

Marine Magnetic Studies over a lost wellhead in Palk Bay, Cauvery Basin, India

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Abstract: Close grid marine magnetic surveys in the vicinity of a drill well site PH 9-1 in Palk Bay revealed that the area is characterized by smooth magnetic field except for a local anomaly caused by a lost wellhead. The smooth magnetic field is attributed to the deep burial of Precambrian granitic basement devoid of any charnockite intrusions. The seismic reflection records of the study area show >3200 m thick sediments over the basement.

Keywords: Marine Geology, Geophysics, Palk Bay, Cauvery Basin

INTRODUCTION

The east coast of India was beginning to take shape in Upper Jurassic with the background of old crust and huge accumulation of marine sediments and the depocentres during the Jurassic-early Cretaceous near the western part of Cauvery Basin (Krishnan, 1968). Geological and geophysical investigations are in progress for the last three decades along the coastal sedimentary belts of Madras/Tamil Nadu state. These studies were carried out with a view to investigate the thickness of the marine sediments and their stratigraphical and structural disposition for assessing their hydrocarbon potential. Several structural features on land (Fig.1) have been brought out along with the main Cauvery Basin and its Ariyalur-Pondichery, Tranquebar-Tanjore and Ramnad sub-basins (Gulatee, 1956; Kailasam, 1958, 1961; Sastri *et al.*, 1977; Bhandari and Shukla, 1982). These basins experienced marine conditions during lower Cretaceous. The major portion of the Ramnad sub-basin extends into Palk Bay and Gulf of Mannar and the maximum depth to the basement in the Ramnad-Palk Strait depression is likely to be of the order of 4.0 km of which nearly half may be comprised of Cretaceous sediments and the rest by those of Tertiary age (Sastri *et al.*, 1977). The multichannel seismic

reflection studies by Oil and Natural Gas Commission (ONGC) established hydrocarbon pros-

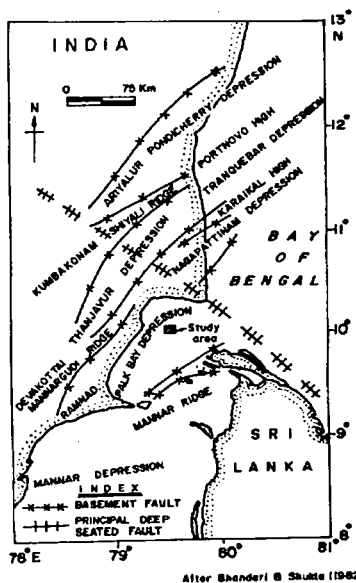


Fig.1. Generalized structural map of Cauvery Basin (after Bhandari and Shukla, 1982). Block with hatching indicates the study area.

pects in Cauvery Basin and subsequently a few exploratory wells were drilled for exploitation.

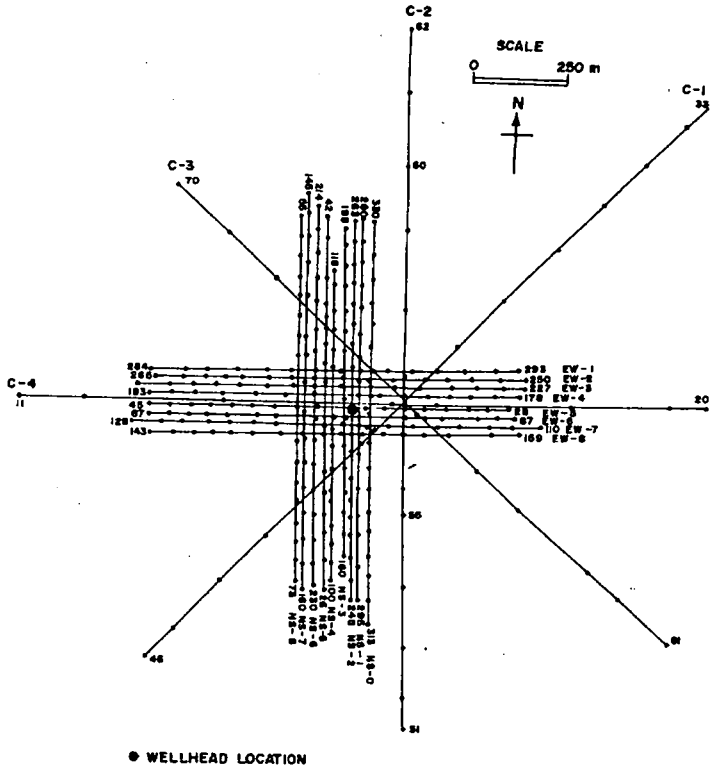


Fig. 2. Map showing the survey tracks.

