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Marine magnetic anomalies over the Direction Bank, off Bombay Western continental shelf of India.

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ABSTRACT

Total magnetic intensity data were collected over the Direction Bank, off Bombay on the western continental shelf of India and the isomagnetic anomaly map prepared at a contour interval of 25nT show NNW-SSE trend resemble those of the Dharwarians. Two dimensional model studies were carried out to understand the basement configuration of the Direction Bank. Derived models indicated that the source of the anomalies lie at a depth of 2.2 to 3.0 km and suggest that the subsurface formations were faulted over the Bank. A comparative study of these models with the seismic sections of ONGC suggest that the sources of the anomalies are from the Middle Eocene base present at those depths and indicate faulting of the Eocene base over which the present configuration of the Direction Bank lies.

INTRODUCTION

The continental shelf off the west coast of India is divided into four sedimentary basins namely Kutch, Bombay, Konkan and Kerala offshore basins (Ramaswamy and Rao, 1980). The Bombay offshore basin is controlled by several faults and rift systems (Fig.1). The Direction Bank, situated at about 70 km southwest of Bombay on the western continental shelf of India rising from 60 m of water depths to 40 m (Pl.1) forming a conspicuous



Plate.1 Bathymetry showing the topographic high over the Direction Bank.

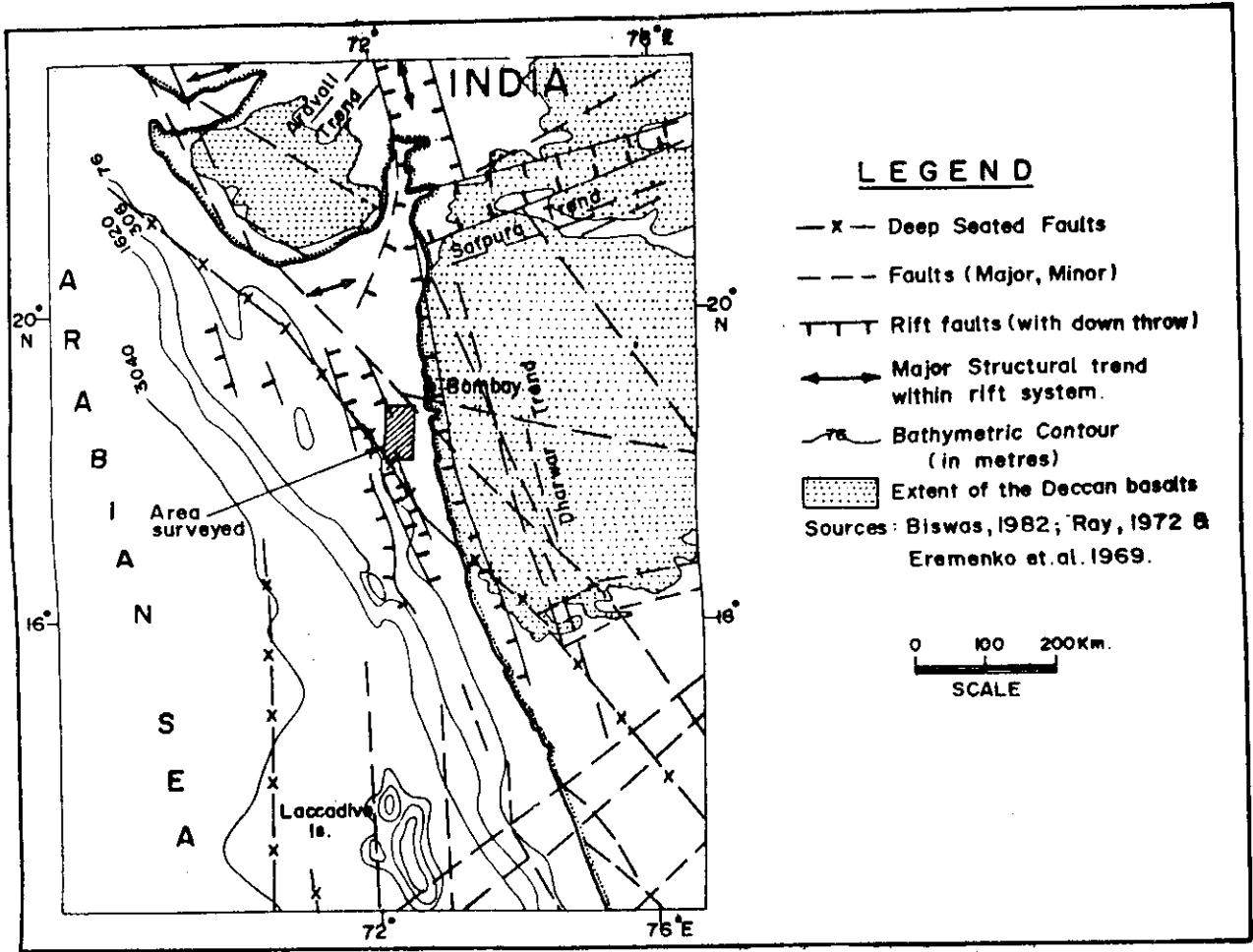


Fig. 1 Geological and Tectonic map of western part of India.

bathymetric feature and occupying an area of about 700 Sq.km. As a part of the Institute's project to study the magnetic signature over the western continental shelf of India (Gopala Rao, 1984; Subba Raju and Subrahmanyam, 1985; Ramana et al, 1986; Bhattacharya and Subrahmanyam, 1986 and Subrahmanyam, 1987), total magnetic intensity measurements were carried out over Direction Bank on board RV Gaveshani during April, 1980 with Barringer Proton Precession Oceanographic Magnetometer. The position fixing was done by Decca Navigator System.

MARINE MAGNETIC DATA

The total magnetic intensity data were collected by towing the magnetometer sensor about 170 m behind the vessel in order to avoid the ship's stern effects. The survey was conducted along 16 E-W tracks with a spacing of 3-5 km and along 3 cross lines. The survey tracks were shown with bathymetry and coastal geology (Anonymous, 1976) in Figure 2. The diurnal variation at the Alibag magnetic observatory (18°38'N, 72°52'E) was used to apply diurnal correction

