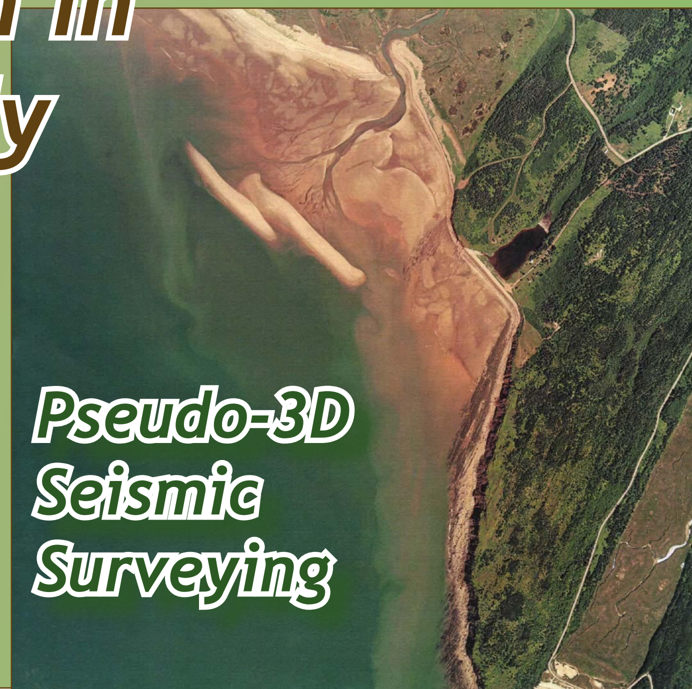
FastTIMES

March 2008
Volume 13, Number 1
www.eegs.org

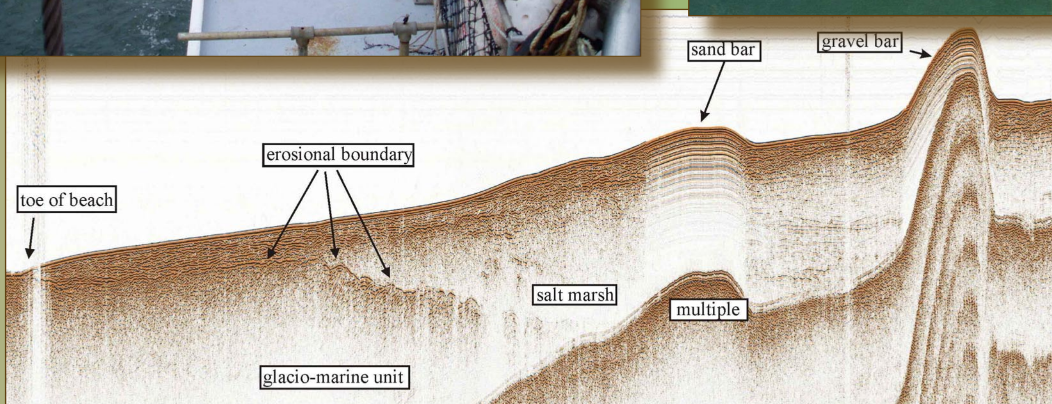
News for the Near-Surface Geophysical Sciences

Published by the Environmental & Engineering Geophysical Society

Geophysical Fun in the Bay of Fundy



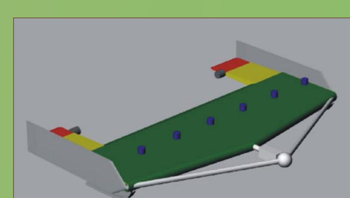
Pseudo-3D Seismic Surveying

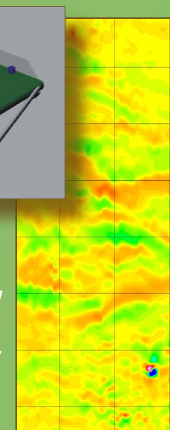


Also in this issue . . .

- Looking for Underwater UXO
- Exploring for Italian Groundwater with TDEM
- 21st SAGEEP Convenes in Philly April 6-10
- Whither SAGEEP? EEGS Wants Your Opinion

. . . and more!





Undersea Sensor Wings


EEGS ANNUAL MEETING
PHILADELPHIA
2008
Photo by J. Handley for GPTMC
CONFERENCE HIGHLIGHTS
New! – Environmental & Engineering Geophysical University (EEGU) track. Overview level sessions of geophysical approaches to engineering and environmental problems for non-geophysicists, managers, regulators, and new students
• Oral & Poster Presentations
• Short Courses
— Borehole Geophysical and Hydrophysical Logging for Environmental and Geotechnical Applications - Introductory and Advanced Courses
— Surface Waves are for Everyone
— Demystifying the Art and Science of GPR
— Geophysics Applied to Foundations Analysis: Integration of Electrical and EM Surface/Borehole Methods with Seismics
• Keynote Speaker: Dr. Robin E. Bell, Doherty Senior Research Scientist at Lamont-Doherty
• Luncheon Speakers:
— William P. Owen, CALTRANS
— The inaugural recipient of the EEGS/ Geonics Early Career Award
• Outdoor Equipment Demonstrations on the grounds of Independence Hall
• Full Day and Half-Day Field Trips
• Special Evening Event at Constitution Center
• And Much More!
21st SAGEEP
SYMPOSIUM ON THE APPLICATION OF GEOPHYSICS TO ENGINEERING AND ENVIRONMENTAL PROBLEMS
New Partnerships, New Discoveries
April 6–10, 2008
Marriott Philadelphia Downtown
Philadelphia, Pennsylvania
EEGS
www.eegs.org

On the Cover

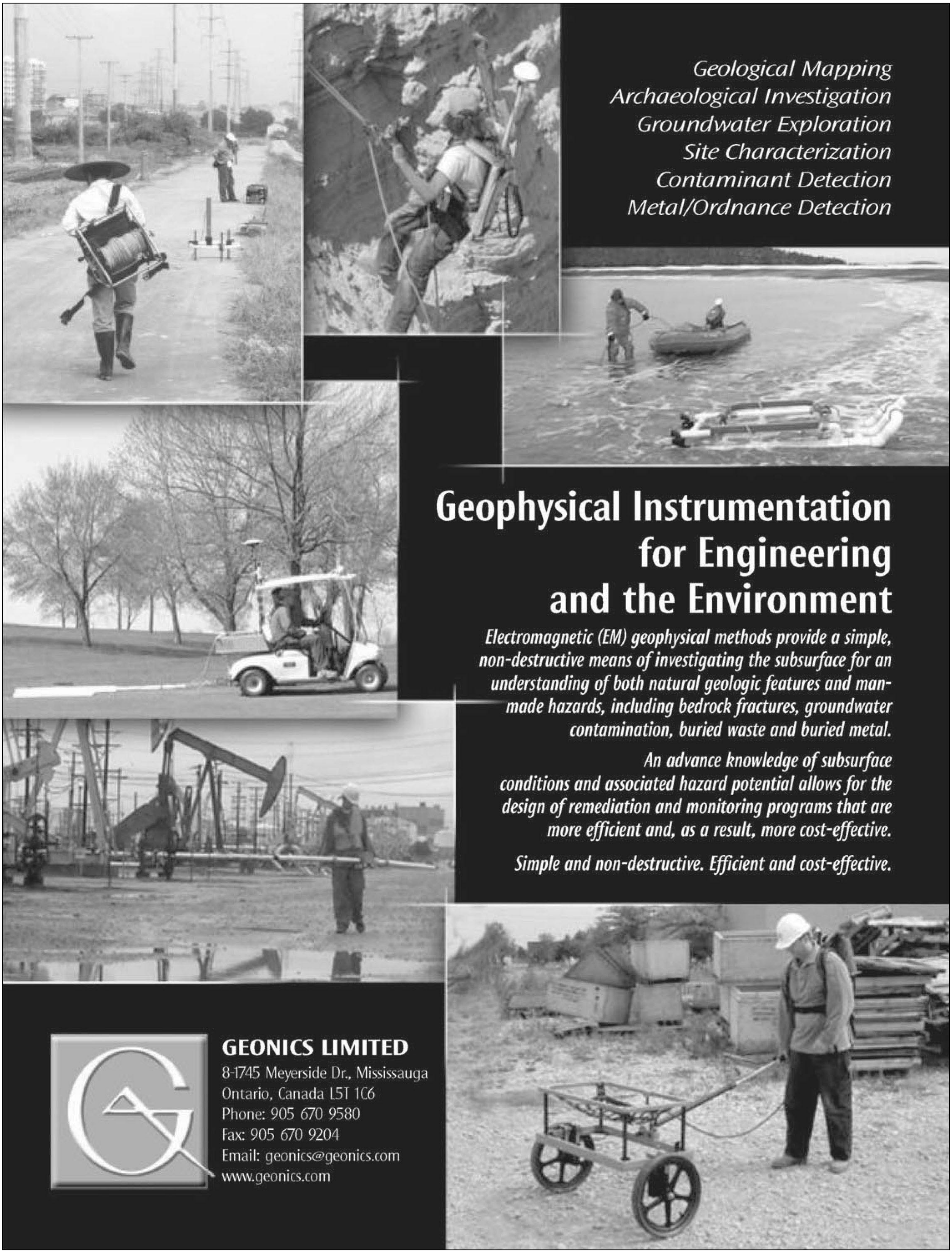
Center: Karl Butler (University of New Brunswick) and colleagues conduct pseudo-3D, sub-bottom seismic profiling using two SEISTEC systems in a shallow Quaternary coastal and deltaic environment off Waterside Beach, upper Bay of Fundy. **Lower right**: SAIC's new Marine Unexploded Ordnance Survey System is tested in a shallow marine setting in the Outer Banks area of North Carolina.

What We Want From You

The ***FastTIMES*** editors appreciate most any geophysical contribution, but for the June 2008 issue we would like to highlight agricultural applications of geophysics. We also always welcome photographs and brief noncommercial descriptions of new or innovative instruments with possible environmental or engineering applications, news from other geophysical or earth-science societies, notices of upcoming conferences, and brief reports from recent conferences. Please submit your items to a member of the ***FastTIMES*** editorial team by May 15, 2008.

Advertisers

Contents



Geological Mapping
Archaeological Investigation
Groundwater Exploration
Site Characterization
Contaminant Detection
Metal/Ordnance Detection
Geophysical Instrumentation for Engineering and the Environment
Electromagnetic (EM) geophysical methods provide a simple, non-destructive means of investigating the subsurface for an understanding of both natural geologic features and man-made hazards, including bedrock fractures, groundwater contamination, buried waste and buried metal.
An advance knowledge of subsurface conditions and associated hazard potential allows for the design of remediation and monitoring programs that are more efficient and, as a result, more cost-effective.
Simple and non-destructive. Efficient and cost-effective.
GEONICS LIMITED
8-1745 Meyerside Dr., Mississauga
Ontario, Canada L5T 1C6
Phone: 905 670 9580
Fax: 905 670 9204
Email: geonics@geonics.com
www.geonics.com

FastTIMES

FastTIMES is published by the Environmental and Engineering Geophysical Society (EEGS). It is available electronically (as a pdf document) from the EEGS website (*www.eegs.org*).

About EEGS

The Environmental and Engineering Geophysical Society (EEGS) is an applied scientific organization founded in 1992. Our mission:

"To promote the science of geophysics especially as it is applied to environmental and engineering problems; to foster common scientific interests of geophysicists and their colleagues in other related sciences and engineering; to maintain a high professional standing among its members; and to promote fellowship and cooperation among persons interested in the science."

We strive to accomplish this mission in many ways, including (1) holding the annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (**SAGEEP**); (2) publishing the ***Journal of Environmental & Engineering Geophysics (JEEG)***, a peer-reviewed journal devoted to near-surface geophysics; (3) publishing ***FastTIMES***, our society newsletter, and (4) establishing and maintaining relationships with other professional societies relevant to near-surface geophysics.

Joining EEGS

EEGS welcomes membership applications from individuals (including students) and businesses. Annual dues are currently $90 for an individual membership, $50 for a student membership with a ***JEEG*** subscription ($20 without ***JEEG)***, and $650 to $3750 for various levels of corporate membership. The membership application is available at the back of this issue, from the EEGS office at the address given below, or online at *www.eegs.org*.See the back for an explanation of membership categories.

EEGS Office

1720 South Bellaire, Suite 110
Denver, Colorado 80222-4303
(303) 531-7517; 820-3844 fax
staff@eegs.org

FastTIMES Submissions

To submit information for inclusion in ***FastTIMES***, contact a member of the editorial team:

Jeffrey G. Paine
jeff.paine@beg.utexas.edu
(512) 471-1260

Roger A. Young
ryoung@ou.edu
(405) 325-5753

Brad Isbell
bisbell@hgiworld.com
(406) 541-3240

To advertise in ***FastTIMES***, contact:

Jackie Jacoby
staff@eegs.org
(303) 531-7517

The next ***FastTIMES*** will be published in June 2008. Please send articles to a member of the editorial team by May 15. Advertisements are due to Jackie Jacoby by May 15.

Calendar

*Please send additions, errors, and omissions to a member of the **FastTIMES** editorial team.*

2008

March 9–12	GeoCongress 2008: New Orleans, Louisiana
March 14	SAGEEP 2008 early registration and group-rate reservation deadline
March 30–April 3	2008 NGWA Ground Water Summit: Memphis, Tennessee
April 6–10	SAGEEP 2008, Philadelphia, Pennsylvania
April 30–May 2	GARS 2008: Symposium on Geophysics and Remote Sensing in Determination of Near-Surface Structures, Izmir, Turkey
May 27–30	2008 Joint Assembly, Fort Lauderdale, Florida
June 9–12	70th EAGE Conference & Exhibition, Rome, Italy
June 15–18	ICEEG 2008: 3rd International Conference on Environmental and Engineering Geophysics, Wuhan, China
June 15–19	GPR 2008, Birmingham, United Kingdom
July 6–10	XVIII International Conference on Computational Methods in Water Resources, San Francisco, California
September 14–17	Near Surface 2008: 14th European Meeting of Environmental and Engineering Geophysics, Krakow, Poland
October 20–23	24th Annual International Conference on Soils, Sediment, and Water, Amherst, Massachusetts
November 9–14	SEG International Exposition and 78th Annual Meeting, Las Vegas, Nevada
December 1–4	2008 Highway Geophysics–NDE Conference, Charlotte, North Carolina

2009

March 29–April 2	22nd SAGEEP, Fort Worth, Texas

President's Message: Polarity

Jeffrey G. Paine, President *(jeff.paine@beg.utexas.edu)*

First, I cordially invite all to enjoy the fruits of EEGS' year-long labor at SAGEEP in Philadelphia April 6–10. Please be sure to drop by the **EEGS Town Hall** meeting on Wednesday afternoon (April 9), where we'll consume free beer and snacks while dissecting the past and plotting the future.

As another "EEGS Year" (on the SAGEEP cycle) draws quickly to a close, I'm feeling two strong emotions: joy (that it is nearly over!) and sadness (that it is nearly over!). As geophysicists, I suppose we should be accustomed to polarity, and I find that the concept applies just as well outside of geophysics. A couple of examples from the Board experience: it was a long year (monthly board conference calls, fall and spring Board meetings, endless SAGEEP preparations, and literally thousands of emails), and it was a short year (rushing to end conference calls before the allotted time expired; "the abstract deadline was WHEN?" and even "it can't possibly be time for another President's Message," let alone another SAGEEP.

Polarity applies to our thoughts about EEGS too. We've all heard or thought that EEGS is (pick one): too academic or too applied; too lavish or too frugal; too provincial or too ecumenical; too large or too small; too esoteric or too pedestrian. All I know for certain is that EEGS is made up of an intrepid, fear-less, energetic, innovative, entrepreneurial, and hard-working mass of individuals who never cease to amaze. It has been a true pleasure to serve this group for the past year, and I will miss it (and enjoy it) when it's over!

As a society, we have accomplished a lot this year. Your EEGS Board of Directors, key contributors (see the list of names on page 3), and the EEGS staff led by **Kathie Barstnar** and **Jackie Jacoby** were indeed busy. To list a few highlights: we got the EEGS Foundation up and running, we organized the first "Environmental and Engineering Geophysical University" sessions for non-geophysicists at SAGEEP (with financial support from DOE), we made a successful editor transition at the Journal of Environmental and Engineering Geophysics, we will begin serving SAGEEP papers from our web site by the end of March, we entered an agreement with SEG to make SAGEEP and ***JEEG*** papers available through the SEG Digital Library and the American Institute of Physics' Scitation® platform under the "EEGS Research Collection," we navigated a financial crunch, we sent four "Best of SAGEEP" presenters to Istanbul for Near Surface 2007, we enjoyed a wealth of strong board candidates, we've achieved closer ties with other professional societies such as SEG, AGU, EAGE, GSA, NGWA, Geo-Institute, AEEG, ASEG, and AEG India, we inaugurated the EEGS/Geonics Early Career Award, and we've seen ***FastTIMES*** evolve into a widely read electronic newsmagazine and community outreach tool.

