Jahnsite from the Fletcher Mine, Groton, NH

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One of the specimens that I analyzed during the March, 2022, MMNE sponsored EDS session at Boston College was a visually identified jahnsite group mineral. I found this piece in a small box of unsorted Fletcher mine chunks collected by Clayton Ford that were given to me by Gordon Jackson. The 4.5 cm specimen contains a large vug of rockbridgeite that is over-coated with lustrous, lumpy, root-beer brown, jahnsite crystals.

Figure 1: **Jahnsite-CaMnFe**
Fletcher Mine, Groton, NH. 5 mm field of view

These dark, lustrous, crystals were difficult to photograph. This photo is from stack of 17 images with diffused lighting, 5 second exposures. Most New Hampshire jahnsite is found in similar aggregates of indistinct crystals.

The jahnsite group, a sub-group of the whiteite group, has fourteen members (including keckite). The Fletcher mine is the type locality for jahnsite-(CaMnFe), with chemistry $CaMn^{2+}Mg_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$. All group members have a common $(PO_4)_4(OH)_2 \cdot 8H_2O$ component (except keckite, which has $\cdot 7H_2O$). A Fletcher Mine specimen with analysis was included in *Mineralogical Magazine* article, vol. 42 num. 323 September 1978: *I. Whiteite, a new species, and a proposed nomenclature for the jahnsite-whiteite complex series. II. New data on xanthoxenite. III. Salmonsite discredited.* PAUL BRIAN MOORE AND JUN ITO. *
The article provided an empirical formula for the Fletcher jahnsite-(CaMnFe) as:
$Na_{0.14}\,Ca_{0.50}Mn^{2+}{}_{1.55}Mg_{0.72}Fe^{3+}{}_{2.14}Fe^{2+}{}_{0.95}\,(OH)_{2.0}(H_2O)_{8\,.00}(PO_4)_{4.0}$

The chemistry computed from the element percents of the Boston College EDS is:
$Ca_{0.73}Mn_{0.76}Mg_{0.56}Fe_{1.8}Al_{0.07}P_4O_{26.1}$ Normalized for 4 P.
[EDS cannot assign oxidation states to the Fe or Mn, nor provide guidance as to the distribution of oxygen between (PO_4), (OH), and (H_2O).]
For reference:

Jahnsite-CaFeMg	$CaFe^{2+}Mg_2Fe^{3+}{}_2(PO_4)^4(OH)_2 \cdot 8H_2O$
Jahnsite-CaMnFe	$CaMn^{2+}Fe^{2+}{}_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$ (Fletcher is type locality)
Jahnsite-CaMnMg	$CaMn^{2+}Mg_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$

The analyzed specimen has all the right elements for a jahnsite group mineral, although the cation (Ca, Fe, Mn, Mg) content ratios are off. The result has Mn > Mg, suggesting perhaps an intermediate jahnsite-(CaMnFe) - jahnsite-(CaFeMg). With so many different "flavors" of jahnsite, one might expect some intermediate chemistries. As of March, 2022, mindat.org does not have a photo of a Jahnsite-CaMnFe.

George Adleman performed a Raman analysis of the same polished grain that was used for EDS, Figure 6. The Raman spectrum gave a best match for jahnsite-CaMnMg. The moderate Mg content in the Moore et. al. analysis of jahnsite-CaMnFe , when viewed with this Raman result and the BC EDS analysis, certainly presents difficulty in selecting a specific jahnsite species for my specimen.

The Jahnsite from the Fletcher mine has multiple habits. I have several in my collection, including the lumpy yellow form, Figure 2, and a flattened prismatic form, Figure 3. The yellow, Figure2, jahnsite is most likely jahnsite-CaMnMn, with chemistry $CaMn^{2+}Mn^{2+}{}_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$. A polished grain analysis from this computed a chemistry of $Ca_{0.84}Mn_{1.73}Fe_{1.04}Al_{0.39}P_4F_{0.73}O_{50}$, normalized for 4 P. I have struggled to get a satisfactory identification for this specimen. The aluminum and fluorine observed in the analyses are bothersome. However, a 1974 *American Mineralogist* article by Moore and Araki references "The jahnsite structure type provides a range of compositions from an

aluminum analogue $Ca(Fe,Mn)^{2+}Mg_2(H_2O)_8Al^{3+}{}_2(OH)_2(PO_4)_4$ …", suggesting jahnsite structures may accommodate some aluminum. Jim Nizamoff's thesis on the Palermo 2 pegmatite included three jahnsite group member analyses. All contained measurable amounts of aluminum.

Several mindat.org photos of jahnsite-(CaMnMn) compare favorably with this Figure 2 Fletcher specimen. Material from Figure 2 specimen was submitted for a powder XRD, but the analytic service reported that the amount that I submitted was too small to give a conclusive result.

Figure 2: Yellow **Jahnsite** with pink phosphosiderite-strengite (unresolved dimorphs) and black rockbridgeite. Fletcher mine, Groton, NH. 4 mm field of view.

Figure 3: **Jahnsite**
Fletcher mine, Groton, NH. 0.8 mm tall prisms.

Figure 4: **Jahnsite** prisms protruding from rockbridgeite Fletcher mine, Groton, NH. 1.4 mm field of view.

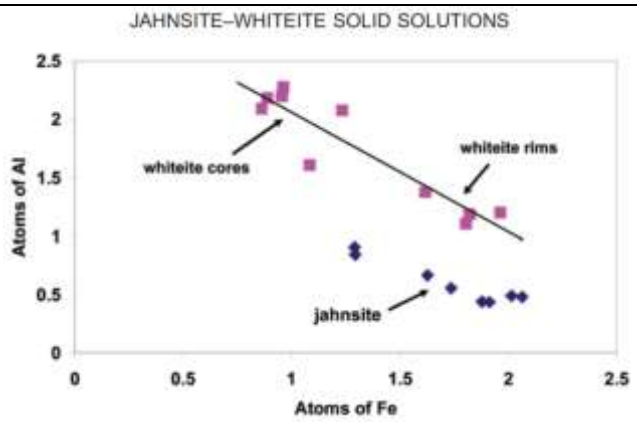

Figure 5: Aluminum content in whiteite group minerals.

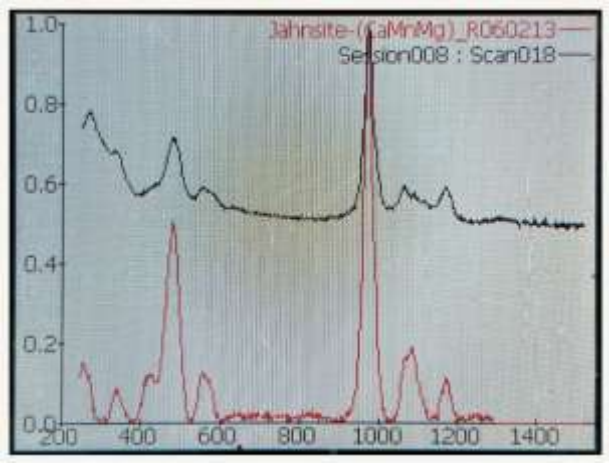

Figure 6: Raman spectrum plot of Fletcher Mine sample

*Available at: https://rruff.info/rruff_1.0/uploads/MM42_309.pdf