The behaviour of Mg isotopes during brine evaporation and its implications on ancient seawater chemistry

PAN ZHANG[1], KANG-JUN HUANG[1], CHONG-GUANG LUO[2]

[1]State Key Laboratory of Continental Dynamics and Shaanxi Key Laboratory of Early Life and Environment, Department of Geology, Northwest University, Xi'an 710069, China

[2] State Key Laboratory of Ore Deposit Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550081, China

Phanerzoic secular changes in the mineralogies of late-stage salts of marine evaporites have been widely used to trace the evolution of seawater chemistry, since the potash evaporite mineralogies coincided with the observed variation in seawater Mg/Ca ratio during this period. However, evaporates minerology can barely distinguish the geological processes, such as seafloor spreading and dolomitization, which are considered as the major controlling factors of secular seawater chemistry variation during the Phanerozoic. Magnesium isotopic composition of marine evaporates may record seawater $\delta^{26}Mg$ signature and offer an opportunity to elucidate the source of seawater Mg, because the relative contribution of earth surface geological processes that influence the seawater Mg budget can be quantified by seawater $\delta^{26}Mg$. Therefore, the understanding of Mg isotopes behavior during the evaporation is crucial for applying evaporates to reconstruct past seawater chemistry.

Herein the course of evaporation were performed by using concentrated brine, and the Mg isotopes of brine and evaporates were measured. As the evaporation processed, the evolved brine was gradually enriched in ^{26}Mg in both two parallel experiments, resulting in isotopically lighter $\delta^{26}Mg$ in precipitates. These ^{26}Mg depleted evaporates were consisted mainly of halite (NaCl) and bleodite ($Na_2Mg(SO_4)_2 \cdot 4H_2O$), and there were relatively constant fractionation fractor between brine and these two evaporates as the evaporation enhanced. As evaporates deposits, they record the evolution of brine through the changing of Mg isotopes in precipitates. These results highlight that Mg isotope system in evaporates can document the certain course of brine evaporation, and then potentially explain past seawater chemistry.