Northwest
Micro Mineral
Study Group

MICRO PROBE

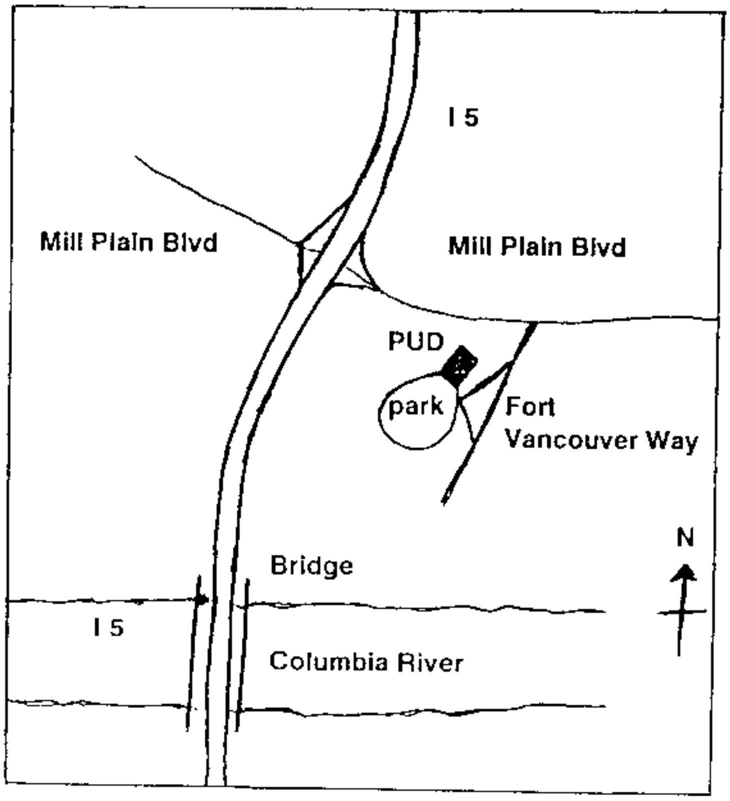
FALL, 1992 VOLUME VII Number 6

FALL MEETING...............VANCOUVER, WASHINGTON

November 7, 1992 9:30 am to 9 pm

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

It's time again to share your good times and new finds with the rest of us. Bring your microscopes, bragging pieces, and some things to trade. And be sure to bring some pieces for the give-away table for others to enjoy.



Short business meeting at 1:30 pm followed by slides of mineral collecting in New Zealand presented by Don Howard. There will be many New Zealand minerals to examine during the morning and late afternoon

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

Bring slides of collecting trips or of newly photographed minerals to share after dinner.

Dates of future meetings to keep open: May 1, 1993
Nov 6, 1993

CAPTIONS TO THE PICTURES ACCOMPANYING THIS ISSUE

NOTE: Numbers are in the lower right corner of each electron micrograph.

#020 Apophyllite (x130)
Opononi Quarry, Hokianga Harbor, Northland, New Zealand
Two crystals aligned approximately coaxially and rotated 45° to form a sort of "twisted twin".

#050 Allanite (x150)
Liberty Bell, Washington Pass, Okanogan Co., Washington
Tabular crystal habit showing twinning on (100).

#060 Allanite (x150)
Liberty Bell, Washington Pass, Okanogan Co., Washington
Equant habit displaying monoclinic nature.

#074 Kainosite (x 75)
Liberty Bell, Washington Pass, Okanogan Co., Washington
Clear glassy crystal showing surface etching

#076 Titanite in Granite (x 25)
Wainui Beach, Golden Bay, Nelson, New Zealand
The crystal must have formed early, since its faces are sharp while the quartz and feldspar surrounding it have no sharp faces.

#079 Titanite (x 50)
Franz Josef Glacier, Westland, New Zealand
Two crystals forming a boat-shaped twin on (100).

#086 Tschernichite on Clay (x320)
Santiago de Pursical, San Jose, Costa Rica
All crystals observed so far from this location are untwinned and have prominent, roughened (001) face. Notice the striated surfaces give a rather rounded appearance to the pyramidal faces.

CREDITS: All micrographs taken by D. G. Howard
Specimen #079 provided by David Cattermole, Kirwee, N.Z.
Specimen #086 provided by Rudy Tschernich

SOME BIOLOGICAL EFFECTS OF INHALED MINERALS
OR
AVOID THE DUST--ESPECIALLY THE FIBERS!

BY BOB BOGGS

We are all aware of the ordinary and obvious hazards of mineral collecting, but we are sometimes exposed to fairly dangerous situations that are not so obvious.

Though I have known about the toxic effects of asbsestos for years and respected it, I never expected to read that one of the fibrous zeolites (erionite) was essentially in the same catagory until I read an article in the March-April 1992 American Mineralogist by George D. Guthrie, Jr. on the BIOLOGICAL EFFECTS OF INHALED MINERALS.

Many fibers have the potential to induce fibrosis, lung cancer and mesothelioma, the latter a rare cancer with an extremely high morbidity rate. The Guthrie article is 15 pages long so if you want the full treatment, look it up.

Guthrie lists many mineral species as either being only slightly active, active, or highly active as follows: (this is by no means a complete listing). Hematite dust is only slightly active except in very heavy concentrations, while brucite is highly fibrogenic and carcinogenic. Also while mordenite is only slightly active, erionite is highly active; nearly as active as crocidolite as far as I can tell from his report of a study in Turkey in 1979. Offretite was not mentioned in the report, but with its close relation to erionite you will no longer see me blowing the dust off of an Adel, Oregon zeolite specimen, absolutely beautiful specimens with a thick offretite overgrowth on levyne (but loaded with fine fibers!)

In parts of the border granite at Washington Pass, there is more than an ample supply of fibrous riebeckite (crocidolite) and I have been very careful over the years not to create a dusty situation when handling it; and espeially not to get it scattered over the shop floor, around the scope or in the house anywhere for that matter. It is one of the most carcinogenic forms of asbestos.

Usually the small amounts of these materials the collector handles save us from any real danger, but be aware of the potential and keep a neat work area.

Guthrie's article deals mostly with fibrous material, but dusts containing the heavy and toxic metals like lead, mercury, cadmium, thallium and uranium to mention a few of the worst should also be avoided. Especially the flakey micaceous secondary uranium minerals (schrockingerite, autunite etc.) Galena could get into the dust form in a hurry on a shop floor because of its cubic cleavage and is something like a hundred times more toxic when inhaled than when injested. The fine dust in the lungs gets into the bloodstream that much more easily.

How to create a dust? Well, for years I have done it by blowing the fine chips (and yes sometimes fibers) off the newly collected specimens in the field before I check with the loupe. Lately I have been trying to "break the habit" and to also wear a dust mask in really bad situations. The dust mask has a twofold purpose; it keeps the lungs a little cleaner and effectively stops one from "blowing out a vug"! Masks are not that comfortable to wear and more troublesome in hot weather, so that route seldom works either. One thing that does help though is to take a newly collected piece and turn the good side down and tap a corner against a rock, this will often get the specimen clean enough to judge its worth.

