THE PHOENIX

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DIAMONDS AND ICE

A winter "ice road" stretches 600 km north of Yellowknife in Canada's Arctic, mainly across frozen lakes. During the frigid northern winter, the ice road is used to truck supplies to the new diamond mines in the Lac de Gras region. (In the summer there are no roads at all.)

Using nature's road, Phoenix conducted an innovative combined Long Period MT / MT survey in March of 1998, for the Geological Survey of Canada (GSC), to determine the thickness of the earth's crust near the diamond mines.

Diamonds are formed 150 km deep in the earth, where the rock is molten and enormous pressure squeezes carbon atoms into a tetrahedral crystal form. (See p. 4 for a tetrahedron lesson.)

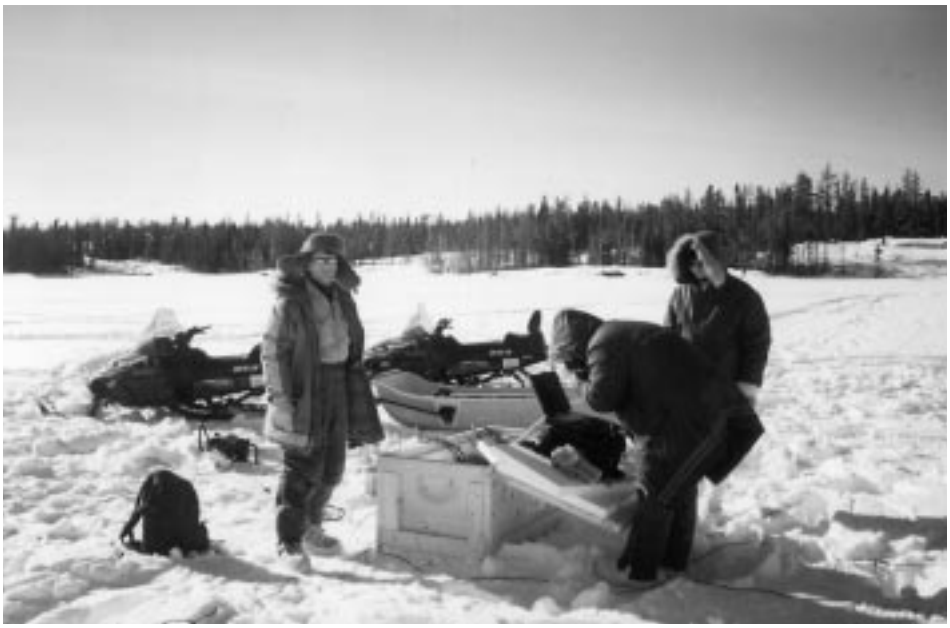
Diamonds get to the surface when zones of weakness develop in the depths and the molten rock, carrying diamonds, begins its ascent to the surface. Forcing its way upward faster than a race horse can run, the molten rock bursts through the surface and then cools.The lava eventually weathers to a type of rock first found near Kimberley, South Africa. Ever since these diamond-bearing, carrot-shaped bodies have been called "kimberlite pipes".

In the last few years, kimberlites have been discovered in northern Canada; some of the pipes contain diamonds in commercial quantities. Whether or not a pipe contains commercial diamonds depends on how deep the lava originated. It must come from at least 150 km deep where the pressure is high enough to create commercial grade diamonds.

The earth's crust is 150 km or more thick only in the centres or "keels" of the ancient continents, areas which have been land for hundreds of millions of years. These ancient continental cores are called "cratons"; and it is only in cratons that kimberlite pipes will produce commercial diamonds.

To know whether a kimberlite contains commercial quantities of diamonds or not, diamond companies must mine and process several tens of tons of rock. This is obviously very costly. If you could "just" measure the thickness of the crust, you would know whether to expect diamonds or not.

But how? There is no man-made signal strong enough to investigate these depths. One way is to use the so-called "teleseismic" technique, observing the seismic waves from distant earthquakes and deducing the depth of the solid-liquid boundary from the change in character of the waves. But this is tedious, expensive and imprecise.



Phoenix crew members Lucien Patry, Doris LaBrecque and Gary McNeice install V5 System 2000 MTand Long Period MT equipment in an insulated box on lake ice in Canada's Northwest Territories. Snowmobiles were used to access the sites which were several km off the winter road. Manmade noise is absent here but a strange new noise source turned out to be the Northern Lights (aurora).

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MESSAGE FROM THE PRESIDENT

When one of our colleagues retires, reflection is inevitable.

When Mr. Keizo Ogawa, of Nittetsu Mining Consultants,Tokyo, retired recently, we felt a mixture of goodwill, good wishes and a keen sense of loss. Mr. Ogawa was a good friend and faithful business colleague for more than 14 years of a dynamic business relationship with Phoenix. He initiated NMC's development support for the V5 System 2000 system during 1997. NMC's support crystallized at the critical moment and Mr. Ogawa became known at Phoenix as "the godfather of the V5 System 2000".

