LUMINESCENCE SIGNALS AND EMISSIONS FROM GRAINS OF QUARTZ PREPARED FROM A PORTUGUESE GRANITE AND PEGMATITE

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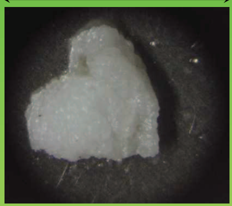
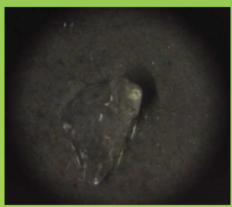
Approx. 3 mm



AG1, from Pegmatite



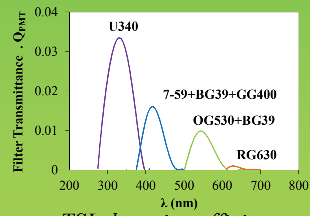
MUR4, from Granite

Material

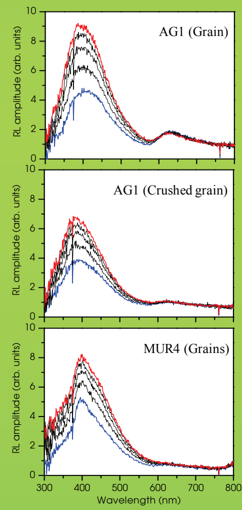
Quartz grains have been prepared from Portuguese granite and pegmatite samples, including repeated HF etching. The quartz obtained from the granites is transparent and exhibits clean crystal facets little attacked by the HF. That from pegmatites is milky and exhibits severe pitting.

Methods

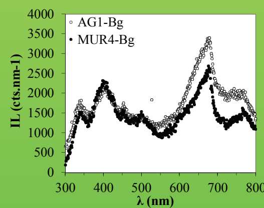
Large (ca. 1 mm diameter) hand picked grains were measured using IRSL, post-IR OSL and post-IR&O TSL (500°C), in a regenerative protocol. The TSL response of each grain was then measured repeatedly, using different detection filters to observe emissions in the NUV, Blue, Green-Yellow and Orange-Red. The samples were then annealed for 1 hour in air and both measurement sequences repeated, for anneals of 600, 800, 1000 and 1100 °C, to examine changes induced by heating. RL and IL spectra from un-annealed grains of these samples were measured, for repeated X-irradiations and under continuous proton irradiation, to explore their emission characteristics in greater detail and provide indications of radiation quenching effects.



TSL detection efficiency



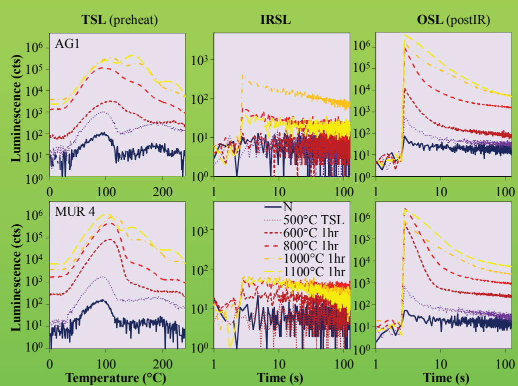
RL spectra, repeated irradiation with 20 kV X-ray source



IL spectra, 1MeV proton irradiation

Strengths of Different Signals and Emissions

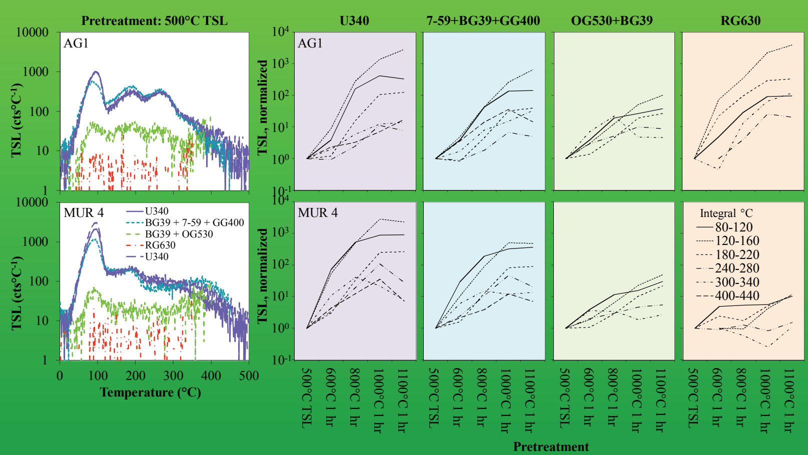
IRSL signals in the NUV were 3 orders of magnitude lower than OSL signals. TSL and RL emissions were strongest in the Blue, particularly for TSL at higher temperatures: lower temperature TSL emissions were also strong in the NUV. Both Blue and NUV RL emissions quenched strongly under X-irradiation. Peaks in IL emission were resolved in the NUV and Blue, but the strongest signals were observed in the Orange-Red: stronger for pegmatititic than granitic quartz. RL in this band was not radiation quenched, but was found to be weaker when a grain of heavily pitted pegamtitic quartz was split to expose un-etched crystal.



TSL, IRSL and OSL in the NUV, 35 Gy β

Sensitization of TSL and OSL signals

The TSL and OSL sensitivity of these geological samples increased by around 1 order of magnitude after rapid heating to 500°C. Initial OSL and low temperature TSL signals in the NUV sensitized by up to 4 orders of magnitude following 1 hr anneals. In granitic quartz the increase tended to be strong at 600°C but stabilised or reversed by 1100°C. In pegmatitic quartz the main activation was at 800°C and continued at higher temperatures. Sensitization of emissions in the Orange-Red was stronger in the pegmatitic quartz than the granitic.



TSL in the NUV, Blue, Green-Yellow and Orange-Red, 35 Gy β

Relationships between TSL and OSL signals

In most emission regions the strongest TSL sensitization related to a peak around 150°C, which came to dominate the 100°C TSL peak in the pegmatitic quartz. Initial OSL signals sensitized more than the 100°C TSL peak, but their pattern of sensitivity change followed a combination of decline in the 300-340°C TSL region for anneals above 800°C, and the continued strong increase of the 150 °C TSL peak. The contribution of centres related to the 150 °C peak was evident as a slightly slower decaying component in the OSL signal, even after the trapped charge from this peak was preheated out.

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