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Structure and growth of the lower crust beneath SW Japan: constraints from xenoliths in Cenozoic alkaline basalts

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Felsic continental crust is thought to be unique to the Earth and is important to constrain material circulation of the crust-mantle system throughout its history. The continental crust is estimated to be chemically stratified; the upper crust is considered to be felsic and the lower crust to be mafic. The crustal materials may interact with the mantle via subduction of crustal materials and/or delamination of the lower crustal rocks. However, lack of a direct evidence of such processes, in particular the latter for the lower crust, prevents us from understanding evolution of the crust-mantle system even in a qualitative sense. The purpose of this study is to constrain a timing of formation and growth mechanism of the lower crust, which will provide fundamental information to discuss evolution of the continental crust and the mantle.

Subduction zones are thought to be a site of continental growth and differentiation. We have conducted detailed analyses of various types of xenoliths in alkali basalt from the Gongen volcano in the Kibi plateau, SW Japan. As we particularly concern the formation and growth timing of it, zircon U-Pb age dating has been conducted, as well as petrology of the xenoliths.

We have collected total 40 xenoliths and observed them using optical microscope and electron probe micro analysis (EPMA). The xenoliths consist of various rock types; peridotite, gabbro, pyroxenite, anorthosite and quartzite. Based on the petrological analysis including EPMA and phase relation study, gabbro, anorthosite and quartzite are likely to have derived from the lower crust. Among the xenoliths, pyroxenite may represent a dense igneous cumulative materials located around the Moho beneath the area. Temperature of the pyroxene cumulate is estimated to be 810 degree C based on olivine-spinel geothermometry [Fabries, 1979]. Anorthosite, in which corundum is observed, exhibits Al-rich bulk compositions. Kyanite and garnet are observed in quartzite xenoliths. The kyanite-bearing quartzite xenoliths, which is estimated to have been formed in granulite facies, exhibits silica-rich and CaO-poor bulk compositions, indicating that sedimentary materials are incorporated into the lower crust of the SW Japan.

To constrain the formation age and the underplating process of sedimentary rocks, we have measured U-Pb ages of zircon crystals in the lower crustal xenoliths. Based on the zircon U-Pb age and petrological analyses, structure and growth process of the lower crust beneath SW Japan is discussed.

Keywords: lower crust, xenolith, south west Japan, zircon U-Pb age