Northwest
Micro Mineral
Study Group

MICRO PROBE

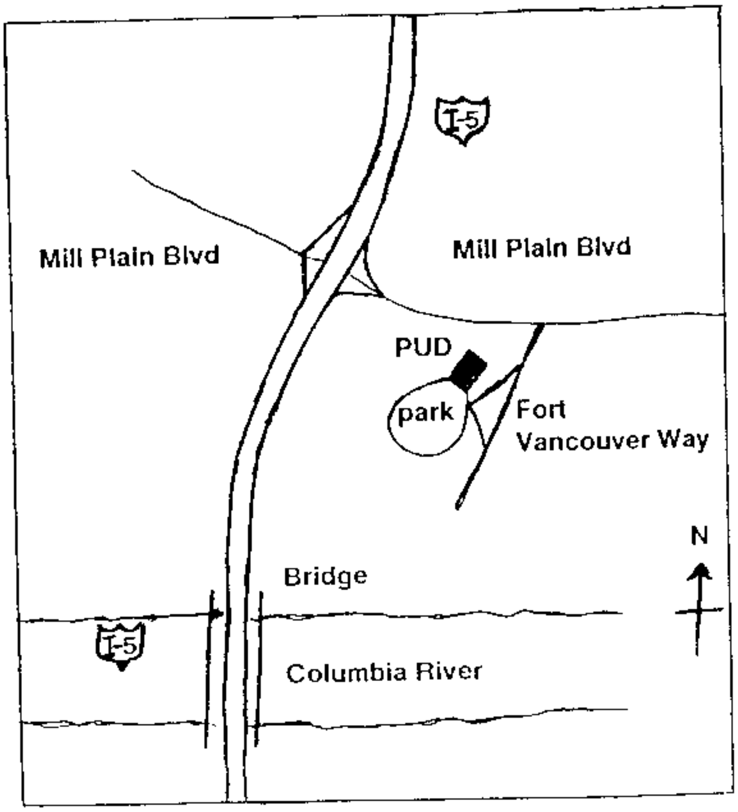
FALL, 1994 VOLUME VII, Number 10

FALL MEETING . . . . .VANCOUVER, WASHINGTON

November 5, 1994 **9:30 am to 9 pm**

Clark County P. U. D. Building
1200 Fort Vancouver Way
Vancouver, Washington

Come join us for a day of good fun and fellowship about mineral collecting. Bring your microscopes and the best of your new finds from this last summer. Also be ready to share information about the status of collecting spots in your area. And be sure to bring some pieces for the give-away table so that everyone will come away with new material.



There will be a short business meeting at 1:30 with a chance for everyone to share information about collecting. Russ Boggs will be showing slides and talking about his recent trip to the Kola Peninsula, Russia, and Rudy Tschernich will show slides of Wolf Point Quarry in anticipation of a possible field trip on Sunday. (weather permitting).

As usual, we will have specimens from the locations featured in articles in this issue for you to examine.

Pot Luck Dinner will start around 6 pm. Bring a salad, hot dish, or dessert. We will supply ham, potatoes and coffee.

Bring slides of collecting trips or newly photographed minerals to share in the afternoon after the talks.

ZEOLITES FROM THE 200/237 QUARRY, NEAR WOLF POINT, COWLITZ COUNTY, WASHINGTON

by
Rudy W. Tschernich
526 Avenue A
Snohomish, Washington 98290-2414

An operating quarry located at the junction of the main logging road 200 with the small side branch 237 is found east of Wolf Point, south of the South Fork of the Toutle River, Cowlitz County, Washington. It was discovered by Steve Satra in the spring of 1994. The present day quarry is operating in the site of a much older quarry that was used when the 200 road was originally built to cut old growth trees. Mounds of soil that were removed from the top of the old quarry when it was first started are seen on the southwest side of the present quarry are covered with second growth trees that are now large enough to be harvested. Weyerhaeuser numbers it's new logging roads with larger numbers each year and was using 8000 road numbers in the 1970s. The 200 road was one of the very first roads constructed in this area. According to Weyerhaeuser foresters, what is now the 200 road was a logging railroad built in 1930 to transport logs to Headquarters Logging Camp and to lumber mills. Logging of second growth timber is now taking place in the area and the old roads are being reopened and resurfaced with rock from this quarry. This quarry has been there undiscovered for 64 years.

The new quarry consists of two levels, each in a different flow. The rock is a black Eocene basalt of the Kalama River Group (the same rock unit that makes up all the productive zeolite sites on Elk Mountain). According to U.S.G.S. Open File Report 92-362 these basalts are low-potassium tholeiites similar to mid-ocean ridge basalt. The flows contain 10-35 percent plagioclase and up to 6 percent olivine phenocrysts set in a ground mass of plagioclase, olivine, augite, and Fe-Ti oxide. Some of the plagioclase phenocrysts are partly replaced by smectite, albite, laumontite, stilbite, and calcite while the olivine is replaced by smectite. It is highly vesicular in some areas with some cavities reaching 20 cm in diameter although most of the cavities are under 2 cm across. The mineralogy is similar in both flows although some species are restricted to small areas in the quarry or even to a single boulder. It is wise to collect from many different areas in the quarry and from many different boulders if a suite of species is desired. Rocks rich in fibrous white zeolites scolecite and laumonite also contain stilbite and psuedomorphs. Rocks without scolecite and laumontite contain more epistilbite, cowlesite, analcime, and phillipsite. With the exception of laumontite and scolecite most of the minerals are micro-size and difficult to identify in the field.

Laumontite and scolecite are abundant in both the upper and lower flows and are difficult to distinguish from each other when fresh. Laumontite that is exposed to the dry air in time turns white and falls apart. The lower level contains most of the larger cavities and the high silica zeolites: stilbite, heulandite, and epistilbite. Most of the levyne and phillipsite are also found on the lower level. The upper level contains an abundance of thin needles of scolecite and laumontite that make outstanding specimens. Cowlesite has been found only in the rocks from the upper level. Analcime was found in one rock in the lower level. White rhombohedral pseudomorphs after calcite are found in both flows. Good specimens are also found in the boulders scattered along the edge of the road near the quarry and over the bank north of the quarry.

The rock is not hard to work in the quarry but is difficult to trim to exact sizes. It tends to break along cracks already in the rock that usually go right through the cavity.

The quarry is being actively worked this year and at times machinery is present. The quarry is not posted and access does not appear to be a problem. Gates are in place across all roads leading to this site; therefore, collecting can be cut off at any time. Since slash from the logging operation is a fire hazard, expect this area to be closed during the summer.

This site is most notable for excellent specimens of scolecite, epistilbite, calcite, pseudomorphs, odd forms of phillipsite, and unusual parallel growths of epistilbite, levyne, stilbite, heulandite, scolecite, and laumontite. It is not known why so many of the minerals at this site form parallel growths on the walls of the cavities or even why several generations of parallel growths of different species cover each other. Parallel growths can be recognized when the same crystal faces on all the crystals of a single species reflect light at the same time. This indicates that the crystals all have their crystal axes in alignment (the same as epitaxial overgrowths of two different species). These kind of growths do not happen by random chance. If crystallization of a mineral starts at one point in the cavity, continued growth usually enlarges the single crystal. If for some unknown reason, growth does not enlarge the first crystal, additional crystals can form along side the first crystal using the first crystal as template or parent crystal. All the smaller crystals will then have their axes oriented in the same direction as the parent crystal. Ideally as additional crystals form, each of the newly formed crystals will be in alignment with all of its relatives until the entire surface of the cavity wall is lined with a family of crystals. Not all of the crystals to are in perfect alignment. The further you go from the first parent crystal faults or mutations occur that cause crystals become slightly misaligned. The parallel growth then gradually forms radiating growths that are nearly parallel with its neighbors but are further are out of alignment to crystals further away from the crystal. Additional complications occur when crystallization starts at two or three points in the cavity. Parallel growths then extend from each of parent crystals until they come in contact with its neighboring family. Each of these families will have a different orientation of parallel growth. One family will have a parallel growth showing only the terminations. The neighboring family might display only the side edges of the crystals and all be tilted in the same direction. A third family in the same cavity will have still a different orientation, yet within each family or set of crystals they are all related to each other.

In many of the cavities a second crystallization period occurred and in most cases it simply enlarged the pre-existing families of crystals and formed phantoms where the two generations came in contact. A few cavities contain a second family of aligned crystals forming over the earlier formed family of crystals that have a different crystal alignment from the first family. Most of these observations are seen on epistilbite crystals, but the other minerals show it to a lesser extent. In the case of epistilbite and levyne, the early formed family of epistilbite crystals are covered by a differently oriented parallel growth family of levyne crystals. Even fibrous crystals like scolecite and laumontite that normally always crystallize perpendicular to the cavity walls, form parallel growths laying down on the walls of the cavity. We can observe and describe what happened in a cavity but it is much more difficult to explain why it happened.

The minerals found at the 200/237 Road Quarry are described in order they first crystallized in the cavities.

CLAY (probably an iron-rich smectite) forms a dark green to black lining, 3 mm thick, in most of the cavities and predates zeolite crystallization. Some cavities contain a jumble of clay fragments, shells, and plates that have become detached from the cavity walls probably during folding and faulting of the volcanic rock in the Mt. St. Helens area. The later-formed zeolites have grown over and cemented the clay fragments together. Many of the zeolites form unusual, thin, parallel growths that cover the clay lining and the fragments. The zeolites are usually colorless and transparent but appear black or dark green due to the color of the clay being transmitted through the colorless zeolites.