To mark his retirement, we presented to Mr. Ogawa the first prototype V5 system 2000 MTU box with an inscribed silver plate. We wish Mr. Ogawa a long and happy retirement.

Dr. Patrick Killeen of the Geological Survey of Canada (GSC) in Ottawa has, since 1992, edited the GSC's annual survey, International Exploration Geophysics. Extremely well-liked and well-known within Canada's geophysical community, Pat is now Scientist Emeritus at the GSC and has started his own consulting company. (He can still be reached at the GSC.) All of us at Phoenix wish him success in his new business.

GSC Buys V5 System 2000

A new chapter unfolds in the long relationship between Phoenix and the Geological Survey of Canada (GSC), as the GSC has purchased four MTU-5 units of the System 2000, with MT and Long Period MT functions. The System 2000 boxes are equipped with the MT function. During the next year, Phoenix will also develop the Long Period MT function for the System 2000.

This is the third generation of Phoenix MT equipment acquired by the GSC. In 1982 the Survey purchased the MT-16 system, the first real-time, remote reference MT system; in 1986, it bought the first V5-16 system. With the V5 System 2000, GSC now owns state-of-the art with MT equipment. (See our front page story for an innovative use of the GSC's equipment.)

– Leo Fox

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Another way is to use Long Period Magnetotellurics. MT senses conductivity contrasts; there is a significant and measurable contrast at the solid-liquid boundary at the bottom of the crust. Dr. Alan Jones of the GSC developed the concept of using long-period MT in this way in the article "Geophysical measurements for lithospheric parameters" published in *Searching for Diamonds in Canada*. The interpretation of the long-period (LRMT) measurements is improved by having additional, higher-frequency information – the MT band.

The hard part is how to actually carry out a combined Long Period MT / MT survey in the Arctic craton of Canada with a limited budget. A helicopter-supported summer survey is too costly. A winter survey along the ice road costs less but is technically challenging because of the low temperatures (as low as -33°C), the difficulty of making electrode contact on the ice, of making magnetic measurements on the moving lake ice and of logistics in general, especially weight of equipment and batteries.

Power consumption is a key issue because for every 20°C drop below +20°C, battery capacity drops by half. Low-powered equipment is a must so this dictated the use of the V5 System 2000 for the MT measurements, since each System 2000 MTU box weighs only 4kg, and uses only 8 watts, with a battery of only 8kg. Besides, since the telluric measurements had to be made on and through the lake ice, a system with separated telluric / magnetic measuring capability – the System 2000 – was essential.

For the long-period measurements, the GSC's "LIMS" system was used. To conserve heat, the systems were installed with batteries in special insulated equipment boxes. Telluric measurements were made on the lake ice and magnetic measurements nearby on the "portages" where the ice road crosses islands.

Phoenix crew members Lucien Patry, Doris Labrecque and Gary McNeice worked with James Cassels and Alan Jones of the GSC. In just 21 days, the crew mobilized, tested sites near Yellowknife, drove hundreds of km up the winter road, installed and acquired 11 combined LRMT / MT sites, drove up to 200 kilometres a day dodging heavy trucks and blowing snow, trekked by snowmobile to off-road sites and finally demobilized – all without any significant equipment problems. Congratulations to the expert crew on a job well done under extremely difficult conditions!

Thanks also to the very helpful people of the Northwest Territories, who generously provided valuable assistance and advice during the survey. ■

Mr. Ogawa (seated, left) accepts his MTU box from Phoenix's Mits Yamashita. Looking on are Nitttetsu colleagues, standing left to right, Mr. T. Takahashi, Mr. T. Kasagi, Mr. M. Kishimoto and Mr. T. Deguchi.

Dr. Patrick Killeen at an Exploration '97 party in Toronto, September, 1997, contemplates the future.

ON THE ROAD

IN April and May, Lu Yi and Gerry Graham made a four-week odyssey through China. Lu and Gerry first visited Szechuan to assist the Fifth Exploration Division of CNPC in their deployment of the V5 System 2000. They then traveled back to Beijing, flew to Urumqi in Xinjiang and drove two days to the southern margin of the Tarim Basin and the Taklimakan Desert. There they conducted acceptance tests and training for Xinjiang Pteroleum's new V5 System 2000. They next stopped in Xinjiang to work briefly with a different field team from the Fifth Division, also using the V5 System 2000. Next, back to Beijing for acceptance tests and training for Beijing Petroleum University's V5 System 2000. The field location was interesting, right next to the famous Ming Tombs.

Meanwhile, Mits Yamashita traveled to Mexico for a brief TDEM training session with UNAM near Queretaro.

