Agate is Just a bunch of Quartz---Except when it is Neotocite

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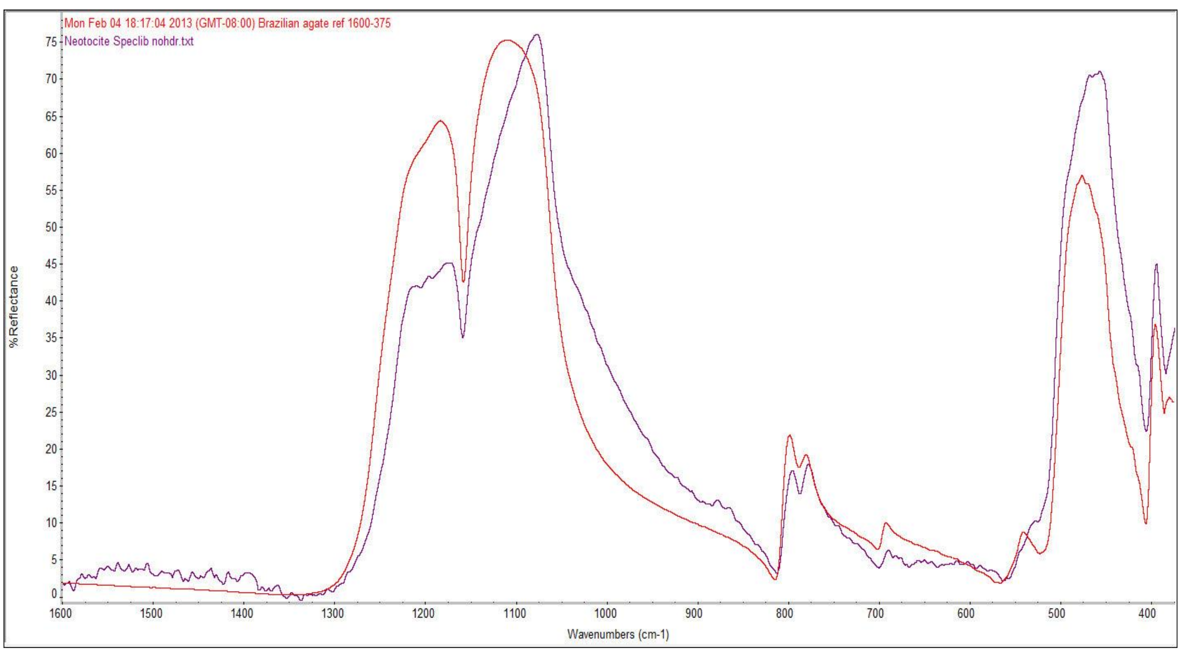
For any geologic study, we first have to specify our use of terms, since the literature is often poor, conflicting, and just out right backwards.

Looking up quartz, we have opal and quartz crystals, and since their infrared spectra are quite different, they are not all just a bunch of SiO_2. IR spectra reports structural information and compositional information, so different spectra are different minerals. For this reason, the author has written and posted before that opals are most likely SiO_2, and quartz is SiO_4. The silica group without including opal is all SiO_4. So that would be tridymite, quartz, cristobalite, melanophlogite, moganite, coesite, stishovite, and all their low and high temperature and intermediate transitional forms of them.

For neotocite, its formula is listed as (Mn, Fe, Mg)SiO_3 x H_2O. Let us compare a quartz and neotocite reference standard, since they are both based on the SiO_4 structure (Figure 1).

Figure 1. Brazilian agate comprised of quartz versus a neotocite reference (red spectrum) from Arizona State University Speclib project. They use emission infrared to mimic satellite probes of planets, whose infrared is quite similar to reflectance infrared the author uses. The neotocite is contaminated with a small amount of calcite making a peak at 1600-1400 cm-1 and 875 cm-1. The other calcite bands are not discernible. Those visible bands are seen around quartz refractive minima.



What is the difference in these two silica minerals in infrared? The neotocite is clearly SiO_4 related quartz structure, with a greatly reduced 1200 cm-1 region peak. The presence of foreign cations appears linked to this band suppression, as it is consistent and does not occur otherwise.

