

Letter Section

A PRELIMINARY INTERPRETATION OF TWO MARINE GRAVITY PROFILES ON THE CONTINENTAL SHELF MARGIN WEST OF BOMBAY (INDIA)

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ABSTRACT

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Part of the gravity data collected by the U.S.C. & G.S. Ship "Oceanographer" from the continental margin west of India has been analysed. The analyses reveal a deep-lying (>8 km) crustal fracture which trends parallel to the continental margin (NW—SE) above 180 nautical miles west of Bombay.

INTRODUCTION

To date, few gravity profiles have been run on the continental shelf in the Arabian Sea and Bay of Bengal. In the former, marine gravity data were collected in 1967 by the U.S.C. & G.S. Ship "Oceanographer" and Bouguer anomalies along these profiles have been supplied in digital form on microfilm to the N.I.O. participants. Two of these profiles indicate that there is a major fault (or faults) in the region off Bombay. The present article briefly presents these findings.

TECTONICS OF THE STUDY AREA

In the Arabian Sea, the ancient Indian shield, composed of the different folded systems, is considered to extend westwards beyond the present continental shelf edge. It was segmented into blocks by various fractures controlled by tectonic trends. The development of large tectonic blocks in the shield area was related to deep-seated faulting (Ermenko, 1969; Krishnan, 1968; Wadia, 1966). Extensive movements took place along the NW—SE and NE—SW fractures during Gondwana time and the western part of the Indian shield started subsiding (Ermenko, 1969). Deposition of sediments took place

in the depressed areas. A strong subsidence of the central part of the described territory started along the sub-meridional fractures resulting in a graben-shaped depression. The relatively straight margin of the western shelf of India is due to normal faulting (Krishnan, 1968; Harbison and Bassinger, 1970).

INTERPRETATION

The locations, directions and lengths of the two gravity profiles considered are shown in Fig. 1. Details and bathymetry are given in Fig. 2. In both profiles it is observed that the gravity anomaly decreases from southwest to northeast. The gravity anomalies are not related to variations in sea-floor topography. The very small fluctuations of these profiles may have little significance, because the observational accuracy is not less than ± 5 milligals.

The middle part of profile 021 F when smoothed, shows the typical shape of a profile over a fault. The gravity anomaly above this smoothed trend on the southwest, and below it on the northeast, cannot be quantitatively interpreted due to insufficient data at the ends of these profiles. The middle part of profile 19F also shows a typical fault indication.

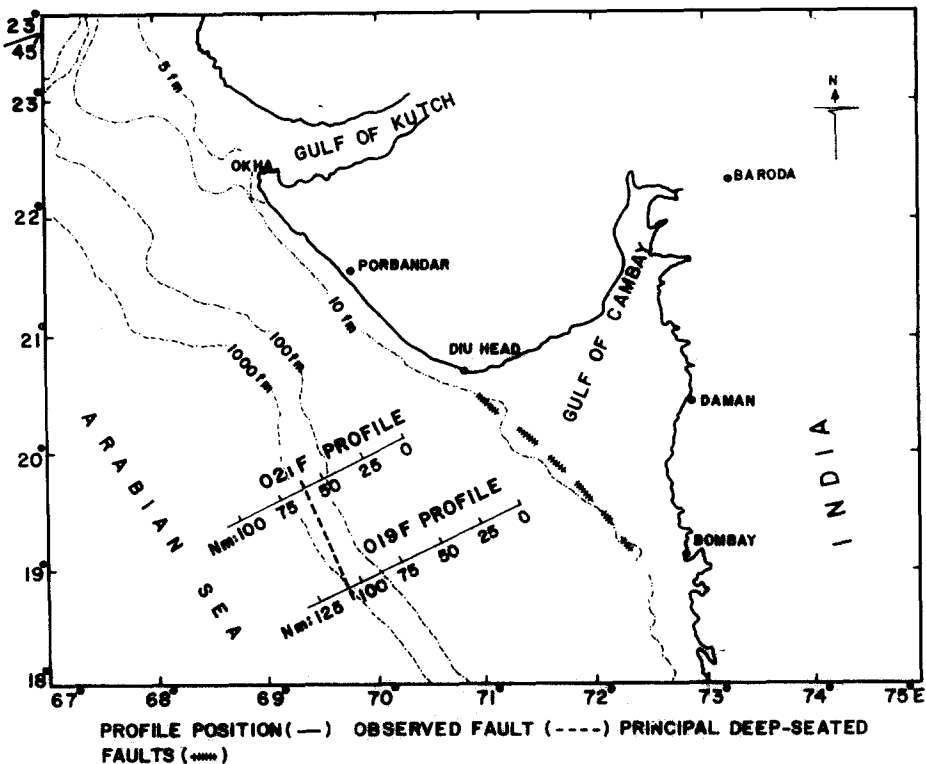


Fig. 1. Locations of gravity profiles and observed faults.

