

Thermal and mineral water sources in South-Central Chile

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In the Andean Cordillera between 39°-42°S, 46 areas of thermal and mineral water sources have been recognized. Generally, they are soft (<50 mg/l CaCO_3), show neutral to moderately alkaline pH (7.22-9.65), and mesothermal to hyperthermal ($35 < T^{\circ}\text{C} < 100$). Based on the chemical composition the hot spring waters can be classified in five types: sodium sulfate, sodium chlorides, sulfate-bicarbonate sodium, sodium bicarbonate and magnesian-calcic sulfate. The isotopic compositions of ^{18}O and D ($\delta^{18}\text{O}$ -10.15 and -8‰; $\delta^2\text{H}$ -70 and -50‰) from 11 thermal and mineral sources are similar to samples of superficial water ($\delta^{18}\text{O}$ -8.75 and -7.58‰; $\delta^2\text{H}$ -59 and -52‰), suggesting that their origin is mainly meteoric.

The chemical and isotopic characteristics indicate that meteoric water dominates in the geothermal system. Based on geologic setting the hot spring can be subdivided in to groups: the first one is closely associated with regional faults and fractures (exogenous hot spring), whereas the second is spatially related to active volcanic centers ("mixed hot spring systems). Exogenous hot spring include mesothermal sodium sulfate, sodium chlorides and sulfate-bicarbonate sodium waters, and they are formed by infiltration of meteoric water through fractures, where the chemical and isotopic features are determined by the superficial water, temperature and petrographic-geochemical characteristics of the surrounding rocks through which they circulate. The "mixed" hot spring system include sulfate calcic-magnesian and bicarbonate sodium types, with high mineral concentrations, as well as being of hyperthermal character. In this case, the volcanic activity would introduce volatile components in the system during the deep circulation of the meteoric waters.