The Xanthoxenite Mess

Tom Mortimer

The Palermo #1 Mine in N. Groton, New Hampshire is the co-type locality for xanthoxenite. Moore and Ito provided a lengthy discussion on this species in their 1978 article in *Mineralogical Magazine*. Their opening paragraph stated: "*A review oj xanthoxen and xanthoxenite.* Xanthoxenite is an enigmatic species. Originally described by Laubmann and Steinmetz (1920) as *Xanthoxen* from the Hiihnerkobel pegmatite, Bavaria, Frondel (1949) resurrected the name for a basic calcium ferric phosphate from the Palermo No. I mine, North Groton, New Hampshire." A few paragraphs later, we have "Unfortunately,Frondel could not locate the type specimen of Laubmann and Steinmetz. He stated, 'The conclusion thus seems forced that the Palermo material is identical with xanthoxenite, in spite of the discrepancies in the description of the two substances.' It was impossible to locate any 'xanthoxenite' or 'xanthoxen' sample that unambiguously proved to be the type specimen". Following much technical discussion the Moore and Ito article concludes: "We propose that the xanthoxenite of Frondel (1949) be adopted as the specific term in mineralogical nomenclature and that his material be defined as the neotype. It is a late-stage mineral and occurs as a cavity and fracture filling from the Palermo pegmatite, [and]Hiihnerkobel, Hagendorf"

Moore and Ito describe xanthoxenite as very soft, waxy translucent and pulverulent character. "Pulverulent" is an unfamiliar term. The dictionary definition is given as "Crumbly, friable, given to crumbling to powder." Mindat.org gives the xanthoxenite chemistry as $Ca_4Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 3H_2O$.

Xanthoxenite has been included on New Hampshire mineral species lists for many decades. Phillip Morrill, 1960, *New Hampshire Mines and Mineral Localities* booklet lists it from Alstead, not Groton, which in hindsight, is most surprising.

I purchased my first xanthoxenite specimen from Excalibur Minerals, Peekskill, NY, Aug 11, 2006, at the East Coast Mineral show. Given Excalibur was the source for this specimen, I greatly trusted the identification. Reviewing the xanthoxenite species in 2024 and knowing Tony Nikischer of Excalibur performed EDS for many years, I contacted Tony to inquire if he had analytic data to support the identification. The label accompanying the specimen had a blacked out name of Curten Mineral Co. Forwarding this information to Tony, he replied: "The late Forrest Cureton was the king of rare species dealers, and his identifications were consistently excellent. He relied on authors, analytical work by the late Dr. Sidney Williams of Phelps-Dodge, Andy Roberts, chief X-ray mineralogist at the Geological Survey of Canada, and many other competent scientists. I have a very high level of confidence in his material."

Bob Whitnore's book, *The Pegmatite Mines Known as Palermo*, has a rather remarkable Fred Wilda illustration of xanthoxenite crystals, p.174. Bob loaned me many of his rarer specimens to photo in 2013. One was a xanthoxenite specimen, figure 2. I believe this is the specimen that was the source for Wilda's illustration. It is unknown how Bob arrived at the xanthoxenite identification.

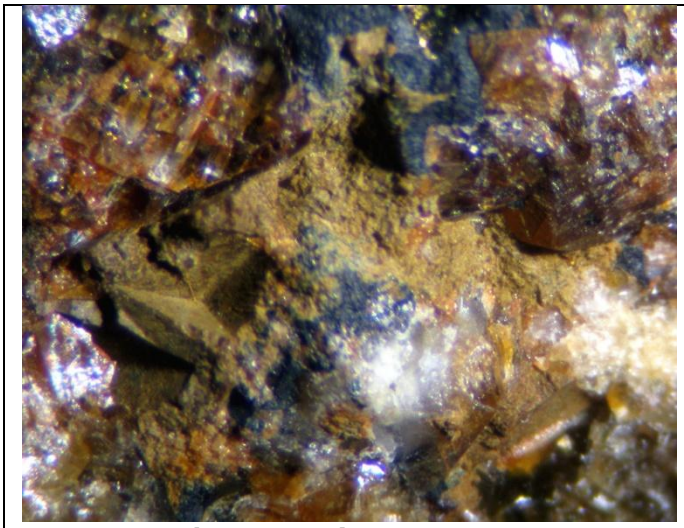

Figure 1. Xanthoxenite Palermo Mine, Groton, NH
6 mm fov, yellow-brown, waxy, Xanthoxenite in center

