Differing behaviour of Sr and ^{40}Ar in white mica as a function of deformation and fluid-mediated chemical exchange

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Recent technological advancements now permit *in-situ* Rb/Sr geochronology of mica in addition to the more established $^{40}Ar/^{39}Ar$ geochronology. Consequently, Rb/Sr and $^{40}Ar/^{39}Ar$ geochronology can be directly compared in the context of mica grain size, structural positions, and chemistry to elucidate the behaviour of Sr and ^{40}Ar in white mica in response to fluid-interaction and deformation in rocks with different intrinsic properties (i.e., permeability, bulk chemistry). For this purpose, a schist (bulk Sr: 19 µg/g) and a marble (bulk Sr: 518 µg/g) were obtained from the base of an allochthon-bounding shear zone in the northern Scandinavian Caledonides. The shear zone superposed rocks of the Köli Nappe Complex (Upper Allochthon) over continental-ocean transition rocks of the Seve Nappe Complex (Middle Allochthon). The schist and the marble are representative of the Seve Nappe Complex that experienced eclogite-facies metamorphism (2.4-2.6 GPa and 590-660°C) at c. 486-481 Ma. The two rocks were overprinted by high-strain fabrics associated with emplacement of the Köli Nappe Complex, generally occurring in lower amphibolite/greenschist facies conditions at c. 430-420 Ma throughout the Caledonides. In the schist, high-pressure metamorphism is primarily preserved by garnet, high-celadonite white mica (X_{Cel}: 0.22), and apatite. The high-strain overprint and retrogression is reflected by S-C' fabrics, recrystallized plagioclase, low-celadonite white mica (X_{Cel}: 0.09), and chlorite replacement of garnet and crystallization within C' shear planes. Specifically, the low-celadonite mica envelopes the high-celadonite mica within single grains, exhibiting irregular and diffuse boundaries between the two chemical generations. The low celadonite mica are also enriched in V, Sr, Nb, Ba and depleted in Li, Ti, Co, Zn relative to the high-celadonite mica. Single-spot dates from high-celadonite mica, calculated with initial $^{87}Sr/^{86}Sr$ (0.7281) obtained from apatite, yielded a weighted average of 485 ± 8 Ma (MSWD: 1.3; n: 27). The low-celadonite mica are likely not in chemical equilibrium with apatite and yield a large scatter c. 440 Ma (n: 18). White mica $^{40}Ar/^{39}Ar$ dates are dispersed from 491 ± 4 Ma to 427 ± 4 Ma (n: 19) with the youngest dates yielded by low celadonite mica. The marble comprises calcite with white mica and minor quartz, plagioclase, titanite, and opaques. High-pressure metamorphism is recorded by high-celadonite white mica (X_{Cel}: 0.28). The high-strain overprint is reflected by the shape preferred orientation of calcite and white mica that defines the foliation, and a grain size distribution of the latter, found as bundles of coarse- to fine-grains and isolated fine-grains within the calcite-dominated matrix. White mica chemistry is homogeneous regardless of grain size and position; a low celadonite generation is not present. Single-spot Rb/Sr dates for all white mica, calculated using initial $^{87}Sr/^{86}Sr$ (0.7122) obtained from titanite, provide a weighted average of 481 ± 4 Ma (MSWD: 0.8; n: 41). The $^{40}Ar/^{39}Ar$ dates are dispersed from 486 ± 4 Ma to 428 ± 4 Ma (n: 22) with the youngest dates obtained from the finer grained white mica. Altogether, the schist demonstrates that high-strain deformation and fluid-mediated chemical modification of white mica enabled open-system Sr exchange and ^{40}Ar loss in mica, resetting the high-pressure mica record. The white mica in the marble also exhibits ^{40}Ar loss during deformation, but mica was closed to Sr diffusion. The greater Sr content of the marble and its impermeability relative to the schist likely impeded mica-bulk rock Sr exchange, allowing the high-pressure record of white mica to be preserved. These results demonstrate how bulk rock properties control coupled or decoupled behaviour of Sr and ^{40}Ar in white mica during deformation.

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