THERMOLUMINESCENCE OF APOLLO 16 FINES
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Thermoluminescence (TL) in the following samples of Apollo 16 fines has been studied with a view to determining their thermal and radiation history: (A) 62281, II; (B) 66081, 9; (C) 68501, 21. Both natural TL and that induced by γ and UV irradiation have been measured in the temperature range 20-550°C (rate of heating, 5°C/sec; grain diameters <63 μm; for details, see ref. 1). Further work on these samples is continuing.

Fig. 1 shows a representative set of glow curves for sample C, both natural TL and that induced by superimposing varying γ-ray doses (from Co-60) being shown. Two points are worth noting. First, the temperatures of emission of peak I (in irradiated samples) and peak II are the lowest of any fines samples (from Apollo 12-16) studied by us (all heated at 5°C/sec); they come closest to those for Apollo 15 fines (ref. 2), but are considerably lower than those for Apollo 12 (ref. 1) and Apollo 14 (ref. 3). This can be seen from Table 1. Secondly, a fair amount of natural TL has survived below ~250°C in Apollo 16 fines samples, which again parallels Apollo 15 fines and is different from the Apollo 12 and 14 cases. Thus, there is discernible glow in 68501, 21 ('sample C') at 135°C (it begins at ~150°C in sample B and at ~175°C in sample A), which indicates a relatively low lunar temperature of storage (assuming similar E and s values as found for most Apollo fines samples; e.g. the values for peak I in sample B (66081, 9) are 1.17 eV and ~9 x 10^{-13} sec^{-1}), though not as low as the exceptionally cold storage temperature found for sample 15261, 70 (where natural TL could be seen at ~100°C, giving a value of T = 251 ± 5 K; see ref. 2).

RESPONSE TO γ-DOSE eff Fig. 2 shows the response of the natural samples C (68501, 21) and A (62281, II, see inset) to superimposed artificial γ-ray dose. The integrated TL glow is shown (in arbitrary but always identical units) in the temperature intervals 20-300°C (peak I) and 300-500°C (peak II) for sample C, and in the interval 20-500°C for sample A (the contribution of peak II being small). By adopting procedures similar to those explained in ref. 1, curves such as these can be used to estimate the lunar storage temperature for a given sample (e.g. from Fig. 2, curve (a), R ≈ 100 krad; R₁ ≈ 220 krad; N/n₀ ≈ 47 for peak II). It may be noted that the TL sensitivity of sample C fines to γ rays was enhanced by a factor of 2.3 by their having been pre-dosed and heated up to 550°C in a previous readout.

UV EFFECTS In Fig. 3, the effect of exposure of a natural sample (A) to UV radiation (centred at 254 nm; 10^{-2} W cm^{-2} at sample position) for 1 hr is shown. As in the case of Apollo 14 fines (ref. 3), UV radiation fills peak I traps, while emptying some of the peak II traps. Whether the peak II trapped electrons are transferred to peak I traps by UV irradiation remains to be tested (the results were negative for Apollo 14).
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DURRANI S. A. et al.

EMISSION SPECTRUM The TL emission spectrum from sample A has been studied by employing a series of interference filters. As in Apollo 12, 14 and 15 samples, the emission is found to be almost entirely in the blue-violet region (peaking at approximately 400 nm) at high readout temperatures (e.g. 450°C). The long wavelength contribution (peaking at approximately 550 nm) becomes increasingly larger at low readout temperatures (e.g. 250°C). Some anomalously high emission in long wavelengths (>550 nm), observed at intermediate readout temperatures (300-400°C), is being further investigated.

References

Table 1. Glow Temperatures T* (in °C) for peaks I and II in Apollo 12-16 fines samples (rate of heating, 5°C/sec; Ilford 'Bright spectrum blue' Filter No. 622 (375-530 nm) used). The imparted γ-ray dose is indicated in parentheses.

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<th>Peak I</th>
<th>160°C (470 krad)</th>
<th>165 (145 krad)</th>
<th>165 (145 krad)</th>
<th>125 (170 krad) (170 krad)</th>
<th>125 (630 krad) (500 krad) (208 krad)</th>
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<td>Peak II</td>
<td>450°C (470 krad)</td>
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<td>475 (524 krad)</td>
<td>430 (170 krad) (170 krad)</td>
<td>375 (630 krad) (333 krad) (460 krad)</td>
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TL OF APOLLO 16

S.A. Durrani

Fig. 1. NATURAL AND 2 gm INDUCED TL IN MKC 3.

Fig. 2. RESPONSE OF MKC 3 TO E IRRADIATION

Temperature interval: 20-300°C (Curve 3)

Fig. 3. EFFECT OF UV IRRADIATION ON NATURAL SAMPLE. 62289 (b)

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