University of St Andrews

Facility for the Luminescence of Minerals

High Sensitivity Luminescence Measurements of Materials – The St Andrews Luminescence Facility
by Adrian A Finch, Yafang Wang, Peter D Townsend, Martin Ingle

Supplementary Information 2 – Images in Black and White Formats for Readers with Colour Impairment

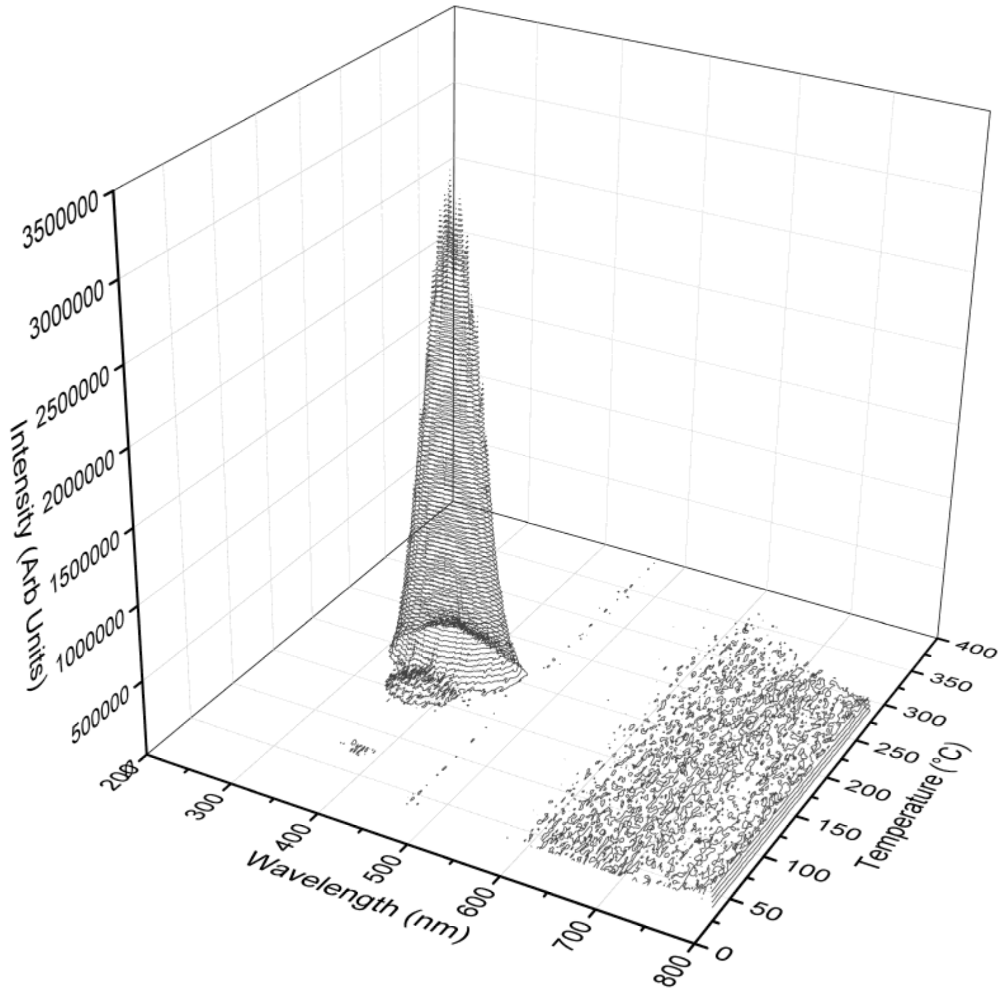

Figure 3: High Temperature TL of GR200 dosimeter material expressed as a 3D graph. Data are system corrected and the region of the spectrum where significant black body radiation is observed (above 320°C at 800 nm and moving diagonally across the graph) has been deleted. The strong TL emission centred at 381 nm and 188°C is clearly visible. Such data are an improvement over conventional TL measurements which have no spectral component.

