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Spatial Correlation of Airborne Magnetic Anomalies with Reservoir Temperatures of Geothermal Fields, Western Anatolia, Turkey

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Geothermal areas in Western Anatolia are remarkably located throughout Büyük Menderes Graben (BMG) and Gediz Graben (GG). These E-W trending grabens have been subjected to N-E stretching since Miocene. Except for these major outcomes of the extensional forces, NE-SW oriented and relatively short grabens take place in Western Anatolia as well. Among them, BMG and GG are remarkable with topographic escarpments that reveal footwall of steeply-dipping active normal faults. They manifest themselves via numerous earthquakes and geothermal activity (fluid discharges from springs and wells). Geothermal discharges are aligned along the rims of E-W trending normal faults trending over detachment faults. Concerning BMG, geothermal manifestations extend along the northern sector of the graben. Geothermal reservoirs inside BMG are the limestone and conglomerate units within Neogene sediments and the marble-quartzite units within The Menderes Massif rocks. The main high and low enthalpy geothermal fields along BMG and their reservoir temperatures are as follows: Kızıldere (242°C), Germencik (232°C), Aydın-Ilıcabası (101°C), Yılmazköy (142°C), Salavatlı (171°C), Söke (26°C), Pamukkale (36°C), Karahayıt (59°C), Gölemezli (101°C) and Yenice (70°C). Through GG, reservoir temperatures decrease from east to west. Geothermal reservoirs inside GG are metamorphics and granodiorite of the Menderes Massif rocks. The Neogene sediments act as cap rock of the geothermal reservoirs. Geothermal fields inside the graben and their reservoir temperatures are as follows: Alaşehir (215°C), Salihli (155°C), Urganlı (85°C), Kurşunlu (135°C), Caferbey (150°C), Sart (100°C).

In order to investigate the spatial correlation of magnetic anomalies and the reservoir temperatures of geothermal fields in the region, we analysed airborne magnetic data which were collected by General Directorate of Mineral Research and Exploration (MTA) of Turkey. Airborne magnetic data were taken at about 70-m intervals along the profiles and the profile interval was set as 1-2 km. Necessary corrections including the IGRF correction were carried out by MTA. After removing the horizontal planar trend and regional background, a reduction to the pole process was performed to residual magnetic data. The pole reduced magnetic intensity values vary in the range of -368 and 395 nT in the image map. In general, relatively high amplitude magnetic anomaly zones indicate the geothermal fields having higher reservoir temperatures than 200°C in the region. On the other hand, moderate magnetic intensity values point geothermal fields having lower reservoir temperatures than 200°C. It can be inferred that higher and moderate magnetic intensity values in the region are positively and spatially in accordance with higher and lower geothermal reservoir temperatures relative to 200°C. Consequently, obtained results were discussed in terms of magnetic intensity, geothermal heat source and geothermal reservoir temperatures.

Keywords: Magnetic Anomalies, Reservoir Temperatures, Geothermal Fields, Western Anatolia, Turkey