Estimation of the Moho depth in the Bay of Bengal using gravity data and understanding of its tectonic implications

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Introduction

- The Bay of Bengal (BOB) is the northeastern part of the Indian Ocean, surrounded on the north by Bangladesh, on the east by Andaman- Sumatra arc, on the west by eastern coast of India. The tectonism of this region is complex.
- Its oceanic lithosphere was evolved due to rifting of India and Antarctica during **Early Cretaceous** period.
- Three major phases of seafloor spreading: first, NW-SE spreading up to the Mid-Cretaceous period, second, the N-S spreading until the early Tertiary and the present NE-SW spreading (Curray et al., 1982; Krishna et al., 2009). (Royer and Sandwell 1989) observed that most of the BOB oceanic crust was formed during the above first two phases (Rao et al., 2015).
- Two long and linear (almost N-S oriented) aseismic ridges situated in the Bay of Bengal, 85°E and Ninety-east ridges, and sediment loaded upper Bengal fan in the North of BOB.

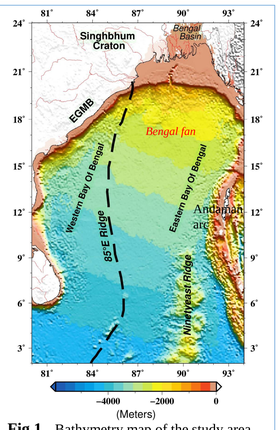


Fig.1 Bathymetry map of the study area (http://www.ngdc.noaa.gov/mgg/global/global.html)

Motivation

- As per the previous studies (Prakash et al., 2018 and reference therein), many ≤ 6 earthquakes occurred over the two aseismic ridges. Why does earthquakes occur over the aseismic ridges?
- What is the behaviour of sediments loaded upper Bengal fan in the subsurface of study region?

Data and Methodology

Database and its processing

- Gravity data: EIGEN-6C4 (http://icgem.gfz-potsdam.de/ICGEM)
- Elevation data: (http://www.ngdc.noaa.gov/mgg/global/global.html)
- Sedimentary thickness data: GlobSed Model (Straume et al., 2019)
- Corrected Bouguer anomaly was calculated after removing the gravity effects of sediments.

Methodology

- Gravity Moho was determined based on gravity data inversion using Parker-Oldenburg inversion method (Gomez-Ortiz´and Agarwal, 2005). Inversion required known parameters at Moho: average density contrast and average depth which was calculated from Power Spectral Analysis of the gravity.
- Isostatic compensation of lithosphere was estimated by computing the Isostatic Moho and additional density variations in the upper mantle required for isostatic equilibrium.
- Isostatic-Moho was determined using seismic constrain and elevation data and density variations of the uppermost mantle using equation of Kaban et al., 2016.

