Northwest
Micro Mineral
Study Group

MICRO PROBE

FALL, 1998 VOLUME VIII, Number 8

FALL MEETING . . . . .VANCOUVER, WASHINGTON

November 14, 1998 9:30 am to 6:30 pm

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

Bring your microscopes and prize specimens along with your special trading material and something for the free table to share with others. Be sure to include a box label that lists all the species present, give complete locality information, and includes your name so questions can be directed to the person bringing the material. Some people like to include the collector in their mineral data base.

Morning program:

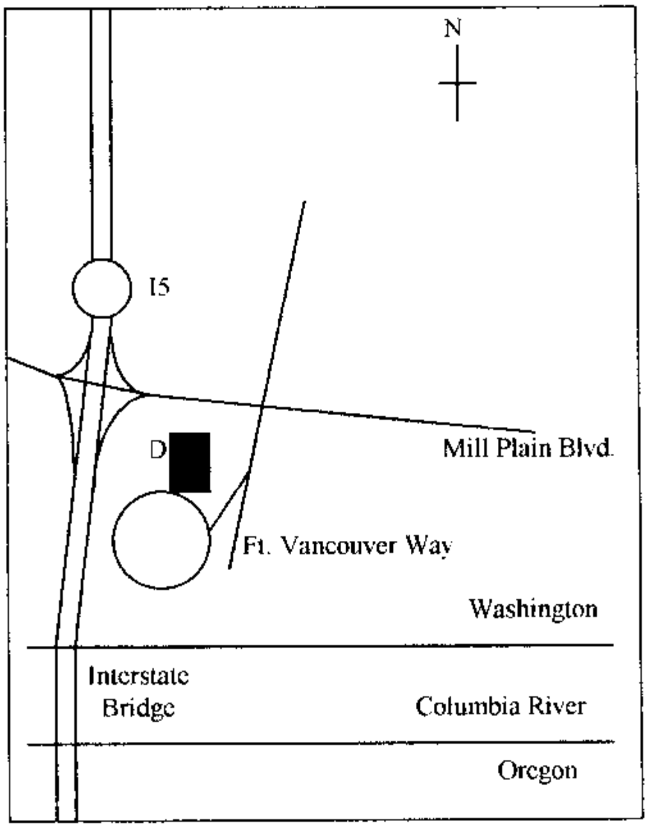
10:30 John Cornish will talk and show slides of "Breccia Minerals from the Big Chief claim, King County, Washington". Several people should have material on the free table from the landslide site on Rock Creek described in the accompanying article.

Afternoon program:

2:00 Our usual informal business meeting, including reports on the status of local collecting spots.

3:00 Don Howard will give an informal class on crystal shapes and faces. If you have slides of mineral specimens or collecting localities that you would like to share, bring them along; we will have a projector and screen available.

The kitchen area is available as usual and we will provide lemonade, coffee, popcorn, etc. There will be a snack table, so bring snacks to share with others for lunch and during the day. However, there will be no potluck dinner. Restaurants are available in the local area. Some of us will plan to eat together, so please join us.



In Memorium

Beulah Murphy

It is sad to have to report the passing of another charter member of our Group. Beulah Murphy passed away in July of this year at the age of 84.

Beulah served for many years as Secretary and Treasurer of our Group until illness made it difficult to accomplish the duties. She was always thinking of minerals, thinking of our group, and eagerly providing supplies for us whenever she came across a "bargain". She continued to take as active a part as she could, attending meeting in an electric cart up until the last year or so, when it became prohibitively difficult to get out of her house.

Those of us in Portland will always cherish the once-a month Thursday evenings when for many years we would gather in the Murphy's workroom to swap minerals, look at interesting stuff, and share an evening of fellowship about minerals. Beulah's enthusiasm was unending. Even after her body was not well enough to get out, her heart was still fixed on looking through her microscopy, on getting out in the hills one more time to hunt for the unusual mineral or perfect crystal. We had to tell her all about what was happening in the field and share with her our new finds. Beulah's house was always open to collectors, and she encouraged many of us to deepen our knowledge of mineral lore. She set an example of going back to the Community College to study chemistry!

Beulah's favorite hunting ground was along the Clackamas River, and it was her effort that brought the Oak Grove Fork location to everyone's attention and finally succeeded in identifying the mineral as gismondine. My favorite memory of her was on my first field trip with the group, which was to Mill Creek many years ago. Beulah took a tumble that had everyone frightened, came up unhurt and proclaimed that she might not have been able to catch herself, but she didn't let go of the crystal vug in her hand! She made sure before the day was out that everyone present had good material to take home. Her workroom was full of boxes of specimens from many years of collecting, and she was always generous in sharing what she had, particularly with youngsters and people new to the hobby.

Beulah will be sorely missed, for her dedication, for her enthusiasm, for her generous heart, but especially for a lifelong love of collecting minerals. Surely there must be rocks somewhere in her part of heaven, and if there are, Beulah will know where they are and be waiting to share them with us. Bless you, Beulah!

ROCK CREEK, STEVENSON, SKAMANIA COUNTY, WASHINGTON

Don Howard

The basalts along Rock Creek have produced outstanding specimens of mordenite off and on for many years. A recent rock slide has exposed fresh material, and once again the collecting is excellent.

The collecting area is along the creek in the vicinity of the Steep Creek Bridge. To reach the bridge, turn off the Columbia River Highway (Washington 14) just at the west edge of Stevenson at the sign for Skamania Lodge. Proceed along Rock Creek Drive for about two thirds of a mile, where you make a sharp left turn onto Ryan Allen Road. This loops around the side of the hill, and in another two thirds of a mile turn left onto Red Bluff Road. (If you get to a bridge over Rock Creek you have gone too far.) Red Bluff Road quickly turns into a gravel road. The Steep Creek Bridge is about five miles from the end of the pavement. It should be the first time that you cross Rock Creek.

Fifteen or twenty years ago, the collecting spot was a shallow quarry a few hundred yards north of the bridge. That area is completely grown over now. Collecting has been possible along the creek, especially in the vicinity of the small waterfall that is just upstream from the bridge, and around the base of the bridge itself. However, the mordenite tends to mat unless fresh exposed rock is broken, and the banks are not easy to break enough off of to get fresh material.

