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Uganda's Nationwide Airborne Geophysical Programme

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ABSTRACT

This paper outlines the five-year Sustainable Management of Mineral Resources Project commenced in Uganda in 2004. It incorporates a comprehensive airborne geophysical programme over most of the country, including high-resolution horizontal magnetic gradiometer and gamma-ray spectrometer surveys, with time-domain electromagnetic surveys in selected areas. The surveys commenced in late 2006, and mark the first large-scale use of the new Genesis electromagnetic system. The data will be incorporated in a geological mapping programme and, ultimately, will stimulate mineral investment in Uganda.

HISTORICAL AIRBORNE GEOPHYSICS

The historical airborne geophysical coverage for Uganda is shown in Figure 1. The onshore portion of the southern part of the country (south of 1º00´ N) was flown with a magnetic and gamma-ray spectrometry system by Geosurvey in 1980, at 1 km line spacing. Magnetic surveys were flown by Intera Kenting in 1983 as part of the "great Lakes" programme, covering Lake Victoria with triplets spaced 40 km apart, and the western part of Uganda, including Lakes Albert and Edwards, at 5 km line spacing. The survey blocks in the north and northeast were flown by Hunting in 1959, and incorporated electromagnetic and radiometric, as well as magnetic surveys. The magnetic data from these surveys were recompiled as part of the African Magnetic Mapping Project (Barritt, 1993), and released in 1992. Not shown in Figure 1 is an aeromagnetic survey flown by Intera Kenting in 1992 in the Kidepo Valley – Moroto – Mt. Elgon region, focused on petroleum exploration.

SUSTAINABLE MANAGEMENT OF MINERAL RESOURCES PROJECT

In 2004, the Ministry of Energy and Mineral Development of the Republic of Uganda embarked on the five-year Sustainable Management of Mineral Resources Project (SMMRP). The project covers the following aspects:

a. Strengthening of Governance in Mineral Sector Management;
b. Community Development and Mineral Resources;
c. Establishment of Environmental/Social Systems;
d. Geo-information and Development; and
e. Project Management and Coordination.

Financial support for the project is supplied by the World Bank and the African Development Bank, the Nordic Development Fund, in addition to the Government of Uganda. This endeavor is modeled after similar projects carried out in Africa in recent years (e.g. Mozambique, Madagascar, Nigeria).

The Department of Geological Survey and Mines (DGSM) in Uganda is tasked with the collection, analysis and dissemination of geoscientific data and, as such, is playing a critical role in the SMMRP. One of the main objectives of the programme is to promote Uganda as a destination for mineral exploration by domestic and international companies. An important contribution of a geological survey is to make high-quality geoscientific data accessible, for companies to assess the mineral potential of a country or area and, ultimately, to attract mineral investment.

A new geological mapping programme will be one of the legacies of the SMMRP. Airborne geophysical data provide the framework for such a programme, by mapping lithology, structure, metamorphism, alteration and tectonics, which provides a focus for the geological fieldwork. The geophysical data themselves are extremely useful in characterization of ore environments and exploration targets, and are in high demand by the exploration community.

In "Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration" edited by B. Milkereit, 2007, p. 1221-1223

