Northwest
Micro Mineral
Study Group

MICRO PROBE

SPRING, 1991 VOLUME VII Number 3

SPRING MEETING ---- VANCOUVER, WASHINGTON

May 4, 1991 10 am to 10 pm

Clark County P. U. D. Building
1200 Ft. Vancouver Way

Time again for our Spring get-together. Bring your microscopes and some new special specimens to share. Also bring some material for the give-away table so that everyone will have something new to take home. Help us spend the day trading minerals, stories, and information about our hobby. Material from Monument will be available, as will identified specimens for examination.

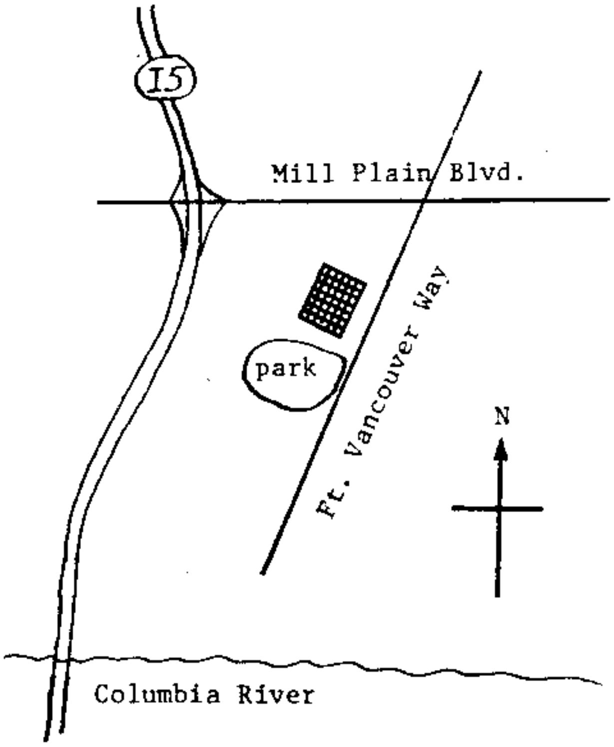
Short business meeting at 1:30 pm, followed by two talks:

Rudy Tschernich will be speaking on "Morphology of Zeolites", using crystal diagrams from his soon-to-be-published book.
Don Howard will be speaking on "Crystal Growth and Twinning"

Pot Luck Dinner around 6 pm. Bring a salad, hot dish, or dessert plus plate, cup, tableware.

Bring slides to show after dinner.

Easy to reach -- approximately 2 miles north of the Interstate Bridge on I5. Take the Mill Plain Blvd. exit and go east to the first intersection. Turn right onto Ft. Vancouver Way. The PUD building is on the right. Ample parking at the south end of the building,where the Auditorium is located.



TECHNIQUES OF MICROMOUNTING

Milton L. Speckels

INTRODUCTION

Micromounts (m/m) may be described as permanently mounted mineral specimens which require magnification and illumination for proper observation.

Microminerals have the perfection and beauty that makes mineral collecting so fascinating. A collection of several thousand m/m's can be stored in a small wall cabinet.

Much material may be collected in the field from road cuts, quarries, mine dumps, mines, and in rock outcrops. Today, there are mineral dealers who specialize in m/m's and some who sell microminerals along with their larger specimens. Lower cost of specimens is certainly an advantage.

Some species or associations of minerals are only available in micro size. Prominent among these are the filiform pyrites.

Micromount symposia and conferences are held annually by a number of organized groups all over the world. A one-day micromount conference is held at the annual show in Tucson, AZ each February. The Baltimore Mineral Society, Southern California Micromineralogists, Northern California Mineralogical Association, Northwest Micromineral Study Group, and others all hold annual and/or semi-annual conferences which include programs and workshops. Most of these groups also hold monthly meetings where they bring their microscopes and trade specimens, and look at each others micromounts.

Generally, more species, better crystallized minerals, and more esthetic specimens are available in microminerals than in the larger sized mineral specimens.