The good news is that in 1996, a portion of the cliff downstream from the bridge gave way and came down. The bad news is that it is on the other side of the creek, so that everything you collect has to be brought back across. There is a large gravel bar on the west side of the creek under scattered trees, and the rock slide has created a decent sized pool just upstream from the collecting area -- a perfect swimming hole if you can stand the temperature of the water!

The fresh basalt in the cliff appears to be rather bluish in color. It is granular and will break under the action of a chisel and hammer. It tends to crumble on the trimmer, and break through rather than around cavities, so it is best to take larger pieces in the field rather than try to trim them with hammer and chisel, and nibble off bits later under controlled conditions. Weathering turns the matrix to a brownish color and leaves it even more crumbly, though with this fresh material, it is very possible to get good matrix specimens.

The large blocks of rock along the creek (typically piano-sized) are made up primarily of the brownish matrix, with only a bit of bluish rock in their interior. One piece clearly showed a transition from lots of fine, small cavities near the top to progressively larger and more separate vugs below. The larger vugs were more likely to have mordenite sprays on the heulandite base. After two to three feet down, the cavities began to be filled with chalcedony instead, and below this level few good zeolite cavities could be found. The mineralized zone of larger cavities in these rocks make excellent collecting. Cavities up to 4 inches across have been found which contain sprays of white mordenite needles on a reddish background of heulandite.

Farther up the rock pile, a very large boulder (house-sized) is composed of the bluish, fresh matrix. Near the top it shows an open seam perhaps ¾ of an inch wide, several inches high, and running an undetermined distance back and down into the rock. The seam is lined with mordenite. Water would have long since ruined the material, but it is heavily covered with rice-grain quartz crystals. On the east (bank) side of the seam, the wall is lined with very short mordenite hairs that are so covered with quartz that it has the appearance of a gray concrete – not at all attractive and interesting only under magnification. The west side of the seam is formed of much longer mordenite hairs and a lighter sprinkling of quartz, and where fresh can produce some decent specimens. What is more interesting is that the rock immediately next to the seam on the east side has produced many outstanding pieces of short tufts of snow-white mordenite on a dark background that is very striking.

MINERALS PRESENT – in order of crystallization

Clay – The first thing to form on the walls of the cavities appears to have been a light brownish clay. This was sometimes followed by subsequent layers that were brown, green, or blackish. The first clay layer decomposed rather easily, and for this reason many of the crystal linings pop out rather easily. Much of the material collected many years ago was in the form of "eggs" that were then cracked with a pair of pliers. Many of the smaller cavities that pop out of the current rock are composed almost entirely of a black clay, which seldom has any other minerals inside.

Heulandite – The first zeolite to form over the top of the clay layer(s) was a fine-grained heulandite that is bright red in color. This is always a very thin shell of material. It formed the base in most of the "eggs" collected years ago, making excellent contrast for the white sprays of mordenite and the black smectite balls. In the vicinity of the large seam, the heulandite crust is practically colorless, and since it formed over a last black clay layer, it gives the cavities a very dark lining to contrast with the white mordenite.

Mordenite – Sprays of mordenite needles make rounded tufts on the heulandite. These needles are generally from one to about 5 millimeters in length. Tufts vary from a few needles to ones of many hundreds. The small tufts appear snow white, but the larger ones have a pale orangy overtone to the white. Where the mordenite formed on the clay directly, it usually completely covered the wall, making a solid layer on the outside and needles sticking into the interior. Without the heulandite crust for protection, these cavities tend to let in water readily and the mordenite is often matted.

Smectite – Balls of very dark green to black smectite appear to have formed next. These have the typical bladed structure of a crystallized clay. They formed scattered on the heulandite and occasionally impaled on the mordenite needles. It may be this clay that made thick linings to many of the cavities that were not already mineralized. Because they were late in the sequence of mineralization, they seldom have other minerals present.

Heulandite – A second generation of heulandite followed. This generation is clear and colorless, and tends to form bigger crystals. While rare in the material found years ago, it is generally the rule in the current cavities. Some of the crystals show mordenite inclusions, while many show buried smectite balls. Occasionally, clear heulandite crystals can be seen impaled on the mordenite needles. This layer tends to hide the intense color of the original heulandite layer, so the contrast on the current material is not as pronounced as that of the cavities collected years ago.

Quartz - Silica seems to have come in late, after zeolite formation had ended. Some specimens show a dusting of very tiny rice-grain quartz crystals on the mordenite. Cavities with various forms of silica abound in the lower layers of the formation. These generally start out with a porcelain-like white material that is either chert or a chalcedony-mordenite mixture. Chalcedony layers often follow. If the cavity has not been completely filled by this point, a layer of quartz crystals formed on the surface. These are usually short and stubby, mostly termination with very little prism faces developed.

Calcite – Calcite appears to be the last mineral formed, though its relationship to quartz is somewhat in doubt. The calcite crystals are clear and colorless. Most are elongated along the c-axis, often forming rather sharp needles. Some have a very etched surface. When formed in the heulandite/mordenite cavities, they often have mordenite inclusions, and mordenite hairs sticking out from their faces. Well formed calcite crystals have been found in the black clay cavities as well.

In addition to these minerals, very rarely stilbite crystals have been found. Since these are not associated with other minerals, it is impossible to locate them in the order of crystallization. One specimen of chabazite variety phacolite on quartz was found near the waterfall in past seasons, and one specimen that showed analcime crystals on mordenite.

In summary, the crystallization order seems to be:

Clay >heulandite>mordenite>smectite>heulandite>quartz>calcite

It is good that an area that has provided much good collecting in the past is fully productive again. Take heavy hammers and wading shoes and give it a try before weathering once again mats all the mordenite down in the cavities. It is only about 60 miles from Portland (an hour and a half drive), and is a beautiful place where the family will enjoy picnicking while you pound on rocks.

