

Excess argon in phengite from the Sanbagawa eclogites: Constraints on argon behavior during subduction zone metamorphism

ITAYA, Tetsumaru^{1*} ; TSUJIMORI, Tatsuki²

¹Okayama University of Science, ²Okayama University

K-Ar system dating of phengitic mica is a powerful tool to determine cooling ages of HP/UHP metamorphic rocks. However, discordant ages in a same metamorphic unit have been often reported, particularly from rocks in Alpine-Himalayan type collisional metamorphic belts. For example, UHP-metamorphosed continental crust materials of the Dola Maira massif (western Alps, Italy) show the discrepancy due to the existence of excess argon in metamorphic minerals that has been inherited from the precursor rocks with polyphase metamorphic records. Over the last two decades, we have addressed an excess-argon free hypothesis in oceanic petrogenesis of Pacific-type convergent margins. According to the hypothesis, metamorphosed oceanic materials in Pacific-type HP metamorphic belts with only a monophase metamorphic records do not contain significant amount of excess ⁴⁰Ar; in other words, the K-Ar system in syn-metamorphic phengitic mica is significantly reset during fluid-induced metamorphic recrystallization at a Pacific-type convergent margin. Well-documented geological examples are of schists from Sanbagawa, Suo and Renge metamorphic belts in SW Japan, and from Otago metamorphic belt in New Zealand. Ar-Ar phengite analyses of HP-UHP metamorphosed oceanic lithologies of the Lago di Cignana (western Alps, Italy) also show negligible excess ⁴⁰Ar in eclogite-facies syn-metamorphic phengitic mica.

In the year 2000, as a preparation to guide participants for the IEC Conference in Japan, we have determined K-Ar ages of phengite and paragonite from the eclogite-facies Sanbagawa metamorphic rocks in Shikoku; the twenty-two results were obtained from four localities including Seba (84-89 Ma), Gongen (123-136 Ma) and Western Iratsu (78-80 Ma), and Kotsu/Bizan (82-88 Ma). Excepting for the quartz-rich kyanite eclogite from Gongen (GO), phengite and/or paragonite yields similar cooling-age ranges of metasedimentary rocks of the Sanbagawa metamorphic rocks in central Shikoku. Phengite K-Ar ages of GO eclogites are significantly older than syn-metamorphic zircon U-Pb ages at the same unit. These old ages are interpreted as the presence of excess ⁴⁰Ar in phengitic mica. The bulk-rock compositions of GO eclogites suggest a sedimentary protolith such as greywacke. When, where and how has the excess argon been trapped in phengite crystals? Considering the geological fact that the GO eclogites are closely associated with the Higashi-Akaishi (HA) meta-peridotite body, the false age obtained from phengite were likely attributed to an interaction between the meta-sediment (GO eclogite) and the meta-peridotite (HA peridotite) at eclogite-facies depth. We postulate that the fluids exchange between deep-subducted sediments and mantle material enhanced a hydration of peridotite and mantle-derived noble gas (including extreme ⁴⁰Ar) was diffused from mantle material to the sediments. During the exhumation of them, the rigid HA peridotite might have prevented a ductile deformation of GO eclogite and consequently mantle-derived argon gained from HA peridotite in GO eclogite might have been inherited by the limited-argon-depletion due to less deformation. This is not only very rare example of false K-Ar age of metamorphosed oceanic materials but also remarkable observation to explain argon behavior during sediments/peridotite interaction at a deep portion of subduction zone environment.

Keywords: Sanbagawa belt, eclogite, phengite, excess argon