Timing of melt metasomatic event at arc deep crust beneath Ichinomegata crater (Northeast Japan) constrained by LA-ICP-MS U-Pb geochronology of zircon from the mafic xenoliths

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In the Ichinomegata crater, Oga peninsula in the Northeast Japan, abundant amphibole-bearing ultramafic to mafic xenoliths occurred with andesitic magma erupted 0.06–0.08 Ma. The previous studies on their texture and isotope composition suggest that they were metasomatized by aqueous fluid or silicate melt at deep crustal levels. In order to constrain timing of the metasomatic event, we obtained ^{206}U-^{238}Pb ages of zircon from three biotite-bearing hornblende gabbro xenoliths consisting of amphibole ($Mg/Mg+Fe_{total}$= 0.60–0.65), plagioclase (An_{53-86}), biotite ($Mg/Mg+Fe_{total}$= 0.62–0.68), magnetite, apatite and zircon. Zircon grains collected from these biotite-bearing gabbros displayed sub-rounded morphology and complex zoning in cathodoluminescence and BSE images. The textual variation of zircon grains was divided into three types: (1)heterogeneous zircon, which is characterized by heterogeneous Th concentration domains with thorite and rhyolitic melt inclusion, (2)magmatic zircon characterized by oscillatory zoning, and (3)mixed zircon characterized by the “heterogeneous zircon” mantled by the “magmatic zircon”. All the zircon grains exhibited sub-rounded to rounded form. The microstructure of the heterogeneous and mixed zircons suggests that those zircon grains were subjected to recrystallization coupled with dissolution and reprecipitation (CDR) mediated by felsic melt. The rounded shape of most zircon grains suggests that they experienced dissolution in the last stage although magmatic growth followed the CDR for the mixed zircon. The spot ^{206}U-^{238}Pb dating of heterogeneous and magmatic zircon, conducted with a LA-ICP-MS at National Museum of Nature and Science, revealed that concentrations of radioactive Pb derived from U decays in zircon were very low, close to or lower than the detection limit. This means that the recrystallization ages were significantly young (< 1.0 Ma). This is consistent with the observation that the metasomatic agent (silicate melt) has similar isotopic signature to the andesitic host magma (Yamamoto et al. 2013). The recrystallization of these zircons is likely to have occurred in the pre-eruptive activity on the felsic magmatism at a deep crust beneath the Ichinomegata crater.

Reference
Yamamoto et al. (2013) Lithos, 162–163, 88–106

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