Irvine Building, North Street, St Andrews, Fife KY16 9AL
Tel: 01334 462384 Fax: 01334 463949 Email: Adrian.Finch@st-andrews.ac.uk

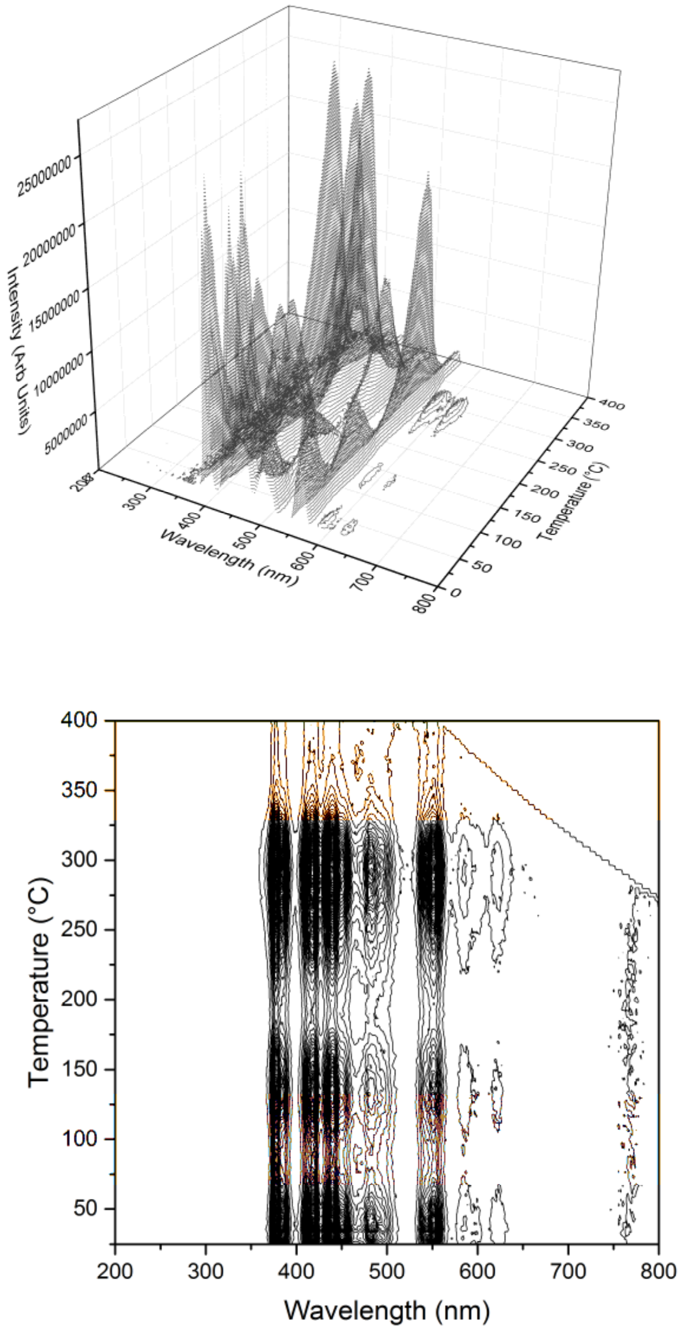

Figure 4: High Temperature **TL of Mg_2SiO_4:Tb expressed as a contour plot.** Tb emissions at 376, 417, 438, 483, 550, 586 and 621 nm are observed and TL glow peaks occur at 35, 133 and 293°C.

