillatory Slug Test Data
Jeffrey R. Hale, P.G., Key Environmental Inc.

Ground Water in Fractured Bedrock: A Water Supply Approach
Raymond W. Talkington, Ph.D., P.E., LSE Geosphere Environmental Management Inc.

Pumping Test Analysis in a Fractured Crystalline Bedrock – H. Jean Cho, Matthew H. Daly, and R. Joseph Fiacco Jr., Environmental Resources Management

A New Visual Conversion Tool for Transient Test Data – Christian Enachescu and John Wozniewicz, Golder Associates Inc.

3:00–3:20 pm Refreshment break

Gas Injection Tests – Michael C. Marley and Bruce L. Clitt, Xpert Design and Diagnostics LLC; Clifford J. Brucel and Chenju Linag, University of Massachusetts–Lowell

Large Drawdown Slug Tests – Gonzalo Pullido, HydroQual Inc.; Thomas P. Ballestero and Nancy E. Kinny, University of New Hampshire

4:00–5:00 pm Day One, Track Two: Regional Scale Geology

Moderator: Carole Johnson, U.S. Geological Survey


Vertical Distribution of Hydraulic Conductivity in Cambrian Sandstones in South-Central Wisconsin – Kenneth R. Bradbury, David J. Hart, and David L. LePain, University of Wisconsin-Extension; Beth L. Parker, Diane C. Austin, and Jessica R. Myer, University of Waterloo

Hydrogeology of Granitic Terrains: A Comprehensive Study of Minho Region (Northwestern Portugal) – A.S. Lima, Universidade de Minho; M.O. Silva, Universidade de Lisboa

5:00–7:00 pm Poster session and ice breaker reception in the exhibit hall
Monday, September 13, 2004

Poster Session (in the exhibit hall)

Lessons Learned from Bedrock Blast Fracturing and Bioremediation at a Superfund Landfill – Stuart C. Pearson, P.E., Brian B. Johnson, P.E., and Nelson Walter, P.E., MACTEC Engineering and Consulting Inc.; Richard Galloway, Honeywell

An Integrated Approach to Contaminant Mass Removal from Vadose and Saturated Fractured Bedrock – Brian Vanderglas, Parsons Corp.; Brian Murphy, Camp Stanley Storage Activity

Evaluating the Performance of a Seepage Barrier Constructed with Coal Combustion Product Grout to Reduce the Loss of Ground Water Seeping into a Former Coal-Mining Shaft – Nathanial Warner, Matthew Erbe, and Leonard Rafalko, Environmental Resources Management Inc.; Paul Petzrick, Maryland Power Plant Research Program; Gary Fuhrman, Western Maryland Resource Conservation and Development

Toward an Improved Risk Assessment of the Contaminant Spreading in Fractured Underground Reservoirs – Christos Tsakirgoulou, Ph.D., Maria Theodoropoulou, Ph.D., and Vaggelis Karoutos, Ph.D., FORTH/ICE-HT; Knud Erik S. Klint, Ph.D., and Peter Gravesen, Ph.D., Geological Survey of Denmark and Greenland; Catherine Laroche, Ph.D., Laurent Teny, Ph.D., and Pierre LeThiez, Ph.D., Institut Francais du Petrole

Importance of Flowmeter Logging for Aquifer Characterization at Contaminated Bedrock Sites – Carole D. Johnson, John H. Williams, and Frederick L. Pailet, U.S. Geological Survey

Angled Borings in Fractured Crystalline Bedrock Investigations Mark A. Worthington and Michael Y. Horesh, Environmental Resources Management; Bernard H. Kueper, Queen’s University; Michael J. Elliott and Patrick Webb, Texas Instruments

Characterization of Heterogeneous Flow Zones in a Crystalline Aquifer with Borehole Logging and Cross-Borehole Flowmeter Experiments – T. Le Borgne, Université de Rennes; E.L. Paille, University of Maine; O. Bour, Université de Rennes


An Innovative Approach to Investigation of an MTBE Plume in Fractured Bedrock – Timothy S. Burke, Sarah A. Czajka, and David C. Raymes, Geologic Services Corp.

