

AN OXYGEN ISOTOPE STUDY OF ENSTATITE METEORITES

Jason Newton [1], Ian Franchi [2], Colin Pillinger [2]

[1] Earth and Planetary Phys. Univ. of Tokyo, [2] PSRI, Open Univ.

Oxygen isotope measurements were carried out for 18 EH and 21 EL chondrites, and 13 aubrites. In agreement with existing data, most fall close to the terrestrial fraction line (TFL; $d_{17O} = d_{18O} \cdot 0.52$). Homogeneity of oxygen isotope compositions increases in the order $EH < EL < aubrite$, and the mean d_{18O} values of the groups are indistinguishable. No discernible variation exists within the EH group, whereas for the EL chondrites, d_{18O} values of the samples increase with metamorphic grade. This could be a function of primary differences in mineralogy, metamorphism or shock. There are also some unusual samples which lie >0.3 permil from the TFL; some of these data can be accounted for by the documented presence of clasts of other meteorites.

Four discrete reduced parent bodies (1) are represented by two unmelted groups of meteorites (EH and EL chondrites) with metamorphic temperatures between 300°C (E3) to above 1000°C (E6), and two melted groups (aubrites and the Shallowater meteorite). With respect to oxygen isotopes (2), enstatite meteorites are notable in falling on a line on the 3-isotope plot which coincides with the terrestrial fractionation line (TFL). That is, the deviation in d_{17O} from the TFL, -normally described as D_{17O} , is 0. Moreover they also fall on the same part of the line as lunar and mantle pyroxenes. This means that enstatite meteorites, the Earth, and Moon, probably formed from the same oxygen reservoir in the solar nebula.

The results here were measured on ~1 mg HCl-treated samples using a laser BrF₅ fluorination system with an associated blank of <2 microg of O₂. Routine analyses of oxygen isotope ratios have a precision of 0.06 permil in d_{18O} and 0.015 permil in D_{17O} on well-homogenised standards (3), and this study involves a re-evaluation of the oxygen isotope systematics of enstatite meteorites. The aims are: to see if EH and EL chondrites and aubrites are isotopically distinguishable, to see if there are any regular variations within each group, and to identify those with exotic clasts.

This is an update of preliminary work (4), and we have now analysed 18 EH's, 21 EL's and 13 aubrites. One difference between these samples is that the d_{18O} analyses of EH's form a broader range than those of the EL's. Given that most of the EL's are all highly equilibrated (EL5-7) samples it is not surprising that the oxygen composition is homogeneous, and since the EH's here are mainly types 3 to 4, they still record a certain amount of heterogeneity. The aubrites are the most homogeneous of the three groups. If we exclude outliers and weathering-tainted samples from the dataset, the mean D_{17O} values of the EH and EL chondrites and aubrites analysed so far in the study are $+0.028 \pm 0.106$ permil, $+0.021 \pm 0.064$ permil and -0.022 ± 0.048 permil respectively. There is an evident increase in homogeneity from EH to EL to aubrite which is equivalent to the degree of equilibration, but there is no significant difference between the groups as a whole. The fact that aubrites are less restricted in D_{17O} than, for example, the SNC's (± 0.013 permil; 4), is explained by all aubrites being breccias (1).

It is not evident that the EH3 subgroup are isotopically lighter than the more equilibrated samples as has been reported elsewhere (2). In contrast, the oxygen isotope compositions of the EL's do appear to be correlated with petrologic type, the EL3's being ^{18}O -poor with respect to the EL6 samples. Whether this is a function of metamorphism, shock (EL3's are generally more shocked than EL6's) or mineralogy (EL3's contain up to 5 vol.% olivine, in EL6's it is absent) remains to be discussed.

Despite the general uniformity of the data, there are some outliers. The Cumberland Falls aubrite lies 0.531 permil above the TFL, which is explained by the fact that it contains ordinary chondrite clasts (5). Galim (b) is an E3 assemblage which is part of a larger breccia which also includes ordinary chondrite clasts, and lies 0.211 permil above the TFL indicating some interaction between the two assemblages (6). Other deviations from the TFL include the EH's South Oman and PCA 91461, which both lie about 0.3 permil below the TFL.

ACKNOWLEDGEMENTS: Samples were provided by the NHM, London, ANSMET, and MNHN Paris.

REFERENCES: (1) Keil K. (1989) *Meteoritics* 24, 195-208. (2) Clayton R.N., Mayeda T.K. and Rubin A.E. (1984) *J. Geophys. Res.* 89, C245-C249. (3) Franchi I.A., Sexton A.S., Wright I.P. and Pillinger C.T. (1997) *Lunar Planet. Sci.* 28, 379-380. (4) Newton J., Franchi I.A. and Pillinger C.T. (1998) *Lunar Planet. Sci.* 29. (5) Kallemeyn G.W. and Wasson J.T. (1985) *GCA* 49, 261-270. (6) Christophe Michel-Levy M. and Bourot-Denise M. (1988) *Mineral. Mag.* 52, 519-525.