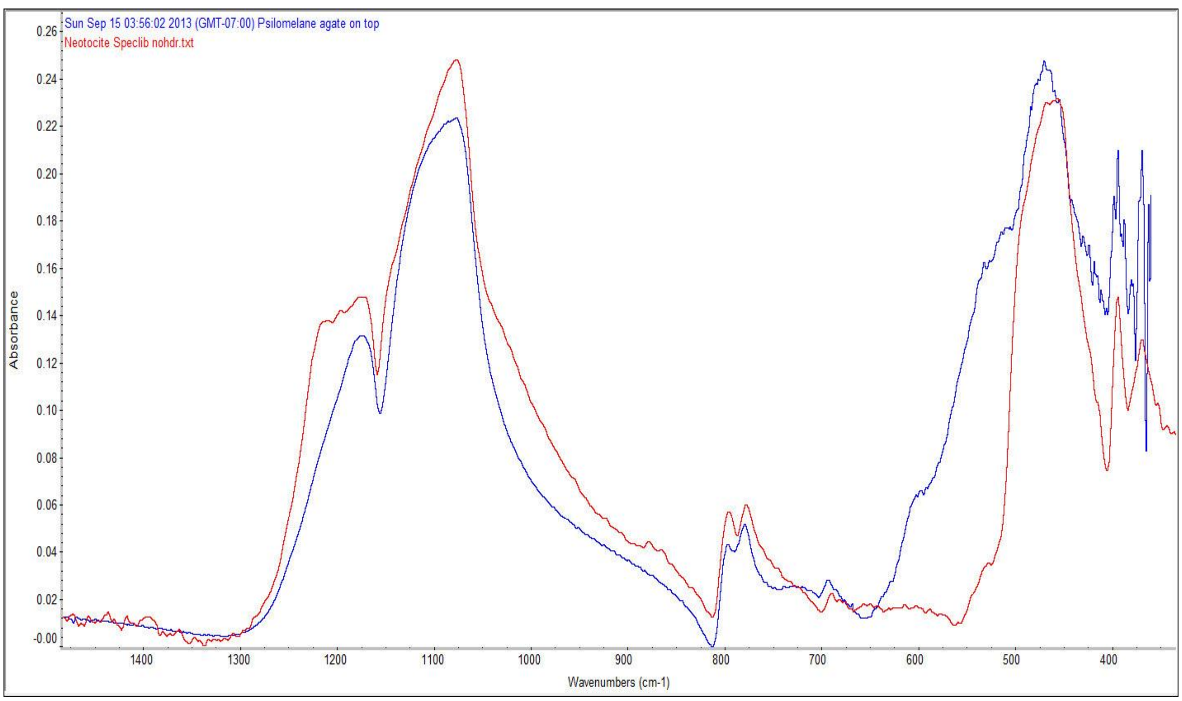
The second thing we see is that in the proposed formula, Fe and Mn are transitional metals. They are put there because their atomic structure relates to similar chemical and physical behavior, so the author would then propose that the following metal cations can be found in neotocite when we start looking, which is: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn. In addition, it is found with goethite which is FeOOH and the author finds this IR behavior in dolomitic agates, which has CaMg. Titanium, vanadium, and zinc are rare, so we will exclude those. We then get the formula for neotocite as:

Neotocite: (Cr, Mn, Fe, FeOOH, Co, Ni, Cu, Mg, CaMg) SiO3 x H2O, a quartz analogue

Since Mg is an alkali metal, and so is Ca, our list may include all of the alkali metals we find with this quartz related IR structure in the future.

