

MICRO PROBE

Fall, 2018

VOLUME XII, Number 8

Fall MEETINGCAMAS, WASHINGTON

November 10, 2018

9:30 am to 4:30 pm

Camas-Washougal Fire Station #42 4321 NW Parker Street Camas, Washington

We are looking forward to another day of fun and fellowship together examining minerals and exchanging stories. Bring microscopes and things for the give-away tables as usual.

We will be meeting again at the fire station in Camas. To get there, from north or south, take I205 and come off onto SR14 just north of the Columbia River headed for Camas. From the east, you are already on SR14. Take exit 10 onto SE192nd Ave. An immediate right turn will put you on Brady Rd., which will soon swing around to become Parker St. There are name changes on streets between Vancouver & Camas, but don't let that throw you!

We will have the Club provide sandwich makings (bread, meat, lettuce, cheese, dressings, and coffee, tea, cocoa) for our lunch potluck: Please bring salads, chips, pop, nuts, chili, cookies, pie, or cake to add to the lunch.

Beth Heesacker will be updating us about her adventures about establishing a system for photographing minerals. We also plan to have a discussion about cleaning mineral specimens Bring your favorite methods to share with the group, as well as the pictures you have taken recently.

	Mill Plain Blvo	d. SE 15 th St.	Bybee Rd.
15	1205	SE 192"	NW 38 th Ave Ave. NW Parker St.
Vancouver		SE 34 th St.	Pacific Rim Blvd.
	SR 14	Exit 10	Brady Rd.
Columbia River			

Micro Photography: An Update By Beth Heesacker

In the last issue I promised you that I would take some pictures with my micro setup. I have spent some time, days, trying different options. I still have more to go but I am slowly learning.

To recap I have a Canon T6i camera with a 1-5x macro-zoom lens, with my microscope objective attached to that, on a Stack-Shot rail. My stacking is done by Zerene Stacker.

- 1) I realized that attaching my microscope objective to my macrozoom lens does not work. I can bring that setup right down to the specimen, and although the area starts to come into focus, I cannot focus it. I intend to try using it on my regular lens but am going to continue the work with the macro-zoom lens alone for now.
- 2) I learned to verify that the rail and the camera are level. I was having a lot of trouble with "flares" and it seemed to be caused by my rail not straight up and down, so the camera was not shooting in exactly the same spot each time.



- 3) Do not do any walking around, so that vibration is kept to a minimum. Remind anyone else in your area that you are taking stacked pictures so that they will not vibrate the house. Make sure that your specimen is anchored well so it does not vibrate as the rail moves the camera. This also reduced "flares". This hint was given to me by Doug Merson.
- 4) Carefully clean the specimen. Dust particles are not what I wanted to take pictures of.

5) I have learned to use less light than if I am trying to see a specimen under my microscope, especially if the crystals are highly reflective and white/clear. Now this may not apply to all specimens, but it is a place to start. I started with 4 of the Ikea lights on and one layer of velum as a diffuser. I am now down to one light with a double thickness of diffuser. I still need to work on reducing the light or changing the angle of the light striking the crystals for less overexposure.

I still have the 4 Ikea lights set up around my stage, but I can turn on one, or more, as I need, and try out different angles on the specimen without having to move the lights around.

6) Try different lighting angles. I ended up using a higher angle for the light. which reduced some of the glare off the specimen. Of course, this will not be true for all specimens. Just try adjusting the lighting up and down, left to right and from different sides.

7) Another thing I learned rather quickly is that the batteries in the camera run down faster than it takes them to be recharged. It also is very frustrating to have the battery die in the middle of the stacking shoot. I finally purchased the AC adapter for my camera and can take pics as long as I want.

8) To find out the field of view of your setup, place a ruler with mm markings on your stage and take a picture of it. This hint was given to me by Bruce Kelly.

9) I was really astonished to find out that I could see more with my camera than with my microscope at 30x. When I took my specimens back to my microscope I could not find all the details I was seeing through my camera. I found much smaller crystals through the camera that I did not know were even there when examined under the microscope.

10) I tried various step lengths, from 10um down to 2um. What you use all depends on the depth of field of your lens and the size of your crystals you are trying to picture.

Ok, enough of that. I am sure that you who are reading this will have input and I welcome it. I have shared my efforts and struggles with Don Howard, Bruce Kelly and Doug Merson and thank them for their words of wisdom.