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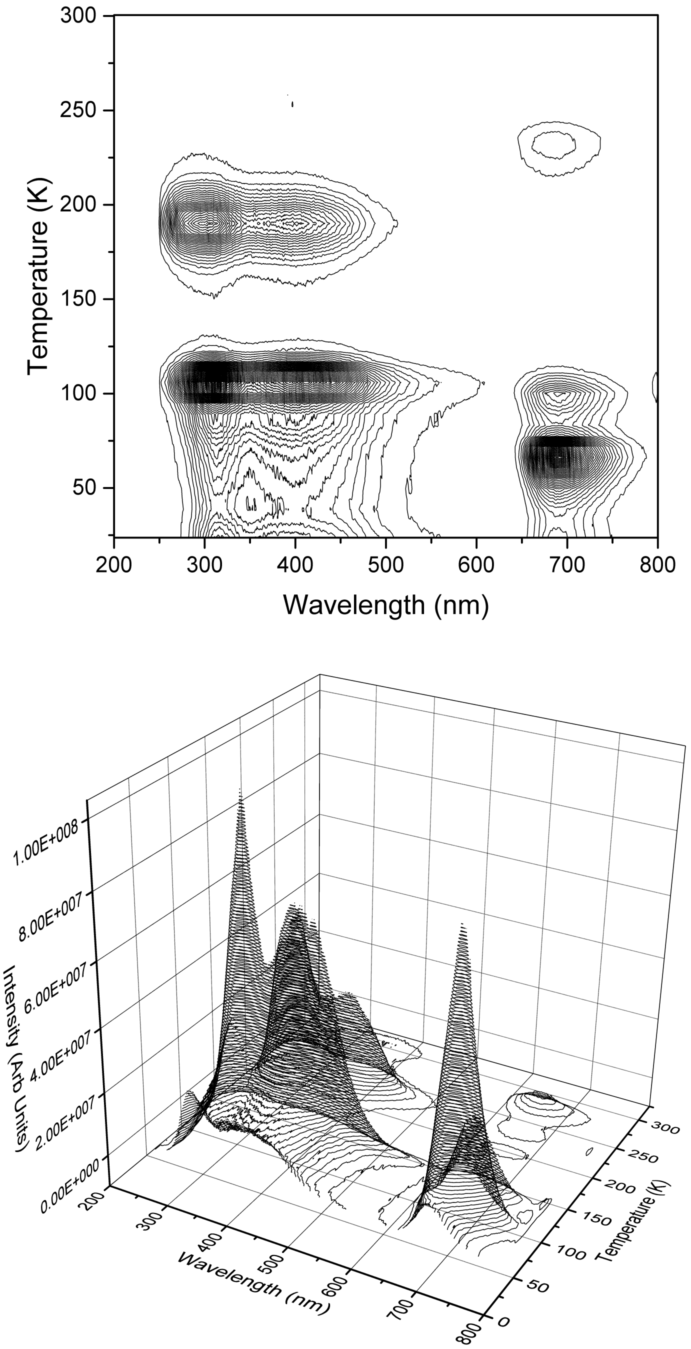

Figure 5: Low Temperature TL of pink sodalite (AF-07-35) as a contour map. Data are system corrected and expressed as arbitrary intensity using the colour scheme on the right. A variety of TL glow peaks are observed at 66, 105, 190 and 232 K, whose responses occur at different wavelengths. The 66 and 232 K TL peaks occur at 690 nm whereas the 105 and 190 K peaks predominantly occur in the UV and blue (309 and 411 nm). Conventional TL would not recognise the unusual interplay between temperature and TL emission wavelength.

