Assessing mechanisms of argon isotope redistribution in muscovite: Preliminary results from the Black Hills, South Dakota

Vidar Jakobsson¹ and Richard Spikings¹

¹Department of Earth Sciences, University of Geneva, 1205 Geneva, Switzerland

Several key assumptions form the basis of extracting continuous thermal history information from the Ar isotopic compositions of minerals. Recent in-situ ⁴⁰Ar/³⁹Ar and geochemical analyses have shown that argon distributions are frequently a consequence of fluid-associated retrograde reactions, even in gem-quality mica (Naumenko-Dèzes et al., 2021). Mica can retain ⁴⁰Ar/³⁹Ar crystallisation ages at temperatures above 500°C (Airaghi et al., 2018), despite predicted closure temperatures. However, retrograde re-equilibration often occurs, rendering mica useful for hygrochronometry (Villa, 2016). We test the hypothesis that diffusion profiles in white mica can remain over geological timescales, despite the effects of partial retrograde re-equilibration.

A Mesoproterozoic metasedimentary sequence is intruded by a granitic core in the Black Hills. The metasedimentary rocks yield white mica ⁴⁰Ar/³⁹Ar total-fusion dates that increase with distance from the granite, span several 100 Ma and have been interpreted to record cooling (Dahl & Foland 2008). However, the role of fluid interaction on the Ar isotopic compositions has not been thoroughly assessed. To test the hypothesis, we have re-sampled the metasedimentary units and the Harney Peak Granite. White micas are initially classified using optical light petrology and QEMSCAN, before detailed characterisation using EPMA, EBSD, TEM, SIMS - δ¹⁸O and in-situ Rb-Sr dating to add a petrographic and temporal context for the in-situ Ar isotopic data. In-situ Ar isotope analyses will be compared to Ar isotopic data acquired using furnace step-heating to assess the causes of inflexions in Arrhenius trajectories. By studying a range of textures to provide recommendations for interpreting ⁴⁰Ar/³⁹Ar mica ages.

REFERENCES