ASSESSING THE POTENTIAL OF ^{230}TH/U DATING OF GYPSUM AND OTHER EVAPORITES

CHRISTINA OBERT[1*], CARSTEN MÜNKER[1], MICHAEL STAUBWASSER[1], DANIEL HERWARTZ[1]

[1] Institut für Geologie und Mineralogie, Universität zu Köln
*cobert@uni-koeln.de

Gypsum and other evaporite deposits, such as halites and nitrates, are a predominant sediment component in the arid areas of the Earth. Analyses of their composition as well as isotope signatures yield the potential to reconstruct the climate conditions at the time of deposition.

The ^{230}Th/U dating method bears the potential to determine the absolute ages of different materials up to ca. 600 ka. Here we present new method developments for the application of ^{230}Th/U dating to evaporite materials as well as the first results for samples from the Atacama Desert, Chile.

Uranium concentrations of gypsum plot between 4.0 and 730.9 ng g^{-1}. The respective ^{238}U/^{232}Th isotope ratios range from 0.64 to 130, proving sufficient initial fractionation of Th from U for the application of disequilibrium dating in most cases. For low ^{238}U/^{232}Th isotope ratios, extremely low U concentrations are observed, which might indicate post-depositional U loss.

Calculated initial ^{234}U/^{238}U activity ratios range from 1.0000 to 1.8980 indicating varying degrees of disequilibrium between the U isotopes at the crystallization of the evaporites. These differences could either hint at changes in the isotope composition of the water from which the minerals originated or post-depositional alteration. There is no general correlation between either the ^{230}Th/^{238}U or the ^{234}U/^{238}U activity ratios with the ^{232}Th or ^{238}U concentration or the ^{238}U/^{232}Th ratios, respectively.

The halite samples yield more variable U concentrations ranging from 0.55 to 35.5 ng g^{-1} and ^{238}U/^{232}Th ratios between 0.25 and 8.61. In combination with the ^{230}Th/^{238}U and ^{234}U/^{238}U activity ratios, this hints at open-system behaviour after deposition, most likely U loss possibly associated with recrystallization.

The low ^{238}U/^{232}Th isotope ratios of nitrate samples between 0.2 and 0.7 imply that Th has not been fractionated from U during their formation. These ratios indicate a different formation compared to gypsum and halite, for example by hydrothermal processes instead of precipitation from an aqueous solution.