Not a bad year, but back to the concept of polarity for a moment: as the amount we do increases, the amount that needs to be done seems to increase at a faster rate! We have tasks aplenty for those who wish to lend a hand to help the society and the discipline grow and mature. If you are so inclined, let me introduce you to **Bill Brown** (bbrown@aeroquest.ca), now at Aeroquest Limited, who will be leading EEGS as President through the next year. Please find him when you get to Philadelphia and let him know that you are willing to help. He's already taking names!

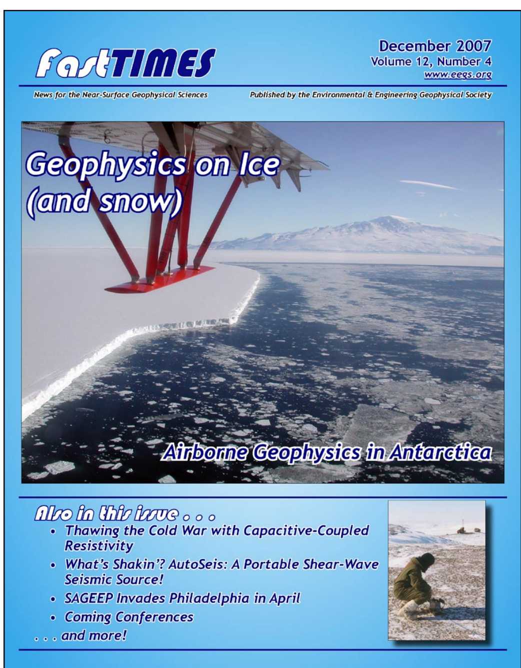
Bill Brown


pulseEKKO® PRO surveying on the mountain glacier Tianshan, China.
For the GPR Professional
Address any application with a keen eye
CMP
WARR
Transillumination
Multi-Channel
The pulseEKKO PRO addresses any GPR application from mineral exploration and glaciology to geotechnical investigations and the examination of concrete structures.
■ Unparalleled performance
■ Unmatched versatility for near surface mapping
■ Broad frequency range from 12.5 to 1000 MHz
■ Fully Bistatic
■ Compact and rugged
■ Multiple deployment configurations
Sensors & Software
pulseEKKO® PRO
by Sensors & Software Inc.
subsurface imaging solutions
www.sensoft.ca, sales@sensoft.ca, Tel: (905) 624-8909, North America: 1-800-267-6013

There are many who should be acknowledged for their leadership, efforts, and assistance this year. At the head of the list are those whose terms on the Board are ending, including **John Clark** (Past President), **Dennis Mills** (Vice President, Committees), and **Dwain Butler** (who has already signed up to be Technical Chair for SAGEEP 2009 in Fort Worth!). Next are those who have led the effort to organize SAGEEP 2008 in Philadelphia, including General Chair **Jon Nyquist,** Technical Chair **Ron Kaufmann**, International Liaison and Exhibition Coordinator **Micki Allen**, and Vice President, SAGEEP **John Stowell**. They, the session chairs, and the entire EEGS staff have outdone themselves this year. Those doing the heavy lifting for the EEGS Foundation include **Bill Doll**, **John Clark**, **Dennis Mills**, **Mark Dunscomb**, **John Nicholl**, and **Bill Barkhouse**. **Bruce Smith** has persistently pursued closer ties with several professional societies. **Janet Simms** is hitting her stride as she completes her first year as Editor of ***JEEG***. **Greg Baker**, **Bill Doll**, **Phil Sirles**, **Bill Owen**, **Mark Dunscomb**, and **David Lesmes** have helped put together the inaugural EEGU sessions at SAGEEP this year. **Roger Young** shepherded us through the first Early Career Award. **Doug LaBrecque** and **Jennifer Holt** led the "Best of SAGEEP" selection process. Of course, there are many not named here who have contributed their time, talent, or funds to make this a successful year, including the entire EEGS Board of Directors, contributors to ***FastTIMES*** and ***JEEG***, SAGEEP presenters and exhibitors, and EEGS individual and corporate members. And finally, a sincere nod of thanks once again to EEGS staff member **Jackie Jacoby**, who has borne the brunt of our deluge of activity with unfailing efficiency, professionalism, and good humor.

From the FastTIMES Editorial Team

FastTIMES is distributed as an electronic document (pdf) to all EEGS members, is sent by web link to several related professional societies, and is available to all for free download from the EEGS web site at www.eegs.org/fasttimes/latest_issue.cfm. The most recent issue (December 2007, cover image below) was downloaded more than 6900 times through February, and past issues of ***FastTIMES*** continually rank among the top downloads from the EEGS web site. Your articles, advertisements, and announcements receive a wide audience, both within and outside the geophysics community.



To keep the content of ***FastTIMES*** fresh, the editorial team strongly encourages submissions from researchers, instrument makers, software designers, practitioners, researchers, and consumers of geophysics—in short, everyone with an interest in near-surface geophysics, whether you are an EEGS member or not. We welcome summaries of recent conferences, notices of upcoming events, descriptions of new hardware or software developments, professional opportunities, problems needing solutions, advertisements for hardware, software, or staff positions, and short research articles or descriptions of geophysical successes and challenges. Contact a member of the editorial team to discuss your ideas!

The *FastTIMES* Editorial Team

Jeffrey G. Paine (jeff.paine@beg.utexas.edu)

Roger Young (ryoung@ou.edu)

Brad Isbell (bisbell@hgiworld.com)

SAGEEP Site Selection

by Dennis Mills, EEGS Vice President, Committees (dmills@expins.com)

As we look forward to SAGEEP this spring in Philadelphia, some EEGS members are already at work planning next years' meeting in Fort Worth, Texas. One of the tasks taken up by the EEGS Board of Directors is the selection of venues for future SAGEEP meetings. This is a continual process of evaluating previous experiences and investigating new possibilities. There are a lot of factors that go into the decision of venue and because participation by the EEGS membership is a crucial part of SAGEEP's success, we want to enlist everyone's aid in the selection process. A perusal of the major factors that affect site selection may answer questions that you have and, hopefully, enable you to make a suggestion or two to the selection committee.

Geographical Consideration

Owing to our historical roots in the Mining Geophysicists of Denver, we have always tried to host SAGEEP in the Colorado environs about every three years. However, a quick study of the map (Figure 1) shows we've made a concerted effort to move the conference around the USA to enable attendance by members in various regions and to expose geophysics to a wider, more diverse audience. Many sites have had typical geophysical targets and associated problems that became subjects for sessions in the Symposium. This can stimulate interest in attendance by people who are not part of our usual circle. SAGEEP can be a terrific outreach tool when used in that way.

Important factors in picking a location include easy air access, sufficient hotel facilities, possibility for local attendance, and a local support group.

Figure 1. SAGEEP locations, 1993 to 2009.

Hotel and Meeting Facility

SAGEEP is a little unusual in its requirements for attendees, meeting rooms, and exhibits. Registrations for the meeting are typically 300 to 400; we use three or four large meeting rooms for the symposium and there may be as many as 45 vendor booths in the exhibit hall. What this translates into is that we're too small for a convention center and too big (in meeting and exhibits) for many smaller hotels. SAGEEP isn't big enough to book space into even a small part of most convention centers. However, only larger hotels have the meeting and exhibit space we need and they won't book it without a guaranteed number of room reservations. So, often the most crucial parameter that we look at in considering a city is: Is there a quality hotel there that can host us?

Access

Choice of a hosting city must also take into consideration attendance by our international members. Site selection has been made on the west coast in hopes of easing travel for Asian attendees. Similar consideration is made for European travelers to sites in Boston, Arlington, and Philadelphia. Most attendees and exhibitors would like to have air access to a city without having to make a regional transfer in order to take best advantage of air fares. As a compromise between housing and transportation, we sometimes move the venue to a second-tier city in an effort to bring hotel costs down. This would be a location close to a city easily reached by air, but typically requiring some kind of extra ground transportation to reach the venue.

On a number of occasions, a city outside of the lower 48 has been considered. Both Canadian and Caribbean possibilities have been discussed at length. However, potential travel constraints have always been the major concern here and so these sites have been pushed down the list. Attendance by the majority of members is crucial at this time in the financial life of EEGS/SAGEEP. A poor showing is a risk that cannot be underwritten right now.

Local Support

Since part of the decision to locate the conference is based on consideration of the regional members, it also requires local participation. In this age of internet access, most of the technical organization is done by remote control. On-site inspections of hotel facilities are often done by EEGS management, but arrangements for off-site events need to be done by others who can do a physical evaluation of an area for, say, outdoor demonstrations. A local organizing committee is also vital to communicating with companies, individuals and institutions that otherwise might not be aware of the Symposium.

Timing

SAGEEP is traditionally held in the spring. The dates have been selected to take best advantage before the summer field season or vacations get into full swing. Timing is usually a secondary decision after city and hotel, but shift by a number of weeks to accommodate availability in the hotel, spring break, and religious holidays. Many of the potential cities which also host state legislatures cannot accommodate SAGEEP while the legislature is in session. A look at the calendar (Figure 2) indicates that in five of the last eight years, we have scheduled the meeting in the first half of April.

Future Sites under Discussion

It is likely that we will attempt to locate a site for the 2010 SAGEEP in the Rocky Mountains. However, after that, the options are many. The cities listed below have been suggested for future SAGEEP meet-

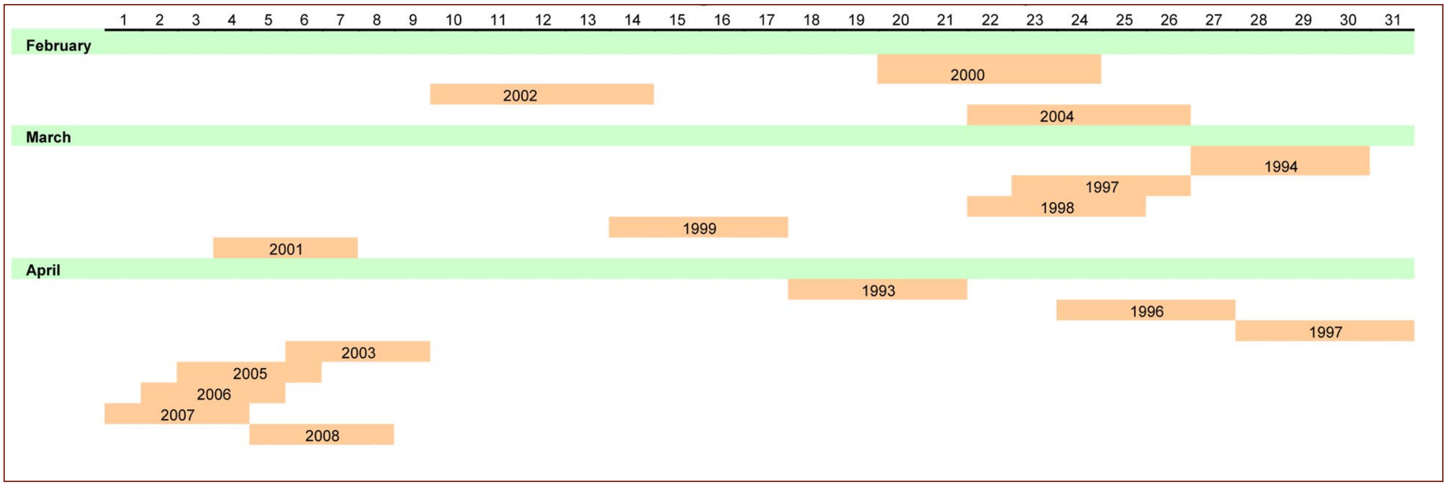


Figure 2. SAGEEP meeting dates (by month).

ings. You will note that with the exception of Knoxville, there is not much representation of the east-central part of the USA and I think there are a lot of possibilities.

- *San Diego*
- *Sacramento*
- *Tucson*
- *Albuquerque*
- *Knoxville*

The SAGEEP Site Selection Committee would like to have your comments and suggestions with regard to venues for meetings in the years to come. We would like to entertain proposals from members, considering the following criteria:

1. *Is the location reasonably accessible by air? If not, is there a balancing feature of the location that makes it worth the extra effort?*
2. *Is the location of interest and will it draw attendees to it? Everyone wants to have choices of places to eat and drink off-site.*
3. *Is there a local community of members that can provide support?*
4. *What is the likelihood of enticing local/regional attendees who might otherwise be outside the usual sphere of influence? This is very important for the exhibitors.*
5. *Is there a quality hotel facility that can host the conference?*
6. *Is there a year that works better for this location than others? Perhaps the possibility of working with another organization's conference at the same time and place?*
7. *Should we consider a SAGEEP outside the U.S. in Canada, Mexico, or the Caribbean?*
8. *Is it time to revisit a previous city? Do you have a favorite location to which you would like to see us return?*

Please send your comments and suggestions to the Selection Committee, c/o Dennis Mills at dmills@expins.com.

GeoCare Benefits Insurance Program

EEGS's GeoCare Benefits Insurance Program recently teamed with Liberty Mutual to offer members Liberty Mutual Advantage™ — a program that provides savings on auto and homeowner insurance, in addition to many other personal insurance plans.

With Liberty Mutual Advantage, members (US members only) will enjoy competitive rates on auto and home insurance based on a discount system including membership, education, age, driver background, and auto equipment.* Auto rates are guaranteed for 12 months and automatic monthly payment is offered with no finance charges.

In addition to auto and homeowners, Liberty Mutual also offers personal umbrella liability insurance, renters insurance, condo insurance, and boat, RV, and motorcycle insurance.

EEGS Members may obtain information about the Liberty Mutual plans by three different means:

1. *Internet Quotes: Quotes and coverage can be accessed on-line 24/7. Go to www.geocarebenefits.com/eegs-autohome.asp.*
2. *Call Centers: The GeoCare toll-free number is 800-789-6419. Call centers are staffed from 8 AM to 11 PM in all US time zones.*
3. *Local Office: A member can be connected to the nearest Liberty Mutual office (during local business hours) by calling 800-225-8281. The call will be transferred according to the member's requested zip code.*

Rates will be the same, regardless which option is used. For maximum discounts, mention your EEGS membership or EEGS's client number (#112949).

General questions regarding this new program may be directed to the GeoCare Benefits Broker's Office at (800) 254-4788.

* Discounts vary by state.

EEGS Sponsorship Opportunities

There are always sponsorship opportunities available for government agencies, corporations, and individuals who wish to help support EEGS's activities. Two specific opportunities are listed below.

Online Delivery of SAGEEP Papers

EEGS already has one founding sponsor (Exploration Instruments) supporting development of an online delivery system to enable SAGEEP papers to be served from the EEGS web site. We are seeking additional sponsors to support maintenance and annual updates. Contact Jeffrey G. Paine, EEGS President, if you are interested (jeff.paine@beg.utexas.edu).

SAGEEP 2009 Sponsorship

SAGEEP is heading to Fort Worth,Texas for 2009. SAGEEP would not be possible without the generous support of government and industry sponsors. Sponsorship opportunities for 2009 are available at all levels, including general conference, individual session, icebreaker, conference bag, speaker and session chair gifts, and the Environmental & Engineering Geophysics University sessions. Contact Micki Allen (mickiallen@marac.com; 905-474-9118) for more information.

Reminder: Please Renew Your 2008 EEGS Membership!

The majority of EEGS members have already renewed for 2008. If you are one of those who haven't yet gotten around to it, please do so now. In addition to the more tangible member benefits (including a print subscription to ***JEEG***, ***FastTIMES*** delivered to your email box quarterly, discounts on EEGS publications and SAGEEP registration, and benefits from associated societies), EEGS counts on your dues to support major initiatives such as producing our annual meeting (SAGEEP), publishing ***JEEG***, making our publications available electronically, expanding the awareness of near-surface geophysics outside our discipline, and enhancing the functionality of our web site to enable desired capabilities such as membership services, publication ordering, and search and delivery of SAGEEP papers. As always, members can renew by mail or fax. EEGS also has an online renewal system. Visit www.eegs.org to take advantage of this capability.