A stereoscopic, wide-field binocular microscope is the most desirable magnifier. You will usually use magnification from 10x to 30x, but magnifications up to 50x are desirable. Anything above 50x will be unnecessary, as depth of field is almost limited to a flat surface. You will never be satisfied with a monocular microscope. Shop around. There are sometimes second-hand microscopes available.

Fiber-optic lights or Tensor desk lamps provide adequate lighting for viewing specimens. The Tensor lamps provide a much cooler light than the usual spot lights sold with microscopes. The fiber-optic lights are very intense cool lights, but they are expensive.

There are no specific rules as to how micromounts should be made unless you enter competitions. For the beginner it is as simple as this: choose a specimen; trim, clean, and glue it to a black pedestal; mount it in a black box; label it; and enjoy the results with a microscope or other magnifier. Make the micromount to suit yourself.

Experience in selection and preparation of specimens, along with pride in workmanship, will improve your techniques. Interest in the specimens will teach you to observe them closer and learn more about them through further study.

Here is a check list of tools and materials that may eventually be useful for micromounting:

For Preparing Specimens:

Diagonal Pliers - 4"	Trim Saw
End Cutters - 8"	X-acto Set
Dental Probes	Assorted Steel Needles
Pin Vice	Toothbrush
Small Hammer	Camelhair Brush
Grinding Wheel	Single Edge Razor Blades
Drying Boxes For Mounts	

Mounting Tools:

- Magnifier
- 10x or 14x Hand Lens
- Tweezers, Straight point - 4 1/2"
- Tweezers Curved point - 4 1/2"

Materials and Miscellaneous:

Plastic Boxes	Abrasive Paper
Black Marking Ink Pencils	Black Enamel
Cement or Glue	Self-adhesive Labels
Corks	Gelatin Capsules
Balsa-wood Sticks	Notebook
Pencil Leads	Plastic Adhesive
Toothpicks	

References:

Drury, Paul O., Jan 1954, The Micromounter's Kit of Tools, GEMS AND MINERALS

Sanders, Francis A., Dec. 1958, Making Micromounts, GEMS AND MINERALS

SELECTING SPECIMENS

Mineralogical and aesthetic aspects are both important criteria for the selection of a specimen. The purpose for which the collection is made will certainly be a factor in the quality of the specimens. Any size crystallized specimen may be considered as adequate for a mount for those who collect in the field. Important things to consider from the mineralogical aspect are crystallization, association with other minerals, inclusions, and physical qualities. Important aesthetic considerations include broken or damaged areas, weathering, color, delicacy, composition, and rarity.

There may also be historical aspects for which a specimen is collected, such as type localities, or locality suites from famous deposits.

Quality certainly is a very important criterion for a micromount. The quality of the final mount is in large measure the result of proper initial selection of the specimen, and the purpose of the collection. Minerals collected in the field from one locality do not always occur in quality specimens, so the collector prepares the specimen for a mount in the best way that he knows. All of my specimens collected in the field are not necessarily quality specimens, but they represent the best I could find. It is better to have a poor specimen than none at all.

If you are in doubt about what should be mounted, the thing to consider is your individual taste or objective in collecting minerals. Think about the almost unlimited variety to choose from. Perhaps crystallography holds a special interest for you. Minerals from historical localities, minerals of one family (i.e., zeolites), minerals personally collected in the field, etc., take work and study to put into a worthwhile collection.

TRIMMING THE SPECIMEN

The specimen you select to mount probably will need to be reduced in size, and broken or damaged material will need to be removed. The specimen should be trimmed to the most appropriate size to show the features that are important.

If the specimen is large, it may be necessary to use a hydraulic trimmer. For smaller pieces, a screw trimmer may serve the purpose. These mechanical breakers vary in size and inventiveness and can either be made or purchased. It takes much experience to learn what to expect when trimming the many types of matrix on which crystals grow. There will be disappointments, so care must be taken at all times. To the author, a specimen almost always appears more attractive if it is on matrix.

