Apatite- and K feldspar-hosted primary carbonatite melt inclusions from mantle xenoliths, Hungary

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Samples

We studied metasomatic mantle xenoliths, consisting of clinopyroxene, apatite, K feldspar and phlogopite, were found in lamprophyre dikes in central Hungary. A large number of multiphase primary carbonatite melt inclusions (CMI) were observed in apatite and K feldspar, but clinopyroxene and phlogopite are barren. Average PM normalized REE distribution of apatite and K feldspar hosted CMI (n=60 and n=20, respectively) are shown on Fig. 1. Both CMI in apatite (Ap) and K feldspar (Kfs) are extremely enriched in LREEs relative to HREEs analyzed by LA-ICP-MS.

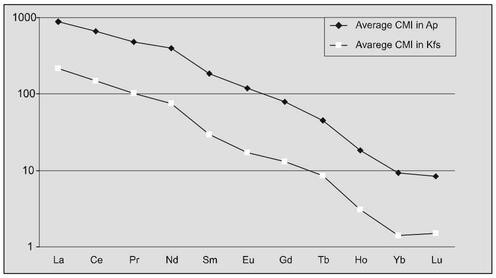

Figure 1: PM normalized REE patterns.

Discussion

It is a characteristic geochemical feature that CMI in Kfs contain small amount of P and that in Ap do small amount of K. The REE distribution of CMI in both host minerals show similar pattern (Fig. 1), suggesting common origin of their melts. It is also supported by some unique CMI hosted in Ap having trace element composition and pattern similar to CMI of K feldspar. All of these indicate that there was a liquid-liquid separation between a P-bearing carbonatite melt and a carbonate-bearing silicate melt before crystallization of the host minerals. It seems that the liquid-liquid separation was caused by dramatic compositional change in the continuously migrating “initial” carbonatite melt. This change was linked with an open-system metasomatic interaction between the “initial” melt and the peridotite mantle.

Conclusion

The studied xenoliths were formed by metasomatic interaction between the peridotite mantle and the P-bearing, Mg-calcitic “initial” carbonatite melt.

Fluid composition, density and viscosity changes along terrestrial Pressure-Temperature paths associated with particular tectonic processes

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Physical properties determine how buoyant fluids rise (density) and how fast they flow (viscosity). Such physical properties will also depend on fluid composition, especially where mineral solubility is high. We have modeled the thermal and chemical behavior of dehydration fluids with dissolved constituents generated in and above subduction zones, and also along burial and exhumation paths in the crust. Silica solubility has been used as an example (e.g., Gerya *et al.* 2005). SiO_2–H_2O fluid viscosities at quartz-saturation have been modeled following Audétat & Keppler (2004). Silicate-bearing fluid densities have not yet been measured, so in the interim, we have modeled SiO_2–H_2O fluid densities at quartz-saturation. We assumed an ideal mixture and combined solubility data with properties of the end-member liquids. The results show that fluid-rock interactions are likely to follow distinct patterns along different *PT* paths. For example, buoyant fluid flow into the overlying hot mantle wedge is up *T* (while down *P*) and follows a dissolution path, whereby fluids may create permeability, facilitating higher fluxes. Fluids flowing along the slab-mantle interface move to lower *T* and *P* and precipitate dissolved matter, which acts to decrease porosity and probably permeability and reduce flow rates in that direction. Our analysis reveals that subtle differences in fluid *PT* ascent paths, strongly influence both solubility and fluid density-viscosity evolution along paths and thus also the efficiency and rate of mass transport. Low-viscosity and low-density fluids have the greatest chance of moving at higher velocities. With increases in density, solute concentration increases, buoyancy decreases and viscosity increases. Increased solubility of mineral in fluid thus decreases ease of ascent, but tends to work in the opposite *PT* direction. So fluids related to rock burial become increasingly dense and more viscose, and thus less mobile. In contrast, rising fluids tend increase their buoyancy and decrease their viscosity but because solute concentrations also decrease, fluid ascent can become restricted by precipitation.

References

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