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NATURAL THERMOLUMINESCENCE OF ANTARCTIC METEORITES: A STUDY OF THERMAL/RADIATION HISTORY AND PAIRING. Fouad A. Hasan, Munir Haq and Derek W.G. Sears. Chemistry Department, University of Arkansas, Fayetteville, AR. 72701.

Because of its dependence on thermal and radiation history, the natural thermoluminescence (TL) of meteorites can be used to make unique inferences concerning terrestrial age, unusual orbits, and unusual shielding (1-6, see 7 for a recent review) and, together with TL sensitivity, can help resolve questions of pairing. Such information is also relevant to an understanding of the ice movements responsible for concentrating meteorites in regions of Antarctica (11). Here we report natural TL measurements of 75 ordinary chondrites from Antarctica, about one-half of them petrologic type 3, and we discuss the possible pairing of 10 of them.

The natural TL was measured in three 5 mg splits from ground non-magnetic extracts. The apparatus and other experimental techniques are similar to those described in ref 8. Natural TL data are normalized to remove the effects of differences in sensitivity, such as those caused by shock, metamorphism, sample heterogeneity or weathering; this is done by taking the the low-temperature to high-temperature peak height ratio (LT/HT) or calculating the equivalent dose (7).

Our natural TL data are shown in Fig. 1 along with data for 40 non-Antarctic meteorites (4). The Antarctic samples are skewed to lower values, having a mode near 0.9 in addition to that at 4.0; this is probably a consequence of their larger terrestrial ages. Al-26 data are available for 20 of the present samples (9), but with 2 exceptions are in the "normal" range for Antarctic meteorites (35-60 dpm/kg). The exceptions are ALHA77297, which has unusually high Al-26 (70+/-7) and unusually low natural TL (0.15+/-0.01) and ALHA77002 which has unusually low Al-26 and natural TL near the middle of the range (1.16+/-0.03). One interpretation is that 77297 experienced an anomalous orbit which resulted in both a high cosmic ray dose and higher mean temperatures, or a fortuitous combination of high dose rate and large terrestrial age. The low Al-26 of 77002, and normal LT/HT, is most readily interpreted as normal terrestrial age with unusually low cosmic ray exposure age. Clearly the samples merit closer attention. ALHA77015, 77167 and 77249 have TL near the upper limit of the normal range (LT/HT = 2.5-3.5) and Al-26 at the bottom of the normal range (35-40 dpm/kg); we suggest that these meteorites have experienced abnormally large shielding.

Ten of the present samples are paired according to ref. 10 (Table 1, heavy outlines in Fig. 1). The natural TL levels and TL sensitivities of these samples are often similar (sometimes identical), but caution may be necessary concerning their pairing. Duplicate 30mg samples from type 3 ordinary chondrites can differ in TL sensitivity by a factor of two and weathering can lower the TL sensitivity by a factor of three, but there is no previous experience of fragments differing by more than a factor of 4 in TL sensitivity and 2 in natural TL; there may be two or three falls represented in these 10 samples. It is interesting to note the variety of Al-26 content of these fragments (Fig. 1).

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Table 1. TL data for 10 Antarctic L3 chondrites paired by ref. 10. (Errors = 1 sigma; Tmax = temp. of max. TL emission; FWHM = full width of the TL peak at half its max. intensity).

Meteorite	TL sens. (Dhajala=1)	Tmax (°C)	FWHM (°C)	LT/HT	ED(250°C) (krad)
ALHA 77214	0.041+/-0.007	123+/-11	84+/-4	2.4+/-0.5	252+/-25
ALHA 81031	0.041+/-0.006	118+/-7	82+/-7	2.8+/-0.5	258+/-68
ALHA 77249	0.043+/-0.009	120+/-1	90+/-5	2.4+/-0.5	202+/-48
ALHA 81032	0.064+/-0.010	123+/-8	89+/-3	.64+/-0.2	32+/-18
ALHA 77167	0.064+/-0.010	120+/-5	81+/-2	2.6+/-0.4	235+/-25.
ALHA 81030	0.081+/-0.006	119+/-2	72+/-6	5.6+/-0.4	440+/-135
ALHA 77260	0.14+/-0.03	105+/-2	56+/-2	4.3+/-1.2	322+/-88
ALHA 77015	0.18+/-0.04	118+/-6	88+/-3	3.3+/-0.2	238+/-28
ALHA 77050	0.18+/-0.05	128+/-2	90+/-2	.38+/-0.01	7.3+/-1.5
ALHA 77011	0.46+/-0.09	131+/-1	110+/-2	.93+/-0.20	135+/-43

