Diamonds and earthquakes don't, at first glance, have anything in common, but a new research project, aided by Phoenix MT equipment, is helping scientists find diamonds and predict the severity of earth tremors.

Canada's POLARIS project collects data on continental structure and dynamics; POLARIS is an acronym for Portable Observatories for Lithospheric Analysis and Research Investigating Seismicity. The improved imaging capability of POLARIS, combined with innovative interpretation techniques, promises breakthroughs in several geoscience disciplines.

POLARIS will help Canada's emerging diamond industry by contrasting the geophysical signatures of diamond-bearing and non-bearing lithosphere.

In the field of earthquake research, POLARIS will enable scientists to image earthquake faults, predict the severity of ground tremors, and study long-term variations of Earth's EM field.

POLARIS will also permit scientists to study the relationship of earth conductivity structure to the GICs (Geomagnetically Induced Currents) which sometimes cause costly power blackouts (as in Québec in 1989).

This scientific research has significant economic benefits for Canada. New diamond mines can add hundreds of millions of dollars a year to the national economy; and the ability to predict earthquake severity, particularly in urban areas, can lessen loss of lives and property. Although severe earthquakes occur very infrequently in Canada, it is still important to understand the earthquake risk near critical infrastructure such as nuclear reactors.

The POLARIS research consortium involves scientists from several universities, businesses and government departments, led by POLARIS President Gail Atkinson, an Earth Sciences Professor at Carleton University, Ottawa.

The POLARIS network of mobile geophysical observatories includes 90 seismographs, 30 long-period magnetotelluric (MT) systems, six broadband MT.

Continued on page 2

POLARIS scientists visited Phoenix for familiarization with their new System 2000 MT equipment during August, 2003. Left to right: Tesfakiros Halle (Phoenix), Dr. Ian Ferguson (University of Manitoba, Winnipeg), Michelle Folta and Dr. Claire Samson, both of Carleton University, Ottawa, listen as Phoenix engineer Gerry Graham explains interpretation techniques.

At left, Gerry and Ian interpret a bit of shade.

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systems, and satellite communications equipment for transmitting data to research centres.

The geophysical equipment can be installed in one place for relatively long periods (“observatories”), or moved at suitable intervals to new locations. Most of the seismic equipment will remain fixed for relatively long periods.

POLARIS MT equipment includes both long period systems (frequencies below 0.1 Hz) and six “broadband” portable systems (10,000 sec to 10,000 Hz) purchased from Phoenix. Some of the long-period MT systems are co-installed at the semi-permanent seismic stations. By contrast, the broadband Phoenix System 2000 equipment will generally “roam” between the semi-permanent observatories.

POLARIS MT equipment will be used in two modes. One is for lithospheric structure imaging, “seeing” less than 200 km beneath Earth’s surface; the second use will be for deep-mantle imaging (to depths of 1,000 km beneath Earth’s surface).

Many countries have national seismic networks, but Canada’s POLARIS is the only one that includes MT measurements at every seismic station. The combination of seismic and MT greatly improves our ability to “see” into the Earth’s interior.

Prof. Martyn Unsworth of the University of Alberta will coordinate POLARIS MT activity in Canada’s seismically active west-coast province, British Columbia. Dr. Alan Jones of the Geological Survey of Canada (now at DIAS, see below) was instrumental in the POLARIS project definition.

Related websites:
POLARIS - http://www.polarisnet.ca/
Diamonds in Canada-
http://ec-mj.com/1rmining_canadian_diamond_rush
http://magma.natolgeographic.com/nm/data/2002/03/01/html/rt_29020901_l.html
Earthquakes in Canada
http://www.pgc.nrcan.gc.ca/seismology/html
Geomagnetically Induced Currents (GICs)
http://www.umanitoba.ca/geoscience/faculty/ferguson/Ferguson.htm
http://www.lund.it/rgc/gic/gicIntro.html

POLARIS scientists lay out an air-loop sensor. The air-loop, which is placed on the surface, is more convenient than an induction coil for measuring the vertical magnetic field, especially in hard ground. The induction coil requires a hole to be dug one metre deep.

