Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.6972

Hydrogeochemical processes in volcanic closed basins: Insights from Sr and Li isotopes in the Salar del Huasco and Lagunilla, Altiplano, Chile.

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Salar del Huasco and Lagunilla are two adjacent closed basins located in the Precordillera and Western Cordillera of the Andes. Surface geology of their catchment is dominated by Miocene to Pliocene ignimbrites and volcanic units. The limited precipitation and high evaporation of the area allow the development of evaporitic environments with saline lakes. The aim of this work is to determine the origin of solutes in these waters by linking hydrogeochemical modelling with geochemical and isotopic data.

We modeled rock-water reactions, evaporation, evaporite dissolution and geothermal-surface water mixing through PHREEQC software and contrasted these models with geochemical and isotopic data measured in natural waters.

Inverse modelling shows weathering of volcanic and volcanoclastic units, plus salt dissolution (halite and gypsum). The similarity of $^{87}Sr/^{86}Sr$ between volcanoclastic rocks (0.7061 - 0.7079) and waters (0.7056 - 0.7066) are consistent with the solute source proposed. Furthermore, rNa/rCl ratios of inflow waters (2.27 - 4.60) validate silicate weathering processes with no halite dissolution, suggesting that it's contribution was overestimated. δ^7Li values also evidence the formation of secondary minerals related to volcanic rock weathering, with inflow water values between +5.47‰ to +11.26‰ and lakes between +8.80‰ to +36.09‰.

Modeled evaporation of dilute water indicate the formation of Na-SO_4-Cl brine in agreement with the hydrogeochemical compositions of the Salar del Huasco and Lagunilla lake, and Na-CO_3-Cl brine in the northwest of Salar del Huasco, the latter suggesting mixing processes. Evapoconcentration in the basins is consistent with constant rCl/rBr ratios (~10^7) with increasing salinity.

No mixing of geothermal waters with other types of fluids was recognized, and a hydrothermal influence remains unclear. Sr isotope values of geothermal waters (~0.7066) are comparable to the other natural waters, reflecting similarities in source rocks or water contribution of this type of fluid.

Modelling and multi-isotope approach carried out in this study suggest that the origin of solutes in the catchment area is mainly derived from the volcanic and volcanoclastic rocks and that brines are produced by evapoconcentration, with no significant evaporite influences.