*The **Journal of Environmental & Engineering Geophysics (JEEG)**, published four times each year, is the EEGS peer-reviewed and Science Citation Index (SCI®)-listed journal dedicated to near-surface geophysics. It is available in print by subscription, and is one of a select group of journals available through GeoScienceWorld (www.geoscienceworld.org). **JEEG** is one of the major benefits of an EEGS membership. Information regarding preparing and submitting **JEEG** articles is available at http://jeeg.allentrack.net.*

Contents of the March Issue

Journal of Environmental & Engineering Geophysics

March 2008 Volume 13 Issue 1

Contents

Choon B. Park and Richard D. Miller
Roadside Passive Multichannel Analysis of Surface Waves (MASW) 1

Dalibor Matysek, Helena Raclavska and Konstantin Raclavsky
Correlation between Magnetic Susceptibility and Heavy Metal Concentrations in Forest Soils of the Eastern Czech Republic 13

Fred Kofi Boadu, Frederick Owusu-Nimo and Aboagye Menyeh
Nitrate Contamination in Groundwater at Farmlands in Nsawam, Ghana: The Role of Fractures from Azimuthal Resistivity Surveys 27

Annika Steuer, Bernhard Siemon and Detlef Eberle
Airborne and Ground-based Electromagnetic Investigations of the Freshwater Potential in the Tsunami-hit Area Sigli, Northern Sumatra 39

Author Biographies 49

The Environmental and Engineering Geophysical Society

Journal of Environmental & Engineering Geophysics,

v. 13, no. 1, March 2008

Editor's Scratch

Style. Yes, ***JEEG*** does have style. However, the ***JEEG*** Instructions for Authors have lacked details in how a manuscript should be formatted. This is evident by the wide variety of formats in which manuscripts are submitted. To facilitate the formatting, reviewing, and editing for the authors, associate editors, and me, I have attempted to capture the main style elements in a document that has been posted on both the ***JEEG*** website (http://jeeg.allentrack.net) under "Author Instructions" and the EEGS website (www.eegs.org) under "JEEG / Authors". I encourage all potential ***JEEG*** authors to refer to the style file. Current issues of ***JEEG*** are also a good reference for determining how to format a manuscript. Let's all try to keep in style.

Read on and write on!

Editor-in-Chief

Dr. Janet E. Simms
US Army Engineer R&D Ctr.
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
(601) 634-3493; 634-3453 fax
janet.e.simms@erdc.usace.army.mil

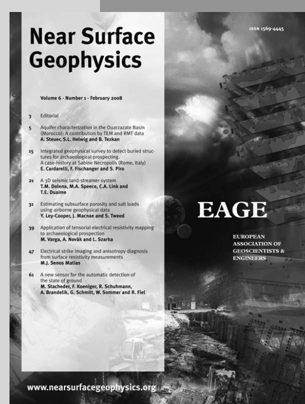
EAGE's Near Surface Geophysics Journal, February 2008

*As a courtesy to EAGE and the readers of **FastTIMES**, we reproduce the table of contents from the February issue of EAGE's **Near Surface Geophysics** journal. The journal is the continuation of the **European Journal of Environmental and Engineering Geophysics** published by the former Environmental and Engineering Geophysical Society — European Section.*

ALSO INTERESTING

Near Surface Geophysics

Volume 6 · Number 1 · February 2008



Content

EAGE
EUROPEAN ASSOCIATION OF GEOSCIENTISTS & ENGINEERS

New Tools

*New tools, whatever the source, are one of the key ingredients to innovation in near-surface applications of geophysics. We continually solicit contributions describing new tools with near-surface promise and have highlighted several instruments in the last few issues. These entries are written by representatives of the companies that make the tools and have been only lightly edited. Of course, these descriptions are provided as a professional courtesy only and neither the **FastTIMES** editors nor EEGS have verified the information presented herein. The **FastTIMES** editors welcome new submittals, to be considered for publication in **FastTIMES** as space is available. We encourage short, noncommercial descriptions that focus on technical capabilities, specifications, and possible applications.*

Marine Unexploded Ordnance (UXO) Survey System

by Chet Bassani, SAIC, Advanced Sensors and Analysis Division, 120 Quade Dr, Cary, NC 27513 USA
(chester.f.bassani@saic.com)

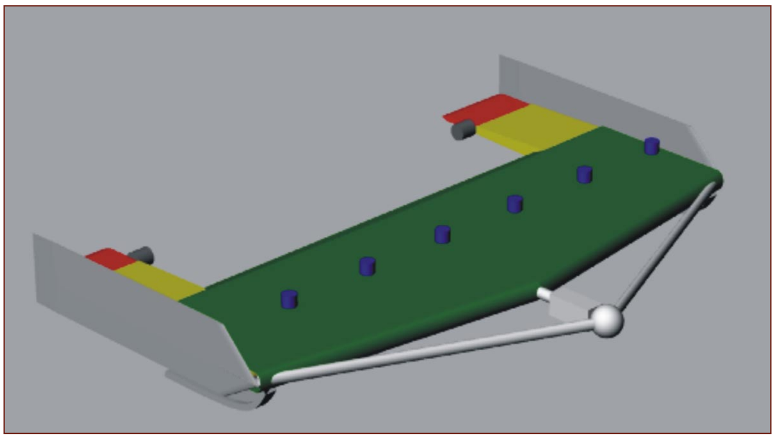


Figure 1. Perspective view of the MTA Sensor Platform showing Cesium magnetometers (blue), stern planes (red), and the wing-shaped body (green).

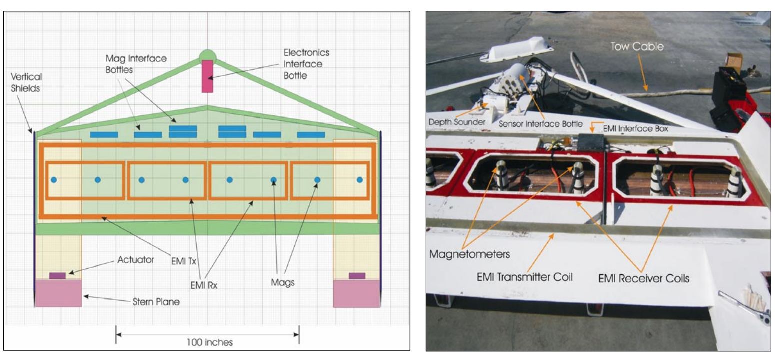


Figure 2. Position of Cesium vapor magnetometers and time-domain EMI transmitter (Tx) and receiver (Rx) coils.

SAIC has developed a unique underwater UXO detection system for use in shallow water with typical depths up to 6 m (20 ft) and a maximum depth of 10 m (30 ft). This new system, known as the Marine Towed Array (MTA) completed its first successful UXO survey on the Currituck Sound in Duck, North Carolina in May 2005. A perspective view of the sensor platform is shown in Figure 1.

The MTA detection capability is derived from two primary UXO sensors, an array of Cesium vapor magnetometers and a time domain electromagnetic induction (EMI) system. There are eight Cesium magnetometers positioned to provide a cross-track spacing of 0.6 m. The EMI system has one large rectangular transmitter (Tx) coil and an array of four receiver (Rx) coils (Figure 2).

The sensor platform orientation is controlled by the two stern planes, which provide pitch and roll stability. The pitch setting also controls altitude above the bottom or depth below the surface. The stern planes are operated by an autopilot using altitude or depth values from sensors on the platform as the command input into a multiple feedback closed-loop system. A platform mounted SONAR altimeter provides altitude above the bottom data and a pressure transducer supplies the depth below the surface. Other inputs affecting the closed loop are the pitch, roll and yaw angles of the platform, rates of change of these three angles, the platform velocity, and the magnetic heading of the sensor platform.

The sensor platform is towed by a thirty foot, triple float pontoon boat with a 140 HP outboard engine (Figure 3). A pontoon boat design was selected for its shallow draft and good stability. It is outfitted to support all field UXO survey operations. Positioning and navigation is derived from a dual-antenna (located at the bow and stern), real-time kinematic (RTK), global positioning system (GPS). Topside electronic instruments provide data acquisition, power distribution, autopilot operation, EM signal control/processing, and ancillary sensor interfaces; these instruments are housed in two standard 19-inch racks with weatherproof enclosures.

Figure 3. Triple float pontoon tow vessel outfitted with equipment for marine survey.

Sensor Platform and Design

Design of the survey system began with the sensor platform. Among the approaches considered were: a single platform with rigidly fixed sensors; sensors mounted on a sled designed to tow along the bottom; a towed sensor platform with an above-water GPS antenna mounted to the platform; and a submerged sensor platform (towed with either a rigid boom or a flexible cable) without an above-water GPS antenna. After extensive modeling, a (flexible cable) towed platform design without an above-water GPS antenna was selected. The platform shape was selected to be a typical wing outline with a curved leading edge and a tapered trailing edge; the top and bottom surface contours are flat and parallel. The wing thickness is nominally 15 cm. The overall width of the sensor platform is 4.7 m and the length is 4.15 m. Rear body extensions were implemented to provide distance between the detection sensors and the actuators required to control the stern planes (Figures 1 and 2). The sensor platform is fiberglass to keep the overall metallic content low. It weighs 590 kg (1300 lbs) dry and it presents an underwater towing force of 1560 N (350 lbs) at 9 km/hr (5 knots) and 5 m depth. The submerged platform is flooded; the combined weight of the platform and contained water is about 1360 kg (3000 lbs).

The Cesium magnetometers are mounted with a spacing of 60 cm so that they do not interfere with the mounting of the EM Rx coils. The magnetometers' output data are received in two groups of four each at a synchronous rate of 20 Hz. This synchronized aspect is achieved by using one magnetometer as a master and having its output daisy-chained with the remaining three magnetometers in its group and again with the other four magnetometers in the second group. The magnetometers are individually connected to the Sensor Interface Pressure Vessel (SIPV), depicted as the Sensor Interface Bottle on the right side of Figure 2. This allows the SIPV diagnostic central processing unit (CPU) to separately monitor each magnetometer's current draw, to disconnect the magnetometer if excessive current draw is measured, and to report the operational status to the topside electronics.

The EMI system has one large rectangular Tx coil measuring 4.5 m by 1.0 m and four Rx coils measuring 1.0 m by 0.5 m. The EMI system has an interconnection box installed between the Tx and Rx coils. This interconnection box also contains the preamplifiers, one for each Rx coil. Each preamplifier conditions the raw Rx coil signal and outputs the signal differentially, which allows topside removal of all common mode noise that may have been picked up along the tow cable.

The stern plane positions are controlled by rotary actuators coupled through a fiberglass linkage mechanism. Each actuator has an integrated optical encoder with a resolution of 0.00176º of output shaft rotation. The output shaft is coupled to the rotary actuator through 1:5 ratio harmonic drive gearing. This harmonic drive gearing produces zero backlash because each gear is engaged on both sides of the tooth flank. It also has a very high torque/weight ratio because approximately 30 % of the teeth are engaged at all times. The actuator mechanical output is rated at 60 N-m (45 lb-ft); it draws a maximum of 4 amps at a supply voltage of 28 Vdc. The actuators have three modes of control: position, velocity, or torque. Each primary control mode uses the other two as operational limits. All communications are handled through data commands and acknowledgments with integrated communication timeouts to prevent possible runaway conditions. Each actuator has mechanical rotation stops to prevent mechanical damage, which could result from malfunctions. During software initialization, the control interface routines command the actuator to rotate in one direction until no motion is detected. The software then determines the encoded position and commands the actuator to rotate in the opposite direction until no motion is detected. Once encoder positions for both mechanical stops are known, software limits are calculated, which are just inside the mechanical stop locations. After initialization, the control interface routines await position commands from the autopilot software module.

The SIPV contains all the ancillary sensors and interfaces for the sensor platform. These include a pressure transducer (for depth), a tactical-grade Inertial Measurement Unit (IMU), a platform magnetic heading compass, and internal pressure vessel temperature and humidity sensors. The IMU has an accelerometer bias of 1 milli-g and a gyro bias of 1º/hr. It performs internal raw sensor adjustments and compensations at 600 Hz. The IMU outputs flight control information at 600 Hz and inertial data at 100 Hz. An internal CPU constantly monitors mag sensor and actuator currents, as well as the various supply voltages. All diagnostic information is acquired at 10 Hz and serially transmitted topside for monitoring and recording via the Data Acquisition System (DAQ). All RS-232C sensor output signals are converted into RS-422 levels prior to exiting the SIPV to the tow cable.

Tow Cable

The tow cable has all of the electrical wiring embedded in addition to an integral Kevlar strain member, which has a working load rating of 4.5 kN (1000 lbs) and a breaking strength of 24.5 kN (5500 lbs). The tow cable has two topside tow point connections, one at 16 m length and a second at 22 m. The 22-m length allows routine submerged operation up to 7 m depths, whereas the 16 m cable length is used for 5 m maximum depths. A stainless steel cable weak link is used as a safety release topside to connect the tow cable to the tow point on the vessel. This weak link is designed with a breaking strength of 6 kN (1350 lbs), approximately four times our operating force and one fourth of our tow cable breaking strength.

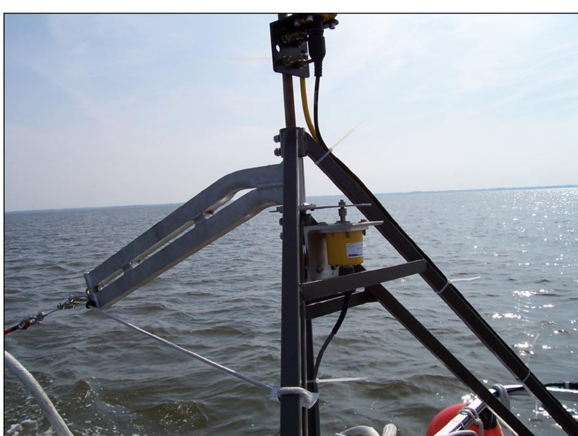


Figure 4. Tow point mechanism to allow tow cable angle measurement and provide GPS equipment mounting. The optical encoder and the tow cable weak link are visible.

The tow cable connects to the tow point mounted at the stern of the vessel (Figure 4). The tow point is a specially designed fixture that allows us to measure the cable azimuth angle with respect to our vessel heading. It is comprised of a free-wheeling arm coupled to an optical encoder through two spur gears. The arm is mounted on the shaft through two needle bearings with top and bottom thrust bearings yielding a very low movement resistance. The optical encoder has a resolution of 0.1º and is read through a dedicated CPU that is used for positional calibration and output data formatting. Its output data are transmitted serially to the DAQ at 10 Hz.

The tow point fixture also serves as the primary GPS antenna mounting location and provides the mounting for the two-way RF radio communications link to the RTK GPS base station. The tow cable topside connections are quick disconnect; they are designed to release at 220 N (50 lbs) of tension. This feature prevents any permanent damage if the sensor platform is snagged and causes the stainless steel weak link to break. If the weak link breaks and the vessel operator is not able to stop the vessel fast enough, the tow cable becomes disconnected with a rope and a buoy attached to it for easy recovery.

GPS and Navigation

A dual-antenna RTK GPS system provides positional control and navigation. The primary antenna is directly above the tow point and the second antenna is mounted at the bow of the vessel. This arrangement provides a vessel heading measurement, a pitch measurement, and the primary location measurement of our tow point. With the vessel tow point location, heading measurement, tow cable angle, and the sensor platform depth, we can calculate our sensor platform tow point. After we have located our sensor platform tow point, we use the sensor platform magnetic heading and the sensor mounting positions to determine the exact location of the magnetic sensors (Figure 5).

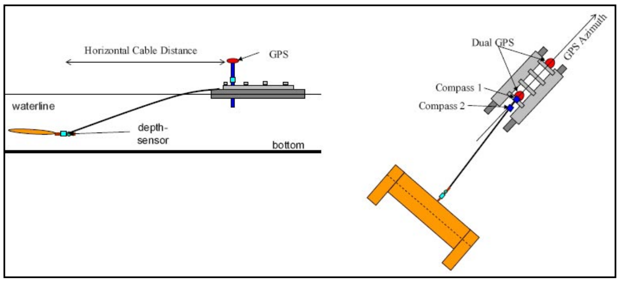


Figure 5. Equipment locations and parameters required for positional calculations.

The RTK GPS system outputs positional information at 10 Hz. The horizontal positional accuracy is ± 1 cm while communicating with the stationary land based RTK base station. Wireless RF communication between the vessel and the base station is supported by Frequency Hopping Spread Spectrum (FHSS) radios. The GPS positional data are recorded by the DAQ and also used by the real-time navigation system.