DUBLIN INSTITUTE PURCHASES PHOENIX AMT / MT SYSTEMS

Dr. Alan Jones is purchasing three full AMT / MT systems from Phoenix as part of his start-up of electromagnetic studies at the Dublin Institute for Advanced Studies (DIAS) in Dublin, Ireland.

Dr. Jones has been appointed the new head of the Geophysics Section of the School of Cosmic Physics at DIAS, effective January, 2004. The institute, established in 1940, is a publicly-funded independent centre for research in basic disciplines.

A world expert in electromagnetic (EM) methods, Professor Jones has had a long working relationship with Phoenix during his more than 15 years as a Senior Research Scientist at the Geological Survey of Canada in Ottawa.

Dr. Jones’ first research activity will take place in the autumn of 2003 when he will study a region of major diamond mines in Southern Africa.

We congratulate Dr. Jones on his new appointment and look forward to continuing our technical cooperation.
Canadian GG To Open Phoenix Auditorium

In September, Her Excellency the Right Honourable Adrienne Clarkson, Governor General and Commander-in-Chief of Canada, will receive an honorary doctorate from the St. Petersburg State Mining Institute and unveil the Canadian Auditorium containing state-of-the-art geophysical research equipment acquired from Phoenix Geophysics.

Look for information about this gala event in our next issue.

SPMI Seminar

St. Petersburg State Mining Institute held a seminar for geophysical and geological managers in April, 2003 (see Issue 28). This will become an annual event. The 2003 program included invited papers on applied electro-prospecting, poster sessions and interesting discussions. The seminar ended with an excellent excursion to the Hermitage Museum. The full program of the 2003 event may be obtained from Phoenix.

Russia Field School

The fourth annual Russian-Canadian Field School will be held in May 2004 at the field camp of Moscow State University in Alexandrovka, approximately 250 km south-west of Moscow. The last two schools were fully booked; a limited number of qualified non-CIS participants can be accommodated on a first-come, first-served basis. If you are not from a CIS country, and if you would like to participate in the 2004 event, send an email to Phoenix. The field camp includes oral and poster presentations, invited papers and training in processing and interpretation software.

SPMI Purchases Equipment

SPMI (St. Petersburg State Mining Institute), led by Rector Prof. Dr. Vladimir Litvinenko, increased their stock of Phoenix MT/AMT equipment to twelve systems, the largest equipment stock in Russia. SPMI did extensive MT field surveys for oil and gas exploration in northern Russia during summer 2003. Phoenix geophysicists participated in the pilot project.

Above left to right: Prof. M.A. Ivanov, Dean of Geological Prospecting Faculty of SPMI, Prof. A.V. Kozlov, leader of the project, Caroline Finateu (Phoenix), Prof. N.V. Pashkevich, First Pro-Rector of SPMI, Yann Avram and Olex Ingerov (Phoenix), check first results of MT data interpretation.

Moscow Conference: Leo Fox and Olex Ingerov attended the SEG-EAGE-EAG International Conference and Exhibition in Moscow. Sept. 1-4. Many Russian and foreign geophysicists and geologists attended. After the conference, Leo and Olex visited Moscow State University, above, they are welcomed by the head of the Geophysical Department of the Geological Faculty, Prof. Victor K. Khmelevskiy (left). Many generations of Russian and CIS students studied electro-prospecting from his famous textbooks.
Russian Clients Ready for International Work
The Russian organizations below all own state-of-the-art Phoenix MT/AMT equipment, have experienced field crews and interpretation experts, and are interested in international work. If you would like to send an inquiry to any of these organizations, please contact Phoenix.

Spetsgeofizika (Moscow), one of Russia's famous state-owned geophysical companies, this year added AMT capability to all six Phoenix MT systems they have used intensively all over Russia, under the direction of Field Crew Leader Vladimir Chik.

State Geological Company "Kavkazgeologiya" (Essentuki) added additional equipment for field work in the Caucasus (see photo, Issue 26).