PRELIMINARY REPORT ON THE SECOND OCCURRENCE OF TSCHERNICHITE

by
Rudy W. Tschernich
Snohomish, Washington
and
Ronald A. Boyd
Costa Rica

Little had been known about zeolites in the extensive volcanic rocks in Costa Rica until Ronald Boyd started a systematic search. Many zeolites sites have been found near La Cruz, Guaitil, Quebrada Grande, Puente La Garita, Rio Veijo, and Rio Barbilla that have produced remarkably good micro sized crystals of heulandite, stilbite, laumontite, mordenite, thomsonite, mesolite, chabazite, analcime, phillipsite, levyne, offretite, and natrolite. A description of the minerals at these localities can be found in *Zeolites of the World* by Rudy Tschernich (1992). In March 1992 RB sent two unknown samples from a new zeolite locality to Rudy W. Tschernich for identification. One of the unknowns turned out to be hexagonal plates of levyne. The other unknown described by RB as possibly apophyllite with truncated, striated, anatase-like dipyramids, was recognized by RWT and has now been confirmed by X-ray diffraction at the University of Chicago by J.V. Smith, as tschernichite. Tschernichite was first found in 1972 by RWT at Goble, Oregon and has been published as a new species in 1992 by Boggs, Howard, Smith, and Klein. This is now the second locality in the world for this mineral.

Tiny dipyramids of tschernichite are very rarely found in small, clay-lined vesicles in gray-colored, Upper Miocene, volcanic rocks in the La Cruz Formation in central Costa Rica near Santiago de Puriscal (known locally simply as Puriscal or Santiago), 27.5 km southwest of San Jose. The zeolites are found in loose chunks of highly weathered rock that disintegrates into rounded fragments, up to 2 feet in diameter, with a hard core . The rock is mixed with mud in debris along a road bank, 100 feet long and 50 feet high, that has been exposed in the last two years by a land slide due to heavy rain or earthquakes. Only some of the rock is vesicular. Tschernichite has been found in only two rock fragments. Other cavities contain an abundance of heulandite, epistilbite, and stilbite, and rarely mordenite, levyne, calcite, and chabazite. The scarcity of tschernichite indicates some very special conditions are required for it to crystallize. No zoning or segregation of the zeolite species has been noticed. The minerals are described in the order that they appear to have crystallize in the cavities.

CLAY forms a 1- to 2-mm thick lining in all the cavities and precedes zeolite crystallization. The clay layer is composed of up to five alternating light cream to dark brown layers. These layers were probably shades of light and dark green before weathering and oxidation of the iron in the clay changed the color.

CALCITE rarely forms milky-colored grainy masses that fill the cavities or is intergrown with mordenite fibers and covered by heulandite. Calcite probably accounts for the numerous empty hemispherical cavities, up to 5 mm in diameter, found beneath some of the zeolites.

TSCHERNICHITE forms tiny, transparent, colorless, light yellow, or deep golden colored crystals (some of the color imparted from the clay beneath the crystals) from 0.1 to 0.3 mm long. The crystals form steep dipyramids always terminated with a small {001} pinacoid in vesicles up to 8 mm in diameter. Most of the crystals are doubly terminated and lie on their sides. Striations on the pyramidal faces are common. Twinning of the tschernichite crystals, that is so common at Goble, Oregon, has not been observed at Puriscal. The tschernichite crystals are very scarce. Only 30 cavities have been found. Levyne and white altered epistilbite are the only two minerals seen in the same cavities as tschernichite, although all of the other minerals are found in nearby cavities. Levyne and epistilbite clearly cover tschernichite crystals making it the first zeolite to crystallize. Due to the similar transparency and color of all the zeolites and the small size of the tschernichite crystals, tschernichite could easily be covered by other zeolites and not be noticed.

EPISTILBITE commonly forms colorless, transparent, lustrous blades, up to 3 mm long, with a diamond-shaped cross section, fanlike groups, and hemispherical aggregates that resemble thomsonite. Some of the epistilbite crystals have a frosted dull-appearing termination.

MORDENITE forms white, thin, fibrous inclusions within heulandite and chabazite crystals and interferes with the surface growth of these two minerals to form a white fibrous surface. White mounds of mordenite are also seen on epistilbite crystals.

HEULANDITE commonly forms colorless, transparent, crystals, up to 4 mm across, flattened on the b-axis. A few crystals contain mordenite inclusions deep within the crystal or a fibrous milky surface that appears to have grown around mordenite needles. Stilbite crystals are clearly on top of heulandite crystals and in a few cavities radial groups of epistilbite preceded heulandite.

STILBITE commonly forms colorless, transparent, blades, up to 4 mm long, on heulandite. The stilbite blades are commonly composed of large triangular corners with a small to large flat termination. Rectangular flat-topped stilbite crystals are rare. Some flat-topped stilbite forms radiating botryoidal groups with a lustrous surface. Sheaflike stilbite groups are also present. Stilbite crystals are easily confused with heulandite and epistilbite.

LEVYNE rarely forms colorless hexagonal plates and groups of crystals on the clay, stilbite, heulandite, epistilbite, and tschernichite crystals and is covered by offretite and chabazite. Many of the thin levyne crystals have a slightly milky appearance due to minute amounts of offretite on the {0001} faces of the crystals. Thicker crystals of levyne are transparent and colorless like window glass.

OFFRETITE forms a very thin, silky, white overgrowth on the {0001} faces of thin plates of levyne. Broken levyne/offretite crystals display the colorless center of levyne and the white fibers perpendicular to the broad {0001} pinacoid of the levyne.

CHABAZITE rarely forms colorless, light yellow (transmitted color from the clay base) rhombohedra and penetration twins on heulandite, stilbite, and levyne. Some chabazite crystals have a milky fibrous-appearing surface due to an intergrowth with mordenite fibers.

CRYSTALLIZATION SEQUENCE:
Observed sequences:
Clay > tschernichite > levyne
Clay > mordenite (inclusions) > heulandite
Clay > mordenite (inclusions) > chabazite
Clay > epistilbite > mordenite
Clay > epistilbite > heulandite
Clay > epistilbite > stilbite
Clay > epistilbite > levyne > offretite
Clay > heulandite > stilbite
Clay > heulandite > stilbite > levyne
Clay > heulandite > levyne
Clay > heulandite > stilbite > chabazite
Clay > levyne > chabazite

Generalized sequence:
clay > calcite > tschernichite > epistilbite > mordenite > heulandite > stilbite > levyne > chabazite

All of the zeolites at Pursical are dominate in calcium. The most abundant zeolites are high in silica and appear to have crystallized due to a progressive decrease of silica in the solution. Tschernichite, with the highest silica content, crystallized first, followed by the high-silica zeolites epistilbite, mordenite, heulandite, and stilbite while levyne and chabazite, with the lowest silica content, crystallized last. Boggsite, which is associated with tschernichite at Goble, Oregon is not present at Puriscal. Epistilbite appears to take the place of boggsite in the crystallization sequence.

Zeolites from the Beech Creek Quarry, Mount Vernon, Grant County, Oregon

by
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526 Avenue A
Snohomish, Washington 98290-2414

One of the primer zeolite localities in the Pacific Northwest is a small abandoned quarry known simply as Beech Creek. The quarry is located 10 miles north of Mt Vernon, Grant County, Oregon and 0.1 mile east of Highway 395 along the east fork of Beech Creek leading to Magone Lake. It was first located in July 1961 by Milton Speckles while he was traveling from Ritter to Mt. Vernon and has been a popular collecting area ever since then. This quarry produces some of the finest levyne crystals (overgrown with an intergrowth of offretite and erionite) in the world as well as good specimens of thomsonite, phillipsite, chabazite, and other micro sized zeolites.

The quarry was operated to obtain rock for the road and to dike the sides of Beech Creek. Collecting was exceptional in the 1960s but has declined after the most of the productive boulders had been reduced to rubble and carted off. Productive boulders are still found buried in the rubble piles along the faces of the quarry and along both sides of the creek. Good specimens can still be removed from the quarry faces.

