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Geophysical Investigations in Schirmacher Landmass

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Abstract

Multifrequency EM, magnetic and radiometric measurements were carried out covering an area between longitudes 11° 26' E to 11°50' E, along thirteen traverses in the Schirmacher landmass during the Fifth Indian Scientific Expedition to Antarctica. Out of these, two traverses were laid across the reported secondary sulphide mineralisation and the two others in the area where secondary sulphide mineralisation was seen near a suspected fissure zone.

No appreciable EM anomaly was found along all the traverses. Absence of this is attributed to very low percentage of sulphide mineralisation that does not yield any significant EM response.

Magnetic measurements carried out along the above mentioned traverses reveal that various geological formations in the area do not have appreciable susceptibility contrast. Laboratory measurements of susceptibilities of various rock samples from the region also support this view. Four anomalies along traverses 4, 7, 10 and 11 are identified. They are attributed to local tectonic features or dyke intrusions. This is also supported by the lineament map of the region.

Gamma ray spectrometry measurements were also carried out along all the traverses. Potassium, Thorium, Uranium and Total counts were recorded. No Significant anomalies were obtained, indicating the absence of radioactive mineralisation in the area. However, analysis of the radiometric data indicate a high potassium count over Felspathic Gneisses as compared to Hornblende/Biotite Gneisses.

Result of the studies indicate that most probably there is no significant mineralisation in the Schirmacher landmass.

Introduction

During the Third Indian Scientific Expedition to Antarctica, geological studies indicated occurrence of sulphide and graphite mineralisation in Schirmacher Landmass lying between longitudes 11°26' E and 11°50' E. These reported occurrences were motivation for carrying out geophysical studies to understand details of mineralisation. For exploring the mineral potential of Schirmacher Landmass,

it was planned to carry out multifrequency electromagnetic, induced polarisation, magnetic and differential gamma radiation surveying during the Fifth Expedition. Besides, it was also planned to study seismic activity, if any, in Schirmacher region.