Nordwest Company and EMRC (Electromagnetic Research Center), both in Moscow, added AMT capability to their existing MT equipment. Nordwest, led by Dr. Andrei Yakovlev, has close ties with the world-famous Moscow State University. EMRC is led by the well-known Russian EM expert Dr. Igor Feldman.

Russian State Geophysical Research Company GEON (Moscow), a new member of the Phoenix "club", is led by energetic General Director Dr. Leonid Solodilov. GEON’s AMT experts include Prof. Victor Belyavsky and Dr. Yuly Konovalov.

Irkutskgeofizika owns five Phoenix systems, has wide electroprospecting experience in Siberia and has high level experts including Dr. Alexandr Pospeev and Dr. Alexandr Pashevin.

St. Petersburg State Mining Institute (SPMI) owns twelve Phoenix AMT-MT systems. With its large stock of equipment, EM experts, and experienced field crews, SPMI is poised to become a key player in the market.

Resistivity Signature of Hydrocarbon Deposits: MT Surveys in Western Uzbekistan
The article below is excerpted from the poster. A complete copy of the poster is available from Phoenix.

It was well known in the former Soviet Union (FSU) that most hydrocarbon deposits display characteristic resistivity signatures in the sedimentary rocks above the deposits. For this reason, electroprospecting techniques were used more, at all stages of hydrocarbon exploration, than in Western countries. This widespread practical application stimulated the relatively deeper and broader theoretical development of EM techniques in FSU.

In FSU, the MT technique was used in three ways: for reconnaissance (wide-area regional surveys), for prospecting (focusing on a smaller area) and finally, for detailed mapping of structures previously identified by seismic. In the latter case, MT "checked" the seismic structures by showing whether the structures possessed the characteristic signature associated with presence of hydrocarbons – in essence, direct hydrocarbon indicators (DHI).

A characteristic signature for gas deposits is well revealed in Figure 2. The MT profile traverses the previously identified (but shut-in) Akkum and Parsankule gas deposits as shown in the plan view (Figure 1). The vertical cross-section of resistivity (Figure 2) shows a characteristic high-low-high-low signature. In general, resistive layers above the deposits become more resistive, and conductive layers become more conductive, with an overall total increase in resistivity. The anomalous behaviour is greatest in the rocks directly above the deposits.

The overall increase in resistivity has been attributed to such processes as calcite cementation (a commonly observed process) caused by CO₂ (carbon dioxide) which is usually found with natural gas. This is consistent with the trap model described in the article "Design and Function of Oil and Gas Traps", Roberts, W.H., AAPG Bulletin Vol. 63, pp 217-240, 1979.

Figure 1: Structure contours from seismic and borehole data on Jurassic marker horizon, Akkum (i) and Parsankule (ii) Gas Deposits

Figure 2: Profile 01A, 2-D Inversion and Stratigraphy from Wells. The gas deposits lie in Jurassic strata, approx. 2000m subsurface. Blues and greens indicate higher resistivity; yellows and oranges, lower resistivity.
ShanXi Acceptance

Mits Yamashita and Wang Fei spent July 10-22 in TaiYuan, the capital of ShanXi province, for acceptance of a V6A system purchased by the ShanXi Water Resource Bureau.

Shanxi is short of water, especially in its mountainous regions. ShanXi Water Resource Bureau (a government department) will use the V6A mainly to look for underground water to help local farmers. The news of the V6A acceptance and training made the local TV news and newspapers.

Shipment to China

The 5th Division of BGP, Gucheng, China ordered additional System 2000 equipment for overseas work. The equipment, comprising 20 units with 70 channels and AMT/MT functions, was shipped on July 16.

AGENT'S CORNER

Phoenix is pleased to announce that Laurel Industrial Company, Inc. is now our agent for China.

Laurel employs more than 50 people in their offices in Beijing, Shanghai and San Jose, California. Laurel represents numerous high-tech companies as they prepare to expand into the booming Chinese market. Laurel’s San Jose office is in the heart of “Silicon Valley”, California – the fabled birthplace of the personal computer and the internet.