Now for some pictures, as promised. This first group are quartz and unknowns from the Zaca Mine, Alpine Co., California, USA. Note the "flares" on some surfaces and so much is out of focus. It was after these that I purchased a small level and leveled up my whole setup.



Then I found some red areas and started to investigate them. Still not a clear pic but interesting.



Bruce told me the quartz color was off so I tried doing a white balance. Much better but not perfect (by the way this is try #13). By researching using Mindat, I identified the red as pyrargyrite. The field of view is < .5mm.



Bruce told me to try something easier. I resisted that for a while since I always try to attack the harder first and learn from that. But I finally followed his advice, I think. At least the specimen is larger.

This is from the Clackamas, Oregon area, North of Estacada. FoV is 3 mm. I believe it is offretite covering the surface of something I do not recognize for sure. I have searched Mindat for all the Clackamas area minerals and cannot find anything pictured like it. It also has some blue and some yellow/orange smaller crystals on it that I cannot identify (also not listed on Mindat). The first pic is an early try. Overexposed and out of focus.



Ok, 9 tries later . . ., lit from a different angle, double vellum diffuser, etc. and still overexposed. I will keep trying.



Some of these stacks are close to 1000 pics, some only about 200. Different settle times, different step sizes, different start and stop positions, etc. Many experiments.

I still have a lot to learn. I will be trying other specimens, maybe different colors, etc. but I wanted to let you know that I am working on it and encourage others to attempt to take pics of their specimens. You never know what you may find. Now, what are those unknows???

Thanks again to Don, Bruce and Doug for their encouragement and comments.

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Vanadium Minerals

Don Howard

Those of us who live in primarily basalt lands can get pretty tired of black and white mineral specimens and hanker for a bit of color. Some of us indulge that by hunting up some secondary copper minerals and luxuriating in the rich greens and blues. It can be exhilarating!

But I would like to suggest that there are other groups of minerals that can provide the color. For the purpose of this article, I would like to suggest the minerals that contain vanadium.

Now when I mention vanadium, most rock hound's first thought would probably be vanadinite, Pb₅(VO₄)₃Cl, one of beautiful brilliant red hexagonal prisms that come from Arizona or Mexico, such as the ones shown in fig. 1. I love those pieces, too. But vanadinite is not always red. Often it is more orange, or even yellow. The caps on the ends of the prisms shown in Fig. 2 are such an example. The variation is due to the fact that the color is being created by impurities, probably largely iron. The lead chlorovanadinate is actually colorless without those impurities, as shown in the crystals in Fig. 3.



Fig. 1 Vanadinite Apache Mine, Globe, Gila Co., Arizona



Fig. 2 Bicolored Vanadinite Rowley Mine, Maricopa Co., Arizona

Fig. 3 Clear, colorless Vanadinite Macy Mine, Hillsboro, Sierra Co., N.M.





Fig. 4 Wakefieldite-(Ce) in Brewsterite Yellow Lake, British Columbia, Canada

Fig. 5 Clinobisvanite and Pottsite Linka Mine, Lander Co., Nevada

One reason that vanadium minerals come in a wide variety of colors is that the vanadium atoms can possess a number of valencies. There are basically five outer electrons that can be transferred, two very easily and the other three with increasing difficulty. Thus we can have V^{+2} , V^{+3} , V^{+4} , and V^{+5} .

Vanadium in the +5 state usually acts as an acid radical, surrounding itself with four oxygen atoms to make $(VO_4)^{+3}$. As such, it behaves very much like the arsenates, $(AsO_4)^{+3}$, and phosphates, $(PO_4)^{+3}$, and forms compounds, vanadates, very similar to theirs. Examples of simple vanadates are wakefieldite, Ce(VO₄), very dark blood red (Fig 4), and clinobisvanite, Bi(VO₄), a bright vellow-orange (Fig. 5). The larger, paler yellow prisms showing at the bottom of Fig. 5 are another vanadate, Pottsite, $Pb_3 Bi_2 (VO_4)_4$

As you look at the illustrations thus far, you probably will have noticed that the pieces have come from a wide variety of places. Vanadinite generally comes from lead mining districts. The wakefieldite location is one for zeolites. Linka Mine is basically a garnet scarn. So where does the vanadium come from? Estimates put the concentration of vanadium in igneous rock at about 0.02%. As a trace element, it is leached out by ground water. And with a different chemistry than most of the rest of the primary rock, it eventually accumulates somewhere until the concentration is high enough to begin to form compounds with whatever else is around. At Yellow Lake, while the aluminum and silicates are forming zeolite minerals, it teams up with another trace element, cerium, to form wakefieldite, since neither element fits into zeolite-type lattices. In areas where there are primary lead, copper and zinc minerals, it joins the crop of secondary minerals forming from the oxidation of the primary sulfides. This crop of secondary minerals is therefore a great place to look for interesting, colorful vanadates in addition to the fore-mentioned vanadinite.

