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Some qualitative analyses of the ground magnetic survey in the Kedah Peak Rest House Area, Kedah

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Abstract: Qualititive analyses of a ground magnetic survey suggest that the complex magnetic anomalies occurring in the Kedah Peak Rest House area are due to

(1) near-surface magnetite veins occurring at the vicinity of the Rest House, and,

(2) larger magnetite bodies at estimated depths of 90 to greater than 250 m.

These magnetic sources at depth are thought to be magnetite concentrations within the quartz porphyry itself or at the contact with the metasediments of the Jerai Formation. The quartz porphyry is regarded as an apophysis of the main igneous body which is endomorphosed on solidification before the main processes of intrusion are completed. The natural escape route for the mineralising fluid (high Fe-Content silicic differentiates from the magma chamber) would be the sheared quartz porphyry rather than the metasediments. Occurrence of magnetite in the metasediments result from replacement processes rather than primary ore deposition.

INTRODUCTION

Airborne magnetic survey by Agocs *et al.* (1958) over parts of Kedah and Perlis revealed several anomalous features in the Gunung Jerai Region. A ground magnetic survey was conducted to investigate into the causes of a major anomalous feature at the Kedah Peak Rest House area. Location of the area is shown in Fig. 1.

An area of approximately 3.5 km^2 of steep hilly terrain was covered in the magnetic survey. Two magnetometers were used; the M700 McPhar Magnetometer and the Unimag Proton Magnetometer. The former with reading accuracy of up to $\pm 5\gamma$ measures relative vertical field while the latter measures the absolute total field intensity with sensitivity of $\pm 10\gamma$.

Field operations for the survey lasted 6 weeks, beginning from the month of April. Being of preliminary nature, terrain and elevation corrections were deemed not necessary for the magnetic survey. The data is, however, corrected for daily drift. Detailed geological mapping of the area was carried out to aid the interpretation.

GEOLOGY

The metasediments of the Jerai Formation, predominantly quartzite and quartz-mica schist with some hornfels and calc-silicate rocks, underlie a major part of the surveyed area. Much controversy surrounds the origin of the quartz porphyry occurring in the area. Early workers like Willbourn (1926) regarded it as an early phase sheared granite porphyry. Paramanathan (1964), from field mapping, came to the conclusion that it is intrusive and Rao (1972) referred to the quartz porphyry body as an aplite dyke. It was Bradford (1972) who first suggested a metasomatised arenaceous origin on the basis of its slight sedimentary semblance. Almashoor (1974) however suggested a bedded tuffaceous origin.