Mont Saint-Hilaire Mineral Species List (3/7/98)

Source: Laszlo & Elsa Horvath
Reprinted from the International Micromounter's Journal

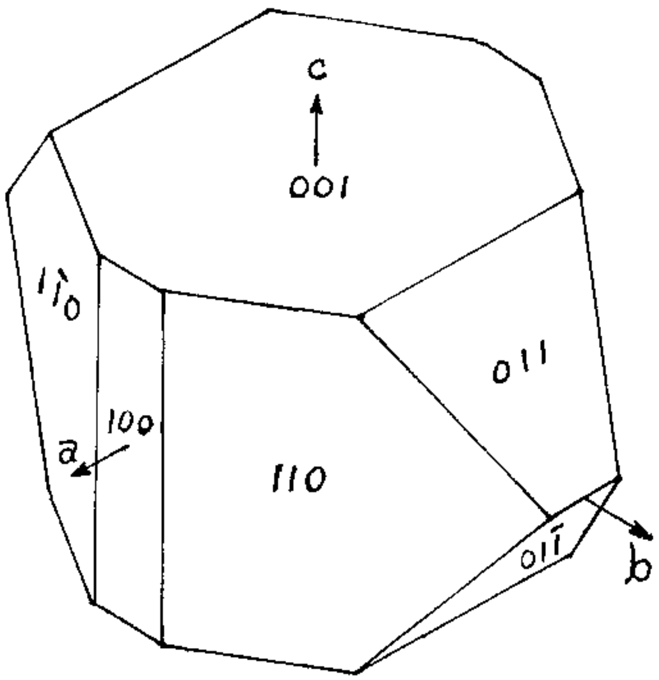
Abenakiite-(Ce) [UK85]
Acanthite
Actinolite
Aegirine
Alabandite
Albite
Allanite-(Ce)
Analcime
Anatase
Ancylite-(Ce) [UK3,10]
Andesite
Andradite
Anglesite
Ankerite
Annite
Anorthoclase
Antimony
Aragonite
Arfvedsonite
Arsenopyrite
Ashcroftine-(Y)
Astrophyllite
Augite
Barite
Barylite
Barytoamprophyllite
Bastnaesite-(Ce)
Bavenite
Behoite
Berthierine
Beryl
Beryllonite
Beudantite
Biotite
Birnessite
Bismuth
Bonshtedtite
Bradleyite
Britholite-(Ce) [UK22]
Brochantite
Brockite
Brookite
Burbankite
Calcio-ancylite-(Ce)
Calcioburbankite
Calciohilairite
Calcite
Cancrinite
Carbocernaite [UK40]
Carbonate-fluorapatite
Caresite-3T
Carletonite [UK15]
Catapleiite
Celestine
Cerite-(Ce)
Cerussite
Chabazite
Chalcopyrite
Chamosite
Charmarite-2H & -3T
Chkalovite
Clinochlore
Cordierite
Cordylite-(Ce) [UK12]
Corundum
Cryolite
Daqingshanite-(Ce) [UK44]
Datolite
Dawsonite
Dehayelite (?)
Digenite
Diopside
Djurleite
Dolomite
Donnayite-(Y) [UK33]
Dorfmanite
Doyleite [UK45]
Dravite
Edingtonite
Ekanite
Elpidite
Epididymite [UK14]
Epidote
Epistolite [UK46]
Erdite
Erythrite
Eudialyte
Eudidymite
Ewaldite [UK37]
Ferroceladonite
Ferrocolumbite
Fluorapatite
Fluorapophyllite
Fluorbritholite-(Ce)
Fluorite
Franconite [UK43]
Gaidonnayite [UK23]
Galena
Ganophyllite
Garronite
Gaultite
Genthelvite
Gersdorphite
Gibbsite
Gismondine
Gmelinite
Gobbinsite
Goethite
Goetzenite
Graphite
Greigite
Griceite [UK54]
Grossular
Gypsum
Haineaultite
Halite
Halotrichite
Harmotome
Hedenbergite
Helvite
Hematite
Hemimorphite
Hercynite
Hershelite
Hessite
Hibschite
Hilairite [UK20]
Hiortdahlite
Hisingerite
Hochelagaite [UK50]
Hornblende
Horvathite-(Y)
Hydroandradite
Hydrocerussite
Hydroxyapophyllite
Hydrozincite
Hypersthene
Ilmenite
Ilmenorutile
Jarosite
Joaquinite-(Ce)
Kaersutite
Kainosite-(Y)
Kaolinite
Kellyite
Kogarkoite
Kukharenkoite-(Ce)
Kupletskite
Kutnohorite
Labuntsovite [UK5]

Lamprophyllite
Langite
Lanthanite-(Ce)
Lavenite
Lead
Leifite
Lemoynite [UK13]
Lepidocrocite
Leucophanite
Leucosphenite [UK8]
Lintisite
Lizardite
Loellingite
Loparite-(Ce)
Lorenzenite [UK1.7.16]
Lovozerite Group
Lueshite
Lukechangite-(Ce)
Magadiite
Magnesio-arfvedsonite
Magnesiohornblende
Magnesite
Magnetite
Makatite [UK66]
Mangan-neptunite
Manganotychite
Marcasite
Mckelveyite-(Y) [UK30]
Meionite
Melanterite
Microcline
Milarite
Millerite
Mimetite
Miserite [UK36]
Molybdenite-2H & -3R
Monazite-(Ce)
Monteregianite-(Y) [UK6]
Montmorillonite
Muscovite
Nahpoite
Nalipoite
Narsarsukite [UK2]
Natrite
Natrolemoynite
Natrolite
Natron
Natrophosphate
Natrosilite
Neighborite
Nenadkevichite [UK19]
Neotocite
Nephline
Neptunite
Nickeline
Nontronite
Nordite-(Ce)
Norstrandite
Normandite
Oligoclase
Opal
Orthojoaquinite-(Ce)
Parakeldyshite
Paranatrolite
Paraumbite
Parisite-(Ce)-18T & -72T
Pectolite
Penkvilksite [UK41]
Perraultite [UK17]
Petarasite [UK42]
Petersenite-(Ce)
Phillipsite
Phlogopite
Phosinaite-(Ce)
Pirssonite
Polylithionite
Posnjakite
Poudretteite
Prehnite
Pyrite
Purochlore
Pyrophanite
Pyrrhotite
Quartz
Quintinite-3T
Raite
Rasvumite
Reederite-(Y)
Remondite-(Ce)
Revdite
Rhabdophanite-(Ce)
Rhabdophanite-(La) (?)
Rhodochrosite
Richterite
Riebeckite
Rinkite (mosandrite)
Roentgenite-(Ce)
Rosenbuschite
Rouvilleite
Rozenite
Rutile
Sabinaite
Sanidine
Sazhinite-(Ce)
Sazykinaite-(Y) [UK88]
Schairerite
Scheelite
Schorl
Searlesite
Senaite
Sepiolite
Serandite
Sheldrickite
Shigaite
Shomiokite-(Y)
Shortite
Siderite
Siderophyllite
Sidorenkite
Silinaite
Smectite Group
Sodalite
Spertiniite
Spessartine
Sphalerite
Steacyite [UK4]
Steenstrupine-(Ce)
Stillwellite-(Ce)
Strontianite
Struvite
Sugilite
Sulfur
Synchysite-(Ce)-12T & -24T
Szomolnokite
Tadzhikite-(Y) [UK39]
Taeniolite
Tennantite
Terskite
Tetrahedrite
Tetranatrolite
Thalcusite
Thaumasite
Thenardite
Thermonatrite
Thomasclarkite-(Y)
Thomsonite
Thornasite
Thorogumite
Titanite
Tremolite
Trona
Tugtupite
Tundrite-(Ce) [UK18]
Tuperssuatsiaite
Ussingite
Vaterite
Vesuvianite [UK21]
Villiaumite
Vinogradovite [UK28]
Vitusite-(Ce)
Vuonnemite
Wadeite
Wagnerite
Weloganite
Willemite
Woehlerite
Wollastonite
Wulfenite