Grinding wheels can be used to grind away excess material on a pedestal. The wheels can be used on most matrix specimens.

A diamond trim saw will be useful to get the specimen down to proper size, unless the mineral is soluble or made up of acicular crystal groups, like mordenite. The grit from the saw may also be difficult to remove from some specimens. Again, experience will be the teacher. The diamond saw is best for trimming specimens on a hard matrix. Figure 9-7 shows the steps in cutting a small section from the surface of a large specimen. Always work slowly. Small conbination sawing and grinding units are available from lapidary equipment manufacturers.

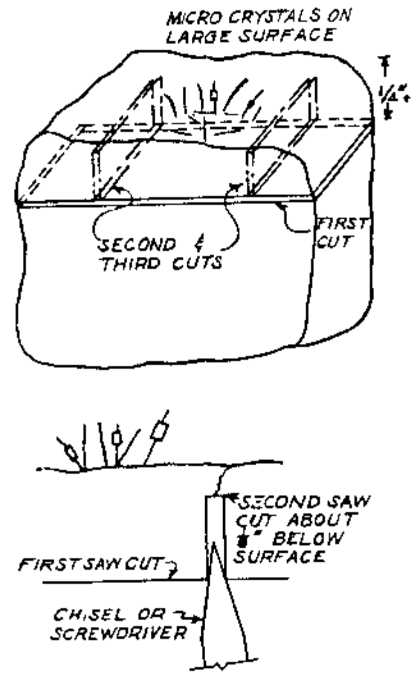


Fig. 9-7. Steps in cutting a small specimen from the surface of a large specimen.

Radiating minerals will break in any direction. Remember that minerals break along cleavage planes. Soft or granular matrix will crumble or break in any direction and only small tools should be used for trimming those specimens.

A sewing needle used in a pin vise or stuck in a wooden dowel will assist in trimming specimens. The needle can be used to pick off broken pieces of crystals or remove other damaged parts. Dental tools are very useful.

A small pair of 4" diagonal pliers or a pair of 8" end cutters are very good for trimming both the soft and hard matrix specimens. The 8" cutters are used for final trimming by many collectors.

It is not essential that a specimen that is large and fragile, or subject to damage by trimming, be trimmed to fit into a small micromount box. Place the specimen in a larger plastic box and still consider it as a m/m.

CLEANING

If possible, a mineral specimen should be cleaned prior to mounting and placing in a box. Cleaning may involve wet washing, dry brushing, treatment with acids, merely blowing on the specimen with the breath or with a syringe, or by the suction of a vacuum cleaner. Always check the cleaning method on a rejected piece of the specimen first, and examine it for damage before subjecting the chosen specimen to the cleaning method. There are too many cleaning methods to consider here, so the details must be read in a mineralogy textbook or other publication.

CAUTION

Chemicals should not be used to clean minerals unless one has the knowledge or experience to work with them.

References: A good guide for cleaning minerals is a book, MINERAL COLLECTORS HANDBOOK, by Richard M. Pearl (1947, Mineral Book Co.) My own book, THE COMPLETE GUIDE TO MICROMOUNTS (1965, Gembooks) is now out of print, but if you can find a copy, it has a few pages devoted to the cleaning of minerals.

MICROMOUNT BOXES

Althor Products, 496 Danbury Rd, Dept. MR, Wilton, CT 06897 is a good source for boxes. You should give careful consideration to the size and type of box you will use. If you will ever want to compete in mineral shows, your micromount box cannot be larger than 1 inch wide by 1 1/2 inches long by 1 inch high. The ALTHOR-P1B box is 7/8 x 7/8 x 3/4 inches in dimensions, and is used by many collectors. The box is available in a clear box with clear lid, black box with clear lid, and black box with black lid. Most micromounters prefer the black box with clear lid.