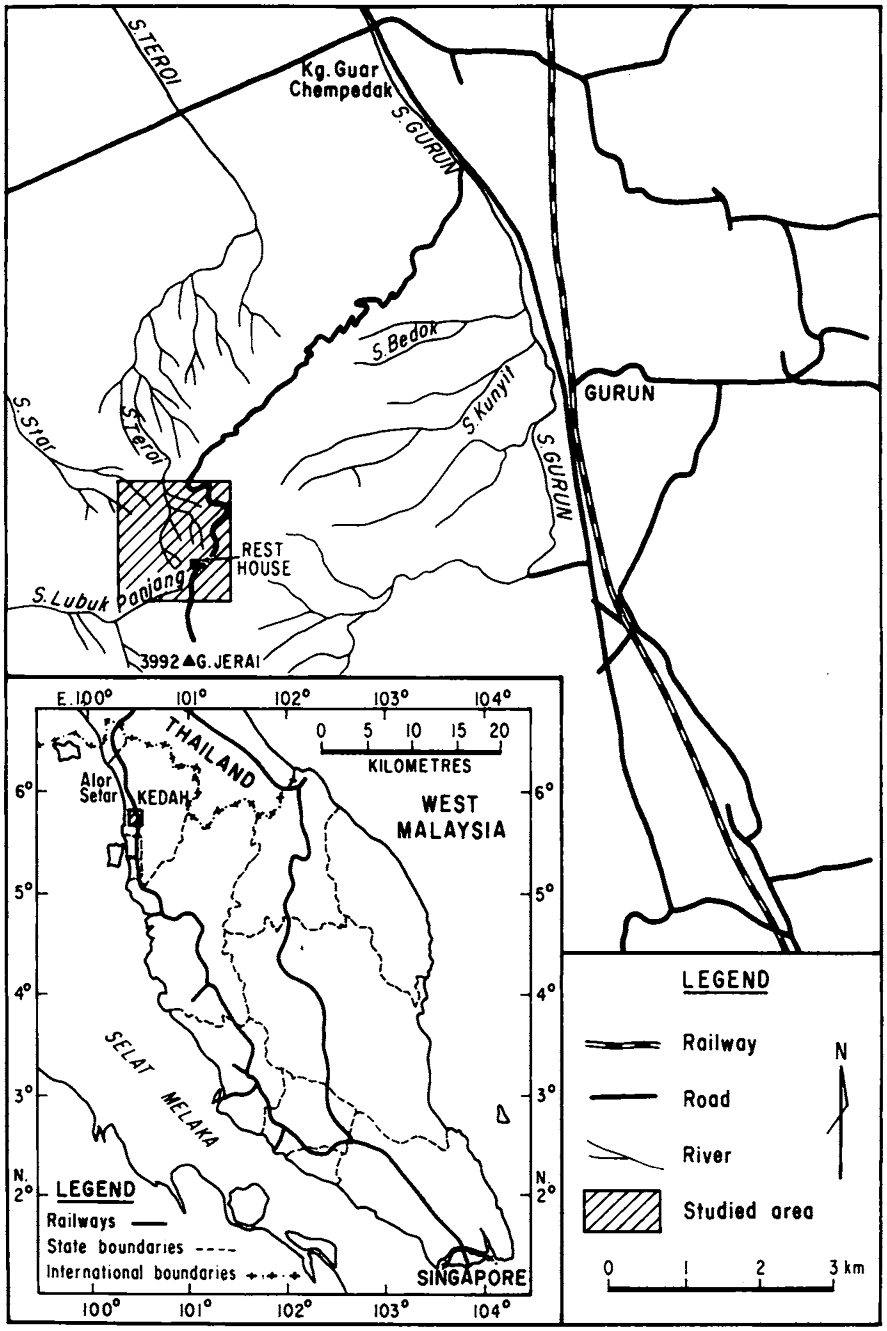

Fig. 1. Location of area surveyed.

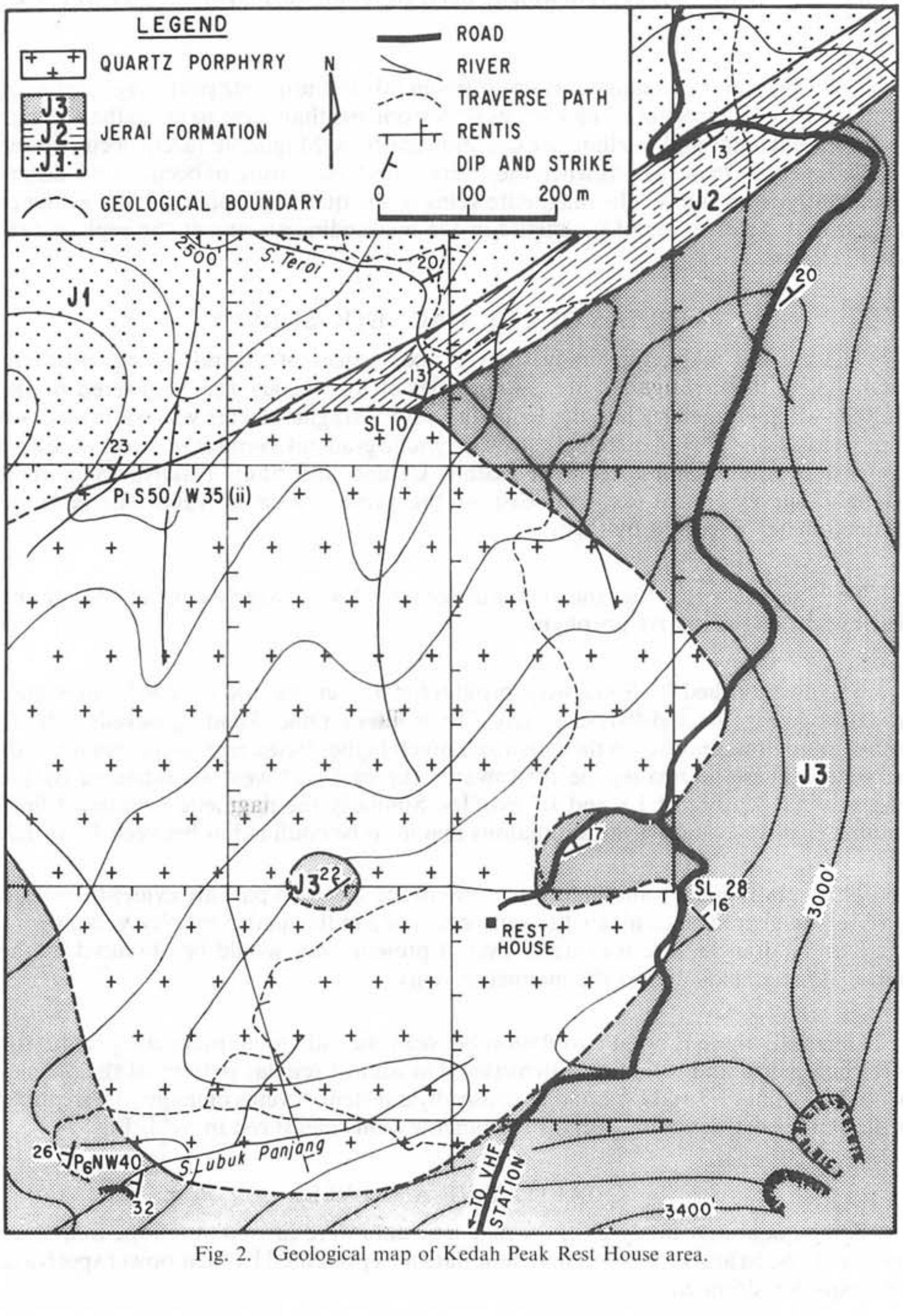

Fig. 2. Geological map of Kedah Peak Rest House area.

Present detailed study and mapping does indicate an intrusive origin, discussion of which is given by Lim (1979) in which a detailed geological map of the area was given (Fig. 2).