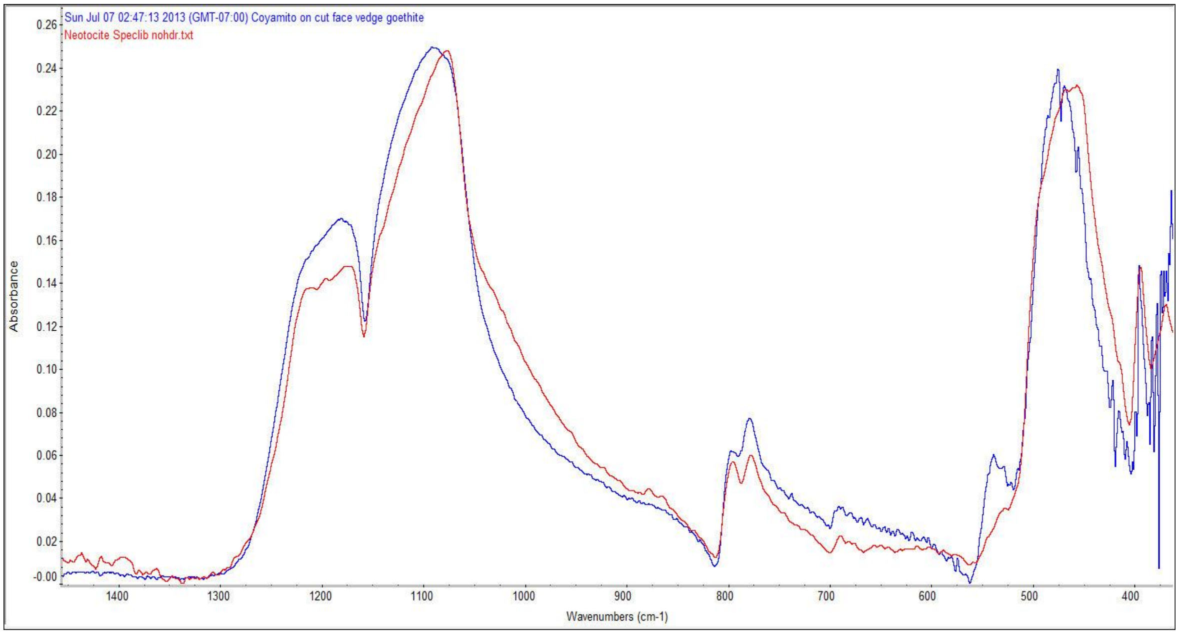
Do we have evidence of an agate with manganese? Yes, we do in a famous mine site in Northern Mexico, and here is its spectrum compare to the neotocite reference (Figure 2).

Figure 2. Psilomelane (romanechite) agate from Mexico versus a neotocite reference (red spectrum). Peak distortions on the right are from very high concentration of romanechite. This is a manganese oxide.



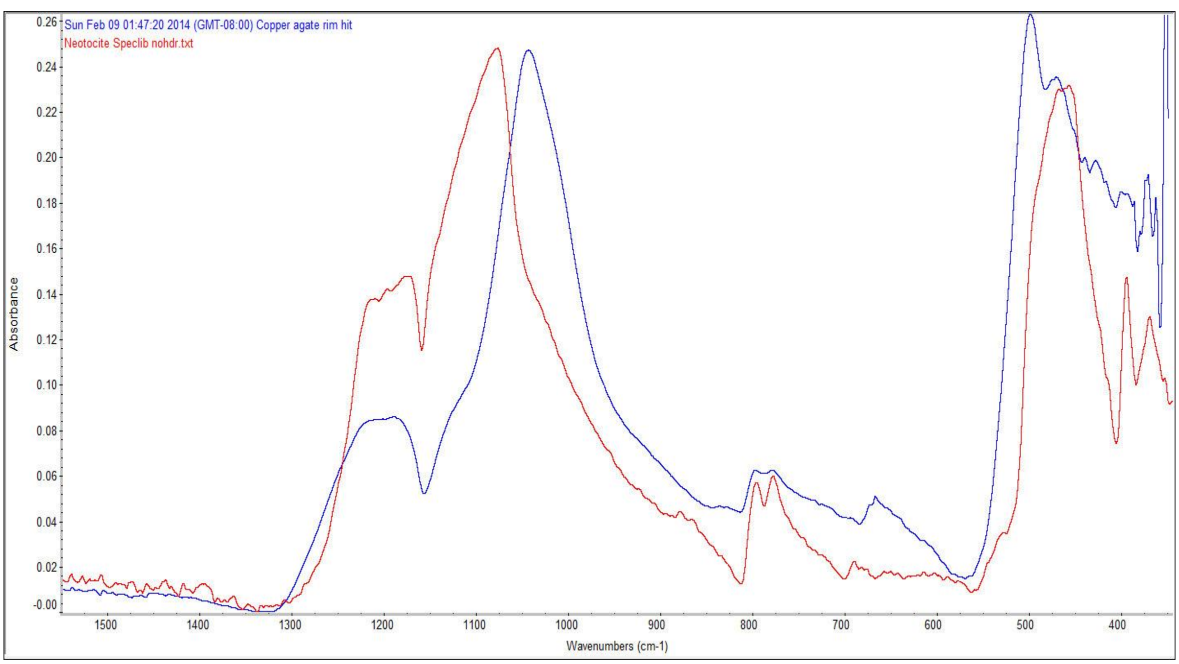
If we take a look at the goethite shell of a Coyamito, Mexico agate, we get FeOOH neotocite (Figure 3).