The real-time navigation system is used to produce survey lines. All survey lines are pre-programmed with start and ending coordinates; this file is transferred to the navigation system for pilot guidance. Line spacing is typically 4 m to minimize data gaps and maximize production rates. The navigation system also uses the tow cable angle information with a selectable fixed tow cable length to calculate the x and y location of our sensor platform as it is the primary vehicle that we are trying to steer for proper areal coverage. The navigation system displays a line representing the tow cable with the vessel tow point at the beginning of the line and the sensor platform tow point at the end of the line. This display method allows the vessel operator to visualize the boat position along with the sensor platform position relative to the survey line. The survey line display shows the vessel and sensor tow point locations and also incorporates a left/right indicator bar showing the actual offset of the sensor platform from the planned survey line. The second navigational aid available to the driver is the vessel SONAR altimeter mounted at the bow of the vessel. This SONAR altimeter measures the depth of the water; the data are recorded by the DAQ and are also displayed for quick viewing (Figure 6). The water depth data are sampled at 10 Hz.

The third navigational aid is a High Frequency Imaging SONAR system. This system operates at two discrete frequencies: 1.1 MHz and 1.8 MHz. The SONAR system is mounted at the bow of the tow vessel with a slight downward angle to produce an intersection point with the bottom forward of the vessel. Its mounting mechanism is similar in design to the vessel SONAR altimeter allowing easy recovery and storage when not surveying. It is set to scan at 5 Hz; all its imaging data are stored on its own rackmount computer. This computer also controls all operating parameters of the SONAR imaging head through an ethernet communications link. Its control software allows for different frequencies of

Figure 6. Navigational aids. The water depth indicator is immediately left of the steering wheel: The survey line display is to the right (and above) the steering wheel.

Figure 7. Instrument racks. Right rack: DAQ system with keyboard and LCD open. Left rack: SAIC DC power distribution unit (PDU).

operation, selectable focal length, selectable field of view, and displays internal parameters such as temperature and supply voltages.

Data Acquisition

All data are stored on the DAQ (Figure 7). This DAQ is implemented through a dual Pentium 4 rack-mount computer, which operates at a 2.4 GHz clock speed and runs MS Windows XP Pro©. It stores all the acquired data onto a hard drive for removal and archiving. One of the major design concerns was the accurate time stamping of all measured data because MS Windows© is not a real-time operating system. Measured data are stored, along with the system time, which can drift throughout the duration of a survey. This time drift is not predictable nor linear, which creates many problems. The most obvious time reference to use is GPS UTC time. In the past, our MTADS systems have used the 1 Pulse Per Second (1PPS) from the GPS system to trigger an interrupt routine that would automatically store the UTC time and the system time in one file. This file was later used to synchronize the two times to reduce timing errors between measured data and positional fixes. Accurate positional fixes alone are of no value if the fix cannot be accurately referenced to the measured data.

The SAIC MTA DAQ overcomes this problem by incorporating two novel methods. The first method employs a complete second GPS system with its own antenna. This GPS system is a PC interface card plugged directly into the PCI bus. It reads and decodes the GPS UTC, and its software allows the MS Windows© system clock to be skewed such that it tracks the GPS UTC. It is accurate to within 1 microsecond of GPS UTC. The second method that we implemented involves kernel-level serial port drivers that timestamp each incoming byte as it arrives in the serial port input buffer. This time stamping is not affected by any Windows© latency and is derived from the 64-bit, high-performance counter that resides in hardware on the motherboard. This high-performance counter has a resolution of 1 nanosecond and is read at each integer second. When the DAQ software reads the serial port data, it also reads the time stamp and calculates the serial port time of arrival relative to the system clock, which is GPS UTC. This is the time that is stored in the data file, along with the sensor data.

Autopilot

The autopilot control software is executed on its individual rack-mount computer. This computer interfaces to the sensor platform instruments and the vessel GPS. Its inputs are from the IMU, acknowledgment feedback from the rotary actuators, pressure transducer output for platform depth, sensor platform magnetic compass output, and topside GPS-derived velocity. The autopilot outputs data to the rotary actuators and to diagnostic files. It has two normal modes of operation and one "Emergency Rise" mode. The two normal modes of operation are altitude (above bottom) control or depth (below surface) control. When in altitude control mode, the autopilot maintains a constant distance above the bottom (as measured by the sensor platform SONAR altimeter). The altimeter has a resolution of ±1 cm. When in the depth control mode, the autopilot maintains a constant depth below the surface (measured by the sensor vessel pressure transducer). The third mode is "Emergency Rise", which is invoked when the large red "Emergency Rise" button is pressed. This button can be seen in the left instrument rack (Figure 7). When "Emergency Rise" is initiated, the autopilot overrides all commands and executes a controlled (steep) upwards sensor platform pitch to bring the platform to the surface. This emergency mode must be reset by operator intervention on the autopilot graphical user interface (GUI). This GUI also displays operating parameters of the sensor platform, such as pitch and roll angles, rate of change of pitch, roll and yaw, angle of the stern planes, and the platform depth and altitude.

Accomplishments

The SAIC MTA UXO system completed its first UXO range survey in Duck, North Carolina on the Outer Banks in May 2005. This range survey was conducted in the Currituck Sound offshore from the former Naval Duck Target Facility. The average survey production rate varied from 1.2 to 3.6 hectares/hr (3 to 9 acres/hr) depending on survey line length, water depth, and the weather conditions. A total of 62 hectares (154 acres) was surveyed between May 9 and May 18, 2005.

To determine the positional accuracy of the system, 23 rebar rods 46 cm (18 in) long and 1 cm (3/8 in) diameter were pushed into the sea bottom vertically. The positions of the rebar rods were then surveyed using a rover-type RTK GPS utilizing the same base station as the survey vessel. The rods were then surveyed with the SAIC MTA UXO system and the data were analyzed as though they were ordnance anomalies using the MTA DAS. Plots were produced from the magnetic field readings, targets were analyzed, and center positions of these analyzed targets were then compared to the surveyed positions. The rebar positions were recovered to an average 22 cm from the target analysis (Table 1).

As shown in Table 1, the average positional accuracy was within 0.22 m. This level of accuracy allowed the recovery team of Explosive Ordnance Disposal (EOD) divers to directly stake out targets from the target list provided without the use of an underwater magnetometer for precise location. This positional accuracy has shown the SAIC Marine Towed Array to be a very efficient underwater surveying system with the ability to search for and precisely locate UXO.

Capabilities

Deliverable products of an SAIC MTA survey include magnetic anomaly, magnetic total field, bathymetry, and electromagnetic anomaly maps (Figure 8). There is also a target dig list produced with locations and calculated target parameters of size, inclination, azimuth, and depth. The high frequency SONAR imager data is stored on DVD discs and available for playback along the surveyed paths.

Acknowledgments

Work described in this article was conducted under ESTCP Project 2000334 and SERDP Project UX-1322. Results are more fully described in "Technology Needs for Underwater UXO Search and Discrimination," Final Report for SERDP Project UX-1322.

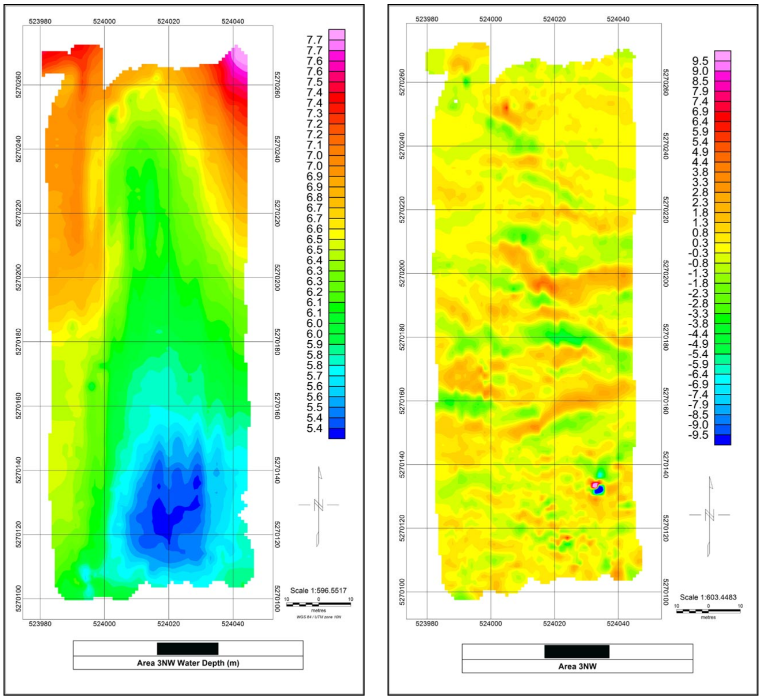


Figure 8. Bathymetric map (left) and magnetic anomaly map (right).

Table 1. Comparison of rebar stakeout coordinates and analyzed measured coordinates.

						Measured coordinates		Staked coordinates					
ID	HE (m)	Size (m)	Mo-ment	Fit quality	Analyst comments	UTM x (m)	UTM y (m)	Easting (m)	Northing (m)	HAE (m)	Miss (m)	x offset (m)	y offset (m)
1	-42.78	0.183	3.2675	0.776	Rebar #1	431751.28	4003800.07	431751.15	4003799.98	-41.27	0.15	-0.13	-0.09
2	-42.74	0.183	3.2548	0.896	Rebar #2	431750.94	4003804.37	431750.97	4003804.01	-41.31	0.36	0.03	-0.36
3	-42.70	0.152	1.8492	0.913	Rebar #3	431750.33	4003808.94	431750.24	4003808.79	-41.32	0.18	-0.09	-0.15
4	-42.76	0.185	3.3234	0.925	Rebar #4	431749.85	4003813.63	431749.54	4003813.41	-41.34	0.39	-0.31	-0.23
5	-42.77	0.227	6.2274	0.917	Rebar #5	431749.27	4003817.83	431749.08	4003817.70	-41.34	0.23	-0.19	-0.14
6	-42.75	0.233	6.7297	0.938	Rebar #6	431748.59	4003822.75	431748.43	4003822.60	-41.40	0.22	-0.16	-0.15
7	-42.80	0.238	7.1657	0.869	Rebar #7	431748.12	4003828.91	431748.03	4003828.76	-41.38	0.18	-0.09	-0.15
8	-42.86	0.152	1.8587	0.844	Rebar #8	431747.84	4003834.38	431747.71	4003834.47	-41.38	0.16	-0.13	0.09
9	-42.96	0.179	3.051	0.670	Rebar #9	431747.54	4003839.66	431747.85	4003839.77	-41.35	0.33	0.31	0.11
10	-42.81	0.164	2.3149	0.812	Rebar #10	431747.46	4003845.51	431747.60	4003845.54	-41.35	0.14	0.13	0.03
11	-42.96	0.227	6.158	0.781	Rebar #11	431747.38	4003851.16	431747.59	4003851.04	-41.36	0.24	0.21	-0.12
12	-42.98	0.247	7.9884	0.741	Rebar #12	431747.08	4003856.67	431747.29	4003856.63	-41.33	0.21	0.21	-0.04
13	-42.88	0.225	6.0604	0.804	Rebar #13	431746.92	4003861.84	431747.02	4003861.93	-41.44	0.13	0.10	0.09
14	-43.06	0.178	3.0023	0.840	Rebar #14	431746.74	4003866.75	431746.80	4003866.65	-41.33	0.11	0.06	-0.10
15	-42.78	0.23	6.4742	0.846	Rebar #15	431746.49	4003871.69	431746.58	4003871.62	-41.29	0.12	0.09	-0.07
16	-42.77	0.267	10.104	0.836	Rebar #16	431746.17	4003876.85	431746.27	4003876.69	-41.31	0.19	0.10	-0.16
17	-42.73	0.211	4.9436	0.804	Rebar #17	431745.95	4003881.70	431746.02	4003881.46	-41.26	0.25	0.07	-0.24
18	-42.59	0.133	1.2429	0.801	Rebar #18	431745.68	4003886.82	431745.78	4003886.76	-41.27	0.12	0.10	-0.06
19	-42.66	0.177	2.9581	0.934	Rebar #19	431745.51	4003892.23	431745.51	4003891.88	-41.25	0.36	0.00	-0.35
20	-42.58	0.192	3.7376	0.916	Rebar #20	431745.36	4003896.54	431745.24	4003896.23	-41.25	0.33	-0.12	-0.31
21	-42.56	0.148	1.7247	0.949	Rebar #21	431745.31	4003901.58	431745.03	4003901.39	-41.23	0.34	-0.28	-0.19
22	-42.81	0.19	3.6296	0.861	Rebar #22	431744.76	4003906.77	431744.76	4003906.78	-41.26	0.01	-0.01	0.01
23	-42.89	0.241	7.4097	0.716	Rebar #23	431744.34	4003911.56	431744.61	4003911.23	-41.95	0.43	0.27	-0.33
										Avg.	0.22	0.14	0.16

Success with Geophysics: Stories from the Field

FastTIMES welcomes short descriptions of successful (or unsuccessful, for that matter; it can be therapeutic to admit a momentary setback!) applications of geophysics to near-surface engineering or environmental problems.

Prospecting for Groundwater in Italy with TDEM

by Antonio Menghini, Consulting Geophysicist, Via Monte Bianco, 5 – 01100 Viterbo – Italy (menghini@stega.it)

Figure 1. Geophysicist with a Geonics Protem TDEM receiver and receiver coil (at right).

Near-surface geophysics demands a higher precision, in comparison with geophysical applications for oil, geothermics, or crustal exploration, because a mistake of a few meters in resolving a fixed target may cause the complete failure of the prospection. This is the case of groundwater research in difficult hydrogeological settings, where it is crucial to define, in the best way as possible, the top of the impermeable substratum which sustains the upper aquifer.

I show the results of a TDEM (time domain electromagnetic induction) prospection on an area that is located close to Canino (Viterbo, Italy), where olive-tree plantations (Figure 1) are common. The survey area is part of the Vulsinian apparatus, one of the main volcanic complexes of central Italy, which was active during Pleistocene. Bolsena Lake, which is located a few kilometers from the survey area and is the largest volcanic lake in Europe, was the product of this intense explosive activity. Tuffs that crop out in the area commonly have high permeability; they may constitute a volcanic aquifer. The underlying clays (Pliocene age) are impermeable; they constitute the bottom of the aquifer.

The presence of the volcanic aquifer is confirmed by a municipal spring (called Fontarsano), which is located about 1.3 km to the east of the survey area (Figure 2). It spouts at an elevation of 129 m above sea level (a.s.l.) and it has a high discharge (about 30 l/s). This spring is fed by an aquifer coming from north and northeast. The piezometric lines show the elevation of the aquifer (Figure 2). We can verify a preferential drainage axis that is oriented toward the south at a hydraulic gradient of about 1 %.

In the survey area, situated at an elevation of 130 to 134 m a.s.l., we expect a piezometric elevation of 110 m a.s.l., which translates to an aquifer depth of about 20 to 24 m. Obviously groundwater flow will be effective only in the case in which the top of the clays (the impermeable substratum) rest at a lower elevation. TDEM prospection was used to accurately determine the depth to the top of clays.

I performed four TDEM soundings (Figure 3) using the following Geonics equipment:

a) *Protem receiver*

b) *EM47 Transmitter*

c) *high-frequency Rx Coil*

d) *Transmitting loop measuring 20 x 20 m.*

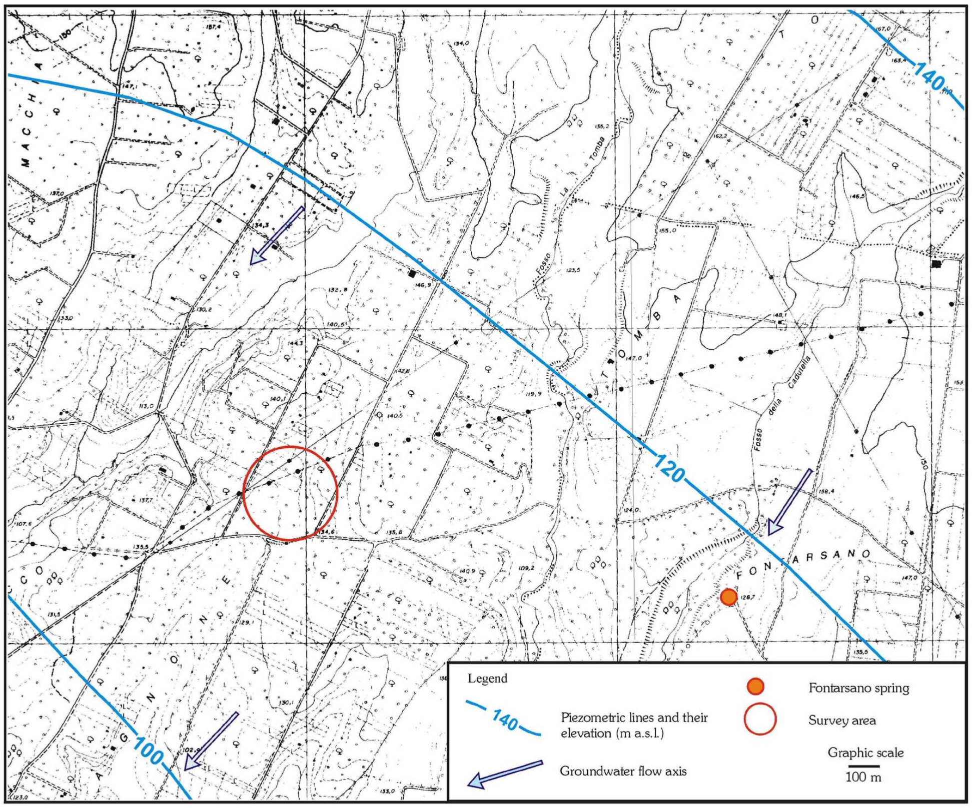


Figure 2. Hydrogeologic map of the survey area.

