OXYGEN ISOTOPIC CONSTRAINTS ON THE ORIGIN AND RELATIONSHIP OF IIE IRON METEORITES AND H CHONDRITES.

K. McDermott[1], R. C. Greenwood[1], I. A. Franchi[1], M. Anand[2] and E. R. D. Scott[3]. Email: k.h.mcdermott@open.ac.uk. [1]PSSRI, The Open University, Milton Keynes MK7 6AA, UK. [2]Dept. of Earth and Envir. Sci., The Open University, Milton Keynes MK7 6AA, UK. [3]HIGP, Univ. Hawaii, Honolulu, HI 96822, USA.

Introduction: Although silicate inclusions are present in only about half the IIE irons so far identified (total no. about 15 [1]), these objects are highly diverse; varying from chondrule-bearing clasts to elongate ribbons of quenched basaltic melt [2]. Models to explain the origin of IIE irons invoke either near-surface asteroidal impact processes [3, 4], or impact mixing during igneous differentiation [5]. On the basis of their similar oxygen isotope compositions, a possible relationship between the H chondrites and IIE irons has been proposed [6]. However, this has recently been called into question because high-precision laser fluorination analysis of equilibrated H chondrites (n=9) [7] indicates that the overlap with IIE irons is relatively limited [8]. To improve our understanding of this important group of meteorites we are currently undertaking a detailed geochemical investigation of the silicate-bearing IIE irons.

Analytical techniques: Oxygen isotope analysis of IIE silicate inclusions and mineral separates from silicate inclusions was performed by infrared laser-assisted fluorination [9]. Samples studied include: Colomera (feldspar, augite), Kodaikanal (augite, glass), Miles, Netschaëvo, Tarahumara and Weekeroo Station (II (augite). In addition, we have also carried out new oxygen isotope analyses of a suite of 12 equilibrated H chondrites.

Results: Oxygen isotope results for IIE irons show a range of $\Delta^{17}O$ values from 0.58‰ for Netschaëvo to 0.89‰ for Colomera. The mean $\Delta^{17}O$ value for the six IIE samples studied is 0.75±0.22‰ (2σ). In terms of their $\delta^{18}O$ values the IIE silicates show a considerable range in values from 3.06‰ for Netschaëvo to 6.25‰ for Miles. As pointed out by [6], this reflects the fact that IIE silicate inclusions are the products of extensive differentiation. Mineral separates from Kodaikanal ($\Delta^{17}O$ = 0.77±0.02‰ (2σ)) and Colomera (0.89±0.02‰) appear to define distinct mass fractionation lines. For comparison, the oxygen isotope analysis of 12 equilibrated H chondrites gave a mean $\delta^{18}O$ value of 4.11±0.56‰ (2σ) and $\Delta^{17}O$ value of 0.71±0.12‰ (2σ).

Discussion: Although earlier work suggested there was a systematic offset between the fields defined by oxygen isotope analyses of IIE silicates and H chondrites, this was based on a comparison of conventional and laser fluorination data [8]. Our new laser fluorination data show that both IIE silicates and H chondrites appear to come from isotopically heterogeneous bodies and their fields almost completely overlap. This confirms that IIE irons are not derived from an asteroidal core and suggests that they may come from the H chondrite body, or at least an H-like body. [6]. Important differences between these groups, including the relatively FeO-poor composition of silicates in “primitive” IIE irons [2] favor separate bodies.

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