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Significance of melt inclusions in Zrn in estimating the duration of high-T metamorphism -An example of the Ryoke belt

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It is important to understand when and how Zrn was formed in order to interpret the U-Pb Zrn ages. Melt inclusion in Zrn is an important evidence of Zrn growth in the presence of melt. Therefore, they contribute to constrain the timing of Zrn growth in high-T metamorphic rocks. In this contribution, we report the occurrence of melt inclusions in Zrn from the migmatite of the Ryoke metamorphic belt at Aoyama area, SW Japan.

In the Aoyama area, the pelitic-psammitic schists dominate in the north, and migmatites (metatexites and diatexites) dominate in the south [1]. Zircon (Zrn) in pelitic-psammitic schists from the low-T part of the Grt-Crd zone is coarse-grained and shows almost no metamorphic overgrowth. On the other hand, Zrn in migmatites from the mid- and high-temperature part of the Grt-Crd zone has a thin, bright layer under BSE image along which tiny inclusions of several microns are aligned [cf. 2]. TEM observation of some of these tiny inclusions gave halo patterns revealing that they are the glass (formerly melt) rich in Si, Al and K. This melt inclusion alignment divides the core with various detrital ages from the rim that gives U-Pb concordia age of 93.1 +/- 2.9 Ma. The rim of the Zrn from the high-T part of the Grt-Crd zone is over 20 um in thickness, and its Th/U ratio is less than 0.02. Presence of melt inclusion alignment at the core/rim boundary shows that the melt was present when the Zrn rim grew. Therefore, the Zrn rim probably grew under the presence of melt and monazite during the Ryoke metamorphism. The melting reaction that consumes Bt + Sil + Qtz and produces Grt + Crd + Kfs +/- Ilm + melt plays an important role in the formation of melt in this area [1]. However, Bt is not an important sink of zirconium [3], and Bt breakdown cannot supply zirconium enough for new Zrn rim growth. In this case, dissolution of pre-existing Zrn is required. It would be difficult to saturate melt in terms of Zrn component by dissolving Zrn when the amount of melt is increasing. Therefore, it is likely that 93.1 +/- 2.9 Ma Zrn rim crystallized during the solidification of the melt in migmatites, possibly near the wet-solidus. Mixed analysis of U-Pb dating of Zrn core and rim reveals that similar young rim is developed, although thin, in Zrn from the mid-T part of the Grt-Crd zone. These results imply that presence of partial melts plays an important role in the dissolution and recrystallization of Zrn [e.g., 4].

Although the whole-rock zirconium content is not especially high in the pelitic-psammitic schists from the low-T part of the Grt-Crd zone, modal amount of Zrn more than 20 um in diameter is higher in them. Zrn less than 20 um in diameter is confirmed to become common in mid-T and high-T part of the Grt-Crd zone, and ca. 30 um Zrn without detrital core are rarely found in the high-T part of the Grt-Crd zone. From these observations, these tiny Zrn grains are considered to have nucleated during the Ryoke metamorphism.

On the other hand, monazite grows at amphibolite facies grade and the presence of the melt does not largely affect its recrystallization [4]. In the case of the Aoyama area, Mnz from the migmatites records the prograde growth age of 96.5 +/- 1.9 Ma during regional metamorphism [5]. Using the difference of growth timing of Mnz and Zrn, that is, Mnz being prograde and Zrn being post peak, the duration of metamorphism higher than the amphibolite facies could be constrained, and it is at least ca. 3.5 Ma in the case of the Aoyama area.

[1] Kawakami (2001) JMG 19, 61-75. [2] Cesare et al. (2003) CMP 146, 28-43. [3] Bea et al. (2006) Can Min 44, 693-714. [4] Rubatto et al. (2001) CMP 140, 458-468. [5] Kawakami & Suzuki (2011) Island Arc, 20, 439-453.

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