Wurtzite-2H, -4H & -8H	*Yofortierite* [UK25,31]	Zeophyllite
Xenotime-(Y)	Zakharovite	Zircon

For species shown in ***italics***, Mount Saint-Hilaire is the type locality.

Verified species:	324	
Unconfirmed species	2	
Type localitic species	33	
UK species to ID	42	(not listed)



Crystal habit of the datolite found growing on stilbite,
Lacamas Creek Quarry, Orchards, Clark Co., Washington

Zeolite Associates -- DATOLITE

Don Howard

Until recently, occurrences of datolite in the Northwest have been few and far between. Crusts of datolite in the form of intergrown crystals have been found at a quarry along the Lewis River, Skamania Co., Washington. This material is usually overgrown by calcite, with probable intergrowth at the interface so that etching in acid provides roughened, rather unattractive specimens. Crystals of datolite have been found from time to time at a small quarry on the side of Cox Butte, Junction City, Lane Co., Oregon. Now, with the addition of the two new locations described in this issue, it seems appropriate to describe the mineralogy of datolite.

Chemically, datolite is a borosilicate: $Ca_2 B_2 Si_2 O_8 (OH)_2$. It has a sheet structure of alternating tetrahedra of SiO_4 and BO_4 groups sharing edges. The hydroxyl groups are associated with the boron tetrahedra. The calcium ions lie in sheets between the borosilicate layers.

Crystalographically, the mineral is classified as monoclinic, but the angle involved is given as 90.2° , so for most purposes we can consider it to appear to be orthorhombic. The alternating sheets lie in the bc plane. The structure is closely related to the beryllium silicates of the gadolinite group, as well as the borosilicates Bakerite and Homilite. The crystals are glassy, clear or a pale greenish color from most locations. They may be very simple, as the diagram opposite shows for the crystals from Lacamas Creek Quarry, but from many locations they are very complex with numerous small faces.

a = 9.63 A
b = 7.61 A
c = 4.83 A

Datolite most commonly forms in basic eruptive rocks, and is a fairly common associate of the zeolites from the trap-rock quarries along the East Coast, sometimes forming groups of intergrown crystals and sometimes producing specimens of large, well-formed individuals. Bergen Hill, N.J. has produced outstanding specimens for many years. Datolite also is known to occur in gneiss, diorite, serpentine, and in some metallic veins and iron beds. Large glassy crystals an inch or more in diameter have been on the market recently from San Luis Potosi, Charcas, Mexico. Datolite has widespread occurrences, such as in Italy, Norway, Russia, South Africa, and Tasmania.

In the Northwest, datolite has been rather scarce because of the general unavailability of the boron. Datolite is usually associated with the higher temperatures needed to free the boron, and is therefore often an early mineral, with the zeolites following later in the crystallization sequence. The boron is often produced from the thermal alteration of sedimentary rocks which, unlike many of our basalts of oceanic origin, contain sufficient boron to allow borosilicates to form in the vicinity.

Datolite may be found at other similar sites in the future, but is not likely to a very common mineral in Oregon and Washington. Still, since it is visually so similar to many of the zeolites, it is something that we will need to watch out for as we collect.

ZEOLITES AND ASSOCIATED MINERALS FROM LACAMAS CREEK, ORCHARDS, CLARK COUNTY, WASHINGTON

by
Rudy Tschernich
526 Avenue A
Snohomish, Washington 98290

Zeolites are abundant in vesicular basaltic andesite in a quarry at the headwaters of the North Fork of Lacamas Creek, northeast of Orchards, Clark County, Washington. The site was first found on February 16, 1998 by Bill Tompkins. The quarry is along the side of a steep logging road that follows the divide between the North Fork of Lacamas Creek and Cedar Creek. The quarry was only 25 feet high, 75 feet long, and 30 feet deep in 1998. Volcanic rock, filled with zeolites, was removed from the quarry to build the road and its embankments for 100 yards leading to the quarry. The rock is mapped and described as thick flows of clinopyroxene basaltic andesite of Oligocene age (Phillips, 1987) with K-Ar dates between 28 m.y. at the top and 37 m.y. at the base (Walsh et al, 1987). The rock in this area was formed from large shield volcanoes and steep-sided stratovolcanoes, which produced a complex, intermix of lavas, pyroclastic flows, and debris flows (Phillips, 1987). In most places it is not possible to trace an individual volcanic unit for more than a quarter of a mile. The rock in the quarry appears to be a mixture of volcanic ejecta and irregular vesicular flows without any well-defined layering or elongation of the vesicles. Because of the different rock types, density, and abundance of vesicles, the rock in some areas has been altered differently, so that some zeolites are highly localized while others are widespread. The rock varies in color and the amount of cavities. Some of the rock is black with widely scattered rounded vesicles, up to 1 centimeter across, that are lined with a dark green to black clay on which a few zeolites are found. Other areas in the quarry contain patches of a maroon-colored, highly vesicular scoria. Cavities in this rock rarely contain clay and are lined with small colorless heulandite crystals and rarely scolecite needles. Large pockets are very rare in the quarry. Only three large cavities have been found to date. Near the base of the eastern portion of the quarry two pockets, 12 to 14 inches across, were found in a brown altered basalt area 6 feet in diameter by Bill Tompkins on February 16, 1998. They contained large crystals of stilbite covered with tiny crystals of datolite, laumontite, chabazite, calcite, and copper. Later an even bigger pocket was found on April 3, 1998 in the same area. It was nearer the road and was 6 inches high, 2 feet wide and over 3 feet deep, lined primarily with laumontite along with a little stilbite, calcite, and datolite.