Large-Scale Solute Transport Modeling in Discretely-Fractured Porous Media – Guillaume Kenny, René Thérien, and André Fortin, Université Laval; Kent Novakowski, Queen’s University

Hydrochemical Facies Analysis of 1,1,1-Trichloroethane and Its Degradation Products in Fractured Bedrock – H. Jean Cho, R. Joseph Fiacco, Mathew H. Daly, and John W. McTigue, Environmental Resources Management

Examination of the Relationship of Rock Structure to Ground Water Flow in a Fractured Limestone Aquifer – William Brandon, U.S. EPA Region I; Robert Hoey, Maine Department of Environmental Protection

Aqueous Chemistry of Various Hydrogeologic Units of the Fractured Bedrock Aquifer in the North Carolina Piedmont – Jack L. Stutts, P.G., Mecklenburg County Land Use and Environmental Services Agency

Imaging Channelized Flow in Bedrock Fractures using Ground Penetrating Radar – Jennifer Talley, Matthew Becker, Ph.D., Gregory Baker, Ph.D., Nicholas Beyerle, SUNY at Buffalo
Tuesday, September 14, 2004

10:00–12:00 pm Day Two, Track One: Lessons Learned in Monitored Natural Attenuation
Moderator: Bernard H. Kueper, Ph.D., Queen’s University

10:00–10:20 am

10:20–10:40 am
Effectiveness of Monitored Natural Attenuation at Predicting In Situ Biodegradation in a TCE Contaminated Granitic Bedrock – N.E. Kinner, M. Mills, T. Eighmy, T. Ballesteros, J. Coulburn, and L. Tisa, University of New Hampshire

10:40–11:00 am
Evidence of Biodegradation at a DNAPL Contaminated Fractured Bedrock Field Site Using Stable Carbon Isotopes – Michelle M. Chartrand, Penny L. Morrill, and Georges Lacramce-Gouluame, University of Toronto; Kevin T. Finneran, Paula Chang, and Peter Zebb, Geoysystc Inc.; Barbara Sherwood Lollar, University of Toronto

11:00–11:20 am
Ground Water and Surface Water Natural Attenuation Demonstrations and Ongoing Remediation Optimization at an 80-Year Old, 2-Square Mile Operating Refinery – Terry Vandell-Bell, Conoco Phillips; Lily Sehayek, Ph.D., and Geo fibrigast, URS Corp.

11:20–11:40 am
Natural Attenuation of Sorb Luke plumes in Bedded Fractured Rock – Michael West and Bernard Kueper, Queen’s University

11:40–12:00 pm

12:00–1:00 pm Lunch (provided) in exhibit hall

1:00–3:20 pm Chemical Oxidation
Moderator: Mark R. Harkness, GE Global Research

1:00–1:20 pm

1:20–1:40 pm
In Situ Chemical Oxidation of Volatile Organic Compounds in a Fractured Bedrock Aquifer – Paul D. Rohde and Cynthia R. Butler, P.E., CH2M Hill

1:40–2:00 pm

2:00–2:20 pm

2:20–2:40 pm
Implementation of In Situ Chemical Oxidation in Fractured Bedrock – Timothy J. Pac, Richard Lewis, and R. Joseph Fiacco Jr., Environmental Resources Management; Edwin Madera, Raytheon Co.

2:40–3:00 pm
In Situ TCE Oxidation Using Potassium Permanganate in the Columnar-Jointed Preakness Basalt of New Jersey – Brian A. Blum, C.P.G., Bill N. Stephanatos, Ph.D., P.E., and Michael E. Poland, Langan Engineering and Environmental Services Inc.; Gary M. Fisher, Lucent Technologies Inc.

3:00–3:20 pm Refreshment break

3:20–4:40 pm Chemical Oxidation (continued)
Moderator: Todd W. Schrauf, Hydro Geo Chem

3:20–3:40 pm
In Situ Chemical Oxidization Using Persulfate for Remediation of Chlorinated VOCs in a Fractured Shale Matrix – Benjamin Alter, P.G., Andrew R. Vitolins, Kenneth J. Goldstein, and Daria Navon, Malcolm Pirnie Inc.; Grant A. Anderson and Stephen P. Wood, U.S. Army Corps of Engineers; Beth Parker and John Cherry, University of Waterloo

3:40–4:00 pm
In Situ Chemical Oxidization with Sodium Persulfate in a Fractured Crystalline Bedrock Aquifer: A Case Study – Charles D. Race, C.G., L.S.P., and Liyang Chu, Tetra Tech NUS Inc.