CALCITE crystallized at several different times. The first generation of calcite formed simple rhombohedral crystals previous to scolecite and cowlesite. A later generation of calcite formed rhombohedra crystals, many with complex faces, on short scolecite needles and was later encrusted by scolecite. Dissolution of these early-formed calcite crystals resulted in hollow scolecite-shells that were usually filled with laumontite to form pseudomorphs after calcite. A few scolecite shells were filled with a fine-grained interwoven mass of scolecite needles. The mineral replacing calcite can only be determined on those pseudomorphs that are broken to reveal their interior.

A late generation of calcite commonly formed colorless, lustrous, highly modified rhombohedra on all of the zeolites. In some of the dark-colored epistilbite-lined cavities a single, highly faceted, transparent, clear calcite crystal with an exceptional luster is found that resembles a cut diamond sitting on black velvet. These crystals make outstanding micro specimens.

MORDENITE rarely forms thin colorless needles included within heulandite and epistilbite and imparts a light-colored appearance to the cavities. In a very few cavities mordenite forms a layer of radiating needles under heulandite. Rarely mordenite forms isolated white tufts of radiating needles scattered on black clay that is covered by epistilbite.

HEULANDITE commonly forms parallel growths composed of colorless crystals that appear green or black due to the color of the underlying clay and lay flat against the walls of the cavity. Parallel growths of heulandite are easily confused with those of epistilbite and stilbite. Heulandite is commonly in the central part of the lower level of the quarry and is usually covered with scattered crystals of stilbite and laumontite. Rarely mordenite needles are found within the heulandite crystals. Cyclic-twinned epistilbite crystals have been found on heulandite in a few cavities. Normal bladed heulandite crystals that grew perpendicular to the cavity walls have been found in a few cavities that contain quartz and pyrite.

PYRITE rarely forms tiny cubes on drusy normal-appearing heulandite crystals in light-colored cavities and is scattered throughout the matrix of the basalt in a few boulders.

QUARTZ rarely forms colorless crystals on heulandite and is associated with calcite in a few cavities. Some of the quartz crystals are cavernous or sceptered and are weakly attached to the heulandite.

STILBITE commonly forms colorless pointed blades, up to 10 mm long, on parallel growths of heulandite and is covered by white laumontite prisms. In many of the cavities stilbite forms a parallel growth on the walls of the cavity with only the c-face (striated side face) showing. Some cavities show scolecite needles included within the outer edge of the stilbite that indicates the two minerals co-crystallized near the end of the stilbite growth. Stilbite is common only in the central part of the lower level of the quarry.

EPISTILBITE is rather common in the small cavities that do not contain the fibrous zeolites scolecite or laumontite. It has not been found in any of the large cavities. It forms many strange parallel growths, radiating groups, and unusual twins. It commonly forms a parallel growth on the cavity walls and appears black or dark green due to the color of the underlying clay being transmitted through the colorless epistilbite crystals. Some cavities contain epistilbite that displays only the terminations in parallel growth, others show only the edges or {110} faces in either parallel or radial fashion. Some cavities contain parallel growths in two or more directions in different parts of the cavity.

The terminations of most of the epistilbite crystals are dull, rough, and appear frosted while the side faces have a very high luster. There appears to be two generations of epistilbite. The first forms a very thin parallel growth on the surface of the clay-lined walls or clay fragments in the cavities. The second generation extends the crystals into the cavity by continued growth of the existing crystals or it forms a second parallel growth that has a different orientation from the first and covers the early parallel growth. In some cavities a parallel growth of levyne takes the place of second generation of epistilbite and covers the epistilbite with a parallel growth of its own. The second generation of epistilbite often develops the best crystals and makes attractive stacks of crystals that are delicately attached to the first generation. These crystals show a phantom-like attachment where the two generations meet and separate from the other crystals very easily. In a few cavities radial groups of epistilbite, several millimeters in diameter, form hemispheres that resemble bladed thomsonite. Actually they are micro-sized representatives of the large epistilbite balls from Jalgon, India.

All simple epistilbite crystals (Fig. 2) are twins with the (100) as the twin plane. The front half and back half of the crystal are two the individuals. The {110} prism faces are lustrous and the terminations are composed of {001}, {$\bar{1}$12} and tiny 011} faces (See SEM photo 213) and Figs 1 & 3). All of these forms are common at Wolf Point.

The second generation of epistilbite also formed flat blade-like twins (Fig. 173 in Zeolites of the World) and V-twins (Fig. 172 in Zeolites of the World) in a few cavities. Very rarely cyclic eightling epistilbite twins (SEM photos 220 & 225) have been found in a single boulder along the 200 road on the east side of the quarry. This is the first time epistilbite cyclic eightlings have ever been reported. The cyclic eightlings are very small,

EPISTILBITE

FROM WOLF POINT, COWLITZ COUNTY, WASHINGTON

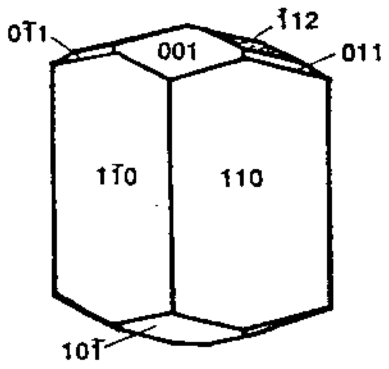


Fig . 1

Common habit
at Wolf Point

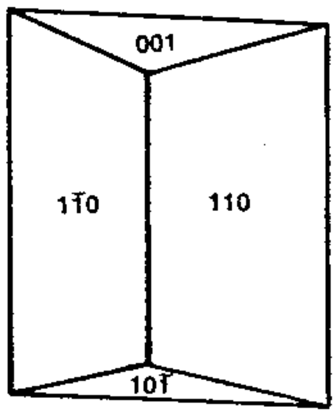


Fig. 2

Common habit at most localities
Rare at Wolf Point

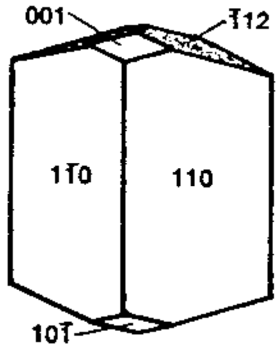


Fig. 3

Common habit
at Wolf Point

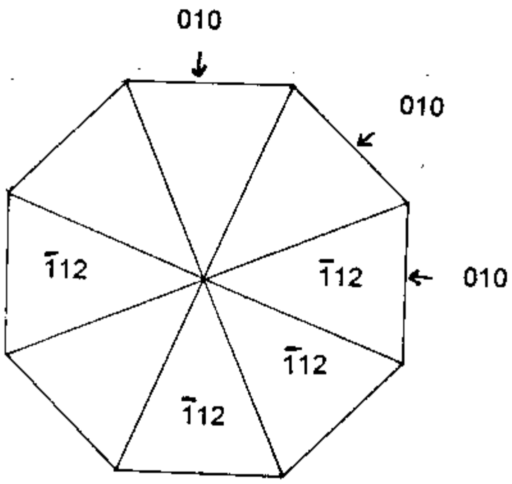


Fig. 4

Ideal 8-ling cyclic twin
due to repeated twinning
on {110}planes

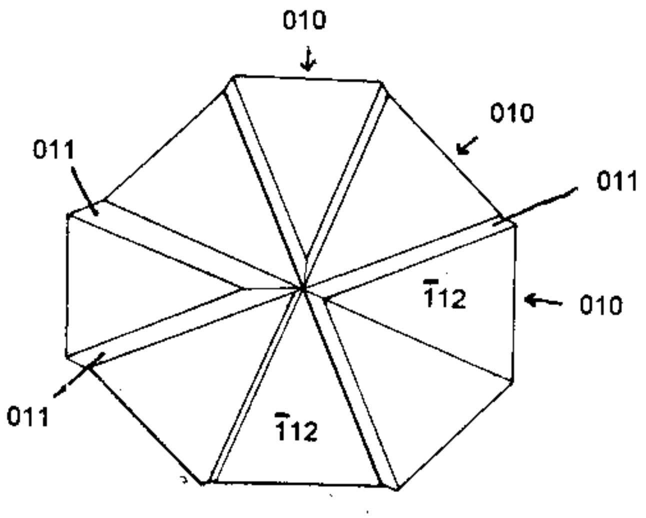


Fig. 5

Off set 8-ling cyclic twin
due to larger or small sectors

under 0.5 mm across, and require at least 40 magnification to study. Several different types of twinning can form a cyclic eightling that ideally is a simple eight-sided prism terminated with eight triangular pyramidal faces tipped at a very shallow angle (Fig. 4) that resembles a hexagonal gmelinite crystal. The side faces of these twins are all bound by {010} faces and terminated by $\{\bar{1}12\}$faces. When sectors of the eightling are larger or smaller than the adjacent sectors or it is offset then small (011) faces are seen (Fig. 5) A simple cyclic eightling requires 8 simple twins (twinned on {100}) and 8 sectors (each twinned on {110}) to complete.

In SEM photo 225 (at the base of the eightling twin) is found two flat twins that are twinned to each other at an angle of 90°. One of the flat twins is normal while the other is lopsided due to expanded growth of one half of the twin.

Rarely mordenite needles are found covered by epistilbite crystals. Cyclic eightlings are found on heulandite in a couple cavities and phillipsite, chabazite, calcite, and scolecite are all found on epistilbite. Stilbite has not been observed in the same cavity as the epistilbite.

ANALCIME is very scarce in the quarry. It forms tiny, colorless, transparent trapezohedra in a few small cavities in a single boulder on the right hand side of the lower level of the quarry. No associated minerals have been observed.

