

Geothermal reservoir evaluation by using TL of Quartz and Fluid Flow Simulation Model of the Kakkonda system in Japan

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Thermoluminescence (TL) of quartz is used in many geoscientist applications: Radiation measurements, geological dating and recently in geothermal activity prospection. After kinetic understanding, a new geothermal reservoir model has been developed based on the analysis of geological thermoluminescence surface samples and cuttings of borehole quartz samples combined with the system behavior equations. This novel methodology has been designed especially for an early stage of geothermal exploration condition and has been validated in the Kakkonda geothermal field in its initial exploration state. The system was simulated from surface to 5 Km on depth. In order to obtain the geothermal model that uses TL as a heat sensor, the sensitivity of the mineral property to natural heat has been monitored and evaluated through kinetic TL quartz decay experiments using aliquots of a standard sample rooted from same geothermal origin and subjected to different controlled conditions of temperatures taken at different time and deconvoluted by keeping constant 4 peak positions for all database; this has allowed the development of novel TL equations that have been coupled in this proposed reservoir model, which, is based on the description of the system through 3 governing equations for a specific control volume: the geothermal potential system balance, the Fourier equation, and the non-steady state heat conduction equation. Coupled with reservoir model and thermoluminescence model, we can obtain a numerical model of three-dimensional geothermal prospecting temperatures at any position (X, Y, Z) got through geoprocessing GIS tools. Finally, the 3D thermal model was used to parameterize a fluid flow simulation that considers the supercritical condition of the system at 5 Km as a heat source model and by using Hydrotherm software many scenarios of natural system evolution were gotten and a novel sustainable application for operation of the geothermal production operation in the Kakkonda Geothermal Power Plant was proposed.

Keywords: Thermoluminescence, Geothermal Reservoir Evaluation, Thermal Modeling

