Raman spectroscopic behavior of nitrogen in CO_2-rich fluid inclusions of mantle xenoliths

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It is known that the majority of the Earth's recent atmosphere consists of nitrogen. It is, however, said that a large fraction of nitrogen resides in the mantle. Nitrogen and its speciation manner in the mantle has been a subject of many studies recently (e.g., [1-3]). The reason is that nitrogen at mantle depth exists predominantly in fluids, from which degasses easily, playing significant role for instance in the Earth's atmosphere formation and modulation. There are different explanations to where the nitrogen can be stored in the mantle, nevertheless, fluid phase remain one of the most significant containers in the mantle.

In this study we offer an option to recognize the formerly non-detected nitrogen in the deep lithospheric. We show a technique by using Raman spectroscopy with high spectral resolution.

Ultramafic upper mantle and felsic granulite xenoliths, having CO_2-rich negative crystal shaped fluid inclusions, have been selected for this study. Raman spectroscopy on these fluid inclusions discovered the presence of nitrogen in small amount (around 1 mol%) in a way that both the peak of nitrogen from the air and from the fluid could be detected.

In addition, peak position of nitrogen in the fluid has been proved to be dependent on the fluid density in the density range of 0.13 and ~0.9 $g*cm^{-3}$. This study, therefore, offers a method to detect even small amount of nitrogen (not less than ~0.2 mol%) within deep lithospheric fluid inclusions and shed lights on a fact that nitrogen could be no longer considered as an exotic component in the deep lithosphere.

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