Is Quartz SiO2 or SiO4? An Infrared Spectroscopy Perspective

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A mineral is based on its unit cell structure. The unit cell structure of quartz is a tetrahedron with silicon at the center and oxygen at each surrounding tetrahedron apex. That is, it is SiO4. This has led for sites such as mindat to call its formula as SiO2 for years, then switch to SiO4 for years, and now it has switched back.

From an infrared standpoint, we can compare two key marker bands of the SiO4 inosilicate and nesosilicate groups to quartz. We use the dominant infrared trough, the Christiansen trough (CT), for one. We use the nearby dominant trough in the Restrahalen region at lower wavenumbers to the CT and call it the Restrahalen trough for the other (RT). These two correlate to each other strongly.

As Figure 1 shows, quartz at the upper-right is exactly within this SiO4 silicate trend. As Figure 2 shows for the spectra of massive milky quartz and opal-CT, from an infrared standpoint, the two don't have very much in common. They are clearly not SiO4 flavors of each other. The author proposes that quartz is SiO4. Tridymite and cristobalite are close to opal but likely still SiO4. The author maps quartzine and moganite bands in infrared as well as distinct minerals. They are only found with quartz, so they are presumptively SiO4 also. All of the opals are SiO2, which is why their spectra are so different.

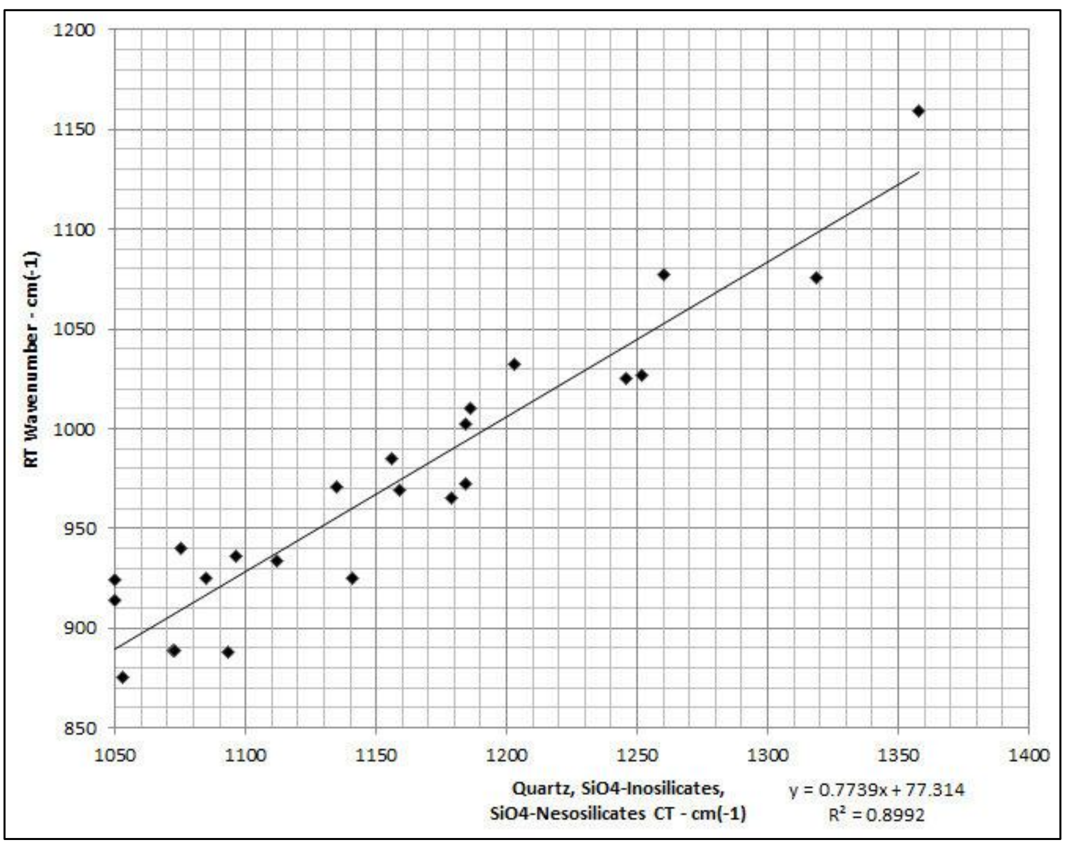

Figure 1. The CT and RT bands for the inosilicates, nesosilicates with SiO4 formulas, compared to quartz.

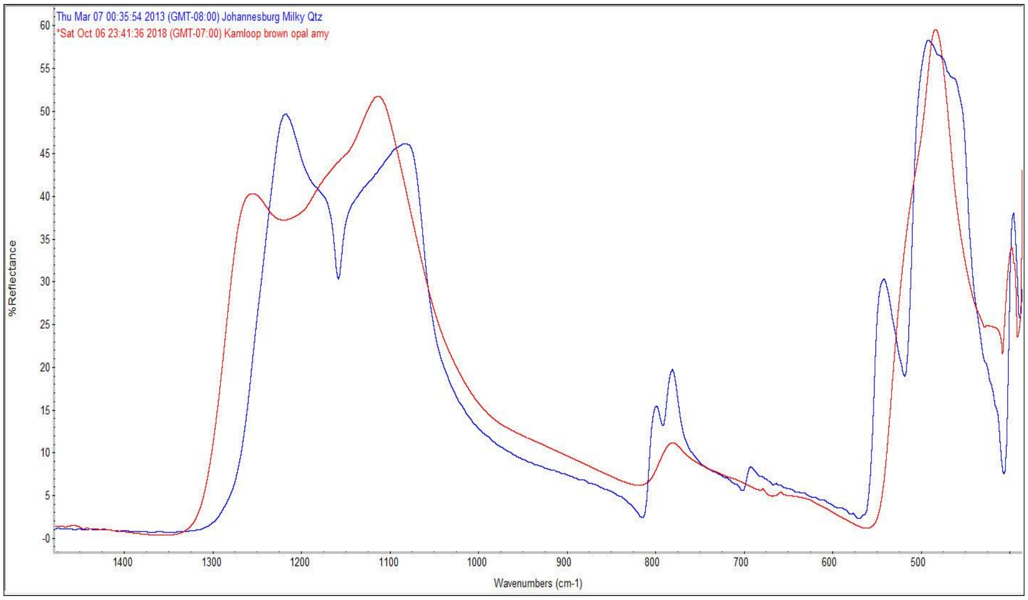

Figure 2. The infrared spectra for milky quartz (blue) and opal-CT (red).