Figure 3. Coyamito, Mexico goethite shell versus a neotocite reference (red spectrum).



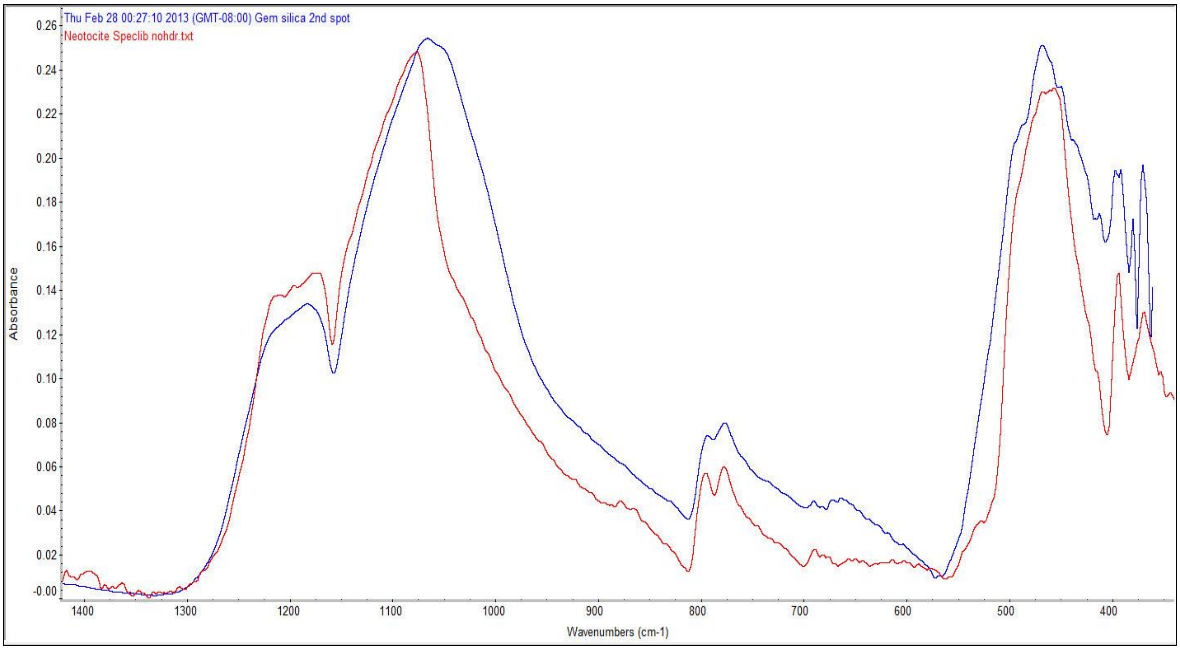
If we want to study Cu, we look at Lake Superior copper agate (Figure 4).

Figure 4. Lake Superior, MI native copper included agate versus a neotocite reference (red spectrum). Its main peak around 1000 cm-1 is also shifted maybe as this is native copper and not a copper oxide or copper carbonate mix.



