SHOCK HISTORY OF ORDINARY CHONDRITES:SOME H AND L ANTARCTIC-NON ANTARCTIC COMPARISONS. Munir Haq, Fouad A. Hasan and Derek W.G. Sears, Department of Chemistry, University of Arkansas, Fayetteville, AR. 72701.

Most of the L chondrites, and many H chondrites, were involved in several shock events which were probably associated with disruption of their parent bodies (1). Since the shock caused loss of Ar-40, as well as the loss or mobilization of many trace elements (2), the event can often be dated by the K-Ar method (3,4). The shock also affected metal and silicate properties (5,6,7) and these enable an evaluation of shock intensity (e.g. shock facies a (unshocked) - f (heavily shocked), 7). Thermoluminescence (TL) sensitivity varies with K-Ar age (8) because intense shock lowers TL sensitivity (9) as the TL phosphor fuses or maskelynizes (10). In the present work, we report TL sensitivity data for 23 L4-6 and 19 H5 chondrites from the Antarctic and 26 non-Antarctic H4-6 chondrites, and we discuss their shock history.

The non-magnetic portions of 0.2-0.5 g samples were ground (100 mesh). Aliquants of 4+/-0.1 mg were then placed in a Cu pan and the TL measured as in ref. 11. The TL sensitivities were normalized to that of the Kernouve H6 chondrite.

The data are shown in Fig.1, together with literature values for non-Antarctic chondrites (8,10). The non-Antarctic L chondrites have the largest spread as they have experienced the largest range of shock intensities; all the meteorites with TL<0.05 for which shock classifications are known are facies d-f (7). There are fewer intensely shocked Antarctic L chondrites in these samples, but the curve is otherwise similar. The non-Antarctic H chondrite histogram is also similar to the L chondrites, but lacks the tail of heavily shock meteorites. However the Antarctic H chondrite histogram is displaced to lower values by a factor of about 3. This displacement to lower values could reflect (i) weathering (12/23 are weathering category C or B/C, c.f. 2/19 for the L chondrites - weathering can lower TL sensitivity by a factor of about 3, 14), (ii) petrologic type (the Antarctic H chondrites are all type 5, whereas the other distributions are dominated by type 6), or (iii) a unique shock history for the Antarctic H chondrites (12). We think the petrologic type explanation is incorrect, since there are no differences in the TL sensitivities of type 5 and 6 falls (13). Problematical about the weathering explanation is that there are many meteorites of category B, A/B and A plotting with the others (category A are rare in both classes).

The TL sensitivity data for the non-Antarctic falls are compared with Ar-40 in Fig. 2. The difference in the plots for the H and L classes again reflects the higher shock intensities suffered by the L chondrites. It is possible to combine the data for TL sensitivity as a function of annealing temperature (10) and Ar-40 release during stepwise heating (14) to estimate post-shock residual temperatures. TL sensitivity displays a 2-fold decrease during annealing 400-1000 C, and then drops 2 orders of magnitude at higher temperatures. Retention of Ar-40 is virtually complete until 800 C when there is 10-fold decrease in retention, while at 1200 C the Ar-40 retention drops several orders of magnitude.

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Thus, to a first approximation, meteorites with normal TL sensitivity (>0.5 unshocked, equilibrated values) and normal Ar-40 (>90% retention) have experienced post-shock temperatures <800 C; those with normal TL and 10-90% Ar-loss have experienced 800-1000 C; while those with low TL (<0.1 normal) and <10% Ar retention have experienced >1000 C. Kinetic factors would modify these estimates somewhat.

(1) Anders (1964) Space Sci.Rev.3, 583. (2) Walsh & Lipschutz (1982) GCA 46, 249. (3) Turner (1969) Meteorite Research (Millman ed.) 407. (4) Bogard et al. (1976) GCA 44, 1667. (5) Heymann (1967) Icarus 6, 189. (6) Smith and Goldstein (1977) GCA 41, 1061. (7) Dodd and Jarosewich (1979) EPSL 44, 335. (8) Liener and Geiss (1968) TL of Geol. Material (McDougall ed.) 559. (9) Sears (1980) Icarus 44, 190. (10) Sears et al. (1984) GCA 48, 2265. (11) Sears & Weeks (1983) Proc LPSC 14th, B301. (12) Lipschutz (1985) 2nd Ant. Met. Wkshp, July 10-12, Mainz. (13) Sears et al. (1980) Nature 287, 791. (14) Bogard & Hirsch (1980) GCA 44, 1667. (NASA grant NAG 9-81).

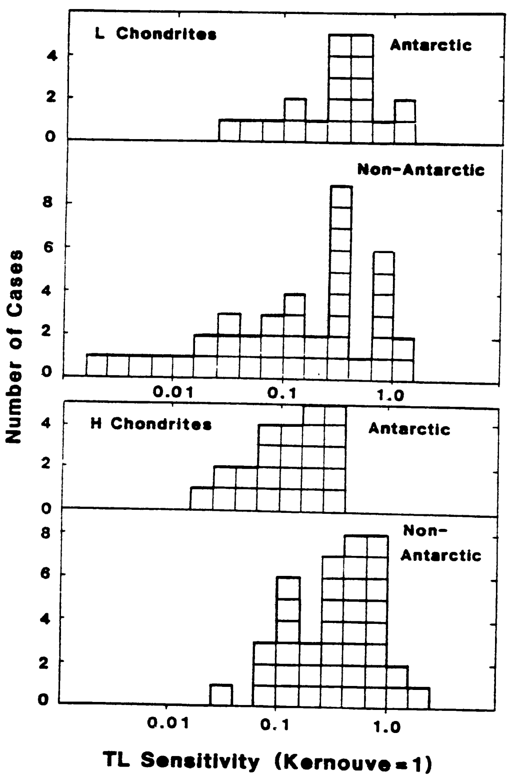

Fig.1 (Above) Histograms of TL sensitivity values in type 5-6 chondrites.

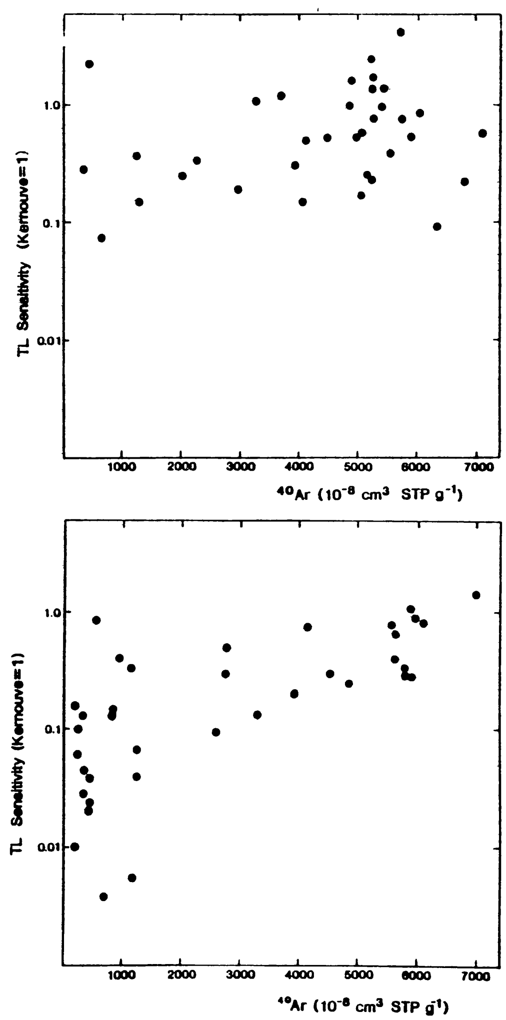

Fig.2 (Right) TL sensitivity vs. Ar-40 in non-Antarctic H (upper figure) and L chondrites (lower figure).