The National Institute of Oceanography, Goa, at the request of ONGC in 1987 undertook a detailed (25 m spacing) magnetic survey (Fig. 2) to locate a lost wellhead (PH 9-1) with Syledis position fixing system. The data thus acquired has been used in the present study to infer the possible subsurface geology in the light of available seismic reflection and borehole data.

GEOLOGICAL FRAMEWORK OF CAUVERY BASIN

The Cauvery Basin occupies most of the coastal plains of Tamil Nadu, the northern coastal plains of Srilanka, the waters of Gulf of Mannar

and Palk Strait (Fig. 1). The basin has an offshore area of about 15,000 sq. km and extends into Bay of Bengal (Prasada Rao, 1976; Berry and Rawat, 1990). The earliest fossiliferous rocks found along the coast south of Madras are Upper Gondwana estuarine formations. An important marine transgression was reported by Krishnan (1968) during middle Cretaceous in the coastal regions of southern Madras. The study area is an integral part of Cauvery Basin which came into existence in the early Mesozoic times and the Phanerozoic section starts with late Jurassic-early Cretaceous and the Archaean granitic gneisses and chnrockites form the basement (Sastri *et al.*, 1977; Sastri and

Babu, 1982). Further, the adjacent on land is characterized by several ridges and depressions oriented in NE-SW alignment parallel to the trend of Eastern Ghats giving way to homoclinally dipping and eastwardly thickening Cenozoic sediments (Sastri and Babu, 1982).

DATA

The magnetic data used in the present study was collected onboard S.V. Neelkmal along the track configuration shown in Figure 2 while the Seismic reflection and borehole litholog data were due to the courtesy of Oil and Natural Gas Commission of India. Magnetic surveys were carried out using proton precession magnetometer (Geometrics, G-801/3) while the positions were obtained by Syledis navigation system. The magnetic data was recorded with an accuracy of ± 1 nT while the positions were obtained with ± 3 m accuracy. The regional magnetic field was subtracted from the observed magnetic field and the data was corrected for the actual tow length of the magnetometer sensor. Then the magnetic anomalies were plotted along the tracks (Fig. 3). The litholog data (Fig. 4) and the seismic records (Fig. 5) were also used for confirming the basement.

RESULTS AND DISCUSSION

The total magnetic anomaly profiles (Fig. 3) are characterized by smooth field except for a local anomaly with 50-70 m wavelength and 200-250 nT amplitude. This local anomaly is inferred to be due to the wellhead PH 9-1 close to the survey lines (NS-2 and EW-5). The magnetic anomaly rapidly falls off on the tracks far away from the wellhead location (Fig. 3). The magnetic field along the profiles NS-2 and NS-3 was interpreted using Werner deconvolution technique (Ku and Sharp, 1983) which shows that the wellhead is situated 8 m below the mean sea level (Fig. 6). Along EW-3, NS-3 and EW-5 profiles short wavelength, double peaked anomalies are observed. Deep seated tectonic features with a magnetization

contrast if exists with the surrounding rocks should show a reasonably long wavelength magnetic anomaly. Though the basement in the present study area occurs around 3200-3500 m and is traversed by number of NE-SW trending faults (Fig 7), the observed magnetic field is free from such long wavelength magnetic anomalies as mentioned above except for the observed short wavelength local anomalies. Hence, the recorded double peaked magnetic anomalies (Fig. 6) are inferred to be the scrap material or debris adjacent to the drill site PH 9-1. Though these double peaked magnetic anomalies are superposed on a 200m wavelength background anomaly, by virtue of its short wavelength, we are not attributing this due to a deep seated subsurface feature. The anomaly of about 300 - 350 m wavelength and 100 nT amplitude observed on profile C4 appears to be the combined effect of wellhead ph 9-1 and raise of the basement.

The study area is also characterized by smooth regional magnetic field. This field perhaps suggests that the basement is occurring either at a great depth or there is no appreciable susceptibility variation within the basement rocks in the study area. Kailasam (1961) and Avasthi *et al.*, (1977) derived 3000-5000 m thick Cretaceous and Tertiary sediments from the deep electrical soundings in Tranquebar depression and regional refraction surveys in parts of Cauvery Basin. The presence of a prominent Bouguer gravity low in Palk Bay was interpreted by Gulatee (1956) as a response of thick sediments lying over the basement. The wells drilled in Palk Bay (Fig.4) clearly show the basement at a greater depth below the mean sea level. The seismic records P-96 and P-156 interpreted in the light of borehole data (Fig.5) are presented for better understanding of the basement and overlying strata. An average sediment thickness of 3200-3500 m above the Precambrian basement has been inferred with the help of litholog data (Fig.4). We therefore infer that the observed smooth magnetic field is originated from this Precambrian basement.