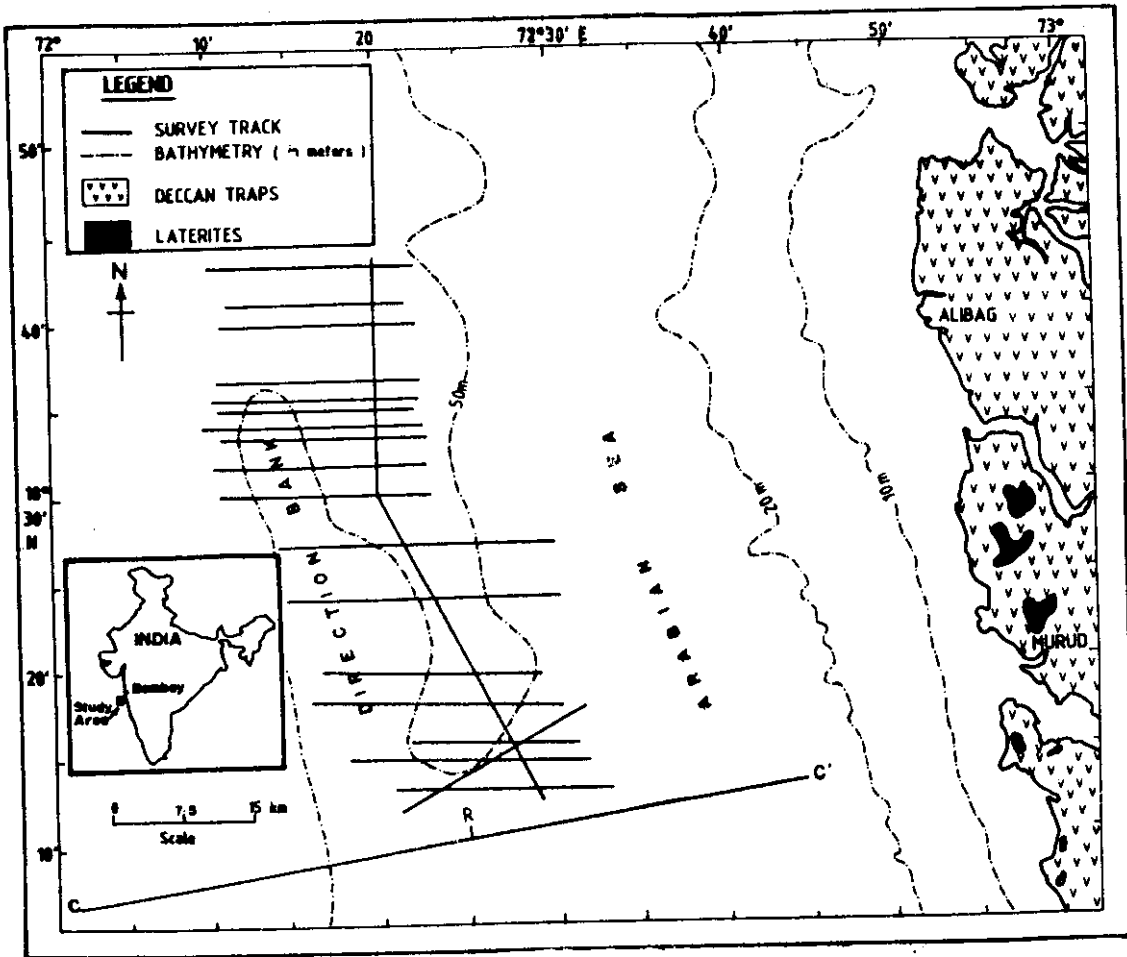


Fig 2 Map showing the survey tracks and the bathymetry of the study area along with coastal geology.