The plastic boxes can be used as received from the manufacturer. Some collectors prefer to wash the boxes, paint or spray the inside with a flat black enamel, and remove the small burrs (that result from the molding process) on the lid and box. I prefer to also sand the edges of the lid and upper edges of the box by a few circular motions on a piece of 600 grit emery cloth. The boxes are then washed in warm water with detergent added, rinsed, and dried. They are then placed in an original package tray. The groove between the boxes is filled in one direction only with strips of cardboard. Then the boxes are lightly spray painted, just enough to eliminate the glare, with Krylon ultra flat black 1602 enamel. DO NOT use a laquer. Laquer will not stick to the box and pedestals will pull loose when boxes are bumped or dropped. Although I prefer the Krylon, the boxes can be painted with any flat black enamel. Most hobby shops have this available. A 3/8 inch wide sable hair artist's paint brush is recommended if you prefer to hand paint the boxes.

The ALTHOR P-1 clear box can be purchased with black paper liner inserts. These inserts are not as neat as the painted boxes. A stick of wood trimmed to the inside dimension of the plastic box is used to insert the liner. (See fig. 1.)

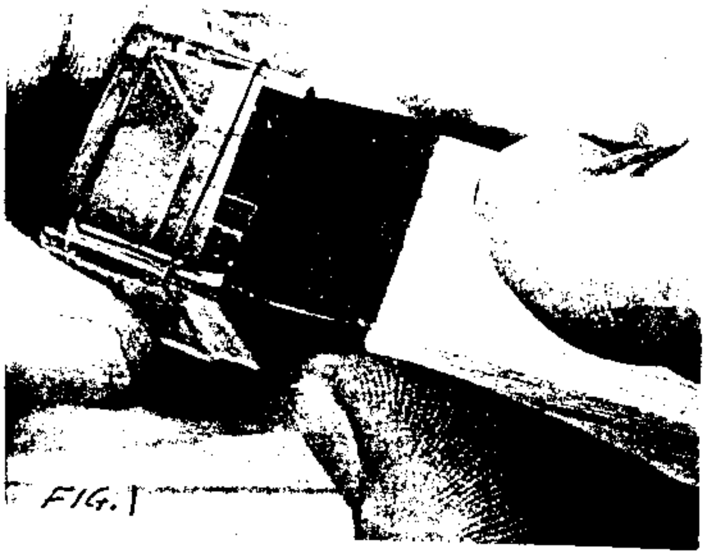


FIG. 1

BASES FOR MOUNTS

A wide variety of materials can be used to make bases or pedestals for micromounts. The variety of materials includes corks, balsa wood, matchsticks, wood dowels, plastic bristles of many sizes, plastic sticks, thumb tacks, small metal rods, cactus needles, pencil leads, and plastic adhesives.

Material for the base must be easy to trim to shape and must not change position by warping, shrinking, or expanding. The base should not be affected by heat or cold. Materials should be selected that can be blackened permanently. The plastic adhesives cannot be blackened, but they are usually used under large specimens where they cannot be seen.

Slender pedestals generally need a supporting base. The longer the plastic bristle and the larger the specimen, the more likely it will be to vibrate. Insect pins and pencil leads require small supports.

The base or pedestal is generally blackened prior to attaching the specimen to it. The sides and top are blackened, but it is not necessary to blacken the bottom.

Small paper discs, cut with a regular paper punch from good quality paper such as business cards, make good mounts for a series of single crystals.

Minerals that are affected by moisture absorption or loss should be placed in small sealed vials or cells. These cells can be made from clear plastic tubing. They can be sealed with clear plastic discs made with a paper punch.

India drawing ink is about the easiest blackening material to use on corks. Place the corks in a small jar and add just enough ink to be able to slosh the corks around. The excess ink can be poured off and the corks emptied onto a piece of window screen. Separate the corks and let them dry. Kodak brushing laquer, dull black, can also be used. It is extremely flammable and must be used in accordance with the instructions printed on the bottle.

Most of the materials used for bases or pedestals can be blackened with india ink, paint spray, or Magic Marker. Choose materials that will result in a permanent mount. If black shoe polish is used on balsa pedestals, be sure it is not the wax variety because wax may grow fine white whiskers after a time.