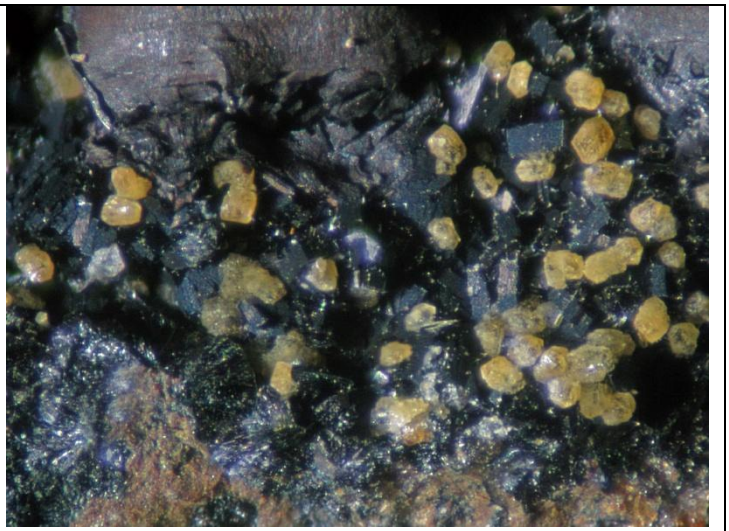

Figure 2. Xanthoxenite – A Bob Whitmore specimen, 2013
0.1 mm (TINY!) xanthoxenite crystals on rockbridgeite

In the fall of 2020 I found a specimen in a tub of Palermo "mine-run" material gifted by Bob Whitmore. This had tiny yellow crystals on rockbridgeite, very similar to those in figure 2. This specimen is shown in figure 3, my # u2734. I have not tested these. A jahnsite group species is a good visual suggestion.

