Extension of Gundlakamma River Fault over Eastern Continental Margin of India

Ongole and its surrounding region has been subjected to structural deformation for the past 3000 Ma. An attempt has been made to study the tectonics in and around Ongole region, in particular along the Gundlakamma River and its significance in the offshore region. The lineament and physiographic map (Figure 1 *a*) indicates presence of NW–SE and NE–SW trending regional faults[1–3]. Ongole and the adjoining Nizampatnam Bay are controlled by several NE–SW trending depressions and ridges (Figure 1 *b*)[4]. The region around Ongole is drained by Gundlakamma, Musi, Palem and Manneru rivers. The NW–SE lineaments control the Musi, Palem and Gundlakamma rivers. Since the flow pattern of these rivers shows probable offshore extension, it may be assumed that submerged rivers are also probably controlled by lineaments. The epicentre data (Figure 1 *a*) shows that most of the earthquakes are concentrated along NW–SE trending lineaments. Ongole and its surrounding areas experienced intermittent seismic activity of moderate magnitude (~5–5.8) earthquakes. The seismic activity is associated with local and regional tectonic disturbances in and around Ongole. Figure 1 *a* shows clustered epicentre disturbances of earthquakes aligned in NW–SE direction along Gundlakamma River, north of Ongole, which is mostly controlled by a major tectonic lineament. It is essential to study the geophysical signatures in the offshore region of Ongole to ascertain the link between structures on and off the coast; the study provides an input to understand the neo-tectonic activity in this region.

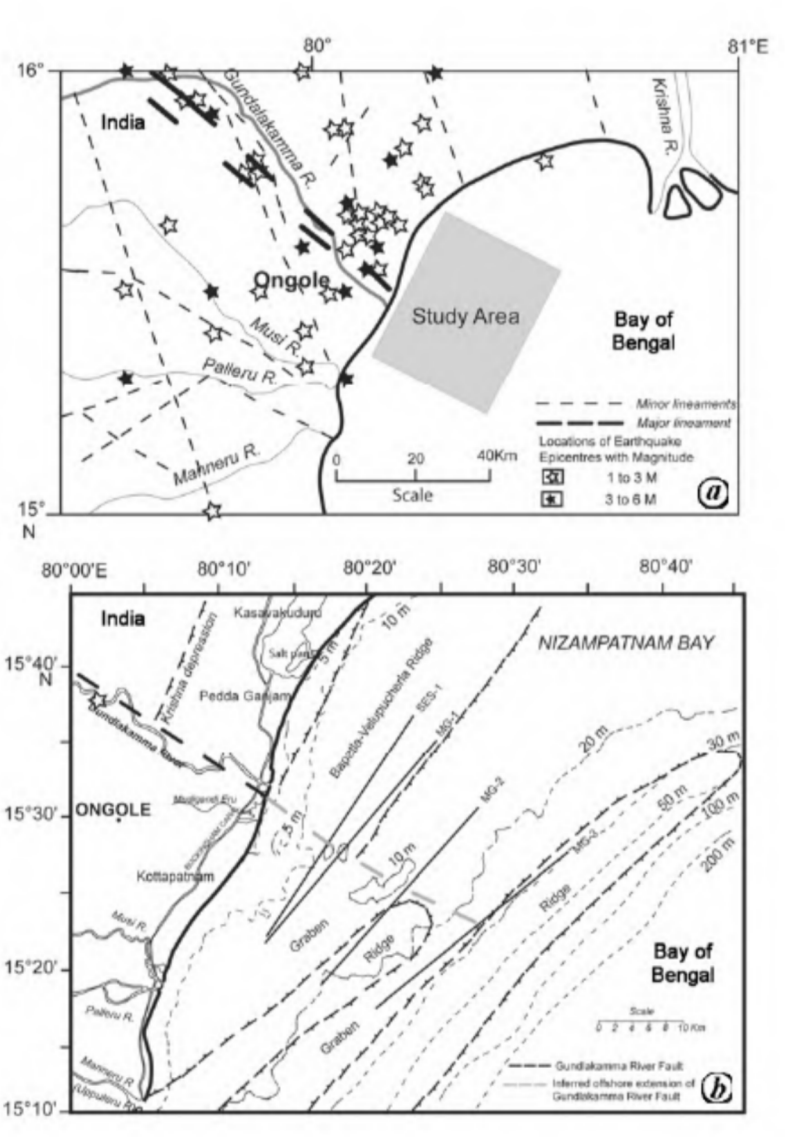

Figure 1. ***a***, Map of physiography and lineaments in Ongole region[1–3]. ***b***, Tectonic map of Ongole and surrounding regions (after ref. 4). Geophysical traverses in the offshore region are shown.

