# A new concept for andesite genesis: a case study of Zao Volcano

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Knowledge of andesite genesis should provide key constraints on the origin of continental crust and differentiation processes during early Earth evolution, as the continental crust, the geochemical reservoir for light elements and the most differentiated end-member among components within the solid Earth, is of overall andesitic composition. To improve our understanding of andesite genesis, detailed descriptions of the two magma series rocks, calc-alkalic (CA) and tholeiitic (TH), from a single volcano are needed.

New insights into andesite genesis are based on precise Sr-isotope micro-analyses (100-300 micron diameter) of plagioclase, the most common phenocryst phase in andesites. Plagioclase occurring both as phenocrysts and in a groundmass in TH rocks shows that 87Sr/86Sr is constant at 0.7043+-0.0001 (2sigma), whereas that in CA rocks varies between 0.7042 and 0.7034. 87Sr/86Sr of plagioclase in CA rocks correlates inversely with An-content. This, together with petrographic evidence for magma mixing exclusively for the CA series involving at least two end-member magmas, suggests that basaltic and felsic magmas crystallizing An-rich and An-poor plagioclase could have 87Sr/86Sr of 0.7034 or lower and 0.7042 or higher, respectively. Isotopic compositions of an inferred felsic end-member magma are close to those of TH rocks. It is thus reasonable to speculate that such a felsic magma is co-magmatic with the TH series.

Two different basaltic magmas, the TH and CA series, therefore, may be produced in the subarc upper mantle. Assuming a homogeneous, pre-fluxed, original mantle source for the two magma series, 87Sr/86Sr ratios estimated for the two types of Zao basaltic magmas suggest that the mantle source for CA magmas is more metasomatized by radiogenic, slab-derived components than that for TH magmas. However, such a significant difference in isotopic ratios cannot be quantitatively explained solely by differing contributions of the slab component.

Alternatively, TH magmas having constant and enriched isotopic signatures can be produced by anatexis of the preexisting mafic lower crust, whereas calc-alkalic magmas are products of mixing a mantle-derived, hence isotopically depleted, basaltic magma and crust-derived felsic tholeiites. If so, then major and trace element variations in TH series rocks could result from different degrees of anatexis, which is consistent with inferred liquid lines of descent for the TH magmas.