4:00–5:00 pm Characterization with Surface and Borehole Geophysics
Moderator: Carole Johnson, Ph.D., U.S. Geological Survey

4:00–4:20 pm
Multi-Method Geophysical Approach for Characterizing a Deep Fractured Bedrock Aquifer, Anniston Army Depot, Anniston, Alabama – Barbara Sherwood Lollar, Tom Lollar, and Gregory Garcia, University of New Mexico

4:20–4:40 pm
Ground Water Exploration by VLF Techniques: A Case Study in Granitic Terrains of Northwestern Portugal – Luis Macedo and Alberto S. Lima, University of Aveiro

4:40–5:00 pm
Hydrogeologic Exploration by Electrical Resistivity Surveys in Hard Rocks of Montalegre Area (Northern Portugal) – Alcino Canas and Alberto S. Lima, University of Minho; João Fonseca, University of Aveiro

10:00–2:20 pm Day Two, Track Two: Site Characterization with Surface and Borehole Geophysics – Moderator: Fred Paillet, Ph.D., University of Maine

10:00–10:40 am
Hydrogeology of the Châteaugay River Transboundary Aquifers, Canada – USA M. Nastev, Geological Survey of Canada; C. Lamontagne, Quebec Ministry of Environment; T. Tremblay, E. Hardy, and M. Lamothe, Université de Quebec à Montréal; R. Leferbyre, A. Croteau, M. Lavigne, and D. Blanchette, Institut National de Recherche Scientifique; D. Paradis, Geological Survey of Canada; N. Roy, Institut National de Recherche Scientifique

10:40–11:00 am

11:00–11:20 am

11:20–11:40 am

11:40–1:00 pm Lunch (provided) in exhibit hall

2:00–5:00 pm Conceptual Models
Moderator: Grant Anderson, U.S. Army Corps of Engineers

2:00–2:50 pm

2:50–3:40 pm
Thermal Hydrosystem of Gerês Spa (Northwestern Portugal): Proposal of a Conceptual Model – Albert S. Lima, University of Minho

3:00–3:20 pm Refreshment break

3:20–5:00 pm

5:00–6:00 pm
Student Career Mentoring Program – As a part of the conference, students should plan to attend the career mentoring program. Professionals will present their views on the opportunities in the ground water industry. Come with questions on ground water careers and have them answered by a variety of professionals.
10:00 – 11:40 am Day Two, Track Three: Conceptual Models
**Moderator: Richard Willey, U.S. EPA**

**Historical and Present Site Conceptual Models for a Fractured Bedrock Superfund Site in New York State** – Lisa G. Campbell, Susan E. Schofield, P.G., Kristen E. Carpenter, and John N. Dougherty, P.G., CDM

**Fractured Bedrock DNAPL/Dissolved Phase Plume Conceptual Model Development at the Eastland Woolen Mill Superfund Site, Corinna, Maine** – Scott Calkin, Peter Thompson, and Peter Baker, MACTEC Engineering and Consulting Inc.; Scott Acone, U.S. Army Corps of Engineers; Ed Hathaway, U.S. EPA

**Structural Characterization and Passive Remediation of NAPL in Fractured Bedrock at a Former MGP Site: Mechanicville, New York** – Michael Gutmann, Eriko Fujita, and Beth Guidetti, URS Corp.; Tracy Blazicek, New York State Electric and Gas Corp.

**Use of Vertical Gradient to Compensate for Disparate Completion Depths When Characterizing Horizontal Flow Direction in Stacked Fractured Aquifers During an MTBE Investigation, Maripos County, California** – William Ackland and Herman Schymiczek, HerSchy Environmental Inc.

11:20 – 11:40 am Geochemical Characterization
**Moderator: Nancy Kinner, Ph.D., University of New Hampshire**

**Monitored Natural Attenuation of Chlorinated Solvents in Fractured Bedrock as a Selected Remedy for Ground Water at a Superfund Site** – Rebecca Lindeman, P.E., and David S. Lipson, CPG, Blasland Bouck and Lee Inc.

11:40–1:00 pm Lunch (provided) in exhibit hall

**Characterization of Three Water Types in a Fractured Schist, High Arsenic, Watershed in Maine**
Gail Lipfert and Andrew Reeve, Ph.D., University of Maine

**Development of a Conceptual Field Scale Flow Model in a Fractured Bedrock Aquifer**
Bibhuti Panda, Ph.D., Amec Earth and Environmental

1:40 – 2:40 pm General Session
**Moderator: Robert W. Masters, NGWA**


**Hydraulic Properties of Granitic Fracture Skins and Their Effect on Solute Transport**
Terence T. Garner and John M. Sharp Jr., University of Texas

Wednesday, September 15, 2004

10:00–11:40 am Day Three, Track One: Technical Impracticability
Moderator: Kathy Davies, U.S. EPA

