Investigation for occurrence of excess ^{40}Ar in retrograde metamorphic amphibole by $^{40}Ar/^{39}Ar$ crushing

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$^{40}Ar/^{39}Ar$ progressive crushing technique has been widely applied to date the ages of fluids associated with hydrothermal mineralization[1-5], hydrocarbon accumulation[6], high pressure metamorphism[7], as well as tectonic activity. Primary and secondary fluid inclusions (PFIs and SFIs) are usually present in minerals. The gas release process can be roughly grouped into three stages: dominantly SFIs in the initial steps; mixed gases from SFIs and PFIs in the medium steps; and dominantly PFIs in the final steps of the crushing procedures. The PFI isochron ages are usually defined by the data points of final steps. It is not easy to obtain an isochron for the SFIs on inverse isochron plot because gases are derived from multiple reservoirs. The K–Cl–Ar correlation plots might also obtain the ages for both PFIs and SFIs[4,5].

A retrograde metamorphic amphibole yielded a saddle-shaped age spectrum by $^{40}Ar/^{39}Ar$ laser step-heating, which implied the presence of excess ^{40}Ar ($^{40}Ar_E$) in the mineral. Joint analysis of $^{40}Ar/^{39}Ar$ step-crushing and furnace step-heating was then designed and expected to help us to better understand the occurrence of $^{40}Ar_E$. Two isochron lines are well defiened by the data points of initial and final crushing steps, respectively corresponding ages of 195 ± 22 Ma with initial $^{40}Ar/^{36}Ar$ ratios (I_0) of 4981 ± 234 and 254 ± 6 Ma with I_0 of 294 ± 13, which are interpreted the SFI and PFI ages. The furnace step-heating for the crushed powder yields a flat age spectrum with a plateau age of 258 ± 4 Ma, corresponding an isochron age of 258 ± 6 Ma with I_0 of 295 ± 5, which are represented the age of the solid amphibole. The I_0 values indicate that the $^{40}Ar_E$ exists only in the SFIs, not in the PFIs and the solid mineral.

Refereces cited

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