Veins of quartz and magnetite occur frequently in the quartz porphyry, the major trend being N–E direction. Thicknesses vary from less than 1 cm to more than 10 cm. Irregular pinchings and swelling are common features. Magnetite rarely occurs in the metasediments. On occasions when they were found, the nature of occurrences differs significantly from that of the magnetite veins in the quartz porphyry. Field evidence suggest that occurrences of magnetite in the metasediments are of the replacement type.

RESULTS OF THE MAGNETIC SURVEY

The ground magnetic survey showed occurrences of several strong, localised anomalies in the investigated area. Anomalies of over 6000γ were registered by the McPhar Magnetometer while the Unimag Proton Magnetometer was 'saturated' on several occasions, due to extremely steep magnetic gradient. Similar findings were also reported by the Japanese team of Toshio Uchino and Shoji Nakayama in their magnetic survey, north-east and east of the present area in 1960. An Askania Magnetometer was used by them.

They also reported that the anomalies observed were largely coincident with the distribution of the quartz porphyry.

The unsmoothed N–S magnetic profiles for the vertical and total field intensities are shown in Figs. 4a and 4b respectively. The profiles for lines 3 and 5 generally indicate broad anomalous features in the north and much higher frequency anomalies towards the south. These anomalies die off towards the east and west as indicated by the relatively flat feature of L1 and L7 profiles. Similarly the magnetic profiles of lines running east-west suggest the anomalous region to be confined in between L1 to L7.

The high frequency anomalous features in the southern part are evidently caused by observed near-surface magnetite veins occurring in the quartz porphyry. No major broad anomalous feature is evident. Even if present, they would be obscured by the high magnetic fields due to the magnetite veins.

Generally there is good correlation between the individual magnetic profiles for both the vertical and total field intensities. The almost regular pattern of the profiles exhibited by lines L3 and L5 could be caused by a system of veins of magnetite trending in the north-east direction (trend of magnetite veins measured in field, Fig. 3).

QUALITATIVE ANALYSES

Some qualitative analyses of the magnetic data were carried out in the frequency domain. Figs. 5a and b show the magnetic data as represented by their power spectra in the frequency domain.

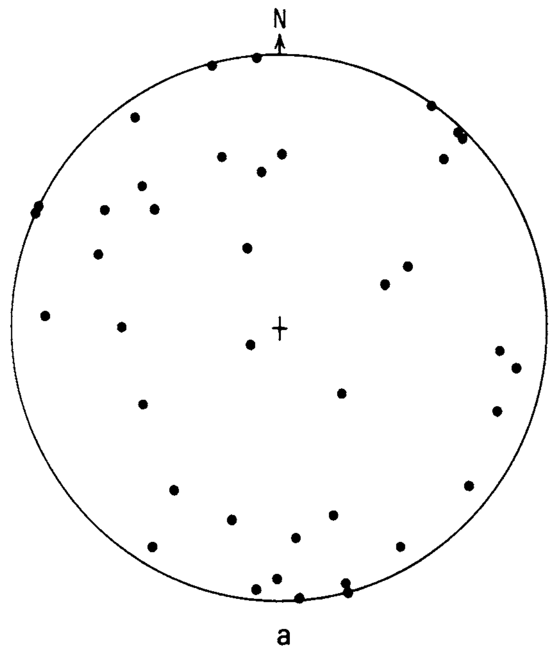

Fig. 3(a). Stereographic projection of the poles to the planes of the barren quartz veins in the study area.

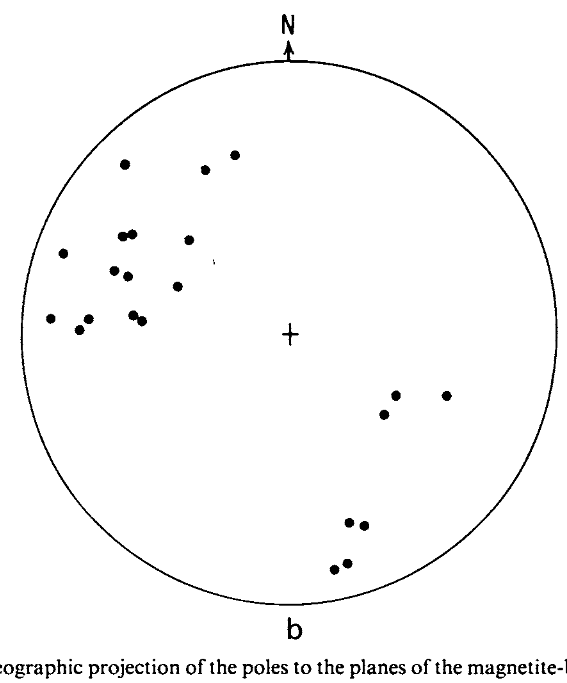

Fig. 3(b). Stereographic projection of the poles to the planes of the magnetite-bearing quartz veins in the quartz porphyry.

