

Raman microprobe constraints on the Ar degassing mechanisms in gem-quality sanidine

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The gem sanidine from Itrongay, Madagascar was credibly documented to lose Ar by Fickian diffusion [1,2]. However, the isothermal diffusion experiments by [1] lasted several days, averaging away any transient behaviour during the 10-30 min degassing steps of ⁴⁰Ar/³⁹Ar runs. An aliquot of [1] was stepheated at unchanging temperature, demonstrating a change of diffusion mechanism over 24-48 h. To constrain how the Kfs structure violates requirements of matrix inertness, we heated an irradiated, otherwise untreated, 1 mm³ aliquot of the same crystal that gave the short-term deviation from Fick's Law. The cleavage chip was heated in air in a Linkham heating stage attached to a Raman microprobe at National Cheng Kung University, Tainan. Raman spectra were acquired every 15 minutes over a 12-hour isothermal run at 900 ± 1 °C.

Raman peak positions are stable, relative peak heights between 100 and 480 cm⁻¹ change over time. These peaks are associated with Si,Al ordering and with the excitation of phonon modes [3]. Peaks broaden and heights increase between 600 and 900 cm⁻¹. We conclude that the short-term (12 h) degassing of sanidine is controlled by crystallographic changes. The long-term (7-30 d) bulk degassing, being the sum of various structural modifications, only approximates a Fickian behaviour that is not verified in short-term detail.

[1] Wartho et al., EPSL 170 (1999) 141-153

[2] Flude et al., GSLSP 378 (2014) 265-275

[3] Salje, Phys Chem Min 13 (1986) 340-346 ; Zhang et al., Am Mineral 81 (1996) 92-104