3D Subsurface Modeling of Gümüşköy Geothermal Area, Aydın, Turkey

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In this study, 3D subsurface model of the Gümüşköy Geothermal Area was generated to identify geology and geothermal system using existing information of various sources. In this perspective, Petrel® modeling software was used to prepare 3D lithology, structural geology, resistivity, and temperature models within the study area. Western Anatolia, where the study area is placed, exhibits a unique importance as it governs most of the geothermal producing systems in Turkey. BM Engineering and Construction Inc. started early exploration studies for Gümüşköy region in 2005 and during five years of period different sources of data including geology, geochemistry, geophysics and well logs have been collected. Geothermal System of Gümüşköy can be defined as hot-water dominated convective hydrothermal resource with deep circulation of water along fractures settled in the Büyük Menderes Graben (BMG). The methodology that we followed was composed of four stages; Data input, Structural Modeling, Property Modeling and Uncertainty. Data input stage includes both conventional and GIS format data. Structural modeling defines the skeleton of the 3D model including Fault Model, Grid mesh, Model Horizons and Zones. Property Modeling is the output stage where, 3D subsurface models like lithology, resistivity, temperature, and pressure were generated. Lithology model has been built using both deterministic and stochastic approaches. Deterministic approach gave more realistic results but there is always uncertainty which can be corrected with the new wells drilled. Resistivity/Temperature model built with different algorithms such as; Minimum Curvature, Gaussian Random Function Simulation (GRFS), trend operation and co-krigging. On the whole, GRFS with collocated co-krigging found to be the optimum solution. Uncertainty expresses the quality of the work done and defines the level of ambiguity. An uncertainty analysis has been conducted to the selected model with probabilistic calculations. All of the relevant data have been investigated to build a suitability model and consistency of the model has also been proved by the new well drilled in the area. Constructing a 3D subsurface model helped for visualizing and understanding of structural framework, geology and interactions of geothermal system. This model will be used as the basis of a 3D numerical modeling (dynamic) of the reservoir.

Keywords: Geothermal, Gümüşköy, 3D Modeling, Structural Framework, Magnetotelluric, Subsurface Temperature