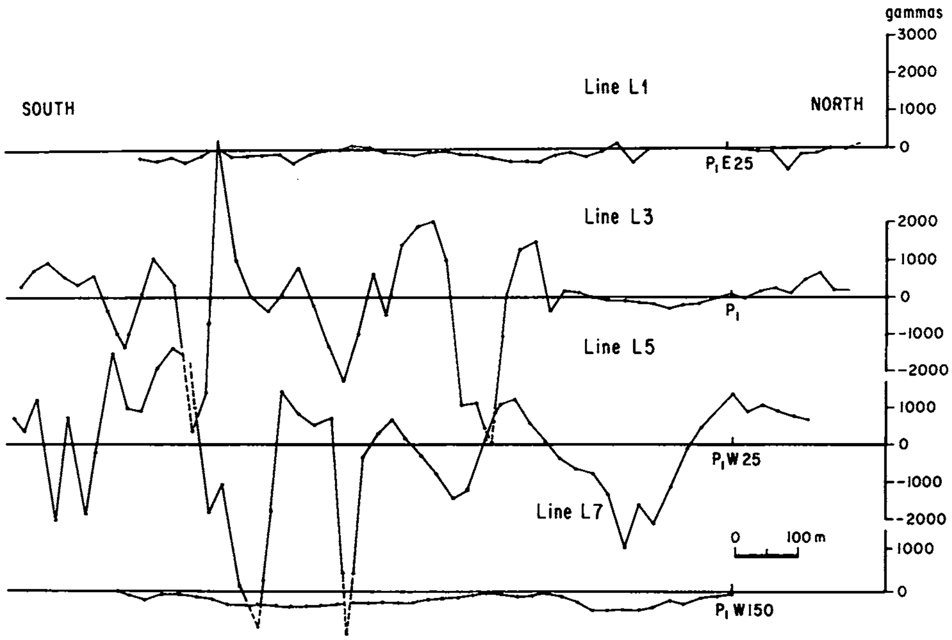

Fig. 4(a). Unsmoothed vertical field intensity N–S profiles.

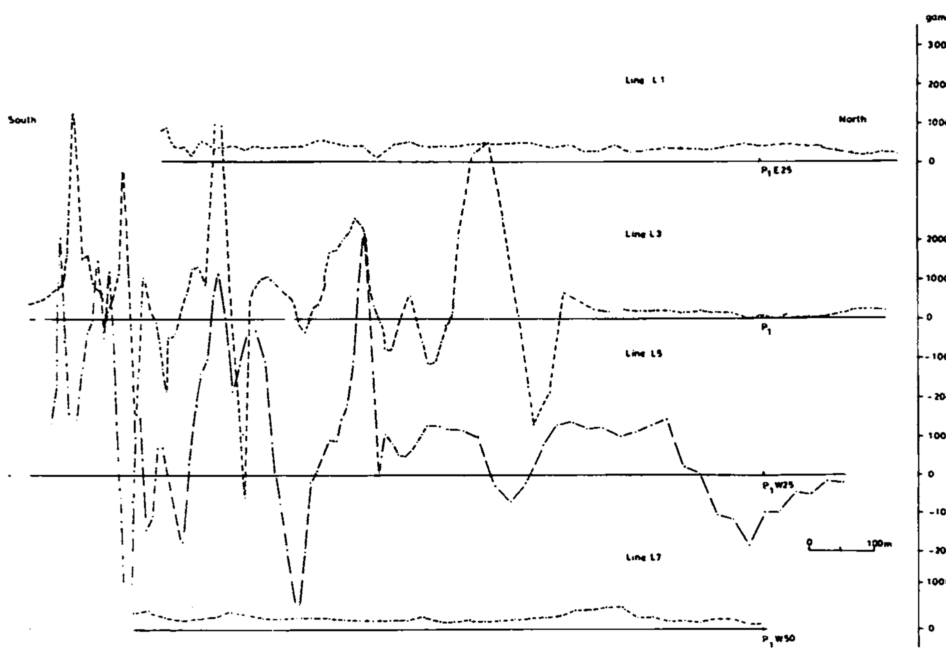

Fig. 4(b). Unsmoothed total field intensity N–S profiles (datum for total field intensity 41000 gammas).