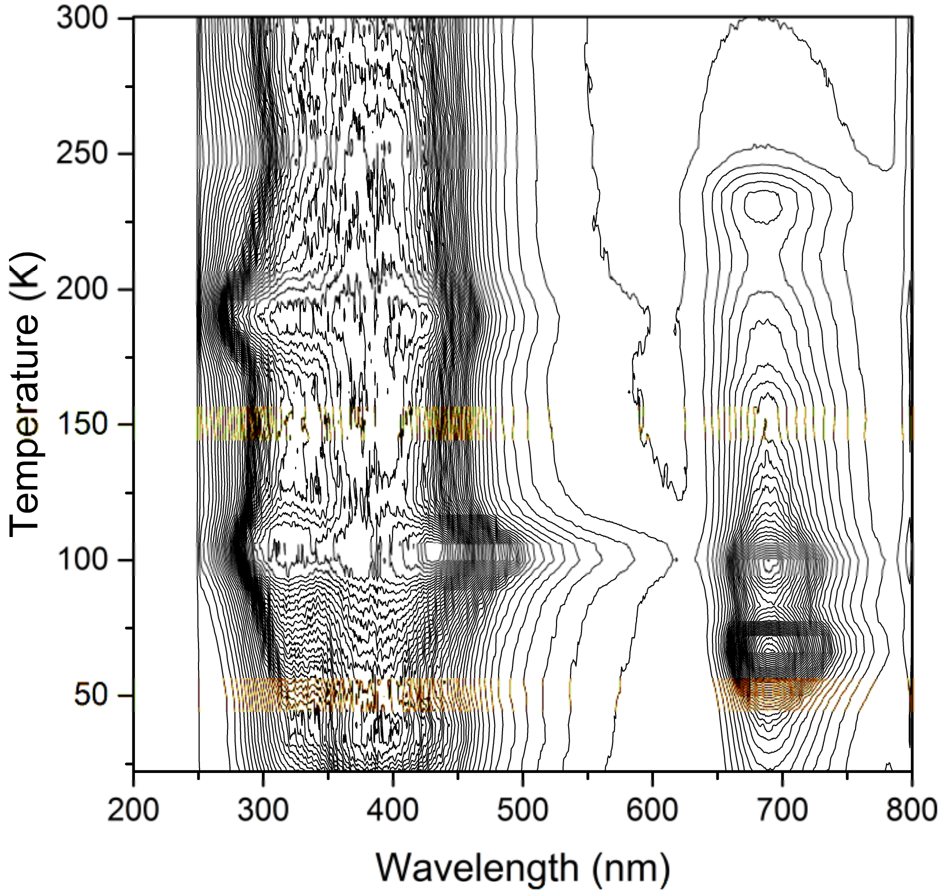

Figure 6: XEOL and TL composite data from pink sodalite (AF-07-35). Where fast ramp rates are employed, XEOL data from the instrument are composites of XEOL and TL. The small peaks in intensity (particularly evident at 690 nm and 66 K) are TL responses (Figure 4) added to the XEOL, better called the XEOLTL response. The true isolated XEOL can be achieved by slowing ramp rates down substantially (although this increases the acquisition times and the data density), or by taking the spectra on the cooling cycle.

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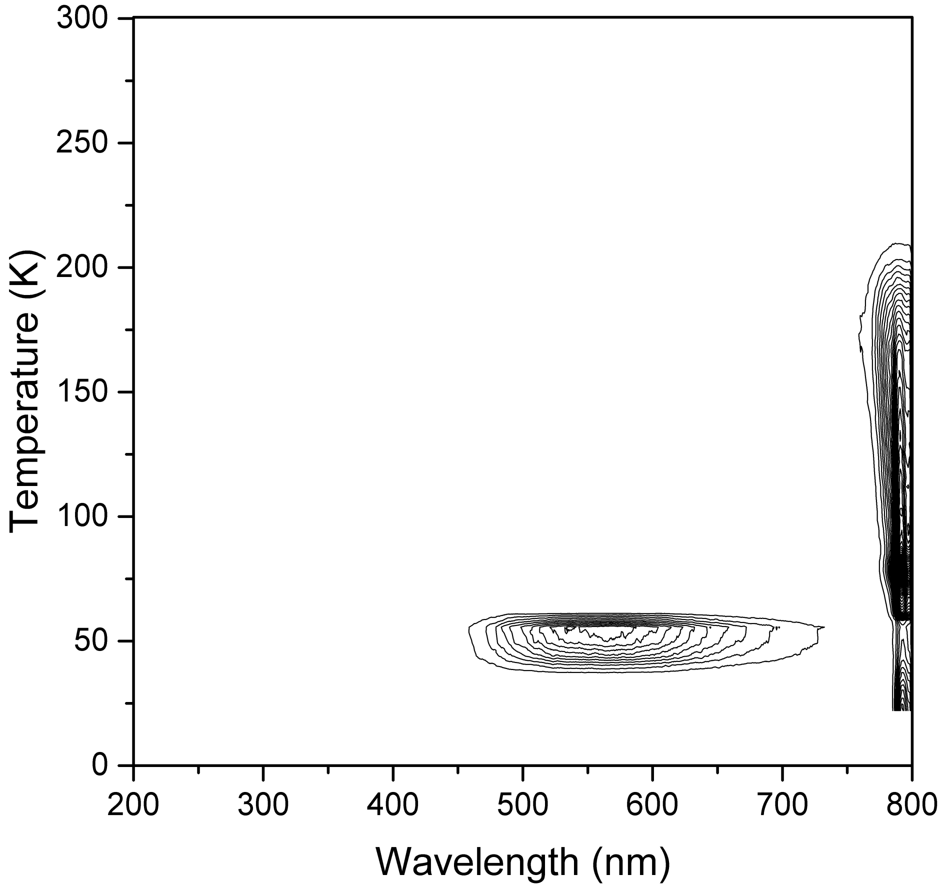