Copper forms several vanadates. The simplest of these, volborthite, $Cu_3V_2O_7(OH)_2$ ²H₂O is shown in Fig. 6. Volborthite is found together with other secondary copper minerals in mining districts in Arizona, Colorado and Utah, but like wakefieldite it can show up in unexpected places, like Summit Rock, Oregon, as one of the very few copper minerals forming from trace amounts of copper and vanadium. Volborthite characteristically forms as clusters of thin blades that are yellow-green in color.



Fig. 6 Volborthite and Brochantite Monument #1 Mine, Navajo Co., Arizona

Fig. 7 Martyite and Magnesiopascoite Burro Mine, San Miguel Co., Colorado

A recently described zinc equivalent mineral, Martyite, $Zn_3V_2O_7(OH)_2$ ²H₂O is yellow in color, as shown in Fig. 7. It also forms as clusters of thin blades, but so far has proven rarer with much smaller blades.

There are also several vanadates with two bases. Mottramite, PbCuVO₄(OH), shown in Fig. 8, combines lead and copper. Mottramite can be green or tan in color, but is often so dark that it looks black. It is often associated with vanadinite, to which it provides an excellent color contrast. The associated lead zinc mineral is Descloizite, PbZnVO₄(OH), shown in Fig. 9. This mineral is another common associate of vanadinite, but because its color is usually orange to brown, it does not make as attractive contrasts to the red vanadinite. Another related mineral, tangeite, CaCuVO₄(OH), (Fig. 10), forms as thin olive green blades similar to volborthite. Namibite, (BiO)₂CuVO₄(OH), (Fig. 11), forms very dark green to black crystal clusters.



Fig. 8 Mottramite Whale Mine, Clark Co., Nevada

Fig. 9 Descloizite Grey Horse Mine, Pinal Co., Arizona



Fig. 10TangeiteFig. 11Namibite on ChrysocollaMonument #1 Mine, Navajo Co., ArizonaLodi #4 Mine, Plumas Co., California

Heyite, $Pb_5Fe_2(VO_4)_2O_4$, is a vanadate colored bright yellow by the ferric iron it contains. The yellow vanadate found at the Silver Coin Mine in Nevada was originally called Heyite, although at the time it was not considered a very good fit. Re-examination of the material showed that it contained phosphate as well as vanadate. Phosphorus is easy to miss in X-ray fluorescence because it is difficult to excite. In the meantime, a mineral called bushmakinite, $Pb_2Al(PO_4)(VO_4)(OH)$, was named from a location in Russia. The Nevada mineral became ferribushmakinite, $Pb_2Fe^{+3}(PO_4)(VO_4)(OH)$, and Silver Coin Mine became its type locality (Fig. 12). A related mineral, Calderonite, $Pb_2Fe^{+3}(VO_4)_2(OH)$, is shown in Fig. 13. Heyite, $Pb_5Fe^{+2}_2(VO_4)_2O_4$, contains ferrous rather than ferric iron.

Another area that has produced numerous vanadium minerals is the region along the southern part of the state line separating Utah and Colorado. This is largely sedimentary rocks that have been infiltrated by solutions that had enhanced amounts of vanadium and uranium. Numerous mines and prospects were developed during the search for sources of the uranium. The two that stand out are the



Fig. 12 Ferribushmakinite on Jarosite Silver Coin Mine, Humboldt Co., Nevada

Fig. 13 Calderonite C & B Mine, Gila Co., Arizona



Fig. 14 Carnotite Anderson Mine, Yavapai Co., Arizona Fig. 15 Tyuyamunite Monument #1 Mine, Navajo Co., Arizona

potassium uranyl vanadate, Carnotite, $K_2(UO_2)_2(VO_4)_2$ '3H₂O, (Fig. 12), and the similar calcium uranyl vanadate, Tyuyamunite, Ca(UO₂)₂(VO₄)₂'5-8H₂O, (Fig. 13). Both are yellow crusts on the sediments that, unlike many minerals that contain uranyl ion, are not fluorescent. When they are found as crystals, they are often in the form of thin, squarish platelets.