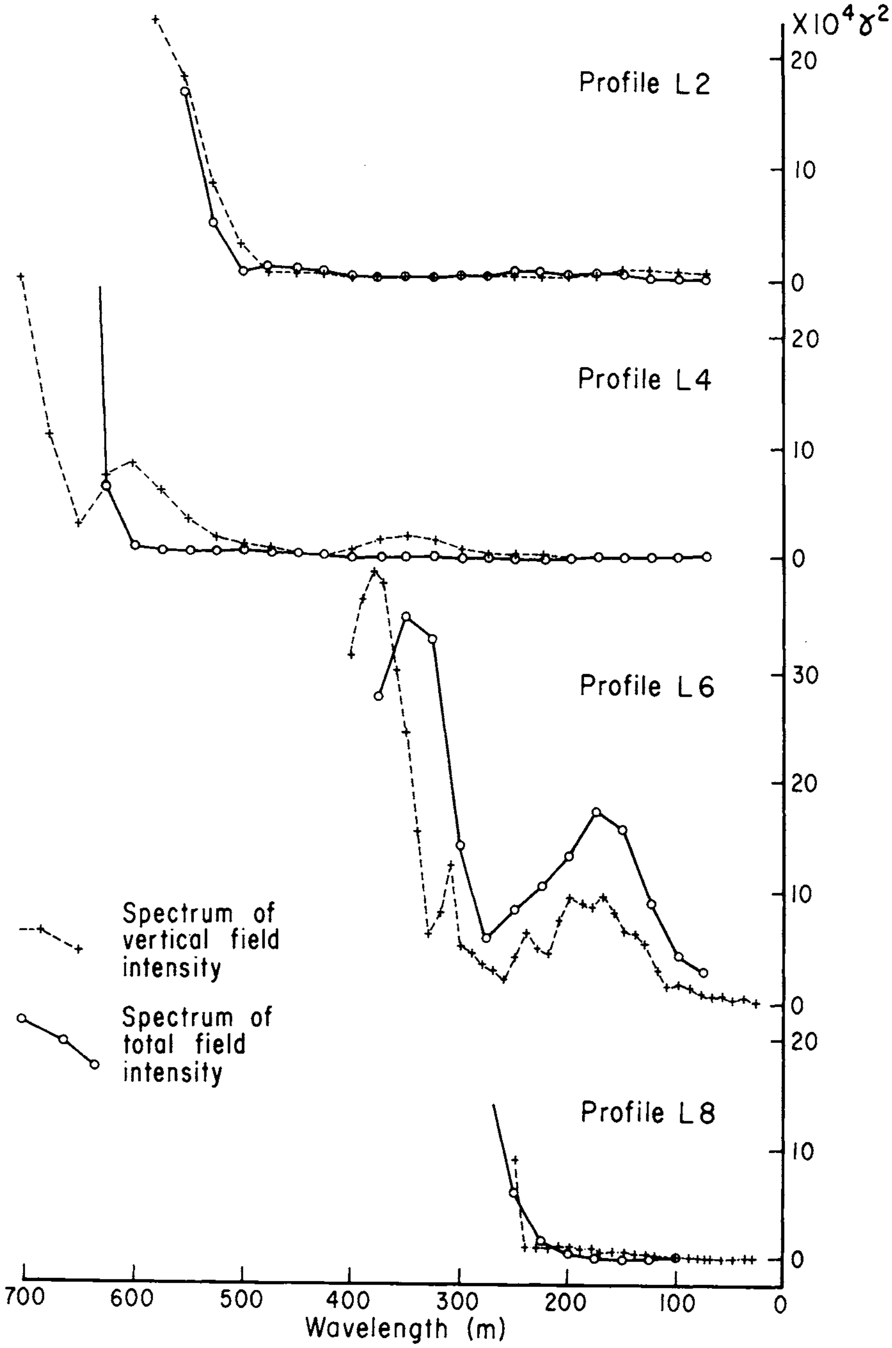

Fig. 5(a). Power spectra of east-west profiles (smoothened by moving averages).

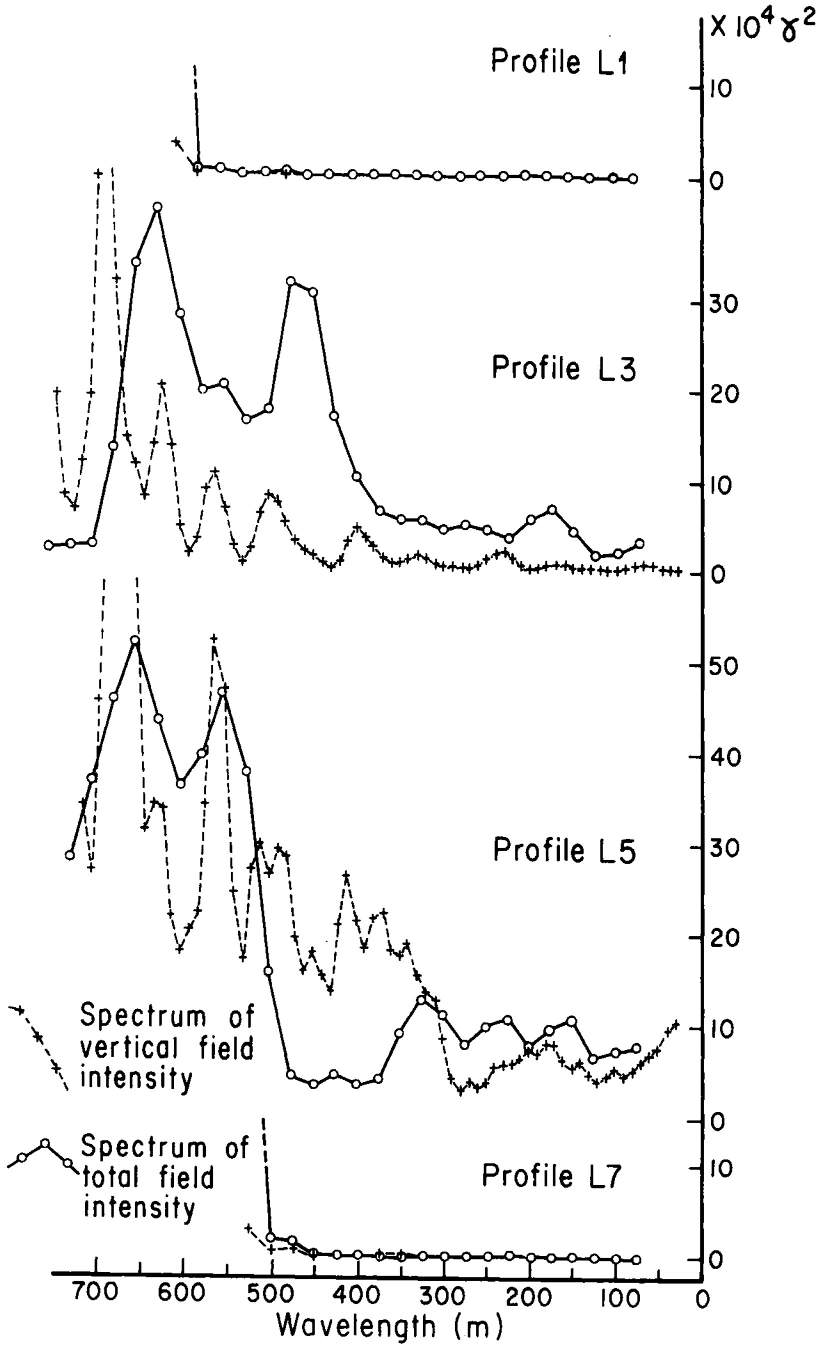

Fig. 5(b). Power spectra of north-south profiles (smoothened by moving averages).