TDEM soundings were interpreted using Temix-GL (Interpex Ltd). They detected 3 different layers, with decreasing resistivity from the surface to the bottom. The first one has a high resistivity (between 67 and 81 ohm-m) and it can be interpreted as tuffs of the Vulsinian apparatus. Thickness of the shallowest layer ranges from 15 to 25 m. The second layer is more conductive (10 to 13 ohm-m). It is constituted by Pliocene clays. The third layer is most conductive (3 to 6 ohm-m); it is also interpreted to be formed by clays. Figure 4 shows a typical one-dimensional model: on the left the apparent resistivity vs. time curve is shown. On the right, the best-fitting model (continuous line) and the equivalent models (dashed lines) are drawn.

To get a clearer view of the results, an EM section (Figure 5) was constructed using Winglink software, Geosystem s.r.l. The section, oriented from southeast to northwest, includes all the TDEM soundings. Layered models (achieved by Inman inversion) are represented by columns, with numeric values showing absolute resistivity of the single layers. Occam inversions are depicted in the

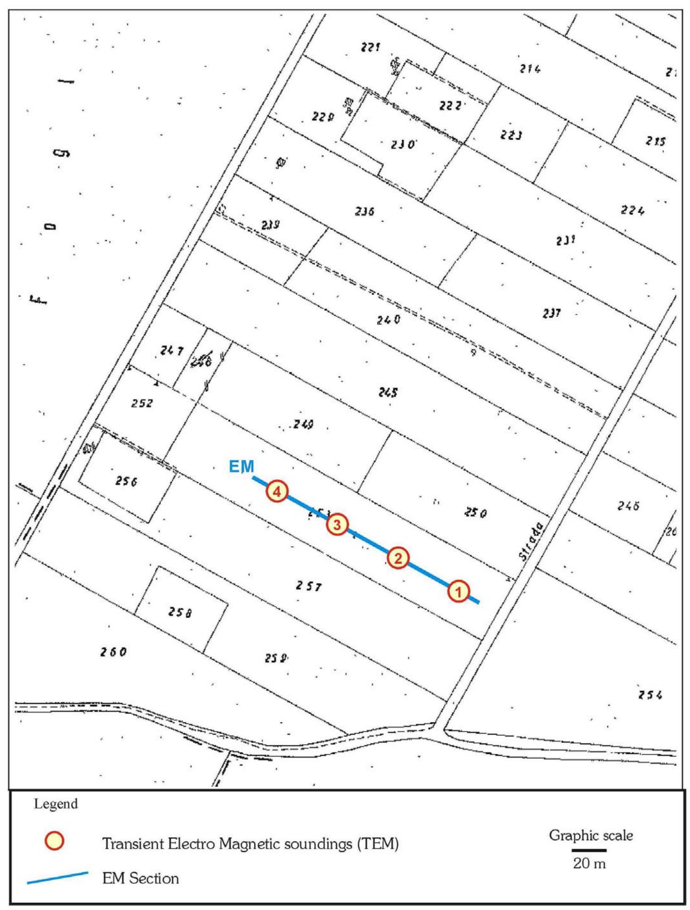


Figure 3. Location of TDEM soundings.

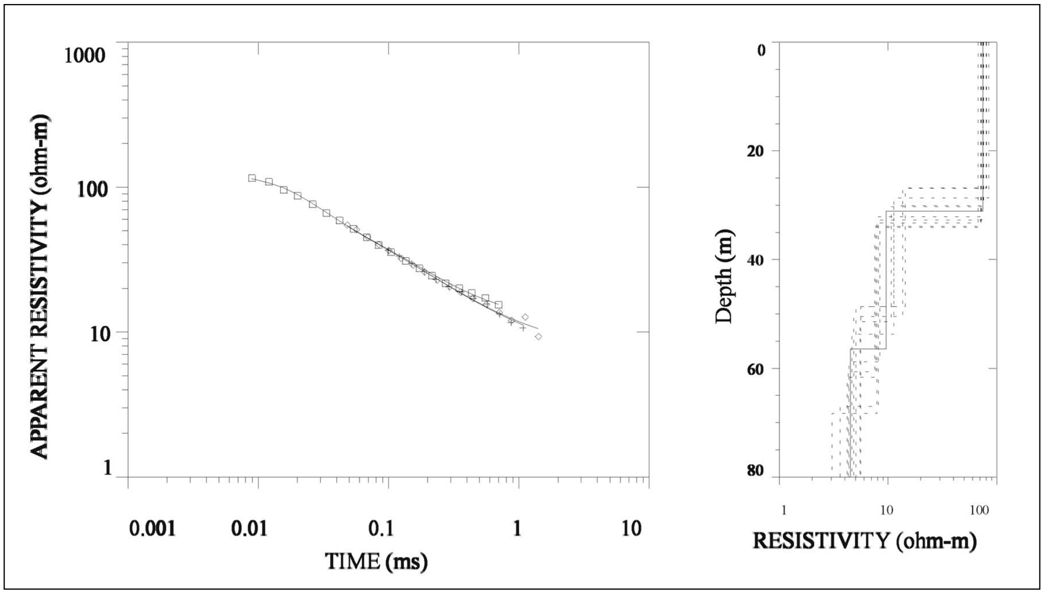


Figure 4. TDEM measurements and models, including the apparent resistivity-time curve (left) and one-dimensional layered models (right). The best-fitting model is shown as a continuous line and equivalent models are shown as dashed lines.

background color contouring. The palette is arranged so that blue colors represent conductive layers, whereas red colors represent resistive layers. Tuffs are well-defined by the orange-red zone; the clayey substratum is represented by blue colors.

Along the TDEM section (Figure 5), the piezometric level (as determined from hydrogeological data) is shown as a dashed blue line. It is clear that the most promising groundwater prospect is between TDEM 1 and 2, where the clay substratum is deeper and we can expect a greater aquifer thickness. The increase would be only 6 to 8 meters and this section may not be productive. Moreover we must take into account the approximation in resolving the top of the clays and, at the same time, the approximation in defining piezometric lines. The aquifer thickness may be less than that determined from TDEM soundings. Thus, the effective detection of groundwater can be considered a challenging task.

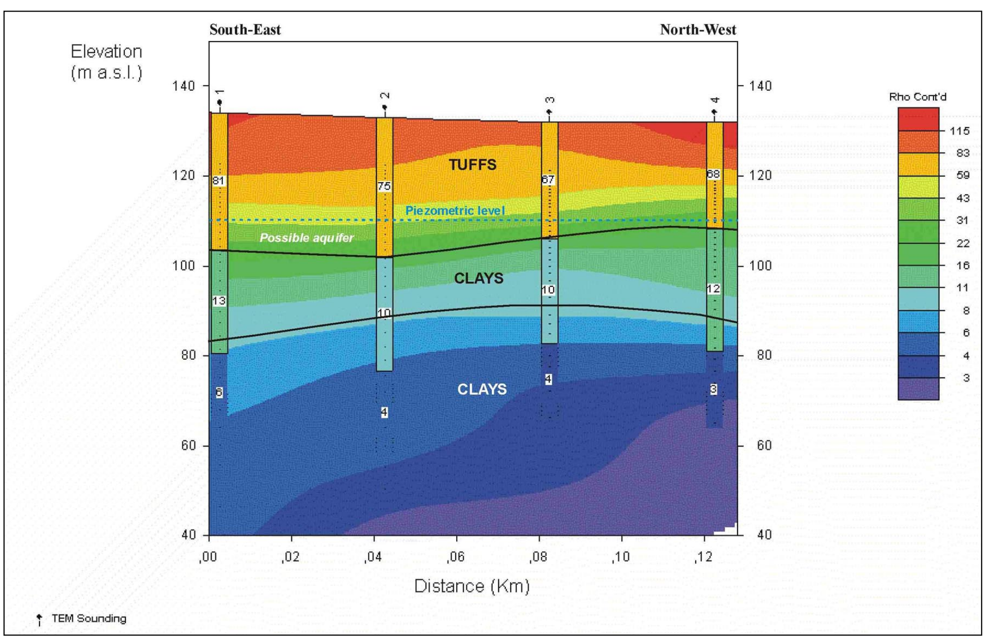


Figure 5. TDEM cross section depicting layered models (columns) and smoothed models (background contouring).

A well was drilled between TDEM soundings 1 and 2. The first formation penetrated was grey-brownish tuffs with interbedded sandy layers ("pozzolane"). These strata were present to a depth of 18 m. The second layer consists of

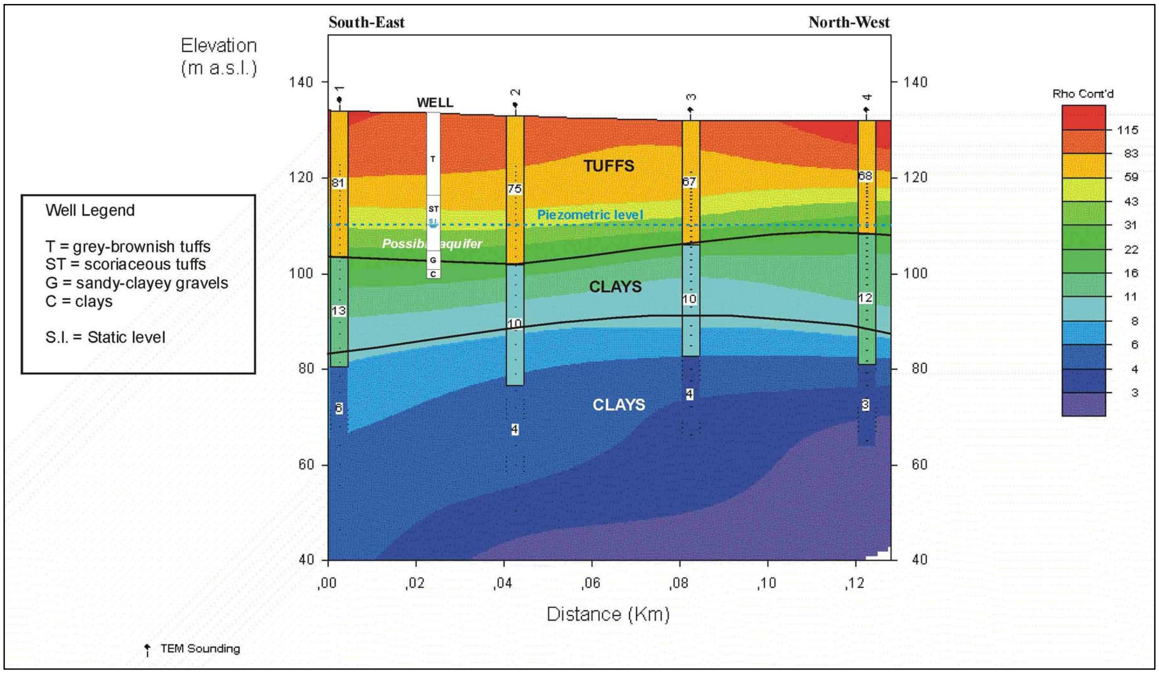


Figure 6. TDEM section including well data.

scoriaceous tuffs and it is present to a depth of 30 m. It represents the local aquifer. Volcanics rest upon a sedimentary substratum that is formed by sandy and clayey gravels, having a thickness of about 4 m. This formation includes yellow-brownish clayey lenses. The well bottomed in one of them at a depth of 36 m. I decided not to drill deeper because TDEM data show the absence of other aquifers to a depth of at least 80 m (Figures 5 and 6).

The most significant groundwater flow comes from the scoriaceous tuffs and, subordinately, from gravels. The well was completed by the setting of the casing, filters, and gravel (pre-filter). The hole was completely cleaned by air lift. Discharge was estimated to be about 0.5 l/s. The static water level was measured at a depth of 24 m, as expected by the hydrogeological data (Figure 2). Thus, the aquifer has a thickness of about 10 m.

If we compare the stratigraphic data with the geophysical model, we see excellent agreement. I have drawn stratigraphic data on the EM section (Figure 6) and it is quite clear that the method was able to resolve the depth of clays, with negligible error.

It must be noted that a different location of the well (even in the order of a few tens of meters) would have provided poor results. Thus, geophysics contributed to save money and time by avoiding the drilling of dry wells and by helping to locate the most productive area.

Pseudo-3D Sub-bottom Imaging in the Bay of Fundy: An Inter-tidal Adventure

by Karl E. Butler[1], Richardo O. White[1], and Peter G. Simpkin[2]
[1]Department of Geology, University of New Brunswick, PO Box 4400, Fredericton, New Brunswick, Canada (kbutler@unb.ca, richardo.white@unb.ca)
[2]IKB Technologies Limited, 51, Raddall Avenue, Unit 10, Dartmouth, Nova Scotia, Canada (seistec@eastlink.ca)

Introduction

The Bay of Fundy, located between the provinces of New Brunswick and Nova Scotia, on Canada's east coast, is famous for tides that are among the highest in the world, exceeding 15 m in some locations. This tidal range, combined with the geological setting, has generated a remarkable coastline which includes expansive salt marshes and mud flats, tall cliffs of sedimentary rock that have yielded flower pot islands and fantastic Carboniferous fossils, and a wide variety of beaches, deltas, and estuaries shaped by the interplay between tides, wave and storm activity, and river discharge.

In 2003, near-surface geophysicists from the University of New Brunswick fell under the influence of some near-surface sedimentologists who were enthusiastically extolling the virtues of the Bay of Fundy as a natural laboratory for the study of coastal sedimentary processes. The inevitable result was the birth of a collaborative project that involved shallow seismic profiling at high tide over interesting depositional environments that could be examined with shovels and a keen geological eye at low tide. At the same time, one of these groups, ever on the lookout for ways to make things more complicated, recognized an opportunity to experiment with strategies for pseudo-3D seismic imaging in shallow water.

This article summarizes our experience in applying a novel swath seismic profiling approach to the study of Waterside Beach (Figure 1) located near Alma, New Brunswick in the upper Bay of Fundy (White and others, 2006). Our intention was to test a pseudo-3D approach that might be cost-effective at the scale of engineering site investigations involving proven instrumentation. Unlike true 3D surveying, sampling in the cross-line direction would remain coarse relative to the width of Fresnel zones at the target depth and relative to the trace spacing in the in-line direction. Instead, our approach was to collect a "swath" of three parallel lines of data with every pass of the boat, achieving sufficient data density and positioning precision to allow heave and tidal effects to be removed and geological cross-line

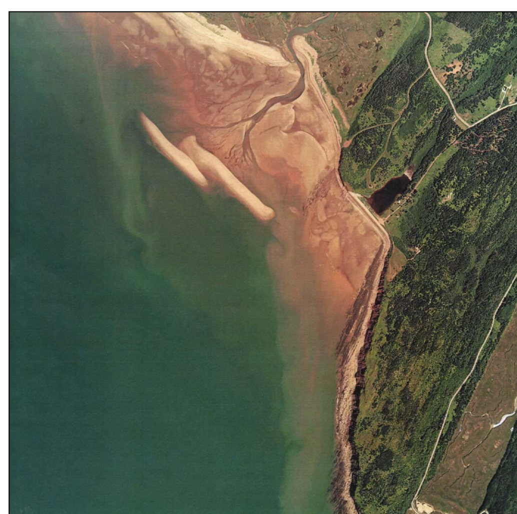


Figure 1. Left: view of the steep, lee side of one of the large gravel bars on Waterside Beach. Right: an aerial view of the southeast end of the beach in 2001 with two bars visible at an intermediate tidal stage. Photos courtesy of S. Dashtgard and Service New Brunswick respectively.

dips to be resolved, thereby producing high resolution subsurface maps without the prohibitive cost of acquiring a full, fine grid, 3D dataset.

