Topographic- and density-driven fluids as sources of iron mineralization and dolomitization adjacent to the Dead Sea Transform

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Shear faults in Upper Cretaceous limestones adjacent to the Dead Sea Transform (DST) feature extensive ferruginous mineralization and dolomitization. This has been related to the flow of metallliferous groundwaters through an underlying clastic (Nubian Sandstone) aquifer and rise of the fluids up the faults into the limestones. However, our studies of the O, Pb, and Sr isotope ratios of Fe-oxides and dolomites along the Paran Fault (central Negev desert) indicate a unique sequence of events whereby density-driven southward migrating brines in the DST were incorporated in topographically-driven groundwater flow along the fault.

Petrographic studies and $\delta^{18}O$ values of dolomites and ferruginous lenses suggest that at least two groundwater fluid flow patterns are involved: an earlier one characterized by $T \leq 50°C$ and a later one characterized by $T \geq 50°C$. $^{87}Sr/^{86}Sr$ values in dolomites (0.7076-0.7089) are significantly higher than the limestone country rock with the lowest ratios (0.7077-0.7083) occurring at the western, most distant site from DST. In addition, there is a positive correlation between Mg-content of the dolomitic rocks, their $^{87}Sr/^{86}Sr$ values, and the proximity to the DST. Fe-oxides also show a positive correlation between $^{87}Sr/^{86}Sr$ values and the proximity to the DST. The $^{207}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$ ratios of Fe oxides and dolomites from all sample sites along the Paran fault plot on a straight line, where the Fe-oxides values are at the non-radiogenic end of the line. $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ vs. 1/Pb relations in dolomites and to a lesser degree in Fe-oxides suggest that mixing between two end-members controls the behavior of Pb in the mineralization products along the Paran fault.

Two types of metalliferous groundwaters were involved in the probably Pliocene dolomitization and iron-mineralization. One water source is the Mg-rich DST brine, migrating in the subsurface before dolomitizing the carbonate bedrock. These brines had a considerable deep path during their transport to the site of mineralization, with temperatures of 50-75°C. Prior to the arrival of the DST brines another type of groundwater, acquiring its high elemental content from leaching igneous rocks and clastic sediments in the subsurface, infiltrated along the Paran fault, precipitating Fe-rich minerals and causing the first stage of dolomitization. This groundwater flowed at shallower depth than the DST brines, and at lower temperatures ($T \leq 50°C$).