THERMOLUMINESCENCE OF SEPARATED ALLEGAN CHONDRULES AND CHONDRITE THERMAL HISTORY AND COOLING RATES

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The thermoluminescence (TL) peak temperatures and widths of the ordinary chondrites are indirectly related to disordering of the Al,Si network of the TL phosphor, feldspar (Van Schmus and Ribbe, 1968; Guimon *et al.*, 1985). Glow curve shapes therefore provide an indication of metamorphic temperatures and cooling rates. Laboratory annealing of Dhajala (H3.8) suggests that the feldspar is a mixture of "high" and "low" forms, and ~ 80% of the chondrules from Dhajala (Fig. 1; Keck *et al.*, 1986; Guimon *et al.*, 1984) produced TL curves associated with the "high" form (peak temperatures 160-220°C), the remainder were in the "low" form (peak temperatures 120-155°C). We have now examined the TL of chondrules from the Allegan H5 chondrite. The meteorite was lightly ground, chondrules were hand-picked and cleaned of adhering matrix. Fifty 0.06-4.93 mg, 0.2-1.5 mm chondrules were separated. After crushing, TL properties were measured as in Guimon *et al.* (1985).

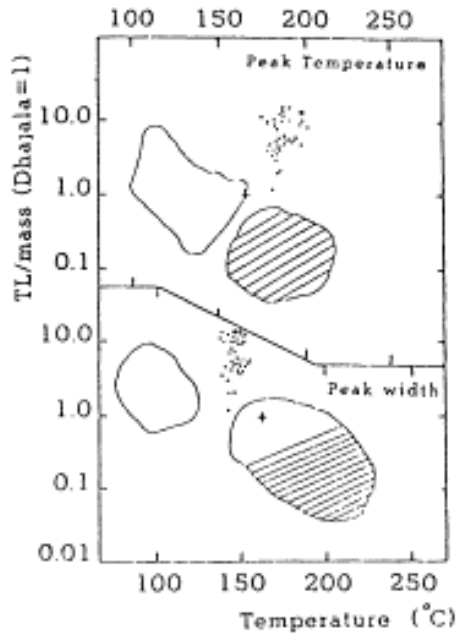

Fig. 1 Mass-normalized TL sensitivity against TL peak temperature and width for Allegan chondrules, the hatched areas indicate greatest chondrule density. Crosses, bulk Dhajala; squares, bulk Allegan.

Figure 1 compares TL sensitivity with peak temperature and width for the separated Allegan chondrules and summarizes the Dhajala data from our earlier study. The TL sensitivity of the Allegan chondrules and bulk powder is 10-100 times that of Dhajala, and the Allegan chondrules form a much tighter cluster than the Dhajala data. Peak temperatures for the equilibrated Allegan chondrules are comparable to the "high" cluster for Dhajala chondrules, but the widths are 25-75°C narrower.

The higher metamorphic temperature experienced by Allegan accounts for the higher TL sensitivity of the Allegan chondrules. Conversion of the "low" form to the "high" form is a very favorable process (10 h at 750°C will suffice) and since both chondrites entered the high field the trends in Figure 1 must have been established during post-metamorphic cooling. The TL sensitivity of certain Dhajala chondrules is comparable to that of the Allegan chondrules, suggesting similar degrees of crystallization, but despite this the low form (whose formation is very sluggish) had a chance to form in Dhajala but not in Allegan. The much tighter cluster of data probably therefore indicates a much faster cooling rate for Allegan than Dhajala. This is contrary to the single "onion skin" parent body model for H chondrites, but would suggest that the type 6 parent body formed sooner, i.e. contained more ^{26}Al, and was smaller than the type 3 parent body.

Guimon *et al.*, 1984. *Nature* **311**, 363-365.
Guimon *et al.*, 1985. *GCA* **49**, 1515-1524.
Keck *et al.*, 1986. *EPSL* **77**, 419-427.
Sears *et al.*, 1984. *GCA* **48**, 1189-2000.
Van Schmus and Ribbe, 1968. *GCA* **49**, 1327-1524.

Guimon, R.K., and Sears, D.W.G. (1987) Thermoluminescence of separated Allegan chondrules and chondrite thermal history and cooling rates. *Meteoritics*, **22**, 396-397.