As detailed by Dashtgard and others (2006), Waterside Beach is a transgressive, mixed sand and gravel beach, backed (and underlain) by salt marsh deposits along most of its length. The beach is approximately 4 km long and oriented northwest–southeast, perpendicular to the prevailing southwesterly winds. It is a high-energy environment that experiences semidiurnal tides with spring and neap tidal ranges of approximately 12 and 6 m respectively, resulting in the exposure of up to 1200 m of intertidal zone. The most remarkable feature of the beach are large gravel bars (Figure 1) measuring up to 800 m long and 6 m high that are exposed at low tide opposite a tidal creek that cuts into the beach and salt marsh deposits. Sub-bottom profiles and grab samples acquired as part of this study (Dashtgard and others, 2007) have revealed that the source of sediment for these massive bars is a glacial outwash deposit exposed subtidally at the toe of the beach directly offshore of the bars. The bars have been observed to migrate landward at up to 50 m per year – their height decreasing as they move up through the intertidal zone. Muddy sediments are deposited in the protected part of the intertidal zone immediately landward of the bars. Elsewhere, the intertidal zone is dominantly composed of sand and/or gravel with sporadic exposures of the underlying salt-marsh deposits throughout the upper intertidal zone.

Data Acquisition

Figure 2. A happy crew with the two IKB-SEISTEC™ sub-bottom profilers upon return to the wharf in Alma. Access to and from the wharf was restricted to a 6-hour window around high tide. Boats sit on the bottom at low tide.

Our instrumentation was based on a pair of IKB–SEISTEC™ single channel profilers, equipped with GPS antennas (Figure 2). The Seistec system employs a broadband electrodynamic boomer source and a vertical line-in-cone receiver mounted 75 cm apart on a rigid, floating frame. Sub-bottom reflections typically exhibit a dominant frequency of 4 to 5 kHz and a bandwidth of several kHz, providing vertical resolution of 15 to 20 cm in marine sediments. The short source–receiver offset and fixed geometry are optimized for shallow-water operation (Simpkin and Davis, 1993).

To collect three parallel lines of data efficiently, we designed outrigger arms, as well as a shot triggering and recording system that allowed two SEISTEC profilers to be fired alternately while being towed in parallel 12 m apart behind a single boat. This strategy allowed for the collection of a swath of three profiles (one below each profiler and one half-way between) with every pass of the boat, thereby reducing acquisition time. The typical firing rate on each profiler was 0.375 s thereby giving an inline trace spacing of 0.75 m on the outer lines (and 0.375 m on the middle line) at the nominal boat speed of 2 m/s (4 knots). A photograph of the two SEISTEC profilers under tow (Figure 3) also shows plastic garbage bins that served as inelegant but effective “helmets” to protect the GPS antennas from banging against the side of the boat during deployment.

We originally, optimistically envisioned that adjacent swaths would be centered 18 m apart, so that the final data set would have a trace spacing of just 6 m in the cross-line direction. In addition, each SEISTEC profiler was to be equipped with a dual-frequency RTK GPS receiver capable of providing

Figure 3. Sub-bottom profilers under tow, 12-m apart during the swath seismic/pseudo-3D field trial. The starboard outrigger can also be seen.

positions accurate to within a few cm with the aid of differential corrections that would be broadcast from a third receiver stationed on land a few km away. In practice, however, our experienced skipper had trouble following tightly spaced lines due to winds and tidal currents; hence, swath spacing was changed from 18 m to 50 m. Furthermore, problems with the RTK radios and with the one of the RTK receivers forced us to use a sub-meter grade GPS receiver on one profiler and rely on post-processing of the dual frequency GPS data from the other profiler to obtain the required accuracies for tidal heights (a successful but very time consuming exercise).

Figure 4 illustrates the coverage obtained in an area measuring roughly 1.5 by 1.4 km showing just the two outer lines on each swath.

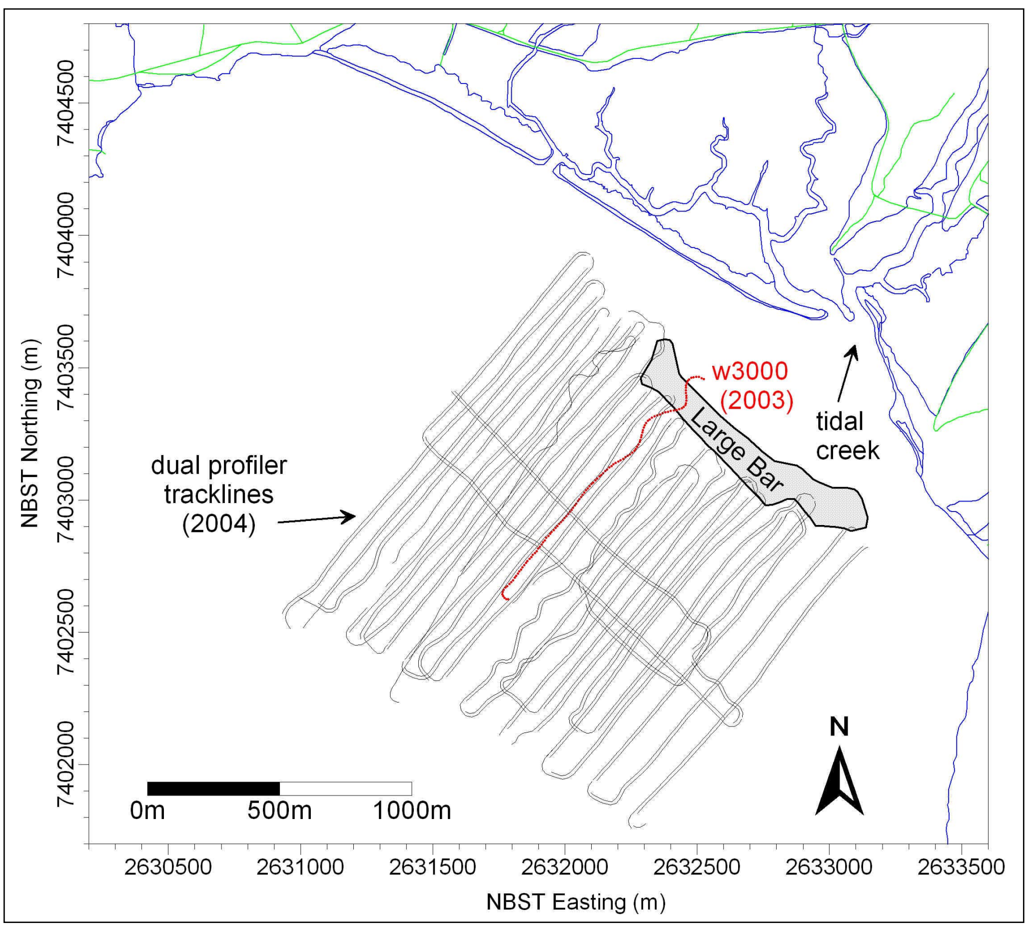


Figure 4. Map of seismic tracklines showing (in black) coverage obtained using dual SEISTEC profilers during the pseudo-3D survey in 2004, and (in red) one of the reconnaissance lines from 2003 that passed directly over the large gravel bar.

Data Processing

Positioning data recorded by the dual-frequency GPS receiver on one profiler were corrected using a PPK (post-processed kinematic) approach. Analysis of the results indicated that errors were less than 3 cm for horizontal positions and about 5 cm for elevations. GPS heights recorded at a rate of 2 Hz were also found to be adequate to track heave of the profiler as it moved up and down 20 to 30 cm with the ocean swell, although they exhibited a lag of 0.4 s relative to the heave signal evident in the seismic profiles (White and others, 2006). Tidal height as a function of time was extracted from the GPS heights by smoothing them to remove high frequency heave effects.

Processing of the digital sub-bottom profiler data involved application of a 1.1 to 11 kHz Butterworth bandpass filter, resampling from 10 to 20 microseconds, and the application of time-varying gain to account for spherical divergence and absorption. Profiles from the middle line of each swath look equally as good as those from the two outer lines but require normal moveout corrections that have yet to be applied to account for the (nominal) 12 m source–receiver offset. Elevation corrections were critical to compensate for tidal and heave effects and reduce the profiles to a common datum. Tidal heights were taken from the smoothed PPK GPS data as described above, while heave corrections were calculated based on a simple water-bottom smoothing approach using a moving window 19 traces (about 14 m) wide. The excellent agreement between water bottom arrival times on intersecting shore-normal and shore-parallel lines ultimately attests to the accuracy of the GPS heights and elevation (tide and heave) corrections. Mis-ties, expressed in terms of water depth, were less that 5 cm after a 1 ms bulk shift was applied to the starboard profiles to compensate for a delay differences between the starboard and port profilers.

Results

The sub-bottom profiles revealed one glacial outwash/glacio-marine unit and three post-glacial units that were interpreted with the aid of geological mapping in the intertidal zone and grab sampling in subtidal areas. We present here two samples of interpreted data. More detail and examples can be found in White and others (2006) and Dashtgard and others (2007).

A shore-normal, sub-bottom profile (Figure 5) passed directly over part of a large gravel bar that would have been completely exposed at low tide but was covered with 2.5 m of water during this reconnaissance survey in 2003. A subsequent soft grounding, and lower tides during the 2004 dual-profiler

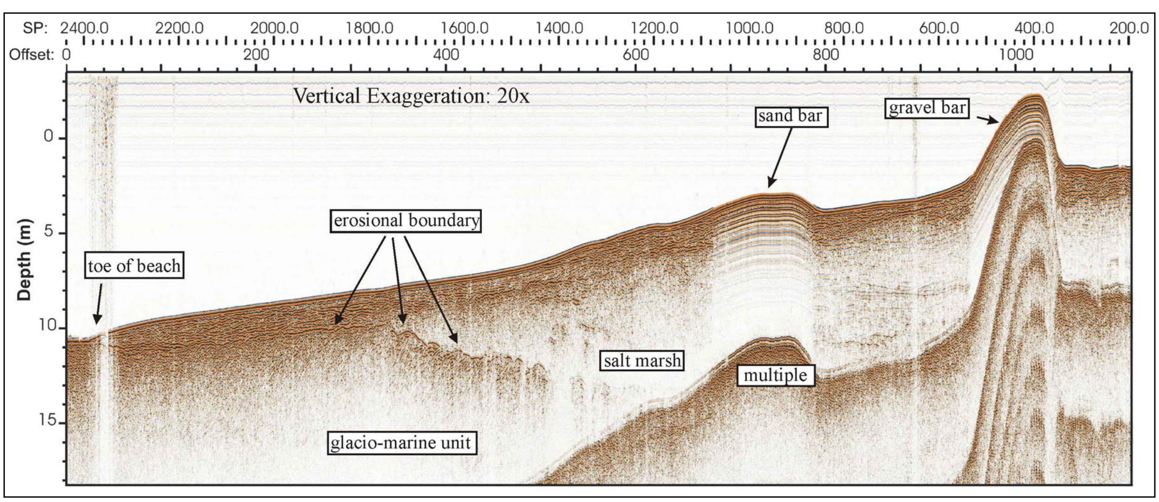


Figure 5. Profile w3000 passing directly over a large gravel bar as shown in Figure 4. The depth scale is referenced to geodetic datum (mean sea level). Vertical exaggeration is 20x.

survey cured us of the need for further such transits. The vertical scale has been converted to depth using a p-wave velocity of 1495 m/s and referenced to geodetic datum (mean sea level). The profile shows a prominent erosional boundary near the middle of the line that separates moderately dipping reflectors in the glacio-marine gravels from the beach and buried salt marsh deposits above. The sand and gravel bars on the beach surface both exhibit banding in the seismic profiles which may be caused by reverberations within the SEISTEC receiver that are excited by reception of an exceptionally strong reflection from those hard bottom areas.

We constructed a 3D topographic map (Figure 6) of the water bottom in the subtidal and intertidal zones using the port and starboard profiles from the pseudo-3D survey. Grayscale shading indicates areas of higher slope including some small inter-tidal bars, and the fronts of two deltas deposited by a tidal creek flowing around the large gravel bar that borders the upper edge of the map. A dashed line encloses an area at the toe of the beach where sub-bottom profiles showed the glacio-marine gravels

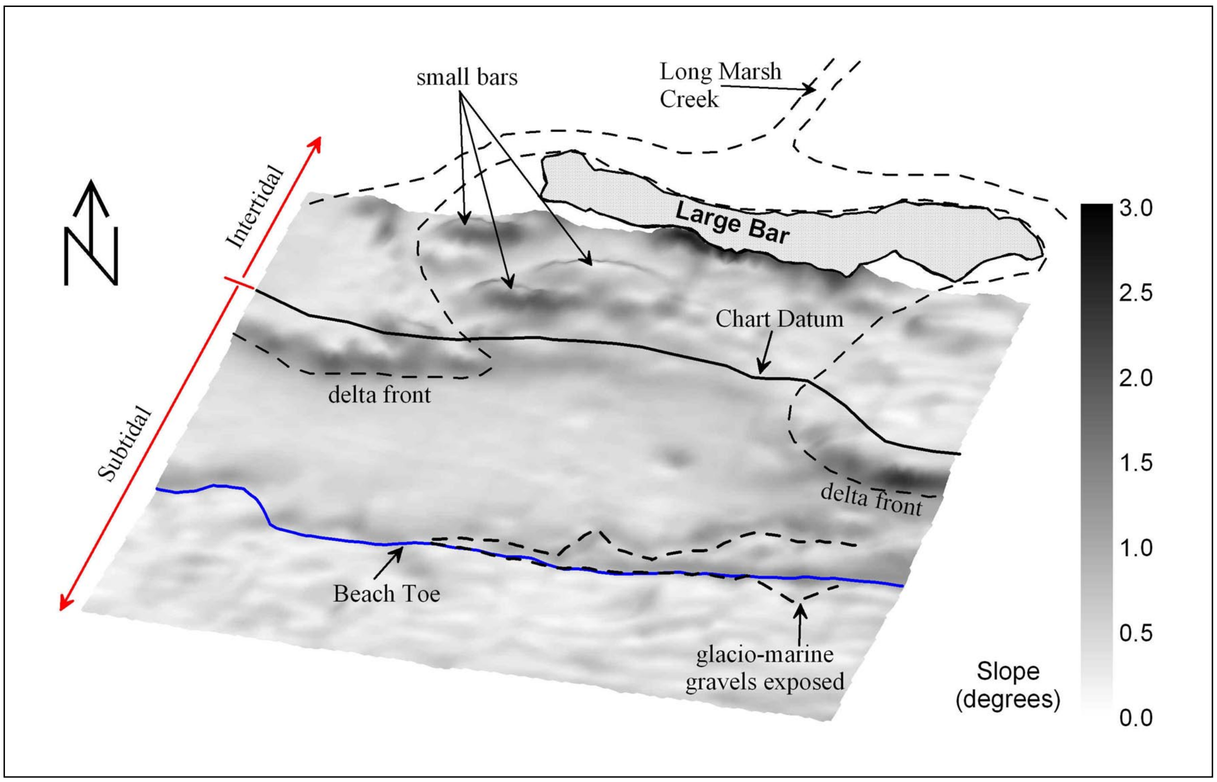


Figure 6. 3D topographic water-bottom map showing subtidal and intertidal features at Waterside Beach. Grayscale shading indicates slope. A dashed line encloses the region where glacio-marine gravels outcrop subtidally, yielding a source of sediment for the large gravel bars that migrate up the beach.

to be exposed on the seafloor, providing a source of sediment for the gravel bars located immediately landward. A similar topographic surface for the erosional boundary at the top of the glacio-marine unit has been used by Dashtgard and others (2007) to help infer the post-glacial evolution of Waterside Beach. Its resolution is not as fine as that seen in the water bottom map, owing to challenges in picking that weaker reflector consistently on adjacent survey lines.

Summary

A field trial at Waterside Beach has demonstrated the feasibility of pseudo-3D sub-bottom imaging employing two fixed aperture surface towed profilers. Difficulties in line tracking due to tidal currents, winds and heave required us to abandon the idea of achieving uniform tight line spacing and instead acquire sets of closely spaced lines within swaths spaced 50-m apart. This did not limit the ability to trace geological units and capture three-dimensional morphology of their gently dipping surfaces. However, it did prevent the production of time slices and data cubes from the seismic data set, which might have allowed us to illustrate such features without the interpretive step of picking reflectors on adjacent lines.