In order to elucidate this phenomenon in the offshore regions, geophysical study comprising magnetic and shallow seismic data has been carried out along four coast-parallel profiles over the Eastern Continental Margin of India (ECMI) between the water depths of 10 and 30 m of Ongole (Figure 1 *b*). The total intensity magnetic data along the traverses MG-1, MG-2, MG-3 and high resolution shallow seismic data along the traverse SES-1 were collected onboard the research vessel *Sagar Sukti* by the National Institute of Oceanography, Regional Centre, Visakhapatnam in 2008. The aim of the study is to delineate the offshore extension of the major onshore fault, which controls the Gundlakamma River. The offshore total intensity magnetic anomaly profiles were plotted after correcting for the International Geomagnetic Reference Field[5] and presented in Figure 2 *a*. The anomalies are characterized by high amplitude and medium wavelength of the order of 160 nT (range +80 to –80 nT).

Qualitative analysis of the part of magnetic profiles (MG-1 and MG-2) between 750 and 1500 SP (shot-points) indicates the presence of a fault/contact like structure with steep gradient portions at P and Q, as indicated in Figure 2 *a*. However, the steep gradient was subdued in the anomaly R of the profile MG-3. The inferred fault may be at shallow depth over the region of anomalies of P and Q compared to the region of anomaly R.