The minerals are described in the apparent order in which they crystallized.

CLAY commonly precedes crystallization of the zeolites in most of the cavities. When fresh, it is a dark green to nearly black color, but in altered pockets it is a dark tan color.

HEULANDITE forms colorless blocky crystals, 2 mm across, in vesicles up to 2 cm across, in the soft maroon-colored scoria. In these cavities, no clay precedes the heulandite. Rarely, scolecite needles are on the heulandite. Heulandite also forms colorless crystals, up to 5 mm long, in a few small black clay-lined vesicles in the dark rock. Heulandite has not been found in the large stilbite/datolite pockets.

STILBITE is common only in the two large cavities in brown altered rock in the quarry. It forms colorless, translucent, lustrous crystals, up to 1.5 inches long, that quickly dehydrate upon removal from the damp rock in the quarry and turn white. Compact intergrown crystals of stilbite formed on the bottom of the cavities with individuals scattered part way up the cavity walls. The roofs of the cavities were barren of large stilbite but were covered with datolite, laumontite, and drusy rectangular stilbite crystals, less than 1 mm long. Nearly all the large stilbite crystals are covered with tiny datolite and white laumontite crystals.

SCOLECITE forms colorless to white radiating needles, up to 1 inch long, that usually completely fill angular cavities in the rock. Rarely a small space in the center of the scolecite-lined cavity is open enough to contain terminated crystals. When terminated, the crystals are flattened and possess reentrant angles between portions of the crystal that indicates they are twinned. Scolecite is common and widely spread throughout the rock in the quarry, but very few good specimens have been found. Scolecite fills many of the smaller cavities, covering a lining of heulandite. One cavity contained tiny rectangular stilbite crystals, under 0.5 mm long, on the scolecite crystals.

COPPER forms 1-mm bleb-like crystals either on or near the surface of some large stilbite crystals. It is often altered on the surface to blue chrysocolla and green malachite.

LAUMONTITE is common only in the large stilbite pockets. It forms simple colorless prisms with a single sloping face, commonly up to 10 mm long, on clay, datolite, and stilbite. Rarely laumontite is covered by drusy rectangular stilbite on the roof or is engulfed by continuous growth of the larger stilbite on the floor of the cavities. White mounds of apophyllite and chabazite rarely are found on the laumontite. Laumontite completely lined the largest cavity found in the quarry with crystals up to 1.5 inches long and 5 mm wide.

DATOLITE forms colorless to frosted crystals that are either equant or slightly elongated along the c-axis, resembling malformed analcime or chabazite variety phacolite. The crystals are difficult to orient. Some of the faces are bright and lustrous while others are highly distorted and composed of numerous tiny offset faces, especially on the side {110} faces. Many of the crystals form compact aggregates or round groups, up to 4 mm across, which also make identification difficult.

Datolite occurs on the large stilbite crystals in the lower portion of the cavities and on a clay lining on the roof of the cavities. When on the clay lining, the crystals are often covered with drusy rectangular stilbite laths, under 0.5 mm long, but when on the large stilbite crystals, they are partly engulfed by a continued growth of the surface of the large stilbite crystals. Datolite crystals that have been naturally etched away leave pits, the shape of the original crystals, in the surface of the stilbite. It is difficult to tell the relationship of the datolite with laumontite and it may have formed after laumontite crystallization. Datolite has not been found in association with heulandite or scolecite, which are found in other cavities. Tiny rhombohedra of chabazite are found on some of the datolite.

A disturbance in the larger cavities broke some of the clay, datolite, and small pointed stilbite from the roof of the cavities, after which crystallization of drusy zeolites (flat-topped stilbite and chabazite) cemented them to the top surface of the large stilbite crystals on the cavity-floor.

LEVYNE very rarely forms colorless to white, thick, highly striated rhombohedral crystals, up to 5 mm across, that cover black clay and is covered only by scattered colorless rhombohedra of chabazite or colorless calcite crystals. The crystals do not possess the typical broad flat c-face that is distinctive for levyne and are very difficult to identify.

THOMSONITE rarely forms masses of bluish-gray radiating fibers that completely fill cavities up to 10 mm across. No other zeolites have been found in associated with thomsonite.

CHABAZITE rarely forms simple colorless rhombohedra, under 1 mm across, scattered on datolite, laumontite, and stilbite in the stilbite/datolite pockets. In the small vesicles, it also rarely forms rhombohedra, up to 10 mm across, on black clay and levyne.

APOPHYLLITE rarely forms white, hollow shells of intergrown crystals that often covers some of the datolite crystals that are found on the large stilbite crystals. The morphology of this mineral suggests that it is apophyllite. They are square in cross section, elongated along the c-axis, and have a flat {001} termination. Other corner faces may have been present, but due to alteration, probably to a clay mineral, the morphology is poor. The center of the crystals was attacked first, leaving a hollow shell. This mineral is also found on laumontite, which indicates it crystallized late in the pockets.

CALCITE is scarce in the cavities. It formed masses, up to 4 inches across, in the large stilbite pockets and several clear crystals, up to 2 cm across, in the large laumontite pocket (Bill Tompkins, pers. comm. 1998).

The minerals appear to have crystallized in the following order in the large stilbite pockets:

clay > large stilbite > laumontite > datolite > (disruption & dissolution) > (drusy stilbite & chabazite) > apophyllite > calcite.

