Quantification of irradiation-induced structural damage in nuclear waste-form materials using confocal Ln^{3+} luminescence spectroscopy

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Here we present how confocal photoluminescence (PL) spectroscopy may be used as a tool for the characterisation and quantification of irradiation-induced structural damage in nuclear waste-form materials on a μm-scale. The PL band-widths of trivalent lanthanide ions, commonly incorporated into the structure of nuclear-waste materials, are very sensitive to local structural disorder (Fig. 1).

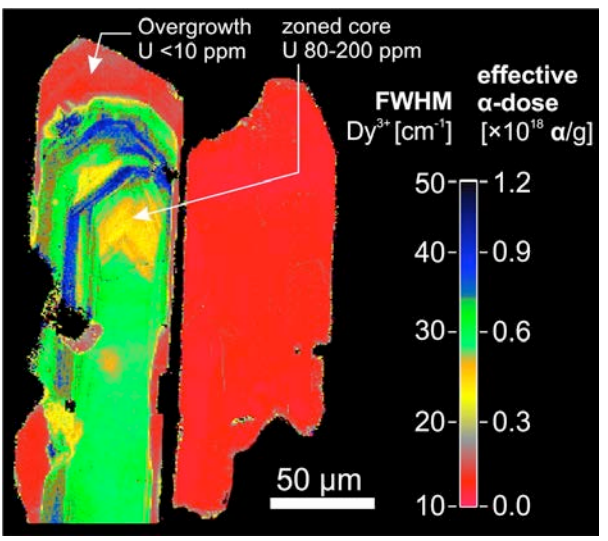

Figure 1: PL map of a cut-in-half, natural zircon sample (age: 2.73 Ga) showing PL band-width distribution (correlated effective doses were estimated using FWHMs of well-studied Sri Lankan, gem-quality zircon samples with known, corrected "effective" α-doses [1]). Right half was annealed (1100°C for 3 days) and shows complete revovery of crystallinity; the un-annealed half (left) retains complex zoning with different states of radiation-damage accumulation, due to different U and Th content in respective zones (after Lenz & Nasdala[1]).

[1] Lenz & Nasdala (2015) Am. Mineral. **100**, 1123-1133.