THE THERMAL AND FRAGMENTATION HISTORY OF H CHONDRITES: ANTARCTIC AND NON-ANTARCTIC COMPARISONS. Derek W.G. Sears and Paul H. Benoit. Cosmochemistry Group, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701.

Several authors have pointed out that meteorites found in the Antarctic differ from those that have fallen elsewhere in the world (1-7), but there has been considerable debate as to whether this is due to weathering of the former (2-4) or whether the difference is extraterrestrial, reflecting different source regions (1) or orbital effects (8). For H chondrites, the cosmic ray exposure age distributions for Antarctic and non-Antarctic samples are very similar, suggesting that a large proportion of both groups suffered a major break-up event around 8 Ma ago (9).

The distributions of induced TL peak shapes for Antarctic and non-Antarctic H chondrites are different (10), probably reflecting differences in the thermal (metamorphic or shock) histories (11). The most unusual Antarctic H chondrites are those producing a cluster of data with peak temperatures >190°C and peak

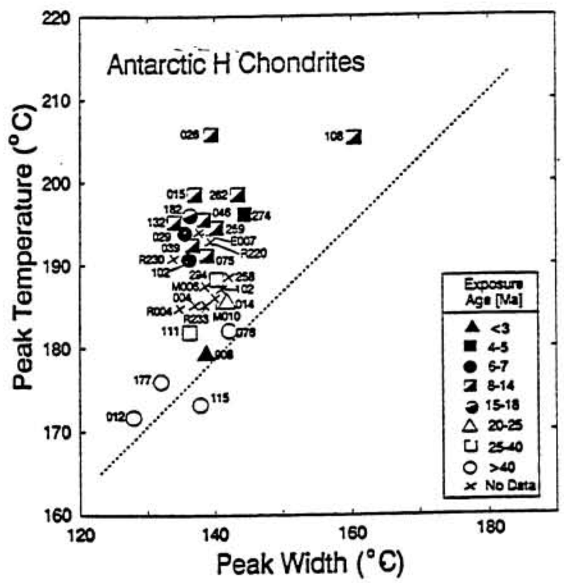

Fig. 1. Plot of the temperature and width of the induced TL peak in Antarctic H chondrites (10), with the cosmic ray exposure ages (9) indicated. The diagonal is the regression line for non-Antarctic H chondrites.

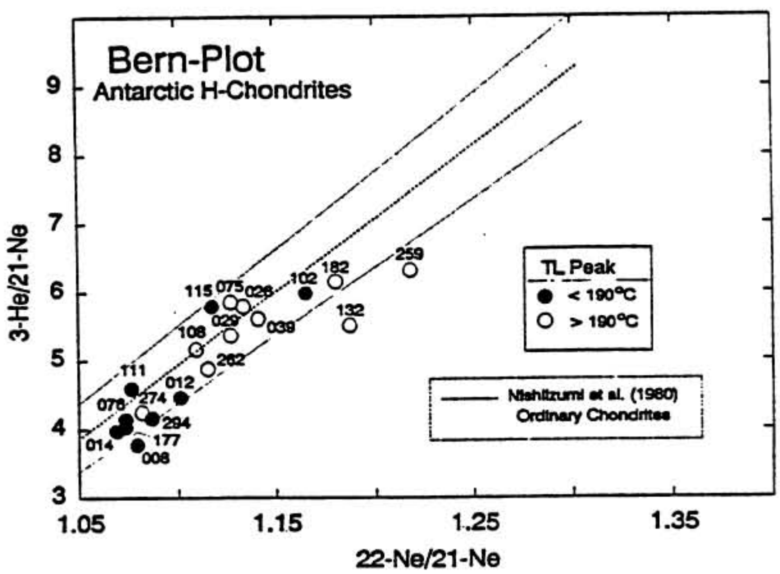

Fig. 2. Plot of cosmogenic isotope ratios in Antarctic H chondrites (9), discriminated by TL peak temperature (10). Placement on the diagonal is governed by shielding, with the least-shielded samples having larger values of $^{3}He/^{21}Ne$ and $^{22}Ne/^{21}Ne$.

widths <150°C. The TL trends are not due to systematic errors in the TL data: (i) standards are routinely run; (ii) they have been observed by an independent researcher in our laboratory; (iii) related trends were observed for independent sample sets (12). Most significantly, the cosmic ray exposure ages vary in a systematic way with the induced TL data for the samples, the cluster with peak temperatures >190°C having exposure ages around 8 Ma (11, Fig. 1). The noble gas data also confirm that the TL trends are not being seriously influenced by weathering or pairing.

We have now found that the induced TL data are related to the amount of shielding experienced by the samples, as well as the cosmic ray exposure age (Fig. 2). H chondrites with relatively high peak temperatures (>190°C) tend to be less well-shielded (higher values of $^{22}Ne/^{21}Ne$ and $^{3}He/^{22}Ne$) than those with peak temperatures <190°C. This is partly because there is a relationship between shielding and exposure age; meteorites with large exposure ages tend to be heavily shielded (L.Schultz, unpublished data).

It is possible that the H chondrite parent object was stratified or otherwise heterogeneous with respect to thermal history (e.g. contained different metamorphic zones or regions, 13, 14), and that a single 8 Ma event put two types of material onto earth-crossing orbits. One type arrived at the earth several 10^5 year ago and is now sampled in the Antarctic, and one type is currently falling. It is possible to test this idea by determining metallographic cooling rates (15). Another possibility is similar to that discussed by Wasson for iron meteorites (8). Wasson has suggested that in space, smaller objects would be more susceptible to velocity changes than larger objects, and they would pass more rapidly through the orbital evolution sequence necessary to get them earth. Although Antarctic H chondrites are two orders of magnitude smaller than non-Antarctic H chondrites, this is probably a result of fragmentation during and after fall. Antarctic H chondrites do not appear, as a whole, to have been less shielded than non-Antarctic H chondrites. *However, the samples in Fig. 2 with peak temperatures >190°C appear to have had especially small amounts of shielding (<10 cm, 16)*. At the time of break up 8 Ma ago, small and less well-shielded objects may have experienced a thermal history different from that experienced by the larger objects. Maybe they are smaller because they experienced greater violence during the break-up. This too, might be apparent in metallographic data (17). In summary, it seems clear to us that there is a difference between Antarctic and non-Antarctic H chondrites and that, with additional data, these differences will provide new insights into the break-up of parent objects and the delivery of these meteorites to earth.

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