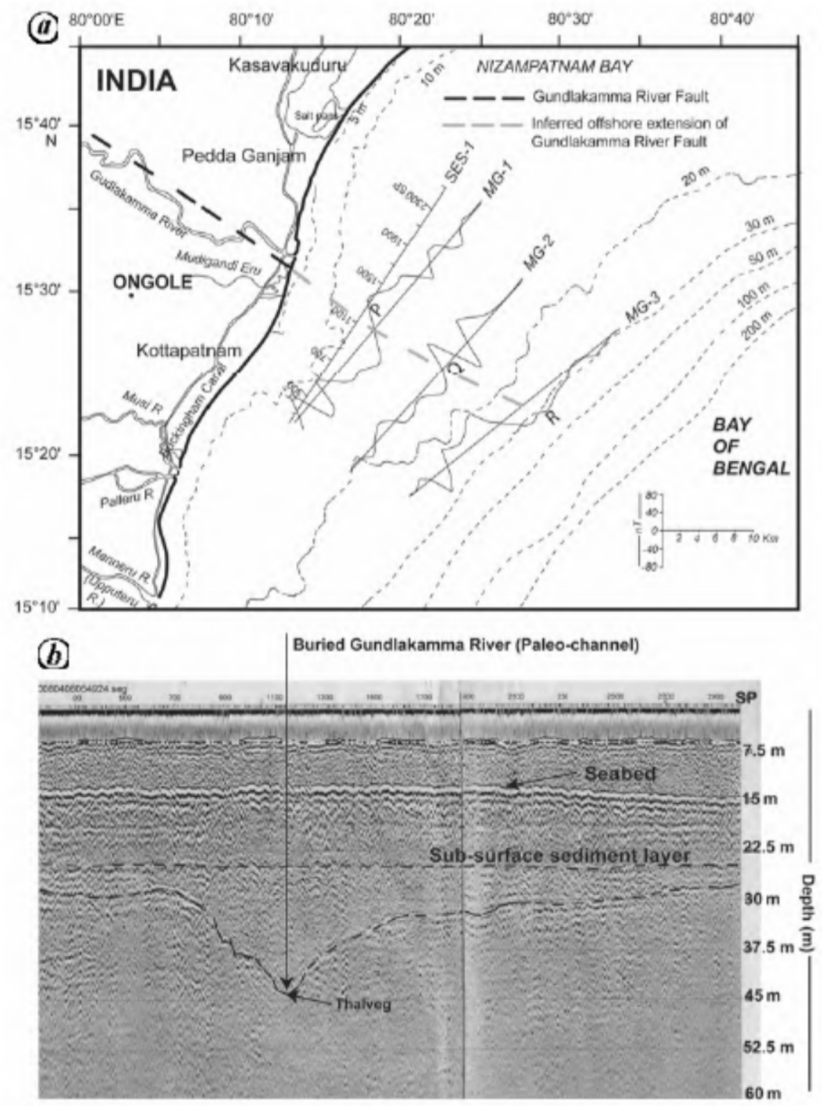

Figure 2. Map showing the stacked total intensity magnetic anomaly profiles along the traverses. SES-1 represents the high resolution shallow seismic traverse. Seismic section shown in ***b***. Offshore extension of the Gundlakamma River Fault is shown. ***b***, Shallow seismic section SES-1 within the water depths of 10–20 m parallel to east coast of India at Ongole. Location of the traverse is also shown in Figures 1 *b* and 2 *a*.

The high resolution shallow seismic record along SES-1 was studied and interpreted. The record reveals smooth seafloor topography, below which horizontal sub-surface sediment layers are observed at a depth of 15 m below seabed (Figure 2 *b*). Below this layer, a palaeochannel-like feature (may be the presence of buried Gundlakamma River) was noticed at a depth of 25 m below seabed. This feature was observed between the SP 800–1600 (Figure 1 *b*). The thalveg (deepest point) of the channel is approximately 25 m below seabed and corresponds to 1125 SP on the traverse (Figure 2 *a*). The location falls and aligns in the direction of the structural feature inferred from magnetic interpretation. This inferred structural feature in the present context is referred as lineament. When the axis of the inferred lineament is extended towards the coast, it correlates well with the onshore fault which controls the Gundlakamma River (Figure 2 *a*).

Our study reveals that offshore extension of NW–SE trending Gundlakamma River Fault (Figure 1 *b*) acts as a crustal junction between ridge–depression configuration of Bapatla–Velupucherla ridge and the Krishna depression in the north and graben–ridge structure originating from the mouth of Manneru River, south of Ongole. Also, the inferred Gundlakamma River Fault is abruptly terminated at the western flank of the NE–SW trending ridge (Figure 1 *b*) in the deeper regions at water depths of 30 m.

1. Babu, V. R. R. M., *Plate Tectonic History of the Indian Plate, Nellore–Khammam Schist Belt*, Indian Academy of Geoscience Publication, 2001, pp. 1–183.
2. Krishna Brahmam, N., *J. Geol. Soc. India*, 1989, **34**, 373–384.
3. Reddy, P. R. and Chandrakala, K., *J. Indian Geophys. Union*, 2004, **8**(2), 143–146.
4. Hardas, M. G., Depositional pattern of Tatipaka–Pasarlapudi sands. In Proceedings of Second Seminar on Petroliferous Basins of India (eds Biswas, S. K. *et al.*), Indian Petroleum Publishers, Dehra Dun, India, 1993, vol. 1, pp. 255–290.
5. IAGA Division I, Working Group 1, *EOS Trans. AGU*, 1986, **67**, 523–524.

ACKNOWLEDGEMENTS. We thank Dr Satish Shetye, Director, NIO, Goa for encouragement. We also thank Dr V. S. N. Murthy, Scientist-in-Charge, NIO, RC, Visakhapatnam for his valuable suggestions. We are grateful to MoES, New Delhi for funding. Our sincere thanks to Mr M. K. Prem Kumar, Milind Naik, Mahesh, Miliketan and crew of *Sagar Sukti* for onboard data acquisition. We extend our thanks to Mr T. Ramprasad for help in processing the seismic data. Thanks are also due to Miss T. Madhavi for drafting the figures and to anonymous reviewers for valuable suggestions for improving the manuscript. This is National Institute of Oceanography contribution number 4770.

Received 11 September 2009; revised accepted 6 May 2010

K. V. L. N. S. SARMA*
V. SUBRAHMANYAM
A. S. SUBRAHMANYAM
G. P. S. MURTY
K. S. R. MURTHY

National Institute of Oceanography,
Regional Centre,
176-Lawson's Bay Colony,
Visakhapatnam 530 017, India
**For correspondence.*
e-mail: kvlns@nio.org