

Sr-Nd-Pb-O isotope geochemistry of a Quaternary, caldera-forming, phonolitic eruptive sequence; The Diego Hernández Formation, Tenerife, Canary Islands (Spain)

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The Sr-Nd-Pb isotope composition of Late Miocene-Pliocene basalts from Tenerife has been well documented, and the data define a restricted range of compositions ascribed to mixing of two distinct mantle sources [1]. Trace-element and O-isotope variations among younger basalts and phonolites from the island may require the addition of as much as 10 – 20% of the phonolite/syenite parts of the volcanic edifice during their ascent and petrogenesis [2]. We present Sr-Nd-Pb-O data from the major pyroclastic deposits of the Diego Hernández Formation (DHF), a Quaternary, caldera-forming sequence that includes the entire spectrum of magma types found on the island. Sr ($^{87}\text{Sr}/^{86}\text{Sr}_i = 0.70302 - 0.70329$), Pb ($^{206}\text{Pb}/^{204}\text{Pb} = 19.62 - 19.82$; $^{207}\text{Pb}/^{204}\text{Pb} = 15.60 - 15.62$; $^{208}\text{Pb}/^{204}\text{Pb} = 39.45 - 39.65$), and Nd ($^{143}\text{Nd}/^{144}\text{Nd} = 0.51288 - 0.51290$) isotope ratios of DHF pumices have a restricted range that lies within the array of Tenerife basalts. Syenite xenoliths, believed to represent two plutons that reside within the island's edifice, have Nd and Pb isotopic compositions similar to DHF phonolites but exhibit more radiogenic Sr isotopic compositions (up to $^{87}\text{Sr}/^{86}\text{Sr}_i \sim 0.7034$). Mean $\delta^{18}\text{O}$ values of feldspar from laser fluorination analysis of DHF pumices range from 5.6 to 6.3 ‰. These values are lower than expected for closed-system crystal fractionation of highly differentiated alkalic magmas. Also, oxygen isotope variations within populations of comagmatic feldspar phenocrysts suggest disequilibrium. We conclude that assimilation of variable amounts of the volcanic edifice ($\delta^{18}\text{O}_{\text{wr}}$ values as low as 1.1 ‰) has buffered magmatic increases in $\delta^{18}\text{O}$ resulting from crystal fractionation. This process is also likely responsible for variations in Sr isotopes. However, these effects are obscured by frequent recharges by basaltic magma that occur just prior to eruption.

References

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[2] Wolff et al., (2000), *JVGR*, **103**, 343-366.

An enriched mantle-derived adakitic granite-porphyry in the India-Tibet continent collision setting

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Adakite was proposed over a decade ago to be products of the melting of young subducted oceanic crust related to incipient subduction. Its research has received widespread attention due to its close relation to porphyry copper deposits, and many other models for adakite generation have been proposed, such as partial melting of basaltic lower crust or of delaminated lower crust and assimilation-fractional crystallization (AFC) processes. Adakite formed by these processes usually shows characteristics of low Mg and high Na rather than high K, as demonstrated by experimental studies. However, many adakitic rocks especially in continental collision setting, showing some features of typical adakite in arc settings, have much higher K_2O contents. The mechanism responsible for such K-enrichment in adakite is poorly understood. Here we show a derivation directly by a low degree partial melting of a metasomatized mantle for the Cenozoic Yulong potassic adakitic granite-porphyry in the Tibetan-Himalayan orogen that hosts the largest porphyry copper deposit in China. Cenozoic Yulong granite-porphyry in the eastern Tibet shows adakitic affinity in geochemistry, e.g., high SiO_2 (64.8-69.4%) and Al_2O_3 (15.4-17.0%), and low MgO (<3%) contents, depleted in Y (5.1-16 ppm), and enrichment in Sr (612-1024 ppm) with high Sr/Y ratios, and no Eu anomalies. However, these rocks also have shoshonitic characteristics, e.g., enrichment in alkalis, high K_2O contents with high $\text{K}_2\text{O}/\text{Na}_2\text{O}$ ratios (1.1-2.7), enrichment in LREE and LILE, high radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ (0.7062-0.7079) and unradiogenic $^{143}\text{Nd}/^{144}\text{Nd}$ ($\epsilon_{\text{Nd}} = -0.8$ to -2.9) ratios. It is difficult to attribute its origin to either of the models for most adakite including partial melting of subducted oceanic crust or of lower crust and assimilation-fractional crystallization processes. We propose the low degree partial melting of the phlogopite-garnet clinopyroxenite that was produced by interaction between garnet lherzolitic lithospheric mantle and earlier subducted slab-derived fluids or melts for its origin.

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