There are several regions where vanadium has been concentrated in more than trace amounts. One is the Colorado Plateau along the Utah-Colorado boundary. Another is at Wilson Hot Springs, Garland Co., just to the west of Little Rock, Arkansas. In both of these areas, the vanadium is primarily in the form of V_2O_5 , with a bit of the vanadium reduced to the +4 valence to account for another positive ion to be included. In the case of Utah-Colorado, the primary added ion is sodium and the mineral formed is Corvusite, $(Na,K,Ca,Mg)_2(V^{5+},V^{4+},Fe^{2+})_8O_{20}\cdot 6-10H_2O$, a black material that coats the sandstone grains and forms shiny black patches of pure material. In Arkansas, the corresponding mineral is Straczekite, $(Ca,K,Ba)(V^{5+},V^{4+})_8O_{20}\cdot 3H_2O$. Straczekite, as shown in Fig. 17, forms parallel bundles of black blades; the picture has had to be overexposed on the matrix to bring out the form of the very black mineral.



Fig. 16 Hendersonite on Corvusite Jo Dandy Mine, Montrose Co., Colorado

Fig. 17 Straczekite crystal clusters Union Carbide Mine, Arkansas



Fig. 18 Metamunirite on Rossite with Pascoite Burro Mine, San Miguel Co., Colorado

Fig. 19 Metarossite, Pascoite and Magnesiopascoite Burro Mine, San Miguel Co., Colorado

These two minerals are then slowly weathered by ground waters. The resulting solutions contain both V⁺⁵ and V⁺⁴ ions that then combine with sodium, calcium, potassium, magnesium and ammonium ions to form an additional variety of colorful minerals, many of which are water soluble and should not ever be washed. The V⁺⁵ vanadate with sodium, Metamunirite, NaVO₃, forms as silky white needles as shown in Fig. 18. In that picture, it is perched on the glassy clear mineral, Rossite, $Ca(VO_3)_2$ '4H₂O

Many of the hydrated vanadates have related minerals that correspond to partial dehydration. The white mineral shown in the lower portion of Fig. 19, Metarossite, $Ca(VO_3)_2$ ²H₂O, is just such a one. It is white where Rossite is clear. Metarossite usually forms crusts or randomly oriented blades as in Fig. 19.



Fig. 20 Schindlerite on Magnesiopascoite Burro Mine, San Miguel Co., Colorado

Fig. 21 Hewettite Gold Quarry Mine, Eureka Co., Nevada



Fig. 22 Navajoite and Gypsum Burro Mine, San Miguel Co., Colorado

Fig. 23 Simplotite Burro Mine, San Miguel Co., Colorado

The bright orange crystals just above the Metarossite in Fig. 19 are Pascoite, $Ca_3V_{10}O_{28}$ ·17H₂O , another calcium vanadate, that is a fairly common secondary mineral at many of the mines in this area. The darker crystals are Magnesiopascoite, $Ca_2MgV_{10}O_{28}$ ·16H₂O . in which one of the calcium sites with its associated water molecule has been replaced by magnesium. There are a whole family of such replacements known involving sodium, ammonium, and aluminum as well as the magnesium. Most of the minerals resulting from such substitutions are some shade of orange. One mineral of this type is Schindlerite, $(NH_4)_4Na_2V_{10}O_{28}$ ·10H₂O , shown in Fig. 20.

Another pair of hydrated calcium vanadates are Hewettite, $Ca(V_3O_8)_2 \cdot 9H_2O$, and its dehydration partner Metahewettite, $Ca(V_3O_8)_2 \cdot 3H_2O$. Both form carmine-red needles of the type illustrated in Fig. 21. The hydrated oxide Navajoite, $(V^{+5}, Fe^{+3})_{10}O_{24} \cdot 12H_2O$, is a black, acicular mineral. The form can best be seen in Fig. 22 just to the right of the Gypsum, which had to be overexposed o allow the black mineral to show up.