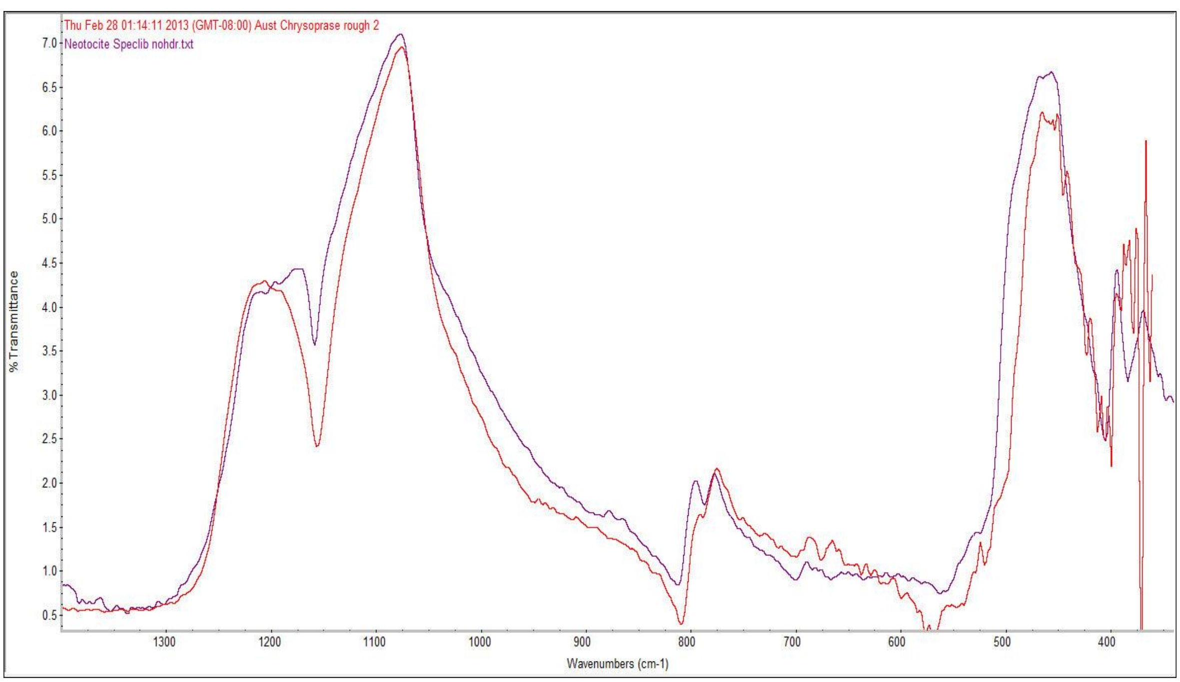
Since the peak shifting of copper in agate is something different, let us look at malachite in agate. Malachite is a copper carbonate (Figure 5).

Figure 5. Malachite agate called gem silica in the mineral trade versus a neotocite reference (red spectrum). Malachite is a copper carbonate. We see the 1000 cm-1 peak is broader.



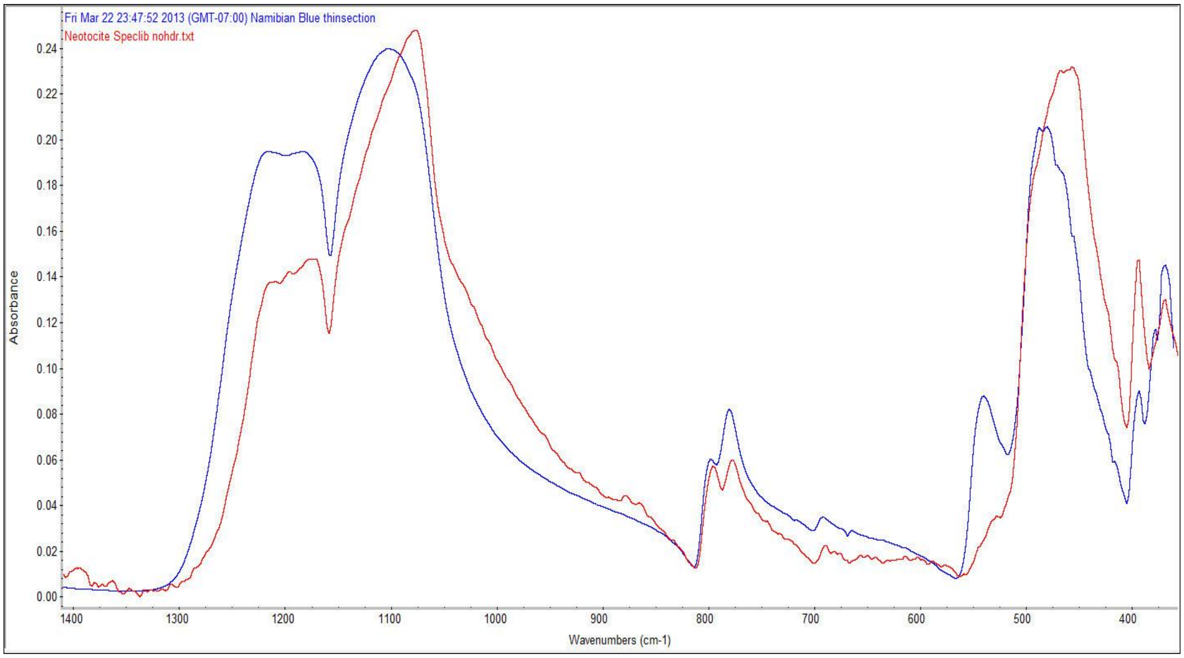
If we want to hunt for Ni, that is quite rare, so we have to get some Australian chrysoprase. This is massive quartz with Ni colorant (Figure 6).

