THE USE OF AEROMAGNETICS AND VECTOR MAGNETICS IN GOLD AND DIAMOND SEARCH WITH EXAMPLES FROM BOTSWANA AND AUSTRALIA

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ABSTRACT

The Vector-Mag system is flown on a Cessna 206 Aircraft and measures the total magnetic field using three Scintrex H6 cesium vapour sensors, two mounted on the wingtips and a third installed as a conventional tail stinger enabling both transverse and longitudinal gradients to be measured. The magnetometer counting circuitry and aircraft acquisition system were developed at Aerodata Holdings Ltd., Australia. Separation between the wingtip sensors is 14.9 metres and the axial separation between the tail sensor and wingtip sensors is 6.9 metres. Compensation of aircraft manoeuvre noise was accomplished with in-house software to reduce noise levels by factors of 10-20.

Recently a PICODAS gradiometer acquisition system was installed in the aircraft. The system samples each sensor with a resolution of 10^{-3}nT and the compensation software reduces manoeuvre noise to less than 10pt/metre.

Gradiometer measurements offer a number of advantages over measurements of the total magnetic intensity. Superior resolution of closely spaced geological features and better definition and location of geological contacts are important advantages in exploration.

Very small variations in the total field data can be assigned to geological or other non-temporal sources if they are supported by corresponding variations in the gradients. This confidence is of vital importance in exploration for diamondiferous kimberlites and lamproites, and other targets such as precious and base metal ore bodies with minor associated pyrrhotite where the magnetic response of the target is subdued. Gradient data also enhances near surface features and discriminates against deeper features.

Horizontal gradient information can be incorporated into the imaging and contouring of total field data permitting a better portrayal of geological trends, overcoming the 'bullseye' and other mapping errors commonly created by anisotropic sampling of data.

Arrow maps where the total horizontal gradient vector is represented as an arrow, and contours of total horizontal gradient and total horizontal gradient processed with automatic gain control (AGC) have proved to be useful displays of gradient data. As with total magnetic intensity information the image processor offers decisive advantages for the display of magnetic gradient data. Judicious use of colour and shading enables a geologically meaningful presentation where subtle magnetic features are emphasized.