Though heave effects were ultimately removed by conventional water bottom smoothing, our analyses demonstrated that high-accuracy GPS receivers could be used to sample the heave and eventually remove it provided that data delays between GPS and seismic recording system were measured and incorporated during processing. In addition, mis-tie analyses demonstrated that excellent datum reduction could be achieved by using high accuracy GPS heights for elevation control in a hypertidal and choppy water environment.

The high vertical resolution of the sub-bottom profiler allowed us to identify four distinct seismic units and an extensive erosional surface and relate them to sedimentological sampling of the intertidal and subtidal zones. The results have contributed to a viable model for the post-glacial evolution of a complex beach and migrating bar environment. Given the challenges involved in working at a site like Waterside Beach (with its winds, heave, 10-m tides, and coarse-grained sediment limiting sub-bottom penetration) the prospects for pseudo-3D sub-bottom imaging in more hospitable environments look very good.

Acknowledgments

Funding for this project was provided by an NSERC Collaborative Research and Development Grant with support from Imperial Oil Limited and IKB Technologies Limited. We are grateful to our sedimentological partners Dr. Murray Gingras and Dr. Shahin Dashtgard, to Dr. Bernard Long for the loan of a SEISTEC profiler, to Russell Parrott of GSC Atlantic for supporting grab sampling, and to skipper Grant Woodworth for his enthusiasm and expertise on the water.

References

Dashtgard, S. E., Gingras, M. K., and Butler, K. E., 2006, Sedimentology and stratigraphy of a transgressive, muddy gravel beach: Waterside Beach, Bay of Fundy, Canada: Sedimentology, v. 53, p. 279–296.

Dashtgard, S. E., White, R. O., Butler, K. E., and Gingras, M. K., 2007, Effects of relative sea level change on the depositional character of an embayed beach, Bay of Fundy, Canada: Marine Geology, v. 239, p. 143–161, doi:10.1016/j.margeo.2007.01.004.

Simpkin, P. G., and Davis, A., 1993, For seismic profiling in very shallow water, a novel receiver: Sea Technology, v. 34, no. 9, p. 21–28.

White, R. O., Butler, K. E., Simpkin, P. G., and Dashtgard, S. E., 2006, Pseudo-3D sub-bottom imaging of a dynamic beach environment in the Bay of Fundy, New Brunswick, Canada: Proceedings of 19th SAGEEP, April 2–6, Seattle, p. 1042–1054.

Coming Events

FastTIMES *highlights upcoming events of interest to the near-surface community. Send your submissions to the editors for possible inclusion in the next issue.*

SAGEEP 2008: 21st Symposium on the Application of Geophysics to Engineering and Environmental Problems

April 6–10, 2008, Philadelphia, Pennsylvania

The Environmental and Engineering Geophysical Society (EEGS), General Chair Jon Nyquist, and Technical Chair Ron Kaufmann invite you to attend the 21st Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP) to be held in the Marriott Hotel in downtown Philadelphia. Philadelphia is a wonderful city, filled with historic sites, and home to the largest municipal park system in the world. Philadelphia is also one of the best dining-out towns in the U.S.; from 5-star restaurants to the Italian market, many excellent choices lie within walking distance of the Marriott.

We have an exciting technical program. More than 140 technical talks and posters cover a wide range of subjects (www.eegs.org/sageep/techsessions.html), including developments in near-surface methods, innovative geophysics for challenging engineering and environmental problems, and many interesting case histories. Pre- and post-meeting short courses will expose attendees to state-of-the-practice geophysical techniques.

New this year is the Environmental & Engineering Geophysics University (EEGU) track. EEGU consists of classroom-style sessions in which near-surface methods and their applications are presented non-technically for new students of the discipline, teachers, and managers or technical staff who are considering geophysics in an environmental or engineering investigation but wish to know more before proceeding. These sessions are concurrent with the technical program and are open to single- or multiple-day registrants.

The Gala will be held in the National Constitution Center, "America's most interactive history museum." Located just two blocks from the Liberty Bell and Independence Hall, "it is the only museum devoted to the U.S. Constitution and the story of *we, the people*." (www.constitutioncenter.org).

Speaking of Independence Hall, we have permission to demonstrate our equipment on the lawn directly in front of this beautiful facility (www.nps.gov/inde/). National Park Service personnel have expressed interest in attending. Who knows? Perhaps our exhibitors will make an historic discovery.

The first of our two field trips is a bicycle tour of the geology and hydrology of Philadelphia on Sunday, April 6th. Unwind from your travels and join us for a leisurely ride along Schuylkill River and Fairmount Park bike trails with numerous stops to examine the geology and a tasty treat at the end. Then, on Thursday, April 10th you can board a bus and travel to the site of the famous battle of Gettysburg (www.nps.gov/gett/) to learn how Mesozoic events and processes impacted American history.

A strong technical program, fine dining, and a chance to explore a city rich in American history – you won't want to miss SAGEEP 2008!!! For the latest information, visit the conference web site at www.eegs.org/sageep/index.html or contact SAGEEP 2008 General Chair Dr. Jonathan Nyquist, Temple University, e-mail: nyq@temple.edu. See you in Philadelphia!

Geotechnical Earthquake Engineering and Soil Dynamics IV (GEESD IV) Conference

May 18–22, 2008, Convention Center and Sheraton Grand Sacramento, Sacramento, CA

GEESD IV will bring together the broad community of geo-professionals working on earthquake engineering and soil dynamics problems for this comprehensive examination of our technical disciplines. You’ll review case histories, practice-oriented papers, relevant research, innovative technologies, and the emerging arts across many of our disciplines. The four-day conference will include 2 to 5 Technical Short Courses/Workshops, 3 Plenary Sessions, 27 Concurrent Technical Sessions, 5 Tutorials, a Poster Session, an Exhibition, a NEES Equipment Demonstration, and Technical Field Trips. Additional events include a Welcome Reception, a Networking Reception in the Exhibit Hall with posters, and a Gala Banquet.

Preliminary program coming soon! Watch the Geo-Institute Conference Web site -- www.geesd.org.

ICEEG 2008: 3rd International Conference on Environmental and Engineering Geophysics

June 15–18, 2008, Wuhan, China

With the acceleration of global urbanization and the dramatic increase in population, human activities on the surface of the Earth have greatly expanded. For example, the construction of large-scale artificial structures and the increased requirements for exploration and utilization of groundwater have caused geologic deformation, and even instability. Therefore, geological disasters have frequently been witnessed and the near-surface environment on which we rely has become very dynamic. As a branch of geophysics, near-surface geophysics is mainly applied in the detection and assessment of geologic and hydrologic units, voids and artificial underground structures. The geophysical techniques are non-intrusive, cost-effective, large-scale or small-scale, and can remotely acquire three-dimensional, and even four-dimensional representations of underground media. Due to the broad application of geophysical techniques in the environmental and engineering fields, they are of great significance for the sustainable development of human society.

Having successfully convened the 1st and 2nd International Conference on Environmental and Engineering Geophysics in 2004 and 2006, respectively, we are once again pleased to be hosting the 3rd International Conference on Environment and Engineering Geophysics in Wuhan, China, June 15–18, 2008. It is our pleasure to invite you to participate in this exciting event and to enjoy the hospitality of Wuhan.

This conference is designed to be a wonderful opportunity for all attendees to share your knowledge, experience, and friendship. We strongly believe that you will find great value in your participation in the conference and exhibits. Visit www.iceeg.cn for more information.

12th International Conference on Ground Penetrating Radar (GPR2008)

June 15–19, 2008, University of Birmingham, U.K.

GPR2008 seeks to showcase not only the best in terms of academic and applied papers and posters, but also the cutting edge of GPR and related technology. A full conference program, technical exhibitions, practical demonstrations and poster sessions will combine to make GPR2008 a very successful conference. Further details on GPR2008 can be found at www.gpr2008.org.uk.

XVIII International Conference on Computational Methods in Water Resources

July 6–10, 2008, Westin Market Street Hotel, San Francisco, California

The XVII International Conference on Computational Methods in Water Resources (CMWR 2008) will be a forum for the dissemination of the latest ideas in the development and application of advanced computational techniques to problems in water resources and related fields, including surface and subsurface hydrology, petroleum exploration, contaminant remediation, carbon sequestration, ecohydrology, climate change, nuclear waste storage, and associated chemical and biological processes. This conference continues the tradition of the 16 previous biennial meetings held in North America and Europe.

Building on the success of the CMWR XVI International Conference, CMWR 2008 will involve four days of regular and special sessions organized to address recurring, emerging, and crosscutting themes in the broader areas of computations and water resources. Several keynote speakers will highlight the sessions. Please visit *www-esd.lbl.gov/CMWR08/* for more information.

Near Surface 2008

Call for Papers: Near Surface 2008

September 15–17, 2008, Kraków, Poland
Abstracts due April 18

The Near Surface division of the European Association of Geoscientists and Engineers will convene "Near Surface 2008 - 14th European Meeting of Environmental and Engineering Geophysics" in Kraków, Poland from September 15–17, 2008. Together with the Local Advisory Committee, a full program will be set up consisting of the conference, an exhibition, social events, a workshop, and a field trip. The conference, exhibition, and the icebreaker reception will take place in the Auditorium Maximum. Information on Kraków and the venue will be available on the Near Surface 2008 website (*www.eage.org*), where you will also find information on exhibition and sponsoring and in due time on the technical program and registration.

About Kraków

Kraków is one of the oldest and largest cities of Poland and is located in the very center of continental Europe. Thanks to its rich history, Kraków represents a synthesis of all things Polish, connecting tradition with modernity. In the beautiful and mysterious streets of the Old Town, you will find everything you need to allow you to escape from everyday life. Galleries full of exhibitions, cafes and restaurants, all of this should be part of any visit to Kraków. Kraków has traditionally been one of the leading scientific, cultural, and artistic centers in Poland.

Technical Program

The technical program consists of oral and poster presentations, covering diverse near-surface geophysical applications disciplines. The oral and poster sessions will run in parallel from September 15 to 17, 2008. Near Surface 2008 is an international conference; therefore all the presentations will be given in English. Your extended abstract should be submitted before **April 18**.

Papers are welcome in all areas, including:

Trends in Electrical, Electromagnetic, Gravimetric, Seismic, and Potential-Field Methods
New Techniques and Technologies in Airborne, Borehole, Environmental and Engineering, Hydrogeological, and Mining Geophysics
Applications on Archaeological Sites
Applications in Civil Engineering
Applications in Environmental Problems on Mining and Industrial Terrains
Applications on Exploration of Geothermal Resources
Applications on Groundwater Exploration and Protection
Applications in Mining Technologies
Applications in Permafrost and Arctic Studies
Detection of Pollution and Remediation Monitoring
Detection of Sinkholes and Cavities
Recognition of Landslide Failure Surfaces and Slope Stability Studies
Recognition of Ground Properties and Deposit Structure
Natural Hazard Mitigation
Studies on Natural and Induced Seismicity and Vibrations
Modeling and Inversion in Geophysics

Call for Papers: SEG 2008

November 9–14, 2008, Las Vegas, Nevada; abstracts due April 9, 2008

The Near Surface Geophysics Section of the Society of Exploration Geophysicists (SEG) would like to invite you to submit an Expanded Abstract for oral or poster presentation at the 2008 SEG International Exposition and 78th Annual Meeting in Las Vegas, Nevada, November 9–14, 2008. The abstract submission system opens on March 12 and the deadline is April 9. Please visit *meeting.seg.org/techprog/index.shtml* for all abstract submission details. If you have any questions or suggestions please do not hesitate to email Rob Jacob (*Robert_Jacob@brown.edu*).

Contributions from all near-surface and environmental geophysics disciplines and from all parts of the world are desired. We encourage paper submissions that emphasize near surface geophysics applied to groundwater resource evaluation, mine dewatering, environmental characterization, engineering evaluation, seismic and geologic hazards assessment, as well as advancements in borehole, surface and airborne geophysical technologies and processing for near-surface applications.

There are multiple Near Surface Geophysics (NSG) events planned for the 2008 SEG meeting, including a shindig fit to celebrate the NSGS 15th anniversary. This year, the SEG Forum Series will kick off the SEG Technical Program, with a focus on hydrogeophysics, where top executives, researchers, and governmental representatives provide their perspectives on the future direction of using geophysics to better characterize our groundwater resources, leading to better management of our groundwater supplies. In addition to the several near-surface and environmental technical sessions that will be developed once abstracts are submitted, the NSGS is sponsoring two special sessions at SEG 2008: Hydrogeophysics in Practice and UXO Detection.

Students are encouraged to apply for one of the multiple NSGS $500 travel grants to attend SEG 2008. See *nsgs.seg.org/travelg.htm* for details. If you are not a member of the SEG-NSG Section, please consider joining (*nsgs.seg.org/join.htm*). NSG Section membership is only $15 (free to students), and SEG membership is not required.

FastTIMES presents contributed summaries of recent events to inform readers who were unable to attend. As a service to other readers, please send the editors summaries of events you attend for possible inclusion in future issues.

Near Surface 2007

Near Surface 2007, Istanbul, Turkey

by John Arthur, Near-Surface Engineering Consultant (geophysics@arthur-home.freeserve.co.uk)

The first thing, for those of us not Turkish or familiar with the locale, was to actually get to the venue. Attractively situated in the northern campus of Istanbul Technical University, this involved at least tram, metro, and the ubiquitous Dolmus (a cunning cross between a minibus and a taxi); and you needed to know where you were going to get off! However, for those of us who made it (and the rumor is that using a taxi did not guarantee a smooth ride, or even arriving where you wanted to go), the effort was well worth it.

The Suleyman Demirel Cultural Centre (DCC) on the Ayazaga Campus proved a very amenable location. Not only light and spacious, but full of tempting pastries to go with your Turska Kaffa or Cay (tea for those who've still to sample the delights of Turkey). And, if you'd acclimatized yourself, there was a delightful terrace on which to take your refreshment overlooking the spacious grounds of the campus.

View of Hagia Sophia (right) and Sultan Ahmed Mosque (left) from the Bosporus, Istanbul.

So a good start to what proved to be an entertaining three days in the city linking Europe and Asia – both for us as delegates pursuing our profession, and for our non-geoscience partners negotiating antiquities of the Byzantine and Ottoman eras.

The opening session of the three-day conference included an entertaining speech by Metin Ilkisik, covering a range of Turkish ground investigation issues, and short talks by EAGE officials. We were soon treated to the four best papers from SAGEEP 2007. This proved a fitting entry to the following four parallel sessions, two oral and two poster, by showing us new technology, developing existing methods, combining systems, and getting us up in the air to look beneath a river. Now we can reciprocate and offer you the Best of Istanbul at SAGEEP 2008…

On the various balconies within the atrium of the DCC we were pleased to welcome companies and institutions to bring us up to date with latest equipment developments and meet up with past colleagues during natural breaks in the program.

It has always been a strong point of the EAGE Near Surface Geoscience Division to embrace the full range of geophysical methodologies and this year was no exception. Electrical resistance tomography in both 2D and 3D forms featured prominently as a tool to deal with archaeology sites, pollution matters, the search for fresh water, and a variety of geological problems. Electromagnetics, both land and airborne, and GPR all feature strongly. Specialized techniques, little known to the oil fraternity, included multichannel analysis of surface waves (MASW) and magnetic resonance sounding (MRS) and their variants, were expounded and near surface applications explored. It was heartening to see that many

The Near Surface 2007 conference hall at the Suleyman Demirel Cultural Centre, Istanbul.

engineering and environmental problems are now being tackled with a multi-disciplinary approach and also benefitting from developments in refinement of reflection and refraction seismics.

Finally, not to forget the more social aspect of the gathering and our partners, we were all able to sample fine Turkish cuisine at the spectacular Sepetciler Kasri, the Hall of the Basket Makers, at the conference evening dinner. This now-traditional event took place alongside the entrance of the Golden Horn into the Bosporus giving us the opportunity to watch the constant passage of vessels under the illuminated suspension bridge, a fine memory of a worthwhile conference.

Geometrics Sponsors EEGS Foundation Student Scholarships to Attend SAGEEP 2008

The EEGS Foundation is pleased to announce that Geometrics has agreed to sponsor a limited number of $300 student scholarships to offset the cost of attending SAGEEP 2008. SAGEEP provides an ideal opportunity to listen to presentations on current geophysical research and applications and to meet people involved in all aspects of environmental and engineering geophysics.

