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黒瀬川帯に産するペルム紀後期の冷たい沈み込みシステムにおける PrP 相-LBS 相への変成過程
The metamorphic evolution from PrP to LBS facies in a late Paleozoic cold subduction system in Kurosegawa belt

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Introduction: Recent progress of thermal modeling and thermodynamic calculation can help the general understanding of the thermal structure of subducting plate and the total movement of H2O stored in high-pressure type metamorphic rocks from the trench to the upper mantle depth in various subduction settings (e.g., Peacock & Wang, 1999; Hacker et al., 2003). For example, Peacock (2009) indicated that the oceanic plate in the Philippine Sea plate subducting below the Kii Peninsula would suffer the cold HP/LT type metamorphism represented by zeolite facies, prehnite-pumpellyite facies, pumpellyite-actinolite facies, lawsonite-blueschist facies to jadeite-lawsonite-blueschist to 2GPa. However, the natural example recording abovementioned progressive metamorphic evolution has not been recognized yet.

Recently prehnite-pumpellyite facies and lawsonite-blueschist facies units have been recognized in the Otao unit of Kurosegawa belt in Yatsushiro area, Kyushu, Japan (Kamimura et al., 2012). However, the relationship of two metamorphic units has not been verified yet.

In this paper, we propose the progressive change of metamorphic grade from the prehnite-pumpellyite facies to lawsonite-blueschist facies based on petrography and thermodynamic phase analysis in metabasite system.

Petrography and Mineralogy: We confirmed that the prehnite-pumpellyite facies assemblage is predominant in the Tobiishi subunit of (Kamimura et al., 2012), but we newly found pumpellyite-actinolite facies from the western end of this subunit.

In the lawsonite-blueschist facies unit, Hakoishi-subunit of (Kamimura et al., 2012), located to the west of the Tobiishi-subunit, following mineral assemblage with excess chlorite, quartz, albite and phengite are systematically distributed from the east to the west in the subunit:

lawsonite + pumpellyite + aegirine-augite,pumpellyite + Na-amphibole,lawsonite + pumpellyite + Na-amphibole, lawsonite + Na-amphibole + aegirine-augite.

The compositions of sodic pyroxene, pumpellyite and Na-amphibole also show the following systematic trend westwards in the subunit; jadeite component of sodic pyroxene generally increases from XJd=0.12 to XJd=0.50 with XAeg= up to 0.5. Al content of pumpellyite increases from 3.7 to 4.6 p.f.u. for O=24.5 Fe3+/(Al+Fe3+) in Na-amphibole decreases from 0.8 (riebeckite) to 0.15 (glaucophane).

Thermodynamic phase analysis: To evaluate stability relationship among abovementioned mineral assemblages, the phase diagram was construct-ed in the NCFMASH system with PERPLE_X soft-ware package (Connolly, 2005) for 1-10 kbar and 100-400 C. The considered minerals are stilbite, laumontite, prehnite, pumpellyite, ferro pumpellyite, tremolite, ferro tremolite, diopside, hednbargite, clinochlore, daphnite, lawsonite, glaucophane, ferro graucophane, clinozoisite and albite with excess, quartz and water. As the first order approximation, solid solution in each mineral was ignored. The new-ly constructed phase diagram predicts following representative mineral assemblages appear with the increase of the pressure along the high HP/LT path.

lawsonite + pumpellyite + clinopyroxene,pumpellyite + glaucophane,lawsonite + pumpellyite + glaucophane,lawsonite + glaucophane + clinopyroxene.

This metamorphic evolution in the model system is coincident well with the natural observation in the Hakoishi subunits.

Conclusion: Mineral assemblages observed in metabasites of the Tobiishi and Hakoishi subunits and the newly constructed petrogenetic grid suggest the metamorphic grade increases from prehnite-pumpellyite facies to lawsonite-blueschist facies westward ca. 20km in the Otao unit of Kurosegawa belt. The westward increase of Al content in pumpellyite, Na-amphibole, and Na- clinopyroxene also suggest the metamorphic grade increases westward. Thus, this area would become a type locality of a cold subduction system as proposed by the Peacock (2009)s thermal modeling.

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