Assessing Ar solubility in metamorphic muscovite

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One of the major underlying assumptions in $^{40}Ar/^{39}Ar$ geochronology is that the mineral initially crystallises with no initial Ar incorporated into its structure. Ar isotopes that are subsequently measured in the mineral are thus considered to be either the product of the radioactive decay of ^{40}K, ^{40}Ca or ^{37}Cl, or the result of atmospheric contamination, or the result of diffusion into the grain from a high concentration grain boundary fluid at high temperatures. Many metamorphic micas show contamination with "excess" argon – ^{40}Ar that is decoupled from its parent ^{40}K and which results in $^{40}Ar/^{39}Ar$ ages that are older than expected from other chronometers.

In order to determine the solubility of Ar in muscovite, and thus to determine the extent to which metamorphic micas can incorporate Ar into their structures during crystallization, we have grown mica from muscovite-composition glass in an Ar-rich fluid in high pressure anvil cells at varying temperatures and pressures. The preliminary results show that the solubility of Ar in muscovite is low, but measurable, with implications for both $^{40}Ar/^{39}Ar$ dating but also for deep Earth noble gas transport and degassing models.