The quarry consists of a single Miocene basalt flow of the Columbia River series. The upper part of the flow is a highly vesicular, zeolite-rich, olivine basalt that is colored brownish-black with zones that are grayish-red. The middle part of the same flow is massive to columnar and does not contain cavities. The lower part of the flow (rarely exposed) is vesicular and contains zeolites similar to the upper part of the flow. Other rock exposures near the quarry do not contain zeolites. Basalt road cuts one mile south of the quarry along Highway 395 contain chabazite on calcite crystals in vesicles and vertical veins.

The cavities are generally 1 to 5 cm in diameter with a few reaching 10 cm across. The larger cavities are lined only with drusy chabazite. The smaller cavities contain the more interesting minerals.

Two types of rock are found in the quarry. The most productive rock is a brittle, highly vesicular, brownish-black rock that is cut by numerous fractures and is lined with black clay. The center of joint blocks of this type of rock contain numerous cavities lined with only a thin layer of velvety black clay. The vesicles along the edges of these blocks are lined with scattered crystals of levyne-offretite/erionite, analcime, chabazite, and rarely thomsonite, phillipsite and cowlesite. This type of rock produces the best specimens. Crystals of levyne and phillipsite are poorly attached to the vesicles; therefore, they often fall off during collecting. Minimal field trimming should be done with a hammer. Larger chunks of rock should be taken home where a mechanical trimmer (that delivers less shock to the crystals) can be used.

The second type of rock is a light grayish-red vesicular rock that is much harder and is not brittle. Cavities in this type of rock lack the black clay lining but are all lined with zeolites. Chabazite rhombohedra are very common but some areas are completely lined with thick crystals of levyne covered by a thin overgrowth of offretite/erionite. Rarely, phillipsite or chabazite are on top of the levyne-offretite/erionite.

There are no access problems encountered at this quarry. The quarry does face south and can get very hot in the summer; therefore, collect on cool days or early or late in the day. Very rarely rattle snakes and scorpions have been seen in the quarry and along the creek.

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

CLAY lines all the cavities and predates the crystallization of the zeolites. The clay was originally green (still seen in the center of some boulders) but oxides to a velvety-black color in most of the cavities. Some of the clay settled by gravity to form a flat base or floor in the cavities. This floor may be only a few millimeters thick in the smaller cavities but in some of the large cavities the clay floor reaches several centimeters thick and is covered with drusy chabazite. When exposed to that atmosphere in the quarry, the clay floor falls out of the cavities and leaves the lower portion of the cavities empty and the upper portion covered with zeolites. A suspended platform, usually consists of chabazite, divides the cavities. Many of the cavities also have a distinctive thin brown layer of clay, 1 to 2 mm thick, that settled by gravity to the floor of the already black clay-lined cavities. The presence of the flat floors and brown layers of clay indicate the orientation of the cavities when the clay and probably the zeolites crystallized. The orientation of these cavities in the quarry walls is difficult to determine but appears to be parallel to the basalt flow.

COPPER rarely forms irregular spongy masses a few millimeters long that are covered with transparent analcime or less commonly thomsonite. The copper within analcime crystals remains bright and shinny and make exceptional micro specimens while the copper exposed to the air becomes tarnished and dark.

ANALCIME commonly forms colorless trapezhohedra, 1 to 3 mm in diameter. Some crystals display tiny cube faces on the dominant trapezhohedra. Analcime is particularly attractive when covering native copper or is scattered on or between levyne-offretite/erionite plates. Transparent analcime covering black clay appears black because the color of the clay is transmitted through the analcime. Analcime is commonly found alone in the cavities but does occur between and on levyne/offretite crystals. A few cavities show that levyne has grown on analcime. Other cavities contain analcime that formed on levyne and restricted grown of the offretite. These observations demonstrate that analcime, levyne, and offretite have grown nearly simultaneously.

LEVYNE forms thin, transparent, colorless hexagonal plates, up to 10 mm in diameter, that are covered with a silky white epitaxial overgrowth of offretite/erionite. In the grayish-red rock the levyne plates, 2 to 3 mm thick, completely line the cavities. These plates of levyne are covered with a thin offretite/erionite overgrowth that crystallized only on the large flat {0001} pinacoid of the levyne. The sloping edges of the levyne crystals are not covered.

In the brownish-black rock the levyne crystals are extremely thin (less the 0.5 mm) and are all completely covered with 2 to 5 mm of offretite/erionite on both the {0001} pinacoid and the edges. The offretite/erionite overgrowth in many of these cavities is 10 to 20 times the thickness of the levyne. The extremely thin levyne plates are very delicately attached to the wall of the cavities. The offretite/erionite has grown only on the levyne and is not attached to the cavity. These crystals often break off during collecting. Levyne-offretite/erionite crystals are usually alone in the cavities although analcime, phillipsite, thomsonite, and chabazite rarely cover them. Specimens of levyne that are associated with other minerals are more durable since the associated minerals cement the delicate levyne-offretite/erionite crystals together. Levyne is very heat sensitive; therefore, always cover newly collected levyne specimens from the sun.

COWLESITE rarely forms tiny, pointed, gray blades that form a thin inconspicuous cavity lining. Cowlesite is easily overlooked because it closely resembles tiny blades of thomsonite. Rarely cowlesite is associated with compound levyne-offretite/erionite crystals. Cowlesite is seen on plates of levyne and restricting the crystallization of offretite on the surface of the levyne, thus placing it after the crystallization of levyne and before offretite.

OFFRETITE-ERIONITE form a silky white fibrous epitaxial overgrowth on all levyne crystals at Beech Creek. This overgrowth is best seen on broken crystals. The core of the aggregate is water clear and glassy levyne while the parallel fibrous overgrowth is colorless near the levyne becoming white at the surface of the aggregate. The morphology of offretite and erionite is a simple hexagonal prism terminated by a {0001} pinacoid. The fibrous overgrowth on the levyne at Beech Creek is so thin that even with high magnification the terminations have not been seen. The fibers appear to taper to a thin fibrous filament. Offretite and erionite have a very similar structure; therefore, these two zeolites often intergrow in the same needle. The overgrowths on levyne at Beech Creek have been the subject in many professional mineralogy papers and both species appear to be present. The offretite/erionite forms thin hexagonal fibers that are oriented parallel to the c axis of the levyne plate. Thick levyne crystals (in the whitish-red rock) contain a very thin offretite/erionite overgrowth only on the large flat {0001} faces. Thin levyne crystals (in the brownish-black rock) are covered with an exceptionally thick offretite-erionite overgrowth, 5 to 20 times as thick as the levyne plate, and covers both the large {0001} face and the edges.

PHILLIPSITE rarely forms colorless to white blocky crystals, up to 10 mm long, that resemble harmotome. One exceptional crystal, 25 mm long, has been found. A few cavities have been found with elongated prisms phillipsite terminated by four diamond-shaped faces that resemble apophyllite. The largest phillipsite crystals are found in the brittle brownish-black rock and are weakly attached to the walls of the cavities; therefore, good display specimens are very hard to obtain.. Phillipsite is commonly found alone in the cavities. Rarely phillipsite is found on and between levyne/offretite crystals and both under and on top of gray thomsonite linings. The gray thomsonite and phillipsite appear to have grown simultaneously.

THOMSONITE is common in some areas of the quarry but is usually not present with the levyne- or phillipsite-bearing rock. Three generations of thomsonite are recognized.