Small vesicles crystallized in the order:

clay > heulandite > scolecite > laumontite or clay > levyne > chabazite > calcite.

References:

Phillips, W.M. (1987) Geology of the Yacolt Burn State Forest. Washington Geology, V 19, No. 2, pp 17-23.

Walsh, T.J., Korosec, M.A., Phillips, W.M., Logan, R.L. and Schasse, H.W. (1987) Geologic Map of Washington Southwest Quadrant. Geologic Map GM-34, Washington Division of Geology and Earth Resources, Olympia, Washington.

ZEOLITES AND ASSOCIATED MINERALS FROM THE BEAVER FALLS QUARRY, SAPPHO, CLALLAM COUNTY, WASHINGTON

By
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White veinlets commonly cut low temperature metamorphose basalt of the Eocene Crescent Formation in the Beaver Falls Quarry two miles north of Sappho along the Burnt Mountain road (Highway 113) that leads to Clallam Bay on the northern tip of the Olympic Peninsula, Clallam County, Washington. Most of the thin white veinlets are completely filled with a fine-grained intergrowth of massive colorless to white laumontite, datolite, quartz, calcite, prehnite, and black bitumen. After several years of watching this quarry, John Cornish found in the spring of 1998, two veins with small separations, up to 5 mm wide, lined with terminated crystals that cut the greenstone in the middle level of the quarry. These veins first appeared to be lined with only small crystals of calcite and laumontite, but upon closer examination they were found to also contain an abundance of wedge-shaped datolite crystals that resemble calcite.

The rock is a fine-grained basalt with little or no flow structure. It makes up the hill in which the quarry is located and is also exposed along Highway 113 northeast of the quarry. This is also the resistant rock responsible for Beaver Falls in the river just east of the quarry. Much of the Eocene volcanic and sedimentary rocks in this area have been tipped on edge, folded, and compressed with enough pressure and elevated temperatures to produce minerals that are stable in what is called the Green Schist Facies. This group of rocks typically contains the green minerals pumpellyite, epidote, and prehnite, which are stable at temperatures and pressures that are higher than those where zeolites are stable. Laumontite is one of the few zeolites that can survive under these conditions. Datolite, a borosilicate, is often found in hydrothermal areas where sedimentary rocks are altered; therefore, releasing the boron needed for the mineral to crystallize. Datolite can be expected in the Crescent Formation where considerable sedimentary and volcanic rocks are present. It can also be expected in the andesite rocks of the Cascades where sedimentary rocks are melted along with oceanic basalt to produce silica-rich andesite. In the southern Washington Cascades, datolite is found at several sites along the Lewis River in Skamania County and at Lacamas Creek, in Clark County. Thick sequences of oceanic Crescent Formation basalt, without sedimentary rock and Miocene basalt, so common in the Washington and Oregon are boron deficient and do not contain datolite. The presence of hydrocarbons in the cavities gives additional evidence that the fluids were influenced by the sedimentary rocks, which originally contained the organic remains that were converted to oil, gas, or the solid hydrocarbon we call bitumen.

Evidence of hydrothermal mineralization is abundant. The thin white and black veinlets cut the rock everywhere, but open veins where terminated crystals are present are very rare in this quarry. All the detailed descriptions of the minerals found in the quarry are from the only two open veins. The minerals appear to have crystallized in the order

laumontite > calcite-prehnite > bitumen-calcite-datolite > datolite > calcite > laumontite > ? pumpellyite

and are described in the order in which they first appear.

