India's Geothermal Energy Landscape and Role of Geophysical Methods in Unravelling Untapped Reserves

Authors : Satya Narayan

Abstract : India, a rapidly growing economy with a burgeoning population, grapples with the dual challenge of meeting rising energy demands and reducing its carbon footprint. Geothermal energy, an often overlooked and underutilized renewable source, holds immense potential for addressing this challenge. Geothermal resources offer a valuable, consistent, and sustainable energy source, and may significantly contribute to India's energy. This paper discusses the importance of geothermal exploration in India, emphasizing its role in achieving sustainable energy production while mitigating environmental impacts. It also delves into the methodology employed to assess geothermal resource feasibility, including geophysical surveys and borehole drilling. The results and discussion sections highlight promising geothermal sites across India, illuminating the nation's vast geothermal potential. It detects potential geothermal reservoirs, characterizes subsurface structures, maps temperature gradients, monitors fluid flow, and estimates key reservoir parameters. Globally, geothermal energy falls into high and low enthalpy categories, with India mainly having low enthalpy resources, especially in hot springs. The northwestern Himalayan region boasts high-temperature geothermal resources due to geological factors. Promising sites, like Puga Valley, Chhumthang, and others, feature hot springs suitable for various applications. The Son-Narmada-Tapti lineament intersects regions rich in geological history, contributing to geothermal resources. Southern India, including the Godavari Valley, has thermal springs suitable for power generation. The Andaman-Nicobar region, linked to subduction and volcanic activity, holds high-temperature geothermal potential. Geophysical surveys, utilizing gravity, magnetic, seismic, magnetotelluric, and electrical resistivity techniques, offer vital information on subsurface conditions essential for detecting, evaluating, and exploiting geothermal resources. The gravity and magnetic methods map the depth of the mantle boundary (high-temperature) and later accurately determine the Curie depth. Electrical methods indicate the presence of subsurface fluids. Seismic surveys create detailed sub-surface images, revealing faults and fractures and establishing possible connections to aquifers. Borehole drilling is crucial for assessing geothermal parameters at different depths. Detailed geochemical analysis and geophysical surveys in Dholera, Gujarat, reveal untapped geothermal potential in India, aligning with renewable energy goals. In conclusion, geophysical surveys and borehole drilling play a pivotal role in economically viable geothermal site selection and feasibility assessments. With ongoing exploration and innovative technology, these surveys effectively minimize drilling risks, optimize borehole placement, aid in environmental impact evaluations, and facilitate remote resource exploration. Their cost-effectiveness informs decisions regarding geothermal resource location and extent, ultimately promoting sustainable energy and reducing India's reliance on conventional fossil fuels.

Keywords : geothermal resources, geophysical methods, exploration, exploitation
Conference Title : ICGEE 2024 : International Conference on Green Energy and Environment
Conference Location : Istanbul, Türkiye
Conference Dates : June 27-28, 2024