

Contributions of the different water sources to the Elqui river runoff (northern Chile) evaluated by H/O isotopes

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We present the results of an isotope (^2H and ^{18}O) and hydrogeochemical study in order to constrain the origin, recharge, and evolution of the surface and groundwater in the arid Andean realm of the Elqui watershed. The results of ^2H and ^{18}O analyses of water samples obtained during our summer and winter campaigns indicate a generally meteoric origin of the river and spring waters of the watershed. The isotope signature of water of the Elqui river and its tributaries as well as that of groundwater in the coastal region fits the ^2H – ^{18}O relation of $\delta^2\text{H} = 7.61\delta^{18}\text{O} + 6.1$. A relatively fast discharge and a quasi-closed catchment area can be asserted for water along the river flow path. The tributaries from the more arid coastal area, north of the Elqui river, differ in their isotopic signature due to evaporation and hydrochemically due to interactions with the strongly altered and fractured volcanic rocks of the basement. In the Andean zone, the ^{18}O -enriched hydrothermal spring of Baños del Toro exhibits the influence of water–rock interaction processes.

The chemistry of the river water changes from sulphate- to chloride-rich along the river course from the high Andean mountains to the coast. The sulphate-rich character of these Andean waters reflects their passage through sulphide-rich rock massifs that were subjected to strong oxidation processes in the near superficial environment. This sulphate signature is enforced by past and present mining of precious metal epithermal deposits (e.g. those of El Indio-Tambo Au–Cu–As district), in which mineralised zones were developed during a series of Miocene magmatic-hydrothermal episodes in the Andean realm.

Owing to the proximity of the lower Elqui river waters and its tributaries to the Pacific coast, the chloride character may be induced by agricultural and marine (sea spray, fog) sources. Generally, the main source of the Elqui river water is mainly attributed to surface runoff and less to contributions from the basement fractured aquifer.

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