Fig. 24 Cavansite on Heulandite Owyhee Dam, Malheur Co., Oregon

Fig. 25 Pentagonite Owyhee Dam, Malheur Co., Oregon



Fig. 26 Sincosite Ross Hanibal Mine, South Dakota

Fig. 27 Phosphovanadylite S. Rasmussen Ridge, Caribou Co., Idaho

Not all the secondary minerals have the vanadium in the +5 state. Simplotite, $CaV_4O_9.9H_2O$, is a vanadate with the vanadium in the +4 state. The small pale green crystals shown in Fig. 23 look like little cubes, but in actuality are monoclinic with an oblique angle less than half a degree from a right angle, too small to be able to pick up on visually.

Almost all the vanadates thus far mentioned have vanadium in the +5 state. There are also compounds of V⁺⁴. Such salts in solution involve the vanadium picking up an oxygen atom to form the intense blue vanadyl complex: $(VO)^{++}$. Minerals containing vanadyl ion, such as Cavansite (Fig. 24) and its dimorph, Pentagonite (Fig. 25), Ca(VO)Si₄O₁₀·4H₂O, are correspondingly bright blue in color. The two minerals were first named from occurrences in Oregon, though the largest and most spectacular specimens have come from the zeolite locations in India.

There are also phosphates of V⁺⁴, such as Sincosite, $Ca(VO)_2(PO_4)_2 \cdot 4H_2O$. This is a green mineral that forms as thin tetragonal platelets comprising books, as shown in Fig. 26. A closely related phosphate, Phosphovanadylite-Ca, $Ca[V_4P_2O_{12}(OH)_4] \cdot 12H_2O$ (Fig. 27), forms as tiny cubes that are electric blue when freshly exposed, but quickly fade through dark green to black as the action of light and air oxidizes the V⁺⁴ to V⁺⁵.

Another interesting place to find vanadium is in garnets. The garnets are a group of cubic minerals with the oxygen ions arranged in such a way that there are several types of sites to be occupied by positive ions. Three of these sites have dodecahedral symmetry, two have octahedral symmetry, and three have tetrahedral symmetry. In most garnet minerals, the tetrahedral sites are occupied by silicon, but in two minerals they are occupied by V^{+5} . In both cases, the three dodecahedral sites are occupied by two calcium ions and a sodium ion. The two minerals differ in what occupies the two octahedral sites: in Schaferite, $\{Ca_2Na\}[Mg_2](V_3)O_{12}$, it is magnesium, while it is manganese in Palenzonaite, $\{Ca_2Na\}[Mn_2](V_3)O_{12}$. Both garnets are red in color, with Palenzonaite (Fig. 28) being much the darker red of the two. In addition, there are two garnets with silicon in the tetrahedral sites but with V⁺³ in the octahedral sites. They are Goldmanite, $\{Ca_3\}[V_2](Si_3)O_{12}$, and Momoite, $\{Mn_3\}[V_2](Si_3)O_{12}$, and both are a deep green similar to the chromium garnet Uvarovite, $\{Ca_3\}[Cr_2](Si_3)O_{12}$.



Fig. 28 Palenzonaite Molinello Mine, Genova, Italy

Fig. 29 Schreyerite and Chalcopyrite Satra Mine, Ostergotland, Sweden

Having vanadium in the very reactive +3 state is rather unusual. I am aware of one other mineral with V^{+3} , Schreyerite, $V_2Ti_3O_9$, an odd, chocolaty brown mineral shown in Fig. 29. This seems to be a case where the vanadium is acting more like one of the transition metals. Two other minerals with vanadium in a sulfosalt-type arrangement are the mineral Sulvanite, Cu_3VS_4 , shown in Fig. 30, and the mineral Colusite, $Cu_{12}VAs_3S_{16}$, shown in Fig. 31. Both are cubic sulfides where covalent bonding is probably important, so the valence state of each element is not of primary concern. Both have a metallic luster that very much resembles pyrite.

So, I hope I have demonstrated the wide range of the vanadium minerals. They come from many localities, as a brief survey of the source line for the 31 minerals illustrated will prove. They also range in color from black to white, and through reds, oranges, yellows, greens and blues. Many are colorful and lovely and have a deserving place in any collection.



Fig. 30 Sulvanite Thorpe Hills, Tooele Co., Utah

Fig. 31 Colusite Fantiscritti, Carara, Italy