Spatial and temporal variations of granitoid plutons in the Izu collision zone, central Japan: Implications for transformation of juvenile oceanic arc into mature continental crust

Satoshi Saito[1] and Makoto Arima[2]
[1]Research Institute for Humanity and Nature (RIHN), Kyoto, JAPAN, saitotetsu@chikyu.ac.jp
[2]Yokohama National University, Yokohama, JAPAN, arima@ed.ynu.ac.jp

Abstract

Neogene granitoid plutons are widely exposed in the Izu Collision Zone (ICZ), central Japan, where the northern tip of the Izu-Bonin arc (juvenile oceanic arc) has been colliding with the Honshu arc (mature arc) since middle Miocene. Three main granitoid plutons are distributed in this area: Tanzawa Plutonic Complex (TPC), Kofu Granitic Complex (KGC), and Kaikomagatake pluton (KP). The TPC and southern part of the KGC were intruded in submarine volcanic piles of the Izu-Bonin arc, while the KP and the northern and central parts of the KGC were intruded in Shimanto metasedimentary rocks of the Honshu arc. The TPC consists of tonalite and trondhjemite and characterized by low K_2O contents (< 2.5 wt %), whereas the KP is characterized by relatively high K_2O contents (3-5 wt %) and composed of granodiorite and monzogranite. Rocks of the KGC range from tonalite, trondhjemite, granodiorite to granite, and show wide variations of K_2O (0.5-7 wt %). Rocks of the TPC and southern part of KGC are significantly lower in incompatible elements such as K_2O than the average upper continental crust. In contrast, rocks of the KP and northern parts of the KGC have compositions comparable to the average upper continental crust.

These ICZ plutons provide an excellent example of the transformation of a juvenile oceanic arc into mature continental crust. Various petrogenetic models have been proposed for these plutons, which are (1) the TPC formed by lower crustal anatexis of juvenile basaltic rocks of the Izu-Bonin arc (Kawate and Arima 1998), (2) the KGC formed by anatexis of hybrid lower crustal sources comprising of both basaltic rocks of the Izu-Bonin arc and sedimentary rocks of the Honshu arc (Saito et al. 2007a, b), and (3) the KP formed by anatexis of hybrid lower crust consisting of K-rich rear-arc crust of the Izu-Bonin arc and sedimentary rocks of the Honshu arc (Saito et al. 2012). These studies collectively suggest that the chemical diversity within the ICZ granitoids reflects the chemical variation of basaltic sources as well as variable contribution of the sedimentary component to the source region. Our model suggests that hybrid nature of the ICZ lower crust.

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