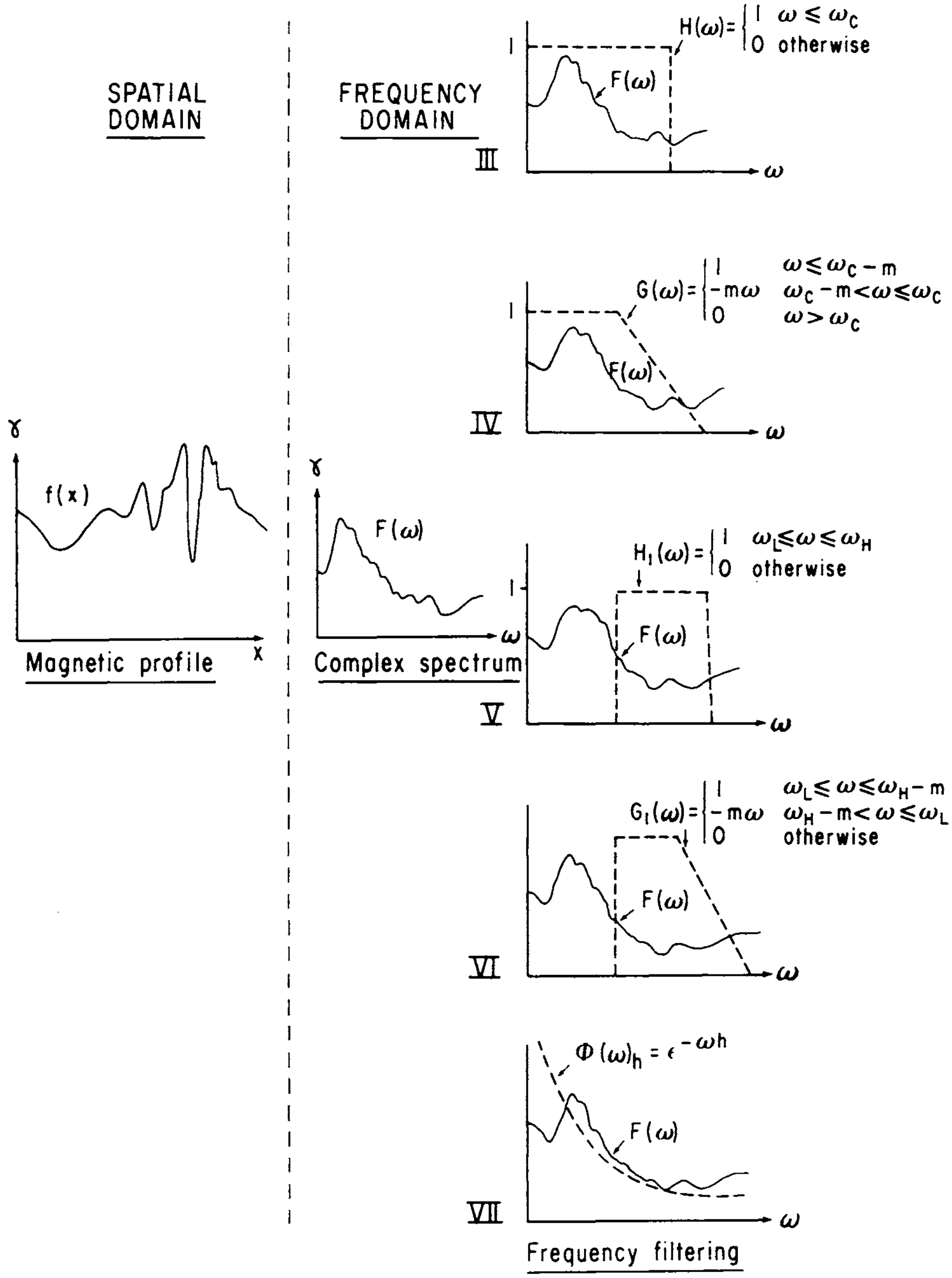

Fig. 6. Diagrammatic representation of filtering in the frequency domain.