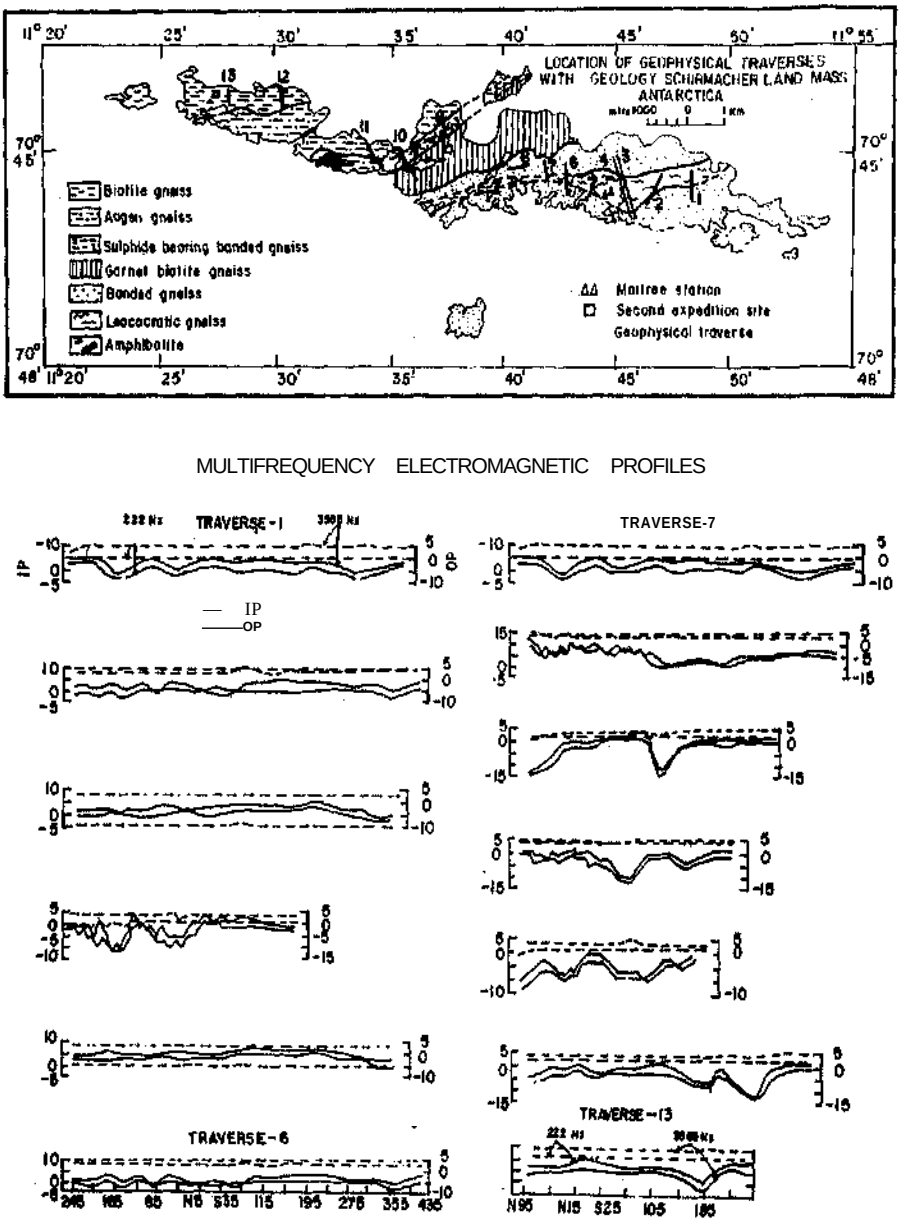

Fig. 1. Geophysical investigation in Schirmacher Region

Location, General Geology and Geophysical Layout

The Schirmacher range is located approximately 80 km south of the Indian Research Station, Dakshin Gangotri, and approximately 100 km north of Wohlthat massif. The range is about 20 km long and east-west trending with a maximum width of 2.7 km in the centre. The average elevation is 100 metres with number of peaks higher than 180 metres, the highest being 228 metres. The area is criss-crossed by large number of fresh water lakes.

According to geological reports, lithologically, the area consists of variety of high grade metamorphic gneisses, amphibolites, migmatites, mylonites and blastomylonites. The sulphide mineralisation is present mainly along a shear zone in rusty banded gneiss. Thirteen traverses measuring about 7 line kilometres were laid in the entire area with station interval of 10 or 30 metres. Two traverses 10 and 11 were laid at locations where surface indication of mineralisation were present. Traverse 3 and 4 were laid across suspected shear zone which could be mineralised as malachite stains were observed in host rock. The remaining nine traverses were distributed over the entire area from east to west. The layout of traverses are shown in upper part of Fig. 1.

Methods of Study

Electromagnetic Measurements: Electromagnetic measurements in Slingram mode i.e. horizontal loop mode with coil separation of 50 metres and station interval of 30 metres (station interval of 10 metres near anomalous zone) were carried out with Maxmin II Portable EM equipment of APEX PARAMETRICS LTD., Canada. Inphase and out of phase measurements were carried out on all the thirteen traverses for all available frequencies ranging from 222 Hz to 3555 Hz. The results of measurements for only two frequencies i.e. 222 Hz and 3555 Hz over all the traverses are presented in lower part of Fig. 1.

Magnetic Measurements: Magnetic measurements on the same traverse as for EM measurements were carried out with Geometric model G 316/826, Proton Precession Mangnetometer. During field investigations diurnal magnetic measurements were carried out with NGRI made Proton Precession Magnetometer. Fig. 2 shows diurnal total magnetic field variation at Maitree base station on two different days. Later on magnetic measurements were corrected for base as well as diurnal variation. Fig. 3 shows results of magnetic measurements on various traverses.

Gamma Radiation Measurements: On the same traverses differential gamma radiation measurements were carried out using Scintrex GADr6 four channel spectrometer with GSP-3 sensor (3" X 3" Nal crystal). The measurements were carried out in differential non-strip mode. Due to constraints of time factor and fast decay of batteries, counting was carried out for ten seconds. To get an idea of background counts, measurements were carried out over shelf area near Indian

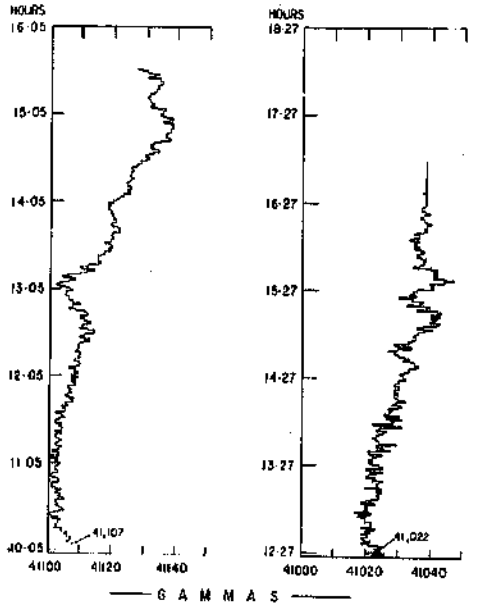

Fig. 2. Diurnal total magnetic field variation

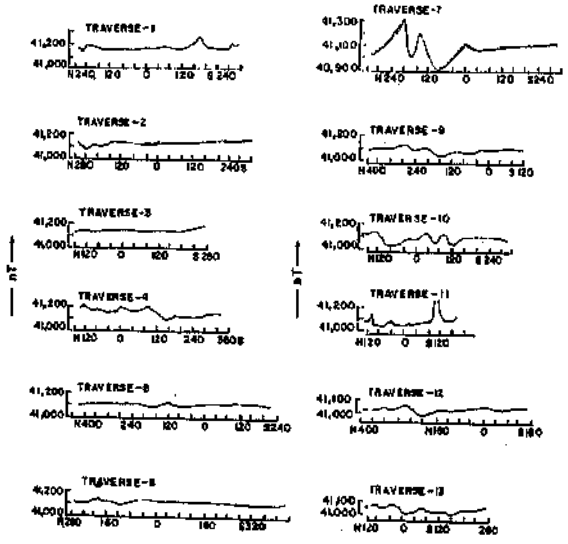

Fig. 3. Magnetic profiles

Research Station, Dakshin Gangotri, where shelf is very thick and hence background is mostly due to cosmic radiations. Channel count rates were converted into potassium percent and U and Th parts per million. Fig. 4 shows results of gamma radiation measurements on various traverses.

