Comparative studies on heat and stress build up in jointed and intact granites at depth of 220 m, Bhima Basin, India

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Two-dimensional simulation of heat transfer through a granite rock mass forming part of Proterozoic granites in Bhima Basin (BB) and associated groundwater flow and bulk stress distribution is carried out using structural geological features joints, fractures, etc. measured in field and laboratory evaluated mechanical, thermal and hydraulic parameters of 56 rock samples coupled with prevailing *in situ* stress field. The modelled rock mass (20 m × 10 m) consists of D-shaped opening at 220 m depth containing cylindrical heat source (500 Watt) and clay buffer with two sets of joints dipping at 90° and 45°. The intact rock mass under combined thermal and overburden stresses registers a maximum 19.77 MPa stress while it is 23.34 MPa in jointed rock mass due to additional stresses imposed by groundwater in the joints resulting in maximum displacement, groundwater flow and temperature of 4.46 mm, 1.93 × 10^{-8} m/s and 78.21°C respectively. The present study produces database on response of BB granites to applied thermal *in situ*-groundwater stresses.

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were tested for estimation of thermal, mechanical and hydraulic parameters as required for numerical simulation of coupled interaction of these processes and listed in Table 1. For identification of prominent joint sets in the studied rock mass, 40 rock joints were examined at the surface in the outcrop immediately adjacent to the Bhima group rocks, as well as in the core samples. Examination showed two primary joint sets having strike directions of N55°E and N33°W and dips of 90° and 45° respectively. The mean spacing between the two joint sets is found to be 0.5 m. A D-shaped opening of 4 m × 4 m has been considered at a depth of 220 m in the granites within which a single cylindrical heat source (500 W) of 2 m length and 0.35 m diameter has been placed in a vertical cylindrical excavation having 4 m depth and 0.4 m radius[9–12]. The numerical model has been loaded with vertical stresses of 5.82 MPa representing 220 m of overburden and additional groundwater pressure of 2.15 MPa as per the prevailing site condition. The intervening space between heat source and granite has been filled with sodium smectite clays to provide mechanical cushioning and smooth heat dissipation. The model mimics a reference GDS under consideration in India for heat emitting radioactive waste canister