A GEOPHYSICAL CASE HISTORY OF THE AK1 LAMPROITE PIPE

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Following the discovery of the AK1 lamproite pipe in October 1979 (Atkinson et al, 1984), several geophysical surveys were undertaken over the pipe to determine the most effective method(s) for locating additional lamproites in the surrounding area.

In January 1980, a small detailed aeromagnetic/radiometric survey was flown by Geometrics Ltd, over the immediate area of AK1. Survey specifications included north-south flight lines and a line spacing of 250 metres. Examination of the results showed a low amplitude (5 nT) magnetic response coincident with the northern margin of the pipe (Figure 1).

This led to the commissioning of a larger airborne survey (15000 line km) in July 1980, to explore the ground surrounding AK1, now under title to the Ashton Joint Venture. Geometrics were again awarded the contract. Both magnetic and radiometric data were collected using a line spacing of 300 metres and NW-SE flight lines. The line direction was changed from that of the initial test survey to account for regional strike and to try and minimise the effects of rugged topography. This survey, however, failed to detect the magnetic response located by the original survey (Figure 2).

Detailed helicopter-borne and ground magnetic surveys were subsequently completed along traverses orthogonal to the strike of the pipe to better elucidate its magnetic signature. Results again showed the general lack of magnetic response over the pipe but did confirm the presence of a low amplitude anomaly at its northern end (Figure 3). Ground coverage was severely limited by the harsh topographical relief. Detailed modelling of this feature predicted depths ranging from 100 to 150 metres, a southerly dip which was in contrast to the northerly dipping stratigraphy, and magnetic susceptibilities between 200 and 600 x 10^{-5} SI units, typical of a lamproite source.

Drilling however, failed to intersect magnetic lamproite before the holes were terminated in footwall sediments of the Lissadell Formation. Drilling depths ranged from 100 to 140 metres. Magnetic susceptibility measurements on the core yielded values less than 50 x 10^{-5} SI units for the lamproite. It was therefore concluded that the magnetic source must emanate from within the sedimentary sequence (possibly a raft of Lissadell Iron Formation) and not from lamproite as was originally thought. More recent thinking, however, based on a better understanding of the pipes structural setting, may suggest the above conclusion needs further consideration.

Modelling of a weak magnetic response along the western contact, successfully predicted a steep westerly dip to the pipe, which at the time was not regarded as geologically feasible (see cross sections in Boxer et al, this volume).

Examination of the radiometric data failed to locate a recogniseable response over the pipe. Average potassium contents for the lamproite were found to vary from 3 to 6 percent.

Electrical methods were also tested over the pipe both in the air and on the ground. A trial INPUT survey flown in late 1980 by Geoterrex Ltd., detected a weak 4-channel anomaly (figure 4) over the northern end of the pipe where the pipe width is greatest (500 metres) and the topographical relief smallest. Excessive flying altitude due to the rugged terrain helped to minimise INPUT responses elsewhere over the pipe.

An EM 34 survey using vertical coplanar coils and a coil separation of 20 metres was subsequently undertaken (Figure 5). Apparent resistivities over the lamproite were found to range from 40 to 100 ohm-metres, the more conductive section coinciding with non-sandy tuff, whilst values greater than 200 ohm-metres were encountered over the surrounding Lissadell Formation. A limited Sirotem survey confirmed the low near surface resistivities but indicated the fresh lamproite (sandy tuff) was much more resistive (Figure 6). Results of the EM 34 survey helped to delineate pipe contacts during the early phases of exploration.

Downhole geophysical logging, measuring density, natural radiation and resistance was undertaken in selected drill holes as an aid to geological logging. Variations in density and resistance were found to correlate with altered zones associated with fracturing, whilst there was little recorded variation in the natural gamma log. Efforts to correlate these parameters with such things as diamond grade were unsuccessful.

REFERENCES

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BOXER, G. L., LORENZ, V. & SMITH, C. B., 1986. The geology and volcanology of the Argyle (AK1) lamproite diatreme. This volume.