Figure 6. Australian chrysoprase, a massive granular quartz with Ni versus a neotocite reference (red spectrum).



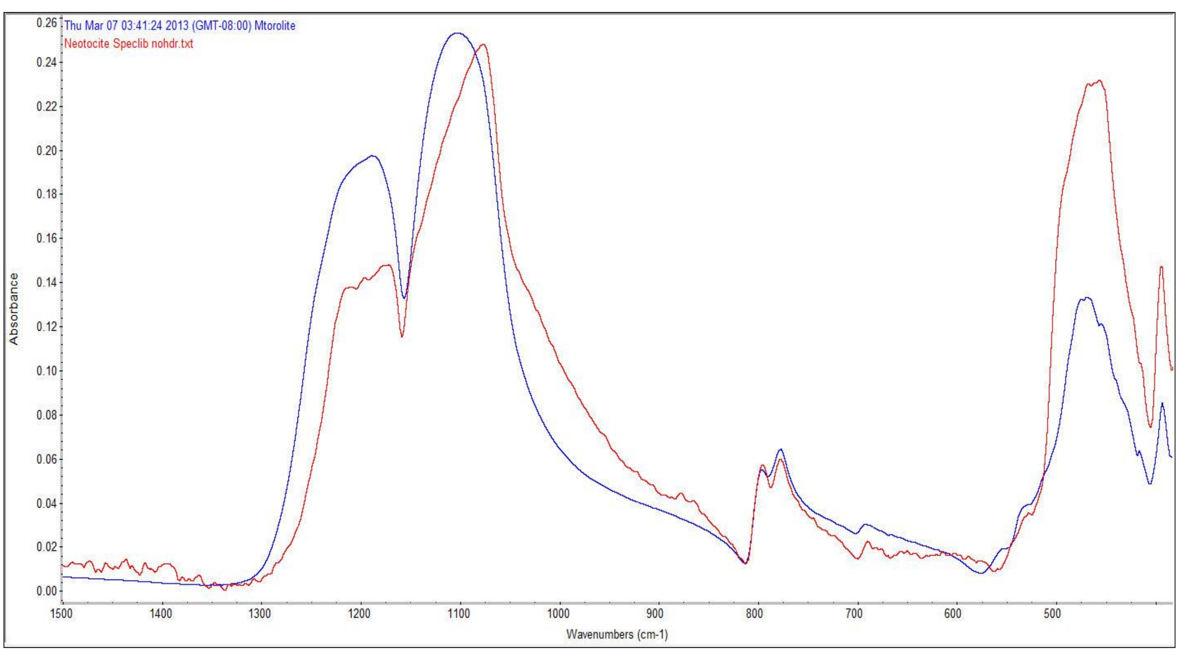
In the neotocite cation list, the author includes dolomite as CaMg, because of Namibia blue, shown in Figure 7, and the implication in some formula reports of neotocite with Mg.

Figure 7. Namibia blue, a vein agate from Namibia with powder blue color, formed in dolomite, versus a neotocite reference (red spectrum). This has crystalline quartz instead of fine quartz grains so the 1100cm-1 peak in Namibia blue is rounded not slanted, an effect of granularity.



An agate out of Zimbabwe called mtorolite has a mix of Ni and Cr. Its spectrum is shown in Figure 8.

Figure 8. Zimbabwe mtorolite with Cr and Ni, versus a neotocite reference (red spectrum). The very low 475cm-1 peak of mtorolite is from a high concentration of moganite. The 550cm-1 ledge is not quartz, it is moganite.



Conclusions:

The following statements of the literature summarized at the mindat web site on neotocite are false:

1. The mineral is amorphous. No, it is a quartz analogue.
2. It is a phyllosilicate. No, it is a quartz analogue. It is microgranular quartz and transitional metal cations and at least some alkali metal cations.
3. It is isotropic. No, quartz is not isotropic.
4. There doesn't seem to be any basis to link neotocite to hisingerite in a mineral series.

Metal cations in infrared mixed with quartz quashes the 1200 cm-1 quartz doublet substantially, and causes the 1100 cm-1 peak to arch over to lower wavenumbers. This is part of the v-wedge broadening of these two peaks that seems related to granularity of some quartz specimens.

Neotocite is not amorphous, it is granular quartz with transitional metal cations.