

Dose rate dependence of Anomalous Fading (AF) in natural apatites.

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Introduction: Apatite crystals are well known for their use as thermoluminescence (TL) dosimetric material. Several studies about their luminescence properties have taken place. Present work has the aim to study the Dose Rate effect as well as the initial rise of natural apatites which exhibit the AF effect, with the laboratory names Durango and Mexico A1.

Experimental Procedure: The samples used in this experiment were crashed gently in an agate mortar and grains 30-80 μ m were selected. TL measurements were carried out using Harshaw-3500 TLD-Reader. The irradiations were applied through a ⁹⁰Sr/⁹⁰Y beta source, delivering a dose rate of 0,02 Gy/sec. All measurements were performed in a nitrogen atmosphere with a low constant heating rate of 2 °C/s.

The first protocol applied was (Initial Rise):

Step 1: Dose of 35Gy.

Step 2: Record TL glowcurve up to $T_{max}= 50^{\circ}C$

Step 3: Repeat Step 2 for a new T_{max} , where the measurement step is 5 $^{\circ}C$ and the final TL is up to 400 $^{\circ}C$.

Step 4: Dose of 52Gy on a fresh aliquot.

Step 5: Repeat Step 2-Step 3 after storage of 22hours in dark room.

The protocol applied for the second experiment is:

Step 1: Record of S_0 up to $T_{max}:400^{\circ}C$ for each sample (10 samples) after TD: 61.6Gy.

Step 2: TD on each sample

Step 3: Different storage time (t_i) for each one.

Step 4: Record of S_f for each sample after TD.

t_i : 0, 20min, 1hour, 1.6h, 3.2h, 6.9h, 11.5h, 17h, 24.5h.

Results: Following are presented in figure 1 the results of the first experimental protocol. On the right of the figures is the activation energy as a function of temperature. It is obvious that the AF affects especially the traps of lower energy. The plateau corresponds to the 300 $^{\circ}C$ peak, since a shift towards lower temperatures is observed after the Initial Rise method.

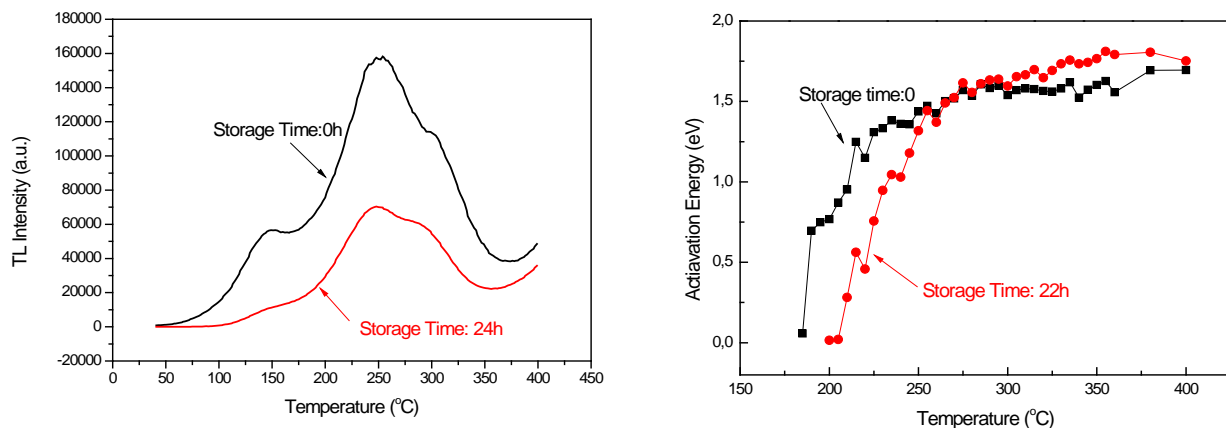


Figure 1: (left): Glowcurves recorded right after irradiation (black) and after 24hours (red). (right):Initial rise for Durango apatite crystal after irradiation (black) and after 24hours (red).

References:

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