DEVITRIFICATION AND THE THERMOLUMINESCENCE PROPERTIES OF TYPE 3 CHONDRITES. G.E. Lofgren*, R.K. Guimon+ and D.W.G. Sears+, *Johnson Space Center, Houston, TX., +Department of Chemistry, University of Arkansas, Fayetteville, AR.

The 10^5- fold range in TL observed for unshocked ordinary chondrites is known to be metamorphism related.(1) Mineral separations indicate that in equilibrated chondrites the TL phosphor is plagioclase(2), so we have suggested that the TL range is associated with the production of the TL phosphor by the crystallization of feldspathic glass during metamorphism (or equilibration) of the chondrites. The chondrule to chondrule variation in TL sensitivity, which is associated with variations in the amount and composition of the chondrule mesostasis, is consistent with the proposed devitrification mechanism.(3) Also consistent with the phosphor being feldspar is an observed increase in the TL peak temperature and TL peak width induced by annealing the Allan Hills A77011 and Sharps chondrites at >700°C; the same changes in TL properties are observed in terrestrial Amelia albite similarly annealed.(4) In the case of the Amelia albite, the changes are associated with the transformation of the low-temperature (ordered) to the high-temperature (disordered) form.(5) To shed further light on the mechanism responsible for the TL range in ordinary chondrites we have performed annealing experiments on the Sharps H3.4 chondrite under conditions appropriate to cause the devitrification of glass.(6)

Eight 50 mg samples of Sharps were annealed in pairs under four sets of conditions: (a) dry; (b) 2 wt% H_2O; (c) 2 wt% H_2O, and 2 mole% sodium disilicate; (d) 10 wt% H_2O and 2.0 mole% sodium disilicate. The runs without NaDiSi were annealed for 168 h at 755 ± 5°C and 1.0 ± 0.1 kbar, and the others were annealed for 174 h at 855 ± 5°C and 0.77 ± 0.04 kbar.

Annealing at 755°C without added NaDiSi produced very little change in the TL properties of the samples. The samples annealed at 855°C with 2 wt% H_2O and 2 mole% NaDiSi showed an increase in peak temperature and peak width similar to that observed for samples annealed dry at one atmosphere in our previous experiments.(4) The samples to which 10 wt% water and 2 mole% NaDiSi had been added, produced TL glow curves showing the increase in peak temperature and broadening of the peak previously observed, but superimposed on the glow curves was a sharp peak at 210°C in one sample and 220°C in the other, with the result that the TL sensitivity in the 200°C region increased by factors of 3 and 10, respectively, compared with the unannealed samples (Fig. 1).

We suggest these data are consistent with the devitrification of glass mechanism for the relationship between TL sensitivity and metamorphism. Two processes appear to have occurred during the annealing treatment. First, the low-temperature form of the phosphor was converted to the high-temperature form (this is the process responsible for the increase in peak temperature and width) and, second, the addition of fluxes produced a new generation of feldspar through the devitrification of the chondrite glasses (this process produced the new narrow peak at 200°C). Most noteworthy, the "new" peak is much narrower than that in ordinary chondrites. It may be that while our experiments produced a fairly pure form of the high temperature feldspar, the chondrites contain a mixture of the high and low forms. The width of the TL glow curves may therefore have new implications for the thermal history and cooling rate of the type 3 ordinary chondrites. Supported by NASA grant NAG 9-81 (DWGS).

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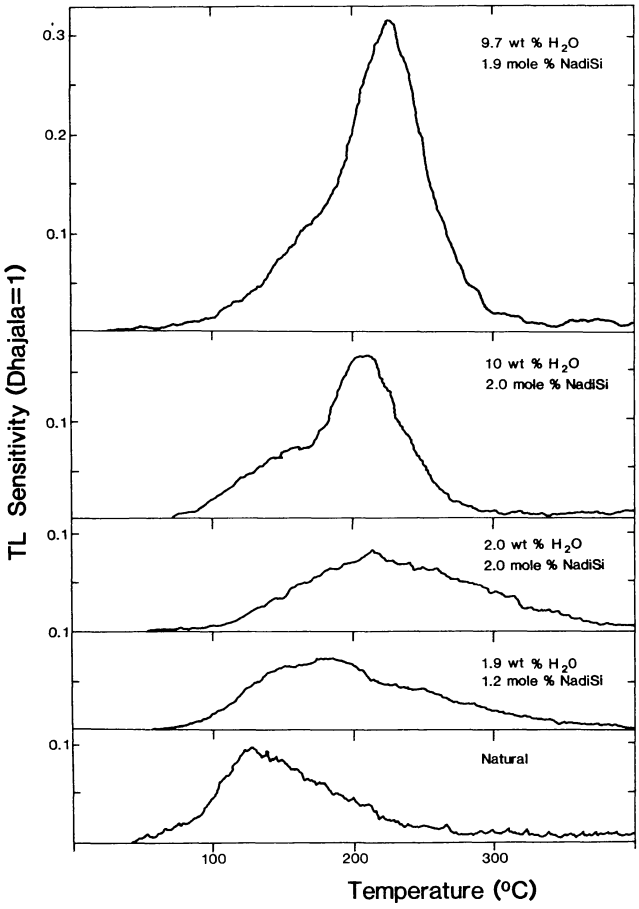

Fig. 1 Glow curves for samples of the Sharps meteorite annealed at 855°C and 0.77 kbar for 174h in the presence of water and sodium disilicate.