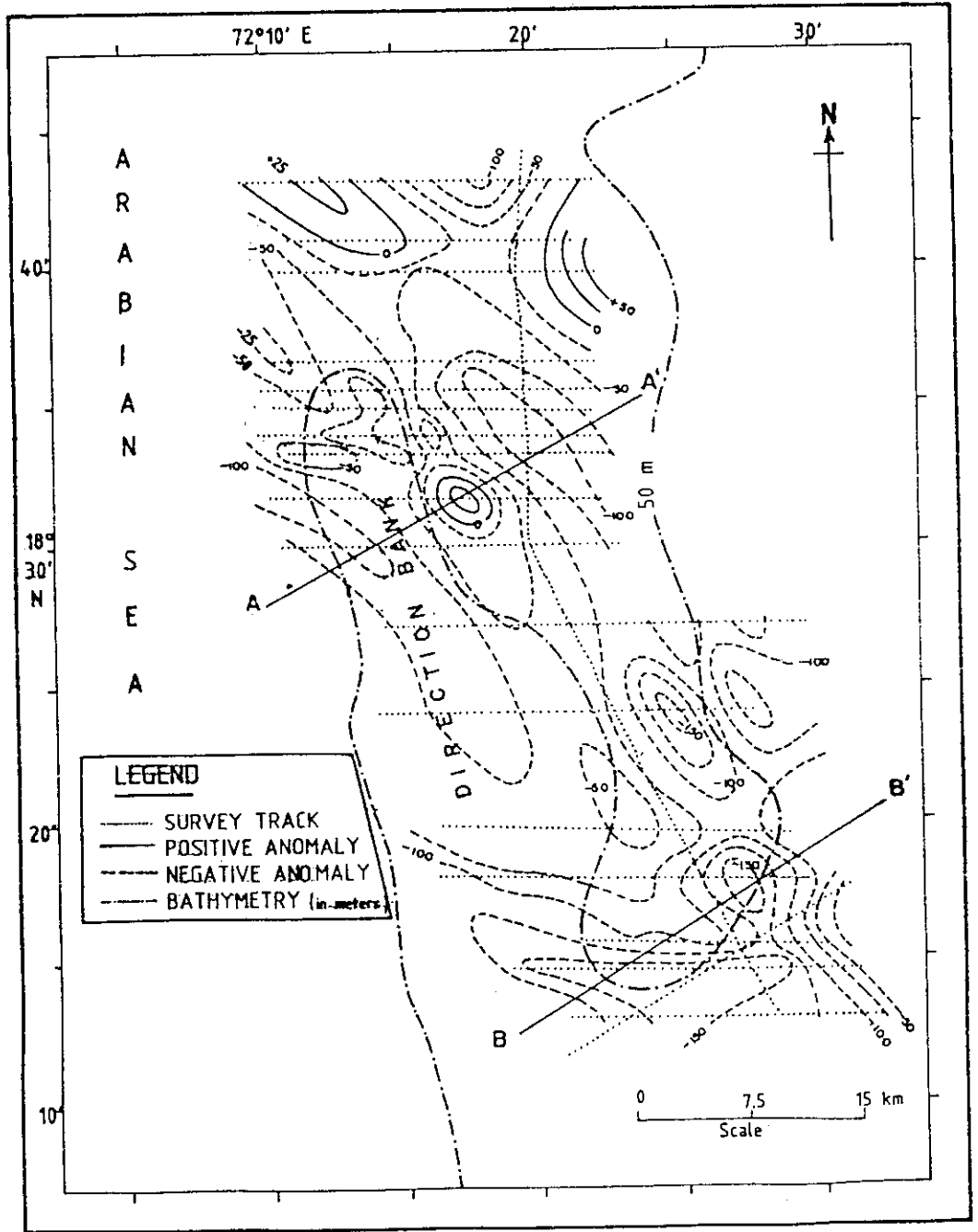


Fig. 3 Isomagnetic anomaly map of the study area (contour interval 25nT).

to the magnetic data. The total magnetic intensity anomalies were calculated by removing the International Geomagnetic Reference Field (IGRF) of 1980 as regional field. The isoanomaly map was prepared at a contour interval of 25nT (Fig.3).

GEOLOGY

To the east of the study area, on land, vast expanses of Deccan flood basalts of Late Cretaceous to Early Eocene are extended and part of these basalt flows extend towards offshore also (Bhagwan Sahay, 1978). Seismic studies by Prasad Rao and Srivastava (1981) revealed considerable thick sediments present on offshore while the thickness diminishes towards coast and Deccan Traps exposed on land.

RESULTS AND DISCUSSION

The isoanomaly map with 25nT contour interval (Fig.3) shows pre-dominant NNW-SSE striking anomalies ranging from 35 to -165 nT in the study area. Quantitative interpretation was carried out by using the two dimensional model studies of Talwani and Heirtzler (1964). Profiles AA' and BB' (Fig.4) from the northern and southern parts of the area respectively were chosen for model studies. Study of the basalts drilled from the offshore areas of Bombay (Gopala Rao, 1984) indicated that these basalts are with reverse magnetic polarity (with a remanent magnetisation around 3.0 A/m and inclination around + 50°) and induced magnetisation around 1.1 A/m. Theoretical anomalies were generated for an assumed polygon by considering the above information. Model studies bounded by a number of surfaces were generated to explain the observed profiles and the anomalies were