COWLESITE has been found in a few cavities in non-fibrous zeolite-bearing rock that contains epistilbite from the upper level of the quarry. It forms tiny mounds of colorless, transparent, pointed blades that glisten like transparent cellophane foil. The mounds of cowlesite were found directly on the clay-lined cavities or on rhombohedral calcite crystals. Phillipsite rarely covers the cowlesite. Cross sections of cowlesite aggregates show that they are composed of many tiny crystals that build up on each other to form a hemispherical mound rather than being composed of a radiating group of simple single crystals that extend from the base to the surface of the mounds.

PHILLIPSITE is scarce in the quarry. It rarely forms transparent colorless to white, blocky, simple, Morvenite twinned crystals (Fig 484 in Z of W) and Stempel twins (Fig. 502). More commonly it forms the unusual pseudo-dodecahedra (Fig 503) scattered on clay, epistilbite, or cowlesite in a few cavities in the non-fibrous zeolite rock. Close inspection of the pseudo-dodecahedra shows intersecting striations or growth patterns on the surface of the faces and notches along the edges of the crystals that indicate the crystals are twinned compound crystals.

LEVYNE is rather scarce in the quarry, although it is found in a number of tiny cavities in the right hand side of the lower level of the quarry. Only rarely does it form the common thin hexagonal plate with broad c-face and beveled edges. When a broad c-face is present offretite is found on it, producing a rough or frosted-appearing surface. Most of the levyne forms unusual parallel growths that completely line the cavity. The growths are composed primarily of lustrous complex rhombohedral faces that lack a c-face. These parallel growths resemble chabazite or gmelinite more than levyne. In a few cavities the parallel growth of levyne covers or partly covers an earlier formed parallel growth of epistilbite.

Rarely coarse scolecite needles are seen embedded in the outer edge of levyne crystals. This relationship shows that the two minerals were co-crystallizing at the end of levyne crystallization.

OFFRETITE is scarce at the 200/237 Road Quarry. It forms colorless to slightly white needles that have grown perpendicular to the c-face of levyne crystals. Most of the levyne at this site forms unusual crystals that do not have the c-face; therefore, offretite has little place to grow.

GONNARDITE forms fine-grained, white, tough, fibrous masses, commonly covered by colorless coarse scolecite needles, that usually completely fill the cavities. Rarely partially filled cavities contain a white gonnardite base covered by a colorless hemisphere of terminated scolecite needles. When breaking the basalt hollow cavities are exposed but filled cavities, that often contain gonnardite, are tough and remain intact. These nodules pop out of the rock and must be broken open to see if they contain the fine-grained white gonnardite or one of the other massive zeolites such as scolecite, laumontite, or heulandite.

SCOLECITE forms lustrous colorless to white needles that are terminated by a simple pyramid or V-twinned to form flattened needles. Most of these crystals grow perpendicular to the cavity wall and completely line the cavity. The scolecite is commonly covered with scattered prisms or radiating needles of laumontite or rarely by rhombohedra of chabazite and calcite. Rarely the scolecite forms on stilbite, epistilbite, and levyne. Some cavities contain both coarse scolecite crystals and much shorter, thinner needles of the same mineral.

Scolecite forms unusual radiating groups and parallel growths on the surface of white rhombohedral pseudomorphs. Rhombohedral holes surrounded by scolecite needles and thick walls of scolecite with smooth interiors on short scolecite crystals indicates that calcite probably crystallized during scolecite crystallization and was later dissolved away. Scolecite psuedomorphs after calcite have been found.

Sprays of scolecite have been found, up to 15 mm long, in cavities, 15 cm across, although most of the cavities are much smaller. Although most scolecite needles have grown perpendicular to the cavity walls, some cavities contain scolecite needles that lay down in a parallel growth on the walls of the cavity that resembles the trees that have been blown down by the nearby Mt. St. Helens eruption. These needles have not been broken off and cemented to the walls of the cavity but have grown parallel to the cavity wall like so many of the minerals at this locality.

THOMSONITE has been identified in one cavity. It forms a curly white overgrowth on scolecite needles that are perched on a levyne cavity lining.

LAUMONTITE is the most common mineral at the 200/237 Road Quarry. It forms both stout prisms and thin radiating needles in the same cavity. Fresh laumontite is very difficult to distinguish from scolecite needles. Laumontite lines cavities, up to 20 cm in diameter, with thick colorless prisms that turn white after removal. It commonly forms attractive groups on parallel growths of stilbite, heulandite, and scolecite. Rarely it is covered by chabazite and calcite. Many of the small cavities contain beautiful radiating sprays of thin laumontite prisms on the other zeolites. Most of the thin laumontite crystals are V-twinned. Laumontite needles also form parallel growths that cover the cavity walls.

Fresh laumontite is colorless and hard. If it is to be saved, it must be placed in water or covered with damp paper towels until it can be trimmed, cleaned, and preserved. Unpreserved laumontite will in time loose its water content and its structure will collapse causing it to crumble and fall apart. Avoid collecting specimens that contain laumontite in association with other species for they are difficult to save. Attractive micro groups of laumontite, if mounted and handled carefully, survive fairly well.

PSEUDOMORPHS with a rhombohedral form are found, up to 15 mm across, and are replacements of calcite by laumontite or scolecite. The interior of the pseudomorphs are usually composed of tiny white grains of laumontite. The surface of the pseudomorphs are covered with parallel growths of scolecite needles that lay flat or radiate on the surface of the rhombohedra. Radial groups of thin needles and blocky prisms of laumontite are found on the scolecite-covered surface of the pseudomorphs.

The pseudomorphs appear to have formed when calcite crystallized on short needles of scolecite that lined the cavities. Continued growth of the scolecite lengthened the crystals not covered by the calcite and deposited an increstation of scolecite on the surface of the calcite. In some cases the scolecite coating reached several millimeters in thickness. The solution then became unstable for calcite and was it was dissolved away leaving empty scolecite-covered shells with a smooth surface on the interior of the shell and terminated scolecite crystals on the outer portion of the shell. Laumontite then crystallized, forming radiating groups of crystals in the vesicles and on the surface of the scolecite-covered shells. Laumontite also formed inside the then hollow scolecite shells but this time it formed tiny equant grains that completely filled the space inside the shell and taking the shape of the calcite crystal that had previously filled the space. A few of the calcite crystals were covered by scolecite on only one or two sides. When the calcite was dissolved from these crystals, scolecite walls remained with terminated crystal on one side and smooth surface on the other side where the calcite had been in direct contact. Laumontite did not fill in the space if a complete enclosure was not present. Some of the scolecite walls show small scolecite crystals on both sides, that indicates the scolecite continued to crystallize after the calcite had been dissolved and surfaces not totally enclosed were then covered with scolecite. A few of the scolecite shells were filled with a interwoven mass of scolecite to form scolecite psuedomorphs after calcite.

CHABAZITE is common in the quarry and is the last zeolite to crystallize. It forms small colorless rhombohedra commonly on laumontite and scolecite but is also found on epistilbite, levyne, heulandite, and stilbite.

OBSERVED SEQUENCES OF CRYSTALLIZION

Clay > levyne > scolecite
Clay > epistilbite > levyne > chabazite
Clay > heulandite > stilbite > laumontite > calcite

Clay > heulandite > stilbite-scolecite-stilbite > laumontite > calcite
Clay > epistilbite > levyne > offretite
Clay > calcite > scolecite
Clay > epistilbite > phillipsite
Clay > calcite > cowlesite
Clay > cowlesite > phillipsite
Clay > heulandite > pyrite > stilbite
Clay > heulandite > quartz
Clay > mordenite > epistilbite
Clay > mordenite > heulandite > quartz
Clay > epistilbite > scolecite > chabazite
Clay > laumontite > chabazite > calcite
Clay > laumontite > calcite
Clay > scolecite > laumontite
Clay > epistilbite > chabazite
Clay > epistilbite > phillipsite > chabazite > calcite
Clay > gonnardite > scolecite
Clay > levyne > scolecite > thomsonite
Clay > (levyne-scolecite)
Clay > heulandite > cyclic-twinned epistilbite
Clay > calcite > scolecite > calcite > scolecite > dissolution of calcite > scolecite > laumonite > calcite

GENERALIZED SEQUENCE OF CRYSTALLIZATION

Clay > calcite? > mordenite > heulandite > pyrite > quartz ? > stilbite? > epistilbite? > cowlesite? > levyne > offretite > ?gonnardite > scolecite > thomsonite > laumontite > chabazite > calcite

Relationships needed:

stilbite to epistilbite
mordenite, heulandite, stilbite, epistilbite, levyne to cowlesite
phillipsite to heulandite and stilbite
gonnardite to everything
quartz to stilbite, epistilbite, and levyne
analcime to everthing

If anyone finds any of these species together, please let me know the order in which they crystallized.

COLLECTING TRIP

A field trip to the 200/237 Road Quarry is planned for Sunday November 6th (the day after the Fall micro meeting) if weather permits. All vehicles can make this trip. Bring normal collecting tools: 4 lb. hammer, chisel, 8 lb. hammer (optional), small bar, boxes, wrapping material, and a hand lens. Collecting is very good for micro minerals.

Specimens from the 200/237 Quarry will be available for study at the micro meeting. Slides will be shown of the quarry and the minerals studied in this report.

MINERAL PHOTOGRAPHY BY BOB BOGGS

By the trial and error method back some years ago Bob Boggs and his Son Russell set out to photograph the smallest mineral crystals possible with the equipment at hand or at least with the most inexpensive stuff we could find.

An antique monocular scope was tried first with some success, but the lack of a diaphragm to stop down was a serious drawback and discs inserted into the system were cumbersome to use.

In December of 1984 extension tubes as long as nine feet were used, with 50 MM and 35 MM lenses in the reversed position attached to take the pictures. We got ample magnification but in spite of all efforts we could never achieve sharp focus! (Large fuzzy crystals).

