

STABLE STRONTIUM AND MAGNESIUM ISOTOPES BEHAVIOR IN COASTAL AQUIFERS DURING LONG-TERM SEAWATER CIRCULATION

ANAEL COHEN¹, NETTA SHALEV² AND YAEL KIRO³

¹Weizmann Institute of Science, Israel

²The Hebrew University of Jerusalem

³Weizmann Institute of Science

Groundwater-derived solute and isotope fluxes to the ocean, once deemed subordinate, have emerged as significant contributors to ocean chemistry. The chemical composition of these coastal aquifer groundwaters is affected by mixing between fresh and saline water bodies and by water-rock interactions. The latter also depend on the residence time of the intruding seawater and its flow paths. This study delves into the chemical dynamics of a carbonate-rich silicate aquifer at the Nitzanim Nature Reserve in Israel, unraveling the behavior of stable strontium and magnesium isotopes in the context of groundwater flow and water-rock interactions.

Notably, calcium, potassium, sodium, and strontium concentrations exhibit non-conservative behavior, contrasting with the conservative nature of magnesium. Our comprehensive approach integrates both magnesium and strontium isotopes, offering a holistic understanding of coastal aquifer dynamics. Strontium, akin to calcium and distinguished by its stable isotopes, enriches insights into the intricate processes governing these aquifers, contributing to a comprehensive comprehension of marine strontium dynamics.

Focusing on magnesium isotopes, our $\delta^{26}\text{Mg}$ data (ranging from -1.46 to -0.82‰) reveals depletion compared to the conservative mixing line. Proximity to the coast mirrors seawater values, becoming more negative along the salt-water flow path from the sea into the aquifer over centuries. Estimating the contribution of long-term circulated submarine groundwater discharge (SGD) to the magnesium isotope budget emphasizes its magnitude ($-2 \text{ Tmol yr}^{-1} \cdot \text{‰}$), comparable to rivers ($-1.4 \text{ Tmol yr}^{-1} \cdot \text{‰}$). This underscores the necessity of linking isotope values to flows on diverse time scales within coastal aquifers, emphasizing water-rock interaction and residence time in determining the isotopic composition of terrestrially-derived solute fluxes to the ocean.

Our unique methodology connects isotopic values to flows on different time scales, providing crucial insights into the contribution of coastal aquifers to the marine isotope system. This study lays the groundwork for understanding the global budget by incorporating both magnesium and strontium isotopic systems.