

Northwest
Micro Mineral
Study Group



MICRO PROBE

FALL, 2022

VOLUME XIII, Number 6

FINALLY!!!

FALL MEETING

November 12, 2022 9 AM to 4 PM

Sons of Norway Columbia Lodge
2400 Grant St,
Vancouver, WA 98660

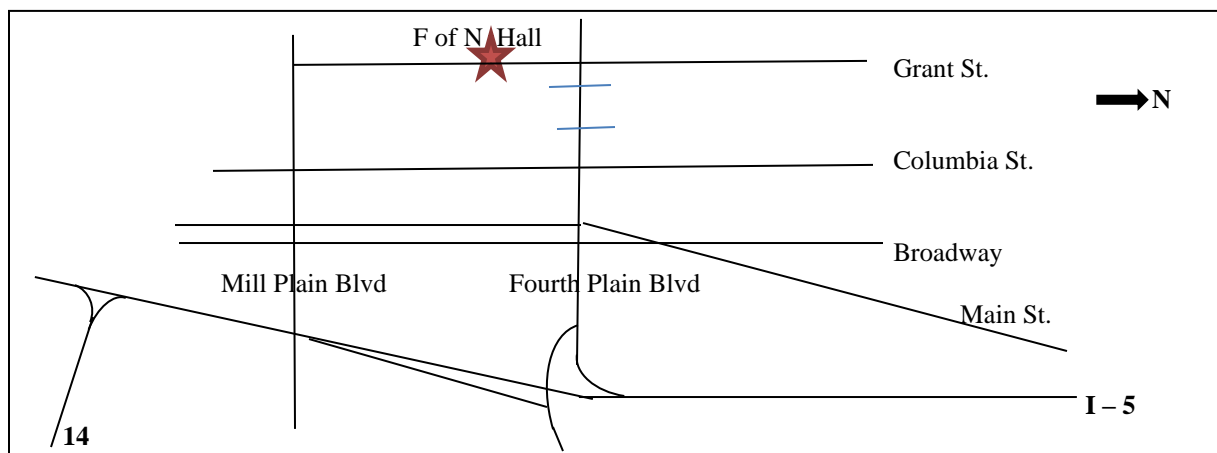
We are going to be trying a new meeting place. The major complication is that there is no designated parking spot. We will be unloading at the door and then parking on the street in the neighborhood. Please unload and then move on so others can have a turn to unload their things. There are a couple of steps up once inside. We will try to have people helping with the unloading process.

As usual, we will have sandwich makings provided. Bring salads, chips and deserts to round out our midday feast.

Directions:

FROM WASH. HWY 14: Continue west to Interstate 5, keep right and take I-5 North. Then keep right and continue to Exit #1D -Fourth Plain Blvd

FROM INTERSTATE 5: In Vancouver, take Exit #1D to Fourth Plain Blvd. Head west on Fourth Plain Blvd. to Grant St. and turn left. Go two blocks to 24th St.



President's Message:

Finally, we get to come together again to share friendship, knowledge, and minerals. As noted on the cover of this issue we need to shift to a new location. The firehouse has itself booked for an Academy of some sort even though I have been pestering them every couple of months.

The Sons of Norway Lodge has allowed us to meet there. Many thanks to Pam Harris for setting this up for us. In the past we have not had to pay any rent, but we do have to pay \$75 for the day at this location.

As most of you know, our treasury is not very well funded. It gets us by, but this rent will take about half of it. There are a number of options for how we can replenish it:

- 1) Contribute \$5, plus paying dues, to the club treasury at the meeting.
- 2) Bring 5-10 really nice specimens, neatly trimmed and labeled, but not necessarily mounted in a perky box (folded box ok), that will be sold for \$1 each. The money to be given to the club to defray the cost of the rental of the building. You can keep the specimens at your space so you can take any home that do not sell.
- 3) Bring something else of higher value that might be of interest to the members, to be sold and part of the purchase price (% to be determined by you) donated to the club.

There are probably other options available but let's not get this too complicated. Choose one option (or more) with the idea that each attendee contribute at least \$5 toward the building rental.

