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# Estimates of Ar diffusion and solubility in leucite and nepheline: Electron microprobe imaging of Ar distribution in a mineral

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## ABSTRACT

Leucite is unique among minerals that have been exploited for K-Ar and Ar-Ar dating, in that it exhibits a major phase change at 645–665 °C, across which Ar diffusion and solubility can be studied. In addition, well-developed twinning occurs only in the low temperature form, offering further opportunity to examine the effects of crystallographic change upon Ar diffusion. Nepheline was studied to compare the effect of its 1-dimensional **c**-axis oriented lattice channels with the 3-dimensional channels of leucite. The amounts of Ar introduced into leucite were far higher than those observed in feldspars, allowing its analysis by electron microprobe spot traverses and X-ray maps. This has provided the first high spatial resolution 2-dimensional study of Ar distribution in a K-bearing mineral.

Extreme changes in Ar solubility were observed across the leucite phase transition, with Ar solubilities jumping from ~70 ppm (at 1 kbar) in the tetragonal (low-temperature) form to ~750 ppm (at 1 kbar) in the cubic (high-temperature) form. Argon penetration profiles were complex and estimates of the diffusion rates show that they are more rapid than in K-feldspar. In addition, spikes of high Ar concentration were observed in both forms, suggesting extended defects or micro-inclusions formed argon traps in the structure. No concentration changes could be correlated to leucite twin planes, suggesting that twin planes did not act as fast pathways for Ar movement. Nepheline yielded a much lower Ar solubility of 0.15–0.31 ppm at 1 kbar.