$\delta^{88/86}$Sr and ^{87}Sr/^{86}Sr as combined tracers of the evolution of continental strontium - lessons from soils and carbonates in Israel

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Fluxes of strontium in continental environments, from weathering of rocks, through soils and dust formation, to accumulation and precipitation in rivers and lakes, have traditionally been evaluated using the radiogenic ratio of ^{87}Sr/^{86}Sr. This ratio is a sensitive proxy for material provenance and mixing between strontium sources. The developments in mass spectrometry enabled determining minute variations in the stable isotopes ratio ^{88}Sr/^{86}Sr (expressed as $\delta^{88/86}$Sr), and studying geochemical processes involving fractionation of strontium isotopes. Previous studies of the stable and radiogenic ratios simultaneously demonstrated their potential for quantifying the marine strontium cycle and better understanding the global carbon cycle. This study describes an attempt of applying the dual strontium isotopes system to continental environments.

Strontium isotopic fractionation was shown in precipitation of continental carbonates, producing ^{88}Sr-depleted carbonates. The isotopic fractionations were determined to be $\varepsilon_{\text{carb-water}} = -0.20‰$ for oxygenated systems (speleothems and river-tufas) and $\varepsilon_{\text{carb-water}} = -0.28‰$ for reduced groundwater of high alkalinity. The residual solution of the latter was exceptionally ^{88}Sr-enriched ($\delta^{88/86}$Sr=0.66‰), suggesting that biogenic and other processes governing alkalinity have a significant role in determining aquatic $\delta^{88/86}$Sr value.

By drawing mass dependent fractionation lines on a $\delta^{88/86}$Sr-^{87}Sr/^{86}Sr dual plot this precipitation effect can be differentiated from mixing processes. Thus, the dual plot serves as a powerful tool for reconstructing the evolution of strontium on the continents.