Of course, we are all looking forward to all the items for the free tables. I know I have a large number of flats and egg cartons of specimens ready to bring that have built up over the last couple of years. We may have to allocate a few extra tables at this meeting for the giveaways. Also remember to bring your empty flats and egg cartons that you will fill to overflowing from the tables.

We will have our scope time, as usual from 9-12, then lunch and club meeting followed by slide presentations. I hope to have permission to make a presentation on a new site based on a thesis I was assisting with (taking the photos), a presentation on the Big Cliff area siderite, and my current project on the Clackamas River Drainage, identifying the collection sites, the specimens from them, and the geology (I do not know if this will be ready in time – lots of work to do). I wanted to know more about this area, and I might as well share what I learn. I can put a couple of these on hold if there are others who have some presentations. I do not need to hog all the time so bring your thumb drives and share with us.

I am so looking forward to seeing you all again!

Now that we are back to having meetings again, yearly dues of \$15 will be collected at this meeting. Thank you! Beth

THE MICROPROBE

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The Occurrence of Co-crystallized Pumpellyite and Thomsonite in Douglas County Oregon

Robert M. Housley

Minerals of the pumpellyite group are only known to form under metamorphic conditions of substantial pressure but relatively low temperature. They sometimes occur with zeolites in Michigan, and also in some localities along the East Coast. However, they appear to be quite rare among the younger zeolite bearing rocks of the West Coast, which likely have never been buried deeply enough to feel sufficient pressure. It was therefore with considerable excitement that in June 2002 I discovered the quarry I am about to describe with rocks containing vesicles in which pumpellyite and thomsonite clearly co-crystallized.

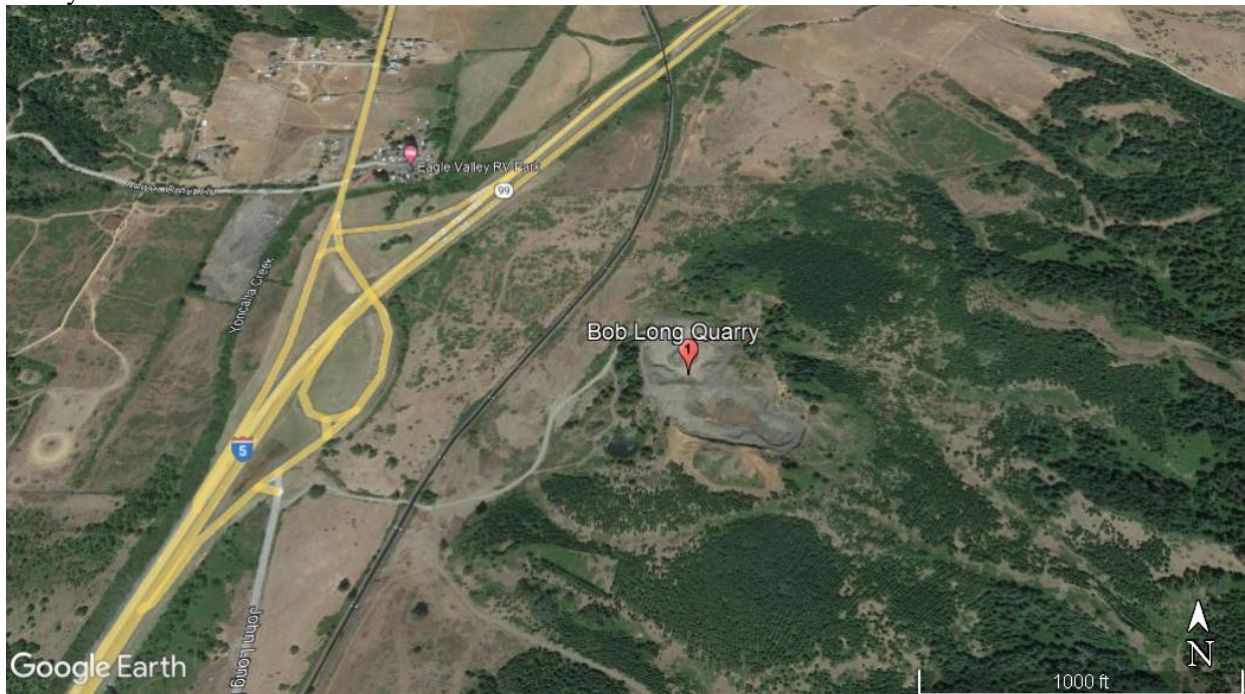


Figure 1. Google Earth view of Drain, Yoncalla, old Highway 99 exit from Interstate 5 north, about 26 miles north of Roseburg, Douglas County OR. Quarry is easily visible near center of image.

The quarry is easily visible from Interstate 5 in either direction about 26 miles north of Roseburg, near the Yoncalla, Drain exit (Figure 1) and appears to have been inactive for years. Having spent the first 10 years of my life on a farm near Yoncalla, and still having relatives in both Roseburg and Portland, I had driven by it many times. I always felt a pang of curiosity when I did so, but the gate to the quarry was always locked and I just drove on. Then on a Sunday afternoon after my 50th high school reunion in Roseburg, I was driving north to have dinner with, and to stay overnight with, my brother in Portland when I happened to notice that the gate was open.

Although I did not have much extra time, I could not pass up the opportunity. I walked into the quarry and met 2 young fellows who said they came to target shoot. One said he was the owner's nephew. Since they planned to be in the lower section of the quarry, I asked if it would be all right for me to look for mineral specimens in the upper part. He said he did not see why not, so I went ahead to the upper part. I also got his uncle's name, Bob Long, and phone number to call later.

When I walked into the quarry, I first saw some long veins of calcite with occasional pockets containing stilbite and quartz and collected some material from them. I then walked a ways and went

down a short decline and came to an area with some malachite staining, and a little farther on found mineralized vesicular rock with thomsonite and green balls of what later proved to be pumpellyite in the vesicles. I collected several pieces of this vesicular material, and by then knew that I would want to come back soon. I left with a backpack full of samples after spending only about an hour and without finishing exploring even the upper level of the quarry, and got to Portland only a little late for dinner.

Unfortunately, when I called the next day, Bob Long seemed angry that I had even been in the quarry, and made it very clear that he would never give me permission to come back. For that reason I have not talked or written about this locality until now. Maybe the access situation has changed in 20 years.

In the vesicular rock, the vesicles range from a few millimeters to over a centimeter in diameter, and from spherical to highly distorted in shape (Figure 2). They are usually initially lined with a few tenths of a millimeter of black chamosite, but only rarely is that all. They are generally subsequently lined either with a few tenths of a millimeter of green pumpellyite-(Fe⁺⁺) or a few tenths of a millimeter of thomsonite-Ca. Those lined with pumpellyite-(Fe⁺⁺) are then generally mineralized with bladed thomsonite-Ca with square terminations to a few millimeters in length. This thomsonite-Ca is frequently intergrown with pumpellyite-(Fe⁺⁺) balls, showing that they both crystallized together (Figures 3 and 4) and scanning electron microscope images (Figures 5, 6 and 7). Vesicles with only pumpellyite-(Fe⁺⁺) after the chamosite are also rare.



Figure 2. Vesicular rock showing thomsonite-Ca blades intergrown with pumpellyite-(Fe²⁺) balls in pumpellyite-(Fe⁺⁺) lined cavities. Images taken with Olympus TG-4 camera and stacked with Combine ZM. Width of view 15 millimeters.



Figure 3. One of the individual vesicles in Figure 2.



Figure 4. As in Figure 3, but a different vesicle

Width of both views: 7 millimeters. All remaining optical images taken and stacked with Dino-Lite 2.0. Pumpellyite-(Fe⁺⁺) can be seen on the thomsonite-Ca blades.

In the other large group of vesicles containing only thomsonite-Ca after the chamosite, the whole interior is first lined with very fine grained thomsonite-Ca. Mineralization frequently stopped there. However, in many cases a spray or sprays of larger pointed thomsonite-Ca crystals also grew in these vesicles (Figures 8 and 9). Rarely calcite also grew with these.

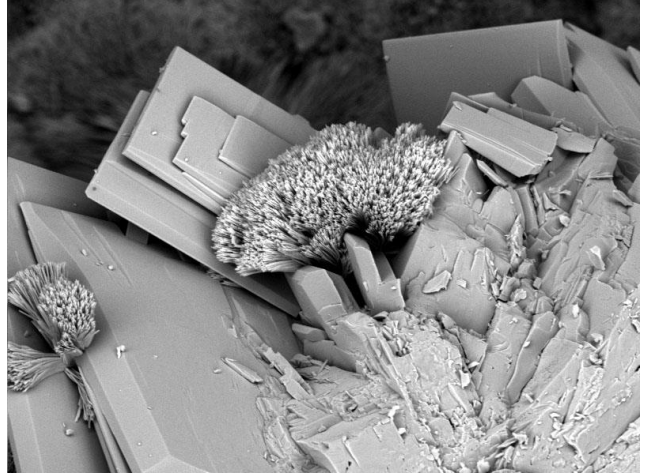


Figure 5. Scanning electron microscope (SEM) image thomsonite-Ca, pumpellyite-(Fe⁺⁺) intergrowth. Width 350 micrometers.

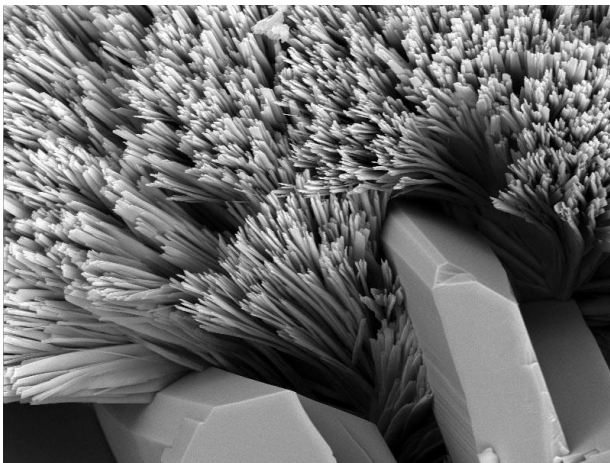


Figure 6. SEM of same region enlarged. Width 70 micrometers.

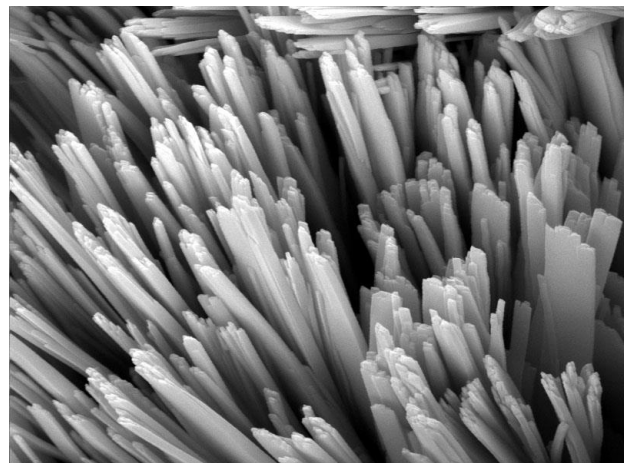


Figure 7. SEM of central pumpellyite-(Fe⁺⁺) needles further enlarged. Width 14 micrometers.



Figure 8. Spray of pointed thomsonite-Ca in vesicle lined with micro thomsonite-Ca. Width 10 millimeters.



Figure 9. Another spray of pointed thomsonite. Width 5 millimeters.

Another common type of filling for these vesicles is fine needles of mesolite formed on the earlier fine grained thomsonite-Ca. These needles frequently formed sprays that fill, or nearly fill the cavity, but they can also be small, randomly oriented, and fluffy (Figures 10, 11, 12, and 13).



Figure 10. Vesicle with tiny mesolite crystals randomly oriented on fine grained thomsonite lining.
Width of view 8 millimeters.



Figure 11. Vesicle with tiny mesolite needles as fluff.
. Width 7 millimeters.

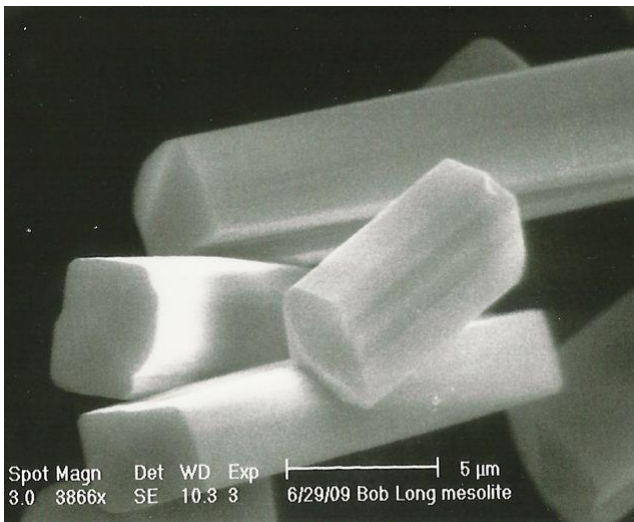


Figure 12. SEM image of perfectly formed mesolite crystals.

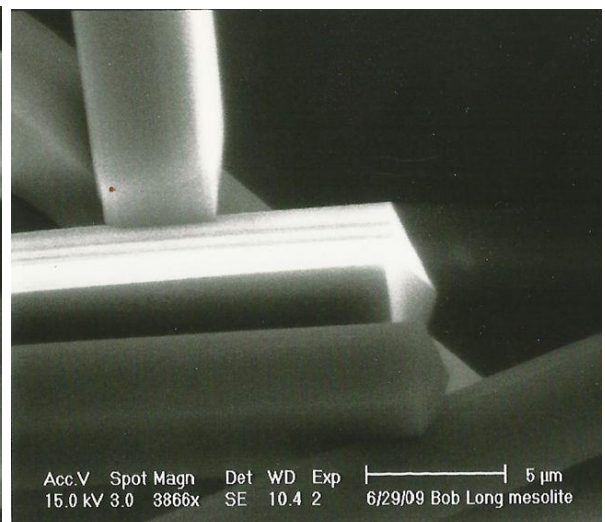


Figure 13. SEM image of perfectly formed mesolite crystals

During SEM examination of the fine grained thomsonite-Ca cavity linings, I discovered that fine grained chalcopyrite can also be present (Figures 14, 15, and 16).

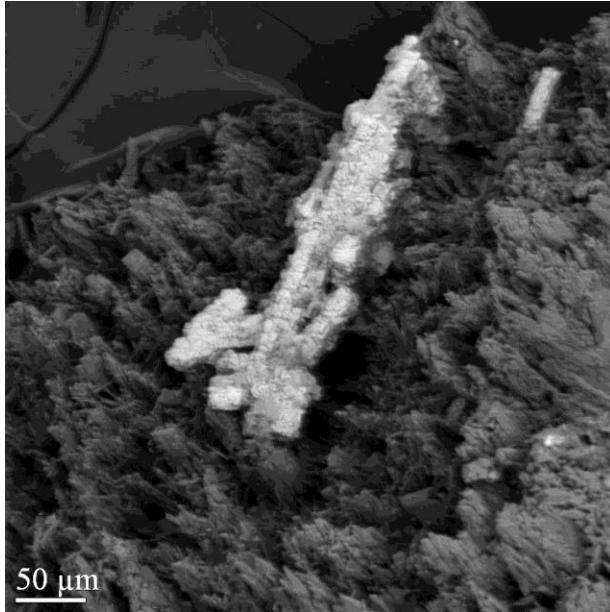


Figure 14. SEM back scattered electron image of cavity that optically showed only the fine grained thomsonite lining. Also now visible are chalcopyrite rods.

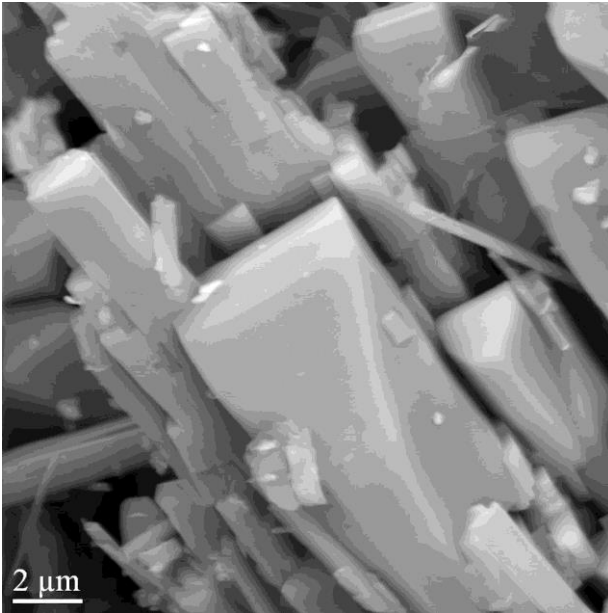


Figure 15. Fine grained thomsonite lining of Figure 14 at high magnification.

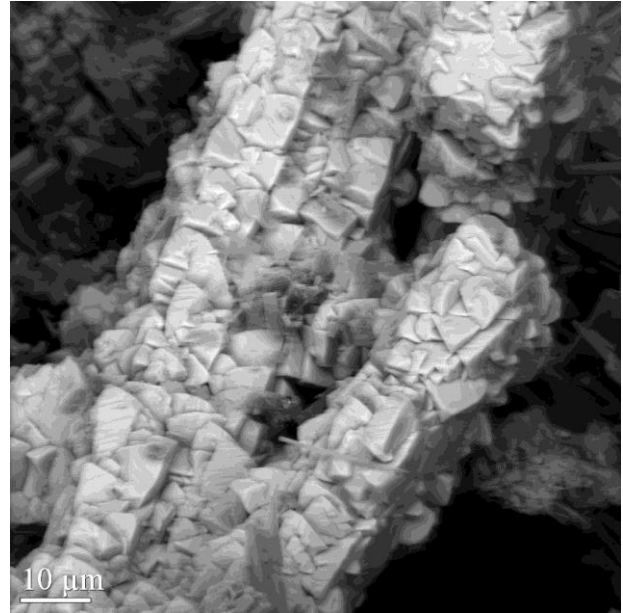


Figure 16. Chalcopyrite rods on the lining in Figure 14 at high magnification.

Zeolites are only stable at relatively low temperatures. Pumpellyites are only stable under relatively high pressures as well as low temperatures. Since both the thomsonite-Ca and pumpellyite-(Fe⁺⁺) grew together, it should be possible with good thermodynamic data to constrain the formation depth and temperature of the mineralization. I suspect that the host rock is a mid ocean ridge basalt that has been brought up and plated onto the Oregon Coast.

Too Big to Fit the Vug?

Don Howard

While going through some of the material that Bill Tompkins gave me years ago from Starvation Creek, I noticed a tendency of the filiform pyrite that I had not noticed on material from other locations. There seems to be an inordinate number of the filiforms that graze along the walls of the cavities that they occupy. These are not broken crystals, but ones still attached in a normal way. This proximity to the walls has allowed “normal” equant pyrite crystals to engulf a neighboring filiform (fig. 1). It also has resulted in causing the filiforms to take on a curved shape to conform with the wall (fig. 2).

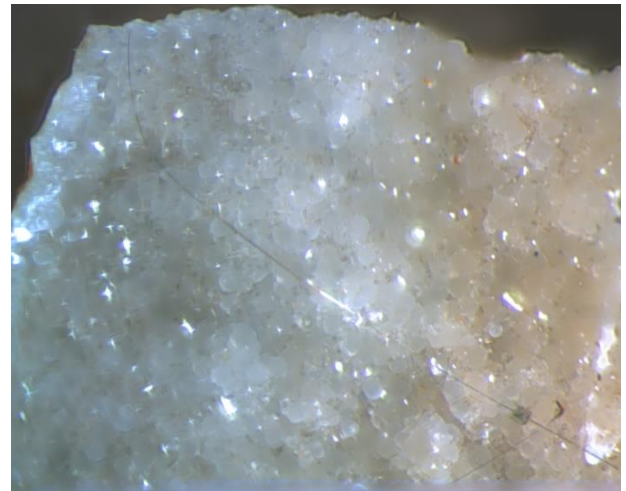
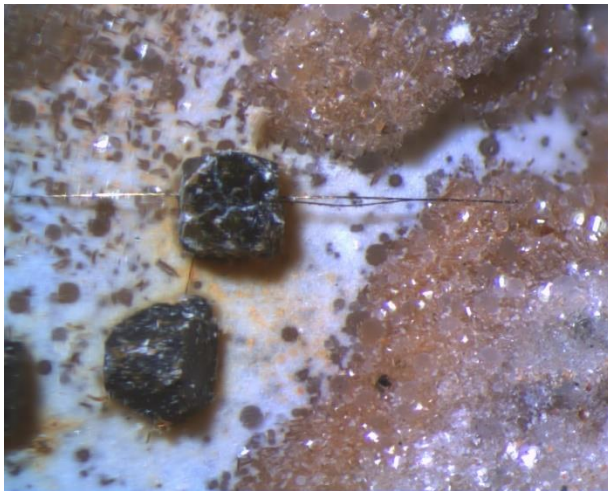


Fig. 1 *Equant pyrite crystal engulfing filiform one* Fig. 2 *Curved filiform conforming to matrix shape*
Starvation Creek, Hood River Co., Oregon

Now this is not particularly in conflict with random behavior. But I came to have a strange feeling that some of these crystals were actually longer than the diameter of the vesicle that they inhabit. How could that be possible? I could not think of a mechanism that would bring that about.

But then I asked what turned out to be the same question in a different way. The filiforms at Starvation Creek are particularly long. What would happen when the growing tip came into contact with the far wall of its cavity?

Before we try to answer this question, we need to step aside and look at how crystals grow. First of all, this is a dynamic process, with material being brought in and material leaving. If the rate of arriving material is greater, the crystal will grow. If leaving dominates, the crystal will shrink and die.

Next, whether a unit stays or not depends on how strongly it is bonded, which in turn depends on how many neighbors it has. Thus, an atom in a complete layer has many neighbors, one at a step has a few neighbors, and one sitting on a flat surface has almost none. This means that crystals tend to finish out layers, and that the limiting process in growth is going to be starting a new layer, called nucleation. This is a difficult step in forming a perfect crystal.

However, no crystal is perfect; entropy demands a certain degree of randomness. This is accomplished by point defects (vacancies and interstitials) and line defects (dislocations). In enhancing growth, the important one is the screw dislocation. This connects adjacent layers to each other around a line like a spiral staircase. Because here, a step always exists perpendicular to that line and can just sweep around and around adding new material. Most ‘ordinary’ crystals are thought to grow utilizing dislocations. Which faces form is determined by which way screw dislocations most easily form.

The conventional explanation for filiform growth is that they are dominated by a particular dislocation and follow its line upward. The trouble with this theory is that it can’t explain right angle

bends, because there is no known mechanism for a screw dislocation to end or change direction. So if this is indeed the mechanism you adopt for filiform growth, the answer to that question is simple. When the end of the filiform encounters to other side of the vesicle, it just stops. Period. There is no new insight there.

An alternative explanation has arisen out of Solid State Physics research. Here, a small body serves to increase the concentration of material and to deliver it to the point of contact with the matrix. As material forms, it lifts the body away from the matrix, leaving it free to go on catalyzing growth. Right angle bends would occur when the catalyzing body is physically shifted sideways by some outside event. The laboratory experiments are done at elevated temperatures, where the small body is usually a drop of fluid metal and the source of new material is the vapor.

Filiform pyrite does not occur at elevated temperature. But the requirements on the small body are that it serve to collect at least one component of the new crystal and that it possesses a large mobility. There is a class of solids that have these properties: the zeolites. I do not believe that it is a mere coincidence that filiform pyrite and zeolites, especially heulandite, occur together in the basalt. Zeolites host divalent ions easily and hold them loosely while providing an open framework that promotes transport and ion exchange. The means of supply is by surface diffusion.

