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

C.J. Burbidge[a]*, M. Martini[b], M. Fasoli[b], L. Alves[a], G. Cardoso[a], I. Villa[b]

[a]Campus Tecnológico e Nuclear, Instituto Superior Técnico, Universidade Técnica de Lisboa, EN 10, km 139,7. 2695-066 Bobadela LRS – Portugal (christoph@ctn.ist.utl.pt)
[b]Dipartimento di Scienza dei Materiali, Università degli Studi di Milano Bicocca, I-20125 Milano, Italy

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.

Experimental:

Quartz grains have been prepared from Portuguese granite (MUR4) and aplite-pegmatite (AG1) samples, including repeated HF etching. Samples were measured using optically and thermally stimulated luminescence (OSL, TSL; Sr/Y β) , radioluminescence (RL; 20 kV X-ray) and ionoluminescence (IL; 1 MV H+), 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.

Results and Discussion:

The granitic quartz was transparent and well crystalized while the aplite-pegmatitic was milky and severely acid pitted. Higher temperature and longer wavelength emissions were more prominent from the aplite-pegmatitic quartz in TSL, RL and IL. Behaviours of emissions in the Orange-Red indicated a direct relationship to OH centres for un-annealed samples, and enhancement of this emission by acid etching. An RL and IL emission peak ca. 495 nm is absent or very weak in these quartzes (Fig 1): this appears to alter the dosimetric response of the 365 nm peak and may provide a useful point of comparison with other quartz samples. The granitic sample exhibited a strong near infra-red (NIR) RL emission. Increases in TSL and OSL sensitivity of up to 105 times following annealing and activation occur in the Ultraviolet (UV) emission (365 nm) of both sample types (Fig. 2), and in the Orange-Red emission from the aplite-pegmatitic quartz. Annealing also produced a TSL peak ca. 150 °C and slower components in initial OSL decays: such peaks may be a common cause of commonly observed OSL components.

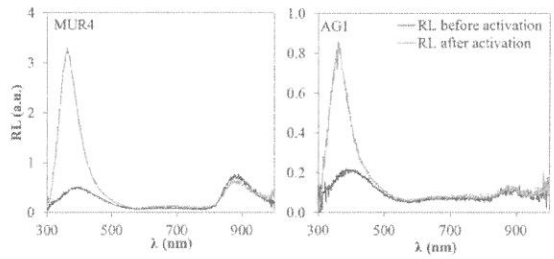

Fig. 1. Radioluminescence spectra measured before and after activation to 500 °C.

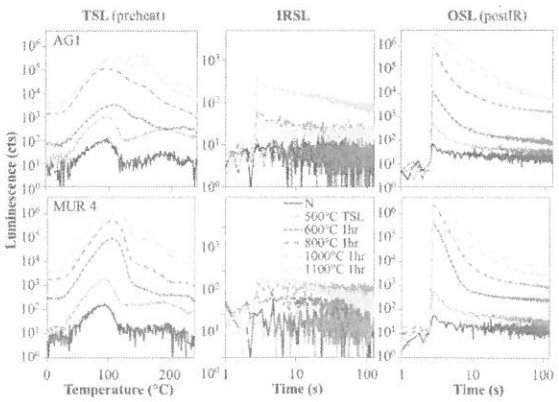

Fig. 2. TSL(240°C), IRSL and post-IR OSL response in the UV to a dose of 35 Gy β, delivered to the heated but not laboratory-irradiated sample, and following activation and anneals of different severities.

Supported by the FCT funded projects italia128584682220330 and PTDC/AAC-AMB/121375/2010 - VADOSE.