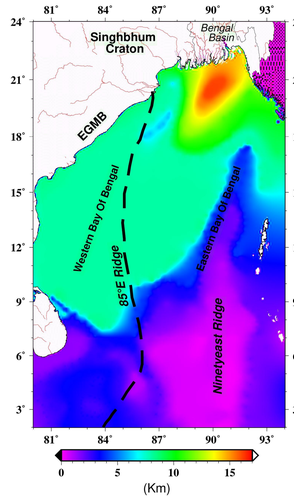


Fig. 2 Sedimentary thickness map

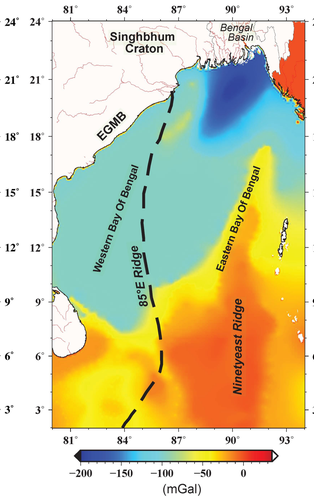


Fig. 3 Gravity effects of Sediments

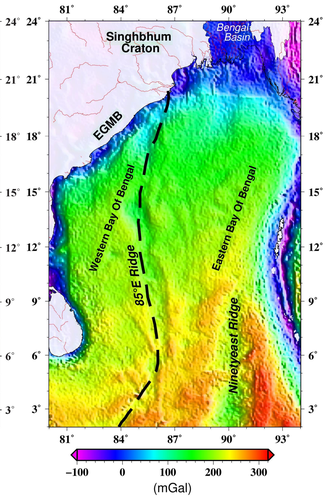


Fig. 4 Bouguer Anomaly map

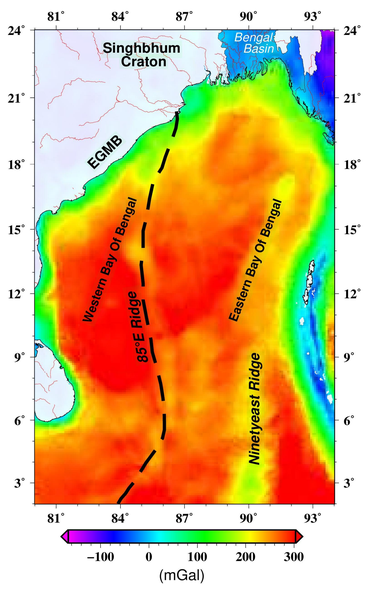


Fig. 5 Corrected Bouguer Anomaly

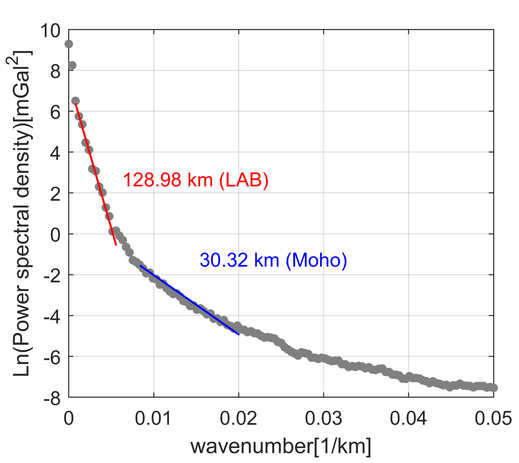


Fig. 6 Power Spectral Analysis of the Bouguer Anomaly

Results

- Gravity Moho derived from gravity anomaly denotes the 'true' Moho.
- Thick crust beneath the ridges suggests interaction of plume.
- Thick depressed crust beneath the northernmost part of BOB, implies that it is due to a load of sediments.
- Isostatic Moho can be used to infer the depth of the crustal compensation.
- Isostatic Moho reflects the topography in the study region.

