1.2.P10

Oxygen isotope geochemistry of pyroclastic clinopyroxene monitors crustal-CO_2 contributions to Roman-type ultrapotassic magmas

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The combined oxygen isotope investigation and major and trace element compositions of clinopyroxene from Alban Hills pyroclastic deposits constrain the petrological evolution of ultrapotassic Roman-type rocks during the 560-70 ka time interval. Clinopyroxene phenocrysts show recurrent chemical characteristics, and vary from Si-Mg-rich to Al-Fe-rich with no compositional break. The $\delta^{18}O$ values of clinopyroxene cumulates (5.5‰) are in the range of uncontaminated mantle rocks, and the deviation from these values monitors the petrological evolution of the parental magma. The $\delta^{18}O$ values of Si-Mg-rich clinopyroxene (5.9-6.2‰) are slightly higher than typical mantle values, and trace element contents are representative of early stages of magmatic differentiation. $\delta^{18}O$ values as high as 8.2‰ are associated with Al-Fe^{3+}-rich clinopyroxene showing high ΣREE contents, characteristic of crystals formed during the late magmatic stages. Geochemical modelling of $\delta^{18}O$ values vs. trace element contents indicates that the ultrapotassic magmas were derived from fractional crystallization plus assimilation of limited amounts of carbonate wall rocks starting from a primary alkali-basaltic melt, and from interaction with CO_2 derived from country rocks during crystal fractionation.

1.2.P11

Partitioning of Li, Be and B in a K–rich rhyolitic ignimbrite

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Lesbos Island (Greece) comprises a thick sequence of Miocene volcanics overlying a metamorphic basement of late Palaeozoic to early Mesozoic age (e.g. [1]). The ignimbrite of Lesbos is 17.0 ± 0.5 Ma old [2], over 100 m thick and covers approximately 190 km^2. The deposit is densely welded and contains a high amount of glass (both ash matrix and fiamme). Glass components are alkali-rhyolitic in composition (69 to 72 wt% SiO_2; 6.6 to 7.9 wt% K_2O). Most of the glass is well-preserved and suitable for analysis with in-situ analysis methods. Therefore, samples of this ignimbrite offer a chance to study mineral/melt partition coefficients for Li, Be and B in rhyolitic melts. Phenocrysts of sanidine, plagioclase, biotite, and minor amounts of Fe-Ti-oxides, clinopyroxene, Ca-amphibole, apatite and zircon are present within the glassy fiamme and the pumice.

Major and trace element concentrations were determined by EPMA, SIMS and LA-ICP-MS in the phenocrysts and in the glass. The abundances of most elements in the glass show little variation, including Be (4.6 to 5.9 µg/g) and B (89 to 105 µg/g). Although phenocrysts may show considerable zoning in their trace element contents, their rim compositions are nearly constant for each phase. Therefore, we can present apparent mineral/melt partition coefficients for sanidine, plagioclase, biotite, clinopyroxene and amphibole.

In contrast, the abundances of Li in the glass are highly and virtually unsystematic variable (4.8 to 46.6 µg/g). Moreover, plagioclase and biotite phenocrysts show a pronounced core-to-rim decrease in Li contents, while Be and B as well as major element concentrations are constant within individual grains. Li concentrations in the glass are always higher than in phenocryst rims and often also higher than in the phenocryst cores, confirming the incompatible character of Li. Therefore, the core-to-rim decrease of Li in the phenocrysts requires a loss of Li from the system during crystallization.

The large variation in Li observed in the glass may be due to a significant loss of Li during eruption and ignimbrite deposition, most probably by degassing of melt fragments. However, the abundances of B and other fluid-mobile elements (e.g. Cs, Ba, U, Pb) in the glass are constant.

References

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