(1) The early generation of thomsonite forms smooth gray to blue hemispheres, up to 5 mm in diameter, or smooth hemispheres with unusual rootlike-growths extending from the surface. Chemical analysis of these growths show that they contain a higher amount of silicon than normal bladed thomsonite and that they appear to have crystallized very rapidly. The cavities that contain the rootlike-growths are not associated with any other zeolites.

(2) The most common type of thomsonite forms colorless to gray-appearing coarse blades and compact cavity-linings. These gray blades are commonly associated with chabazite.

(3) A late generation of thomsonite forms white randomly oriented blades that form delicate loose mounds on top of the gray thomsonite cavity lining. A few cavities contain long projections built of thomsonite blades that terminated with a fanlike or pinhead group. Commonly extending from the white thomsonite mounds are very thin mesolite needles.

MESOLITE rarely forms very thin hairlike fibers that curve or mat similar to mordenite. Mesolite forms cobweblike masses in cavities that contain the white late generation thomsonite and actually has grown from the thomsonite masses.

STILBITE very rarely forms colorless, rectangular, thick blades, up to 8 mm long, alone or on analcime. The stilbite blades have a rectangular cross section and rarely show signs of triangular corners. Other cavities contain blades stilbite with a dominate flat termination with triangular corners. These stilbite blades are covered by chabazite.

HEULANDITE very rarely form colorless bladelike prisms, elongated along the b-axis, alone in a few cavities. The heulandite blades have a cross section where the angles between faces are not at 90 degrees. Chabazite is found on some of the crystals. Rarely the needlelike heulandite prisms are greatly elongated, up to 20 times its width.

CHABAZITE is the most commonly zeolite at the Beech Creek Quarry although it rarely forms exceptional specimens. Most of the chabazite forms colorless to white rhombohedra, 1 to 10 mm across. In a few cavities twinned chabazite variety phacolite is present.

CALCITE forms a white coating on many of the zeolites and is the last mineral to crystallize. Rarely, colorless to light yellow calcite crystals, up to 4 mm long, are found on the zeolites.

CRYSTALLIZATION SEQUENCE:

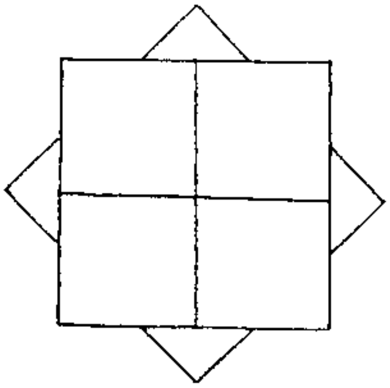
clay > copper > analcime > levyne > offretite
clay > copper > thomsonite
clay > levyne > offretite > phillipsite
clay > levyne > cowlesite > offretite
clay > analcime > levyne-analcime > offretite-analcime
clay > levyne > offretite > chabazite
clay .> thomsonite bladed > thomsonite white > mesolite > chabazite
clay > phillipsite > thomsonite bladed
clay > thomsonite bladed > phillipsite
clay > bladed thomsonite > colorless levyne (no overgrowth)
clay > thomsonite bladed > levyne > offretite
clay > analcime > calcite
clay > stilbite > chabazite
clay > analcime > rectangular stilbite
clay > heulandite > chabazite
clay > analcime > stilbite

Nearly all the minerals present at Beech Creek are low-silica zeolites. Only the trace minerals stilbite and heulandite contain a moderate amount of silica. The minerals appear to have crystallized in the order: clay > copper > analcime > levyne-analcime > cowlesite > offretite-erionite > phillipsite-gray bladed thomsonite-phillipsite > white thomsonite > mesolite > chabazite > calcite with the position of stilbite and heulandite between analcime and chabazite. Considerable amount of over lapping or simultaneous crystallization appears to have occurred.

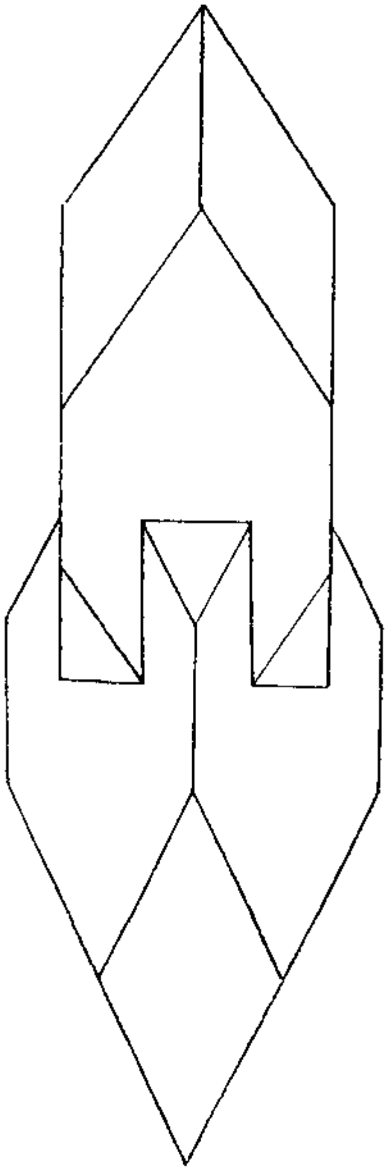
Mineralization in the Beech Creek area is confined to an area not over 100 feet long at the quarry and to an area 1 mile south of the quarry where vertical calcite veins and chabazite are present. Zeolites are common at the Beech Creek Quarry although they line only 10% of the cavities. Zeolites are found in cavities that are intersected by fractures in the rock. Cavities that are not intersected by fractures are lined only with the black clay. Although a thick sequence of Miocene basalt in this area, zeolites are confined to the two places already mentioned. Faults running northwest to southeast are indicated on geologic maps of the area and probably account for the presence of the valley in which the east fork of Beech Creek flows. The occurrence of zeolites at Beech Creek is probably the result of an isolated hot springs that followed the vertical faults when the rock was still deeply buried, altered the rock along minute fractures and deposited the zeolites.

"Twisted" Twins of Apophyllite

Donald G. Howard



An odd twin form of apophyllite has been observed in the rocks from Opononi Quarry, located on the south side of Hokianga Harbor, Northland, New Zealand. The matrix from this quarry is fine-grained tan rock rich in quartz. Mineralization is restricted to thin fissures and cracks running through-out the rock. The order of mineral formation on top of the quartz base seems to be white laumontite followed by clear apophyllite, with tan calcite crystals on top. All crystals are very small.



Most of the apophyllite is elongated along the c-axis to form upright needles with prism (100) and bipyramid (111) the dominant faces. The twin crystals seem to be a bit larger and are laying down, so that the termination at both ends are visible. The two ends are co-axial along c, but with each rotated 45° to form an odd, interpenetrating twin.

Under microscopic investigation, it appears that the alignment is not perfect between the two members, so that strictly speaking this may not be a twin. However, the fact that there are a number of such "twins" present on each specimen would indicate that something very odd is occurring when such "twins" are first nucleated.

Minerals of the GOLDEN HORN batholith -- Part IV

Donald G. Howard

In this issue, we discuss two minerals of the border granite phase. This type of rock is found abundantly in the scree slopes below Liberty Bell, a rocky peak lying just south of Washington Pass itself and standing imposingly above the hairpin curve on its west side.

