

Calc-alkalic vs. tholeiitic series revisited: new insight from isotopic micro-analyses of plagioclase phenocrysts

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Coexistence of calc-alkalic (CA) and tholeiitic (TH) magmas in a single volcano system is commonly observed in rather matured arcs. Generally accepted mechanisms for production of those two types of arc magmas are fractional crystallization of a mantle-derived basalt magma for TH rocks and mixing between mafic TH magmas and crust-derived, felsic magmas for CA rocks. In order to re-examine the origin of TH and CA magmas, rocks from Zao volcano on the NE Japan arc are analyzed.

Major, trace and Sr isotopic compositions of plagioclase phenocrysts in CA and TH rocks were mapped with micro-analyses techniques. $^{87}\text{Sr}/^{86}\text{Sr}$ of plagioclase occurring in TH rocks is constant at 0.70428 ± 0.00005 , whereas that for CA rocks varies from 0.70337 to 0.70418 with decreasing $\text{Ca}/(\text{Ca}+\text{Na})$ or the anorthite component. If we accept the arc crust having more radiogenic compositions than the mantle, the observation is not consistent with the above general model.

Instead, two isotopically distinct basaltic magmas could form beneath the volcano, one for the TH series produced by anatexis of the preexisting hence more radiogenic mafic lower crust and other for the CA series by partial melting of less radiogenic mantle wedge peridotite. A mantle-derived CA basaltic magma will mix with crustal TH melts to form CA andesites.