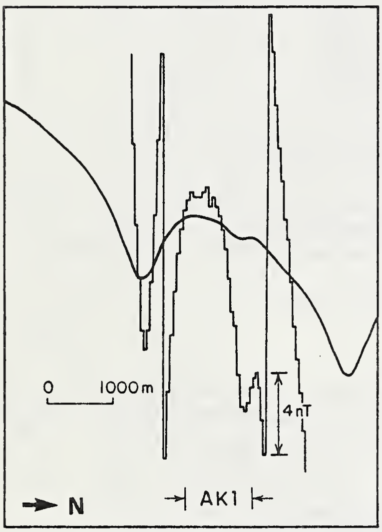

Fig. 1 Aeromagnetic Profile
January 1980 Survey

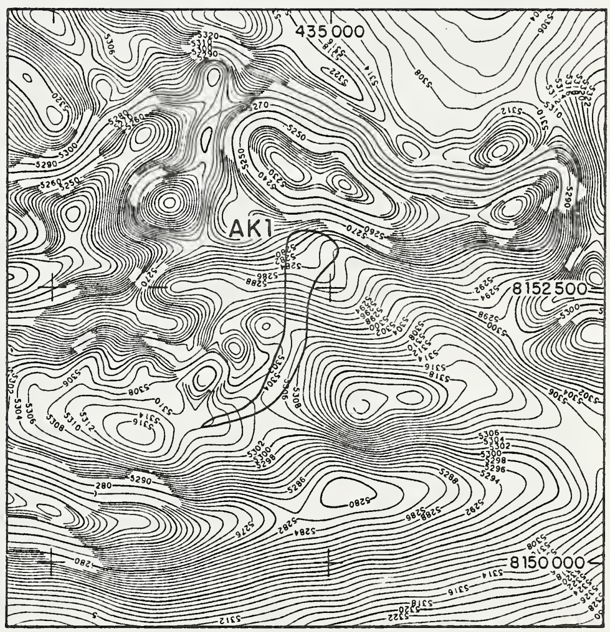

Fig. 2 Aeromagnetic Contours August 1980 Survey

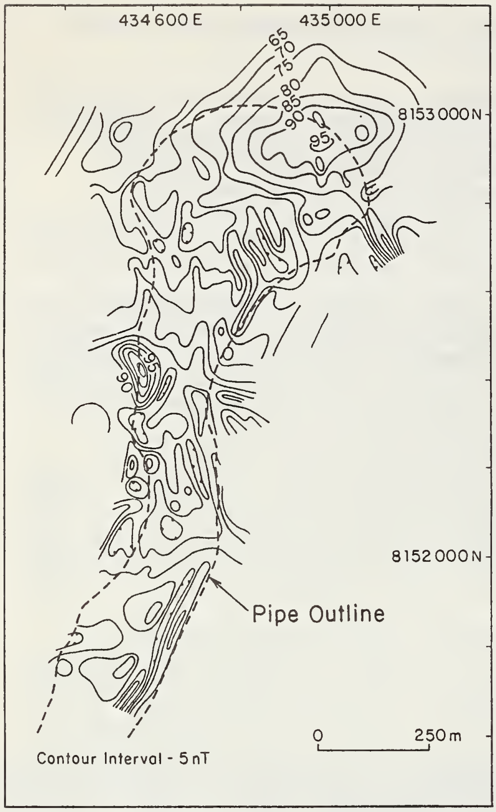

Fig. 3 Ground Magnetic Contours

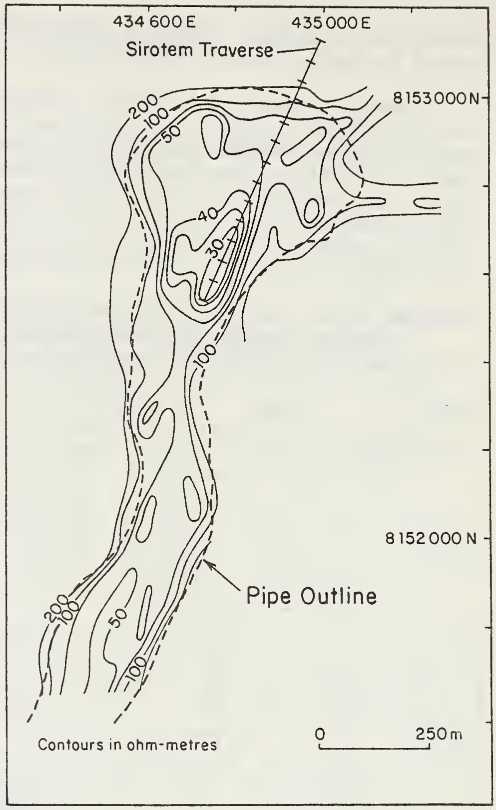

Fig. 5 EM34 Survey
Apparent Resistivity Contours

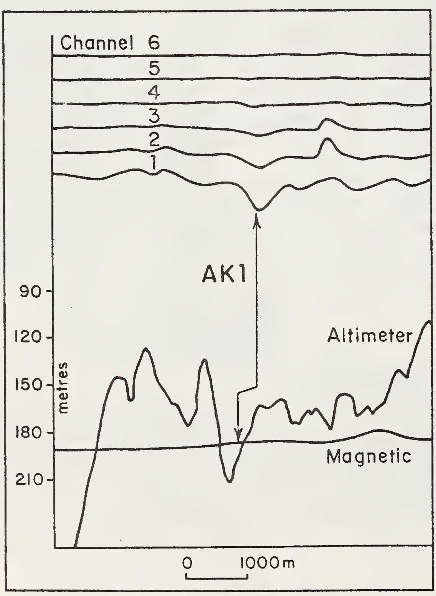

Fig. 4 INPUT Profile

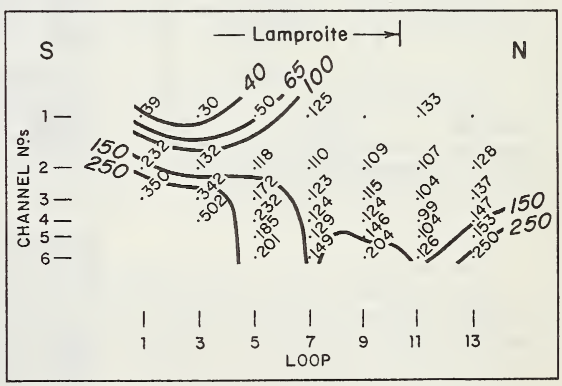

Fig. 6 Sirotem Apparent Resistivity
Pseudo Section