KAINOSITE (Y)

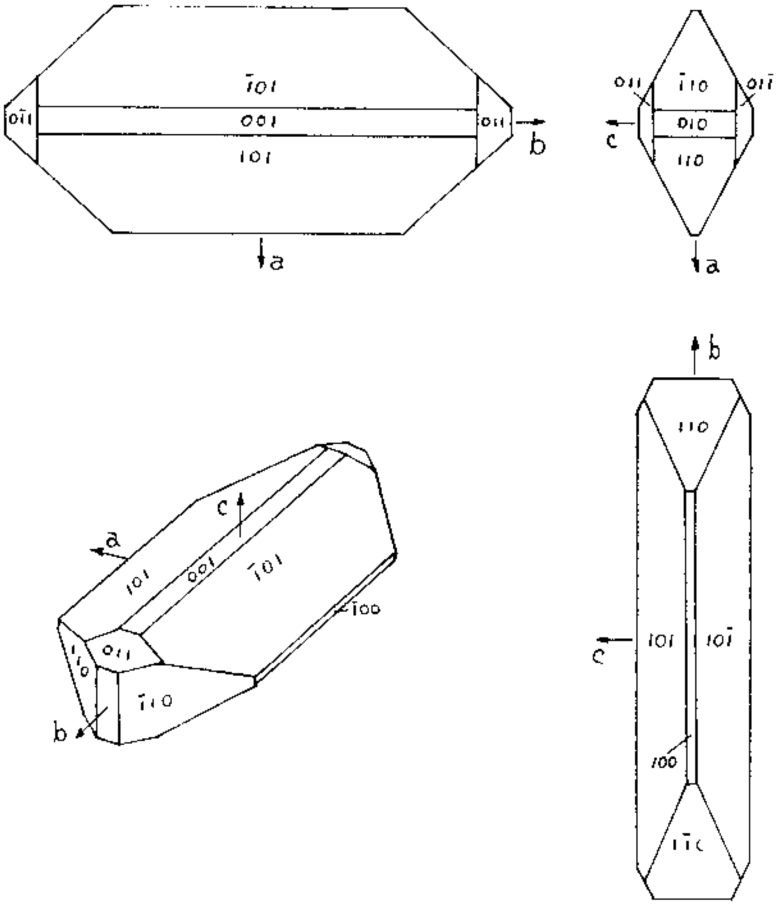
$Ca_2 Y_2 Si_4 O_{12} (CO_3) \cdot H_2O$

Orthorhombic

a = 12.93 A
b = 14.30 A
c = 6.73 A

Crystals of kainosite occur in miarolitic cavities of the border phase granite. They tend to be elongated along the b axis, with prominent (101) and (110) faces. Prism faces (100), (010) or (001) may be present as beveled edges. On terminations, (011), possibly even with (111) faces may appear, often with the set very unequally developed.

When fresh, the crystals are clear and glassy, with only a very faint yellowish tint. Altered crystals appear milky white. In general, kainosite does not contrast with the quartz and orthoclase upon which it is growing, and can most easily be identified by crystal shape.



Crystal habit of Kainosite

Chemically, kainosite is a silicate carbonate of calcium and yttrium. Though some occurrences show partial substitution of cerium for the yttrium, there is little present in the material analyzed from Liberty Bell; most of the cerium seems to segregate into the mineral allanite. The carbonate appears to cause the kainosite to be easily attacked by solutions, so that even the unaltered crystals show considerable etching on a microscopic basis (see Micrograph #074).

Kainosite is often associated with titanite, allanite, and zircon. The zircon crystals are a pale green rather than the usual orangy color, and are composed mainly of bipyramidal faces with no prism present. The cavities also contain brown clinochlore in varying amounts.

ALLANITE (Ce)

$$(Ca_{2-n},Ce_{n})_{2}\ (Fe^{+2}_{n},Fe^{+3}_{1-n})\ (Fe^{+3}_{m},Al_{2-m})\ (Si\ O_{4})_{3}\ (OH)$$

$n = 0.60 - 1.00$ $m = 0.05 - 0.45$

Monoclinic

a = 8.932 A

b = 5.770 A $\beta = 65^{\circ}18'$

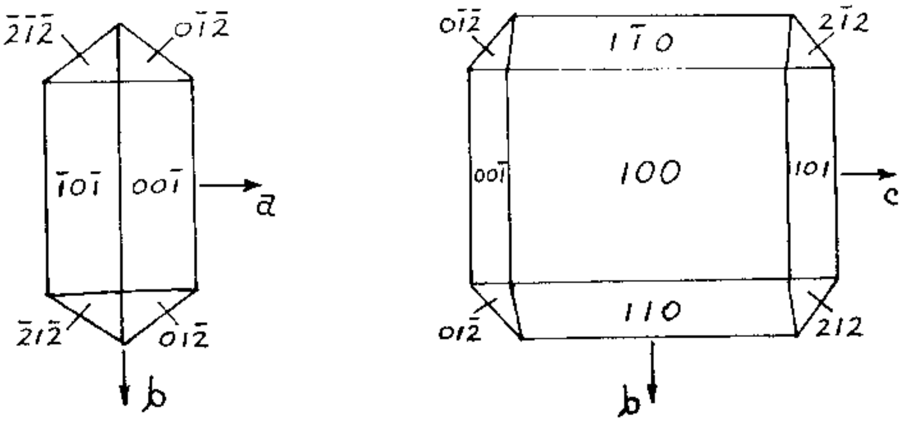
c = 10.158 A

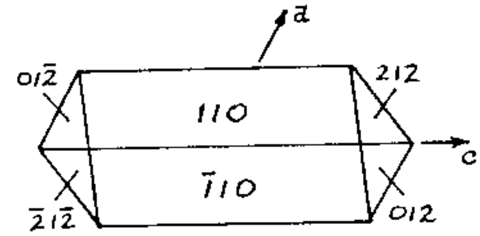
Allanite crystals are also present in the miarolytic cavities of the border phase granite. These are black in color and very lustrous. Structurally, allanite is related to epidote, though the external crystal form is different. Usually allanite crystals are laminar with enlarged (100) faces. In this habit, two edges are beveled with (110) faces, while the other two edges are composed of (001) and (101) faces in varying degrees of relative development. The corners may show small (012) and (212) faces. Twinning on (100) is apparently present, making the crystals appear as a stack of plates under magnification. Micrograph #050 illustrates this habit.

A second, more equant habit is also observed in the same cavities. Here, the (100) face is less prominent and the (110) faces are considerably larger, with (001) terminations. This habit shows much more clearly the monoclinic nature of the mineral. Micrograph #060 dipicts a crystal of this type.

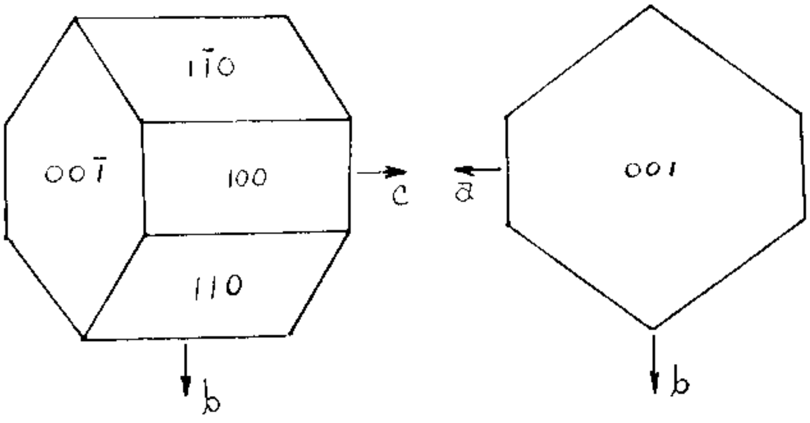
Chemically, allanite is a calcium cerium iron silicate, and seems to be the prefered cerium compound, just as kainosite is the yttrium compound, zircon is the zirconium compound, and titanite is the titanium compound. Very little yttrium or other rare earths are observed to substitute for the cerium, but the crystals contain appreciable calcium, probably near the 1:1 ratio with cerium. The aluminum is probably near the minimum in its range. A little titanium substitutes for the silicon.

