FLUIDS IN UPPER MANTLE XENOLITHS FROM THE RIO GRANDE RIFT, NEW MEXICO, USA

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Mantle-derived volatile-rich fluid inclusions can give important information on chemical features and physical condition on fluid regimes in the upper mantle. These volatiles may play also an important role in understanding the fluid/mantle rock interaction in the lithospheric mantle causing mantle metasomatism (BELKIN & DE VIVO, 1989; O'REILLY & GRIFFIN, 2000). Besides, the Rio Grande rift (abbreviated to as RGR) in New Mexico (USA) is an excellent place to study the evolution of the subcontinental lithospheric mantle to better explain its temporal and spatial heterogeneity. However, fluid inclusions study has not been carried out yet at the RGR.

Alkali basalt-hosted spinel peridotite xenoliths (~15 Ma age) were collected from Adam's Diggings in the RGR. We selected five representative spinel peridotite xenoliths which are the most abundant in fluid inclusions (FIs). Based on fluid inclusion petrography (e.g., ROEDDER, 1984), three kinds of FIs can be distinguished, which are: Type IA (healed, fracture-related, large negative crystal shape; 10–25 μm), Type IB (opaque-solid-bearing, less-small negative shape; 5–10 μm), and Type IC (exsolved spinel-related, spherical shape; 5–10 μm). We studied the FIs by the use of heating-freezing stage (microthermometry), high resolution Raman spectroscopy and FIB-SEM (Focused Ion Beam-Scanning Electron Microscopy) techniques. These FIs are characterized to be CO_2-dominated with other minor components (visible melting occurred at -58.0 to -56.8±0.2 ºC). The calculated CO_2 density for Type IC, IB and IA show 1.05–1.12 g/cm^3 and 0.98–1.08 g/cm^3, and 0.69–0.86 g/cm^3, respectively.

Raman analysis showed that, in addition to the CO_2-rich liquid, Type I FIs contains Mg-carbonate in each case. Furthermore, Type IA fluid inclusions showed a CO_2-H_2O system with hydrous solid (amphibole). Type IB and Type IC FIs showed a CO_2-N_2 system, but they also have a sulfur-bearing opaque solid.

FIB-SEM technique provided more information for solid phases within the FIs. In some FIs a thin glass film with vesicles can be observed at the wall of the FIs. Type IA FIs contain Ca-bearing sulphate, Fe-bearing oxide, Mg-carbonate, amphibole, but Type IB & IC have Fe (Ni-Cu-Co)-bearing sulphide.

Mantle fluids in RGR could experience at least three events in order to form three dominant FIs system indicating the complexity of mantle fluids in the RGR.

References

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