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CHIME monazite dating as a tool to detect polymetamorphism in high-temperature metamorphic terrane

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The chemical Th-U-total Pb isochron method (CHIME) monazite dating was carried out for pelitic-psammitic migmatites and the Ao granite (one of the Younger Ryoke granites) from the Aoyama area, Ryoke metamorphic belt, SW Japan. The Ao granite gives an unequivocal age of 79.8+/-3.9 Ma. The migmatites yield ca. 100 Ma monazite grains with younger domains of ca. 80 Ma. Some grains show ca. 80 Ma overgrowths on the older core of around ca. 100 Ma, and others show patchy rejuvenation of ca. 100 Ma grains.

Recent study on the Pb diffusion in monazite (Cherniak et al., 2004) concluded that Pb diffusivity in monazite is low and thus the closure temperature of monazite is high. However, reinterpretation of Cherniak et al. (2004) data by favoring the SIMS data rather than RBS data showed that results of Cherniak et al. (2004), Suzuki et al. (1994) and Smith & Giletti (1997) can define single array that gives the diffusivity similar to Suzuki et al. (1994). If this interpretation is accepted, the closure temperature of Pb diffusion in monazite becomes low, and about 600-750 ^{o}C provided that the cooling rate is ca.30 ^{o}C/Myr.

With this closure temperature, it is possible to reset monazite in the pelitic-psammitic migmatites from the Aoyama area by the thermal effect of the Ao granite intrusion alone. The patchy nature of the distribution of rejuvenated parts within monazite grains prefers, however, the rejuvenation mechanism other than volume diffusion, such as grain boundary diffusion along the microcracks developed in the monazite grains. Some of the monazite grains with young overgrowth rim are armored in biotite, supporting the possibility of the fluid activity affecting the rejuvenation of monazite grains. Therefore, ca. 80 Ma overprinting on migmatites over the Grt-Crd zone in the Aoyama area is probably caused by the combination of a thermal effect and a fluid activity caused by the Ao granite intrusion. Partial rejuvenation of the monazite grains implies that the thermal and fluidal effects were not too strong to completely reset the monazite grains.

Although the contact metamorphism by the Ao granite is hard to be detected through the field survey and petrographic examination, possibly because the migmatite already possessed the high-temperature mineral assemblage and was immune from the contact metamorphism in terms of major metamorphic mineral assemblage, the CHIME monazite dating reveals the presence of contact metamorphism clearly. The field mapping of the CHIME monazite age can be a powerful tool for recognition of polymetamorphism in high-temperature metamorphic terrains where later thermal effects cannot be easily detected by the growth of new metamorphic minerals.

Keywords: CHIME monazite dating, polymetamorphism, Aoyama area, Ao granite, contact metamorphism, closure temperature