The $\Delta^{17}O$ systematics of gypsum hydration water

DANIEL HERWARTZ[1*], JAKUB SURMA[1], SWEA L. KLIPSCH[1], MICHAEL STAUBWASSER[1] AND DOMENICO COSENTINO[2]

[1]Institut für Geologie und Mineralogie, Universität zu Köln, Germany, * d.herwartz@uni-koeln.de, [2]Dipartimento di Scienze, Università degli Studi Roma Tre, Italy

The small variations in triple oxygen isotope fractionation (expressed as $\Delta^{17}O = \delta'^{17}O - \lambda * \delta'^{18}O$) have proven to be an important tool for investigating the hydrological cycle. Past hydrological cycles are frequently studied using the $\delta^{18}O$ of chemical sediements, but their $\Delta^{17}O$ systematics are poorly understood, mainly due to a current lack of $\delta^{17}O$ data.

Gypsum ($CaSO_4 \cdot 2H_2O$) forms in environments with a negative water budget including soils, sediments, lakes and restricted marine basins. Isotope fractionation factors between gypsum hydration water and the brine are well known for $\delta^{18}O$ [1] and δD [2], but not yet for $\delta^{17}O$.

We have constrained an empirical fractionation factor from a recent natural setting in the Atacama Desert in Chile. A set of 10 ponds with increasing salinities (from 37 g/l to 173 g/l) was sampled for both water and gypsum. In $\delta'^{18}O$ vs. $\Delta^{17}O$ space, the water samples plot on an evaporation curve that passes through local groundwater and intercepts the global meteoric water line [3]. Gypsum hydration waters plot on a parallel curve to ambient water. Hence the triple oxygen isotope composition of gypsum hydration water can give insight into both the $\delta^{18}O$ of the brine from which gypsum precipitated and the $\delta^{18}O$ of the pristine (i.e. unevaporated) water source.

In the Atacama desert case, the water source is meteoric water. In the case of a restricted marine basins, this 'pristine' water source is a mixture of meteoric water and seawater. The $\delta^{18}O$ of such a mixture can be constrained from gypsum hydration water and allows estimating mixing ratios between seawater and meteoric water.

For the Messinian salinity crisis (5.96 to 5.33 Ma ago), strontium isotope systematics suggest a strong influence of meteoric waters [4]. Our preliminary $\Delta^{17}O$ data from Messinian gypsum samples (lower gypsum evaporites from Maiella, Italy) support this view.

[1] Gonfiantini and Fontes (1963) *Nature* **200**, 644-646. [2] Fontes and Gonfitiani (1967) *Comtes. Rend. Acad. Sci. Paris* **265**, 4-6. [3] Surma et al. (2015) this conference. [4] Schildgren et al. (2014) *Geochem. Geophys. Geosys.* 10.1002/2014GC005332.