attributed to the nature of the geological structures. The source of the anomalies were found at two different depth levels viz., 2.2 and 2.6 km in the northern part, 2.8 and 3.0 km in the southern part of the survey area (Fig.4). Table 1 shows the body parameters from the model studies.

Figure 5 shows the multichannel seismic reflection profile C-C' of Oil and natural Gas Commission (Agarwal and Singh, 1981) off Murud, south of Bombay and the location was shown in Figure 2. The section C-C' shows that the Middle Eocene basement (horizon IV) was faulted in both eastern and western sides forming a horst like feature. This upliftment was also reflected in the top horizon IA (location R in Fig.5). The basement depths derived from the magnetic model studies in the study area well matches with the depths to the horizon IV (acoustic basement) in the section C-C' (Fig.5). The uplifted portion from the section C-C' probably indicate the extension of the Direction Bank feature towards south. It is surmised that the magnetic anomalies are associated with the undulations in the basement beneath the Direction Bank.

CONCLUSIONS

- 1) The NNW-SSE lineation of magnetic anomalies reveal structural trend of the area similar to those of Dharwarians.
- 2) The magnetic anomalies are generated due to the basement present at the depths of 2.2 to 3.0 km.
- 3) The present configuration of the Direction Bank is resting over the faulted Eocene Base.