Since the area we were photographing with this set up was only 0.25 MM x 0.38 MM (.010 x .015 inches) locating the desired crystal in the camera viewfinder seemed an impossible task until Russ figured out that we could shine a flashlight into the camera viewfinder and produce a bright spot of light at the focal point of the lens and so to simply move the crystal to that point of light. Once done the bright projector light was put on the specimen so one could compose, focus and shoot. This "flashlight" method is still a practical way to locate the "target crystals" and is sometimes used with the present set up.

From here we went to shorter extension tubes coupled with a bellows and to very short focal length lenses. This period coincided with the appearance of the camcorders on the market and for a while at least there were a fair number of used 8 and 16 MM cameras in the thrift stores and on the used camera market. A few of them had clean fairly good wide angle lenses on them in the 13 MM to 16 MM range. I bought about six of these to get two good clean ones, the others had problems not obvious when I got them and that mostly dirt inside the lens that was probably created by diaphragm parts rubbing and producing a grit that fell on the lens. I have as yet not tried to clean any of these or have it done either.

I have read in more than one place that for this very close up work that these lenses should be used in the reverse position. For ordinary 50 MM lens and the old fashioned screw mounts, reversing rings are available (or at least were once made!!). So far I have reversed all of my wide angle lenses in a very "unscientific" way by gluing them into a short threaded extension tube using a series of cardboard tubes and then painting everything inside except the glass with flat black paint. Since I am not attempting to align these optics up with any other lenses or optical systems, any slight misalignment does not seem to effect the end results.

I use slow daylight film (A.S.A.-25) (for fine grain and fairly good latitude). The light used to actually take the picture is an electronic flash unit that is balanced for this daylight film. I now use two of the least expensive Vivitar flash units (the 1900) that were $19.50 each in 1990. With my present set up I set these lights 3 inches from the subject and judge this distance by attaching a 2 1/2 inch broom straw perpendicular to the flash "lens" with a minute dab of mineral-tak. This leaves the last 1/2 inch to "eye-ball" for the final setting. Depending on the subject the flash units are about 90 degrees apart or up to opposite each other or 180 degrees apart. They may also be set at a high angle to get light into a deep pocket or at a very low angle to better see a texture of the subject surface. For nearly all close up work I use this 3 inch distance for the lights and adjust the exposure for light, medium and dark subjects (and the length of the extension) with the F stop setting.

This iris diaphragm is wide open or nearly so when I locate and focus on the specimen and with a strong beam of light on the specimen from an old 150 watt projector which does not have a blower to cause a vibration. The area to get photographed has been previously chosen under the microscope and the scale bar carefully located. A rough composition and focus are achieved using the bellows rack and pinion, but when locked usually move things slightly. I then make the fine adjustments with a moveable stage I have the specimen sitting on that can be moved up and down with a very fine screw thread. When the above is completed, the lens is stopped down, and the projector light is turned off. The two flash units are on tripods that sit of the floor and can then be moved to the best location to accommodate each specimen, the flash units turned on and the picture taken.

My photography set up is mounted on an eleven by fourteen inch piece of 3/4 inch wood and is placed on the corner of a table and clamped to it. One of my biggest problems is having the projector on one side of the set up (away from the corner of the table) and the two flash units on the opposite side. This is no problem at all as long as the specimen is fairly flat and can be photographed sitting horizontal, but if it needs to be tilted, is irregular in shape or the desired crystals are in a deep pocket then getting the focusing light and the flash units to reach the right place can be a real challenge.

As for the correct exposure, mine are judged from charts I have kept over the years and this is where the "trial and error" part really sets in. Light, medium and dark subjects make a vast difference (dark subjects can really soak up a lot of light). I will list a couple of ones I have used that have worked here just as a ballpark figure. With the 13 MM lens and 18 inches of extension (A.S.A.-25) film and a light subject I set the F stop between F 5:6 and F 8, the same conditions with a dark subject the setting is between F 4 and F 5:6. With the 16 MM lens and 13 inches of extension, same film, light subject at F 11 and a dark subject at F 8. The width of view for the above, with the 13 MM lens one MM, for the 16 MM lens the width would be 3 MM.

More expensive cameras than my old manual Pentax M X have superior viewfinders that give a brighter and sharper image, closer to what I get under my scope. To offset this shortcoming I do a lot of preparation under the scope before I move it on its little wooden block over under the camera set up. I originally made up a set of scale bars (1.0 MM, 0.5 MM, and 0.1 MM) simply to show crystal sizes directly on the film, but soon found out that by carefully positioning these on the specimen parallel to where you want the film plane and at an elevation were you want the depth of focus to start they became a wonderful focusing aid. Much easier to find and focus on than most crystal faces.

For some of the techniques used to manipulate these minute objects under the microscope I am indebted to the late Ford Wilson of our early Northwest group who long ago showed us how much easier and safer it was to handle these with a tiny wet brush than it is to attempt it using tweezers.

Zeolite Associates --- CAVANSITE and PENTAGONITE

Donald G. Howard

Cavansite and pentagonite will always be "Oregon" minerals. Both were named and described from the occurrence near Owyhee Dam, Malheur Co., Oregon. And although subsequently magnificent specimens of cavansite have been found in India, Owyhee Dam remains the sole know place where pentagonite has been found.

The two minerals have many similarities. They are hydrated calcium vanadyl silicates of identical compositions: $Ca(VO)Si_4O_{10}{\cdot}4H_2O$. Both minerals are in the orthorhombic system, with the silica tetrahedra forming into pyroxene-like chains that are then connected laterally into sheets in the a-c plane. In pentagonite, the connections are such that the silica are in six-membered rings, while in cavansite they form both four- and eight-membered rings. This results in unit cells that are only slightly different in dimension, but increases the symmetry in pentagonite so that twinning is possible that is not possible with cavansite. The resulting unit cell dimensions (in Angstroms) are

	a	*b*	*c*
Cavansite	9.778	13.678	9.601
Pentagonite	10.298	13.999	8.891

In this way, the volume of the unit cell is almost exactly the same, so that the minerals have identical densities of about 2.3 g/cm^3. The vanadyl and calcium ions serve to hold the layers together, with the water loosely and irregularly arranged as in a zeolite.

These minerals are not zeolites, since they lack the aluminum which all zeolites must possess. The vanadyl ion does not fulfill the same role as the aluminum. In a zeolite, the aluminum substitutes for a silicon atom in the framework, either randomly or in particular regular positions. The vanadyl ion is located between layers and serves to hold them together. Though these minerals occur with and are closely related to the zeolites, they should not be considered a vanadium analogue of a zeolite.

Cavansite forms simple prisms somewhat elongated along the c-axis. These are generally in groups of crystals of nearly identical length radiating from a center. Neighboring prisms are often in parallel alignment. The sides of the prisms are bounded by (110) faces, while the wedge-like terminations are formed by (101) faces. Crystals of cavansite are always a rich, vivid blue that contrasts attractively with their white zeolite associates.

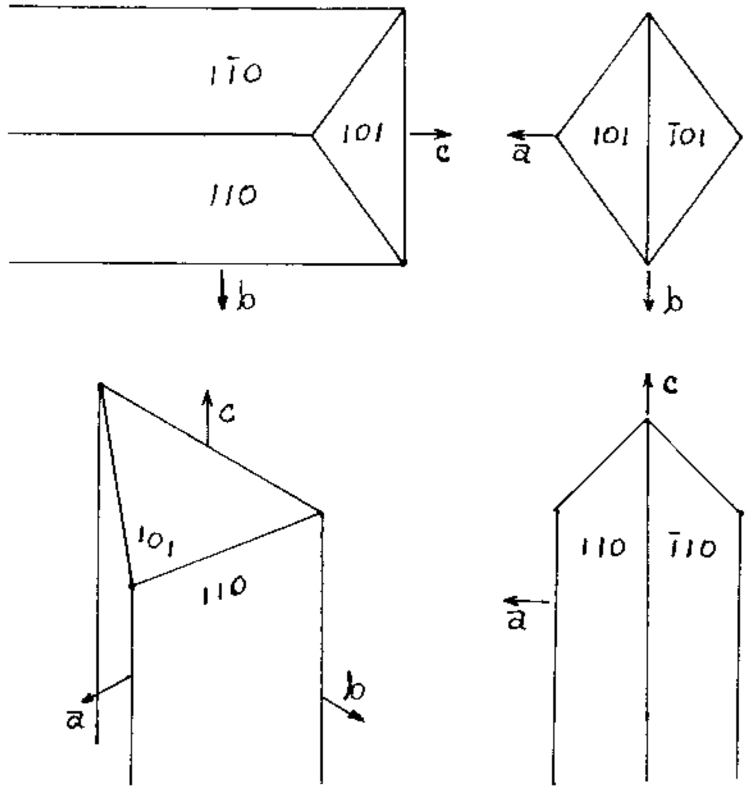
Pentagonite crystals are much more elongated, and are almost always twinned. The angle between the (110) planes on which twinning occurs is 72.7°. Thus twinning around the c-axis can occur nearly five times, and the resulting cross-section is a five-pointed star. This, however, exceeds 360° by 3.4°, so that actually two of the points will be only 69° apart. In reality, natural crystals usually show one poorly developed side because of this slight mismatch. Also, as the micrographs show, there is generally a hole down the axis, probably as a result of the strain field set up by a central dislocation that enables enhanced growth along the c-axis.

Generally, pentagonite crystals are composed of (110) faces along the prism and a flat basal termination, such as those shown in Micrograph #322. Micrograph #321 shows a very unusual crystal where the termination is made up of (111) faces in an odd alternating pattern that illustrates the twinning symmetry but not the orthorhombic nature of the individual crystals. The diagram opposite shows this strange type of crystal. Since it is not possible to match up five such sloping faces, the one where the mismatched crystals meet appears as a double notch.

