Evaluating the Precise $^{39}\text{Ar}/^{40}\text{Ar}$ Dating of Multiple Mineral Potassic Phases in Ultra-alkaline Rocks: Applications to Mantle Systematics

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Abstract: A suite of potassium-bearing minerals from the Walgidee Hills lamproite intrusion in the Kimberley region of Western Australia was selected for $^{39}\text{Ar}/^{40}\text{Ar}$ dating. These included wadeite, jeppeite, priderite, potassium richterite, and phlogopite. All recorded excellent plateau ages, with the mean age of the combined data set being $17.3±0.3$ Ma. Phlogopite recorded the largest uncertainty, whereas, of the other minerals, wadeite gave the best precision. Although rare to absent in common magmatic rocks, these minerals are widely distributed in alkaline complexes and in lamproite, kimberlite and orangeite intrusions. The results indicate this suite of minerals is excellent for $^{39}\text{Ar}/^{40}\text{Ar}$ dating and that they can be used singly or in combination to obtain the precise magmatic crystallization ages of ultra-alkaline rocks. Because of the stability of potassium richterite at mantle depths, $^{39}\text{Ar}/^{40}\text{Ar}$ dating of MARID (mica-amphibole-rutile-ilmenite-diopside) xenoliths should be a more widely-applied technique to investigating mantle geodynamics.

Key words: $^{39}\text{Ar}/^{40}\text{Ar}$ dating, potassium-bearing minerals, ultra-alkaline rocks, MARID xenoliths

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