

Origin of felsic middle crust: Evidence from experimental study for Cretaceous I-type granodiorite in Kyushu, SW Japan

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The Asian continent was formed by continental collision during the Late Paleozoic. Japanese island was situated along the active continental margin before opening into the Sea of Japan. The matured continental crust is generally made of mafic lower crust and felsic middle to upper crust in terms of seismic profiles. Here, we report the formation of felsic middle crust along the active continental margin during the Cretaceous, the eastern end of Asian continent. The northern part of Kyushu is underlain by the Cretaceous granitoids. The granitoids consist mainly of hornblende granodiorite with small amounts of coeval diorites, and include cumulous gabbros as blocks. The granodiorite contains magmatic epidote and its emplacement depth is of the middle crust. The granodiorite and diorite make different chemical trends on some variation diagrams. The initial Sr-Nd isotopic compositions, however, resemble each other among three lithologies. The cumulous gabbro contains euhedral hornblende and clinopyroxene with trace amounts of plagioclase. The hornblende could be equilibrium with the granodiorite melt in terms of trace element compositions. Considering geological and geochemical signatures, the granodiorite magma can be produced by partial melting of the cumulous gabbro. To verify the petrogenesis of granodiorite magma, we performed melting experiment by the piston-cylinder apparatus using the cumulous gabbro as a starting material with 900 degree and 800 MPa. The chemical composition of synthetic glasses resembles that of the high-silica samples of granodiorite. The mineral compositions of run products are the same as cumulous gabbro. Results of this experiment can duplicate the formation of high-silica granodiorite magma. The granodiorite magma was chemically modified by mixing with coeval diorite. The magma ascended through the crust and was emplacement at the middle crust. It is an essential process to form the felsic middle crust underneath the volcanic arc setting.

Keywords: Felsic middle crust, Partial melting, Melting experiment