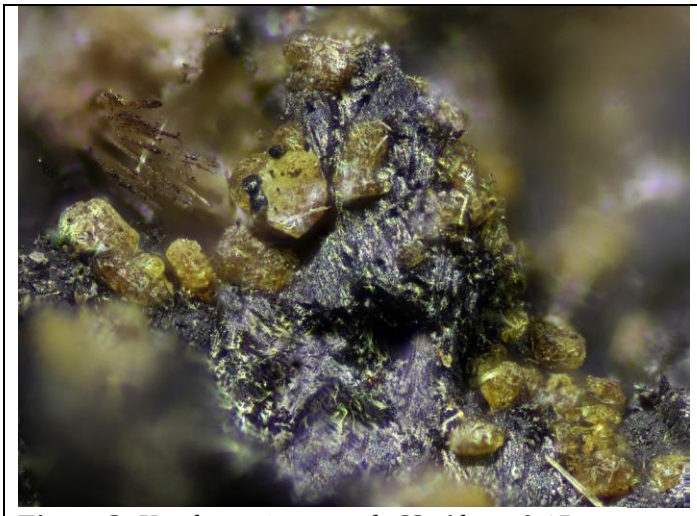

Figure 3. Xanthoxenite crystals ?? About 0.15 mm

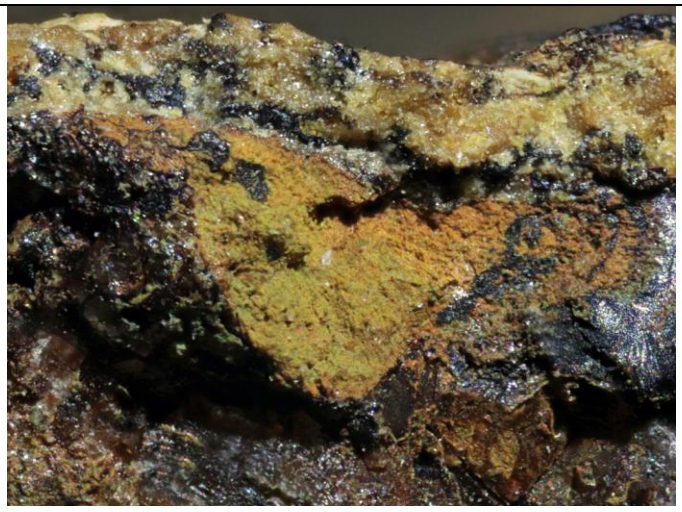

Figure 4. Xanthoxenite like – see discussion. 2.2 mm fov

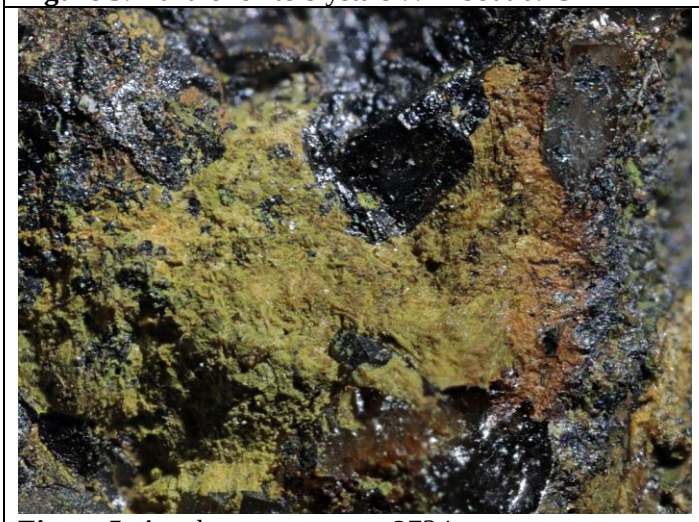

Figure 5. Another area on my u2734

Figure 6. Another area on my u2734

A specimen with embedded brown-yellow masses was in a box of Forrest Fogg Palermo specimens gifted to me by Gordon Jackson, figures 4 - 6. (Gordon acquired much of the Forrest Fogg collection.) EDS analysis of the figure 4 material (BC561) indicated a chemistry of $Ca_{0.38}Fe_{2.22}Mn_{0.18}P_{2.0}O_{7.8}$. The Fe is about the same APFU as P. The best fit would seem to be richellite, $CaFe^{3+}{}_2(PO_4)_2(OH,F)_2$. I analyzed this expecting a chemistry approximating xanthoxenite, as the appearance of this material is very similar to my Excalibur purchased Xanthoxenite specimen.

This prompted a research into xanthoxenite chemistry. Xanthoxenite chemistry has changed substantially over several decades. Going back to *Dana's System of Mineralogy* , 7th edition, 1957, xanthoxenite chemistry is given as $Ca_2Fe(PO_4)_2(OH) \cdot 1.5H_2O$ and includes a supporting analysis of a Palermo sample. Fleischer's 1971 Glossary gives the xanthoxenite chemistry as $Ca_4Fe_2(PO_4)_4(OH)_2 \cdot 3H_2O$, simply doubling the element APFU's of Dana. Moore's 1973 *Mineralogical Record* article "Pegmatite Phosphates", p. 106, lists a xanthoxenite chemistry of $(Mn,Fe)^{2+}{}_3Fe^{3+}{}_3(OH)_3(H_2O)_7(PO_4)_4$ that omits a requirement for calcium and implies a requirement for some Mn. The MR species description notes "Most unfortunate is the apparent loss of the type material of the original investigators." Seigler, Kampf, Whitmore, et. al., Sept./Oct., 1981 *Rocks & Minerals* "Phosphate Minerals of the Palermo Mine" has the 1971 Fleischer formula and describes xanthoxenite "As ~~peruvulent~~ pulverulent [tm article spelling corrected] aggregates and coatings; occasionally as soft laths and tablets to 0.4 mm. Straw yellow to butterscotch yellow."
As noted above, xanthoxenite occurs "occasionally as soft laths." The specimen with the zones shown in the first two photos also has a zone with the "soft laths" shown in figure 6. [tm I need to analyze this.] This area has the appearance of altered messelite.
Messelite, also a calcium iron phosphate, has a similar chemistry: (using the 1.5 H_2O so all have 2 P)
Messelite: $Ca_2(Fe^{2+},Mn^{2+})(PO_4)_2 \cdot 2H_2O$
Xanthoxenite: $Ca_2Fe(PO_4)_2(OH) \cdot 1.5H_2O$
Richellite: $CaFe^{3+}{}_2(PO_4)_2(OH,F)_2$
The chemistry difference between messelite and xanthoxenite is just the loss of one hydrogen atom!

Most recently, I acquired another xanthoxenite specimen, 8/25, from Ted Johnson, Yankee Minerals, at the Capital Mineral Club show, for $15, figure 7. The label indicated that it was an ex. R. Januzzi specimen. George Adleman performed a Raman probe of this specimen, figure 8. The RUFF Raman plot reference plot is not particularly sharp. The Raman plot George obtained is reasonably close to the RUFF reference.

Figure 7. Xanthoxenite (per label)
Palermo #1 Mine, Groton, New Hampshire
4.5 cm specimen. Yellow-tan is purported xanthoxenite

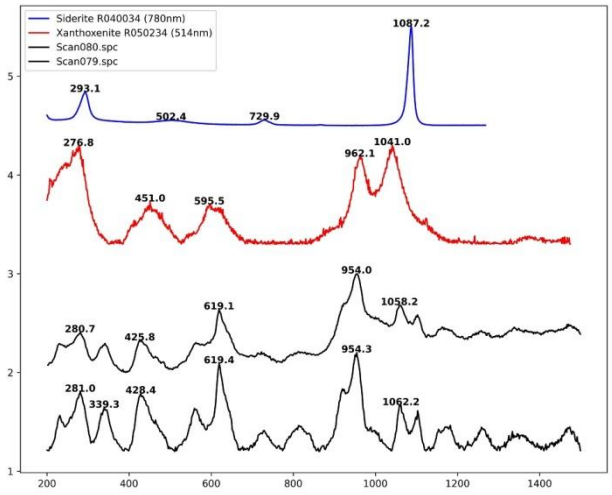

Figure 8. Raman analysis. Red trace is the RUFF reference. Lower two traces are from the tested specimen. Most of the specimen matrix is siderite.

Conclusion. My EDS analysis of candidate xanthoxenite specimens has failed to obtain a good match for the species. None of the mindat.org xanthoxenite specimens have a supporting analysis. Several simply rely on the dealer's label identification. The George Adleman Raman plots are the most convincing to date.