10:00–10:20 am Regulatory and Technical Perspectives on Technical Impracticability
Kathy Davies, U.S. EPA


10:40–11:00 am Technical Impracticability: Panel Discussion
Open microphone

11:40–1:00 pm Lunch (on your own)

1:00–2:40 pm Bioremediation
Moderator: Nancy Kinner, Ph.D., University of New Hampshire

1:00–1:20 pm Evaluating Innovative Bioremediation Technologies and Successful Pilot Test Performance – Tess Rotterro, AMEC; Craig Walmsley, U.S. Army Claims Service; Oliver Kohen, AMEC

1:20–1:40 pm Biosorption of Cr (VI) by Biogas Slurry – Neetu Tewari, University of Delhi; P. Vasudevan and B.K. Gah, Indian Institute of Technology


2:00–2:20 pm Fracture Characterization at a Bedrock Bioremediation Site in New Hampshire – Stanley S. Sadkowski, Wallace A. Bothner, Jean Benoit, Francis S. Birch, and José Escamilla-Casas, University of New Hampshire

2:20–2:40 pm Enhanced Bioremediation of DNAPL in a Fractured Limestone Aquifer: Bench Test Results – Neal D. Durant and Eric D. Hood, GeoSyntec Consultants; Sandra M. Dworatzek and Jeff Roberts, SiREM; Keith B. Rapp, Terry Etter, and William H. Anthony, Unisys Corp.

2:40–4:00 pm Integrating and Prioritizing Characterization Methods
Moderator: Aaron Green, Connecticut Department of Environmental Protection

2:40–3:00 pm Combined Use of Borehole Geophysics and Packers to Site Potable Wells in a Contaminated Area – Aaron Green, Connecticut Department of Environmental Protection; John W. Lane Jr., Carole D. Johnson, John H. Williams, Remo A. Mondazzi, and Peter K. Joesten, U.S. Geological Survey

3:00–3:20 pm Refreshment break


3:40–4:00 pm Fracture Network Characterization for Studies of Retention Processes at the Aspö Hard Rock Laboratory – Thomas Doe and Jan Hermanson, Golder Associates Inc.; Peter Andersson, Geosigma AB; Anders Winberg, Conterra AB

4:00–4:20 pm Application of the Fractured Bedrock Toolbox at Multiple Sites in New England – R. Joseph Fiacco Jr., Matthew H. Daly, and John C. Drobinski, Environmental Resources Management

4:20–4:40 pm Hydrogeological Characterization for Siting Geothermal Wells in Fractured Bedrock at Bronx Zoological Park, Bronx, New York – Dennis Askins and Alex Posner, New York City Department of Design and Construction

4:40–5:00 pm The FLUTE Multilevel Ground Water Monitoring System Used for Study of a Contaminated Dolostone Aquifer – John Cherry, Ph.D., University of Waterloo

10:00–11:40 am Day Three, Track Two: Water Sampling
Moderator: Norman Brown


10:40–11:00 am Ground Water Sampling Method Comparison: Low-Flow and Passive Diffusion Bag Sampling Results for Volatile Organic Compounds in Fractured Metamorphic Bedrock – Thomas R. Eschner and David Dinsmore, Woodard and Curran

11:40–1:00 pm Day Three, Track Two: Water Sampling

11:40–1:00 pm Lunch (on your own)

1:00–2:40 pm Drilling Techniques
Moderator: Vincent B. Dick, Haley & Aldrich Inc.

1:00–1:20 pm Formation and Stability of Pickering Emulsions: Implications for Drilling Through NAPL Source Zones – B.H. Kueper and A. Roy-Perreault, Queen's University

1:20–1:40 pm Use of Angled Drilling Techniques to Characterize Fractured Crystalline Bedrock and Minimize Migration of Suspected Non-Aqueous Phase Liquids (NAPL) – David Finney, P.G., Jeffrey Hershberger, P.G., and Peter Nangeroni, P.E., ESS Group Inc.

1:40–2:00 pm Using Minimal Impact Deep Drilling Techniques in a DNAPL Impacted, Fractured Rock Aquifer – Matthew B. Best and Brian S. Murray, Science Applications International Corp.

