CO_2-SO_2-H_2O fluid inclusions in peridotite xenoliths from Jeju Island (South Korea)

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Representative peridotite xenoliths have been selected for detailed study from three different alkali basaltic outcrops of Jeju Island (South Korea). Based on the modal composition, the majority of the studied xenoliths here is spinel lherzolite with minor amount of spinel harzburgite. All of them shows coarse grained protogranular-porphyroclastic texture.

Fluid inclusions in every xenolith are intergranular, crosscutting the rock-forming mantle silicates, and applying the definition of Roedder (1984) are considered as secondary ones with respect to the formation of the host minerals. The fluid inclusion associations always consist of several hundred negative crystal shaped fluid inclusions ranging in size from 2 to 60 µm. Furthermore, small-sized fluid inclusions (<10 µm), even in olivine, are usually of one-phase at room conditions and show no indication for any decrepitation, whereas the large, partially decrepitated ones contain one (liquid) or two phases (vapor and liquid phase with various volume proportions).

Combined microthermometric and laser Raman microspectroscopic techniques were used to investigate the fluid compositions. By using a Linkam heating-freezing stage we observed the solid phase melts at -56.6°C (±0.3°C) with no other observable melting events indicating that the trapped fluid is dominantly CO_2. In contrast, the homogenization temperatures show a much wider range. As a general rule the smaller the fluid inclusion, the lower the homogenization temperature, regardless of the host mineral.

Fluid inclusions with high density (1.03-1.10 g/cm^3) were found in every xenolith, where sufficient number of heating-freezing experiments could be done. Microthermometric data on Jeju xenoliths did not succeed to identify other volatile components than CO_2. Hence, Raman analyses were carried out to determine other volatile components at room and elevated temperatures (~170°C). At room temperatures CO_2 and SO_2 was detected, whereas at high temperatures, beside the CO_2, and SO_2 the peaks of H_2O dissolved in CO_2 (*e.g.* Sterner & Bodnar, 1991, Diamond, 2001) were also observed resulting in an average composition of the CO_2-rich phase at around 170 ºC as follows: CO_2 94,2 mol%, H_2O 5,72 mol% and SO_2 0,1 mol%. It is noteworthy to mention that SO_2 in mantle fluids is not a common volatile component therefore further investigations are necessary to interpret its presence.

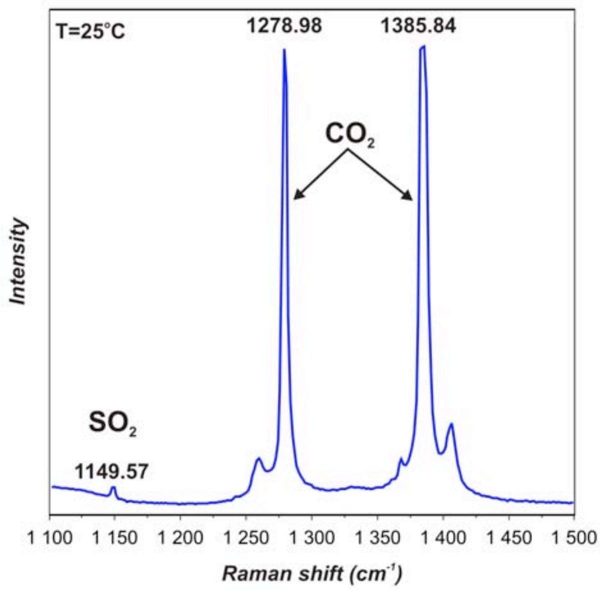

Fig. 1. Representative Raman spectra of CO_2 and SO_2 in orthopyroxene-hosted fluid inclusion taken at room temperature. Peak positions are determined by fitting with Gaussian-Lorentzian function

As summarized, fluid inclusions entrapped at upper mantle conditions in the deep sub-continental lithospheric conditions contain small amount of H_2O and SO_2. The widespread occurrence of fluid inclusions in the Jeju peridotite series also indicate that the upper mantle is crosscut by several C-O-H-S bearing fluid inclusion zones, which could significantly affect the mantle rheology beneath the island, however, based on the petrographic evidences, the fluid entrapment can be regarded as a late stage event in the evolution of the shallow sub-continental lithospheric mantle.

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