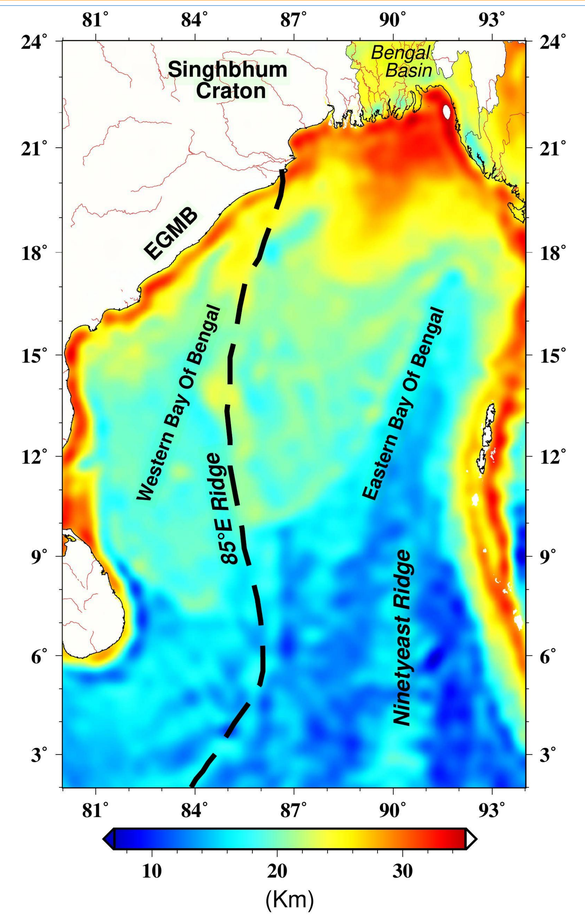


Fig. 7 Gravity Moho depth map

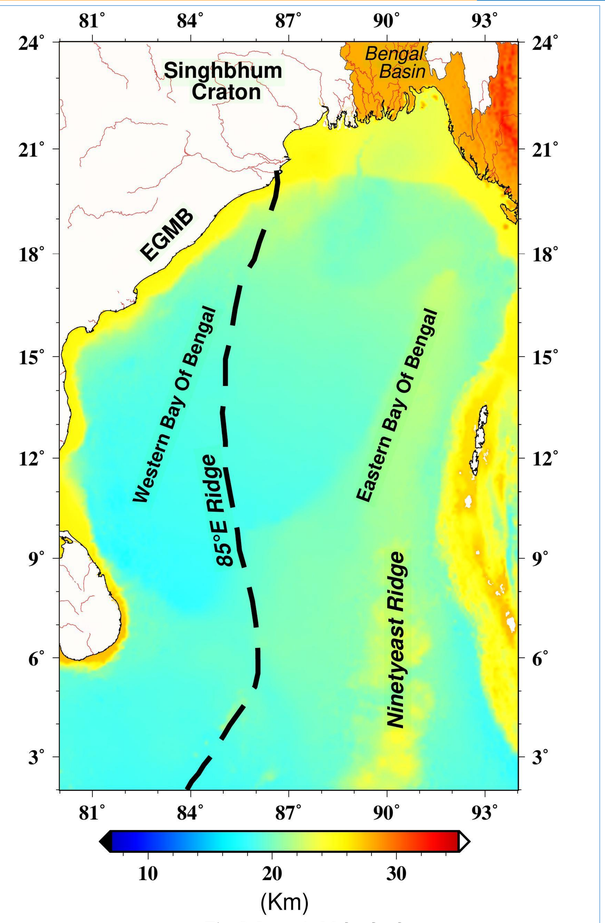


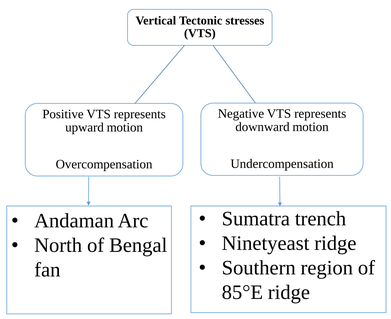
Fig. 8 Isostatic Moho depth map

Discussion and Conclusion

Isostatic compensation of lithosphere

- Direct comparison of the both kind of Moho is used to show the isostatic state of the crust.
- Vertical Tectonic stresses (VTS) can be considered as the representative of the motion of the crust(Gao et al., 2016).

VTS= (density contrast at Moho).g.(gravity Moho-Isostatic Moho)



- In addition to the vertical movement in the lithosphere for compensation, there need an additional material of density variation between 47 to 62 Kg/m^3 in upper mantle to make isostatic compensation.

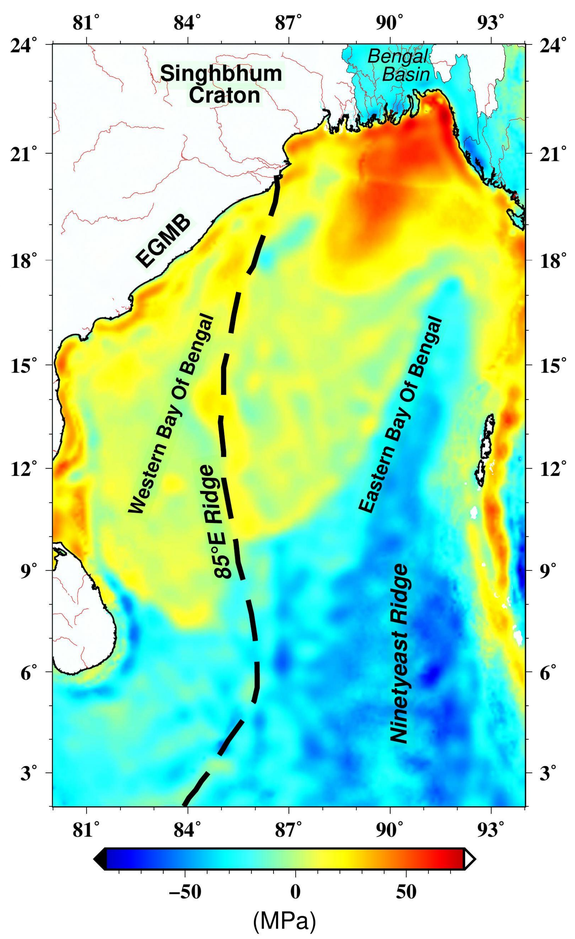


Fig. 9 Vertical tectonic Stress (VTS) map

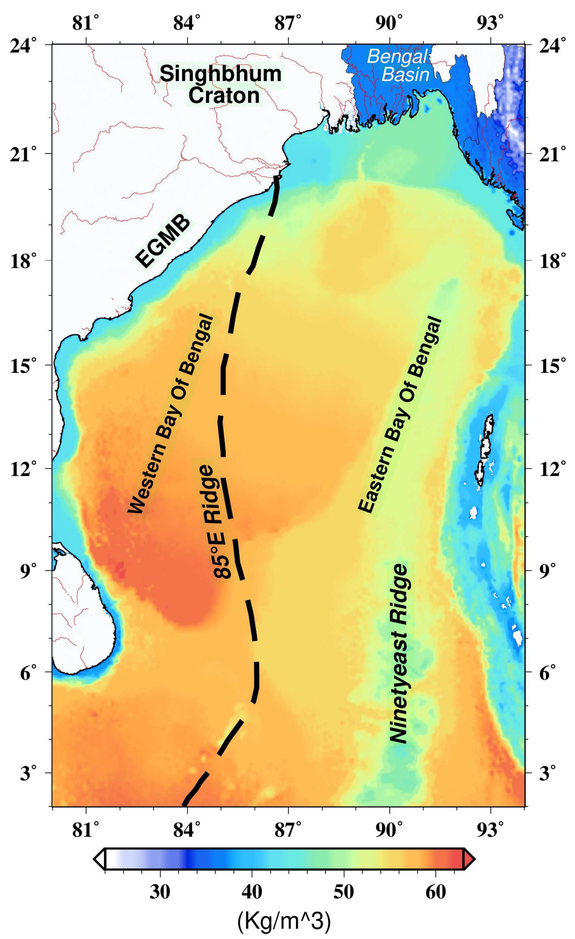


Fig. 10 additional density variations in the uppermost part of mantle required for isostatic compensation of the Lithosphere

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