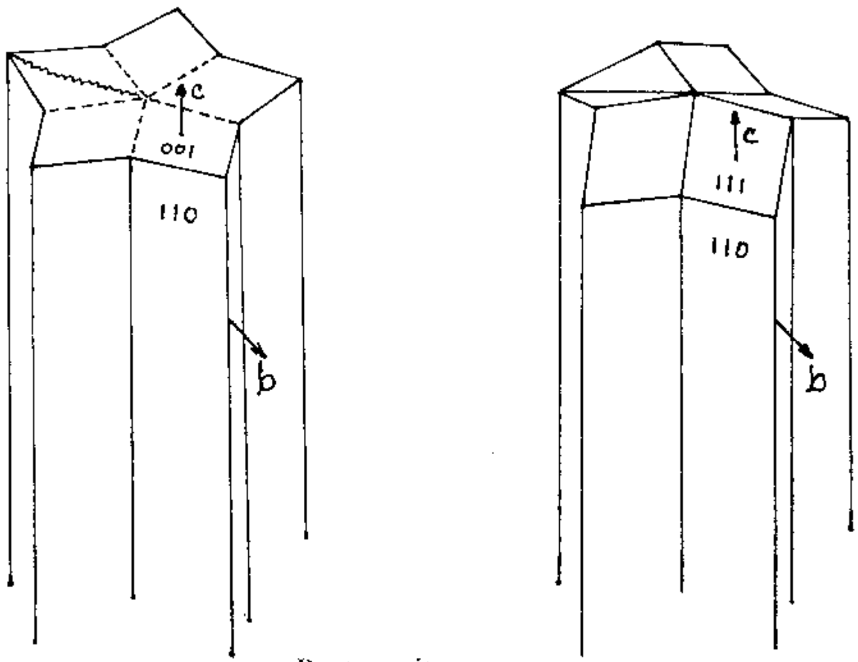
At the Owyhee Dam location, the two minerals are associated with analcime, apophyllite, calcite, heulandite, stilbite and thomsonite. The occurrence of cavansite from Pashan Quarry, Poona, India is usually with stilbite. Small amounts of cavansite were found at one time in the Chapman Quarry just off Neer Road at Goble, Oregon, sometimes associated with calcite. This is not the usual Neer Road zeolite sight, where the bits of blue material are usually copper stains that result from the oxidation of shall bits of native copper.

At Owyhee Dam, the two minerals are only very rarely found in the same specimen. It would appear that the cavansite is mostly in the primary vein, while the pentagonite occupies spaces in small veinlets crossing the main vein. Pentagonite is usually associated with heulandite, and is often completely embedded in the heulandite as needle-like inclusions. Pentagonite would be a rich blue color except that the needles are generally so fine that the color is only apparent when the crystals are viewed end-on; they appear practically colorless when viewed from the side.

Because of their habit of occurring together, the two minerals are sometimes confusing to tell apart. Cavansite normally forms rosettes of reasonably thick crystals that have a very strong blue color. Pentagonite crystals are generally scattered individuals that are thin needles many times longer than they are across. The surest way to differentiate the two minerals is to observe the cross-section and termination of the crystal end.



Crystal habit of cavansite



Pentagonite

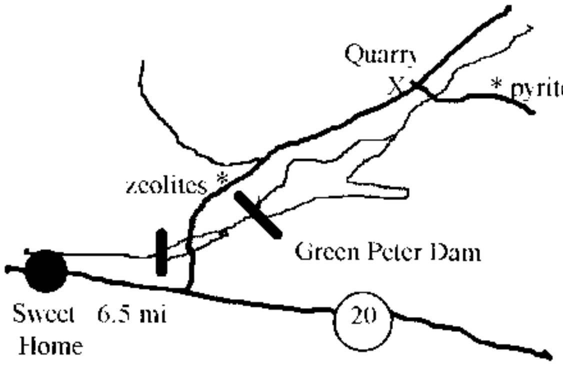
Usual crystal habit with flat c-face
The wavy line is where the crystals join.
Twin planes are shown as broken lines.

Odd termination with alternating (111) faces
The fifth notch is different from the others.
Indices are shown for only one crystal.

Minerals of the Green Peter Dam Area, Linn Co., Oregon

Donald G. Howard and Rudy Tschernich

Green Peter Dam is on the middle fork of the Santiam River a few miles east of the town of Sweet Home. The map below describes the area, and shows a collecting location for zeolites near the dam itself, and a fine location for individual pyrite crystals just above the dam to the north east. Both locations can be reached on paved roads from the US 20 highway turnoff about 6.5 miles east of Sweet Home.



Zeolite Location

Green Peter Dam itself is about 10 miles from the highway 20 turnoff. Just beyond the dam, a gravel forest access road comes off on the left and goes steeply up hill to the west. The rock used as fill along the first few hundred yards of this sideroad is filled with zeolite-laden pockets. Collecting can be done from the main road all the way up to the sideroad along the hillside directly opposite the dam. The original source of this rock has never been discovered -- it may have come from the actual construction of the dam, or it could have originated in an as yet undiscovered quarry in the area.

Most of the vesicles are completely filled with zeolite, so some hunting is necessary to find open pockets with terminated crystals. Most vesicles are only one or two centimeters in diameter. The most abundant mineral present is heulandite, but careful examination will turn up a number of other zeolite and associates. The following is a list of known species in the approximate order in which they formed.

Calcite seems to be both the first and the last mineral formed. Clear, colorless, blocky crystals have been found covered by levyne. Clear scalenohedral crystals have also been observed growing on chabazite.

Heulandite forms colorless, lustrous prisms up to 4 mm long, generally elongated along the b-axis. Cavities of coarser crystals have a pearly appearance. Stilbite and levyne can often be found growing on the coarser crystals. Heulandite also forms drusy crusts upon which other minerals, such as scolecite, form.

Stilbite forms colorless, pointed blades, sometimes singly on heulandite, and sometimes filling their own cavities, in which case they are stacked in nearly parallel growths. Stilbite also forms drusy linings in some cavities.

Levyne forms as milky white, thickened blades. The glassy reflection off the faces show that the color is internal, and that there is no indication of any surface layer of offretite. These crystals have considerable thickness in the c-direction compared to their overall dimensions, though c-faces are still present in most cases. They have been observed covering calcite, and growing on top of heulandite.

The above four minerals are the most common at this location. Other, less common minerals, mostly of later formation, include:

Scolecite form bundles of lustrous, thin, flattened fibers, up to 8 mm long, on drusy heulandite. Some cavities produce thicker needles up to 2 cm long. This is unusual, in that most locations in western Oregon produce mesolite or natrolite rather than scolecite.

Apophyllite is rarely found as colorless prisms on heulandite. The crystals are elongated along the c-axis and terminated with a c-face with tiny triangular (111) faces on the corners.

Gyrolite forms white aggregates up to 4 mm in diameter, composed of thin hexagonal-appearing blades. It is usually associated with apophyllite.

Chabazite occurs as tiny, colorless, transparent rhombohedra in a few cavities. It has been observed on white gyrolite, and as the base mineral under calcite.

In early collecting (1964), Milton Speckles has also reported *laumontite* and *thomsonite* from this location.

Pyrite Location

Another interesting location lies just above the top of the reservoir. At about 20 miles from the turnoff from highway 20, you come to Yellowstone Creek. There is a quarry visible on the left, which contains a small amount of cubic pyrite. Just beyond, a bridge crosses Quartzville Creek and a paved road winds up hill along Boulder Creek. Most of the road cuts in this region show red soil, but at about 1.5 miles there is one with a gray central portion. This is an altered clay in which are embedded numerous pyrite crystals, varying in size from very tiny up to about half an inch.

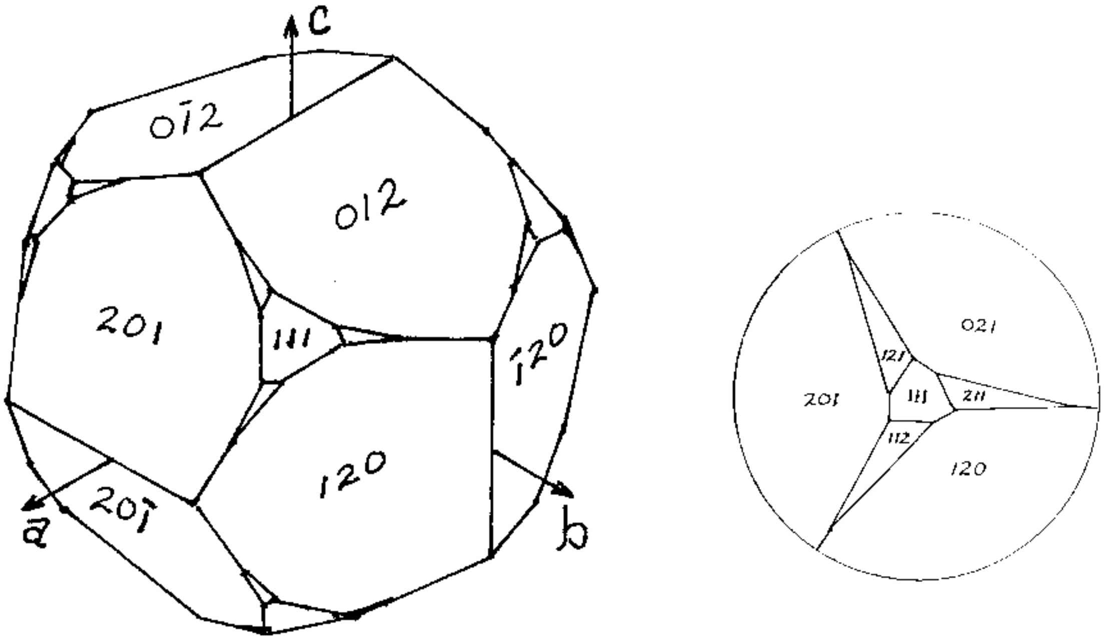
There are various ways to collect at this spot. One way is to sift the finely powdered debris for crystals, and this will produce many fine examples. It is considerably more difficult to obtain matrix specimens, not because it is hard to dig, but because the gray matrix has little structural integrity and the pyrites pop out when the material is broken. This is a site to visit on a dry day; when wet it is a sticky slimy mess and much harder to work, either for loose crystals or for matrix pieces.

