Oxidation state of Iron in Glass Inclusions: a Microspectrophotometric Contribution

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An original setting, combining a Cassegrain microscope and a UV-visible-near IR spectrophotometer, focusing the beam down to 50 μm diameter, has been used to get optical absorption spectra (OAS) of glass inclusions in minerals in the 330 - 2500 nm range.

OAS of trachyandesite glass inclusions trapped in olivine, from the Yasur vulcano (Vanuatu arc) [1], have been studied. The olivine spectrum obtained shows the contribution of Fe^{2+} in M1 and M2 octahedral sites, consistent with previous olivine OAS [2]. It clearly demonstrates the validity of the method. Beam focused by the Cassegrain microscope allows to selectively probe glass inclusions, without any contribution of the host olivine matrix. The broad absorption bands in the near IR indicate a range of distributions between 4-, 5- and 6-fold coordinated Fe^{2+}, in agreement with what can be observed in most Fe-bearing silicate glasses [3]. The extinction coefficient of Fe^{2+} in glasses has been estimated from reduced synthetic glasses which mimic trachyandesitic compositions. The comparison with the apparent absorption coefficient of Fe^{2+} in the glass inclusions gives access to the Fe oxidation state. The redox ratios of Fe are consistent with the results obtained using Fe K-edge micro-X-ray absorption near-edge structure spectroscopy (μ-XANES). This provides a confirmation of the oxidative formation conditions of the trapped melt inclusions. We will discuss the advantages and limitations of this new way to extract redox data on geological samples.

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