A BLUE VARIETY OF ROSE QUARTZ.

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The color of massive rose quartz is due to pervasive pink nanofibrous inclusions of a phase related to dumortierite. The color of natural blue quartz is attributed to the scattering and absorption of light by minute inclusions of iron-titanium oxides. In this work we extracted colored, acid-resistant nanofibers from 2 different colored variations of ‘rose quartz’ from Bahia, Brazil. Both the pink fibers and the initial rose quartz exhibit a broad optical absorption band at 500 nm. A lavender, almost blue, sample and the associated fibers show a pair of absorption bands at 500 and 615 nm, illustrating that the color of the quartz depends upon the color of the fibers it contains. Raman spectroscopy identified both fibrous residues as the dumortierite-related phase.

Heating experiments at 600°C show that the color of the fibers is unstable in an oxidizing atmosphere. The intensity of the 615 nm band decreases more slowly than the 500 nm band. During subsequent heating of the now colorless fibers in highly reducing conditions, blue color (615 nm band) in the formerly lavender fibers returns but pink color does not reappear in either sample.

Because these fibrous materials are close to dumortierite in chemistry and structure, it is reasonable to consider the color-producing mechanisms in dumortierite as a proxy for the fibers from the rose quartz. Different mechanisms involving $Fe^{2+} \Leftrightarrow Fe^{3+}$ and $Fe^{2+} \Leftrightarrow Ti^{4+}$ IVCT were proposed to explain the color of pink and blue dumortierite. Our XRF data show that the lavender and pink fibers have Fe/Ti ratios of 5 and 0.3 respectively, with approximately the same Fe+Ti content. It is likely, that in the low Fe/Ti sample, all of the Fe is involved in charge compensated Fe^{2+}-Ti^{4+} pairs, with no “excess” of Fe to produce $Fe^{2+} \Leftrightarrow Fe^{3+}$ centers. In the high Fe/Ti sample, all of the Ti is coupled to Fe^{2+}-Ti^{4+} pairs, so the intensity of the blue component in the optical spectrum depends on the ferric/ferrous ratio of the sample. Because the absolute number of the Fe-Ti pairs is low in both cases, partial oxidation of Fe quickly removes the 500 nm component of the optical spectrum in both samples. Blue color disappears only when nearly all of Fe^{2+} is oxidized to Fe^{3+}. It is also likely that the duration of our heating experiments is sufficient to assure that enough Fe diffusion occurs along the Al(I) chains to decouple Fe and Ti. If so, we have a plausible explanation for the inability of these samples to regain their pink color component upon reduction.

Our results show that the color of ‘rose quartz’ depends on the color of the fibrous inclusions which itself depends on both the Fe/Ti and the Fe^{2+}/Fe^{3+} ratios in the fibers. In this respect, blue or lavender quartz can be considered a blue variety of rose quartz. In nature we find a range of colors of ‘rose quartz’ from pink to purple, but have not yet seen the blue end member of this continuum.