

What is essential for metamorphic lithology with and without excess Ar on Argon dating?

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K-Ar system dating method is powerful tool to study cooling ages of metamorphic rocks. However, discordant K-Ar and Ar/Ar age relations have been reported in ultrahigh-pressure metamorphic rocks and the associated high-pressure metamorphic rocks in many metamorphic sequences. Metamorphosed continental crust materials like Dola Maira massif in western Alps, which have experienced complicate metamorphic histories, have provided the discordant ages due to the excess argon that was inherited from the protolith. Imperfect resetting for the Ar isotopic system gives older apparent ages in the conventional K-Ar system dating. This type of rock is so hard to date the cooling age.

The Zermatt-Saas zone in western Alps is regarded as an ophiolite. Gouzu et al. (2006) carried out the Ar-Ar analyses of phengites from the coesite-bearing pelitic schist, piemontite schist and Ca-rich schist. The protoliths of later two were formed by hydrothermal activity and in pelagic setting, respectively. Phengites in the rocks from the Lago di Cignana area provide 37-42 Ma plateau ages that have very little variation in comparison with those from Dora Maira massif and are consistent with Sm-Nd and Rb-Sr mineral ages (38-40 Ma) of eclogites and phengite-quartzites. Phengite inclusions in garnet give ages of 43.2 Ma and 44.4 Ma, which are significantly older than the spot age (36.4 Ma) from the matrix phengites, and the plateau ages. Inclusion ages (43 and 44 Ma) are consistent with a zircon SHRIMP age (44 Ma). These results suggest that the oceanic materials that underwent a simple subduction related ultrahigh-pressure metamorphism, form excess Ar-free phengite. These analyses confirm our working hypothesis that the rock with a simple metamorphic history such as the metamorphosed oceanic materials has no significant amount of excess Ar. Well-documented examples of this concept have been already reported from the systematic K-Ar phengite analyses in the Sanbagawa schists, SW Japan (Itaya and Takasugi, 1988) and the Otago schists, New Zealand (Nishimura et al., 2000). In these areas, no sign of excess Ar, i.e. discordant ages and/or significantly older ages, are found because the continuous metamorphic gradient was documented by K-Ar analyses of the phengites.