THE NATURAL THERMOLUMINESCENCE SURVEY OF ANTARCTIC METEORITES - A DISCUSSION OF METHODS FOR REPORTING NATURAL TL DATA. Fouad A. Hasan, Roberta Score* and Derek W.G. Sears. Cosmochemistry Group, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701. *Also SN2/NASA Johnson Space Center, Houston, TX 77058.

In order to identify meteorites that have experienced unusual radiation and thermal histories, we are routinely measuring natural thermoluminescence levels of large numbers of Antarctic meteorites. To date we have published data for 305 meteorites in the Antarctic Meteorite Newsletter, where it is hoped the data will help in the selection of meteorites suitable for detailed study (1,2, see also 3). We have reported the data using two methods of normalization, the peak height ratio (the ratio of the height of the peak at 250°C to that at 350°C) and the "equivalent dose" (the ratio of the natural TL to the induced TL (both at 250°C in the glow curve) multiplied by the absorbed dose (the parameter therefore has units of dose absorbed). Normalization is necessary to remove the effect of meteorite-to-meteorite variation in the TL sensitivity: these variations can be very large and are the result of fluctuations in the amount and type of material producing the thermoluminescence. The purpose of the present paper is to discuss the normalization procedure.

The main disadvantage of the peak height ratio method is that it is only applicable to ordinary chondrites, while the main disadvantage of the equivalent dose determination as described above is its relatively large uncertainty (see refs. 4,5 for further discussion); typical 1 sigma uncertainties are 4-5% of the mean for the former, versus 15-20% for the latter. The greater uncertainty of the second method is a result of the measurements being made on the sides of sharp peaks and the need to compare data from separate measurements, while the ratio method is essentially an internal calibration. Thus a plot of peak height ratio versus equivalent dose for the 237 classified ordinary chondrites for which data have appeared in the Newsletter (Fig. 1), shows considerable scatter which can be attributed almost entirely to uncertainty in the equivalent dose value. We have considered three potential causes of uncertainty in the peak ratio that are not reflected in the uncertainty as currently determined (the standard deviation of three samples) and which are not a problem for direct equivalent dose determination: (1) weathering, (2) petrologic type, and (3) class. However, there is no indication that degree of scatter in Fig. 1 is related to any of these factors (see Table 1).

The determination of equivalent dose at higher glow curve temperature yields values with smaller uncertainty (e.g. the 1 sigma uncertainty on the equivalent dose at 350°C for the data in ref. 3 is 9% of the mean). However, the variation in data is small because in most meteorites the TL in this region is at an equilibrium and does not have a strong dependency on small changes in dose rate and temperature (Table 2); this is even true of meteorites whose low temperature TL shows major draining consistent with recent heating (e.g. due to low perihelion orbit or shock-heating). The mean equivalent dose at 350 and 400°C in the glow curve for the 23 meteorites discussed by ref. 3 are close to 50±7 krad, so the mean ± 3 sigma is 30-70 krad. (The "normal" range, based on histograms of data given in refs. 1 and 2, was quoted as 30-80 krad in ref. 6.) The data also show that the reheating event which drained the TL in the samples with very low TL did not involve excursions >350°C.

Although the scatter in Fig. 1 is large, the regression line relating peak height ratio to equivalent dose at 250°C seems well-constrained (Table

3). It is therefore possible, at least for ratios greater than 0.5 (below this value the peak is poorly resolved and subject to systematic error), to calculate the equivalent dose from the ratio with greater reliability than it can be measured directly, the major difficulty being that the method might be inadvertently applied to unclassified non-ordinary chondrites. We think this danger is small however, because to date all non-ordinary chondrites have been recognized by their unusual glow curve shapes.

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References: 1. Antarctic Meteorite Newsletter February 1988. 2. Antarctic Meteorite Newsletter August 1988. 3. Hasan et al. (1987) Proc. 17th LPSC E703-E709. 4. Sears and McKeever (1980) Mod. Geol. 7, 201-207. 5. McKeever and Sears (1980) Mod. Geol. 7, 137-145. 6. Hasan and Sears (1988) Report to Meteorite Working Group dated October 1988.

Table 1. Distribution of samples (percentages) grouped according to displacement from regression line in Fig. 1, weathering category, type and class.

	n*	Displacement+ <-0.2	-0.2-0	0-0.2	>0.2
A	14	14	43	36	7.1
A/B	29	27	34	31	6.9
B	52	21	38	31	9.6
B/C	37	54	32	51	11
C	66	14	26	45	15
4	20	10	30	50	10
5	74	8.1	31	45	16
6	140	19	36	36	9.3
H	114	9.6	36	40	14
L	106	20	32	39	9.4
LL	17	18	24	53	5.9

+Log of the peak height ratio observed divided by that predicted by the regression line.
*Number of samples.

Table 2. Equivalent doses (mean ± 1 sigma, in krad) at three glow curve temperatures grouped according to peak height ratio (samples as in ref. 3).

Ratio	n	250°C	350°C	400°C
<0.8	6	3.3±3.2	52±8	54±6
0.8-2.0	7	21±7	50±6	44±6
>2.0	10	49±14	52±8	47±5

Table 3. Parameters relevant to the regression line between log (peak height ratio) and log (equivalent dose at 250°C).

Data ref.	n	r	slope	intercept
1	156	0.937	0.785	-0.846
2	81	0.804	0.767	-0.858
3	23	0.963	0.726	-0.818
1+2	237	0.909	0.775	-0.844

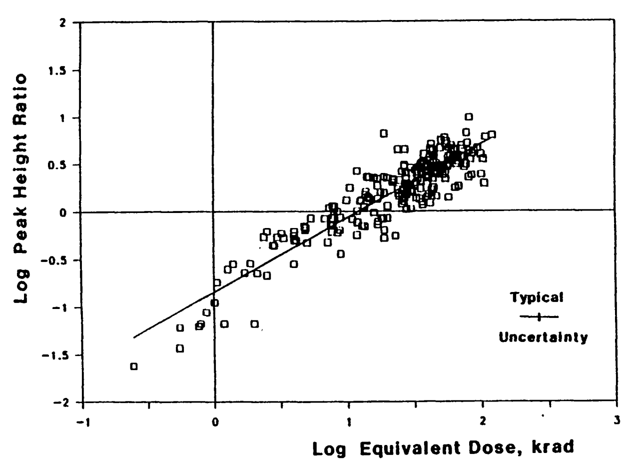

Fig. 1. Peak height ratio against equivalent dose at 250°C for 237 classified ordinary chondrites in refs. 1,2.