

Evaluation of wadeite as a potential Ar-Ar and U-Pb inter-calibration standard

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Recent work has highlighted the uncertainties (>2%) associated with ⁴⁰K decay constants [1], compared to the more precise ²³⁸U and ²³⁵U constants (0.108 % and 0.136%, respectively [2]). Thus attempts have been made to improve the accuracy of the K-Ar system through inter-calibration against U-Pb ages. Min et al. [3] suggest that ⁴⁰Ar/³⁹Ar ages may systematically underestimate U-Pb ages by ~0.5 – 1.0%, due to uncertainties associated with the K-Ar decay constants, although potential complications arise from inherited zircons and magma residence times.

An ideal inter-calibration standard would: i) contain both K and U and, thus, be dateable by both the ⁴⁰Ar/³⁹Ar and U-Pb techniques and ii) have cooled rapidly as a groundmass phase with negligible magma residence. A potential candidate for such a standard is the mineral wadeite, a rare phase in some lamproites (e.g. Walgidee Hills, Western Australia). Wadeite has the chemical formula Zr₂K₄Si₆O₁₈ and contains ~21.5 wt% K₂O and ~31 wt% ZrO₂.

⁴⁰Ar/³⁹Ar laser probe analyses of single wadeite crystals from Walgidee Hills indicate excellent inter-grain age homogeneity, with the high potassium contents and low adsorbed ³⁶Ar concentrations contributing to high precision data. Consequently, wadeite appears to be an excellent standard for ⁴⁰Ar/³⁹Ar dating.

Uranium contents in Walgidee Hills wadeite are relatively low at ~10ppm. Attempts to analyse U and Pb using MC-ICPMS proved unsuccessful, due to interferences from Zr and W on these elements. Therefore, U-Pb dating of wadeite must rely on TIMS analyses.

References

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