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A HYDROGEN ISOTOPE STUDY OF CO3 TYPE CARBONACEOUS CHONDRITES; COMPARISON WITH TYPE 3 ORDINARY CHONDRITES. A.D.Morse, J.Newton and C.T.Pillinger, Planetary Sciences Unit, Department of Earth Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK.

Meteorites of the Ornans type 3 carbonaceous chondrites exhibit a range in degree of equilibration, attributed to differing amounts of thermal metamorphism [1,2]. These differences have been used to split the CO3 chondrites into petrologic sub-types from 3.0, least equilibrated, to 3.7, being most equilibrated [2]. This is similar to the system of assigning the type 3 ordinary chondrites into petrologic sub-types 3.0 to 3.9 based upon thermoluminescence (TL) [3] and other properties; however, the actual range of thermal metamorphism experienced by CO3 chondrites is much less than that of the type 3 ordinary chondrites [2]. The least equilibrated ordinary chondrites show evidence of aqueous alteration [4] and have high D/H ratios [5] possibly due to a deuterium-rich organic carrier [6]. The aim of this study was to determine whether the CO3 chondrites, which have experienced similar secondary conditions to the type 3 ordinary chondrites, also contain a similar deuterium-rich carrier. To date a total of 5 CO3 meteorites , out of a set of 11 for which carbon and nitrogen isotopic data are available [7], have been analysed. Ornans has not been analysed yet, because it does not appear to fit in with the metamorphic sequence exhibited by the other CO3 chondrites [1]; it also has an extremely high δD value of +2150‰ [8], unusual for such a comparatively equilibrated meteorite (type 3.4). Initial results indicate that the more equilibrated CO3's tend to have lower δD values, analogous to the higher petrologic type ordinary chondrites. However this is complicated by the effects of terrestrial weathering and the small data-set.

Powdered whole-rock samples, of approximately 50mg, were combusted in two temperature steps. The first low temperature step, from room temperature to 200°C, was an attempt to remove water due to terrestrial contamination whilst the second high temperature step, from 200°C to 1100°C, was assumed to consist of indigenous meteoritic hydrogen. The water obtained from each temperature step was converted to hydrogen by reduction with zinc shot at 450°C, for isotopic analysis by mass spectrometer. The amount of water released was determined by measuring the intensity of the H_2^+ ion beam.

Most of the CO3 chondrites released between 150µg/g to 260µg/g hydrogen, similar to the results of Kerridge [8], with the more equilibrated ones tending to have a lower hydrogen content than the unequilibrated specimens. Two of the CO3's analysed, Colony and Y791717, generated significantly greater amounts of hydrogen, 1560µg/g and 700µg/g respectively. This high hydrogen content is probably an indicator of terrestrial weathering, since both these meteorites are finds and released high amounts of water during the low temperature combustion step which had a δD of *ca.* -150‰ to -100‰. Ash *et al.*[9] found that the effect of weathering on desert CR meteorites was to increase the water content and reduce the high D/H ratios of these meteorites to terrestrial values. The whole-rock carbon isotopic composition of Colony, $\delta^{13}C$ = -8.8‰, and Y791717, $\delta^{13}C$ = -6.8‰, is another indicator that these two meteorites have experienced terrestrial weathering since most of the CO3 chondrites has $\delta^{13}C$ values in the range of -20 to -13‰[7, 8], apart from the Saharan desert meteorites which have a $\delta^{13}C$ value of approximately -5‰ [7].

The δD values of *ca.* -100‰ of hydrogen released during high temperature steps of the more equilibrated CO3 chondrites is in general in agreement with those of Kerridge [8]. These results suggest that the δD values of the CO3 chondrites decreases with increasing metamorphism, as is the case for the ordinary chondrites[5]. However in this study, the δD of Kainsaz was only -68‰, much lighter than that of δD = +154‰ obtained by Kerridge. This discrepancy could be the result of sample inhomogeneity or incomplete removal of terrestrial contamination during the low temperature step. However we have pointed out previously from carbon and nitrogen studies that Kainsaz petrologic type from that assigned by microscopic studies. A prolonged low temperature combustion at 200°C should be able to resolve the contamination question.

There was no indication of a deuterium-rich component for the least equilibrated CO3, Colony, which had a very light δD value of approximately -150‰. The low δD values obtained for this meteorite, a find, are most likely due to terrestrial contamination; as already reported large quantities of water were released during both low and high temperature steps. Since Colony yields relatively large amounts of hydrogen it will be possible to carry out a stepped combustion with more temperature increments. Longer heating times should ensure that the terrestrial contamination is removed before indigenous hydrogen is released, hence determining whether the least equilibrated CO3's contain a deuterium-rich component, which so far we have been unable to verify.

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