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Geochronology of the Sanbagawa belt in SW Japan

Tetsumaru Itaya[1*], Tatsuki Tsujimori[2]

[1]Okayama University of Science, [2]Okayama University

The Sanbagawa belt was one of the classical high P/T metamorphic belts that trends roughly E-W over 800 km in central to SW Japan. However, recent U-Pb analyses of detrital zircon revealed that the belt consists of two metamorphic belts; Sanbagawa and Shimanto. The Sanbagawa schists consist mainly of metabasites, and pelitic and psammitic schists, with subordinate amounts of siliceous and calcareous schists. The protoliths of the psammitic and pelitic schists are of continental affinity. The protolihs of the metabasites, and siliceous and calcareous schists are oceanic in origin. The protoliths (Triassic to early Cretaceous) were accumulated and mixed at an ancient trench between 142-120 Ma and buried into the subduction zone to be metamorphosed at the conditions from the pumpellyite-actinolite through blueschist to epidote-amphibolite facies and up to eclogite facies.

Timing of peak metamorphism has been estimated by Rb-Sr whole rock isochron method using pelitic schists in the oligoclase-biotite zone (122+-12 Ma), zircon U-Pb method of Iratsu eclogite (110-120 Ma) and Lu-Hf method of garnet-omphacite pair in Seba and Kotsu eclogites (88-89 Ma). Multichronology of Iratsu eclogites concluded the peak age is 115-120 Ma. The oligoclase-biotite zone schists that once reached eclogite facies have the mineral paragenesis (P=7-11 kbar, T= 460-510oC) formed at 85.6+-3.0 Ma with an extensive hydration during exhumation. The Iratsu eclogites also record the over printing of epidote amphibolite facies at 109 Ma. These evidences suggest the overprinting has a long duration (23 mys) and depends on permeability of rocks controlling the timing of overprinting with hydration; less permeable eclogites being restricted in the hydration.

The Sanbagawa and the Shimanto metamorphic belts overlap in phengite argon age though both belts are completely different in their peak ages. This is due to mainly significant argon depletion from phengite in the Sanbagawa schists that have experienced severe ductile deformation for the duration longer than 31 my during exhumation in coparison with the Shimanto schists that have experienced the deformation shorter than 13 my to reset the phengite K-Ar system. This significantly different duration of deformation during exhmumation result in the two contrasting age-temperature-structure relationships of the Sanbagawa and Shimanto metamorphic sequences. The former has the thermal structure that the highest-grade rocks occur in the middle part of the apparent stratigraphy and a positive correlation in age-temperature relationship that the ages get progressively older with increasing metamorphic temperature. The later where the thermal structure for the higher-grade zone is in the lower part of the apparent stratigraphic succession, displays a negative correlation that younger ages are in the higher-grade metamorphic rocks. This contrasting relationship is also observed in the Ishigaki and the Nishiki metamorphic sequences of the Triassic Suo belt. The different natures of subducted oceanic plate boundary may control the different exhumation processes of Pacific type of high P/T metamorphic belts.

Keywords: Sanbagawa HP belt, Shimanto HP-belt, phengite K-Ar ages, zircon U-Pb ages, Sm-Nd ages, Rb-Sr ages