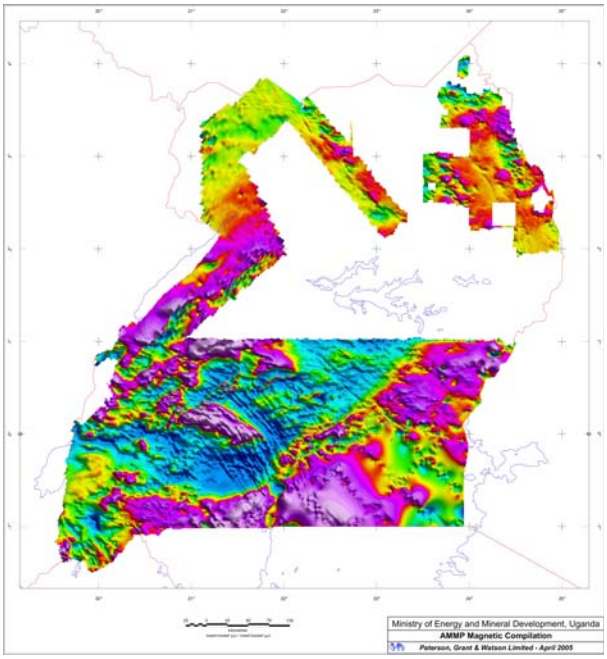

Figure 1: Historical geophysical coverage of Uganda, represented by the total magnetic field, shaded from the northeast, compiled by the African Magnetic Mapping Project.

Airborne Geophysical Programme

The new airborne geophysical programme commenced with data acquisition in December 2006, and will last approximately 18 months. Figure 2 shows the survey blocks. All are being flown with fixed wing magnetic horizontal gradiometer and gamma-ray spectrometer systems. All but Block 6 are being flown at 200 m line spacing and a nominal terrain clearance of 80 m. The line spacing for Block 6 is 500 m, with a terrain clearance of 100 m. The surveys total approximately 623,600 line-km.

Eight smaller blocks, totalling approximately 23,200 line-km, will also be flown with a time-domain electromagnetic system. These will have a 200 m line spacing and system-dependent terrain clearance.

Two separate contracts were let to cover the various survey blocks, both of which were awarded to Fugro Airborne Surveys of Johannesburg, South Africa. As of late May 2007, approximately 32% of the magnetic/radiometric surveys had been completed, as well as one of the electromagnetic survey blocks. As many as four fixed wing aircraft have been operating on the project at any one time.

Paterson, Grant & Watson Limited, together with Earthworks/GeoWitch, was awarded the contract to provide supervision and quality control of the airborne surveys. This contract incorporates a program of institutional strengthening, including formal and on-the-job training. An innovative component is the Management of Change programme provided by the Maastricht School of Management. This focuses on developing awareness of how institutions such as the DGSM must adapt to change as they move into the digital age, and are required to meet the demands of their clients in the 21st century.

Figure 2: Index map of the survey blocks for the new airborne magnetic and gamma-ray spectrometric surveys in Uganda.

Genesis Electromagnetic System

A unique component of the airborne geophysical survey programme is that it incorporates the first large-scale survey by the Genesis time-domain electromagnetic system (Figure 3), which has completed one survey block, and will fly a second, for a total of 7,900 line-km. The remaining six blocks will be flown using the Geotem system on a helicopter platform.

Figure 3: The Genesis electromagnetic system mounted on a Cessna 208B, Kakira, Uganda.

The Genesis uses a configuration typical of the INPUT-style systems, with a single-loop transmitter mounted on the aircraft and towed bird receiver, which measures the X, Y and Z-components of dB/dT. The same aircraft participated in the magnetic and gamma-ray spectrometry surveys both before and after the electromagnetic survey. The transmitter waveform is a

square wave, with a base frequency configurable between 25 and 270 Hz and corresponding pulse width between 10 ms and 0.925 ms.

The data are corrected for geometrical effects to a standard system geometry, which incorporates terrain clearance, pitch and roll of the transmitter, and transmitter-receiver separation (horizontal and vertical). The corrected and windowed data are in the form of B-field rather than dB/dT. Conductivity-depth images are computed for quality control purposes, in addition to examination of the channel data and decay constant.

CONCLUSIONS

The Department of Geological Survey and Mines in Uganda has embarked on a comprehensive airborne geophysical survey programme of its country, forming a key component of the Sustainable Management of Mineral Resources Project. It will play a key role in revitalizing the geological framework, ultimately leading to increased mineral investment and mine discoveries. Similar programmes have recently been, or are being, implemented in developing countries worldwide, particularly in Africa, where the World Bank and cooperating agencies realize the value in developing geological infrastructure.

REFERENCES

Barritt, S.D., 1993, The African Magnetic Mapping Project, ITC Journal, 1993-2, 122-131.