What is the source of fibrosity in pietersite?

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Perhaps the most pervasive and prevailing myth in mineralogy is the presumed composition of pietersite. With a fibrous look and schiller effect, it is widely reported to be from the amphibole mineral riebeckite. Whether reported as such in mindat, or gem web sites from gemselect to gemlab, they all do the same thing, namely, they report common myths, convert them into facts, and publish this information as science. None show a method of spectroscopy to confirm this mineral identification.

Infrared spectroscopy of a sample of pietersite I purchased contains a number of anomalous bands that are hard to identify. But, its water bands are distinct with a quartet at 3666, 3650, 3635, and 3618 cm-1 infrared. This quartet is very rare. Comparing to a Japanese infrared research report on amphiboles in Japan, this quartet is related to the mineral cummingtonite, and in their report they report manganocummingtonite. They studied 7 common amphiboles in infrared. This is the only one they reported with this quartet.

This past week I finally obtained a cummingtonite that is not filled with mostly quartz. While sold as this mineral, it is dominated with a matrix of cordierite with dense fans of cummingtonite within it locally. Its look is so similar to the African pietersite, it led me to compare my unknown graphs of pietersite to this specimen. The graphs are close but not an identical match. Cummingtonite has a number of compositional series, and mine appears to grade to the iron part of the series as grunerite. This shifts the quartet bands somewhat.

So, our pietersite contains cummingtonite not riebeckite. But does Tiger's Eye have riebeckite? The answer is unknown as the fibrous mineral is trace in a sea of quartz, but the Arizona tiger's eye contains quartz, calcite, bentonite, and riebeckite, the latter two identified by their unique water band positions. Riebeckite water sits at 3690 cm-1 with a sharp spike.

Looking at Australian marra mamba, and African tiger's eye, water spectral bands from the atmosphere interfere with the water bands to identify trace riebeckite, so with better tuned optics and improved infrared output in my system, I have to take a look again. At this time, the data leans strongly to the mineralization being richterite, not riebeckite. No band even with atmospheric water noise, indicates riebeckite so far in these rocks.

What has been used to identify riebeckite in these rocks? Generally, the attempt to identify them by refractive index using polarizing microscopes has been the technique. Refractive index is helpful but not conclusive to identify minerals. For example, The U.S. Geological survey 100 years ago used refractive index to claim the identification of nephrite jade on the Eel River in Northern California. This has led hundreds of miners to this region to collect their riches. Google since scanned this report and so it contaminates our literature forever, even though infrared scans of samples sent to me from the miners shows a variety of serpentine minerals dominated by diopside. The Eel River has zero confirmed nephrite as shown by any method of spectroscopy.

The lesson from this is that you cannot reliably identify serpentine group minerals without mineral spectroscopy, just as color does not prove bulk composition, and a look or morphology does not prove a

particular mineral presence. These so-called mineral and gem sites are notorious for repeating populist clichés as science without scientific evidence.

Lastly, let us compare this analysis to the GIA paper on pietersite published in 2010 by Heaney and Hu. They used X-ray spectroscopy which could not get a signal beyond quartz and calcite. Why could they not study the water? X-rays cannot study water. They bounce off crystal structures with a good signal, but not largely amorphous materials such as water, opal, and amber. Based on a look using microscopy, they concluded the mineralization was riebeckite (crocidolite fiber variety). The refractive index they got was 1.54, which is quartz. So essentially, they missed the boat completely with this material, then converted their estimation of crocidolite into a fact.

Arizona cummingtonite in cordierite.

Update:

3737 cm-1 is a spectral band in the mineral water region that forms when heat treating snakeskin chalcedony. As I get a 3735 cm-1 ledge in the water region for some tiger's eye that extends to 3714 cm-1, it does overlap the band position for richterite. However, since the 3737 and 3735 band are the same thing, the most likely outcome is that the specimens I scanned have been heat treated, rather than representing richterite. Other specimens do not have this band, and no amphibole water is detected for African tiger's eye with an updated laser configuration adjustment producing ten times the laser throughput I used previously. The brown layers in tiger's eye are goethite and quartz. The Arizona tiger's eye clearly contains riebeckite. This is detectable as it has areas rich in calcite and was scanned in both silica-rich and calcite-rich areas. The riebeckite was found in the calcite-rich areas. Why? Less vibrational competition with silica as the calcite has very different vibrational band positions. So the riebeckite has less silica competition with quartz to detect with a lot of calcite around.