

THE PHOENIX



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SYSTEM 2000 FUELS EXPLORATION BOOM

IN 1996 Phoenix introduced a new generation of MT equipment – the System 2000. Hugely successful, Phoenix's system is used for the great majority of surveys in China.

China National Petroleum Corporation (CNPC), uses MT more than any other oil company in the world; CNPC moved swiftly to capitalize on the many advantages of the latest generation of MT equipment. MT for oil & gas exploration is expanding, driven by a rising oil import bill, the low cost of MT compared to seismic, a rapidly growing base of successful applications and a great increase in data quality provided by the new technology. Even in very noisy areas such as Hubei and Jiangsu provinces good quality data is now routine.

CNPC quality standards for MT are now much stricter than in most western countries. CNPC uses MT in two basic ways: long continuous profiles (for detailed surveys) and distributed individual points approx. 1 km apart (for reconnaissance). During 2000, thousands of km of profiles, and thousands of square km of prospective areas will be surveyed with MT all over China, from Xinjiang and Qinghai in the west, to Mongolia in the north, Heilongjiang in the northeast, Jiangsu, Hubei, and Anhui in central China, and Yunnan, Sichuan, and other provinces in the south. MT is used not only where seismic records are poor, but also where seismic would be very costly or too difficult.

The scale of MT use in China is much larger than any application elsewhere by the oil industry – yet most hydrocarbon



Lu Yi (second from left), Jin Zufa (right) and MT field crew take a well-earned lunch break after final pre-survey acquisition checks in Western Jiangsu Province. CNPC South China operates a calibration site here and all equipment must produce satisfactory data at this site before paid survey work may begin.

explorationists outside China are unfamiliar with the scale of MT application in China and the degree of its success, not to mention the cost savings compared to seismic.

More surveys require more equipment, so many more MT acquisition units were ordered by several Chinese service companies in late 1999 and early 2000. Most of the buyers are old clients of Phoenix. The accelerating privatization of formerly state-owned groups has produced a very dynamic, profit- and results-oriented MT service industry.

One group of visitors, from the 5th Division (Wu Chu) of the CNPC's Bureau of Geophysical Prospecting (BGP), arrived at Phoenix December 24 and, shortly after the New Year, concluded a contract for a large System 2000 to be

used for MT exploration in north and northwest China. This system replaces a competitor's hardware, nearly doubles "Wu Chu's" MT capability and solidifies WuChu's position as the biggest MT contractor in the world.

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Jiangan Oilfield (JOF) also joined the “New Year party”, significantly expanding the System 2000 they purchased in May, 1999. Zhejiang Petroleum Exploration, headquartered in the beautiful city of Hangzhou, also replaced a competitor’s equipment and joined the “System 2000 club”. (Like WuChu, both JOF and Zhejiang replaced competitor’s equipment with Phoenix systems.)

Two other old clients, divisions of CNC (China Nonferrous Metals Corp) expanded their existing systems.

Finally, Phoenix welcomed its oldest client in China, the First Comprehensive Geophysical Survey Team (in Anhui

Province), as a System 2000 owner in November 1999.

MT surveying is now a year-round business in China, interrupted only by the Chinese New Year celebration in early February. After the New Year, early in the “The Year of the Dragon”, nearly 15 MT crews will be active all over China, earning profits with their Phoenix System 2000 MT equipment.

China now can field nearly 200 Phoenix System 2000 MT units; the scale and priority of the application is causing MT to evolve rapidly in China, both in practical and theoretical terms. ■



On the loading dock: Phoenix Vice-president James Kok (left) and field supervisor George Elliott (right) oversee shipment some of the many System 2000 units sold to China early this year.

MESSAGE FROM THE PRESIDENT

Phoenix will be 25 years old in May, 2000 – the lucky Year of the Golden Dragon. A little introspection is in order at the quarter century mark.

The oldest company in the world is The Hudson’s Bay Company of Adventurers. “The Bay” (as it’s now called in Canada) received a British Royal Charter from Prince Rupert in 1670 to explore the wilderness of Canada and exploit its natural resources – furs. Today The Bay is a famous Canadian retail chain.

Phoenix shares a little of The Bay’s longevity and a lot of its spirit. We, too, are a “company of adventurers”, proud of our 25 years of continued existence. We have no royal charter but we do have the adventurous geophysical spirit, a commitment to be the best at what we do and to provide maximum value to our clients.

My first job in the exploration business was in 1963 in a silver mine in the Yukon Territory where I learned to appreciate the great challenge and constant variety of geophysics – and to use mind, science and technology to find the “needle in the haystack”.

One essential ingredient of exploration is the strong and resilient character typical of people in this industry. They must find the nearly unfindable and “surf” the waves of technical and economic change that forces geophysics to evolve as rapidly as the computer and communication industries.

Phoenix has just experienced a year of record sales and profits. The future for the main sectors we serve (oil and gas, metals and geothermal) is bright. We have robust, rapidly evolving, state of the art technology and a hard- and smart-working, efficient team who have forged their excellent working relationship through good times and bad.

When I look back over this record of our activities, technical and economic, I am pleased by how much we’ve accomplished in so many places.

– Leo Fox



NEWS FROM JAPAN

Japan continues to be a very important market for Phoenix. The Geological Survey of Japan (GSJ) again expanded their System 2000 in March. Dr. Yasuo Ogawa, Dr. Toshi Uchida, Dr. Shinji Takakura and other GSJ researchers will keep their System 2000 busy in Year 2000 with projects both in and outside Japan.

Tokyo Institute of Technology (TiTech) also expanded their System 2000 in March, 2000.



