



Crustal contamination during magmatic differentiation: the case of ultrapotassic magmas of Alban Hills (Central Italy)

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During middle/late Pleistocene the Tyrrhenian continental margin of Italy was interested by ultrapotassic magmatism. Primary magmas originate from metasomatized mantle and are characterized by: high CaO and Al₂O₃, high LILE and LREE associated with low HFSE; high initial ⁸⁷Sr/⁸⁶Sr and low initial ¹⁴³Nd/¹⁴⁴Nd ratios. Then, parental magmas emplace into inhomogeneous continental crust and differentiate due to the combined effects of crystal fractionation and crustal contamination. Therefore, for these ultrapotassic primitive rocks it is not trivial to discern to what extent magmatic differentiation and source composition contribute to their geochemical features. In particular, for Alban Hills rocks, we tried to overcome this difficulty by combining petrology, geochemistry, and experimental petrology.

Alban Hills juvenile products are quite peculiar: they are made up essentially of clinopyroxene and leucite and are mostly K-foiditic in composition; thus, even differentiated products are characterized by low SiO₂ content, while the other Italian ultrapotassic districts are characterized by SiO₂-enriched differentiated products (i.e., phonolitic in composition). On the other hand, Alban Hills magmas emplaced into “thick” limestone units and this suggests that carbonate contamination plays an important role during magmas differentiation. Mass balance calculations, indeed, demonstrated that Alban Hills differentiated products can be obtained from the primitive ones (plagioclase-free phono-tephrites) by means of crystal fractionation (Cpx+Lc±Mgt±Ap) and carbonate contamination. Moreover, the measured variabil-

ity of REE, $^{87}\text{Sr}/^{86}\text{Sr}$, $\delta^{18}\text{O}$ of single crystal clinopyroxene gives insights into the mantle source and confirms the mass balance calculations model.

To further constrain the mentioned geochemical model of differentiation, we performed experiments under dry, hydrous and hydrous/carbonated conditions by using the plagioclase-free phono-tephritic composition as starting material. Experiments were carried out at 1 atm, 0.5, and 1 GPa, temperature ranging from 1050 to 1300 °C, amount of H_2O and CaCO_3 in the melt up to 2 and 7 wt%, respectively.

Experiments performed under dry and hydrous conditions produced residual melts showing chemical compositions not comparable to the peculiar Alban Hills liquid line of descent. Under these conditions the melts evolved towards higher SiO_2 contents (i.e., phonolitic composition). On the contrary, experiments performed simulating carbonate contamination produced a differentiation trend resembling the Alban Hills one. The occurrence of carbonate in the melt, indeed, leads the composition of residual melts towards lower SiO_2 contents (i.e., towards K-foiditic composition).

Noteworthy, the comparison of different plumbing systems emplaced in limestones (e.g., Alban Hills versus Vesuvius) shows that not always carbonate contamination leads to SiO_2 -poor residual melts. We believe that an important factor controlling the efficacy of crustal contamination is the dynamics of the plumbing system.