IGU

Promoting Earth System Sciences

# $61^{st}$ Annual Convention

&

# Diamond Jubilee Celebration of Department of Geophysics, BHU

on

## Advances in Earth System Sciences with special reference to weather and climate

**3-5 December 2024**


Jointly Organized by

**Indian Geophysical Union (IGU), Hyderabad**

and

**Department of Environment and Sustainable Development**
**& Department of Geophysics**
**Banaras Hindu University, Varanasi**

# ABSTRACTS

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this study, we investigate the applications of RTM to synthetic data from different complex geological models, including simple flat layers, dipping layers, thrust faults, synclines, and the challenging Marmousi model. For all models, RTM successfully recovers the reflectors with high resolution and effectively images steeply dipping structural deformations, showcasing its strength in handling complex geometries. Additionally, our models representing a highly heterogeneous and structurally complex subsurface, demonstrates RTM's ability to handle strong velocity contrasts in both directions. We thus demonstrate the applications of the method in retrieving from simple to complex geological subsurface structures.

**Key words:** Seismic Imaging, Reverse Time Migration (RTM), Finite-Difference, Wavefield Cross-Correlation, Complex Geological Structures, Dipping Layers

## 3D INVERSION OF MAGNETOTELLURIC DATA ALONG A NORTH-SOUTH PROFILE IN THE WESTERN ARUNACHAL HIMALAYA FOOTHILLS

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## ABSTRACT

The Himalayas, one of the most seismically active regions in the world, were formed through the tectonic collision and ongoing underthrusting of the Indian Plate beneath the Eurasian Plate, resulting in significant crustal shortening accommodated by major thrust faults. The Himalayan Frontal Thrust (HFT), the youngest of these faults, marks the southern boundary of the mountain range. To image the HFT in the Arunachal Himalaya, we collected magnetotelluric (MT) data from nine stations along a 35 km transect between Tezpur and Bhalukpong using Phoenix MTU-5A instruments. The time series data were processed to derive impedance and tipper estimates across a period range of 0.004 to 110 s. Following the dimensionality analysis of the MT responses, we applied 3D inversion using ModEM software on the supercomputer of the Russian Academy of Sciences. The study area was discretized into a core grid of 1.1 km, padded with 12 cells on all sides, with the vertical grid cell size increasing from 40 m at the surface. The grid consisted of 64 horizontal cells, 41 vertical cells, and 48 vertical cells in total. For the initial model, we assigned a resistivity of 250 Ωm for depths up to 100 km and 100 Ωm for the layers below that. We conducted 14 inversion runs, adjusting parameters such as input data subsets, error floors, initial damping factors, model covariance, and others. In all inversion models, key features were consistently observed, although their extents and resistivity values varied. Our preferred inversion model achieved a RMS value of 1.3 after 72 iterations. To visualize the inversion results and track their evolution, we developed custom Python software. The final geoelectrical model, extending to a depth of 45 km, provided a detailed electrical resistivity image of the HFT, buried beneath a thin layer of conductive Quaternary alluvial deposits. The geometry of the thrust fault appeared as a distinct boundary separating the resistive Indian crust from the highly conductive Siwalik sediments.

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