Provenance and grain size effects of siliciclastic sediments in the Dead Sea basin from Pb-Sr-Nd isotopes and trace chemistry

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The history of the late Quaternary Dead Sea basin (DSB) hypersaline lakes is closely coupled with orbital and millenial scale climate change in the Northern Hemisphere. In addition, these water bodies were the terminal sink for proximal Cenozoic carbonate bedrock and eolian material originating from the Sahara, suggesting that the deconvolution of the sediment source end members can provide quantitative constraints on the flux of pluvial and eolian material to the DSB during different climate stages.

We present Pb-Sr-Nd isotopic compositions combined with trace and minor element concentrations of siliciclastic sediments deposited over the last 70 ka in Lake Lisan, the last glacial Dead Sea. For each sample, analyses were performed on three grain size fractions of carbonate free material (>20um, 20-5um, <5um).

Significant differences are observed between the composition of the grain size fractions, whereby relative to the two coarse grain size populations, the <5um fraction displays more radiogenic values of $^{87}Sr/^{86}Sr$ (0.7106-0.7125, compared to 0.7087-0.7096 in the coarse fractions) and $^{206}Pb/^{204}Pb$ (18.26-18.93, consistantly higher than coeval coarse fractions), while $^{143}Nd/^{144}Nd$ values in all grain sizes overlap within a range of ~0.5120-0.5123. In addition, the <5um fraction is relatively enriched in lithophilic elements such as Zr, Nb, Pb, and Be.

While the range of lead isotopic compositions corresponds to values measured in proximal bedrock and thus monitors local sources, $^{87}Sr/^{86}Sr$ compositions deviate toward the composition of eolian end member sources, providing distinct constraints on the flux of airbone particles to this area during the late Quaternary. We will present a record of temporal and long term variations in the sediment end member fluxes and compare them to regional climate records. These will further be considered in the context of the grain size distribution and its effect on the chemical and isotopic composition of the samples.

Biogenic supergene galena-rich ore in the Las Cruces deposit, Spain

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The Las Cruces deposit, within the Iberian Pyrite Belt, is one of the richest copper deposits worldwide, shows a well developed supergene alteration zone developed on a steeply dipping primary volcanic-hosted massive sulfide deposit of late Devonian age. The supergene alteration zone formed in the interphase between the basement, including the massive sulfides, and a 150 m thick sequence of Tertiary marl, which hosts a confined aquifer; this gossan probably replaces a former subaerial goethite-rich one that was similar to the other ones found in the IPB. It has several horizons including an upper siderite-hematite zone (red gossan), an intermediate galena-siderite-iron sulfide zone (black rock), a barren coarse pyrite zone and a deep chalcocite zone. The black rock includes skeletal crystals of galena intergrown with siderite and fine grained greigite. Galena shows a mat-like distribution and both the sulfur and carbon isotopes are consistent with a biogenic derivation. The rock shows abundant textures indicative of microbial activity, including forms that resemble fossil microbes and a distribution of the galena controlled by possible microbial mats. Galena shows widespread skeletal growth and both the sulfur and carbon isotopes are consistent with a biogenic derivation; sulfur isotopes values in galena are remarkably high (>19‰) and different from the near 0‰ values of the bulk of the mineralization while $\delta^{13}C$ isotopes in siderite are between -33 and -42‰. Finally, the rock shows abundant textures indicative of microbial activity.

Our interpretation is that the former subaerial gossan hosted during burial major heterotrophic microbial activity that coupled reduction of sulfate carried by the aquifer with oxidation of hydrocarbons or methane accumulated below the sedimentary cap, a process that was enhanced by the heat advected by deep circulating fluids.