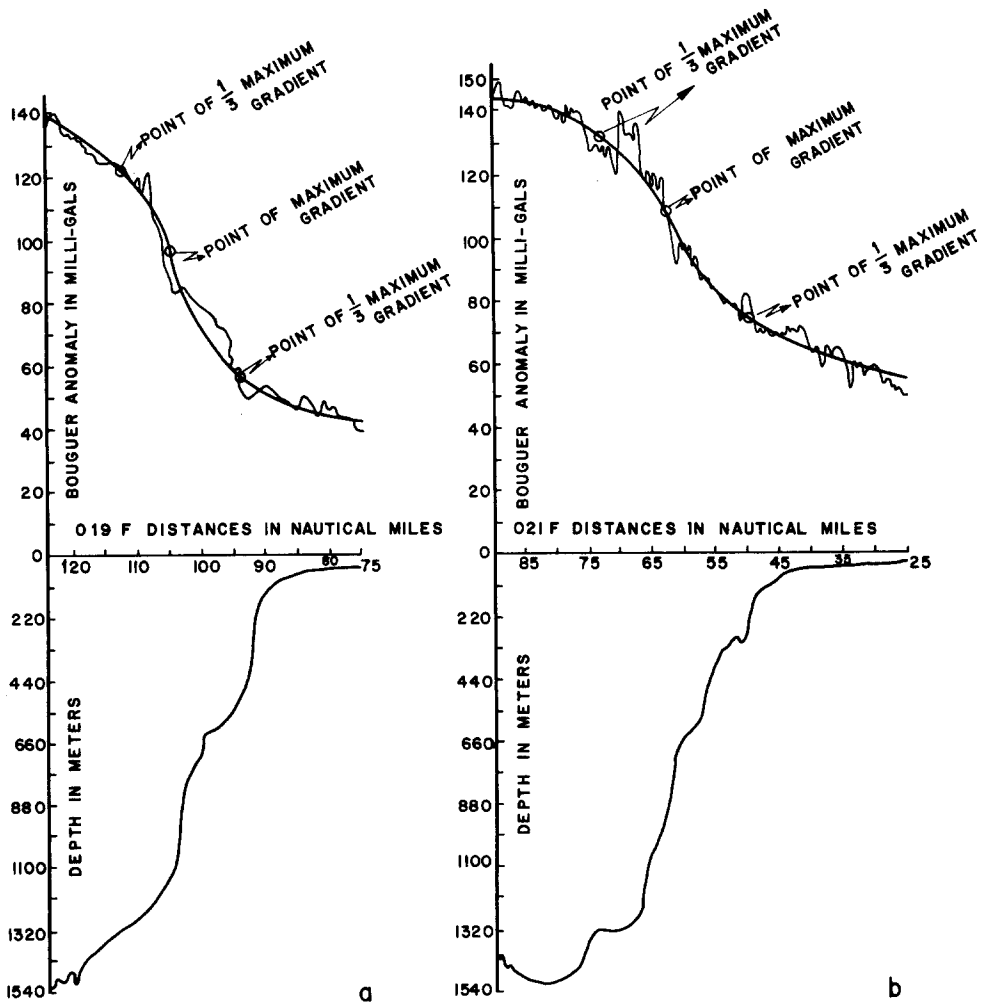


Fig. 2. Bouguer anomalies and bathymetry along the profiles.

The smoothed portions of these profiles are interpreted quantitatively by the method of characteristic curves of Rao et al. (1974). Briefly the method involves the estimation of: (1) positions of the points of maximum and 1/3 maximum gravity gradients and anomalies of them; and (2) ratios of the distances of the points of 1/3 maximum gravity gradients from the point of maximum gravity gradient and the ratio of the difference of the anomalies at the 1/3 maximum gravity gradient points and maximum gravity gradient point. Making use of these ratios the three shape parameters of the fault viz., Z_1 (depth to top), Z_2 (depth to bottom) and i (fault angle) have been obtained from the characteristic curves and also the density contrast. The position of the origin is scaled to a distance of $(Z_2/Z_1 - 1)Z_1 \cot i / (Z_2/Z_1 + 1)$

TABLE I

Depths and dip estimated by the method of Rao et al. (1974)

Anomaly	Fault			
	depth to the top of fault (km)	depth to the bottom of fault (km)	dip of the fault plane (°)	observed throw (km)
Profile 019F (75—125 n.m.)	8.2	18.4	23	10.2
Profile 021F (25—90 n.m.)	8.8	22.0	50	13.2
Mean	8.5	20.2	—	11.7

from the inflexion point. The formation obtained by making use of these curves is given in Table I.

The depths obtained for the two profiles are in fair agreement. Thus, it appears that the investigated portions of these profiles are due to a major fault located at a depth of 8.5 km and having a throw of 11.7 km. Its approximate location on profile 019F is 18° 50' N and 69° 45' E and on profile 021F 19° 45' N and 69° 20' E. The estimated density contrast, 0.3 g/cm³ may be attributed to the density differences between the basalts and acidic igneous rocks. Based on the results obtained from DSDP Sites 219 (water depths of 954 fathoms) and 220 (water depths of 2182 fathoms) in the southeastern Arabian Sea (Weser, 1972) these basalts and acidic igneous rocks are considered to be of continental crust. The direction of the faulting is along a NW—SE axis as indicated in Fig. 1. This is parallel to the western continental shelf edge of India and is close to the 1000-fathom line. The depth of 20.2 km to the lower boundary of the fault, its eastward dip, and its direction along the western continental shelf edge, support the hypothesis of block subsidence of the basement due to faulting (Ermenko, 1969).

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