Role of Hydrogen and Oxygen fugacity in incorporation of Nitrogen in reduced magmas of the early Earth's mantle

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In a series of experiments in the system Fe-bearing melt + molten Fe phase + N + H conducted at 4 GPa, 1550 °C, and $f\mathrm{O}_2$ from 2 to 4 log units below IW buffer we have characterized the nature and quantified the abundance of N and H species dissolved in a model silicate melt ($\mathrm{FeO} + \mathrm{Na_2O} + \mathrm{Al_2O_3} + \mathrm{SiO_2}$). To elucidate the mechanisms of nitrogen and hydrogen dissolution in magmas, we studied the glasses produced by quenching the melts using infrared and Raman spectroscopy's in a manner similar to that reported by [1]. Experiments indicate that under the reduced conditions corresponding to the $f\mathrm{O}_2$ path during metal segregation and self-oxidized of mantle [2] and magma ocean [e.g. 3, 4] the silicate melt would contain species with N-H bonds ($\mathrm{NH_3}$, $\mathrm{NH^{4+}}$, $\mathrm{NH^{2-}}$, $\mathrm{NH^{2+}}$) as well as $\mathrm{N_2}$ and oxidized H species (OH- and $\mathrm{H_2O}$). Some hydrogen is present in the melt in molecular form. The formation of N–H bonds in the reduced silicate melts results in a significant increase in nitrogen solubility that can reach 1–2 wt. %. It is suggested that significant amounts of nitrogen, comparable to those estimated for the present-day mantle, could have been incorporated in the early Earth by dissolution in reduced magma ocean.

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[1] Mysen *et al.* (2008*) AmMin* **93**, 1760–1770 [2] Galimov (2005) *EPSL* **233**, 263–276. [3] Wood *et al.* (2006) *Nature* **441**, 825–833. [4] Frost *et al.* (1008) *Phil Trans Royal Soc* **A 366**, 4315–437,

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Differentiation of ophiolitic and nonophiolitic gabbros using confocal Raman spectroscopy: Central Anatolia Turkey

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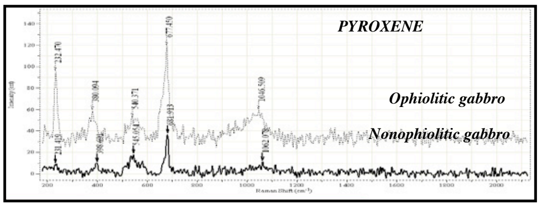
Ophiolitic gabbros are mostly exposed at west of Tuz Lake and nonophiolitic gabbros are exposed at east of Tuz Lake in Central Anatolia. Ophiolitic and nonophiolitic gabbros have almost same mineral and geochemical compositions. Discrimination of the ophiolitic and nonophiolitic gabbros was carried out using the Raman spectra of the pyroxene minerals. Based on Raman peak positions, the major-element composition of the (Mg, Fe, Ca)-pyroxenes are determined and classified.



Results and Discussion

Raman vibrational modes were observed for the pyroxenes in the wave number range between 200 and 1200 cm^{-1} (Figure 1). The Raman modes showing the greatest variation in frequency with the $\mathrm{Fe^{2+}}$and $\mathrm{OH^{+}}$content are potentially capable of being used as an index for determining the ophiolite and nonophiolite pyroxenes of the gabbro series. The best Raman modes for this purpose in the ophiolite pyx series are ν_6 (232–540 cm^{-1}) and (677–1046 cm^{-1}) pairs that show about 60 cm^{-1}across the series. The ν_{15} (931–950 cm–1) mode can also serve as a supplementary mode for the determination of the composition. These modes are characteristic and fairly intense. However, in the nonophiolite pyx series, because only the ν_3 (231–545 cm^{-1}) and $\nu_{3'}$ (681–1046 cm^{-1}) pairs show a variation more than 20 cm^{-1}. These provide a weaker basis for the composition indices. The uncertainties in the determination of the Fe content with the Raman modes are of the order of 3 and 7%.

[1] Lin, I.H. (1995) *Raman Spectroscopy study of (Ca, Mg, Fe)-Pyroxene*. Master Thesis, National Taiwan University, **74** p.