The crystals are all primarily pyritohedral in shape with bright shiny (102) faces. Small octahedral (111) faces form triangular truncations to the corners. Around these truncations, small pinwheels of three (112) faces complete the pattern These crystals clearly show the three-fold symmetry and lack of fourfold symmetry characteristic of the crystal class to which pyrite belongs.

* * * * *

The combination of these two locations, set in beautiful natural surrounding, make a fine place to spend a day collecting. Neither place is far from the car or at all difficult to reach. Only relatively light tools are required: a medium hammer for breaking the basalt, and a small pick or the pointed end of a rock hammer for collecting the pyrite (perhaps also a medium-mesh screen). Moreover, the roads are all paved and in good condition, so they can be handled easily by any type of automobile.

Good collecting to you!



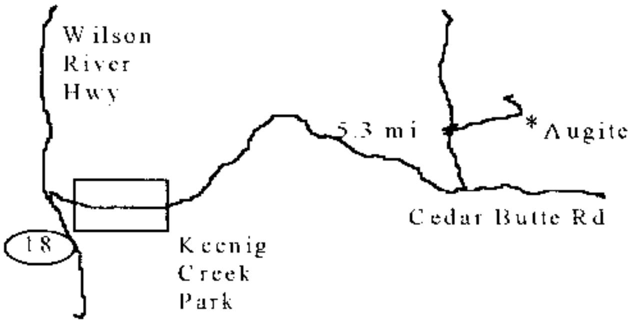
Crystal habit of pyrite from Boulder Creek, Green Peter Dam, Linn Co., Oregon
The inset at right gives the structure of the (111) corners in greater detail.
This is for the right side of the (201) face; the left side is the mirror image.

Augite Crystals from Cedar Butte, Tillamook County, Oregon

Donald G. Howard

The Cedar Butte location is essentially a one-mineral collecting area. It is accessed from the Wilson River Highway (approximately milepost 18) through the Keenig Creek Forest Park. A bridge at that point provides one of the few routes across the Wilson River. Cedar Butte Road proceeds up the hill from that point, climbing to the top of the ridges. The road is not particularly in good condition due to tree cutting operations, and it is possible to lose the main road in places where current work is in progress. Fortunately, these side branches generally do not extend very far.

Follow the main Cedar Butte Road 5.3 miles, to a point at which a somewhat inconspicuous sideroad comes off to the left. Within about a tenth of a mile, this opens out into a small flat, from which two roads leave, one continuing westward and the other going down the hill to the north. It is the north road that you want. It has not been kept up, and water runoff has carved some rather deep grooves, so unless you have four-wheel drive and a very high center, the flat is the best place to park. The north road goes down through the trees and makes a sharp doubleback to the left about a quarter of a mile down the hill. The doubleback is just below the collecting area; deer trails will take you the last hundred yards up the hill to the north until you can see the exposed rocks and the dirt slides below them.



The augite occurs as scattered, well-formed black crystals embedded in a granular black matrix that is composed largely of more augite with minor amounts of olivine and other dark minerals. This rock is very black, but it develops a rusty surface layer of oxidized iron on exposed faces. The augite is a low-calcium variety sometimes called pigeonite, $(Mg,Fe,Ca)(Mg,Fe)Si_2O_6$. A few crystals were probably present as a slurry when the magna was extruded, and these formed sharp faces before the groundmass solidified. Crystals can be found up to half an inch, and are generally quite equant in dimensions.. Perhaps a third of those found are single, showing the prism (110), orthopinacoid (100), and clinopinacoid (010) in about equal development to give a rather eight-sided cross-section. Most of these crystals are terminated by two pyramidal (111) faces. If a small basal face (001) is present, it is usually poorly developed, and somewhat rough and indistinct with rather rounded edges. Occasionally, small second-order pyramids (221) and (021) form small bevels along the edges of the first-order pyramidal faces.

A majority of the crystals found are simple contact twins on the orthopinacoid (100). These may also be equant, but very often show an elongation along the c-axis. The "top" end then shows four pyramidal faces, and looks tetragonal. Again, if the basal plane is present at all, its effect is simply to round off the point, leaving the termination rather indistinct. The "bottom" end generally shows the reentrant angle made by the pyramidal faces, but here a rough basal plane usually trancates the "wings" to minimize the reentrant nature of the "bottom". Second-order pyramids (021) further flatten off this end, and are often present even when the (221) bevels do not show at all on the "top" end. As a result, it is difficult to find a twinned crystal with sharp terminations on both ends.

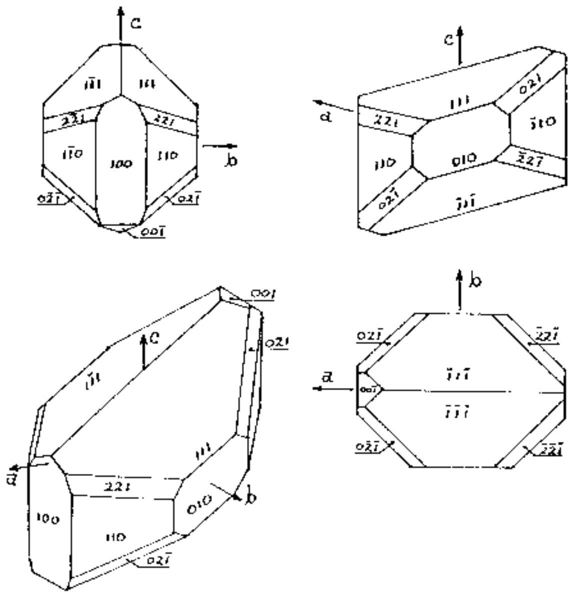
The best collecting equipment to use at this site is a plastic bag. Loose crystals that have weathered out of the cliffs above can be found by sifting through the abundant gravel and soil that makes up the sloping, slippery hillside.

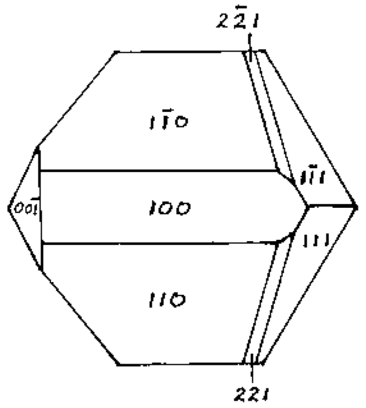
Getting matrix specimens can prove much more difficult. The rock is soft and can be broken (crumbled) with the pick-end of a rockhammer, or with a small chisel and light hammer. Large pieces can be broken out with little effort. However, they do not trim well at all, since the crumbly groundmass generally breaks in such a way as to loosen the crystals. Considerable time and care are necessary to find reasonably solid material that can be broken down with care later, and even then many specimens end up being loose crystals. Again, a bag to house loose crystals is a must during work on the bank to obtain matrix specimens. A number of good-sized pieces have come loose and rolled down the hillside into the fern bank below, so it is not always necessary to climb up to the exposed cliff-face to obtain matrix specimens. When crystals are loosened during trimming, they often leave behind a sharp pocket, so it is sometimes possible to "repair" loose crystals with a little glue to hold them in place inconspicuously.

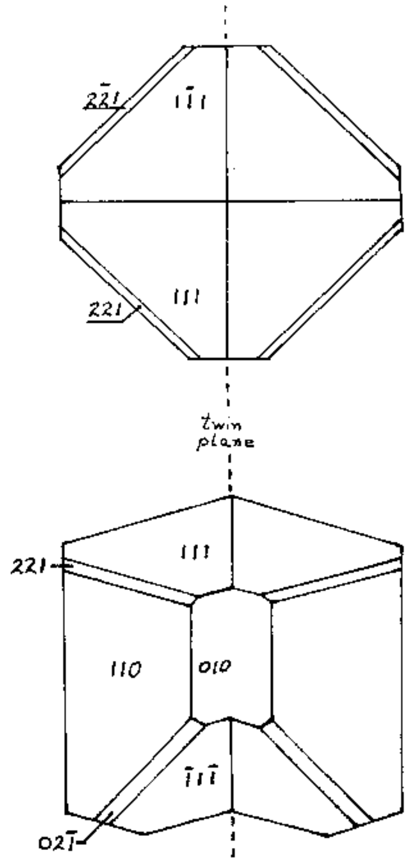
One of the troubles with specimens from this location is that they are black-on-black, and therefore show little contrast when mounted. Cracks and faces on the cliff, however, develop a rusty color due to oxidized iron. Hard faces (rare) of this type with shiny black embedded crystals often make the most attractive specimens.