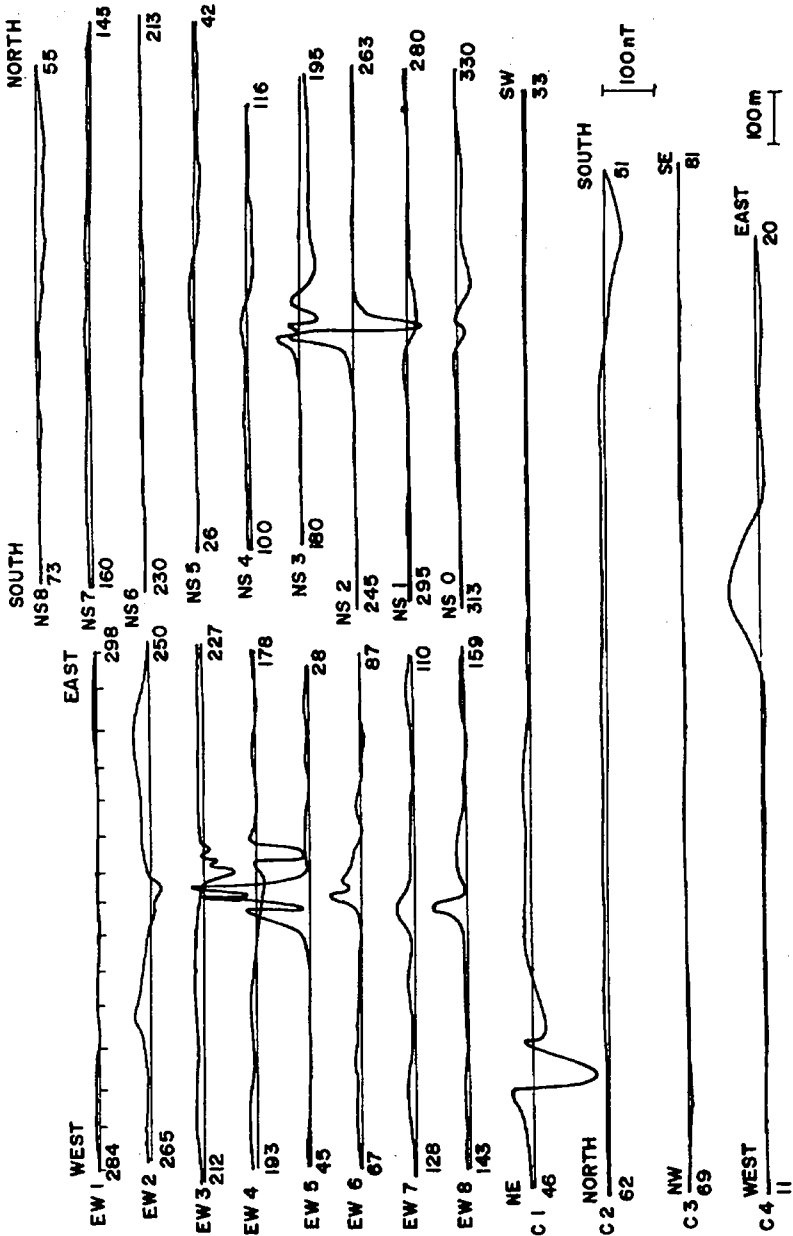
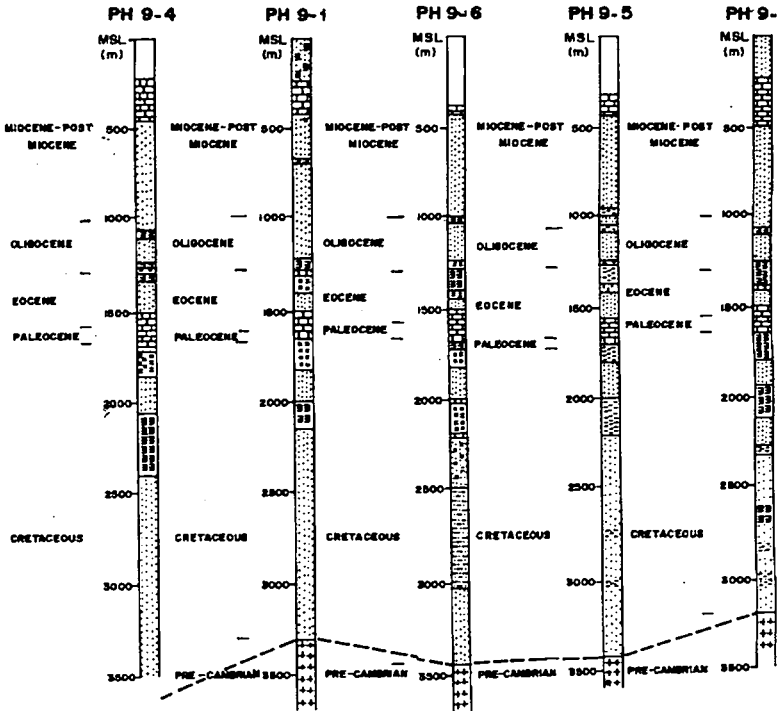


Fig.3. Total magnetic intensity profiles along the tracks. Locations shown in figure 2.



