Sinkankasite and Gatumbaite from the Palermo Mine, N. Groton, NH

Tom Mortimer

Sinkankasite is a very rare species found at the Palermo mine. A Fred Wilda illustration of a Palermo sinkankasite is included on page 160 of Whitmore and Lawrence's *The Pegmatite Mines Know as Palermo*. It shows stellate sprays of milky crystals about 0.2 mm across on vivianite. When Bob Whitmore offered me the opportunity in 2015 to photograph his Palermo specimens, he did not have a sinkankasite. Bob did, however, have a boxed miniature specimen with sprays of gatumbaite, Figures 1 and 2. The specimen label reads: "Found by G. Bjareby in 1948." Gatumbaite is not listed in *The Pegmatite Mines Known as Palermo*.

Figure 1: "GATUMBAITE" Palermo Mine, N. Groton, NH
2 mm field of view. Gatumbaite on bed of vivianite crystals.

Figure 2: "GATUMBAITE" Palermo Mine, N. Groton, NH
7 mm field of view. Radial sprays of gatumbaite on bed of vivianite crystals.

The inner area of the sprays of Figure 2 appear zoned dark-blue suggesting perhaps a different mineral? The mineral base for the specimen is un-altered triphylite. The triphylite surface is covered with very small vivianite crystals. The gatumbaite is on top of these micro-vivianites. From *American Mineralogist*, vol. 69 pg. 382: "Sinkankasite has been found at the Palermo Mine, in North Groton, New Hampshire, on only one specimen. It occurs as flattened, circular, 2-3 mm sprays of white acicular crystals associated with vivianite in a fracture in massive triphylite. This material was previously described as gatumbaite by Segeler et al. (1981)." So, is the specimen of figures 1 & 2 gatumbaite or sinkankasite? Perhaps we will never know. The specimen, recently sold by Bob, is now destined for the Smithsonian collection. I feel fortunate to have had the opportunity to photograph it.

Gatumbaite chemistry is $CaAl_2(PO_4)_2(OH)_2 \bullet (H_2O)$
Sinkankasite chemistry is $H_2Mn^{2+}Al(PO_4)_2(OH) \bullet 6(H_2O)$
Gatumbaite requires calcium, sinkankasite does not. Sinkankasite requires manganese, gatumbaite does not. Energy Dispersive Spectroscopy (EDS) should easily differentiate between these two species.

I receive frequent mineral inquiries from many people visiting my mindtanh.org website. As a result of a recent email dialog, a Canadian collector, Arnaldo Brunetti, sent me several Palermo specimens for identification suggestions. One of these was labeled gatumbaite. Arnaldo found it in a box of "Palermo rough material". I photographed this specimen (Figure 3) and took a sample grain before I returned it to Arnaldo. An EDS analysis (BC160 - 3/2/17) of one of these white balls (on carbon tape) gave a result for which gatumbaite may be a "best fit" with some Sr and K substituting for some Ca. The analysis suggests a chemistry (normalized for 2 P): $Ca_{0.35}K_{0.07}Sr_{0.17}Al_{3.21}(PO_4)_2(O)_{11}$

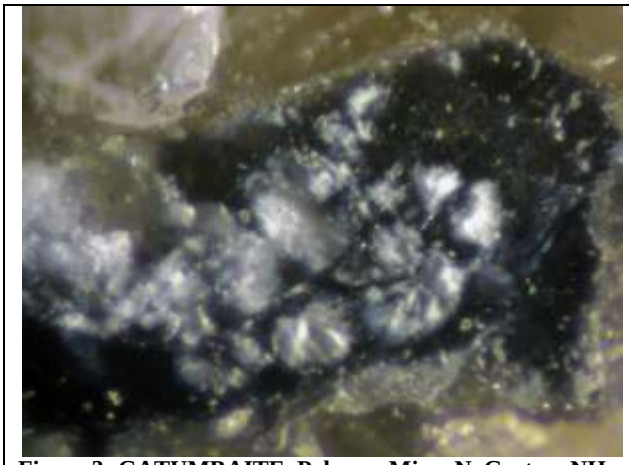

Figure 3: GATUMBAITE Palermo Mine, N. Groton, NH
2 mm field of view. White sprays embedded in vivianite

Figure 4: **UNKNOWN on Vivianite TM # u1378**
Palermo Mine, N. Groton, NH
0.2 mm white balls on vivianite

A similar specimen of white balls on vivianite from my collection was also analyzed (Figure 4). One probing showed the presence of P, Al, Si, Fe, O and a bit of Ca. A second probing (noisy, with low count values) showed the presence of P, Al, Sr, Ba and O. The chemistries suggested by these EDS analyses could not be matched to any known mineral, so this specimen will retain an "unknown" label.