2:00–5:00 pm Numerical Modeling
Gloria Sosa, U.S. EPA

2:00–3:00 pm Investigation of the Impact of Fracture Intersection on Solute Transport in Fractured Carbonate – Catherine Ledoux and Rene Therrien, Université Laval; Kent Novakowski, Queen’s University; Donna Kirkwood, Université Laval

3:00–3:20 pm Large-Scale Solute Transport Modeling in Discretely-Fractured Porous Media – Guillaume Kenny, Rene´ Therrien, and Andre Fortin, Université Laval; Kent Novakowski, Queen’s University

3:20–3:40 pm Multiscale Site Characterization for the Numerical Mapping of NAPL Migration Pathways in Contaminated Fractured Igneous Rocks: A Case Study in Northern Spain – Knud Erik S. Klint, Ph.D., and Peter Gravesen, Ph.D., Geological Survey of Denmark and Greenland; Catherine Larche, Ph.D., Laurent Trenty, Ph.D., and Pierre LeThiez, Ph.D., Institut Francais du Petrole; Christos Tassiolou, Ph.D., FORTH/ICE-HT


4:00–4:40 pm Discrete Analytic Domains: A New AEM Formulation for Modeling Anisotropy and Heterogeneity – Charles Fitts, University of Southern Maine


4:40–5:00 pm Multiscale Site Characterization for the Numerical Mapping of NAPL Migration Pathways in Contaminated Fractured Igneous Rocks: A Case Study in Northern Spain – Knud Erik S. Klint, Ph.D., and Peter Gravesen, Ph.D., Geological Survey of Denmark and Greenland; Catherine Larche, Ph.D., Laurent Trenty, Ph.D., and Pierre LeThiez, Ph.D., Institut Francais du Petrole; Christos Tassiolou, Ph.D., FORTH/ICE-HT


4:40–5:00 pm Discrete Analytic Domains: A New AEM Formulation for Modeling Anisotropy and Heterogeneity – Charles Fitts, University of Southern Maine


5:00–6:00 pm Statistical Modeling of a Non-Parametric Data Distribution to Determine an Exposure Point Concentration During Risk Assessment – Adam P. Chen and Joan V. Gonzalez, Burns and McDonnell Engineering Inc.


5:00–6:00 pm Ground Water Flow and Contaminant Transport Modeling of Fractured Bedrock Aquifer with Solution Channels at a Southeastern Pennsylvania Superfund Site – Henry He and Andrew H. Thalheimer, P.E., Environmental Resources Management Inc.

5:00–6:00 pm Statistical Modeling of a Non-Parametric Data Distribution to Determine an Exposure Point Concentration During Risk Assessment – Adam P. Chen and Joan V. Gonzalez, Burns and McDonnell Engineering Inc.


5:00–6:00 pm Ground Water Flow and Contaminant Transport Modeling of Fractured Bedrock Aquifer with Solution Channels at a Southeastern Pennsylvania Superfund Site – Henry He and Andrew H. Thalheimer, P.E., Environmental Resources Management Inc.
A Simple Analytical Model for Heat Flow in Fractures: Application to Steam Enhanced Remediation Conducted in Fractured Rock – K.S. Novakowski, Queen's University; K.M. Stephenson, Golder Associates Ltd.; E.L. David and S. Carroll, R.S. Kerr Environmental Research Center; G. Heron, Steamtech Environmental Services Inc.; K. Udell, University of California

10:20–11:40 am Workshop: Demonstration of the Westbay MP Multilevel Ground Water Monitoring System
Delineating the extent of a groundwater contaminant plume in geologic materials requires a three-dimensional array of sampling points. Multilevel monitoring can provide increased data density and therefore an improved understanding of site conditions. This demonstration will show how the Westbay MP System, one type of multilevel monitoring well, is installed and operated. Also discussed will be field quality control procedures, potential applications, case studies, and the advantages of more (and better) data for optimizing project management.

1:40–2:40 pm Workshop: Strategies for Monitoring the Performance of DNAPL Source Zone Remedies
Eric Hausamann, New York State Department of Environmental Conservation; Naji Alkadiss, Maine Department of Environmental Protection; Thomas Early, Oak Ridge National Laboratory; Linda Fielder, U.S. EPA; Laurie Haines, U.S. Army Environmental Center; Konstantinos Kastarelos, Polytechnic University; Hans Meinardus, Intera; and Michael Smith, Vermont Department of Environmental Conservation

2:40–4:00 pm Panel Discussion: Performance Assessment: Measuring Success in Remediation
Co-Chairs: Kathy Davies, U.S. EPA
Beth Moore, U.S. Department of Energy