Senior Geophysicist Yuan Mingde, Sales Manager Huang Xinge, Customer Service Manager (Geophysical) Cheng Daxiang and Customer Service Engineer Wu Seyuan, from Laurel’s Beijing office, spent two weeks in August in Toronto learning about Phoenix equipment and services.

Contact info: Laurel Industrial Company, Inc., 2100 Fortune Drive, San Jose, CA 95131, USA, Tel (408) 526-9022; Fax (408) 526-9023 e-mail: laurel@laurelindustrial.com

OWNED BY BGSU

NEWS FROM JAPAN

Sumiko Purchase

Sumiko Consultants' Technical Research Division has purchased a System 2000 in August, 2003. Dr. Akiko Chiba will use the MT system for various geophysical tasks. Sumiko is a division of the famous Sumitomo conglomerate.

Earthquakes near GSI observatory

Two earthquakes occurred recently near Geographical Survey Institute’s Mizusawa MT observatory, one quake with magnitude 7.0, 50km SE in May, and a second with magnitude 6.2 100km south in July.

The earthquakes caused damage and 600 injuries in Miyagi prefecture.

The Mizusawa MT equipment was upgraded to System 2000 in March 2003 (See Issue 28). Japanese scientists are analyzing the data for possible evidence of earthquake precursors.
Phoenix MTU-5 equipment was used by the New Zealand Institute of Geological and Nuclear Sciences (IGNS) as part of a research project to study the Australia-Pacific plate boundary. The MT survey, conducted in March 2003, consisted of soundings at 30 sites, about 20 of which were within the borders of the world-heritage designated Westland National Park.

Westland National Park is located on the west coast of New Zealand's South Island. The 'Coast', as locals call it, has amazing topography. The IGNS survey extended inland from the rugged coastline of the Tasman Sea to the 'main divide' (or crest) of the Southern Alps. Nestled amidst the jagged snow-capped peaks of the Southern Alps, fast flowing rivers and rainforests are small pockets of flat land that provide nearly ideal (noise-free) MT sites easily reached by helicopter.

The major geological feature of the park is the Alpine Fault, which marks the inland boundary between the Pacific tectonic plate (carrying the Southern Alps) and the Australian tectonic plate (carrying the lowlands and coast). Although the plates slide past each other along the Alpine Fault, about seven million years ago a component of convergent motion (compression) developed causing the rise of the Southern Alps. This movement is still active, and close to the fault the rate of uplift is very high (about 10 mm a year).

Scientists estimate that the total uplift in the last seven million years has been in excess of 20 km (12.4 miles). But because of an equally high rate of erosion the mountains may never have been higher than their current altitude, greater than 3.5 km (12000 ft) at their highest point at Mt Cook. These characteristics partially explain why the mountains rise so abruptly from the coastal lowlands. The Alpine Fault itself runs right at the foot of the mountains, and on the main divide the highest summits are seldom further than 25 km (15.5 miles) from it.

The field work was funded by New Zealand's Foundation for Research Science and Technology. The research is a cooperative project with Dr. Yasuo Ogawa of the Tokyo Institute of Technology (TITech) and Prof. George Jiracek of San Diego State University, California (supported by NSF funding). Dr. Jiracek used a month of his sabbatical to work in the field with the IGNS team, Stewart Bennie, Hugh Bibby and Grant Caldwell.

The aim of the IGNS research is to gain a better understanding of the geological and physical processes involved in the formation of the Southern Alps. These results, and the results of previous MT work to the north with Dr Philip Wannamaker of Energy & Geoscience Institute at the University of Utah in 1995-98, add significant new information about these processes and have important implications for the genesis of large earthquakes on the Alpine Fault.

Five MTU-5 systems were used for the survey; Dr Ogawa provided two TITech systems to supplement the three owned by IGNS. The survey coincided with a three-week period of nearly perfect calm and fine weather, an exceptionally rare occurrence on the Coast where the rainfall can be measured in fathoms.

Our New Zealand correspondent reports that data quality is very good and that further measurements east of the main divide are planned in the coming months.

Hoping To See You ...

☆ at the SEG in Dallas, Texas, October 26-30, Booth 2141.

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