

Monazite ages in the HT Ryoke Belt (SW Japan): cooling ages ?

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We explore the significance of monazite ages obtained in metamorphic rocks from the Ryoke Belt (SW Japan), where protracted magmatic activity generated a typical LP/HT metamorphic gradient.

Monazite is present in low to high grade samples. In the biotite and muscovite-cordierite zones, it forms tiny Th-poor aggregates associated with xenotime and surrounding minute allanite relicts. Grain size increases with metamorphic grade, and concentric zoning can be observed in larger grains from anatectic gneiss. In higher grade samples, monazite mostly occurs in the matrix, but is also included in prograde andalusite or cordierite porphyroblasts.

EPMA analyses reveal that Th concentration in monazite increases with metamorphic grade, which mirrors the increasing whole-rock Th content. No reliable age was obtained for Th-poor monazite from low grade schist. In high grade gneissic rocks, EPMA monazite ages range from 100 to 75 Ma, with a peak of the distribution at 85 Ma. In detail, older ages of about 95 Ma are preserved in relatively Th-poor monazite domains (cores, but not always), whereas younger ages come from domains with a higher Th content or riddled with tiny holes. One sample of Grt-Crd anatectic gneiss, selected for additional LA-ICP-MS dating, yielded U-Pb zircon ages of *ca.* 100 Ma. Textural observations suggest that this age corresponds to prograde to peak temperature conditions, and is in agreement with U-Pb zircon ages of the surrounding granitoids.

Although several observations point to prograde monazite growth, most EPMA monazite ages are younger than those of prograde to peak conditions. We believe that they were partially reset by a combination of fluid-assisted recrystallization and intracrystalline diffusion at HT conditions. Similar K-Ar results of *ca.* 85 Ma obtained in neighbouring granitoids indicate that monazite ages document cooling of the Ryoke metamorphic belt below ~500 °C. We anticipate that this might be a general case in metamorphic terrains where relatively HT conditions have lasted longer than about 5 Ma.