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The evolution of the 87Sr/86Sr in the Dead Sea brine: from the Sedom lagoon to Sahara dusts

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The history of water-bodies in the Dead Sea brines commenced with the intrusion of the Sedom lagoon, possibly in the late Neogene and continued with the development of hypersaline and freshwater lakes (e.g. the modern Dead Sea and Sea of Galilee). 87Sr/86Sr ratios in these water-bodies decreased over the past ~ 5-6 Ma from 0.7087-0.7084 in salts deposited in the Sedom lagoon to ~ 0.7080 in modern Dead Sea brine. The 87Sr/86Sr ratios in the salts deposited from Sedom lagoon are significantly lower than those of the contemporaneous late Miocene seawater (~0.709). This difference was attributed to modification of the 87Sr/86Sr ratio in the Sedom lagoon solution by influx of Ca-chloride brines. The brines, in turn were formed by dolomitization of marine limestones of the DSR Cretaceous wall rocks (87Sr/86Sr ~ 0.7075) by the ingressing evaporated seawaters (Stein et al., 2000). After the disconnection of the Sedom lagoon from the open sea freshwater filled the lakes that occupied the Dead Sea basin. The freshwater influx modified the strontium isotope and chemical composition of the brine and provided bicarbonate and sulfate to the lake that led the precipitation of primary aragonite and gypsum. Freshwater that currently enter the lake are characterize by 87Sr/86Sr ~ 0.7081, significantly higher than the Cretaceous carbonates. Settled dust that deposits on the Judea Mountains is composed of calcite and quartz grains and is characterized by 87Sr/86Sr ratios ~ 0.7084. It appears that significant amounts of the strontium that entered the lakes with the freshwater originated from dissolution of the dust calcites. Large amounts of dust were transported from the Sahara desert to the Dead Sea watershed during glacial periods when the Sahara was dry and sea-level was low. The source of the detrital calcites however, is not known. They could be derived from dry paleo-lakes in the Sahara that were previously filled by waters that retained the required strontium isotope composition (e.g. by rainwater –rock interaction in the aquifers). The mechanisms described here of strontium isotope modification due to water-rock interaction or dissolution of dust could affect the 87Sr/86Sr composition of ancient seawater in other restricted basins (e.g. the Messinian salts) or Quaternary lakes in other regions of the circum-Mediterranean.

Reference: Stein et al. 2000 Geochimica et Cosmochimica Acta, 64, 2039–2053.