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Single-crystal $^{40}Ar/^{39}Ar$ age variation in muscovite of the Gassetts Schist and associated gneiss, Vermont Appalachians

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Abstract

An exposure near Gassetts, Vermont, contains lithologies varying from staurolite-kyanite grade aluminous schists with paragonitic muscovite to potassic gneiss with phengitic muscovite. Single-crystal laser fusion $^{40}Ar/^{39}Ar$ ages for paragonitic and phengitic muscovite yield similar distributions with ranges between 366 ± 4 and 326 ± 4 Ma. Intracrystalline ages vary from ca. 394 ± 4 to 330 ± 4 Ma. Thus, we find that the intracrystalline (core-rim) age distribution of relatively large, single crystals essentially encompasses the range of ages obtained through total fusion of smaller crystals, consistent with models for development of diffusion profiles and ^{40}Ar-closure during cooling with a diffusion dimension controlled by the physical grain size. However, some of the larger crystals studied, particularly those with prominent microscopic defects (features readily evident such as internal grain boundaries and twin planes), yield relatively young ages and lack significant core-rim age discordance. Furthermore, the overall distribution of single-crystal ages in the two samples is bimodal, and we suggest that this age distribution reflects metamorphic deformation and recrystallization event(s) superimposed on early generation muscovite. Thus, the mean age of muscovite in these samples (typical of K/Ar and $^{40}Ar/^{39}Ar$ incremental heating analysis of bulk mineral separates) has little relationship to any single, hypothetical closure temperature. In view of the similar results we obtain for muscovite of contrasting composition, the net effects of variations in grain size, deformational character, and growth history are interpreted to be more important in forming the observed variations in age than are the chemical substitutions in these samples.

Keywords: Muscovite, paragonite, phengite, $^{40}Ar/^{39}Ar$, geochronology, laser analysis, Appalachians, Acadian