Three-dimensional electrical imaging of the hot springs in the southern part of west coast geothermal province of India

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SUMMARY

The West Coast geothermal system is a prominent geothermal region in the Indian subcontinent, and understanding its geothermal reservoirs is crucial for societal benefits. In the present study, we have acquired Audio and broadband Magnetotelluric (AMT & MT) data obtain grid patterns across the Aravali, Tural, Rajawadi and Rajapur geothermal regions to gain insights into this complex geothermal area.

To better understand these geothermal reservoir characteristics, we employed 3D modeling for the in the West Coast geothermal region. The results of our 3D inversion AMT and MT data across Aravali-Tural-Rajawadi for AMT revealed the presence shallow conductivity anomaly coupled with a high-resistivity basement. On the other hand, the MT data-derived models expose a stratified three-layered structure, comprising a low-resistivity layer ($10 - 100\,\Omega$m), a high-resistivity layer ($> 1000\,\Omega$m), and a layer with moderate resistivity ($100 - 500\,\Omega$m). A thin layer of high resistive granitic crust, which decreases towards the west. The rifting process along the western continental margin of India has introduced magmatism to the lower crust, manifesting as moderate conductivity ($100 - 500\,\Omega$m) in shallow depths (10 km). The cooling and solidification of underplating materials contribute to the heat flux along the West Coast geothermal zone (WCGZ). In addition, the circulation of meteoric water within the deep layers of the Earth gets heated up, and hot water propagation to the surface also contributes to the hot springs. Similarly, 3D inversion in Rajapur geothermal has revealed anomalous conductivity features at a depth of about 0.1 and 0.4 kilometers. These features are associated with fault/fracture zones, which allow hot water to reach the surfaceâthe granitic basement at a depth of about 0.5 to 1.0 kilometers at Rajapur. Meteoric water from Rajapur thermal spring waters from the southernmost part circulates through weathered basalts, Kaladgi formations, and Precambrian granites below the Deccan Traps.

Keywords: Magnetotelluric, 3D modelling, West Coast geothermal zone, Hot springs