Habit of
Untwinned
Augite
Crystals

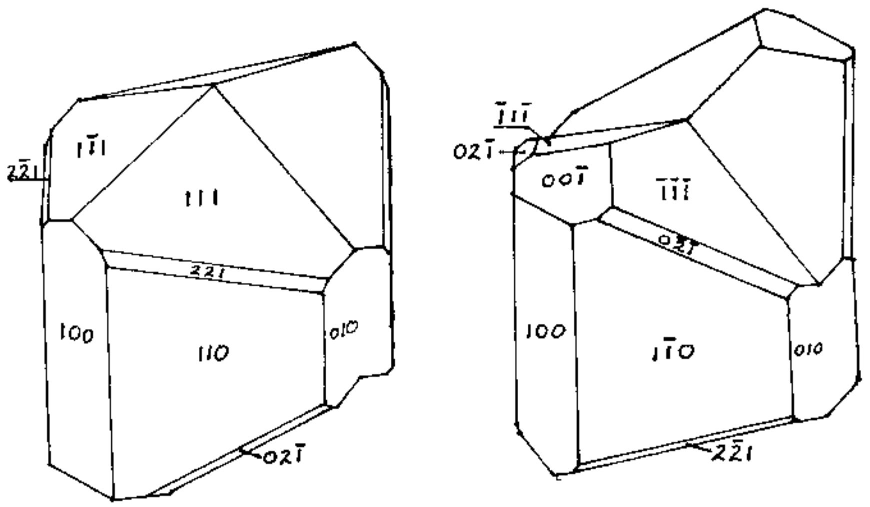
Cedar Butte
Tillamook Co.
Oregon







Orthographic projection
of a crystal of augite twinned
on the (100) plane



Perspective view of the two ends of an augite twin from Cedar Butte.
Notice that the "top" is bevelled by (221) faces while the bottom by (021) faces.
The (001) generally only appear on the bottoms, and are usually very rough.

FIGURE CAPTIONS

Scanning Electron Micrographs -- Number in the lower right corner.

#260 Phillipsite on Smectite (x36)

Wolf Point Quarry, Cowlitz Co., Washington

"Dodecahedral" habit with nearly equally developed faces. The notched edges belie the fact that the crystal is in fact multiply twinned.

#213 Epistilbite (x100)

Wolf Point Quarry, Cowlitz Co., Washington

This is the usual habit for crystals from this location. (See Fig. 3, page 6.) Parallel growths of this type crystal are common, with several differently oriented groups present in the same cavity.

#220 Epistilbite (x100)

Wolf Point Quarry, Cowlitz Co., Washington

A cyclic eightling twin of the type shown in Fig. 5, page 6.

#225 Epistilbite (x100)

Wolf Point Quarry, Cowlitz Co., Washington

A flattened crystal forming a V-twin in front of a cyclic eightling twin. The eightling consists of repeated V-twins of this type, where the reentrant angle has completely filled in with material.

#270 Cavansite on Heulandite (x144)

Owyhee Dam, Malheur Co., Oregon

Crystals in nearly parallel growths forming several radial groups. The wedge-like terminations, similar to the diagram on page 15, are clearly evident.

#322 Pentagonite on Heulandite (x400)

Owyhee Dam, Malheur Co., Oregon

Fiveling twins with the usual flat basal termination. Notice that the side that would correspond to the mismatch intergrowth is greatly underdeveloped. The hole down the axis is probably related to the strain field of a screw dislocation.

##322 Pentagonite on Heulandite (x800)

Owyhee Dam, Malheur Co., Oregon

A fiveling with an odd termination corresponding to alternately sloping (111) faces. Again, there is a hole down the axis of the twin. Notice that at the bottom two sloping faces come together at the intergrowth point. See page 15 for a diagram of this crystal.

Color Photographs -- Number on the back of the prints.

#9 Pyrite on altered clay (x7)
Boulder Creek, Green Peter Dam, Linn Co., Oregon
Pyritohedral crystals with small modifications of (111) and (121) faces

#10 Augite (x2)
Cedar Butte, Tillamook Co., Oregon
A group of three crystals embedded in black matrix. The orangy surface is a result of weathering of an exposed surface.

#11 Photographic equipment as used by Bob Boggs to take pictures of Microminerals. See the article on page 11.

PHOTO ACKNOWLEDGMENTS

The color photograph of the photography setup was taken by Bob Boggs.

The other color photographs were taken by Donald Howard of specimens from his own collection

The scanning electron micrographs were taken by Donald Howard from specimens provided by the following people:

#260, 213, 200 & 225	Rudy Tschernich, Snohomish, Washington
#270, 322 & 321	Mike Sunde, Portland, Oregon

THE MICROPROBE

Published twice a year by the
NORTHWEST MICROMINERAL STUDY GROUP

Donald G. Howard, Editor
356 S. E. 44th Avenue
Portland, Oregon 97215

Dues: $10 per calendar year per mailing address

A NOTE FROM THE EDITOR

With this issue we bring to a close Volume 7 of the **MICROPROBE**. Quite a number of minerals have been discussed and locations described in the last ten issues. So as an aid to being able to find things, we are introducing a new feature. Enclosed with this mailing is an **INDEX** to Volume 7, cross-indexed in a couple of ways. I hope that it proves useful to you.

In conjunction with the **INDEX**, it is my intention to have back issue of all ten numbers available for those of you who may have mislaid one, or who joined within the last five years and have therefore not received them all. Back issue, complete with pictures, will be available at the Fall Meeting for $3 each. For those of you who will not be able to attend the meeting, they will also be available by mail at $4 each (extra to cover postage) -- drop me a note and check, listing the issues that you would like sent.

I will be looking for feedback on the **INDEX**. Is it a useful idea? Is there some other way to cross-reference material that would be of value? I am thinking of preparing a similar index for Volume 6 in the near future if the idea has merit, again with the intention of making back issues available to members.

* * * * *

Our **SPRING MEETING** is scheduled for Saturday **MAY 6, 1995**
at the Clark Co. PUD on Ft. Vancouver Way, Vancouver, Washington

MEMBERSHIP

Changes in telephone numbers:

Russell Boggs (home)	(509) 235-6008
Barry Murphy	(604) 931-8480

Changes in Address:

Dan Rokosz
4832 S.E. Ogden
Portland, Or 97206

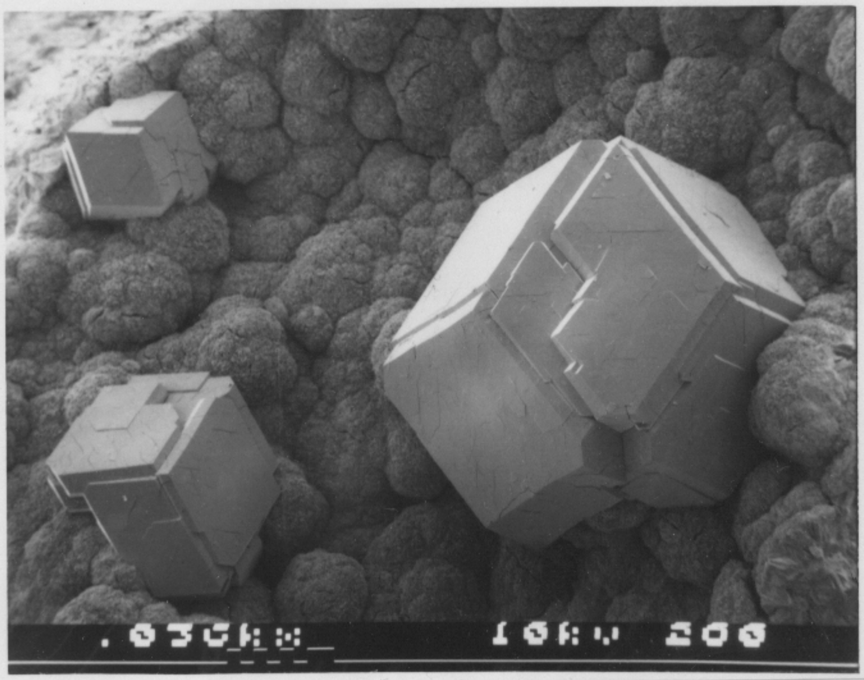
NEW MEMBERS

George & Sue Downey
15781 119th Ave. N.E.
Bothell, WA 98011
(206) 488-0357

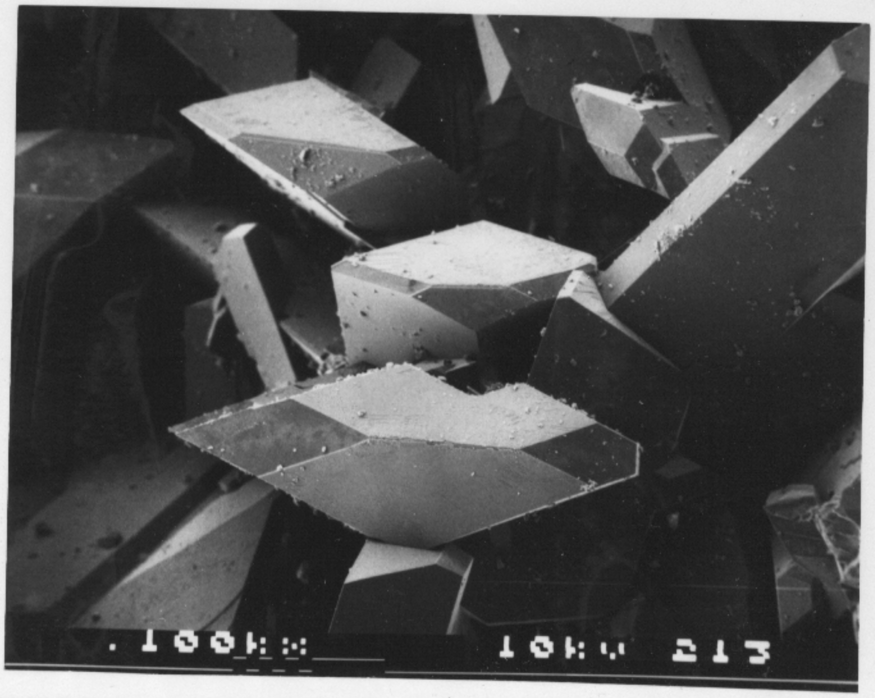
Greg Hammer
51200 Old Portland Rd.
Scappoose, OR 97056
(503) 543-7218

