THERMOLUMINESCENCE AND X-RAY DIFFRACTION STUDIES OF ANNEALED OLIGOCLASE. **Christopher P. Hartmetz and Derek W. G. Sears, Department of Chemistry, University of Arkansas, Fayetteville, AR, 72701.**

Plagioclase feldspar is the main thermoluminescence (TL) phosphor in many meteorite classes (1,2), and the phenomenon provides a uniquely sensitive and quantitative means of monitoring processes (e.g. shock and metamorphic) that affect the mineral. However, an understanding of the relationship between TL emission and the physical state of feldspar is still fragmentary. Of particular importance in our studies of type 3 ordinary chondrites and shergottites are TL peak temperatures, which are related in some way to the thermal disordering of the aluminosilicate framework. The feldspar in ordinary chondrites is oligoclase, and annealing treatments have produced changes in TL resembling those observed for the type 3 ordinary chondrites as one proceeds along the metamorphic sequence. In the present study we have determined the disordering associated with annealing treatments of terrestrial oligoclase. XRD measurements are impossible to make using meteoritic feldspar, since the mineral is present in type 3.3-3.5 ordinary chondrites in extremely small amounts (<few ug/mg).

About 50-75 mg of oligoclase ($Or_{2.3}$, $Ab_{78.0}$, $An_{19.7}$), in the ordered state, were ground and sealed in inert atmosphere (N_2) in high-purity quartz vials. These were then annealed in a wire-wound tube furnace, at temperatures of 438-1080°C for 10-100 hours. The TL of three 4 mg aliquants of each sample were measured as described in ref. 3. The extent of Al,Si disordering was measured by determining the difference (del) between the $2\theta(131)$ and $2\theta(1\bar{3}1)$ lines, del for ordered and disordered oligoclase being 1.5° and 2.0°, respectively (4).

Annealing <635°C, or at 635°C for 10 h, produced no change in the TL peak temperature or the degree of disordering. The peak temperatures remained comparable with those observed in type 3.3-3.5 ordinary chondrites. Samples annealed at 635°C for 100 h, at 743°C and at 786°C for 10 h showed an increase in peak temperature, making it comparable to type >3.5 chondrites, and an indication of small amounts of disordering; del increased by about 0.03°. Samples annealed at 786°C for 100 h or at higher temperatures for 10 or 100 h showed increasing degrees of disorder, approaching almost complete disorder, and had peak temperatures around 280°C. Although a peak this high is present in the glow curves of some meteorites, even under comparable annealing conditions it never dominates. Our data are in reasonable agreement with others concerning the thermal disordering of feldspars (5), and also with those from Pasternak, who compared disordering with TL properties (6). Pasternak found that no disordering occurred after annealing at 800°C or less for 24 h, while the peak temperature increased from 140 to 180°C. Time-dependent disordering occurred during annealing at 1050°C, and the peak shifted to 210°C. The peak temperature changes for Pasternak's albite data were identical to those shown by a type 3.4 ordinary chondrite (7). There was no evidence in the XRD patterns for changes other than disordering associated with the annealing treatment, such as the formation of feldspathoids.

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The present data confirm the less complete data of Pasternak and the interpretations of our earlier data based on them; that is that the TL changes are associated with the onset of disordering, but are not actually caused by the disordering. Possibly the change in the ligand field strength, that allows disordering, is producing the TL changes. The reasons for the existence of the 280°C peak in the terrestrial oligoclase, but its relative weakness or absence in the meteoritic case is unclear. It could reflect differences in thermal history of the samples, since even nominally unshocked chondrites have experienced 10 GPa pressures as they all show Neumann bands in kamacite (8), and shock experiments with this oligoclase sample have shown that the 280°C peak is destroyed by low shock intensities (9).

1) Lalou et al. (1970) C. r. hebd. Seanc. Acad. Sci. (Paris) Serie D 270, 2104. 2) Hasan et al. (1986) GCA 50, 1031. 3) Sears and Weeks (1983) Proc. 14th LPSC, B301. 4) Smith J. V. (1974) Feldspar Minerals, Springer-Verlag, New York. 5) McKie and McConnell (1963) Mineral. Mag. 33, 581. 6) Pasternak (1978) Thesis, Univ. Penn. 7) Guimon et al. (1985) GCA 49, 1515. 8) Wood (1967) Icarus 6, 1. 9) Hartmetz et al. (1986) LPS XVII, 311. (NASA grant NAG 9-81.)

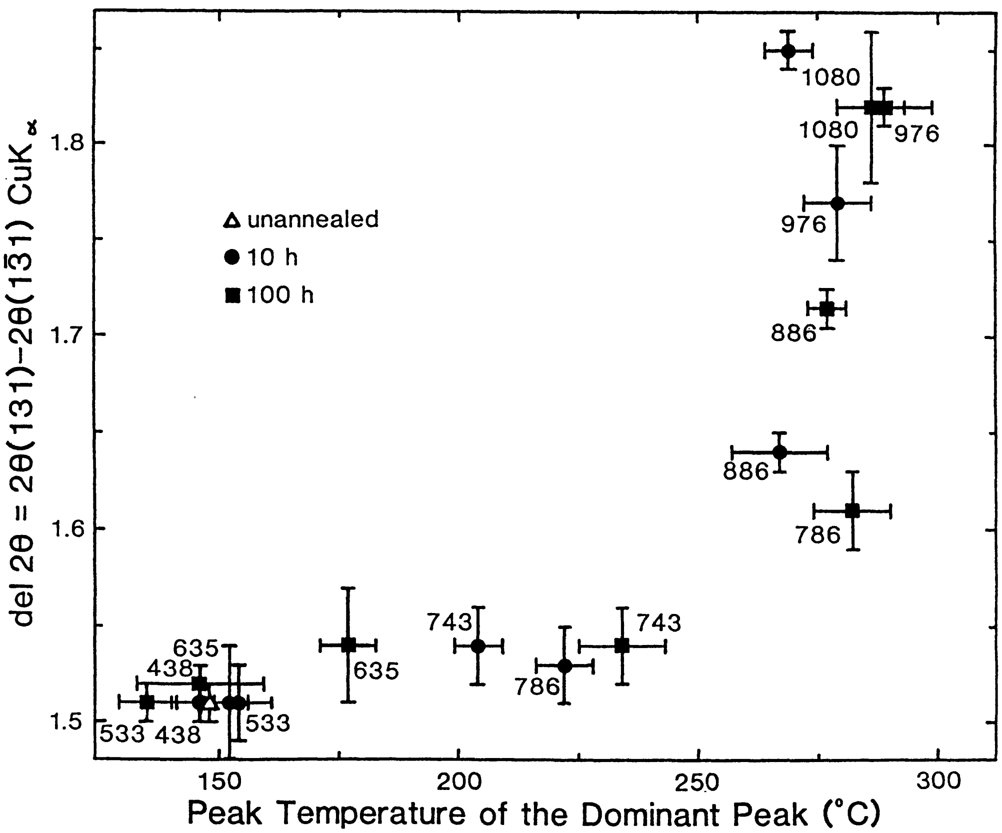

Fig. 1 The del parameter, 2θ(131)-2θ(1$\bar{3}$1), which measures the degree of disordering of the Al,Si chain, against peak temperature for the dominant TL peak in terrestrial oligoclase. The annealing temperature (°C) is shown alongside each data point. Error bars are +/-1 sigma uncertainties.