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Electromagnetic images of the Proterozoic Bhima basin, India

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The Purana Basins are unique feature of Proterozoic geology of Indian Peninsular Shield that include almost un-deformed and un-metamorphosed sediments that occupy more than 20% of the area of Precambrian exposures. Among the seven Proterozoic basins in India, Bhima basin is the youngest (600 ma) and its deeper structures are the least studied geophysically. The sediments occupy an area of less than 5000 sq km; the lithosequence is essentially constituted of limestone units of undisturbed horizontal beds. The basin is located on the northern edges of Eastern Dharwar craton comprising Peninsular Gneissic Complex, intrusive granitoids and a series of subparallel greenstone belts. The initiation of Bhima basin was related to regional tectonism related to Eastern Ghat Mobile Belt (EGMB) and Mid-Proterozoic Mobile Belt (MPMB) orogeny. To the North of the Bhima basin is finalized by the volcanic units of the Deccan Traps.

Magnetotelluric studies were undertaken across this basin for estimating thickness of the sediments and crustal structure of the Eastern Dharwar Craton that underlie the sediments. Data were collected at 33 stations along three NNE-SSW profiles with station spacing of 10 km in the frequency range 100-0.001 Hz. The data were processed using a remote reference robust code.

Dimensionality analysis shows different strike angles for shallow structures (20 degrees) and deeper structures (-55 degrees). This difference can probably be explained by the fact that the strike angle of the crustal units shows the amalgamation direction of the Bhima basin within the Indian continent. On the other hand, the mantle units show the direction of the motion of the Indian plate and probably also respond to the thermal events that have affected the Indian lithosphere since Archaean times.

For the interpretation of the data, we have undertaken 3D inversion of the measured responses. The models show a resistive upper crust in which there are several conductive anomalies, allowing to follow the northwestern extent of the Adoni shear zone, only mapped on the surface. The lower crust and upper mantle of the Bhima basins are fairly resistive, showing a quite homogeneous regional structure under the Deccan Traps, suggesting that the East Dharwar craton has continuation under the volcanics. Finally the electrical astenosphere has been located at about 140 km to the southeast of the study area (south-east of the Bhima basin) and 160 km to the northwest. These values agree with the thicknesses proposed by Agrawal and Pandey (2004) for the East Dharwar craton.