Brendon Laurs
OSU Dept. of Geoscience WLKN 104
Corvallis, Or 97331

Bill Tompkins
12929 S.E. Kathryn Ct.
Clackamas, OR 97015
(503) 698-5601

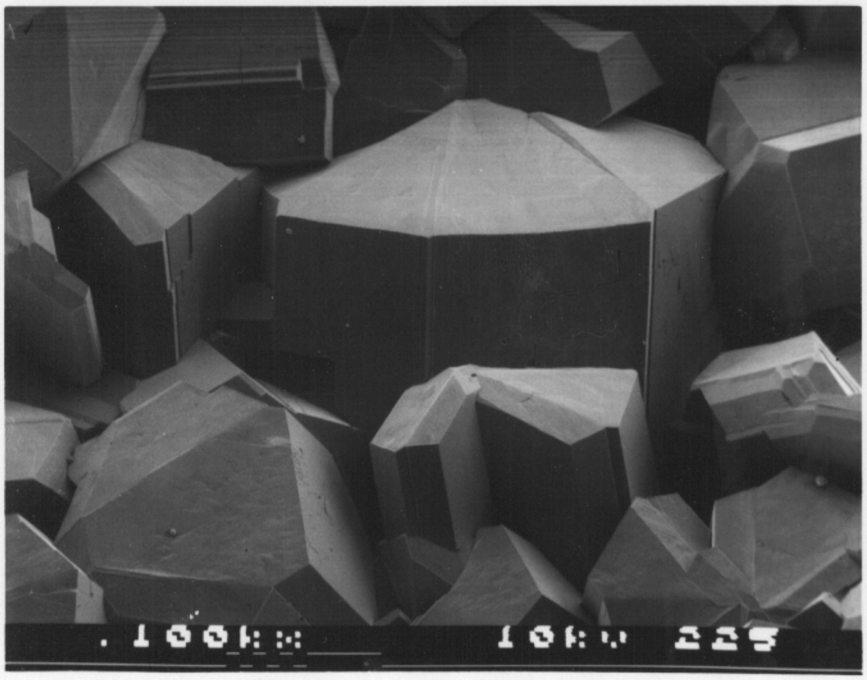


#260 – PHILLIPSITE, SMECTITE – WOLF POINT QUARRY, COWLITZ COUNTY, WASHINGTON – 36X

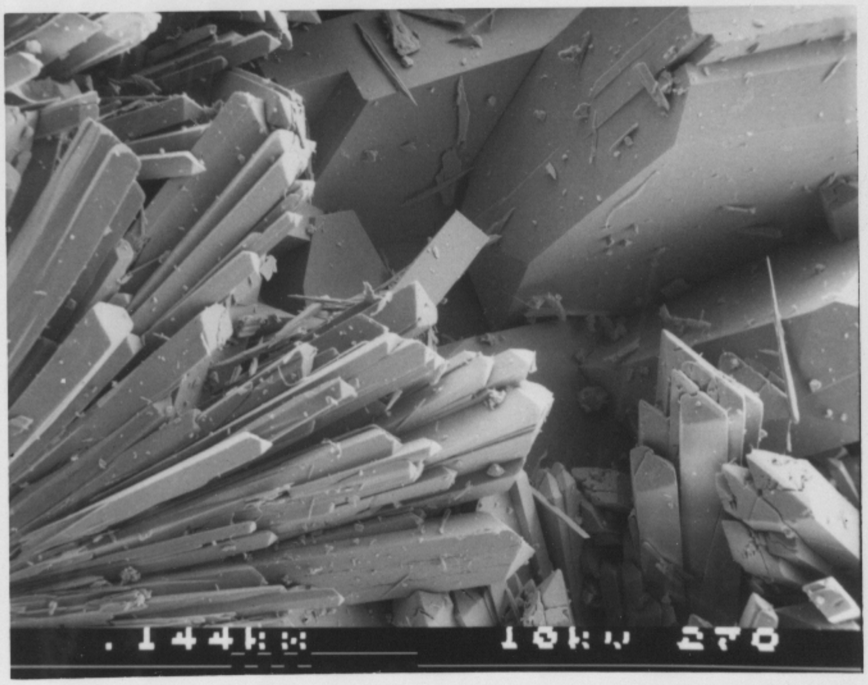


#213 – EPISTILBITE – WOLF POINT QUARRY, COWLITZ COUNTY, WASHINGTON – 100X

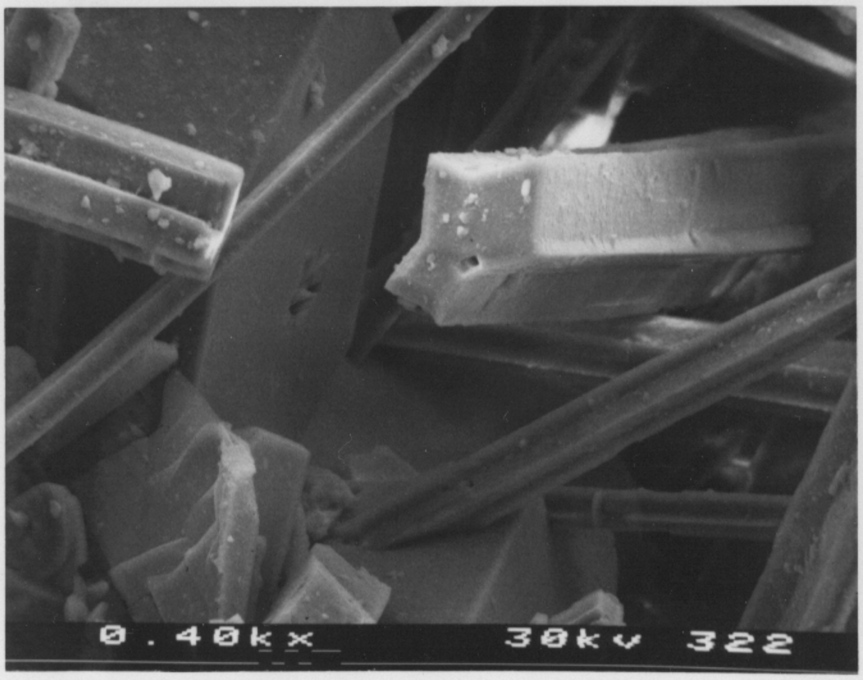
#220 – EPISTILBITE – WOLF POINT QUARRY, COWLITZ COUNTY, WASHINGTON – 100X



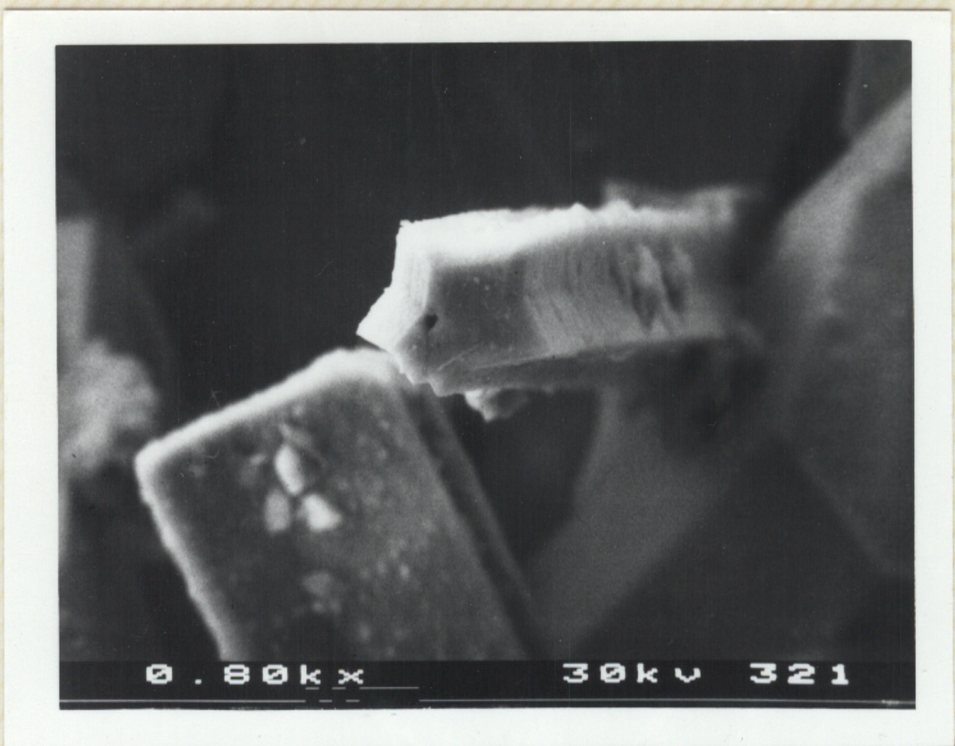
#225 – EPISTILBITE – WOLF POINT QUARRY, COWLITZ COUNTY, WASHINGTON – 100X



#270 – CAVANSITE, HEULANDITE – OWYHEE DAM, MALHEUR COUNTY, OREGON – 144X



#322 – PENTAGONITE, HEULANDITE – OWYHEE DAM, MALHEUR COUNTY, OREGON – 400X



#321 – PENTAGONITE, HEULANDITE – OWYHEE DAM, MALHEUR COUNTY, OREGON – 800X

#9 – PYRITE – BOULDER CREEK, GREEN PETER DAM, LINN COUNTY, OREGON – 7X

#10 – AUGITE – CEDAR BUTTE, TILLAMOOK COUNTY, OREGON – 2X