

THERMOLUMINESCENCE OF OLIGOCLASE AS INDICATOR OF SHOCK METAMORPHIC PROCESSES. A. I. Ivliev, L. L. Kashkarov, G. V. Baryshnikova, and D. D. Badjukov. Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Science, Moscow

Up to one third of all L-chondrites are affected by intense shock metamorphism. Chondrite plagioclases are most sensitive to the shock damage among other minerals of meteorites. On the other hand thermoluminescence (TL) of the plagioclases is well convenient to detect the presence of changes induced by shock [1 - 4]. In the context the goal of the work is to study TL sensitivity of experimentally shock loaded plagioclase.

Our present investigation has been made on the recovery samples of twinned terrestrial oligoclase impacted by high-explosive charge with a plane wave generator (shots 9 and 13 GPa) or a flyer plate (other shots). Construction of the sample containers provided only one shock wave pass through the samples. The physical properties have been reported earlier [5]. For measuring of TL sensitivity was used 2 mg aliquants of the samples and each measurement being repeated not less than three times. The TL sensitivity was calculated as the area under glow curve within temperature interval of 165 - 380 C^o and 80 - 380 C^o for the natural and artificial induced TL respectively and then was normalized to the value of TL sensitivity of an unshocked sample.

Natural and artificially induced TL properties were measured. The natural TL sensitivity of the samples decreases abruptly up to pressure of 22.5 GPa, and then it begins to increase slowly (Fig.1). However the TL sensitivities of 22.5 GPa and 27 GPa samples are 40 and 12 times as low as one for unshocked sample respectively.

Results of the artificially TL averaged from three series are presented in Fig.2. There is not a simple dependence of artificial TL on pressure too. Relatively to the unshocked sample the TL sensitivity values increase up to 1.5 time at 13 GPa pressure, then decrease for the 22,5 GPa sample and also drastically increase up to 2 times at higher pressure. The change of the values is significantly higher than the error of our measurements and similar to the previous data (4). The artificially induced TL glow curves for unshocked samples have the peak at 191 +/-5 C. The full width at one half of maximum (FWHM) of the peak in the unshocked sample is of 120 +/-11 C. For the shocked samples there is some increase of FWHM that reaches maximum at 22.5 GPa (Fig.3). The maximum value of FWHM is observed also at the same sample for TL curves that are provided with both natural and induced radioactivity in the samples.

X-ray data show progressive broadening of peaks of diffraction with the increase of shock pressure. The broadening can be due to the increase of a defect content in plagioclase lattice. At the same time there is the decrease of the intensities of the diffraction peaks for the 22.5, 25.5 and 27 GPa samples because of presence of a diaplectic glass. It can be suggested therefore that the natural TL values for these samples decrease through the same cause. The decrease of natural TL seems to be due to effects of the shock loading and heating, which lead perhaps to glow or destroying of existing centers phosphorescence. More complicated behavior of artificial TL glow curve could be explained by an appearance of shock induced lattice defects as first approach. It can be the case for 13 GPa

THERMOLUMINESCENCE OF SHOCKED OLIGOCLASE: Ivliev A.I. et al.

sample that demonstrates a rise in TL values. The further increase of shock loading can cause the destroying of existed glow centers by absence of the formation of new centers. The second rise of artificial TL glow curve from pressures of 22.5 GPa can be caused by annealing of the formed diaplectic glass at the post shock temperatures following directly after shock pass. Also the annealing can be aroused by short time heating of the samples during preparing to the artificial TL measurements. The annealing lead to reverting of the diaplectic glass to the original plagioclase structure but with high content of defects [6], which can play an important role as centers of phosphorescence.

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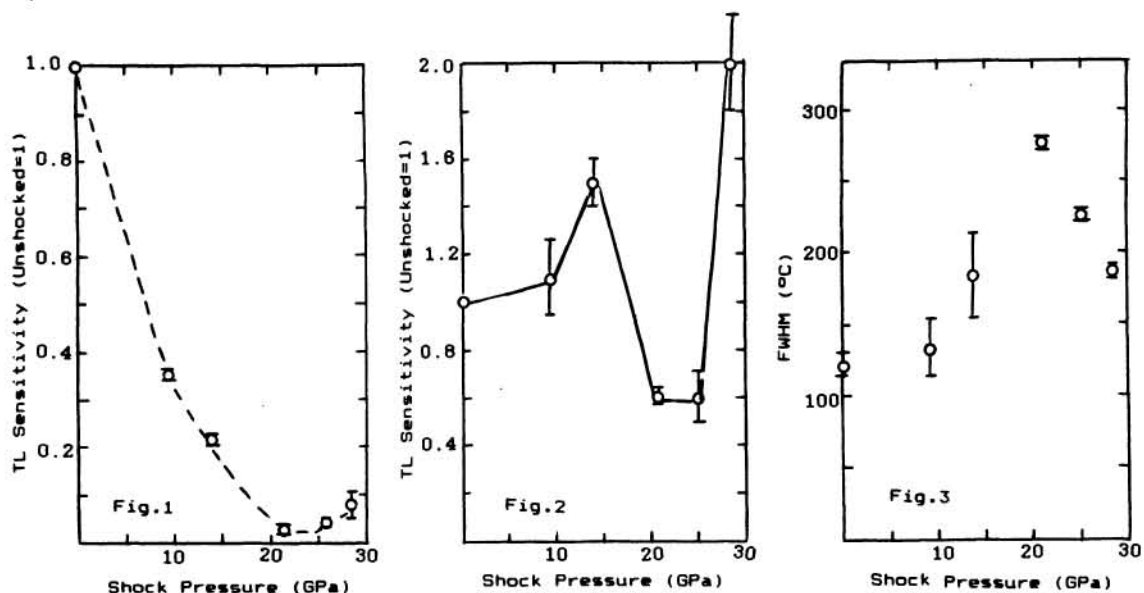


Fig.1. The natural TL sensitivity of the oligoclase samples shocked by various pressure.

Fig.2. The artificial TL sensitivity of the shocked oligoclase samples.

Fig.3. Full width at half maximum for the summary peak of oligoclase against shock pressure.

Errors are 1 sigma from triplicate measurements.