Figure 7: XEOL data from $SrTiO_3$ at 15 kV and 4 mA X-generation. The data are shown as a contour plot. The NIR emission at ~794 nm is close to the wavelength limit of the system and the long wavelength part of the emission is truncated. The temperature dependence of the NIR band is shown bottom right. The intense broad band centred at 568 nm has a sharp maximum at 54 K whereas the NIR band at 794 nm has sharp peaks at 24 and 78 K and a minimum at 54 K – precisely the temperature at which the 568 nm band is strongest. The very sudden loss of the orange band on warming to 60 K and the intense NIR band which peaks at 78 K encompass the temperature of a phase transition in $SrTiO_3$ which is expressed very clearly in the data. Phase transitions are often particularly evidence in the first derivative of the data (see Figure in main body of text) and we infer the two peaks in the first derivatives define different stages of the phase transition.

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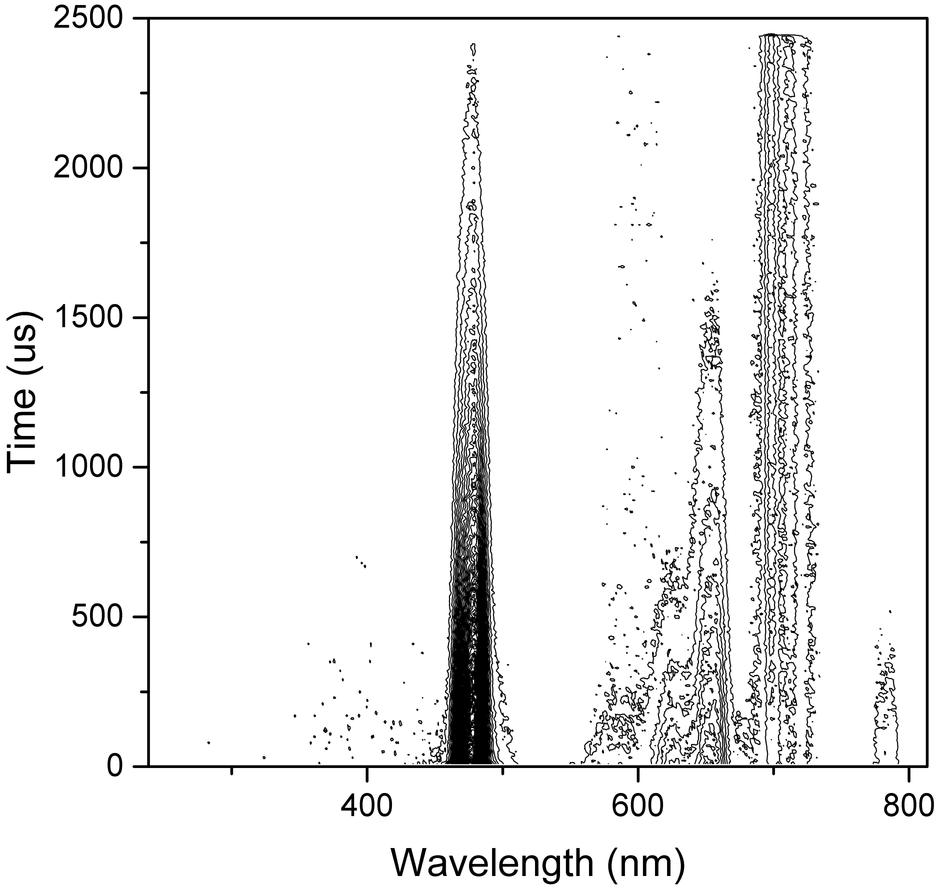

Figure 8: Time-resolved PL of $CaSO_4$:Tm,Li at 155 K. The luminescence intensity as a function of temperature and wavelength is shown in contour format. The decay of the emissions as a function of time is clear for particularly the 477 and 654 nm emissions. A broad emission between 698 and 710 nm is essentially constant over the lifetime of the experiment. The decay profiles of the 477 and 654 nm emissions are fitted in C. The blue component fits a single exponential decay (R^2=0.998) whose slope corresponds to a decay half-life of 582±3 μs; the orange band is initially consistent with this lifetime but the flattening of the data as time increases indicates an additional, longer lifetime component. The intensity of the 697-710 nm region is essentially constant throughout the experiment, showing its half-life is >> 5 ms.

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