...scientists from TiTech, DPRI and other organizations carried out MT measurements at the epicenter of the August 1999 Turkish earthquake



As mentioned in Issue No. 18, scientists from TiTech, DPRI and other organizations carried out MT measurements at the epicenter of the August 1999 Turkish earthquake. The results were reported at the Conductivity Anomaly Research Group Meeting at Tokyo University, Jan.31-Feb.01, 2000 in two papers: "Preliminary interpretation of MT signals detected before and during the Kocaeli earthquake" and "Deep Resistivity structure in the Kocaeli earthquake faults area". ■

NEDO Project: Automated MT system.

Phoenix engineers Gerry Graham and Mits Yamashita visited Japan in January to service equipment and carry out the final installation of the automated monitoring software for the multi-station MT system installed in 1999 at a geothermal field in Kyushu. The system features a permanently installed, solar-powered far remote reference station, about 50 km from the geothermal field.

At the field itself, which surrounds a working geothermal power plant, a fiberoptic network connects a group of System 2000 recording units which measure the electric and / or magnetic fields over the reservoir. The data from all units is automatically collected and transferred to a PC at a central recording site.

GSJ IN INDONESIA



A famous Indonesian volcano, Mount Inerie, makes a spectacular backdrop for field crew members with a System 2000 MTU box. Left to right, Mitsuru Honda of WestJEC, Dr. Toshi Uchida of the Geological Survey of Japan and Mr. Ashari of Volcanological Institute of Indonesian and, standing, Phoenix engineer Lu Yi.



There was a little time for relaxation during the Geological Survey of Japan's project in Indonesia; here Mitsuru Honda of WestJEC cools off in a small waterfall.

The central site PC also automatically telephones the unmanned remote reference station each day and transfers the remote site data to the central unit, where the normal MT post-processing is automatically performed. In the central unit, day-to-day time variation of selected MT parameters or usual MT plots from any day may be displayed. ■

PHOENIX 3-D MT RESEARCH & DEVELOPMENT WITH ECOLE POLYTECHNIQUE

Professor Michel Chouteau is leading a \$330,000 three-year research and development project at the Department of Mineral Engineering at the Ecole Polytechnique of the University of Montreal. Two industrial partners – Falconbridge Nickel and Phoenix Geophysics – contribute funds and data sets; the Natural Sciences and Engineering Research Council of Canada (NSERC) provides matching funding.

The program grew from a 1996 conversation between Phoenix President Leo Fox and Ecole's Prof. Chouteau. Phoenix needed new approaches to interpretation and software to deal with the large amounts of data produced by their new System 2000 3-D MT system; Ecole, combining theoretical strength with practical and applied approaches, matched the needs of an industrial partner.

\$330,000 Three-Year Project

The MT situation now is comparable to that of seismic in the early 1980s when many-channel 3-D systems generated an order of magnitude more data than the older 2-D systems.

The research project was defined during 1997; in 1998, as the use of MT in mining exploration increased, Falconbridge joined in.

Prof. Chouteau and researchers Benoit Tournerie, Wei Sheng, and Erwan Gloaguen are developing new 3-D MT modelling and imaging codes and new processing and display software. They work with real-world data sets from 3-D mining exploration and oil exploration provided by Falconbridge and Phoenix. The mining dataset is drawn from more than 1,500 points and the oil and gas dataset comprises an 81-point 3-D MT dataset from the Pannonian Basin in Hungary.

The project will provide insights and develop software to accelerate the utilization of 3-D MT in mining and oil exploration. Progress reports will be published at geophysical meetings during 2000.

The excellent working relationship between Phoenix and Ecole dates back to the mid-1980s. Ecole is the only Canadian university ever to receive a capital grant for acquisition of MT equipment. Prof. Chouteau's group bought a Phoenix V5-16 system in 1990 after a successful demonstration survey in 1988 over the huge and well-known Emerald Lake magnetic anomaly, north-east of the famous Sudbury nickel mining camp, 400km north of Toronto.

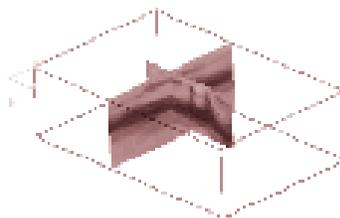
Ecole researcher, the late Marianne Mareschal, initiated the modern wave of 3-D-MT mining exploration in Sudbury with two AMT sites on either side of 1750-m deep Trillabelle nickel Deposit in 1992. ■

HOPING TO SEE YOU

Meeting and Exhibition Schedule

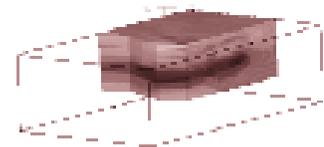
- ✓ Leo Fox will attend the 62nd EAGE Conference and Technical exhibition in Glasgow, Scotland, May 29 to June 2.
- ✓ Phoenix will exhibit at the Society of Exploration Geophysicists in Calgary, Alberta, August 6-11, 2000.
- ✓ Phoenix personnel will attend The International Geophysical Congress in Rio de Janeiro, Brazil in August, followed by an EM Induction workshop at Cabo Frio. Two papers, one by Leo Fox, the other by Olex Ingerov, will be presented.

3-D Resistivity "Cube" from 3-D MT Survey



Left: Resistivity sections along seismic lines. Note the structural high near the centre, in the low resistivity formation. The sections coincide with seismic lines to facilitate joint interpretation.

Right: 3-D resistivity cube generated in Hungarian 3-D MT survey. The resistivity cube is comparable to the 3-D "data cubes" obtained from 3-D seismic surveys.



Note: Darker colour indicates lower resistivity



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