IP Measurements: Using 3 K.W Scintrex Transmitter and Huntec Mark III receiver, attempts were made to carry out time domain induced polarisation measurements. However, due to very high contact resistance of the ground caused by abundance of loosely packed boulders, the measurements could not be continued.

Studies on Seismic Activity: To study the seismic activity in Schirmacher Landmass area, one second portable short period seismometer, Model S-13, from Teledyne GeoTech was installed along with Portacorder Model RV 320B also from GeoTech Teledyne. The seismometer was placed about 3 feet below ground level on firm ground. The portacorder was run with filter settings high pass at Auxiliary 4, low pass at 12.5 Hz. The grains of amplifiers were set at 72 dB and drum rotation of 60 mm/second was selected. The seismometer station was run from 28th December, 1985 to 3rd February, 1986.

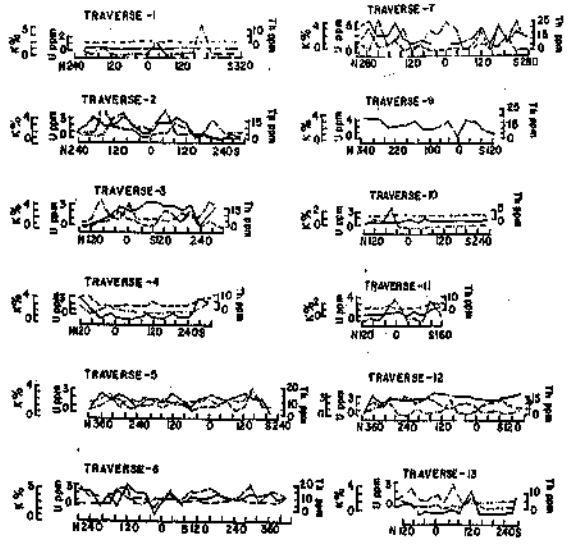

Fig. 4. Radiometric profiles

Discussion

As EM measurements were carried out with 50 metres coil separation, it was expected to register EM anomaly of at least 50 metres width. No anomaly of such width in inphase as well as in out of phase measurements was observed. No appreciable out of phase anomaly was recorded. Some inphase EM anomaly of smaller width were recorded which account for topographic variations. Further EM anomalies. recorded were not found to be frequency dependent and hence they are not considered as induction anomalies. Thus no EM anomaly is considered for interpretation even on the traverse which cross suspected mineralisation. The reason seems to be that mineralisation concentration was too less to make any detectable change in the conductivity of the mineralisation.

Small magnetic anomalies were recorded on traverse no. 4,7,10 and 11. They are attributed to local tectonic features or dyke intrusions. This is also supported by the lineament map of the region.

Gamma radiation surveying showed very low values of Uranium and Thorium. Hence most probably no radioactivity is associated with rock types in the area.

A seismic station was run from 28th December, 1985 to 3rd February, 1986 During this period no seismic event was recorded. The high frequency pick up due to HF and VHF transmission was picked up on records and identified as shown in Fig. 5.

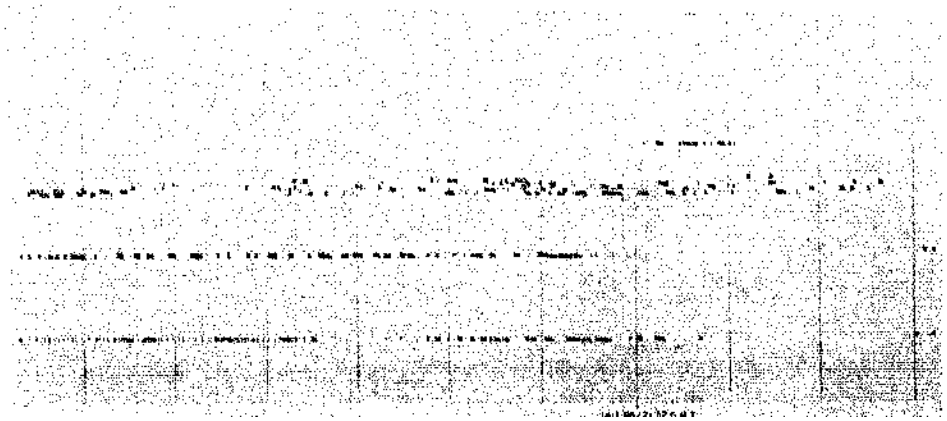

Fig. 5. Sample Seismogram of 13-1-86 & 14.1.86, Schirmacher Land Mass, Antarctica Filter Settings Aux—12.5 H_x. Gain 72 dB; Calibration 10 mA.

Acknowledgements

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