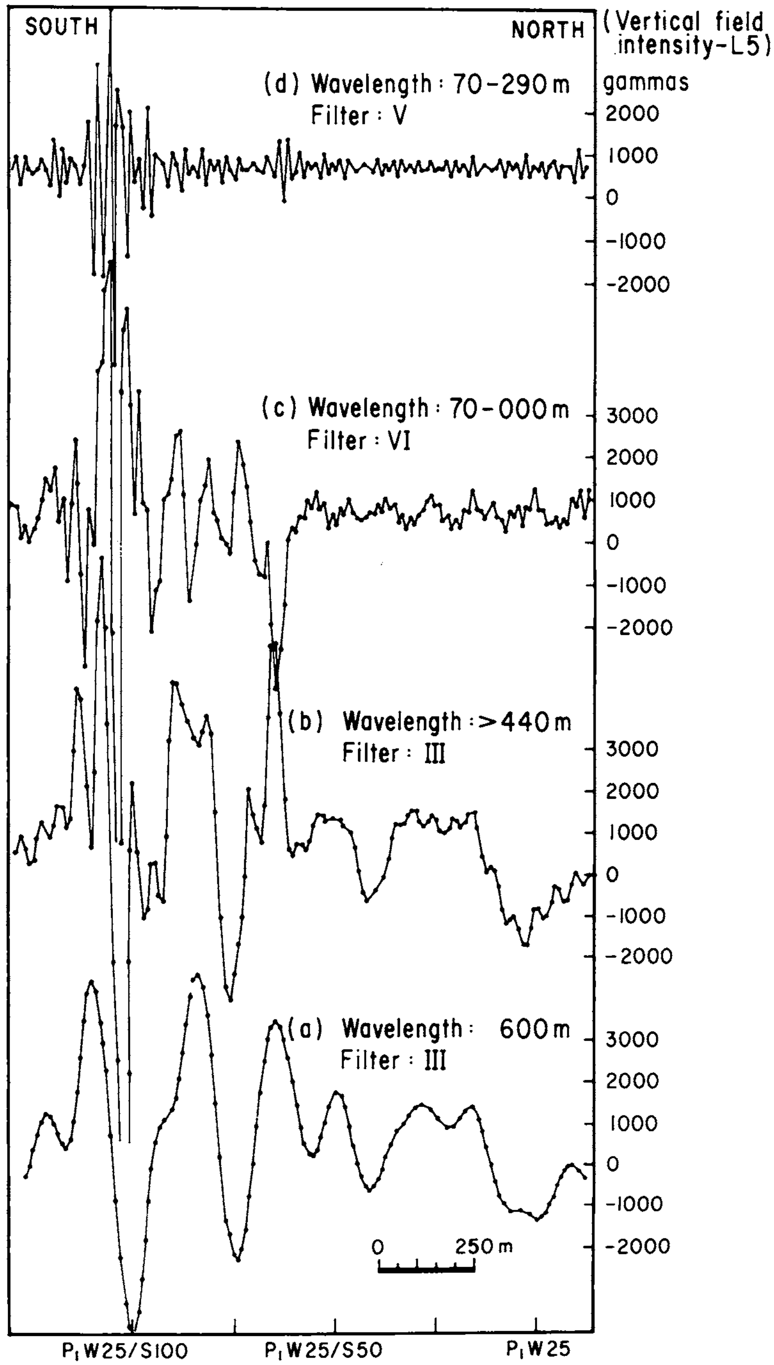

Fig. 7. Separation of anomalies using different band pass (Vertical Field Intensity—Profile L5).

