Lithium and Strontium Isotope Systematics in Arid to Hyper-Arid Watersheds: Implications for Continental Li Brine Formation

LEE ANN MUNK[1] DAVID F. BOUTT[2]

[1]Department of Geological Sciences, University of Alaska Anchorage, Anchorage, AK, 99508, USA
[2]Department of Geosciences, UMASS Amherst Amherst, MA 01003, USA

The weathering processes operating in critical zones in arid to hyper-arid watersheds are dominated by hydogeochemical processes on the catchment scale. These processes can be defined along flow paths from inflow/recharge zones to discharge zones at the basin floor. $^{87}Sr/^{86}Sr$ and $\delta^{7}Li$ signatures of waters in these environments are indicative of sources of water and hydrogeochemical processes affecting the water composition. $^{87}Sr/^{86}Sr$ signatures can be used to track flow paths of water interacting with sub-watersheds dominated by varying types and ages of rocks, whereas, the $\delta^{7}Li$ is more indacative of geochemical processes operating in the catchments, mainly low temperature vs. high temperature (geothermal) weathering and interaction with secondary minerals such as clays and/or salts. When these signatures are interpreted in the context of basic water chemistry and other isotopic indicators such as $\delta^{18}O$, δD, and ^{3}H, complex weathering and transport processes may be deciphered.

The origin of Li brines in globally important closed-basin watersheds is best explained by a wholistic approach which considers the source(s) and processes that release, transport and concentrate Li. The Salar de Atacama (SdA), Chile and Clayton Valley (CV), Nevada, USA basins represent two end-members of Li-enriched salars, mature and immature, respectively. The isotopic studies reveal novel discoveries of which hydrogeochemical processes are most important for their formation. For example the inflow waters of varying temperature have $\delta^{7}Li$ near +4 to +6‰ whereas the brines are +8 to +13‰ indicating that sequestration of ^{6}Li by clays and/or salts is an important processes in forming the Li brines because source rocks have $\delta^{7}Li$ -5 to +2‰. $^{87}Sr/^{86}Sr$ of inflow waters vary from 0.70902-0.71165 in CV and from 0.70656-0.70850 in SdA, brines in CV are 0.71040 and in SdA are 0.70813 reflecting differences in type and age of source rocks and relative contribution determined by water flux.