MMNE member Ray Meyers is keenly aware of my passion for NH minerals and my desire for species additions to my New Hampshire minerals display at the McAuliffe-Shepard Discovery Center, Concord, NH (shameless plug). Ray was recently able to acquire a sinkankasite specimen for the display. Photos of this specimen and supporting provenance are shown in figures 5 through 9.

Figure 5: **SINKANKASITE**
Palermo Mine, N. Groton, NH
1.2 white, bladed, spray on vivianite.

Figure 6: SINKANKASITE
Palermo Mine, N. Groton, NH
1.5 white, bladed, spray on vivianite.

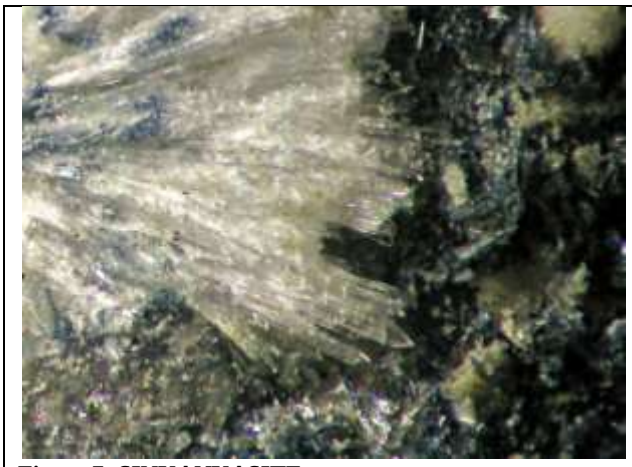

Figure 7: SINKANKASITE
Palermo Mine, N. Groton, NH
Zoom view showing terminations

Figure 8: SINKANKASITE
Palermo Mine, N. Groton, NH
Mike Swanson micro-mount box

Figure 9: **SINKANKASITE Palermo Mine, N. Groton, NH**
Forrest Fogg box within Mike Swanson micro-mount box. Original ID was gatumbaite. Note "Sinkankasite" in pencil.

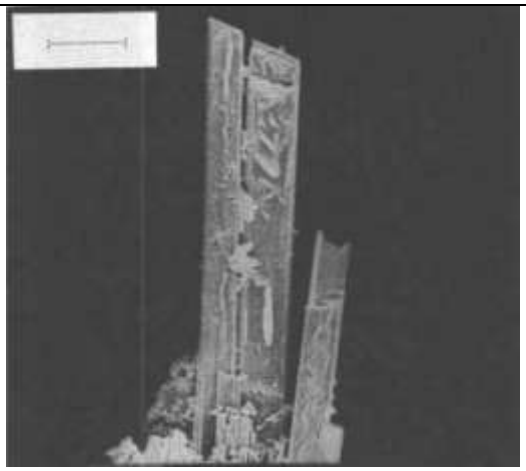

Figure 10: SEM photomicrograph of sinkankasite from *American Mineralogist*, vol. 69 pg. 381. Scale is 0.1 mm.

A tiny blade fragment was extracted for EDS analysis from the sinkankasite spray shown in figure 6 (at about the 8 'oclock position). The semi-quantitative EDS analysis gave a result consistent with sinkankasite (within the limitations we have experienced with this instrument for carbon tape mounted grains.) Two probings were made and the element atomic percents measured were converted to atoms per unit formula (APFU). The instrument cannot detect hydrogen, H. The chemistries suggested were, (normalized for 2 atoms of phosphorous):
Analysis 1: $Mn_{0.81}Fe_{0.32}Al_{0.77}(PO_4)_2O_{5.1}$
Analysis 2: $Mn_{0.59}Fe_{0.17}Al_{0.98}(PO_4)_2O_{12.8}$

It should be noted that manganese (Mn) and iron (Fe) frequently substitute for one-another in phosphate species. For reference, if the sinkankasite formula was written omitting hydrogen, it would be: $MnAl(PO_4)_2O_7$. If these two analyses were averaged together (frequently done in species characterization), we get $(Mn,Fe)_{0.95}Al_{0.86}(PO_4)_2O_9$. More significantly, the *American Mineralogist* original species description had a manganese - iron content of ($Mn_{0.65}$, $Fe_{0.35}$), quite close to this analysis.

Should MMNE members come across similar radial sprays or spherical forms on vivianite, they are encouraged to submit them for EDS analysis.
[Thanks to Bob Wilken for his helpful review of this article]