Conceptual modeling of the geothermal waters in the continental rift zones of the Menderes Massif, western Anatolia, Turkey

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The tectonic position of the eastern Mediterranean area between the Eurasian and African plates, is controlled by the situation of the Anatolian and Aegean microplates. The plate tectonic development results in the lifting of the Menderes Massif showing a dome shaped structure due to compressional tectonic features from Oligocene to Middle Miocene. From Early to Middle Miocene, the continental rift zones of Büyük Menderes, Gediz, and Kücük Menderes were formed by extensional tectonic features, which strike E-W generally and are represented by a great number of geothermal waters, epithermal mineralisations, and volcanic rocks of Middle Miocene to recent age. The geothermal waters and epithermal mineralisations are related to faults which strike preferentially NW-SE and NE-SW and locate diagonal to general strike of the rift zones. These faults are probably generated by the compressional tectonic stress, which leads to the deformation of uplift between two extensional rift zones. The investigated geothermal waters of Kizildere, Bayindir und Salihli represent typical examples of active geothermal waters. In comparison, the fossile epithermal Hg, Sb and Au mineralisations of Haliköy, Emirli und Küre were selected as typical examples for this study. The meteoric fluids in the drainage area percolate at fault zones and permeable clastic sediments in the reaction zone of the roof area of a magma chamber situated at a probable depth of 2-4 km where meteoric fluids are heated by the cooling magmatic melt and ascend to the surface due to their density caused by convection cells. The volatile components of CO_2, SO_2, HCl, H_2S, HB, HF, and He from the magma reach the geothermal water reservoir where an equilibrium between altered rocks, gas components, and fluids performed. Thus, the Geothermal waters ascend in the tectonical zones of weakness at the rift zones of the Menderes Massif in terms of hot springs, gases, and steams. These fluids are characterized by high to medium CO_2, H_2S and NaCl contents. The geothermal waters are exploited for various uses consequently, i.e. for geothermal energy, balneology, and green houses.
The results of stable isotope analyses of $^{87}Sr/^{86}Sr$ show that the geothermal fluids have experienced fluid-rock interaction with the metamorphic rocks. The isotope ratios of $^{3}He/^{4}He$ indicate an origin of volatile components from basic, subvolcanic intrusions originated from upper mantle. The source of sulfur in active and extinct geothermal systems can be linked to magmatic input due to isotope analyses of ^{34}S. In active geothermal systems the presence of gypsum in Tertiary sediments might be considered as a further source. The $\delta^{13}C$ isotope ratios in the active geothermal fluids confirm the magmatic origin of volatile components in these fluids. However, they are affected by the solutions of carbonate rocks which also does not allow the age determination by $^{1}4C$. Finally, the geothermal waters in the continental rift zones of the Menderes Massif were modeled hydrogeologically

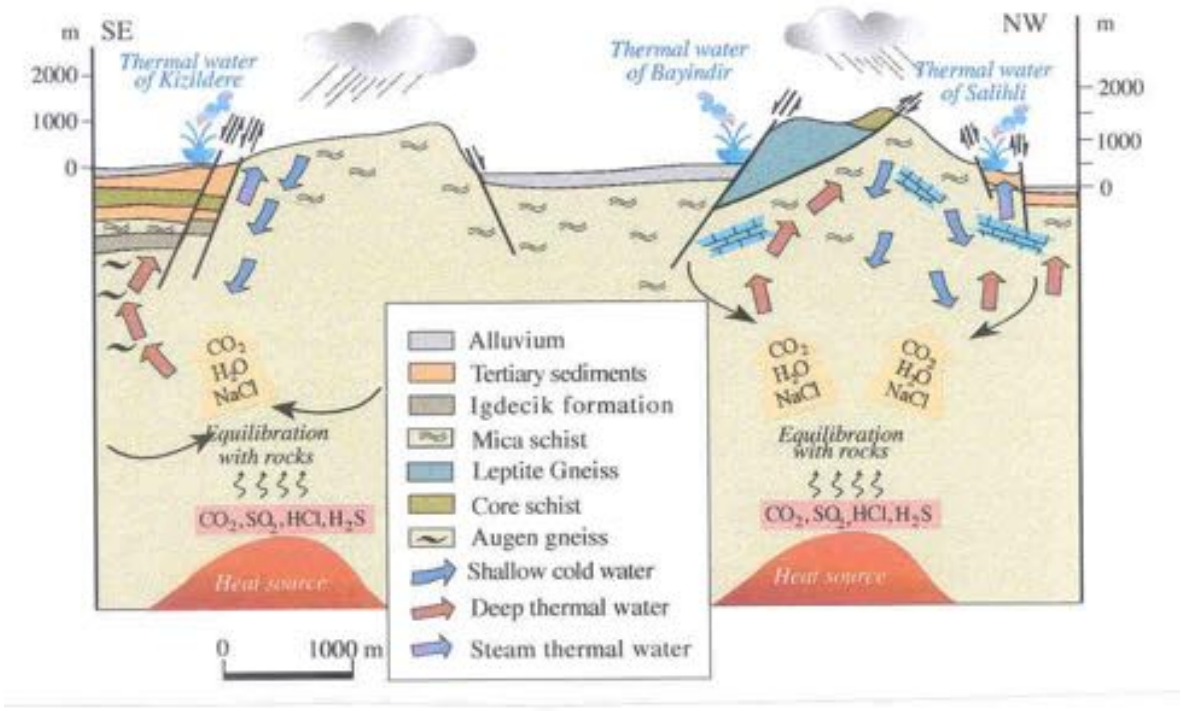

Figure 1. Simplified hydrogeological model of the geothermal waters in the continental rift zones of the Menderes Massif, western Anatolia, Turkey (Özgür, 1998).

References

Özgür, N., 1998, Aktive und fossile Geothermalsysteme in den kontinentalen Riftzonen des Menderes-Massives, W-Anatolien/Türkei. Freie Universität Berlin, Habilitationsschrift, 171 p.