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Goechemical and Hydrogeochemical Properties of Cappadocia Geothermal Province

Mehmet Furkan Sener (1), Mehmet Sener (2), and Tonguc Uysal (3)

(1) Faculty of Arts and Science,Nigde University, Nigde, Turkey (mfsener@nigde.edu.tr), (2) Engineering Faculty, Nigde University, Nigde, Turkey (mssener@nigde.edu.tr), (3) School of Earth Science, University of Queensland, Brisbane, Turkey (t.uysal@uq.edu.au)

ABSTRACT

In order to determine the geothermal resource potential of Niğde, Nevşehir and Aksaray provinces in Central Anatolian Volcanic Province (CAVP), geothermal fluids, surface water, and alteration rock samples from the Cappadocia volcanic zone in Turkey were investigated for their geochemical and stable isotopic characteristics in light of published geological and tectonic studies. Accordingly, the Cappadocia Geothermal Province (CGP) has two different geothermal systems located along tectonic zones including five active and two potential geothermal fields, which are located between Tuzgölü Fault Zone and Keçiboyduran-Melendiz Fault and north of Keçiboyduran-Melendiz Fault.

Based on water chemistry and isotope compositions, samples from the first area are characterized by Ca-Mg-HCO_3 ve Ca-HCO_3 type mineral poor waters and Ca-Na-SO4 and Ca-Mg-SO4 type for the cold waters and the hot waters, respectively, whereas hot waters from the second area are Na-Cl-HCO_3 and Ca-Na-HCO_3 type mineral poor waters. According to δ18O and δ2H isotope studies, the geothermal waters are fed from meteoric waters. Results of silica geothermometer indicate that the reservoir temperature of Dertalan, Melendiz Mount, Keçiboyduran Mount, Hasan Mount (Keçikalesi), Ziga, Acıgöl, and Derinkuyu geothermal waters are 150-173 oC, 88-117 oC, 91-120 oC, 94-122 oC, 131-156 oC, 157-179 oC; 152-174 oC and 102-130 oC, respectively.

The REE composition of geothermal fluids, surface water, and mineral precipitates indicate that temperature has a strong effect on REE fractionation of the sampled fluids. Eu- and Ce- anomalies (Eu/Eu*, Ce/Ce*) are visible in several samples, which are related to the inheritance from the host reservoir rocks and redox-controlled fractionation of these elements during water-rock interactions. REE and Yttrium geochemistry results of altered rock samples and water samples, which were taken from same locations exhibited quite similar features in each system. Hence, it was conclude that the same hydrothermal fluid in geothermal system was reached to the surface and interacted with the surface rocks.

Our conceptual geothermal model for Cappadocia Geothermal Province based on our geochemical and hydrogeochemical data in combination with geological and geophysical information suggest that the geothermal resources in this region are controlled by primary (active fault) and secondary (buried fault) tectonic belts. Further, our geochemical data indicate the Paleozoic-Mesozoic marble and gneiss being the reservoir rocks. Geogradient and impending heat fluxes to the surface with a possible crustal thinning, which was developed after regional tectonic activities during the Late Pliocene-Quaternary period, constitutes the heat sources. In addition, our study suggest that the Quaternary tuff and ignimbrites of Cappadocia Volcanics represent the seal rock of the geothermal system.

In conclusion this study provide evidence for a significant geothermal potential in the Cappadocia region with well-defined seal rocks. However, further studies are needed to resolve the geothermal fluid source problem.

Keywords: Cappadocia, geothermal systems, geochemistry, rare earth elements, hydrogeochemistry, hydrothermal alteration.