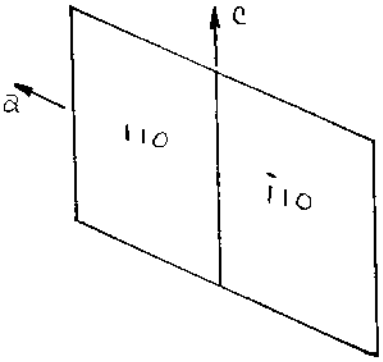
Associated minerals are clinochlore, titanite, kainosite, and zircon.





ALLANITE -- Laminar habit with enlarged (100) face and beveled edges.





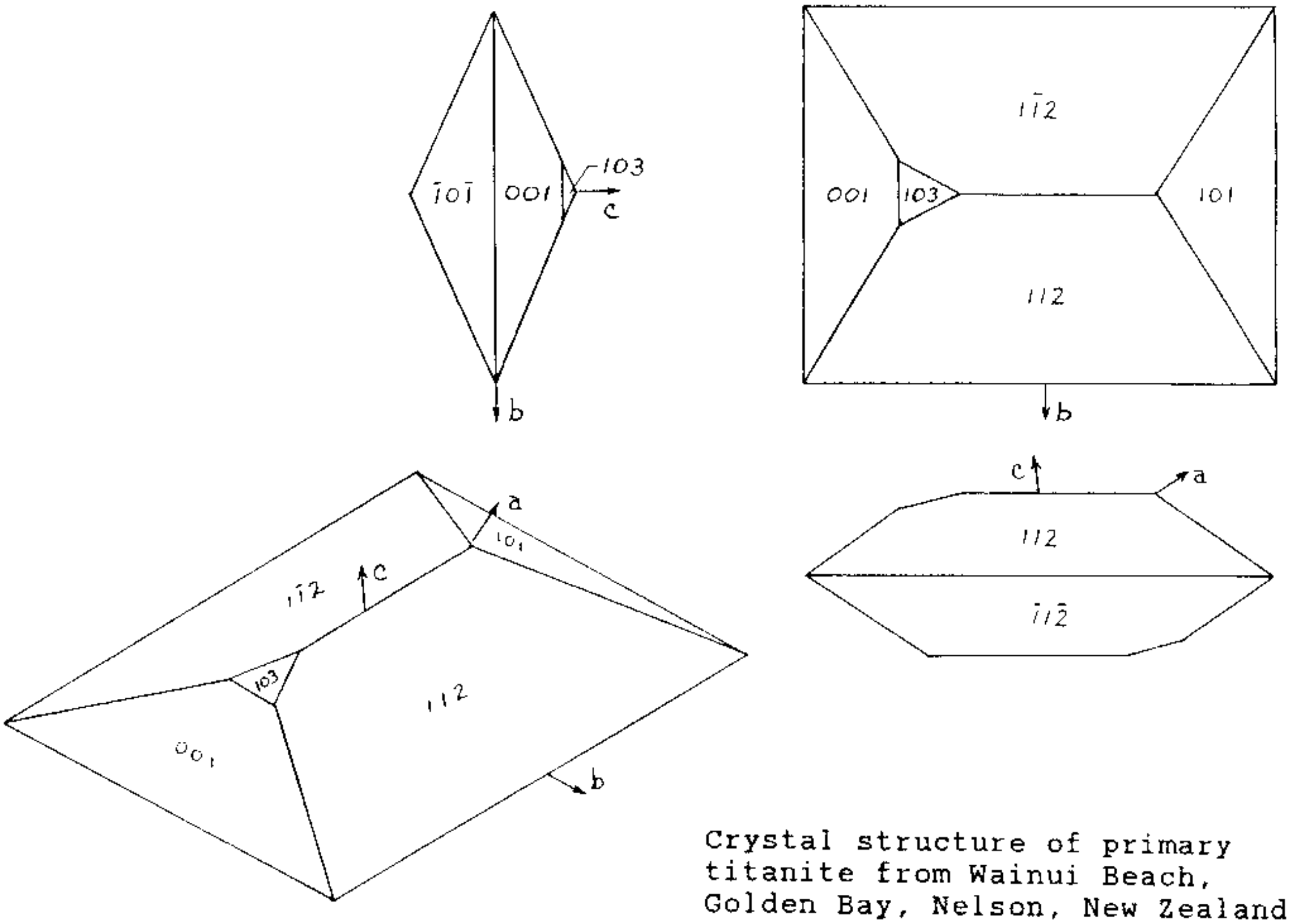
ALLANITE -- Equant habit showing pronounced (110) faces, and clearly depicting the monoclinic crystal shape.

Two New Zealand Occurrences of Titanite

Donald G. Howard

Titanite is a common mineral that occurs in numerous places throughout the world. In its various occurrences, it shows a wide variety of crystal forms. These two occurrences, both from the South Island of New Zealand, feature forms with prominent (112) faces.

Most titanite is of secondary origin, forming in cracks and cavities from the action of ground water. However, titanite can be a primary mineral. At the extreme northern end of the South Island of New Zealand, there is a large area of granite exposed. This has been called the Separation Point Granite after the point of land that extends northward into Cook Strait and divides Golden Bay to the west from Tasman Bay to the east. This golden-colored granite is a prominent feature along the beaches to either side of Separation Point. Collecting of granite specimens containing titanite crystals was done at Wainui Beach on the Golden Bay side of the Point. The beach had an abundant supply of rounded boulders up to about one foot in diameter that could be easily broken. The titanites are golden-brown in color, so they stand out clearly against both the light and dark minerals of the granite. The overall golden color of the granite is provided by mild iron staining.

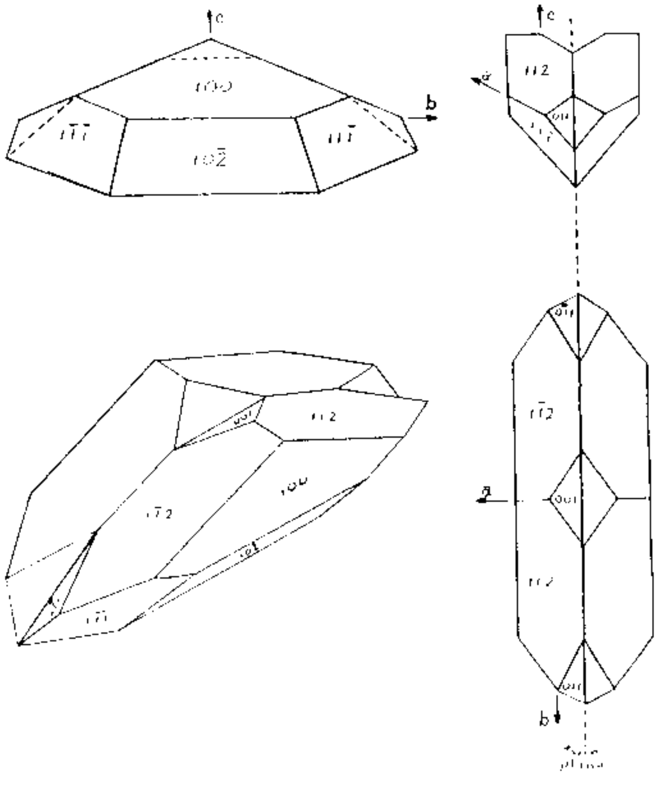


Crystal structure of primary titanite from Wainui Beach, Golden Bay, Nelson, New Zealand

The quartz, feldspar, and hornblend in this granite are in irregular grains with no terminal faces apparent. There are no cavities present where such faces would normally appear. Biotite cleaves easily, so that the hexagonal nature of its crystals can often be discerned. The titanites are embedded in the granite, but normally separate along their faces from the other minerals, so that individual crystals can be observed. These crystals have a complete set of faces, so they must have formed early before the predominent quartz and feldspar had finished solidifying. The only mineral observed to occassionally form inclusions in the titanite is biotite.

