Magma processes of the plutonic rocks in the Susuma region, Yamaguchi Prefecture, SW Japan : Implications for Cretaceous magmatism in active continental margin

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The Inner zone of southwest Japan was located in the active continental margin along the eastern part of Asian continent during the Cretaceous. Voluminous felsic igneous activities occurred from 110 Ma to 80 Ma. Basaltic magma derived from mantle is assumed as a heat source for the fusion of crust to produce the felsic magmas.The Susuma-Nagao granodiorite and Shimokubara granite are exposed in the eastern part of Susuma region, Yamaguchi Prefecture. They geologically occur as the coeval intrusive rocks. The Susuma-Nagao complex lithologically shows granodiorite to quartz diorite accompanied by gabbro.On the other hand, the Shimokubara granite shows leucocratic and contains porphyritic K-feldspar; thereby both suites show petrographically different character. Therefore, we address the petrological investigation of the Susuma-Nagao complex and Simokubara granite, and discuss a characteristic of voluminous igneous activity from the western part of Sanyo Zone. In this study, we refer to Granodiorite and Gabbro hereafter for the granodiorite and gabbro in the Susuma-Nagao complex.
[Susuna-Nagao complex] Granodiorite shows massive and medium grained and contains plagioclase, hornblende, biotite, quartz with small amounts of K-feldspar. Gabbro is subdivide into wo types; Gabbro-A and Gabbro-B. Gabbro-A is medium grained, consisting mainly of plagioclase and hornblende. Gabbro-B is also medium grained. The constituent minerals are plagioclase, hornblende, orthopyroxene, clinopyroxene and olivine.
[Shimokubara granite] The Simokubara granite is characterized by euhedral K-feldspar up to 5 cm in length and is composed of Quartz, K-feldspar, Plagioclase and biotite.
The boundary between the Susuma-Nagao complex and Shimokubara granite is generally unclear and locally including each other. Samples collected from such boundary have mixing and mingling texture, e.g., acicular apatite, acicular biotite / hornblende, and dusty zoned plagioclase. These features suggest that the Susuma-Nagao complex and Shimokubara granite are the coeval intrusive rocks and locally mixed with each other.
In the Harker diagram, Granodiorite and Gabbro-B make monotonous trends. Chemical compositions of Gabbro-B are plotted off this trend. Gabbro-A geochemically shows cumulous features in the SiO_2/Al_2O_3 vs. Mg# diagram. In addition, Gabbro-B represents high-Mg# values similar to a primitive basalt. The Shimokubara granite makes different trends from those of Granodiorite and Gabbro-B.
The Sr-Nd isotopic compositions corrected with 92 Ma for the Susuma-Nagao complex are plotted in the same domain. However, the Shimokubara granite isotopically shows high- ε SrI and Low- ε NdI rather than those of the Susuma-Nagao complex. In addition, Sr-Nd isotopic compositions of the Shimokubara granite are influenced by those of host rocks.
Considering the geochemical features, the Susuma-Nagao complex could be derived from cognate magma series due to fractional crystallization from Gabbro-B as a parent to Granodiorite as a daughter leaving Gabbro-A as a cumulate. Geochemical characters combined with petrography of the Susuma-Nagao complex and Shimokubara granite reveal that they are originally derived from different magma with limited magma mixing / mingling along their boundary.

An wedge mantle is generally metasomatized by water and melt released from a subducted oceanic plate and partial melting takes place into the mantle, giving rise to an arc basaltic magma. Such basaltic magma becomes as the enriched Gabbro-B magma in the Susuma-Nagao complex. On the other hand, the Shimokubara granite is likely to be produced by partial melting of the middle to lower crust because the Sr-Nd isotopic compositions are affected by those of continental crust.

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