Beaver Falls Quarry Minerals

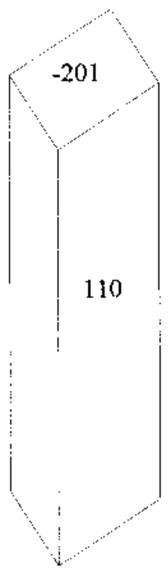

Figure 1
Normal laumontite

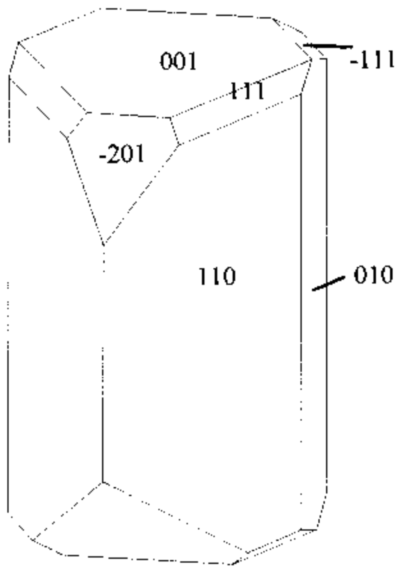

Figure 2
Complex laumontite

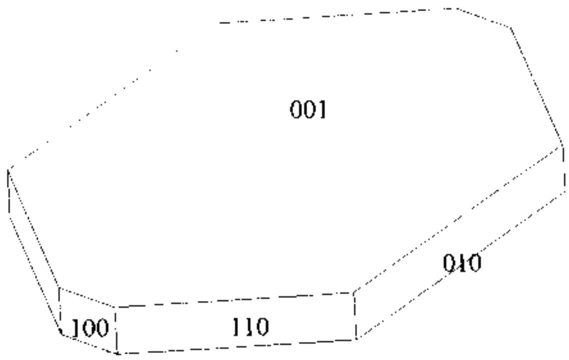

Figure 3
Bladed Prehnite

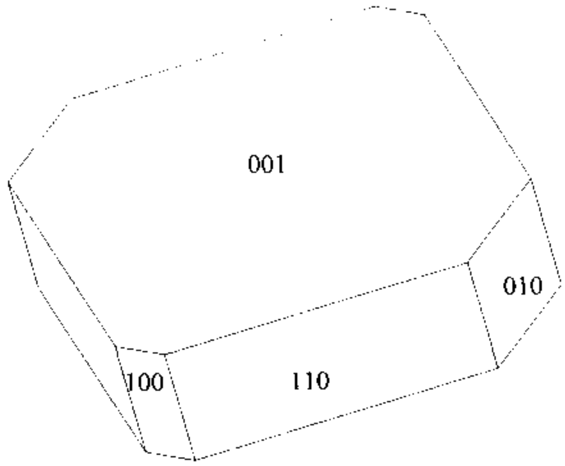

Figure 4
Platy Prehnite

LAUMONTITE is the first and last mineral to crystallize in most of the veins. The first generation of laumontite forms typical square prisms {110} greatly elongated along the c-axis with some reaching 3-mm long. These crystals are terminated by a single sloping face (-201) (Fig. 1). This generation is covered by calcite, datolite, prehnite, and bitumen, which makes the determination of all the faces on the terminations difficult. A much later generation of laumontite is rarely found scattered on the calcite, prehnite, and datolite. It forms short blocky crystals, some slightly elongated along the c-axis, which are often doubly terminated. The terminations of these crystals are made up of some of the most complex combinations of faces seen on this mineral from anywhere in the world. In addition to the common {110} prism faces and (–201) termination are found the very rare forms {001}, {111}, {-111}, and {010} which produce highly faceted crystals (Fig. 2). Unfortunately, the complex crystals are less than 1 mm long, requiring 50x magnification to see, and possess the same problem as does all laumontite: it dehydrates and falls apart. Coating tiny micro laumontite crystals with anything to preserve it only makes it ugly at high magnification.

CALCITE crystallized at several different times. The early generation of calcite formed parallel growths of spotty brownish rhombic crystals, up to 5 mm across, that partly cover fan-like groups of prehnite crystals. They are full of scattered black inclusions of bitumen in a zone just under the surface of the crystals. Colorless datolite crystals commonly cover the brown calcite. A colorless to light yellow calcite crystallized much later, enlarging existing brown crystals, and covering all of the other minerals.

PREHNITE appears to have crystallized at two times. The first generation formed colorless, thin, square to rectangular, blade-like plates, under 1 mm across, with smaller faces on each corner (Fig. 3). This generation of prehnite commonly forms fan-like groups that are partly or completely covered with brown (bitumen filled) rhombic calcite. A later generation of prehnite formed larger, colorless, square plates, 1 to 2 mm across, that have tiny corner modifications (Fig. 4). Both of these generations of prehnite are partly covered by calcite and datolite. Due to its small size and scarcity in the veins, prehnite is not easy to spot on specimens.

BITUMEN is a term used for solid or semisolid hydrocarbons found in rocks. It is common in the veins found at the Beaver Falls Quarry. Black grainy masses of bitumen, several inches across, fill many of the open spaces in the veins. It is also covered by most of the minerals. It may have migrated from one place in the veins to others as the minerals crystallized while the bitumen formed a rounded coherent liquid mass-like mercury. Bitumen forms black shard-like inclusions in the early rhombic calcite crystals, usually in the outer 10% of the crystals. Bitumen also forms black glassy shards that have a conchoidal fracture that resemble hematite crystals in many of the open spaces. It also forms lustrous black rounded spheres (some covered by other minerals) which indicates that the bitumen had melted. Bitumen has not been found within the prehnite. This indicates the prehnite may have crystallized before the bitumen entered the veins. Black bitumen inclusions are found in some small datolite crystals but is not present within the larger crystals.

DATOLITE crystallized at several different times or continuously over a long period of time. The early generation formed small crystals, 1 to 2 mm across, that appear to have grown into the black bitumen, which gives the datolite a gray color due to bitumen inclusions. The main generation of datolite formed colorless transparent crystals, 5 to 10 mm across, that covers hemispherical masses of bitumen, up to 2 cm across. Rarely, piles of tiny datolite crystals are scattered on top of the larger datolite crystals. Datolite crystals resemble calcite, but the former does not react to HCl acid and has a much higher refractive index than zeolites. The datolite crystals are highly lustrous and are covered with many complex faces. Unfortunately, it is also very brittle and good undamaged specimens are not common. Fracturing and rehealing of datolite plates and cemented shards of rock and other minerals onto the crystals indicates disturbance in the rock while the minerals were crystallizing.

PUMPELLYITE forms light-green fine-grained patches in the veins and is responsible for the overall green color of the altered rock. Light green clay-like pumpellyite dust covers many of the crystals in some portions of the veins.

PYRITE cubes, under 1 mm across, are found embedded in the greenstone but have not been observed within the veins.

QUARTZ is very scarce in the veins. Only one small specimen contained tiny colorless doubly-terminated quartz crystals, under 1 mm long, in amongst the black bitumen. They resembled the classic Herkimer Diamond quartz found in New York.

Permission to collect in the quarry is required. Hard hats are required at all times. Terminated crystals are very scarce in this quarry.

Computer Matters:

New Crystal Drawing Program Available

Don Howard

Recently, one of the collectors in France with whom I exchange minerals sent me a program he has written to try out. The program is called **FACES** and is completely compatible with Windows-95, on which I am running it. The collector is Georges Favreau, one of the directors and regular contributers to *Le Cahier des Micromonteurs*, the bulletin of the French Association of Micromineralogy.

Georges says about his new program, "It is a bit like Shape, but easier to use." I can attest to that. The program is based around crystal systems and their symmetry, which is completely selectable. After that, sets of faces can be added and their degree of influence can be continuously varied. A complex crystal can be built up one set of faces at a time. Any set can be easily removed independently of all the others at any time. Each set is identified by its Miller index.

The display is very colorful, with each set of faces depicted in a different vivid color. For the purposes of printing, these may be reduced to line drawings of grayscale shading. Face indices may be added if desired. Everything is accomplished with mouse-activated pull-down lists.

The display is also very flexible. Reorientation of the diagram is accomplished using the scroll-bars, and rotations about any of the three axes can be selected. There is also provision to adjust the overall scale of the diagram.

The major feature missing in the program is that it has no provision for displaying or depicting twinned crystals. This is certainly a nuisance, since several of our most interesting zeolites are commonly twinned. However, for drawing any untwinned crystal, all that is required is a bit of playing around with sets of faces and their degree of development.

FACES is a shareware program for which Georges is asking $40 US. If you would like to try it out, I suggest that you get in touch with Georges at the e-mail address:

Georges.Favreau@alcatel.fr

The program can be sent via e-mail as an attachment. Though there are French, German, and Italian versions, all commands and directions are in English.

NWMMSG field trip to the Olympic Peninsula.