ADHESIVES

Permanence and holding power are of prime importance in selecting adhesives. The adhesive should set quickly, dry within a few hours, and should be practically insoluble in water. Another consideration is that the adhesive be removable from the specimen before it dries completely. This is especially important if the adhesive is accidently smeared during the mounting procedure where it will be seen.

Duco household cement, Bond 527 multipurpose cement, clear nail polish, and similar products are excellent for gluing the specimen to the base. However, the cements dry with a shiny finish and therefore are not satisfactory for gluing very tiny mounts or single crystals. The cements can be thinned with acetone or laquer thinner.

The white glues are used extensively. There are a number of brands to choose from. They can be disolved in water before they dry hard.

The epoxy adhesives are not as easy to use as other types. They are messy and hard to handle.

The white of an egg should be used to glue an especially soft or crumbly material to a mount. Mineral specimens on a porous limonite matrix may be hard to cement with the usual glues but often stick easily with egg white.

A very tiny amount of any of the adhesives discussed will hold your micromount. If too much glue is put on the pedestal, the excess should be removed before placing the specimen or mount in position. Excess glue detracts from the micromount.

MOUNTING THE SPECIMEN

All of the work that has been put into selecting the specimen, preparing the specimen, the box and the pedestal will now pay off. Mounting the specimen is the part of micromounting that collectors look forward to. Getting that delicate piece of material onto a pedestal and into a box without damaging it requires patience and practice.

Each collector places different values on certain mounting features, so no one mounting method can please everyone. Reading the American Federation of Mineralogical Societies rules and regulations for competitive displays is highly recommended.

Techniques will be developed as a collector handles specimens, and that will result in learning the easiest ways in which to manipulate and mount a specimen. Most material can be handled with the fingers without damaging it. However, fibrous materials should be handled with tweezers or some other grasping device. Very tiny specimens or single small crystals can be mounted by the use of a toothpick: touch the toothpick to the tongue to moisten it and the specimen can be picked up and moved about in this manner. Use a sewing needle or stick pin to pick up soluble minerals: touch the needle to the side of the nose to make it oily before trying to pick up the specimen. Toothpicks and needles can also be used advantageously for positioning very small specimens on a pedestal while working under the microscope.

It is very important to devise a system for labeling specimens so that each one is ALWAYS correctly identified through the trimming, cleaning, mounting and drying procedures. A small label should be kept with the specimen at all times. Positive identification at all times is absolutely necessary.

Another item for consideration at this time is a means of protecting your specimens during the drying period, prior to placing the mounts in the micromount boxes. Some sort of box should be prepared in which to dry the mounts. It is essential that the glue on mounted specimens be allowed to dry before trying to put the mount in a m/m box. The pedestal will need to be cut to the proper length after the specimen is mounted and dried. Otherwise, if cut when the glue is not dry, a specimen may fall off or be out of position when the glue dries.

A cigar box or cardboard box can serve as a storage container while the glue on the mount is drying. (See fig. 2.) A piece of corrugated paper can be cut to fit into the bottom of the container. A grid is drawn on the paper with lines spaced to produce squares 3/4 to 1 inch on a side. 1/2 inch long sequin pins are punched through the corrugated board at the intersections of the lines. Sequin pins can be purchased at dress or hobby shops. The pins protrude about 1/4 inch beyond the cardboard. This permits placing a small identifying paper label over the pin and also setting the pedestal with the specimen on the pin.