George Balint visited clients in India at the Indian Institute of Geomagnetism in Mumbai, and the Indian School of Mines in Dhanbad, then flew on to Denmark to visit Danish Technical University. ■

PHOENIX SPONSORS SABLE ISLAND DX EXPEDITION

Amateur radio operators (hams) are collectors. They collect cards (called QSL cards) confirming that they have received a transmission from another station. But not just ANY station. The world is full of hundreds of thousands of hams, and few locations or countries are considered exotic any more. The real prize is the card from the truly exotic location. The rules of ham radio define these exotic locations: for example, an island which is part of territory of a country is nevertheless considered a separate country if it is more than 200 km from the mainland. Right away, you can see that this narrows the field. The Hawaiian Islands qualify, but they are so populated and so easy to get to they are not exotic. No, the island has to be difficult of access. Canada's Sable Island is the perfect candidate. Fogbound much of the year, off limits to casual tourists, and with no facilties, it is a Mecca for hams. Just a speck on your map, 35 km long and 1.6 km at its widest point, Sable Island (the "graveyard of the Atlantic") is a sandy crescent off the shore of Nova Scotia. Although Sable Island was never permanently settled, it has been temporarily occupied at different times by shipwrecked sailors, convicts and pirates. Canadian government weather-and-navigation station personnel are the only inhabitants now, but maintenance personnel, ecologists and geologists visit the island.

Above: George Balint, and left: the attractive QSL card from the expedition. The temporary call sign of the crew was CY0DX. "DX" stands for "distant reception" in ham parlance.

Last fall it was home for 14 days to three friends from Hungary who met in Toronto, drove to Halifax and flew to the island. Phoenix engineer George Balint with Zoli Molnar and Lou Laki weighed and re-weighed their equipment, paring down to the bare essentials (the plane could take only 500 kg and that included the three men).

Several adventures and misadventures later (including flu-ridden pilots, broken airplanes, downed antennas and bad weather), the group had logged more than 34,000 QSO (contacts) in 12 days. That's two per minute, 24 hours per day!

Phoenix was very pleased to sponsor the expedition, an adventure not unlike our geophysical surveys, which often take place in remote locations. ■

HOPING TO SEE YOU...

Meeting and Exhibition Schedule

June 01-03, Tsukuba, Japan. Vice-President Mits Yamashita presents one of three papers co-authored with personnel of Nittetsu Mining Consultants Co., Ltd. describing results of V5 System 2000 field surveys in Japan during 1997.The titles are “Simultaneous Multi-site MT Field Surveys Using Combined V5-2000 SSMT and V5-16 MT”; “Field Synchronization Test of MT System and GPS Clock (For Recording Telluric and Magnetic Data Separately”; and “MT System Evolution in Last 20 Years”.

The papers are in Japanese (with English Abstracts). Full texts are available from Phoenix.

August 16-23, Sinaia, Romania. The 14th Workshop on Electromagnetic Induction in the Earth. Dr. Alan Jones of Geological Survey of Canada presents two papers co-authored with Gary McNeice of Phoenix and others. Titles: “Magnetotellurics in the Frozen North: measurements on lake ice” (see front page story) and “Regional Conductivity Structure of the Island of Newfoundland”, Gary McNeice’s Master’s thesis subject.

Sept 12-19, New Orleans, USA. The 68th Annual Meeting and International Exposition of the Society of Exploration Geophysicists. Watch for the paper on AMT and deep mining exploration co-authored by Gary McNeice of Phoenix and Kevin Stevens of Falconbridge. The MT workshop and session on AMT / MT for mining should attract a lot of interest as the use of AMT in mining exploration continues to evolve and expand.

AGENT’S CORNER

For several years our agent in Germany has been Geo-Center-Nord (GCN) GmbH of Quickborn, Germany. Founded in 1970 by geophysicist Eva Raubold (a graduate of Leipzig University’s Faculty of Geoscience), GCN distributes geophysical soft-ware and instruments for several companies besides Phoenix. (The company was formerly called Ingenieurbüro Für Geotechnik or IFG.)

The company provides equipment for demonstration, replacement and rental as well as customizing and adapting engineering geophysical survey techniques for specific local requirements.

Geophysical Consultant Hans Raubold has had a long and fruitful career. For 30 years he worked with major seismic and oil companies, involved in oil exploration in Europe, the Far East, and Middle East; in 1987 he became an independent consultant.

Phoenix is pleased to have this competent husband and wife team as our representatives in Germany. They can be reached at Torfstrasse 1, 25451 Quickborn, Germany; fax (49) 41 062228 and telephone (49) 41 063470. ■

(above) Eva Raubold, founder of Geo-Center-Nord, Hans Raubold, wearing his Phoenix hat, chats with a young Fox from Phoenix

A tetrahedron (“four faces” in Greek)) is a symmetric solid; such a solid has a crystal form and system of axes both called tetrahedral. The solid shown here, a gigantic concrete casting used to prevent erosion along the seacoast of Japan, has tetrahedral axes. Such a solid always stands upright no matter how it is dropped or turned.

PHOENIX GEOPHYSICS

Phoenix Geophysics
3781 Victoria Park Ave.
Unit 3
Scarborough (Toronto)
Ontario, Canada
M1W 3K5

Tel 416 491-7340
Fax 416 491-7378
e-mail: phxgeo@netcom.ca

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