CALCIUM CARBONATES OXYGEN ISOTOPIC COMPOSITIONS IN CM CHONDRITES

M. J. Verdier[1] , Y. Marrocchi[2] and M. Gounelle[1] . IMPMC,CNRS UMR 7590, Sorbonne Universités, MNHN,UPMC,IRD,Paris France. E-mail: maverdier@mnhn.fr. [2]Université de Lorraine, CRPG, UMR 7358, Vandoeuvre les Nancy, F-54501, France.

Introduction: CM chondrites experienced variable degrees of hydrothermal alteration, which led to proportionate changes in their petrography [1,2]. By-products of this process, such as calcium carbonates (CC), are known to be markers of the fluid isotopic evolution from which they originated [3]. We will present oxygen isotopic composition of CC in 10 different CM chondrites with degrees of alteration ranging from 2.7/2.8 (least altered) to 1 (most altered) according to the scale proposed by [2].

Methods: Calcium carbonates were characterized using classical electron microscopy and electron microprobe techniques. The oxygen isotopic composition was determined using the Nancy SIMS 1280 following the procedure of [4].

Results: 137 measurements of the oxygen isotopic composition of calcium carbonates were achieved. $\delta^{17}O$ values range from +4.71‰ (±0.73) to +23.37‰ (±0.47) and $\delta^{18}O$ from +10.73‰ (±0.40) to +39.76‰ (±1.15) with 1σ errors. $\Delta^{17}O$ values span from -5.51‰ (±1.34) to 5.73‰ (±1.30). Paris carbonates exhibit the highest $\delta^{17}O$ and $\delta^{18}O$ values while the lowest are associated with ALH88045. Several samples contain carbonates with oxygen isotopic composition scattering over a continuous range whereas others are characterized by distinct populations.

Discussion: While $\delta^{18}O$ and $\delta^{17}O$ values of most carbonates are positively correlated to the degree of alteration, some meteorites display CC with unexpectedly high oxygen ratios considering their degree of alteration. This is the case for Murray(2.4), Nogoya(2.2) and Jbilet(2.0-2.3) which showed $\delta^{17}O$ and $\delta^{18}O$ values closed to Paris(2.7-2.8). Such feature and the observed scattering of data restrain us from considering this kind of measurements as sufficient by itself to be an unequivocal tracer of the degree of alteration.

However the difference of $\delta^{18}O$ values between CC and the meteoritic bulk oxygen isotopic composition are anti-correlated to the meteorite degree of alteration and thus might be a good proxy for the amplitude of the alteration.

We estimated the fluid oxygen isotopic composition between 20 and 70°C [5] assuming equilibrium with calcite [3,6]. $\delta^{18}O$ values of the fluid range from -20 to 20‰ and the $\delta^{17}O$ values span from -25 to 5‰. The estimated isotopic composition in oxygen of the fluid is lower than the initial water value estimated by [7] to be: $\delta^{18}O$ =28.1‰ and $\delta^{17}O$ =17.7‰. This result could be interpreted as a precipitation of CC posterior to an interaction between the fluid and the silicates which released the constituents needed for the carbonates to precipitated [8] and resulted in a lighter oxygen isotopic composition of the fluid.

References:

[1] L. B. Browning et al. 1996, *GCA*, 60:2621–2633. [2] A. E. Rubin et al. 2007, *GCA*, 71:2361-2382. [3] M. Horstmann et al., 2014. Abstract #1761. 45th Lunar & Planetary Science Conference. [4] M. A. Tyra et al., 2011, *GCA*, 77:383-395. [5] W. Guo and J. M. Eiler 2007, *GCA*, 71:5565-5575. [6] Kim S.-T. and O'Neil J. R. 1997, *GCA*, 61:3461-3475. [7] R. N. Clayton and T. K. Mayeda 1999, *GCA*, 63: 2089-2104. [8] Alexander et al., 2015, *MAPS*, 50(4):810-833