Jim Etzwiler

The Micro Mineral Study Group met at John and Gloria Cornish's home on Saturday, June 28, 1998, for a field trip. There were members there from Idaho, Oregon, and Washington that attended. John led the group west along the Strait of Juan de Fuca to a locality known as Majestic Beach.

Before beginning to collect John gave a briefing of what to expect to find at the locality. Items to look for were "ugly" fossilized sand dollars (being studied as a possible new species), fragile fossilized starfish, fossil vertebra bones, concretions which could include calcite pseudomorphs, fossils of bone and shells, calcite and pyrite crystals, or even torredo wood. Samples of all of the above except the sand dollar and starfish fossils were found. Agatized snail shells, fossil bones, and torredo wood were also found loose in the beach gravels. Another item of interest found by a member was a present day specimen of snail shell only seen before by him in textbooks. A 10-ft boat complete with oars, fishing pole, and tackle box was found and recovered from the beach.

John provided directions to the Beaver Falls Quarry that has produced some small datolite specimens. Several members visited the quarry later in the afternoon. See Rudy Tschernich's article also in this issue of the Microprobe.

Saturday evening we met again at John and Gloria's home for a potluck and general visitation. The menu included ham, smoked salmon, baked beans, green salad, fruit salad, potato salad, jello salad, potato chips, several varieties of cookies, chocolate cherry cake, fruit juice, soft drinks, and coffee. There were discussions of computer applications for documenting collections, the use of hi vs. low resolution digital photos, lots of stories about collecting sites and stories about collectors that many of us know. A couple of members found in addition to their interest in minerals, they also had a common alma mater and extra curricular club activities at school. John had a microscope set up with specimens to view. John also had a selection of specimens of stilbites and clinochlore lined pockets with calcites from the Beaver Valley Quarry for those that would like to add to their own collections.

Sunday morning we again met at John and Gloria's home. John led the group to the collecting site at Beaver Valley. John again briefed the group of what to expect to find and the general layout of the quarry. Members found specimens of calcites; clinochlore lined pockets with calcites, vugs with fine bright copper wires, clear stilbites, and natrolites.

John was a great host, did not collect much but made himself available to the others for discussions of the localities and specimen identification and made sure every one was successful in finding specimens.

Directions to Majestic Beach: Proceed west from Port Angeles on state highway 101 to the junction with state highway 112. Proceed approximately 15.6 miles along state highway 112 and turn north onto a gravel road by a school bus turn around sign. At about 0.5 miles down the gravel road take the right fork and proceed to the parking area next to the beach. We collected along the beach to the west from the parking area.

Directions to Beaver Valley Quarry: (*Permission to collect required.*) From state highway 104 about 100 feet west of milepost marker 9, turn north onto highway 19 toward Port Ludlow. Proceed about 0.8 miles north and turn left onto a narrow dirt road. Follow the road approximately 100 feet to the quarry. (Milepost marker 9 on highway 104 is about 5 miles west of the Hood Canal Bridge.)

Thanks to John and Gloria for opening their home to us as a base for this field trip and preparing the hot food. Thanks also to John Cornish and Caro Torgesson-Emeny for arranging formal permission to access the Beaver Valley Quarry and making insurance arrangements through the Washington Mineral Council.

Post script: John Cornish reported the found boat to the sheriff's office. An initial contact to the registered owner yielded a response that he had sold the boat several years before. A few days later the current owner was found and he was very happy for the return of the boat. They had stopped on the beach at a camping area. When they returned to the beach, they found the boat was drifting toward Canada and far out of reach the last they saw it.

The pseudomorphs found at Majestic Beach are described in "Petrography and Geochemistry of Rhombic, Calcite Pseudomorphs from Mid-Tertiary Mudstones of the Pacific Northwest, U.S.A.", Sam Boggs, Jr., *Sedimentology*, Vol. 19, Pp. 219-235, Elsevier Publishing Company, (circa 1972)

FIGURE CAPTIONS

Micrograph Number is in the lower right corner of the front.
Photograph Number is on the back in the upper left corner.

#319 Datolite on Stilbite **(x28)**
Lacamas Creek Quarry, Orchards, Clark Co., Washington
Four prismatic crystals on the surface of large, intergrown stilbite from the large pocket.

#38 Mordenite on Heulandite **(x 2)**
Rock Creek, Stevenson, Skamania Co., Washington
Large cavity from the altered zone.

All photos and specimens, Don Howard

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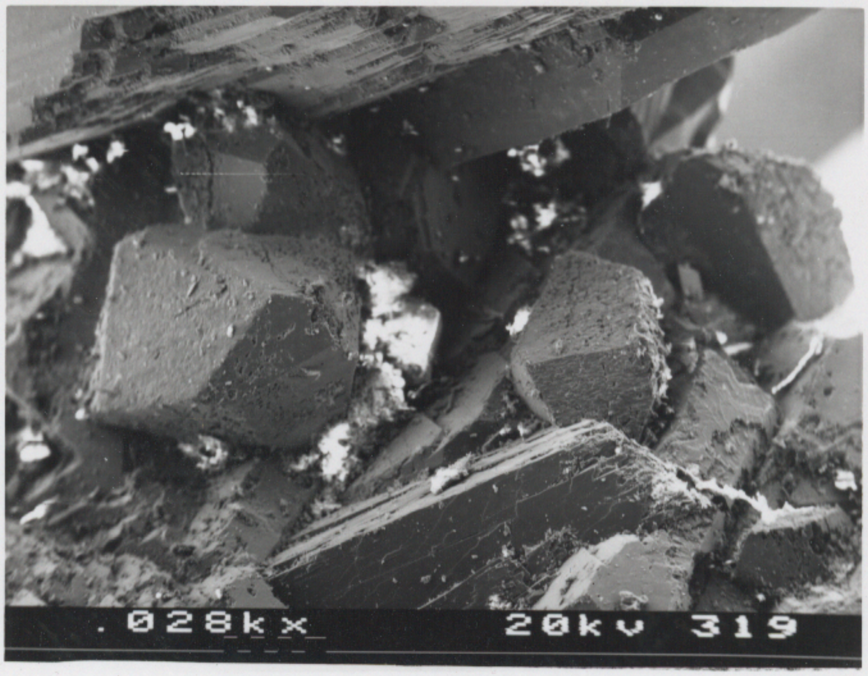
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