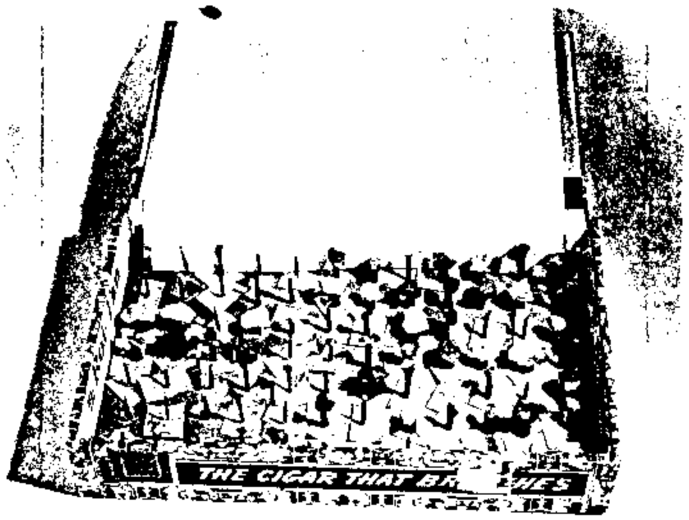
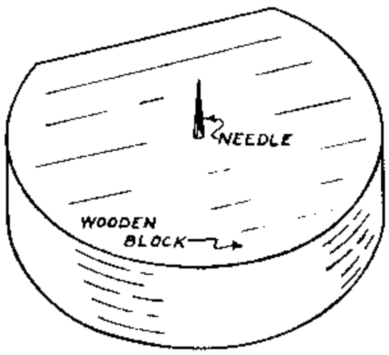


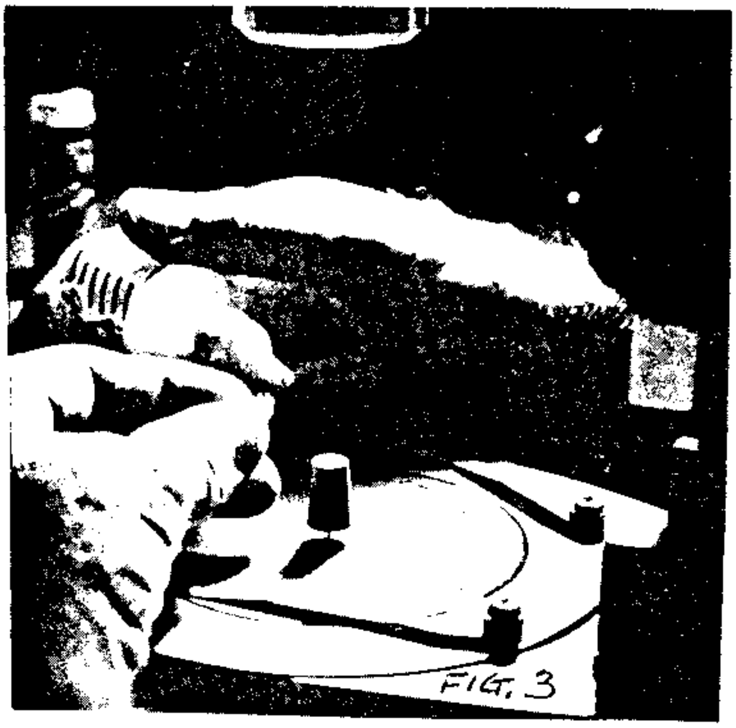
FIG. 2

Another device that may be used while mounting the specimen is a circular piece of wood with a needle or pin protruding at the center. (See fig. 12.2) Cut a piece of plastic or wood the size of the removeable glass in the base of your microscope. Drill a hole at the center and insert a needle so that it sticks out about 1/4 inch. Remove the glass and place this device in the base of the microscope. Your pedestal can then be stuck on the needle and this leaves both hands free to mount the specimen (See fig. 3)



RODEKOHR ORIENTATION DEVICE

Fig. 12-2. Small wood block used to orient specimens before placing them in a micromount box.



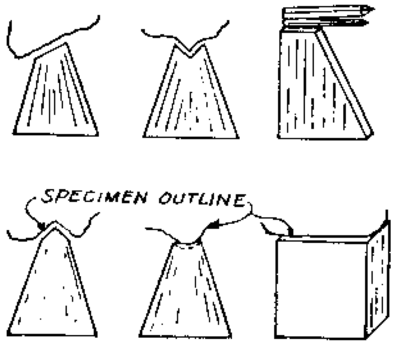


Fig. 12-5. Various cuts made on pedestals or bases. Cuts are made to fit the contour of the bottom of the specimen.