The crystals are interesting in that they are elongated, but not along one of the crystallographic axes. Instead the elongation is along the $[20\bar{1}]$ direction, which is the intersection of the predominent (112) faces. This creates a diamond-shaped cross-section that is very flattened. The c-axis is only a few degrees away from being perpendicular to the elongation direction. The ends are terminated by nearly equally developed (001) and (101) faces into a steeply tapered wedge. Most crystals show a small (103) face toward the (001) end of the crystal.

The second interesting occurrence is high in the Southern Alps on a large mass of rock "floating" on the upper part of the Franz Josef Glacier. Cracks are lined with adularia crystals ranging up to several centimeters across, mostly milky and with greenish chlorite inclusions. Scattered on the matrix around, beneath and between the adularia are small, orange-brown titanites, many of which form odd, boatlike twins. The intimate association with adularia and chlorite identify this titanite as of secondary origin.



Form of Twinning in titanite crystals from the Franz Josef Glacier, Westland, New Zealand.

Twinning in these crystals occurs on the (001) plane. The (100) and (10$\bar{2}$) faces are prominent, with (11$\bar{1}$) faces trimming off the ends. The top is completed by (112) faces that are not present on the bottom. Since the (112) faces are within a few degrees of being perpendicular to the (100) plane, the (112) and its mirror image appear as a single, somewhat roughened "face". This is cut along the twin plane by "notches" formed by the (001) and (011) faces and their mirror images. Some other small faces may modify the ends as well.

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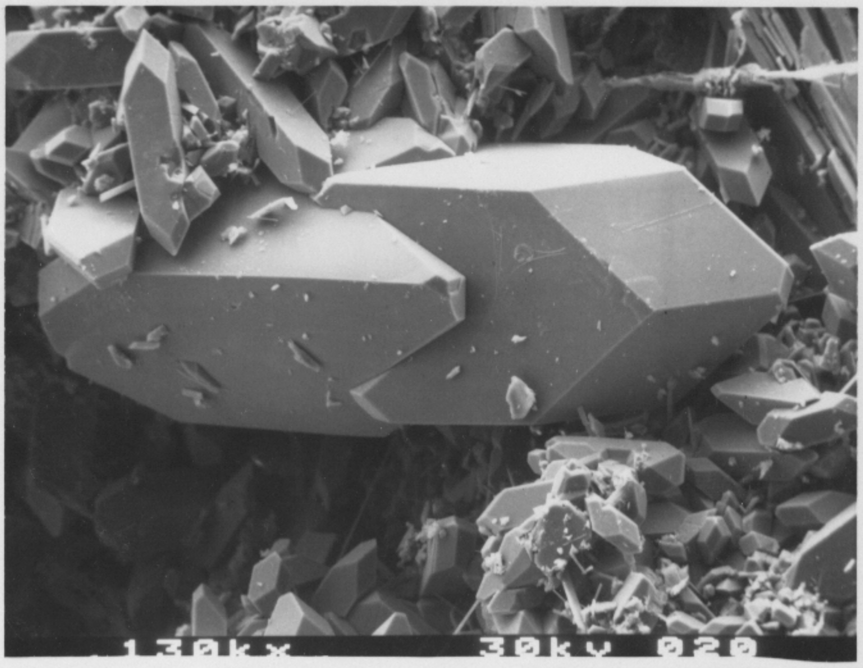
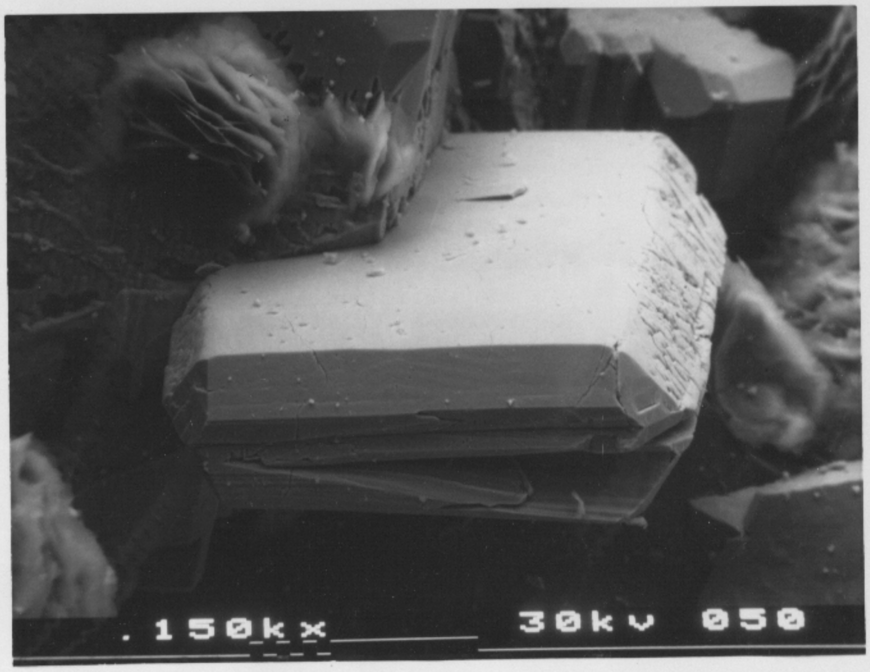
The editor wishes to thank Rudy Tschernich for so ably standing in for the Spring, 1992 issue, and for Evelyn and Chuck Sweany for serving as treasurer during his absence, and for smoothly running the Spring meeting together with Rudy. It is a pleasure to work with an organization where everyone is so willing to pitch in and help.

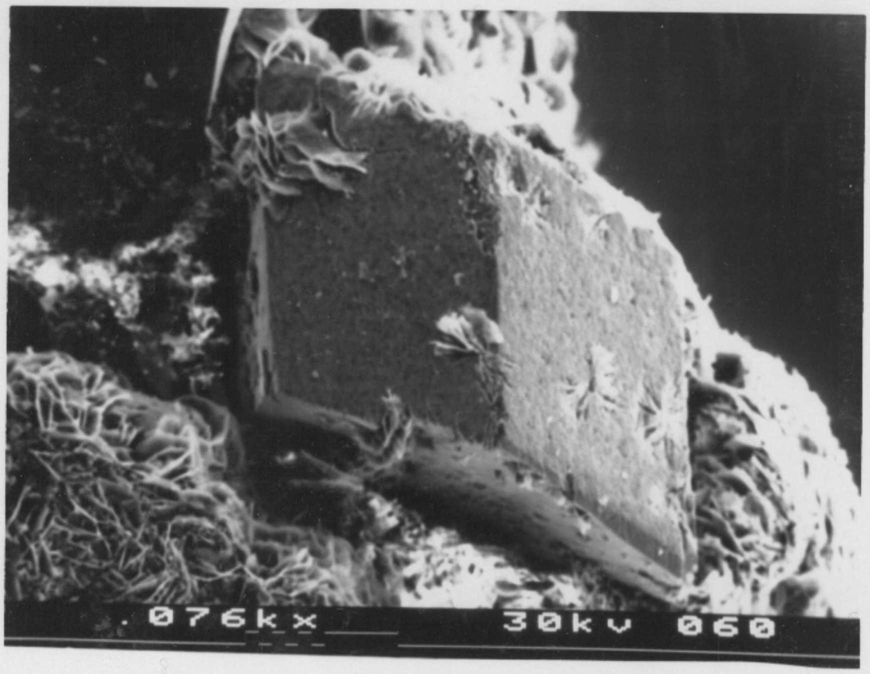
We also are very grateful to Rudy Tschernich and Robert Boggs for articles they have contributed to this issue. Articles related to minerals, mineral locations, or mineral collecting are welcomed. Even though we are based in the Pacific Northwest, interesting and informative articles based on other areas broaden our horizons and are therefore of interest to our group.



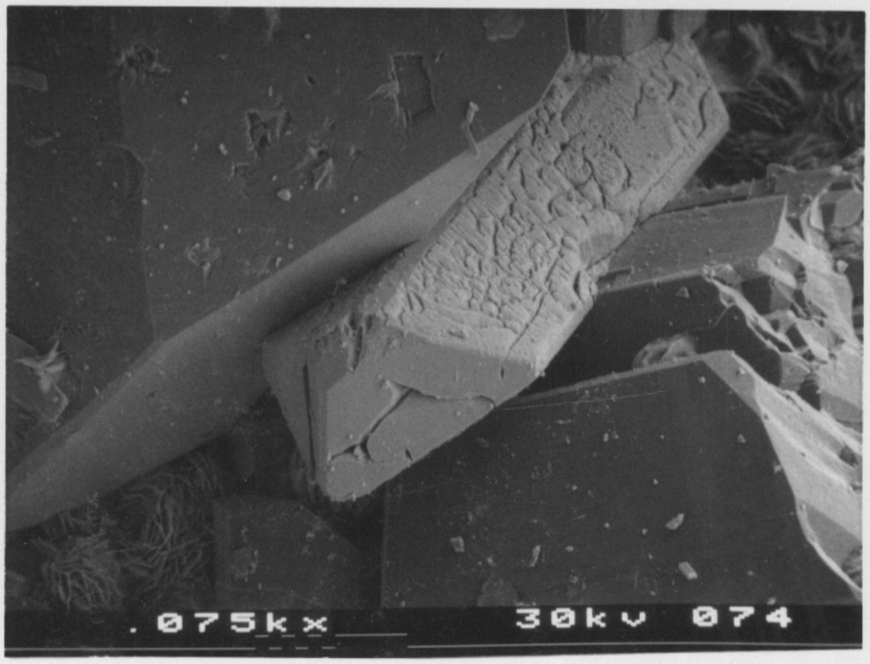
#020 – APOPHYLLITE – OPONONI QUARRY, HOKIANGA HARBOR, NORTHLAND, NEW ZEALAND – 130X



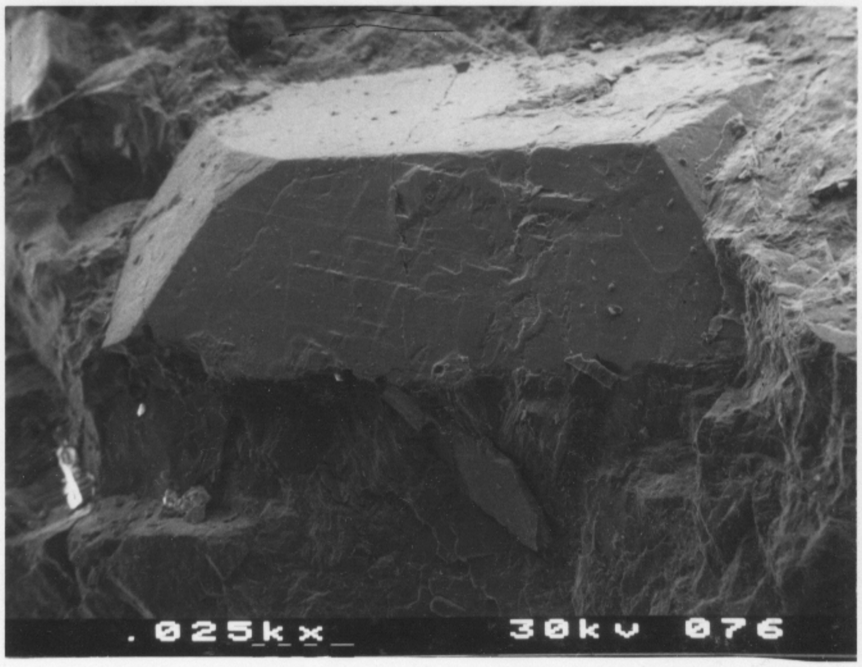
#050 – ALLANITE – LIBERTY BELL, WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 150X



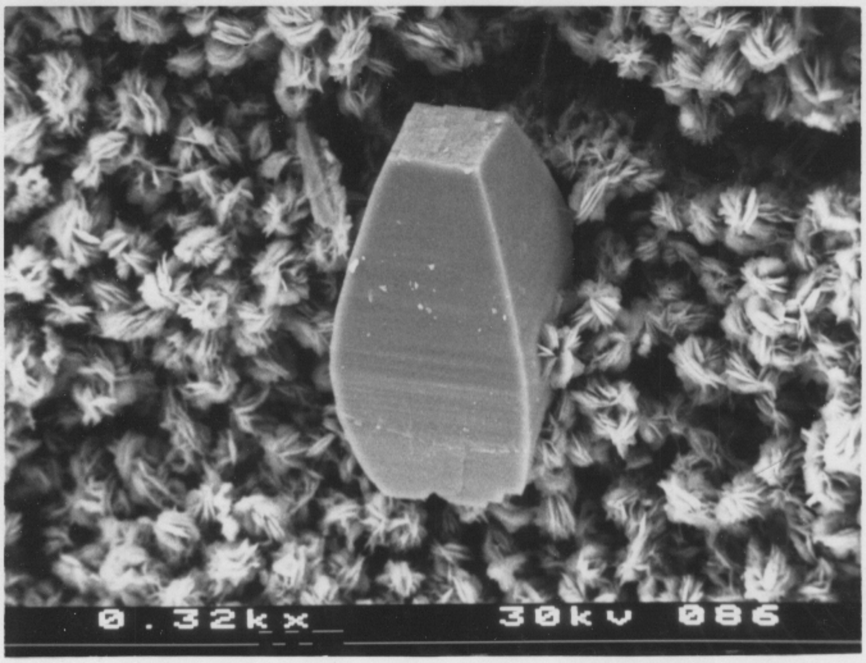
#060 – ALLANITE – LIBERTY BELL, WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 150X



#074 – KAINOSITE – LIBERTY BELL WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 75X



#076 – TITANITE – WAINUI BEACH, GOLDEN BAY, NELSON, NEW ZEALAND – 25X



#086 – TSCHERNICHITE – SANTIAGO de PURSICAL, SAN JOSE, COSTA RICA – 320X