The occurrence of excess $^{40}$Ar in amphibole: implication of $^{40}$Ar/$^{39}$Ar dating by laser stepwise heating and in vacuo crushing

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Amphibole is one of the most common minerals dated by the $^{40}$Ar/$^{39}$Ar method due to its relatively high retentivity for argon and widespread occurrence in metamorphic and igneous rocks [1]. In the Yuka terrane, north Qaidam orogen, NW China, amphibole widely occurs in high/ultrahigh pressure (HP/UHP) metamorphic rocks. There are still only rare $^{40}$Ar/$^{39}$Ar age data available, which have been devoted to amphibole in this terrane thus far. Possible reasons for this include the fact that metamorphic amphibole is easily contaminated by excess $^{40}$Ar.

Amphibole from a gneissic amphibolite from the Yuka eclogite–gneiss terrane, North Qaidam, has been analyzed by $^{40}$Ar/$^{39}$Ar laser stepwise heating and in vacuo crushing methods. The release pattern of heating is somewhat saddle-shaped with a total gas age of 574.5 ± 2.5 Ma. This age is significantly older than the reported zircon U-Pb ages (c. 495 Ma) from the Yuka eclogite [2], indicating the presence of excess $^{40}$Ar. The apparent K/Ca ratios are concordant with a mean value of 0.12 ± 0.02, which is consistent with EMP analysis results.

In order to decipher the occurrence of excess $^{40}$Ar and constrain the age of amphibolite-facies retrogression, a duplicate amphibole sample was employed for $^{40}$Ar/$^{39}$Ar analysis by in vacuo crushing. The crushing experiment exhibits a monotonically declining release spectrum with concordant apparent ages in the later crushing steps, which yields a plateau age of 460.9 ± 0.6 Ma. The data comprising the age plateaux form an excellent isochron with an intercept age of 457.6 ± 0.9 Ma. The crushing K/Ca spectrum shows a hump-shaped feature with a higher mean K/Ca ratio of 0.63 ± 0.05. The distinctly different K/Ca ratios for heating and crushing indicate that the gases released by these two methods are likely to have been derived from different sources.
References:

