Northwest
Micro Mineral
Study Group

MICRO PROBE

Fall, 2016 **VOLUME XII, Number 4**

Fall MEETING . . . . . .CAMAS, WASHINGTON

November 5, 2016 **9:30 am to 4:30 pm**

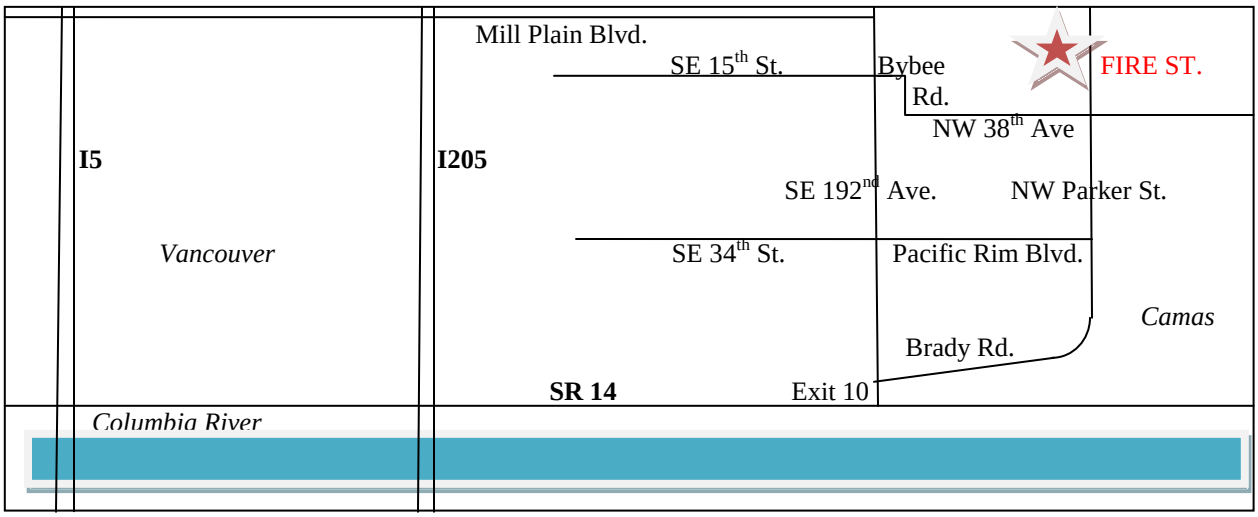
Camas-Washougal Fire Station #42
4321 NW Parker Street
Camas, Washington

Bring microscopes and things for the give-away tables as usual. This time, we have a large infusion of material collected during the 1980s by the Healys from classic locations, many of which are no longer productive – Goble, Shellrock Mountain, Yacolt, Stevenson, Big Bend, and Ritter to name a few. These are larger pieces that can be broken down profitably to provide some very nice micros. (See the article on *New Finds in Old Material*.)

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.

After lunch, let's discuss what locations in the area are still available for collecting, and how to get to them. We will have some pictures of minerals to view. The computer & projector will be available. Please bring the pictures you have to share with the group. We would love to see them.



IN MEMORY OF DEXTER LEONARD

It is with great sadness that we must report the passing of Dexter Leonard in February of this year. He was a regular attendee at the club meetings and we all enjoyed his company and stories of mineral collecting. The following is an excerpt from his obituary in the February 26, 2016 issue of the Corvallis Gazette Times Newspaper.

"On Feb. 5, 2016, Dexter Leonard returned to his Big Sky. Dexter is survived by his wife, Margo; son Zane (Jessica); grandson Wyatt; sister Pat Johnson; and niece Sherri Johnson. Dexter was born in Anaconda, Montana, where he spent his youth and graduated from Anaconda High School in 1961. He graduated from Western Montana University in science education and the University of Idaho in extractive metallurgy. He served in the Army Reserve. He moved to Oregon in 1971 and stayed, working at Wah Chang (ATI) for 33 years retiring in 2004. Throughout his life, Dexter loved geology and minerals, photography, hunting, fishing, hiking, apple trees and blueberries. He often traveled the West to see the land. He will be laid to rest in Montana this summer where he can search for his perfect gem."

Kelly Starnes

IN MEMORY OF DONALD VOLKMANN

We are also saddened by the loss of another Montanan earlier this year, Donald Volkmann. Donald has come down regularly for a number of years from his home in the Bothell, Washington area. At first he accompanied his son, Karl, but he has continued to meet with us after his son graduated and went out in the field to work.

What I remember best was Don's smile, and his cheery greeting. And of course his marvelous stories about the "old days" in the Butte, Montana area where he grew up. He was a regular member of the group that met for dinner at the Buffet, where he would share stories of the wonderful minerals that came out of the mine as well as some of the less wonderful effects the mines had on the community. We will miss the stories, but we will miss most the good cheer that Don always provided.

Our condolences go out to the family, and especially to Karl. We hope to see him again at our meeting when his career obligations permit.

Donald Howard

New Finds in Old Material

Don Howard

In the last issue of the Microprobe, I quoted some advice from Steve Sorrell, and summed up with the editorial statement. "*So the message is, we need to pay attention and go back over the material in our collections.*" That message has been brought home to me personally several times in the last few months. So I would like to take a page or two here to illustrate the wisdom in taking one's own advice.

Firstly, there has been an influx (or is that a flood?) of fresh old material. Janice Healy has had occasion this summer to clean out the material that she and Ed have gathered over the last 30+ years. This is rock that has been gathered from a number of familiar collecting spots around the Northwest, places like Goble, Yacolt, Stevenson, Shellrock Mountain, Burnt Cabin Creek, Three-mile School, and Ritter Quarry. But even though I have been to all those areas, the particular rock that they gathered is not always the same as what I have been accustomed to. And then, it tended to be in BIG chunks. One of the "micros" I have been working down is a cavity 6 inches across in a 35 pound boulder! You all are going to be beneficiaries of that cleaning spree, because much of that material is going to be on the give-away table at our next meeting; all you have to do is take it home and break it down to see what goodies it contains. This is a real bonanza, because it was gathered many years ago at the peak of collecting at many of these places that have since disappeared for one reason or another.

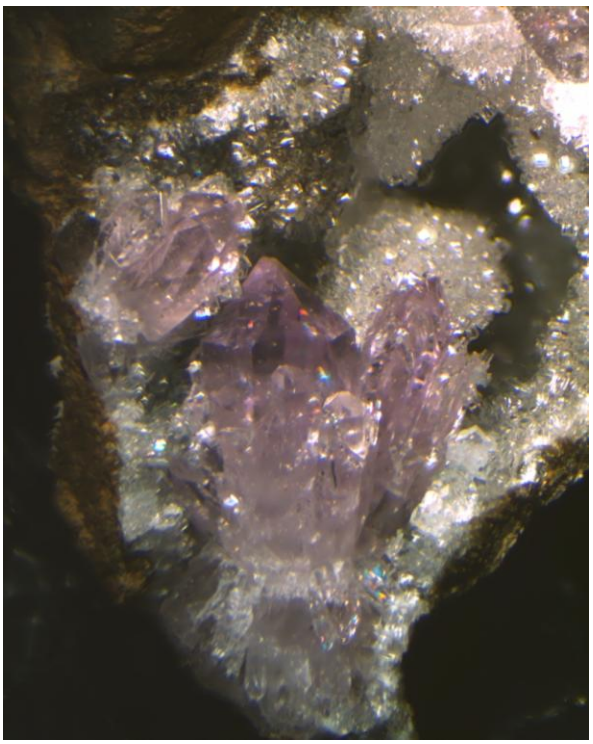


Fig. 1. Amethyst crystals in stilbite
Shellrock Mountain, Hood River Co., Oregon

For instance, the pieces from Shellrock Mountain contain small, clear crystals of stilbite of the variety called epidesmine that forms rectangular solids with flat tops. Quartz crystals are often embedded in the stilbite, and many have a lovely pale violet color – amethyst. See more about what causes that color in quartz and a variety of other minerals in an accompanying article in this issue.

At first I was somewhat disappointed with the pieces from Yacolt. There were considerable heulandites, but they did not have the orange color I had come to expect. Also, the black cavities of smectite with the snow-white clusters of cowlesite were not present. But then I took a closer look through my microscope, and discovered well-formed calcite crystals on the heulandites. Calcite may not be a rare mineral, but it is known as the one with more crystal forms than any other. Goldschmidt's Atlas shows no less than 2544 diagrams, and lists 148 different possible forms for faces! With so many possibilities, the variety of combine forms is practically endless. The particular form on my specimen is shown in fig. 2 at the top of the next page. It is a rhombohedron formed of (30-31) faces with a pronounced c-face and some beveling on the edges. The heulandite is small and the crystals are quite clear, with no mordenite inclusions.

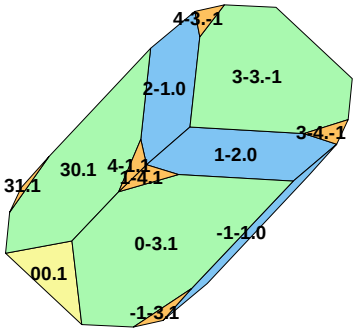


Fig. 2 Calcite on Heulandite
Big Tree Creek, Yacolt, Clark Co., Washington

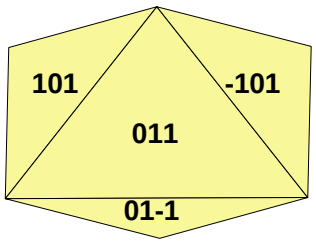
The event that really brought the message home, however, occurred while I was looking for some material to include in a swap by mail. I had found some trimmings from a collecting trip I took with Rudy Tschernich several years ago to Yellow Lake, British Columbia. We had collected a fair amount of material from veins containing brewsterite. We had also spent some effort in another area with small cavities of analcime that had little prism of a very dark blood red that proved to be wakefieldite-(Ce), a very unusual associate of zeolites.

Well, I found a few small pieces with undamaged brewsterite crystals suitable to send, and was just examining a rather scruffy piece that showed some dark minerals in the matrix next to a vein. I had always supposed the dark patches to probably be olivine, and indeed the ones that looked black were probably just that, but I noticed some patches had a reddish look. And when I got the light just right, I found one with a triangular face, but not quite an equilateral triangle. The form had to be a tetragonal bipyramid. And the shape was just right to fit the lattice parameters for wakefieldite. I had not realized that the wakefieldite might be in the matrix phase as well as crystallized in with the zeolites.

Fig. 3 Wakefieldite-(Ce) and Laumontite on Brewsterite
Yellow Lake, Olalla, British Columbia, Canada

There does appear to be a difference between the crystals in the zeolites and those in the matrix. The previous crystals, such as the one shown in fig. 3, are very blocky, composed of prism and c-face only with very little beveling on the edges. The crystal

embedded in the matrix is just a set of (101) faces. This latter form is one that has been noted for wakefieldite-(Ce) from other locations.



So now I am going to have to go back through all the trimmings that remain, and look at the matrix on each of my mounted specimens, to see what I have overlooked. It really does pay to go back over old material to see what else might be there that escaped your notice.

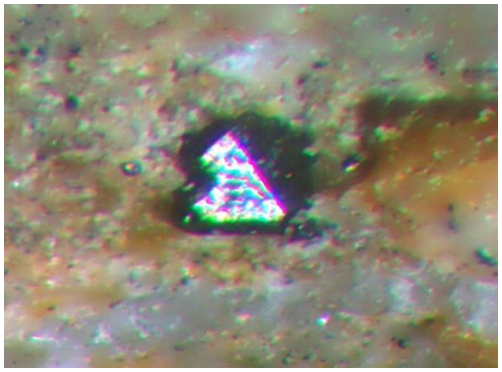


Fig. 4 A very tiny (0.2mm) bipyramidal crystal of Wakefieldite-(Ce) formed directly on the matrix.
Yellow Lake, British Columbia

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Color in Normally Colorless Minerals

Don Howard

Mineralogy can be a curious science. Professional mineralogists are busy describing perfect crystal structures and working out 'end members' of groups that have simplified chemical formulae. In the real world, things just are not like that. Structures have defects, and twinning is not a rare condition. And rather than being pure compounds, minerals generally are mixtures of a variety of elements. We end up naming them in practice after the most abundant chemicals in nature's garbage cans.

So let us start out this discussion by asking, "What causes color in an otherwise colorless compound?" I am thinking of minerals like quartz, fluorite, or adamite, all of which are often transparent and colorless, but can be found in a variety of pastel tints. Obviously, light is involved, so suppose we modify our question to, "How does light interact with a crystal?"

Light is an electromagnetic wave, meaning that it is composed of electric and magnetic fields. It is generated whenever charged particles are accelerated, and when it encounters matter, which is composed of charged particles, it causes them to vibrate. They in turn reradiate, and it is the sum of all radiation, added together in proper phase, that continues the light wave on its way. But this whole process takes a bit of time, and the result is that the wave is slowed down as it traverses the matter. The amount of delay is express by a number: the index of refraction.

Now we add to that the fact that the charges in the atoms and molecules end up having natural frequencies at which they like to vibrate. And the light also has frequencies, which we identify as colors. If the frequency of the light is very different from the natural frequencies of the material, then the light spends just a little bit of time interacting and the index of refraction is close to one. Not much happens and the light goes merrily on its way with just a brief delay. But as the two frequencies get close to each other, the delay gets longer and longer, and it becomes increasingly likely that other vibrations in the material will upset the vibration of the charges before reradiation can occur. In that case, the energy is redirected into other forms of motion, and we observe that some absorption has occurred: the intensity of that particular frequency of light has decreased. White light is a blend of the whole range of visible frequencies. If certain frequencies are thus removed, we observe that the light is no longer white; it has taken on a characteristic blend of the remaining frequencies.

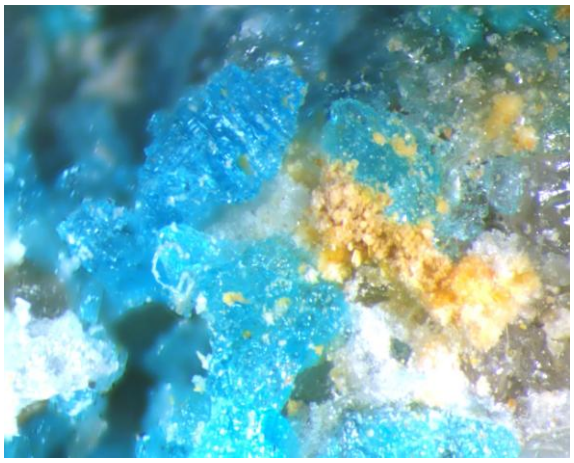

Fig. 1 Chalcanthite and copiapite
Blue Lizard Mine, San Juan Co., Utah

What kind of molecular structures are we talking about? Consider what happens to divalent copper compounds when they dissolve in water. For things like copper nitrate or sulfate, the resulting solution has a deep blue color. This is because the copper ions surround themselves with water molecules to form a complex: $[Cu(H_2O)_4]^{++}$. That complex has resonant frequencies that absorb the red part of the spectrum, so the transmitted light is a rich blue. When copper sulfate crystallizes out of such a solution, the resulting solid, chalcanthite, contains water of crystallization: $CuSO_4 \cdot 5H_2O$. The structure is such that the divalent copper atom is still surrounded by

water molecules, and thus has similar natural frequencies, so the resulting mineral is colored a very similar blue color. However, if you heat chalcanthite to drive off the water, it becomes a white powder! The color vanishes.

Other transition metal ions form similar complexes in water solution. For cobalt, the natural frequencies are higher, so the absorption is in the blues and greens, and as a result, divalent cobalt solutions at rose colored. For the complex with zinc, there are no natural frequencies in the visible part of the spectrum, so divalent zinc solutions are colorless.

Some crystal structures, even without water of crystallization, can contain arrangements of atoms that provide very similar geometries with similar natural frequencies. Consider for instance the mineral adamite, $Zn_2\ AsO_4\ OH$. Here the oxygen atoms of the arsenate and hydroxyl groups surround the zinc in a similar way to the water molecules in solution. The resulting pure mineral is colorless and transparent. However, other transition metal atoms can replace some of the zinc atoms. If these impurities are divalent copper, the resulting structures cause absorption in the red end of the spectrum, and the resulting crystal is blue-green in color. The intensity of the color is dependent on the amount of copper substitution. If instead, the substitution is cobalt in place of the zinc, rose-colored crystals result. Yellow adamite is the result of iron substituting for the zinc.

Fig. 2 Adamite crystals
Mapimi, Durango, Mexico

Iron impurity atoms can add color in a number of ways to clear crystal quartz. The iron atoms may enter substitutionally in place of silicon, or as interstitials in the rather open structure. At first glance, it is rather surprising that iron, normally with a valence of 2 or 3, will substitute for silicon, which has a valence of 4. One of two things will happen: either some oxygen vacancies will result to compensate for the fewer electrons available, or the iron will actually take on a valence of 4. In this latter case, the 4-valent iron impurity will lend a purple color to the quartz, making it what we call amethyst. Amethyst heated in air loses its purple color, and the quartz becomes dark – what we call smoky. Radiating the quartz with x-rays tends to restore the iron to the 4-valent state and returns the amethystine color. Interstitial iron in the 3-valent state colors the quartz yellow-orange – called citrine.

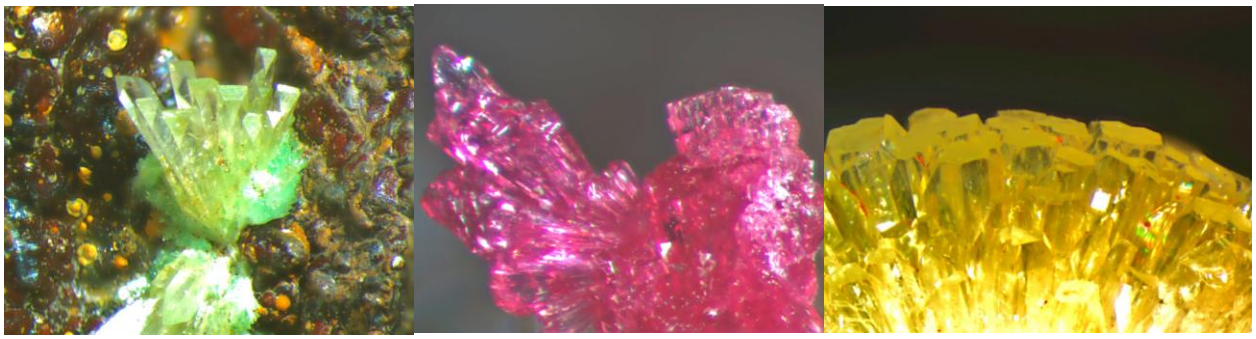

Fig. 3 cuprian Adamite — *Gold Hill Mine, Utah*
cobaltian Adamite — *Vignora Mine, Trento, Italy*
ferroan Adamite — *Ojuela Mine, Mapimi, Mexico*


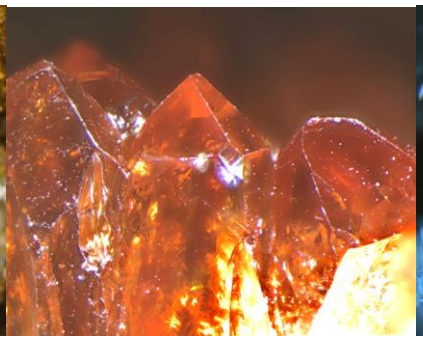


Fig. 4 Quartz var. Amethyst *Quartz var. Citrine* *Quartz var. Smoky*
Shellrock Mtn., Oregon *Brazil* *Sawtooth Mtns., Idaho*

Vacancies can in themselves lend color to a mineral. Consider the group of minerals that have the same structure as halite: Halite (NaCl), Sylvite (KCl), and Villiaumite (NaF) . Halite and sylvite normally form clear, colorless cubes. But villiaumite is usually red-violet in color. Rarely, halite has a violet color to its crystals. All of these salts can be crystallized artificially, and in each case the result is colorless. Even colored natural crystals, if dissolved and recrystallized, end up forming a colorless powder. So where does the color come from?

The atomic structure of villiaumite is particularly simple: a cubic array of alternate atoms of sodium and fluorine. A missing fluorine atom – a vacancy – leaves six surrounding sodium atoms and an electron to donate. The set of sodium atoms without the fluorine looks more positive than the rest of the perfect crystal, and attracts the extra electron into a bound state that resembles a hydrogen atom. And like a hydrogen atom, it has distinct energy levels and can absorb energy resonantly. That resonance happens to be in the green, leaving the light transmitted poor in green so that it looks red-violet. This kind of structure is called a **color center**. Naturally occurring villiaumite, and to a lesser extent halite, tend to have these types of defects.

Another fluoride with a very simple structure is fluorite (see Microprobe, XII, #1, pg5). Here each fluorine atom has four calcium atoms arranged tetrahedrally. A fluorine vacancy has the same effect of a localized increase in positive charge with an extra electron that can be bound. Fluorite often has a violet color due to these types of color centers. Violet color in fluorite is most common when the mineral is associated with uranium minerals, where the radiation damage caused by radioactive decay leads to numerous vacancies occurring in the lattice.

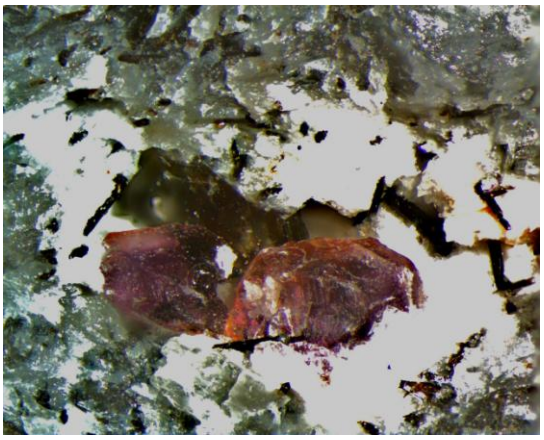

Fig. 5 Villiaumite
Point of Rocks, New Mexico

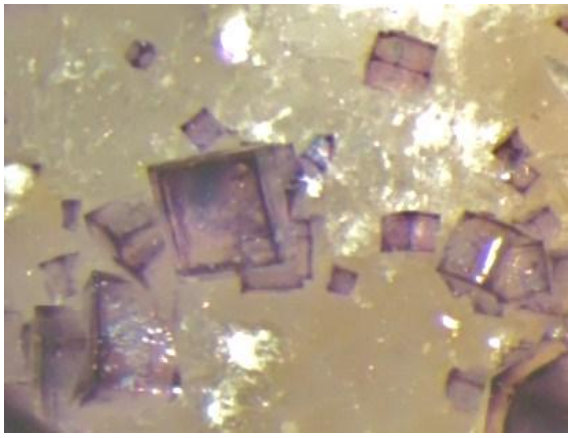

Fig. 6 Fluorite
New Method Mine, California

Tschernichite from New Zealand

Don Howard and Neville Berkahn

To date , tschernichite has been found in six locations scattered all around the world. The mineral was first identified from the site on Neer Road, Goble, Columbia Co., Oregon. That occurrence was described in the Microprobe, Vol. VI, #4, pg2 & #5, pg3 (1987). This was soon followed by a report on the occurrence of tschernichite in Costa Rica, Microprobe, Vol.VII, #6, pg4 (1992). Very little is known about the occurrence in Antarctica other than it was made on a loose rock from a scree slope that also produced several other rare zeolites. The Czech Republic location was described in the issue this Spring (Vol. XII, #3, pg12 (2016)). In each of these four occurrences, the minerals were in small vesicles in basalt. The other two locations differ in that the rock is andesite rather than basalt. We will feature an article on the location in Hungary in the following issue next Spring.

Tschernichite was first found in New Zealand around 1990 by Neville Berkahn. Just as with the crystals found originally by Rudy Tschernich, it was tentatively identified as some form of apophyllite. It has since been properly identified by x-ray diffraction.

We learn from Mindat that several zeolites occur in the Waitakere Stream, a small watercourse draining the Waitakere reservoir in the ranges that lie due west of the city of Aukland. The reservoir and the part of the stream that feeds it lie entirely within the confines of the designated Waitakere park reserve, where collecting is not allowed. Material, therefore, must be gathered below the bridge on Te Henge Road, which marks the park boundary.

Neville writes, "Tschernichite occurs in well rounded water worn andesite in the stream, along with other zeolites in tiny vesicles 5 to 20mm in size. Most of the rocks are Piha (mp) [*Stratified, andesite-breccio conglomerate with minor grit, sandstone, and siltstone*] which are found as alluvial deposits. These water worn rocks have been eroded from the base rock just under the stream bed in some places. The base rock, andesite, was once part of the original Waitakere subterranean volcano that was eroded by sea action before emerging and forming the Waitakere Range as it is today. In the stream there is a good a specimen of conglomerate. This is in the same area as where the tschernichite and other zeolites are found.

"The stream photo [fig. 1] shows the collecting area and the range of rock sizes that vary between 0.25 to 1meter in diameter. The tschernichite has been mostly found in rocks up to 200mm so far. Tschernichite is the rarest zeolite found at this location, and almost always forms by itself as single or twinned crystals from 0.2 to 1.0mm in a vug. Chabazite, erionite, heulandite, levyne and thomsonite have been found in the same rock as tschernichite, but not in the same vug."

Fig. 1 *Waitakere Stream, North Island, New Zealand*

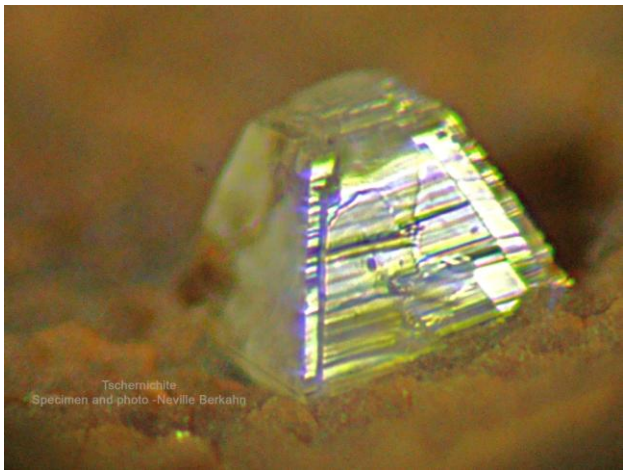

Fig. 2 An individual, striated tschernichite
Waitakere Stream, New Zealand

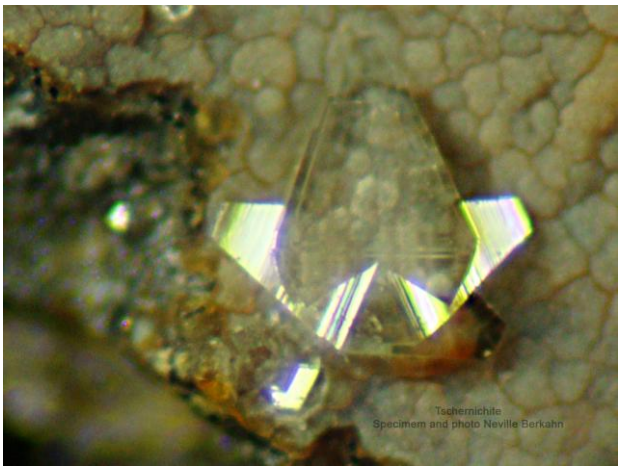

Fig. 3 A small cluster of twinned tschernichite
Waitakere Stream, New Zealand

Crystals of tschernichite are colorless and very clear, which makes them hard to see in the microscope, let alone to try to photograph. The prisms are striated horizontally and tend to have stepped edges, as may be seen in fig. 2. Small clusters of a few twinned crystals are also present, such as the one shown in fig. 3.

Other zeolites are present in other cavities. Levyne forms thin, colorless blades dusted with a light coating of white erionite (fig. 4). In some cavities, the levyne blades stack up in parallel growth, forming thicker glassy crystals, with the central blade longest and the stack tapering off to each side. (fig. 5). Erionite also forms crystals of its own in other cavities.. These tend to be rough cylinders that seem almost round because of heavy vertical striations. The ends of the cylinders are often rather rough, but may be terminated by small six-sided pyramidal caps of triangular faces [*Zeolites of the World, fig.182, pg157*]. One such face is highlighted by reflected light on the prism, upper middle, in fig. 6.

Fig. 4 Erionite dusting thin levyne blades
Waitakere Stream, New Zealand

The erionite crystals of fig. 6 are surrounded by very clear colorless heulandite. The heulandite crystals are quite small and jumbled together to the point that it is hard to distinguish their form. Fig. 7 gives a better view of the crystal shape: a parallelepiped on the end with rectangular sides. This is not the usual coffin-shaped habit, but rather the form elongated along the b-axis with (101) prism faces [*Zeolites of the World, fig.336, pg248*]. The diamond-shaped reflections off the (010) faces can be easily confused for reflections from the prism faces of the tschernichite in cavities where the heulandite is sparse and scattered rather than thick and jumbled.

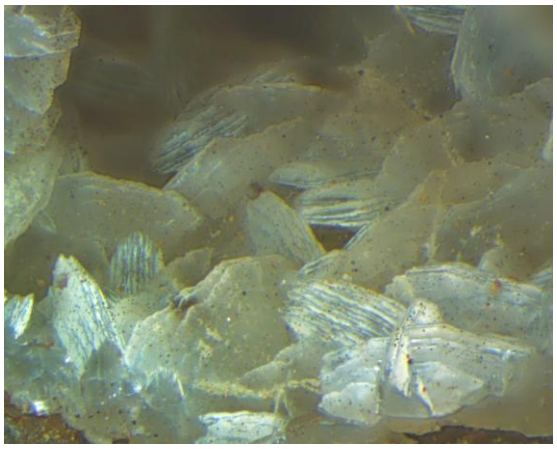

Fig. 5 Bundles of parallel levyne blades
Waitakere Stream, New Zealand

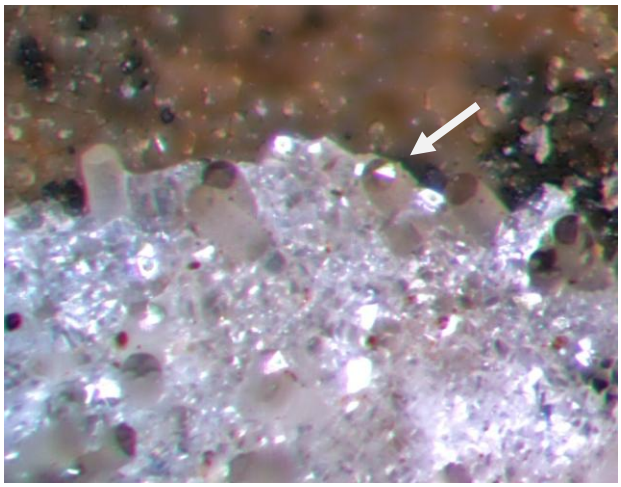

Fig. 6 Heulandite surrounding erionite crystals
Waitakere Stream, New Zealand

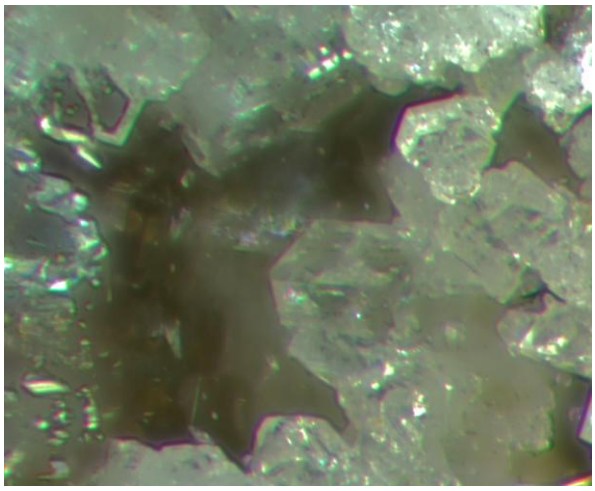

Fig. 7 Heulandite prisms
Waitakere Stream, New Zealand

Thomsonite (fig. 8) forms as fans of rhombohedral blades with flat ends in cavities lined with fine-grained heulandite, as do the pseudocubic crystals of chabazite and bladed stilbite with pointed terminations (fig. 9). All of these are very clear and colorless. Other zeolite species are undoubtedly present. In these sorts of cavities with a lining of druzy heulandite, it would be almost impossible to identify tiny tschernichite crystals that might lay beneath.

It is a shame that material of this type is so limited and so hard to come by. Still, it is an interesting deposit worth further investigation.

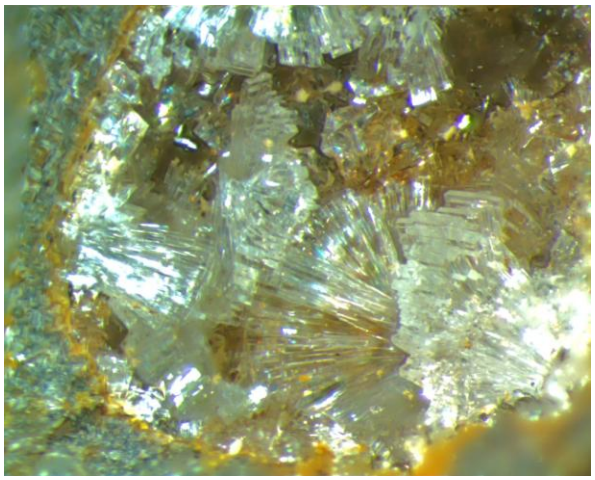

Fig. 8 Fans of thomsonite on heulandite
Waitakere Stream, New Zealand

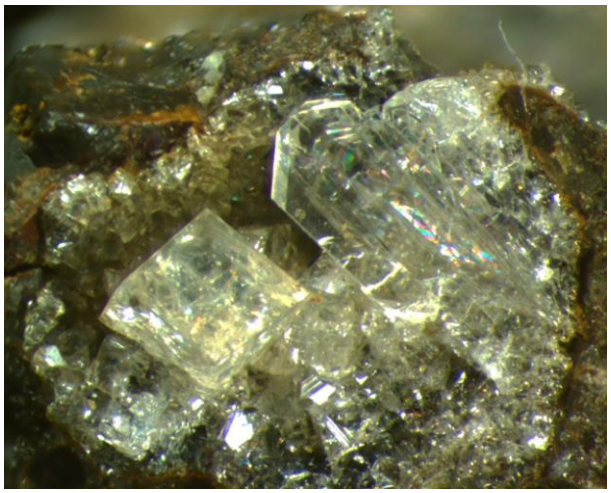

Fig. 9 Chabazite and stilbite on heulandite
Waitakere Stream, New Zealand

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Goble, Oregon, Today

Don Howard

For those of us who have been members of the Northwest Micro Study Group for many years, we look back fondly to the time thirty or forty years ago when the basalts at Goble were yielding up new minerals: first cavansite, and then cowlesite, tschernichite and boggsite. Some batch of us were working the spot just about every weekend.

This summer, I was putting together a talk on type minerals of the Northwest, and decided to take a ride out to Goble to see what the collecting site looked like today. I discovered that the "town" of Goble had changed very little. It had always been little more than a tavern on the west side of the road and a marina on the east side. To be sure, it looked like they had built a new building for the tavern just south of the previous location. The former building now seemed to be some sort of residence.

The new Goble tavern, with the old one in the background at right (greenish roofs).

Highway 30 was still the same two-lane road it had always been. The Marina had perhaps grown a bit, but was substantially unchanged. At that place, there is not a lot of land between the highway and railroad, and the river. Just north of the tavern, Nickolai Road cuts off to the west, and there is a sign advertizing the Quarry up that way. Not much seemed to have changed.

Looking across Highway 30 to the Marina, and beyond that to Kalama across the Columbia River.

Highway 30 is a fast two-lane road. North of the Nickolai Road intersection it crosses Goble Creek. On the north side of that, Neer Road takes off up the hill to the west. Still nothing much was different. But as soon as we started up Neer Road, that all changed. We were startled to discover that most of the bank that had been the north

side of Neer Road had disappeared. There was a huge trench where the bank had been, scooped out and hauled away at some point to provide fill rock somewhere or other. What little still remained of the bank on that side showed very little evidence of zeolites at all. There certainly was a lot more room to pull off and park!

All that remains of the north bank along Neer Road.

The south side of Neer Road was untouched. The pit where we dug out so much rock containing tschernichite and boggsite was still identifiable at the top of the guardrail. The little maple tree that stood between the pit and the road was not so little any more. It had dropped several decades of leaves to make a thick layer of mulch covered in grass. The fringe of shrubby bushes had encroached. Together, they completely covered the ground, so that no rock was showing. One had the impression that a huge amount of work would have to be expended to manage to expose anything.

The tree and the pit on the south side of Neer Road.

The upshot was that I was not motivated to do any prospecting at all. We took pictures and left, thinking that here was a collecting site that had totally disappeared. The remaining minerals from "Neer Rd., Goble" are residing in our basement and garages, and once they are gone, there isn't going to be any more. I hope that gives you pause to consider the next time you see a box of Goble material on the give-away table.