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# Fe oxidation state in heat-treated basaltic blue sapphire samples and its implications to the 3309 $cm^{-1}$-series peaks in infrared absorption spectra

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Ti atoms bond with Fe atoms and exchange their electron particles in the adjacent octahedral sites. This process produces the blue color on the blue sapphire. The Ti content is an important key to the alteration of the 3309 $cm^{-1}$, 3232 $cm^{-1}$, and 3185 $cm^{-1}$ (3309 $cm^{-1}$-series) peaks in infrared absorption (FTIR) spectra of blue sapphire samples. To study the effect of Fe and Ti oxidation state and the behavior of the Ti-related peaks in FTIR spectra during the heating process, the blue sapphire samples from Phrae and Kanchanaburi, Thailand were collected regarding their basaltic origins. The heating experiment was performed. The samples were step-heated at 800 ℃, 1000 ℃, 1200 ℃, 1400 ℃, and 1650 ℃ under an oxidizing atmosphere, with 1 hour soaking time at each temperature. The FTIR spectra and the X-ray absorption spectra (XAS) were measured before and after heating. Before heating, the FTIR spectra showed only the peak at 3309 $cm^{-1}$ while the side peaks at 3232 $cm^{-1}$ and 3185 $cm^{-1}$ start to appear after heating at 800 °C. The 3309 $cm^{-1}$-series peaks were assigned as -Ti-OH stretching. The intensity of those peaks was slightly decreased after heat-treated. The XAS spectra revealed that the oxidation state of Fe is still $Fe^{3+}$ while Ti is still $Ti^{4+}$ in every heating temperature. The results pointed that the alteration of the 3309 $cm^{-1}$-series peaks does not depend on the Fe and/or Ti oxidation state.

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