1. Sears & Durrani (1980) EPSL 46,159. 2. Melcher (1981) GCA 45,615. 3. McKeever (1982) EPSL 58,419. 4. McKeever & Sears (1980) Mod. Geol. 7,137. 5. Melcher (1981) EPSL 52,39. 6. Sears (1975) EPSL 26,97. 7. Sears & Hasan (1986) 2nd Ant.Met. Wkshp, (in press). 8. Sears & Weeks, (1983) Proc. LPSC, B301. 9. Evans et al. (1982) Smith.Contrib. Earth Sci. 24,70. 10. Scott (1985) Proc.9th Symp.Ant.Met., Mem.NIPR, 102. 11. Drewry (1985) 2nd Ant.Met. Wkshp, July 10-12, Mainz. (We thank the MWG for suggesting this study.)

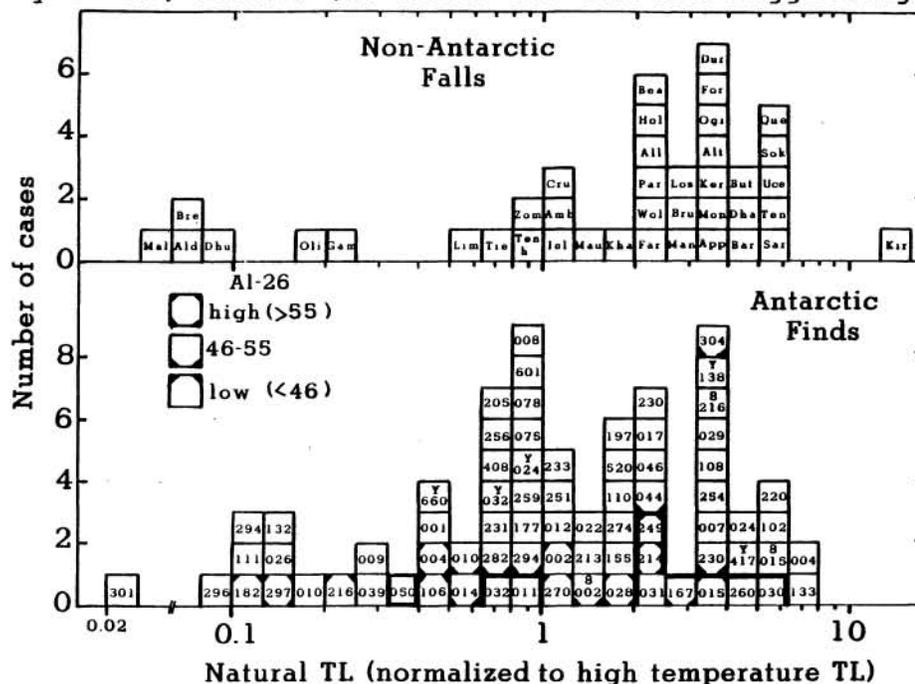


Fig. 1. Histograms natural TL in ordinary chondrites. The Antarctic meteorites which have been paired by ref. (10) are enclosed in heavy lines. AL-26 data are from ref. 9. Key to abbreviations: ALHA76-004; ALHA77-002,011,012,013,014,015,050,155,167,176,177, 182,197,214,216,230,231,249,254,259,260,270,274,282,284,294,296,297,304; ALHA78-044,075,078,106,108,111, 133; ALHA79-008,022,026,029,046; ALHA80-132,205,256,301; ALHA81-8015, 017,021,024,030,031,032,039,251; ALHA82-102,110; EET 82-601; EETA79-007,009,010; EETA83-213; META78-8002,010,028; PCA 82-518, 520; RKPA79-001,004; RKPA80-216,220,230,233; TIL 82-408; Yamato74-Y024,Y032,Y138,Y417,Y660. See ref. 4 for identification of the non-Antarctic falls.