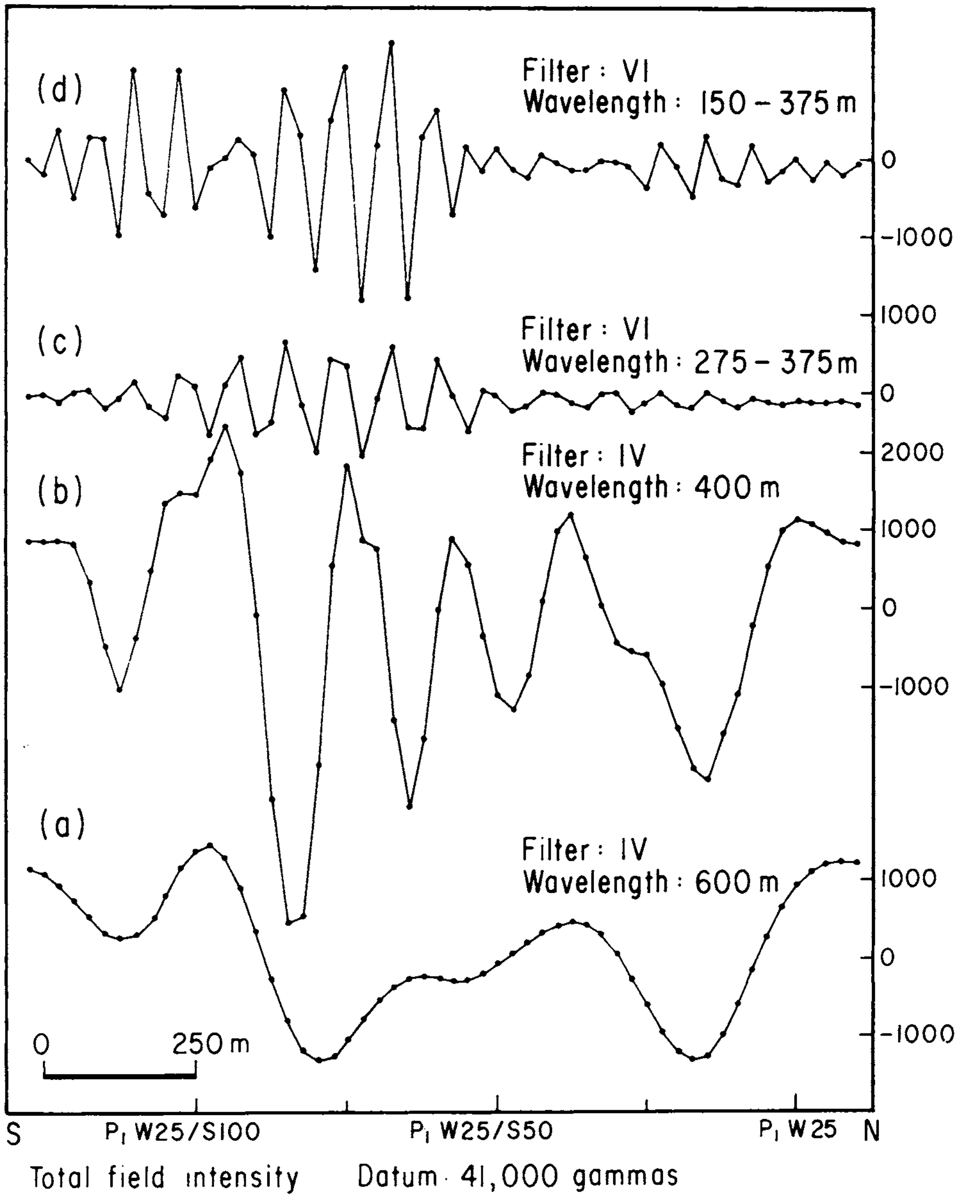

Fig. 8. Separation of anomalies using frequency filtering (m = S) (Total Field Intensity—Profile L5).

From the original data, one would expect high powers in the high frequency range of the spectra. However, the power spectra generally show otherwise i.e. negligible powers in the high frequency range. Even for the profiles L3, L4, L5 and L6, the lower frequency components of these spectra consistently show greater amplitude than the higher frequency components. Hence indications are that conditions at depth might also be anomalous. Their signals could however be obscured by high frequency signals due to near surface magnetite veins.

District splits in the spectra of the profiles L3, L4, L5 and L6 are evident. The anomalous sources probably occur at distinct depths beneath the near-surface magnetite veins. Frequency filtering techniques were attempted to separate the anomalies due to sources at various depths.

The filters used in the frequency filtering exercise are summarised diagrammatically in Fig. 6. All the data is subjected to high pass filter of cut-off wavelength 70 m. Higher frequencies are undesirable since the power spectra indicate that these may be due to noise caused by man-made objects and experimental errors.

Using high band pass (Filter V) of cut-off wavelength 70 to 290 m, the high frequency anomalies consistently appear only in the southern section of the surveyed area coinciding with the distribution of magnetite veins (Fig. 7). The top profiles of Figs. 7 and 8(7(d), 7(e), 8(d) and 8(c)) show that the occurrence of high frequency anomalies are confined to the locality around station P_1W25/S100 where magnetite veins were encountered. In the northern parts where the metasediments of the Jerai Formation forms the bedrock, no anomalous-features are evident. By shifting the band pass filter towards the lower frequency part of the spectrum, parts of the northern sections as well as the southern begin to appear anomalous. These anomalous features are, however, much broader.

Using low pass filter (VI) of cut-off wavelengths of 600 m to filter out high frequency signal, several distinct anomalies are evident in profiles L3 and L5 for both the total and vertical field intensities. Depth estimates to these sources using the half-width method, vary from 90 to over 250 m. Two dimensional modelling using approximations of dipping dikes correspond quite well to the depths estimated.

CONCLUSIONS

The present investigation shows that the complex anomalies in the Kedah Peak area are due to presence of magnetite bodies rather than any special types of intrusive rocks as suggested by Agocs *et al.* (1958). Qualitative analyses carried out suggest that the near-surface magnetite veins occurring at the vicinity of the Rest House probably extend down to bigger magnetite bodies at depth. These magnetite bodies could probably be magnetite concentration within the quartz porphyry intrusives itself or at the contact zone with the metasediments of the Jerai Formation.

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REFERENCES

AGOCS, W.B., PATON, J.R., AND ALEXANDER, J.B. (1958). Extract from the Colombo plan report on Airborne Magnetometer and scintillation counter survey over parts of Kedah and Perlis (Area 6). *Geol. Sur. Malaysia Economic Bulletin,* 1.6, 59p.

ALMASHOOR, S.S. (1974). *Geology of Gunung Jerai Area, Kedah.* Unpubl. M.Sc Thesis, Universiti Kebangsaan Malaysia, Kuala Lumpur.

BRADFORD, E.F. (1972). *Geology and mineral resources of the Gunung Jerai Area, Kedah.* District Memoir 13, Geological Survey Malaysia, 242p.

LIM, B.K. (1979). The nature of the contact between the 'quartz porphyry' and the Jerai Formation in the Rest House area, Gunung Jerai, Kedah. *Warta Geologi,* 5, 67–72.

PARAMANATHAN, S. (1964). *The geology of Gunung Jerai Massif, south Kedah.* Unpubl. B.Sc. (Hons) thesis, Universiti Malaya, Kuala Lumpur.

RAO A. (1974). *The geology and geochemistry aspects of the Southern Gunung Jerai area, Kedah, West Malaysia.* Unpubl. B.Sc. (Hons) thesis, University of Malaya, Kuala Lumpur.

WILLBOURN, S. (1926). The geology and mining industries of Kedah and Perlis. *Jour. Mal. Br., Roy. Asiatic Soc.,* 4, pt. 3, 288–332.