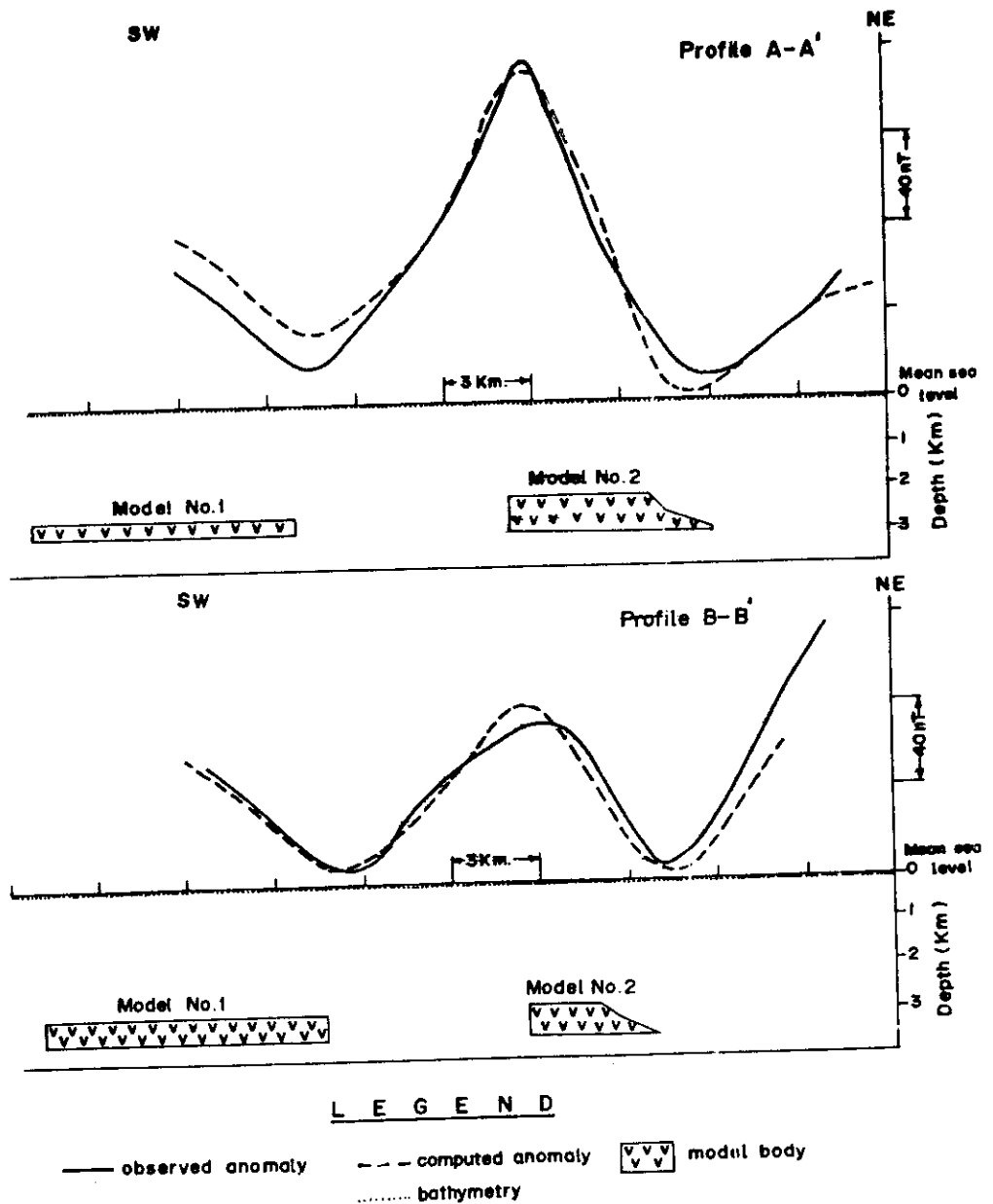


Fig. 4 Observed and Calculated magnetic anomalies over two profiles and two dimensional magnetic bodies causing them

Intensity of induced magnetisation : 1.07 Am^{-1}	Intensity of remanent magnetisation : 3.0 Am^{-1}
magnetic inclination : 24	magnetic inclination : 50
magnetic declination : -1.5	magnetic declination : 130

TABLE 1

Mathematically derived depths and thicknesses
from two dimensional model studies.

