A potential mineral paleo-humidity measure for Martian hydrated evaporite minerals: First results

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The stable isotope fractionation that occurs between a solute and its precipitated solid should produce a Rayleigh fractionation pattern of isotope zonation within and between crystals precipitated from an evaporating brine. Evaporation of a magnesium sulfate brine offers the possibility of many linked Rayleigh fractionation processes. Evaporation of the water will produce a linearly correlated hydrogen and oxygen isotope trend, the slope of which depends on the humidity of the atmosphere [1]. The water of hydration in successive zones of the precipitated mineral will reflect the history of variation in isotopic composition of the brine (shifted by the fractionations between water and water of hydration). The fraction of water left can be calibrated by zoned variation in sulfur and oxygen isotopes of the sulfate, since the extent of precipitation is directly controlled by the amount of evaporation.

We tested the concept with a model system easily conducted in the laboratory: epsomite, $MgSO_4.7H_2O$. We evaporated a magnesium sulfate brine, growing a large single crystal of epsomite, taking samples of brine during the process and then took serial samples through the resulting crystal.

We used our recently-developed, continuous-flow method method for simultaneous isotope analysis of hydrogen and oxygen of water of hydration [2]. For oxygen isotope analysis we precipitated barium sulfate from the epsomite, which was reduced at 1450ºC in the presence of graphite and glassy carbon in a Finnigan TC/EA to produce CO for analysis in a Finnigan 253 mass spectrometer. The corresponding sulfate sulfur isotope analyses have just been started.

Initial analyses show extensive within-crystal isotopic variation, greater than 20 permil for δ^2H and 5 permil for $\delta^{18}O$ in water of hydration; and greater than 3 permil in sulfate oxygen. Interpretation of the data acquired so far indicate an appropriate value of 20% relative humidity for the conditions of the experiment.

[1] Gat JR & Gonfiantini R (eds) (1981) *IAEA Technical Report Series*. [2] Rohrssen MK, Brunner B Mielke RE & Coleman M (2008, in review) *Rapid Comms. Mass Spec.*

Assessing a plume contribution to the Galapagos Speading Center by Neon isotopes

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The Western and Southern Galapagos Islands present high $^3He/^4He$ (>30 Ra), characteristic of the Galapagos plume [reference Kurz ad Geist]. To the contrary, northern islands have low ratios (6-8 Ra). The Galapagos Spreading Center (GSC) seems to be influenced by the plume as well, with clear morphological, geophysical and chemical anomalies. However, samples sampled along this ridge do not report high $^3He/^4He$ [1].

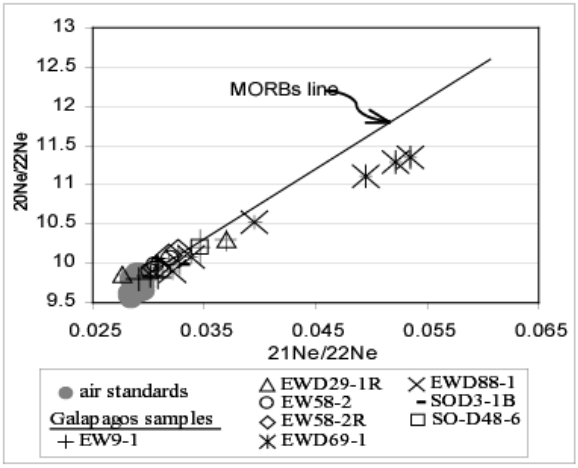

Figure 1: $^{20}Ne/^{22}Ne$ versus $^{21}Ne/^{22}Ne$ in GSC glasses.

To establish the plume contribution along the GSC, basaltic glasses, dredged between 86°W and 98°W on the ridge axis, have been crushed *in vacuo* in order to release volatiles trapped in vesicles. The abundance of CO_2 was measured by capacitance manometer. The ^4He, Ne and Ar isotopes were analysed by noble gas multi-collection mass spectrometer (Helix MC).

Despite significant atmospheric contamination, the additional precision of multicollection allows the trend in Ne three isotope space to be identified. Ne isotope ratios are slightly more radiogenic than the MORB line (cf. fig. 1), and do not seem influenced by the Galapagos plume. Models will be presented to explain a pronounced plume signal in geophysical and lithophile isotopic data (Sr, Nd, Pb) yet associated with volatiles typical of MORBs.

[1] RS. Detrick *et al*. (2002) G^3 **3**, Nb **10.** [2] M. D. Kurz & D. Geist (1999) *GCA* **63**(23-24), 4139-4156.