TSL, OSL, RL AND IL SIGNALS AND EMISSIONS FROM HF ETCHED GRAINS OF QUARTZ FROM PORTUGUESE GRANITE AND APLITE-PEGMATITE

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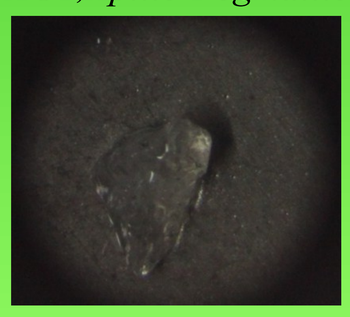
Introduction

The present study aims to survey how a range of luminescence emissions from grains of quartz refined from samples of Portuguese granite and aplite-pegmatite relate to each other and how they are altered by annealing, in order to evaluate the potential of these samples to yield information relevant to understanding luminescence-dosimetric processes in quartz.

Approx. 3 mm

AG1,Aplite-Pegmatite



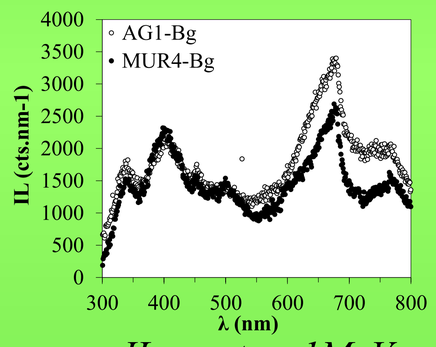
MUR4, from Granite

Methods

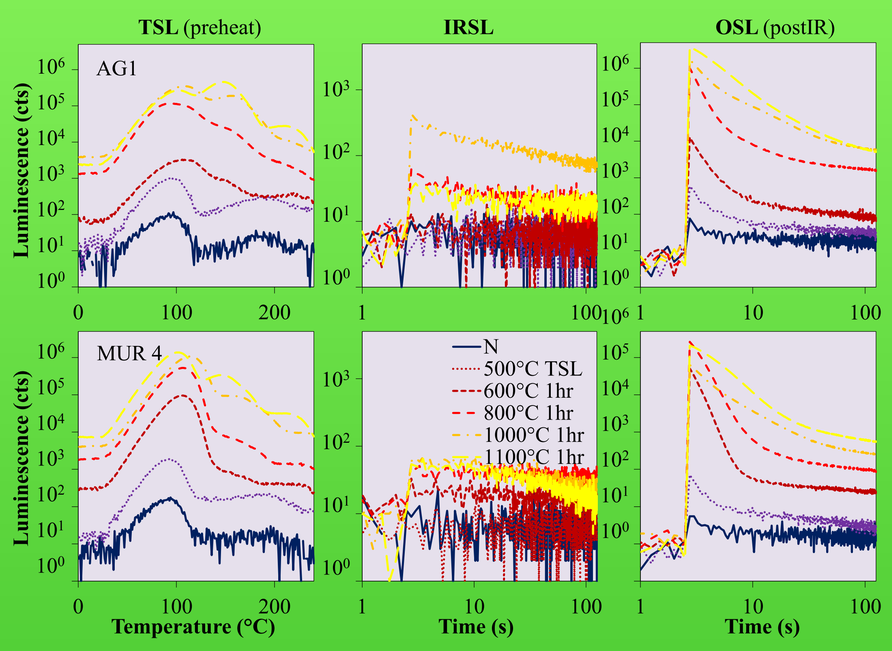
Quartz grains have been prepared from Portuguese granite (MUR4) and aplite-pegmatite (AG1) samples, including repeated HF etching. The granitic quartz was transparent and well crystalized while the aplite-pegmatitic was milky and severely acid pitted.

Hand picked grains were measured using optically and thermally stimulated luminescence (OSL, TSL; Sr/Y β), different grains were measured by radioluminescence (RL; 20 kV X-ray) and ionoluminescence (IL; 1 MV H+). Measurements were made before and after activation, and annealing up to 1100 °C/1hr.

