

The magnetic method can be expected to provide information on discontinuities within the volcanics at the top of the Bitter Springs Formation to depths of 2000-3000 m, but within the ironstone to a depth of only a few tens of metres.

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Magnetic gradiometers for petroleum exploration

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Magnetometers have been employed in differential arrays called gradiometers for over two decades. While the initial impetus for gradiometers was the removal of time variations such as micropulsations and diurnal variations, other advantages are assuming prominence. In general they offer higher resolution of shallow anomalies, remove regional gradients and provide vector information for interpretive use.

Gradiometers are employed for airborne and marine applications in any of three configurations: vertical, horizontal transverse (normal to the profile) or horizontal longitudinal (in the direction of the profile).

Marine gradiometers have been tested in the vertical configuration, as a transverse gradiometer housed in a catamaran and as a longitudinal gradiometer towed as two sensors in tandem. The latter is now in use by over 40 marine geophysical organisations. Airborne gradiometers are being flown in the vertical configuration using towed birds or rigid on-board sensor mountings. A longitudinal configuration with two sensors in tandem has been flown experimentally using the towed bird vertical gradiometer system, but deployed horizontally by changing cable lengths. Transverse gradiometers with sensors mounted in the wing tips of aircraft are in use by four organisations.

A vertical gradiometer is used primarily for the advantages already cited. The longitudinal gradiometer provides, in addition, total field free of all time variations, obtained by integrating the gradient over the distance traversed. The transverse gradiometer, in addition to those advantages of the vertical gradiometer, provides data for a more accurate contour map by utilising the two horizontal gradients as an interpolation aid in compiling the data. When the airborne transverse gradiometer is used together with a tail stinger-mounted sensor, the system provides the advantages of both longitudinal and transverse gradiometers, i.e. total field free of time variations, and data on a two-dimensional map form, with higher accuracy than any other magnetic mapping system.

Examples of some of these configurations are described with respect to their application for accurate magnetic field representation, and to determination of the thickness of sediments and basement structure.

Electrical petroliferous exploration in Australia

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The research project under discussion here was initiated by the Commonwealth Scientific and Industrial Research Organisation to test the ability of electrical methods to detect oil and gas accumulations onshore in Australia. A variety of electrode arrays have been tested over seven oil and gas producing areas in the Surat and Cooper Basins and the Denison trough, in Queensland and South Australia. The object of the research is to test the feasibility of cost effective reconnaissance surveys to collect a minimum of data with the maximum interpretability. An attempt to determine the nature of the alteration that occurs to the rocks above a hydrocarbon accumulation is also being sought. The rocks above hydrocarbon accumulations have been shown to be between 20 and 50% more conductive than those surrounding them.

The vehicle-borne data acquisition system (Fig. 1) is built around a Hewlett Packard 9845T computer, a (Nicolet) digital oscilloscope (ADC), a digital voltmeter and dual channel spectrum analyser, and also a frequency generator and preamplifier-filters. Receiver-transmitter synchronisation is achieved by portable oven controlled crystal oscillators at both sites, and this, coupled to a delay generator, enables a variety of transmitted wave timing to be tested.

Data from the preamplifiers are processed via the digital oscilloscope containing a memory of 4096, 12 bit words (Nicolet) and a digital system voltmeter. Data can also be processed through a dual channel spectrum analyser to the computer, enabling real time Fourier transforms on incoming data. The transmitter is a Geotronics FT15A, 8kW, Induced Polarisation (IP) system, that can deliver

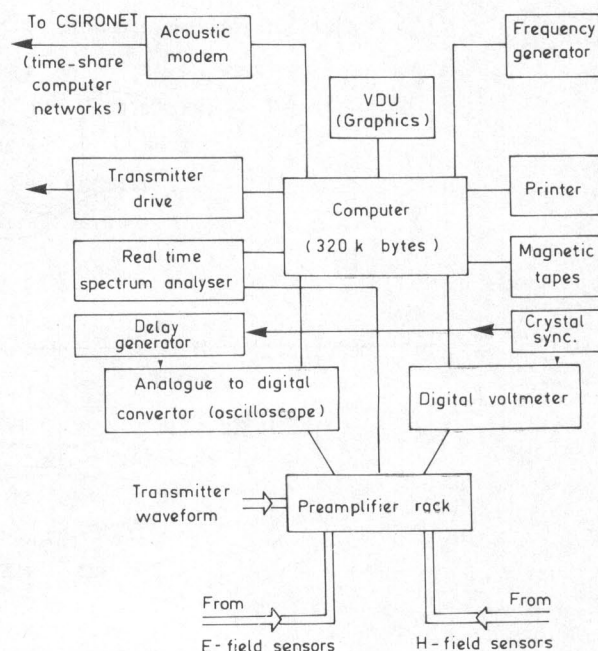


FIGURE 1
Block diagram of vehicle-borne digital data acquisition system.