Thermal history and heat source of the southern part of Hidaka metamorphic belt

*Ryugen Sakata[1], Kazuhito Ozawa[1], Tsuyoshi Iizuka[1], Keewook Yi[2]

1.Department of Earth and Planetary Science, Graduate School of Science, University of Tokyo, 2.Korean Basic Science Institute

The Hidaka metamorphic belt is an exposed collision zone of island arcs, in which the metamorphic grade increases from the east to the west reaching granulite facies in the western end. Shimura et al. (2015) measured zircon U-Pb ages of the Hidaka metamorphic belt and obtained ~37Ma for the eastern lower-grade zone and ~19Ma for the western higher-grade zone. On the basis of this systematic age zonation, they argued that the Hidaka metamorphic belt was formed through piling up of older and younger crustal sections. However, the heat source of metamorphism and magmatism has not revealed yet.
Peridotite bodies representing mantle materials are distributed along the west margin of the Hidaka metamorphic belt. The largest body, Horoman Peridotite complex, underwent heating and partial melting at the depth of >1GPa, followed by exhumation with cooling, particularly rapid cooling at the depth of <0.7GPa (Ozawa, 2004; Takahashi, 2001). Recent seismic studies in the southern part of the Hidaka metamorphic belt revealed a seismic structure characterized by an eastward-dipping wedge of mantle material extending towards the Hidaka main thrust (Kita et al., 2012). These mantle-side observations suggest that peridotite complex with high temperature played a role as a heat source for the Hidaka metamorphism and magmatism. We examined P-T-t path of metamorphic rocks exposed in the southern end of the Hidaka metamorphic belt, which is characterized by the densest distribution of peridotite bodies, and obtained U-Pb zircon age of the rim of grains from metamorphic rocks and tonalite in order to clarify heating mechanism of the Hidaka metamorphic belt.
There are a few small peridotite bodies along Nikanbetsu and Abeyaki rivers in southern end of the Hidaka metamorphic belt, around which pelitic and mafic metamorphic rocks belonging to granulite to hornblende facies and garnet-bearing tonalite are distributed. The pelitic gneiss consists mainly of Pl+Qz+Bt±Grt±Opx±Crd±Kfd and the mafic rock mainly of Pl+Qz+Hbl+Cpx, in which leucocratic veins consisting of Pl+Qz±Bt±Grt±Opx occur. Garnet-bearing metamorphic rocks and tonalite are distrubuted within the distance of 300m from Nikanbetsu and Abeyaki peridotite complexes, suggesting a temperature gradient toward the peridotite bodies. Metamorphic rocks distribute outside of the areas consists of of pelitic gneiss and mylonite characterized by Pl+Qz+Bt±Ms mineral assemblage and absence of leucocratic veins. The metamorphic rocks are bounded in the east by a large tonalite body with a thrust dipping toward the east., because the garnet-bearing zone is dependent on the spatial distribution of the peridotite mass. We investigated the chemical composition of minerals in the garnet-bearing zone. The. chemical compositions and zoning pattern of garnet and plagioclase grains show systematic spatial variations, suggesting a short-distance thermal gradient in the southern end of the Hidaka belt.
The large tonalite body distributed in the east give 36~39Ma U-Pb zircon ages, which is concordant with Shimura et al. (2015). The tonalite and metamorphic rocks distributed in the west yield 19~22Ma, This age is in accordance with or a alightly younger than the Rb-Sr isochron age of 23±1.2Ma obtained from phlogopite veins of the Horoman peridotite complex, which are thought to have formed during exhumation of the Horoman complex (Yoshikawa et al., 1993). These ages suggest that a hot mantle material acted as a heat source for metamorphism and magmatism in the Nikanbetsu and Abeyaki region. The thermal history of mantle material and subsequent cooling during uplift is recorded in the metamorphic rocks.

Keywords: Hidaka metamorphic belt, thermal history, heat source, garnet, zircon U-Pb age