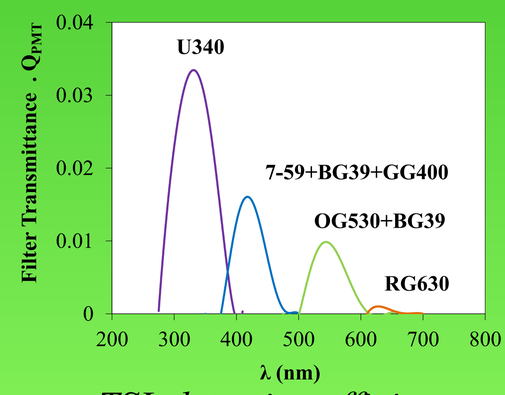
OSL was detected in the Ultraviolet (UV; U340 filter), and TSL in the UV, Violet-Blue (7-59 + BG39 + GG400), Green-Yellow (OG530 + BG39) and Orange-Red (RG630) bands, all using an Electron Tubes 9235QB photomultiplier. RL and IL were detected using cooled CCDs and monochromators in the ranges 210–1200 nm and 300-850 nm, respectively.



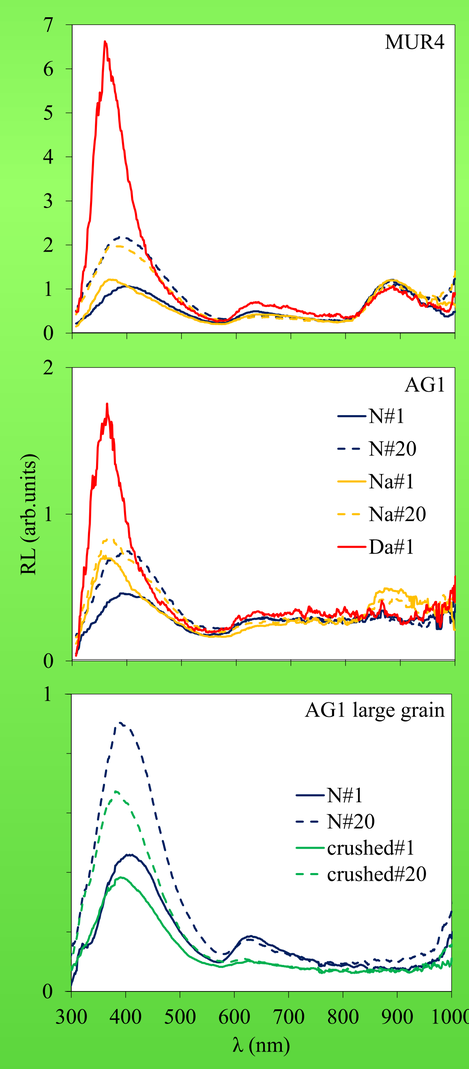
IL spectra, 1MeV proton irradiation



TSL, IRSL and OSL in the NUV, 35 Gy β



TSL detection efficiency



RL spectra, repeated irradiation with 20 kV X-ray source (N=Natural, D=Dose, a= activated, #=RL cycle)

Results and Discussion

Strengths of Different Signals and Emissions

Higher temperature and longer wavelength emissions were more prominent from the aplite-pegmatitic quartz in TSL, RL and IL. An RL and IL emission peak ca. 495 nm is absent or very weak in these quartzes: this appears to alter the dosimetric response of the 365 nm peak relative to the 410 nm peak and may provide a useful point of comparison with other quartz samples. An emission ca. 610 nm was reduced by crushing an etched grain of etched aplite pegmatitic quartz, indicating a relationship to superficial defects. The granitic sample exhibited a near infra-red (NIR) RL emission indicative of Pb emissions often associated with feldspar, despite low IRSL response.

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

Sensitization of TSL and OSL signals

Increases in TSL and OSL sensitivity of up to 10^5 times following annealing and activation occur in the Ultraviolet (UV) emission (365 nm) of both sample types, and in the Orange-Red emission from the aplite-pegmatitic quartz. Lags in the sensitisation of the UV emission from this quartz when compared to its Orange-Red emission and the UV emission of the Granitic quartz suggest the need for removal of H from OH-related centres before dispersal of interstitial ions from Al related centres. Annealing also produced a TSL peak ca. 150 °C and slower components in initial OSL decays: re-trapping during OSL measurement may be the source of many reported signal decay components.

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