5:00 pm Conference adjourns
Fee Information

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<th>Before Aug. 1</th>
<th>After Aug. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGWA Member</td>
<td>$195</td>
<td>$250</td>
</tr>
<tr>
<td>Nonmember</td>
<td>$195</td>
<td>$250</td>
</tr>
<tr>
<td>Full-time Student (I.D. required)</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Field Trip</td>
<td>$50</td>
<td>$60</td>
</tr>
<tr>
<td>Peak’s Island Lobster Bake</td>
<td>$60</td>
<td>$70</td>
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</tbody>
</table>

General Information

Seating is limited. Registrations will be accepted on a first come, first serve basis. When you register, you will receive a confirmation letter and badge. Attendees will receive a program containing abstracts of each talk, beverage breaks, and lunch on the second day. Cancellations received less than 21 days prior to the conference will be charged a $150 processing fee. Cancellations received less than seven days prior to the conference will forfeit the entire registration fee. NGWA reserves the right to limit registrations based on space capacity. Registration will be available onsite from 7:30 am to 5:00 pm daily.

On-Site Registration

If you plan to register at the member rate, please be sure to bring your current NGWA membership card. Your card must be presented to verify membership, along with your onsite registration form and payment.

Hotels

Holiday Inn by the Bay
88 Spring Street
Portland, ME 04101-3924
800 345.5050
www.innbythebay.com

Doubletree Hotel Portland
1230 Congress Street
Portland, ME 04102
207 774.5611
www.doubletree.com
Complimentary shuttle service provided to the Holiday Inn by the Bay.

Cutoff date: August 10, 2004

NGWA has secured a limited block of rooms on a first come, first serve basis at the group rate of $129 per night single/double for September 12–16, 2004. These rates apply to the NGWA room block and are valid until the August 10 cutoff unless our block has been filled before that date. Please mention that you are attending this NGWA program. Remember, you are responsible for securing your own reservations. For guest check-in and check-out times, please contact the hotel directly.

Special Arrangements

If you require arrangements for handicap facilities, equipment, or special dietary concerns, please let us know 30 days in advance of the conference.

Tax Deduction for Educational Expenses

An income tax deduction is permitted for educational expenses (registration fees, cost of travel, lodging, and books) undertaken to (1) maintain or improve skills required in one’s employment or business, or (2) meet expressed requirements of an employer imposed as a condition to retention of employment, rate status, or rate of compensation. Meals and beverages may be deductible up to 50%.

NGWA Membership Benefits

Members of National Ground Water Association enjoy the following:

- Advanced notices of opportunities to participate in professional conventions and conferences
- Registration discounts on progressive continuing education courses, conferences, and trade shows
- Savings on insurance products, rental cars, equipment financing, and more
- Free access to NGWA’s Web site for members-only information such as trade statistics, forum opportunities, and Ground Water On-Line®, the world’s largest private library on ground water and wells
- Depending on division membership, subscriptions to industry publications such as:
  - *Ground Water®*
  - *Ground Water Monitoring & Remediation™*
  - *Water Well Journal®*

September 13-15, 2004 ■ Holiday Inn by the Bay ■ Portland, Maine

<table>
<thead>
<tr>
<th></th>
<th>Before Aug. 1</th>
<th>After Aug. 1</th>
<th>Quantity</th>
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<td>$100</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>Field Trip (9/16)</td>
<td>$ 50</td>
<td>$ 60</td>
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<tr>
<td>Peak's Island Lobster Bake (9/14)</td>
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<td>$ 70</td>
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</tbody>
</table>

My $ ________________ registration fee in U.S. funds is enclosed. (Make check payable to NGWA.)

Name ____________________________________________ Position __________________________________________

Company/Organization Name ____________________________________________________________________________

Business Address __________________________________ City/State/Zip ________________________________

Home Address __________________________________________ City/State/Zip ______________________________

Business Phone __________________________________ Fax __________________________________________

E-mail __________________________________________

NGWA member □ Yes Membership # ___________________ □ No

Please charge my credit card:

Credit Card # ______________________________ Exp. Date __________________

□ MasterCard □ Visa □ American Express □ Discover

Signature _______________________________________________

NGWA provides equal access to those with disabilities. If you require assistance, please list your needs here:
____________________________________________________________________________________________________________________________________________

Please do not mail your registration form after August 15, 2004. After this date, you are welcome to register online, via telephone, fax, and credit card; or plan to register onsite.

If you are not a member of NGWA, but would like to be added to our mailing list, please check this box □ *

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Cancellations received less than 7 days prior to the conference will forfeit the entire registration fee.