

Zircon U-Pb dating from the mafic enclaves and tonalite in Tanzawa Plutonic Complex, Izu arc, Japan

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The study of the arc lower-crust is important for understanding the continental growth. The Izu-Bonin-Mariana (IBM) arc is known as typical intra-oceanic arc. It has been suggested that old IBM arc crust is exposed in the Izu-Collision-Zone due to the collision of the IBM arc against the Honshu arc. The Tanzawa Plutonic Complex, located in the Izu-Collision-Zone, has been regarded as the exposed upper- and middle-crust of the former IBM arc on the basis of the geochemical and seismic data (e.g. Kawate and Arima, 1998; Kitamura et al., 2003). However, petrological and geochemical data of arc lower-crust have not been obtained because it is not exposed on the ground.

To constrain the formation age of the arc lower crust, we applied a method of U-Pb zircon dating from mafic enclaves in granites using LA-ICP-MS. Zircons can survive and retain their formation ages even in the metamorphic overprints and magmatic modifications. We also analyzed trace elements in whole rock and zircons to estimate the origin of mafic enclaves and zircons in them.

In this study, we collected mafic enclaves in the Tanzawa tonalite (4-5 Ma by SHRIMP: Tani et al., 2010), which is intrusive to gabbro (5-6 Ma: Tani et al., 2010) and Tanzawa group (basaltic-andesitic lava and detritus in 3-17 Ma: Aoike, 1997). The mafic enclaves have a doleritic texture. Their shapes are rounded or lenticular, and their contacts with host tonalite are sharp or partially obscure, indicating mafic magma injection into Tonalitic magma. SiO₂ content in mafic enclaves varies from 46.99 to 58.26 wt%. We separated 333 zircon grains from 9 mafic enclaves and 46 grains from the host tonalite and analysed them using LA-ICP-MS at Kyoto University and Advanced Industrial Science and Technology. The REE patterns of zircons in mafic enclaves and tonalite show typical igneous ones. Most zircons in tonalite show clear Eu anomaly, but those in mafic enclaves rarely show. The zircon age population from tonalite indicates relatively narrow range distribution around 5 Ma, resulting in mean age of 4.7±1.5Ma, similar to the U-Pb zircon ages previously determined by SHRIMP (Tani et al., 2010). While the zircon age population from mafic enclaves in tonalite shows wide range distribution from 5 to 43 Ma, most of zircons yielded U-Pb age around 5 Ma. These results imply that the mafic enclaves were affected by mingling/mixing with the tonalitic magma at ca. 5 Ma. Because the Tanzawa group is the juvenile arc basalt on the Philippine Sea Plate, there are three candidates for older than 5 Ma: Tanzawa group (3-17 Ma); the gabbro suite (5-6 Ma); the arc lower-crust. Therefore, the zircons with 18-43 Ma are interpreted to be xenocryst derived from the arc lower crust beneath Tanzawa tonalitic pluton. The oldest zircon age (42.9±8.6 Ma) obtained from mafic enclaves suggests that the arc lower crust formed by at least 42.9±8.6 Ma.

Our result implies that the zircon U-Pb dating for mafic enclave in continental crust can provide a new data for age distribution of the continental lower crust.

Keywords: Arc lower crust, Mafic enclave, Granite, Zircon, U-Pb dating, LA-ICP-MS