(COURTESY OF ONGC MADRAS)
(FOR LOCATIONS REFER FIGURE 7)

Fig.4. Lithologs information of the boreholes drilled in Palk Bay (courtesy of ONGC, Madras).

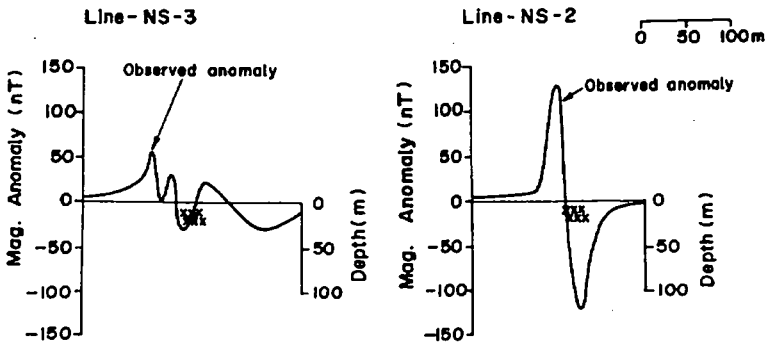


Fig.6. Depth to the wellhead PH 9-1 computed using Werner deconvolution technique.

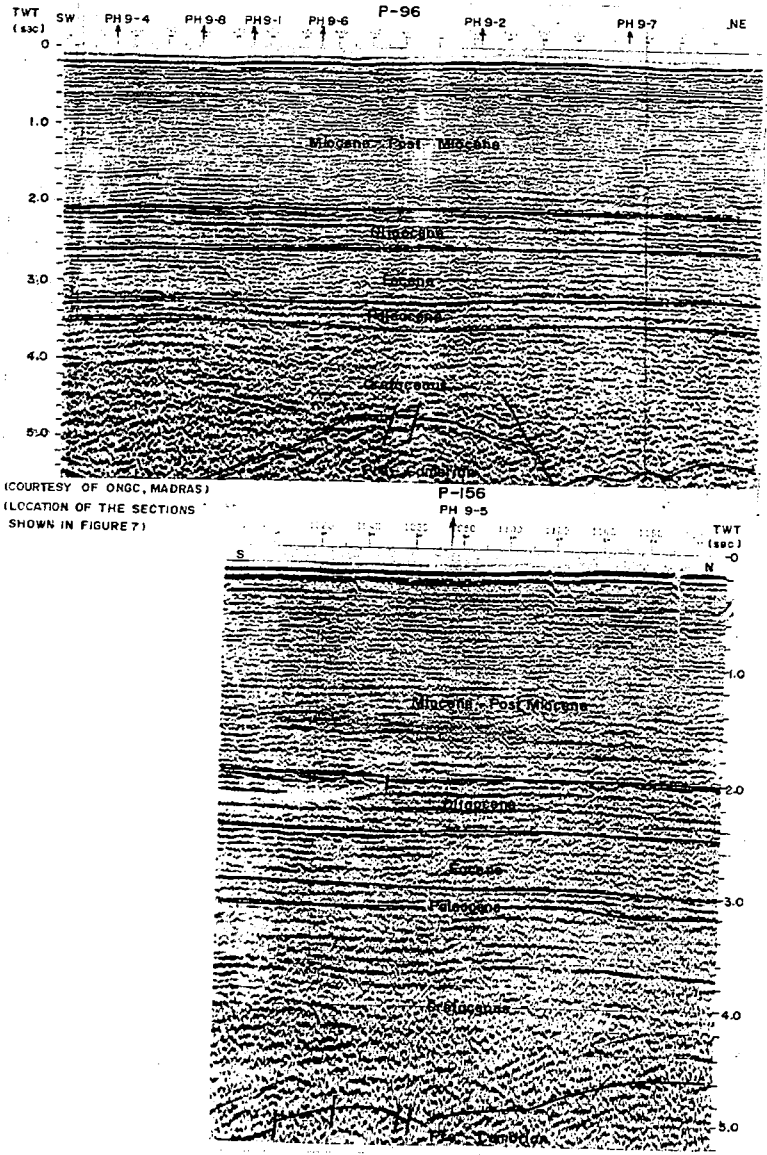


Fig.5. Seismic reflection records along P-96 and P-156 (courtesy of ONGC, Madras).

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(Received: 27 July 1993; Revised form accepted: 11 February 1994)