Preliminary study of CO_2-rich fluid inclusions in upper mantle xenoliths from the Rio Grande rift, New Mexico

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Introduction

Study of fluid inclusions in mantle xenoliths can provide useful information on fluids that interact with the mantle lithosphere (e.g. Andersen and Neumann, 2001; Hidas et al., 2010). Knowledge of their existence and composition is essential in understanding mantle processes (e.g. Roedder, 1984).

In our study mantle xenolith-hosted fluid inclusions have been investigated to get information on fluids in a rift tectonic setting.

Sampling

The studied spinel peridotite xenoliths were collected at the Rio Grande rift (New Mexico, USA) far from the rift axis; occurrence is called Adam's Diggings. The age of the host basalt has been determined up to 15 million years.

Fluid inclusions petrography

Host minerals of fluid inclusions are orthopyroxenes and clinopyroxenes. Two fluid inclusion generations were distinguished on the basis of textural appearance. According to definition of Roedder (1984), one generation is the petrographically primary and psuedosecondary, whereas the other one is petrographically secondary. The primary inclusions can be characterized by having negative crystal shapes with a size ranging between 2 and 14 microns and are randomly distributed and isolated. The secondary inclusions have elongated shapes and occur along healed fractures. Their size varies from 13-80 microns.

In this study we are focusing only on the negative crystal shaped fluid inclusions. These inclusions have mainly one visible fluid phase at room temperature, but solid phase could also be rarely seen.

Microthermometry

We conducted microthermometry to determine composition and density of the inclusions' fluid phase. The melting (dissolution) temperatures are consistently –56.9 °C (± 0.1 °C, n=40).Homogenization into the liquid phase is observed between –30.2 °C and –16.5 °C. These observations indicate that the trapped fluid is dominated by CO_2. The density of CO_2 was calculated between 1.015 and 1.077 g/cm^3 using the equation of state developed by Span and Wagner (1996).

Raman spectroscopy

Raman spectroscopy show Raman peaks at 738.5 and 1094.0 cm^{-1} (when focusing with the laser spot on the solid phase) indicating the presence of magnesite. However, indication for any other fluid molecules than CO_2 was not found, even at high temperature (150 °C).

Conclusions

The presence of fluid inclusions indicates that high-density CO_2 were entrapped in the lithospheric mantle beneath Rio Grande rift.

Acknowledgement

Part of these results has been carried out in the framework of the REG_KM_INFRA_09 Gábor Baross Programme.

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