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The Origin of K-Feldspar Megacrysts Hosted in Alkaline Potassic Rocks from Post-Orogenic Setting: Constraining the Interaction between High-K Calc-Alkaline and Alkaline Magmas

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K-feldspar megacrysts are dispersed in Italian primitive and evolved potassic rocks, which were generated from primary magmas with different end-member affinities (Poli et al., 1984). They also occur in some evolved two-pyroxene rocks and in anatectic rhyolites (Giraud et al., 1986). Populations of megacrysts are commonly found in basaltic alkaline rocks from continental volcanic provinces, but their genesis is not yet clear (Righter & Carmichael, 1993 and references therein). Sr-isotope compositions were used to determine the origin of K-feldspar megacrysts found in primitive potassic and evolved two-pyroxene rocks from the Italian Plio-Pleistocene Volcanic Region. We also want to shed light on the origin of the geochemical variation in alkaline potassic primitive magmas in post-orogenic settings (Foley et al., 1987): is it related to mantle or to low-pressure processes? At Cimino volcano, primitive potassic megacryst-bearing rocks are associated with the evolved rocks. The primitive magmas are shoshonites, which have a lamproite-like affinity, and olivine-latites with a transitional affinity (Conticelli and Peccerillo, 1992), whereas the evolved magmas are evolved latite and trachyte, which have a high-potassium calc-alkaline affinity. No mafic high-K calc-alkaline magmas were, however, erupted from the Monte Cimino system. The evolved two-pyroxene rocks evolved by AFC process associated with refilling by mafic magma, which did not occur in the field. Initial Sr-isotope ratios of primitive rocks strongly increase at constant Mg# and with increasing of incompatible element contents. This trend cannot be generated by either magma mixing between the shoshonitic magmas and the erupted two-pyroxene evolved magmas, or assimilation of high-Sr radiogenic crustal rocks. K-feldspar megacrysts have variable morphologies that range from euhedral in the evolved latites and trachytes to subhedral in the primitive rocks, but in both cases they have unbroken edges. This indicates that they were crystallised in a melt before being trapped in magma en route to the surface. All the megacrysts have a similar chemical composition, which spans a large range from OrD_{88} to OrD_{69}. The composition of phenocrysts and groundmass in all the Cimino rocks is similar to that of the megacrysts, being in the range of OrD_{84} to OrD_{64}, but the groundmass crystals in the olivine-latites are richer in An content than all the other crystals and megacrysts. Core-rim Sr-isotope data were obtained by microdrilling feldspar samples, followed by thermal ionisation mass spectrometry. $^{87}Sr/^{86}Sr$ values of K-feldspar crystals from primitive olivine-latites are between 0.71354 and 0.71398, but core and rim $^{87}Sr/^{86}Sr$ ratios within individual crystals are indistinguishable. In all the primitive rocks, the megacrysts are not in isotopic equilibrium with the host, which is either more radiogenic (0.71385-0.71582) or less radiogenic (0.71333). K-feldspar crystals from both the evolved latite and trachyte have similar Sr-isotope compositions to those in the olivine-latites. However, core and rim $^{87}Sr/^{86}Sr$ ratios of crystals in the trachyte vary significantly (0.71401 to 0.71383, respectively). In contrast, $^{87}Sr/^{86}Sr$ ratios are almost homogeneous in the evolved latite (0.71368-0.71359). As with the olivine latites, the K-feldspar megacrysts are not in isotopic equilibrium with bulk rock compositions of the evolved latite (0.71333) or trachyte (0.71364). On the basis of $\delta^{18}O$ data, some authors have pointed out that the parental magma of the K-feldspar megacrysts are older anatectic rhyolites (Taylor & Turi, 1976), which have higher $^{87}Sr/^{86}Sr$ ratios (0.718-0.720) than the Cimino rocks (Giraud et al., 1986). Self-diffusion processes can, in principle, explain the lower $^{87}Sr/^{86}Sr$ ratios of the Cimino megacrysts with respect to the anatectic rhyolites, but unrealistically long residence times (10^6 years) for the mafic Cimino system would have been invoked. We postulate that the K-feldspar megacrysts are derived from a common parental magma, represented by a relatively low $^{87}Sr/^{86}Sr$ two-pyroxene trachyte. Magma mixing between trachyte and evolved latite and more mafic two-pyroxene liquid distributed the K-feldspar in high-K calc-alkaline primitive magma. Magma interaction between the high-K calc-alkaline primitive magma and lamproite magma distributed the megacrysts among the primitive potassic Cimino liquids (Fig. 1). Magma-magma interaction between high-K calc-alkaline magma and lamproite magma, not evidenced from bulk-rock geochemical data, therefore explains the geochemical trend observed in the potassic magmas with transitional affinity. At Cimino volcano low pressure magma evolutionary processes can explain some of the geochemical variation of the erupted primitive potassic magmas.

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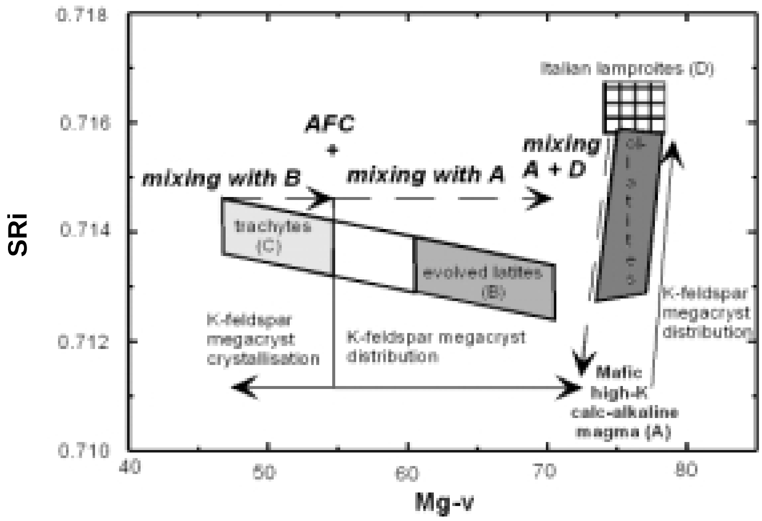

Figure 1: Age-corrected Sr isotope composition (Sri) versus Mg# of Cimino rocks explaining the proposed model for the origin and distribution of K-feldspar megacrysts. This model explain also the geochemical trend observed in the primitive potassic rocks

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