Profile No.	Depth to the magnetic source(Km)		Thickness(Km)	
	Body 1	Body 2	Body 1	Body 2
A-A'	2.6	2.2	0.4	0.8
B-B'	3.0	2.8	0.5	0.7

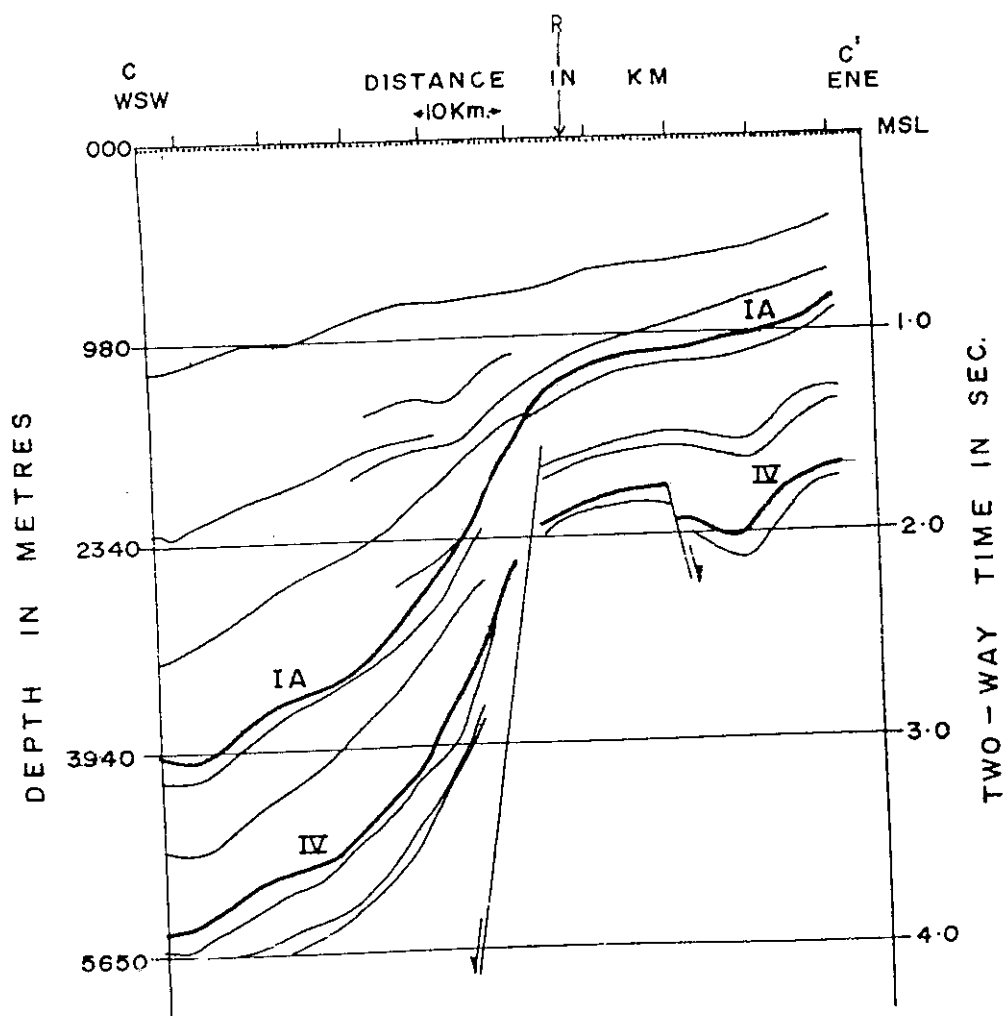


Fig. 5 Seismic section of the subsurface formation near the Direction Bank off Bombay, western continental shelf of India. IA and IV are the bases for Middle Miocene and Paleocene sediments respectively (Agarwal and Singh, 1981)

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