Now we ask again the question: What happens when the catalyst particle encounters the far wall? There are several possibilities. It might just get knocked off, which ceases growth as before. But it might get shifted sideways and keep growing, leading to a right angle bend at the wall. But the most intriguing response was, it might just stop and stay there. Of course, it is still promoting growth of the filiform, but the end has no room to continue. Material builds up, causing an internal pressure. Remember, these filiforms are very thin and flexible. Their response to compression is to bow out sideways into a curve! (fig.3). The more material is added, the bigger the curve. If this continues, eventually they will be forced to the contour of the containing walls. *And the filiform will be longer than the diameter of its vesicle! Wow!*

Now on the way, it may encounter another parallel filiform, and the two may adhere together (fig. 4). Seems like there are a whole number of intriguing possibilities.



Fig. 3 *Filiform arcing between two fixed points*



Fig. 4 *Two filiforms fixed together in the middle*
Starvation Creek, Hood River Co., Oregon

Carbonate Minerals

Text by: Don Howard
 Pictures by: Beth Heesacker

Carbon dioxide has really gotten a bad reputation recently. That's because we have been dumping far too much of it in the atmosphere. But it has been entering the atmosphere for ages past and not caused problems. Under normal circumstances, where does it go? Plants have taken up a good portion of it. But the largest fraction has always ended up dissolving in surface waters.

When carbon dioxide dissolves in water it forms carbonic acid, $\text{CO}_2 + \text{H}_2\text{O} = \text{H}_2\text{CO}_3$. As this solution percolates down into the subsurface layers, it interacts with ions present there that have been released from the various rocks present. It turns out that, while some carbonates are quite soluble in water, many are very sparingly so. Among the ones that tend to drop out of solution are the carbonates of calcium. Calcium carbonate, calcite, is thus deposited in the rock.

This has actually been proposed as a method of removing CO_2 from the environment. The idea is to collect the gas and pump it down to where in time it will dissolve in ground water. As long as the rock is reasonably porous and the water can circulate, the end result would be to form calcite down in the ground to sequester the carbon dioxide.

Why is there free calcium? Basalt is a surface lava, coming out as a viscous mixture of molten rock and seeds of the minerals that are forming, such as feldspars and amphiboles. As the mass cools, those minerals grow in size, but the cooling is so rapid that a portion simply solidifies into tiny patches of glass. Subsequent weathering by ground waters decompose this glass phase most easily, releasing things like calcium, iron and silica. These become the clay linings and zeolites we find in the vesicles. But clays and zeolites hold these ions much more loosely than do the carbonates, such as calcite and siderite.

Calcite is a very common mineral. The IMA defines it chemically as CaCO_3 , and crystallographically as a rhombohedral structure. Actually, it defines a group of minerals with that structure, the Calcite Group. This is because there are several divalent atoms of very nearly the same ionic size as Ca^{++} : Cd^{++} , Co^{++} , Fe^{++} , Mg^{++} , Mn^{++} , Ni^{++} and Zn^{++} . Any of these eight ions can substitute for each other in the lattice. A complete intermixing at any concentration does not occur, however, because of the existence of another group based on the alternate crystal structure of dolomite, $\text{CaMg}(\text{CO}_3)_2$.

A good example of how this intermixing operates is in the basalts along the Clackamas River. Both calcium and ferrous iron are abundantly present. It is therefore very possible that a rhomb forming in one of the vesicles might be either calcite or siderite, but almost surely contains both calcium and iron. Though mineralogists define species in terms of end members, minerals in the environment seldom conform to those kinds of definitions.

We often have a clue as to compositions. Though siderite freshly formed away from the influence of the oxygen in the air would be very much the same creamy color as calcite, the oxygen serves to convert ferrous iron to ferric. Ferric iron does not fit into that lattice, ends up as ferric oxide of some sort that is rusty colored. This leads to a range of color in the rhombs from creamy ones rich in calcium to orangish brown ones rich in iron.

Similar ranges in composition can be found between calcite and rhodochrosite involving manganese, and between calcite and smithsonite involving zinc. The real world is a lot messier than our nicely defined textbooks.

As an example of the range of textures and colors that result, we offer a set of Beth's pictures of these rhombohedral crystals and clusters collected from the Big Cliffs location along the road up the Clackamas River.

Calcite and Siderite Big Cliffs, Clackamas River, Oregon