Students must be in good standing at an educational institution and provide an application letter endorsed by a faculty member.

Your application letter should include:

- areas of interest in geophysics
- graduation date
- dissertation/thesis/senior project topic
- your thoughts on employment after you graduate

Please have your supervising professor forward your application letter (by email only please) to Rob Huggins at rob@mail.geometrics.com and EEGS Foundation Treasurer Dennis Mills at dmills@expins.com. More information can be found at www.geometrics.com.

Call for Papers: Special Issue on Hydrogeophysics - Methods and Processes in EAGE Journal of Near Surface Geophysics

Contributed by Louise Pellerin, Green Engineering, Inc. (pellerin@ak.net)

Groundwater is an increasingly scarce and fragile resource and there is wide recognition of the challenges we face in effectively protecting and sustainably managing clean sources of water for human consumption and agricultural uses. The emerging field of "Hydrogeophysics," being the development of geophysical methodologies to explore and assess relevant hydrologic properties, structures and processes, has a pivotal role to play in achieving these objectives. In response to the rapid expansion of research in this exciting field, the journal of Near Surface Geophysics is going to produce a "Special Issue on Hydrogeophysics" with the objective to collect the currently most pertinent research in this field and to create a widely used, authorative reference volume.

This special issue is a joint venture of the European Association of Geoscientists and Engineers (EAGE), the publisher of Near Surface Geophysics, and the Society of Exploration Geophysics (SEG) to enhance communication between research communities throughout the world, and ensure widespread and effective dissemination of the latest work and results.

Topics of interest include, but are not necessarily limited to:

- *Hydrogeophysical measurement, assessment, and monitoring techniques*
- *New and emerging hydrogeophysical methods*

- *Classical geophysical methods revisited, improved, and adapted for hydrogeophysics*
- *Integration, modeling, and inversion of geophysical and hydrological data*
- *Geophysical characterization of the hydrogeologic framework*
- *Geophysical estimation of petrophysical and hydraulic parameters*
- *Case histories*

The guest editors of this special issue will ensure both its topical focus as well as conformity with the high standards of Near Surface Geophysics. Authors are encouraged to contribute high-level technical research papers. Please inform the guest editors if you are interested in contributing a paper to the special issue.

Guest Editors:

Louise Pellerin, Green Engineering, Inc., pellerin@ak.net
Klaus Holliger, University of Lausanne, klaus.holliger@unil.ch
Lee Slater, Rutgers University, lslater@andromeda.rutgers.edu
Ugur Yaramanci, Berlin University of Technology, yaramanci@tu-berlin.de

---

AAPG Sponsoring April 2008 Short Course on Near-Surface Seismic Reflection Processing

Contributed by Cynthia L. Dinwiddie, Division of Environmental Geosciences Vice Chair, AAPG 2008 Coordinating Committee (cdinwiddie@cnwra.swri.edu)

The AAPG Division of Environmental Geosciences announces its April 2008 short course, Near-Surface Seismic Reflection Processing. The course will be held on Saturday, April 19 from 8:30 a.m. to 5 p.m. (with an optional evening session 6–7:30 p.m.) and Sunday, April 20 from 9 a.m. to 12 noon at the Computer Training Laboratory of Southwest Research Institute® in San Antonio, Texas. Roger Young (University of Oklahoma, Norman, Oklahoma) will be the instructor. Registration is limited to 20 and is $385.

Includes: A Lab Manual of Seismic Processing (EAGE book) and a CD-ROM containing all short course notes, the complete SPW processing software package keyed to the seismic data set, the seismic data and all intermediate processing results generated during the short course. Fee also includes breakfast snacks, lunch, and refreshments. Optional Saturday-evening session includes a pizza dinner and a lecture on the spectral decomposition method of transforming seismic data to a higher frequency representation (comparable to a sonic log) and a hands-on opportunity to implement same.

Intended audience: Environmental geoscience professionals, graduate students, and undergraduates seeking a practical understanding of seismic methods.

Course objective: To come to an understanding, through a hands-on processing experience, of the consequences of model simplifications and mathematical assumptions imposed on the real earth during the processing of seismic data.

Course description: This is an interactive computer-based course of instruction in fundamentals of seismic reflection processing. The course was designed to extend the understanding of principles taught by lectures in an introductory college course in seismic exploration; it consists of lectures and a sequence of 12 computer laboratory exercises:

- *Lab 1 Reformatting seismic data; assigning geometry to seismic trace headers*
- *Lab 2 Trace gathering*
- *Lab 3 Velocity analysis: making semblance maps*
- *Lab 4 Comparing semblance maps*
- *Lab 5 Picking a semblance map; picking reflection events*
- *Lab 6 Normal moveout correction; stacking CMP gathers*
- *Lab 7 Editing: killing and muting traces*
- *Lab 8 Testing and applying statistical deconvolution; bandpass filtering*
- *Lab 9 Residual statics correction*
- *Lab 10 Residual statics correction/velocity analysis iteration*
- *Lab 11 Final stack*
- *Lab 12 Post-stack time migration*

To register for this course and the AAPG 2008 meeting in San Antonio, Texas, please visit: www.aapg.org/sanantonio/courses.cfm.

SAGE: Summer of Applied Geophysical Experience

June 16 – July 11, 2008, New Mexico

Attention Students: Application deadline is March 31, 2008

The Summer of Applied Geophysical Experience (SAGE) is a unique educational program designed to introduce students in geophysics and related fields to “hands on” geophysical exploration and research. The program emphasizes both teaching of field methods and research related to a variety of basic and applied problems.

SAGE...

- *teaches modern geophysical exploration techniques: seismic reflection and refraction, gravity and magnetics, electromagnetics (including magnetotellurics), and electrical resistivity,*
- *involves extensive hands-on field experience,*
- *integrates geophysical methods to solve real geological problems,*
- *addresses geological problems of research and practical interest,*
- *utilizes multi-institutional resources and expertise,*
- *includes classroom instruction and supporting lectures by academic and industrial professionals,*
- *incorporates computer processing and modeling,*
- *provides experience in data synthesis and report preparation,*

- *is open to undergraduate and graduate students,*
- *is open to U.S. and foreign participants,*
- *is sponsored by the Los Alamos National Laboratory branch of the Institute of Geophysics and Planetary Physics, University of California, and*
- *is supported by the U.S. Department of Energy, the U.S. National Science Foundation, the U.S. Geological Survey, the Society of Exploration Geophysicists, a consortium of large and small companies, and student fees.*

SAGE runs from June 16 to July 11, 2008 and is based in New Mexico, USA. Go to *www.sage.lanl.gov* for more information.

Multiple Hires in Earth Surface and Hydrologic Processes

Jackson School of Geosciences, The University of Texas at Austin

The Jackson School is building a premier education and research program in Earth Surface and Hydrologic Processes. We seek outstanding scientists at the forefront of their disciplines who are attracted to challenging areas of scholarship that require collaboration across disciplines and programs. We seek to address compelling questions in surface and hydrologic processes within the broad theme of determining how surface and hydrologic processes are influenced by their dynamic setting at the interface of the lithosphere, atmosphere, hydrosphere, and biosphere.

Over the next three years, the Jackson School plans to hire six or more faculty and scientists who complement our existing strengths. We are interested in a range of research areas from quantitative geomorphology to hydrologic-biologic interactions to societal impacts and resource sustainability, and capabilities ranging from modeling landscape dynamics to remote sensing, near-surface geophysics, aerogeophysics, and monitoring groundwater and coastal systems. We also encourage innovative scientists in other areas related to surface and hydrologic processes to apply. More information can be found at *www.jsg.utexas.edu/hiring/hydro.html*.

FastTIMES Editor-in-Chief

Environmental and Engineering Geophysical Society

The Environmental and Engineering Geophysical Society seeks candidates to serve as Editor-in-Chief for ***FastTIMES***, the society's quarterly electronic newsmagazine for the near-surface geophysical community. Preferred qualifications include (a) broad knowledge of near-surface geophysical methods, (b) an ability to coerce article contributions, (c) facility with electronic publishing tools including Adobe Photoshop and InDesign, (d) willingness to participate in EEGS Board of Directors conference calls and meetings, (e) membership in EEGS, and (f) a commitment to on-time publication of four issues per year (March, June, September, and December). Interested candidates should contact incoming President Bill Brown (*bbrown@aeroquest.com*).

FastTIMES accepts timely and relevant news items from companies as well as brief company profiles. Send your submissions to the editors for possible inclusion in the next issue.

EGA Listed as One of Houston's Largest Environmental Companies

Environmental Geophysics Associates (EGA) has been listed in the Houston Business Journal as one of the "Largest Environmental Companies" in 2007 in the Houston area, Texas.

EGA was founded in 1994 to provide environmental, engineering, and shallow oil and gas geophysical services. EGA provides a complete range of geophysical services to a diverse list of clients throughout the United States and overseas. For more information, visit www.environgeophysics.com.

Aeroquest International Limited Announces the Acquisition of Geophex, Ltd. and UTS Geophysics and Adds New Senior Staff

In December 2007, Aeroquest International Limited acquired Geophex, Ltd. of Raleigh, North Carolina. Geophex, founded in 1983 by **Dr. I. J. Won**, manufactures and sells primarily ground-based geophysical instruments, and also supplies institutions and private entities with specialized survey equipment on a contract-to-build basis. Geophex has established a particular expertise in special and customized geophysical investigations, especially as it relates to environmental projects. Geophex will continue to operate under the trade name "Geophex" and the two most senior officers of Geophex, Dr. I. J. Won and **Mr. Alex Oren**, will continue to oversee the operations of Geophex.

In July 2007, Aeroquest acquired Universal Tracking Systems Pty Ltd. (UTS). "We are very pleased to welcome the employees and customers of UTS into the Aeroquest Group of Companies." said Roy Graydon, President & CEO of Aeroquest; "Together, our companies can now offer a full range of airborne geophysical solutions to our clients around the world." UTS is a specialist in ultra-high resolution magnetic, radiometric, and gravimetric fixed wing surveys. Operating a fleet of 12 aircraft, its clients are located in Australia, Africa, southeast Asia, and Canada.

Bill Brown joined Aeroquest in January 2008 as Vice President, Environmental Services. Many already know Bill from his well-known record in the industry. For those who don't, he has 20 years of experience in business development in the engineering, manufacturing, and consulting sectors. Most recently he has focused on the expansion of environmental services in airborne surveying. Bill has been elected the President of EEGS and will begin his term in April.

Aeroquest International is a world leader in the operation and development of innovative and proprietary airborne geophysical surveying platforms servicing the mineral exploration, petroleum exploration, and environmental industries. Directly, and through its sister company UTS Geophysics, Aeroquest fields a fleet of helicopter and fixed wing systems and is active on almost every continent in the world. More information about Aeroquest can be found at www.aeroquest.ca. More information on UTS Geophysics can be found at www.uts.com.au. More information on Geophex can be found at www.geophex.com.

Join EEGS Now!

Environmental and Engineering Geophysical Society

EEGS
1720 S. Bellaire Street; Ste. 110
Denver, CO 80222-4303
Phone: (303).531-7517 Fax: (303) 820-3844
Email: staff@eegs.org

2008 MEMBERSHIP APPLICATION

Name: Dr./Mrs./Ms./Mr. ______________________________

Company/Organization: ____________________ Office Phone: ____________________

Title: ____________________ Fax: ____________________

Address: ____________________ Home Phone: ____________________

City: ____________ State: ___ Zip: ____ Country: ____________________

Email: ____________________ Website: ____________________

A. Individual Membership Dues Schedule: Select only one Membership Category.

Individual Memberships:

☐ $90 Individual Member

☐ $50 Student Member with JEEG Subscription (recent graduates may receive this rate for two years after graduation. Submit documentation of graduation date).

☐ $20 Student Member without JEEG Subscription (submit copy of current student ID).

A. Membership Dues Investment* ____________

B. Corporate Membership Dues Schedule: Select only one Membership Category.

Corporate Memberships:

☐ $ 650 Donor

☐ $2,250 Associate

☐ $1,800 Partner

☐ $3,750 Benefactor

B. Corporate Membership Investment* ____________

C. Mailing Lists:
EEGS occasionally makes the mailing list available to companies and associations in the industry. If you would like your name *withheld* from these mailings, please check this box: ☐

Payment Information:

☐ Check/Money Order ☐ Visa ☐ MasterCard ☐ AMEX ☐ Discover

Card Number: ______________________________ Exp. Date: ____________

Name on Card: ______________________________

Signature: ______________________________

Total Due $_________

Make your check or money order (in US Dollars) payable to: EEGS.
Return this form with payment to: EEGS, 1720 S. Bellaire St., Suite 110, Denver, CO 80222, USA
Credit Card Payments can be faxed to EEGS at (303) 820-3844.

Questions? Call (303) 531-7517

*Payments are not tax deductible as charitable contributions although they may be deductible as a business expense. Consult your tax advisor.

Membership Information

EEGS welcomes membership applications from individuals (including students) and businesses. The membership application is available from the EEGS office or online at www.eegs.org.

Individual $90

Member receives annual subscriptions to ***JEEG*** and ***FastTIMES*** along with discounts for EEGS publications, SAGEEP registration, and other EEGS functions.

Student $50

Member receives annual subscriptions to ***JEEG*** and ***FastTIMES*** along with discounts for EEGS publications, SAGEEP registration, and other EEGS functions.

Student (without JEEG) $20

Member receives annual subscriptions to ***FastTIMES*** along with discounts for EEGS publications, SAGEEP registration, and other EEGS functions.

Corporate Benefactor $3,750

Member receives 2 individual memberships, 2 exhibit booths at SAGEEP, marketing inserts in SAGEEP delegate packets, a link on the EEGS website, listing in ***FastTIMES***, advertising discounts in ***JEEG***, ***FastTIMES***, and the directory.

Corporate Partner $1,800

Member receives 3 individual memberships, 3 registrations to attend SAGEEP, marketing inserts in SAGEEP delegate packets, a link on the EEGS website, listing in ***FastTIMES***, and advertising discounts in ***JEEG***, ***FastTIMES***, and the directory.

Corporate Associate $2,250

Member receives 2 individual memberships, 1 exhibit booth at SAGEEP, marketing inserts in SAGEEP delegate packets, a link on EEGS website, listing in ***FastTIMES***, and advertising discounts in ***JEEG***, ***FastTIMES***, and the directory.

Corporate Donor $650

Member receives 1 individual membership, 1 registration to attend SAGEEP, a link on EEGS website, and advertising discounts in ***JEEG***, ***FastTIMES***, and the directory.

Corporate Members

Corporate Benefactor

Aeroquest International Ltd.
www.aeroquest.ca

Geometrics, Inc.
www.geometrics.com

Corporate Partner

Your Company Here!

Corporate Associate

ABEM Instrument AB
www.abem.com

Advanced Geosciences, Inc.
www.agiusa.com

Allied Associates Geophysical Ltd.
www.allied-associates.co.uk

ALT: Advanced Logic Technology
www.alt.lu

Exploration Instruments LLC
www.expins.com

Foerster Instruments Inc.
www.foerstergroup.com

Fugro Airborne Surveys
www.fugroairborne.com

GEM Advanced Magnetometers
www.gemsys.ca

Geomar Software Inc.
www.geomar.com

Geonics Ltd.
www.geonics.com

Geophex, Ltd.
www.geophex.com

Geophysical Survey Systems, Inc.
www.geophysical.com

Geostuff
www.georadar.com

GISCO
www.giscogeo.com

Heritage Group Inc.
www.heritagegeophysics.com

hydroGEOPHYSICS, Inc.
www.hydrogeophysics.com

Interpex Ltd.
www.interpex.com

MALA GeoScience
www.malags.com

Mount Sopris Instruments
www.mountsopris.com

Petros Eikon Inc.
www.petroseikon.com

R. T. Clark Co. Inc.
www.rtclark.com

Scintrex
www.scintrexltd.com

Sensors & Software, Inc.
www.sensoft.ca

Terraplus Inc.
www.terraplus.ca

Zonge Engineering & Research Org., Inc.
www.zonge.com

Corporate Donor

Akron srl
www.akronservizi.it

Echotech Geophysical
www.echotech.com

Geogiga Technology Corp.
www.geogiga.com

Geomatrix Earth Science Ltd.
www.georentals.co.uk

Intelligent Resources, Inc.
www.rayfract.com

KD Jones Instrument Corp.
www.kdjonesinstruments.com

Northwest Geophysics
www.northwestgeophysics.com

Technos, Inc.
www.technos-inc.com