The base of a specimen should be ground flat when possible. The top of the pedestal can be trimmed at any angle necessary, so that, when mounted, the specimen surface can be parallel to the box opening. If the base of the specimen is irregular, the pedestal can be gouged, cut or sliced to fit the contour of the base. (See fig. 12-5) This is not difficult once you have experienced the problem. Always use a pedestal with a base nearly as large as the specimen; otherwise, the mount willtear loose from the box when bumped or dropped. (See fig. 12-3) A pair of pointed or curved tweezers can be used to place the mounted specimen in the box. Look at the mounted specimen under the magnifier and determine the position in which the specimen can be viewed best. There is always such a position. Place the mount in the box so that the chosen position faces toward a side of the box. Center the specimen in the box so about the same amount of space surrounds the specimen on all sides.

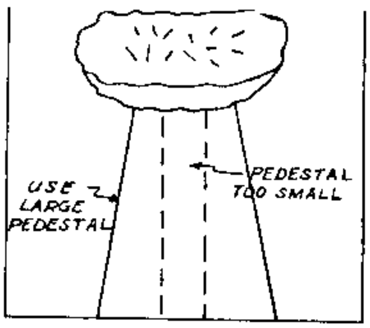


Fig. 12-3. Large specimens should be mounted on pedestals having a base about the size of the specimen. Dotted lines show that a small, straight pedestal would be too small for a large specimen.

Fig. 12-17 and fig. 12-19 show several methods for mounting small single crystals.

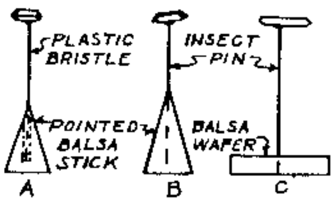


Fig. 12-17. Mounts for very small single crystals.

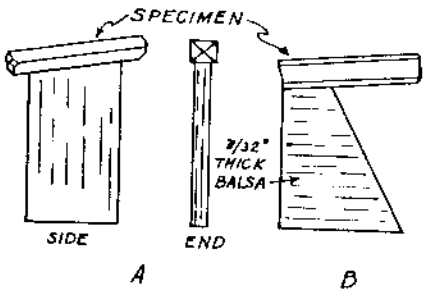


Fig. 12-19. Methods for mounting long single crystals or crystals with inclusions.

After the mount has been placed in the box it should be carefully set aside and left undesturbed until dry. Be sure a label is placed with the box, or that the box is marked with a china marking pencil to assure proper labeling and identification. The mark from the China marking pencil can be easily removed by using a Kleenex or other soft tissue.

CUTTING PEDESTALS TO LENGTH

The mount, when placed in the box, should be just below the rim so it will not be damaged if the lid slides over the top of the box. A uniform height of the mounts also gives a better appearance and prevents unnecessary adjustments of focus when viewing a series of mounts under the microscope.

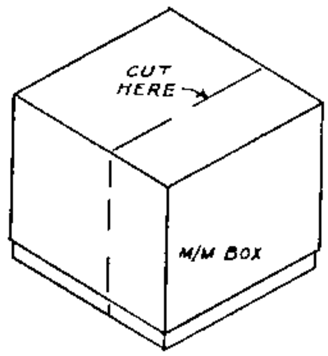


Fig. 12-7. Dashed line shows where to cut plastic box to make a height gauge.

Part of one of the micromount boxes used for your mounts will make a good gauge for cutting the pedestal to the right height (See fig. 12-7) Set the box upside down and with a jigsaw cut it at a mark about 2/3 the width of the box. The larger section should be retained and used upside down. When the pedestal is cut it can be held near the box with a tweezer to determine whether the mount will fit in the box. (See fig. 4) If the specimen does not fit inside, cut off the pedestal a little at a time until the mount can be placed under the box without touching it. This method works especially well with delicate or acicular specimens.

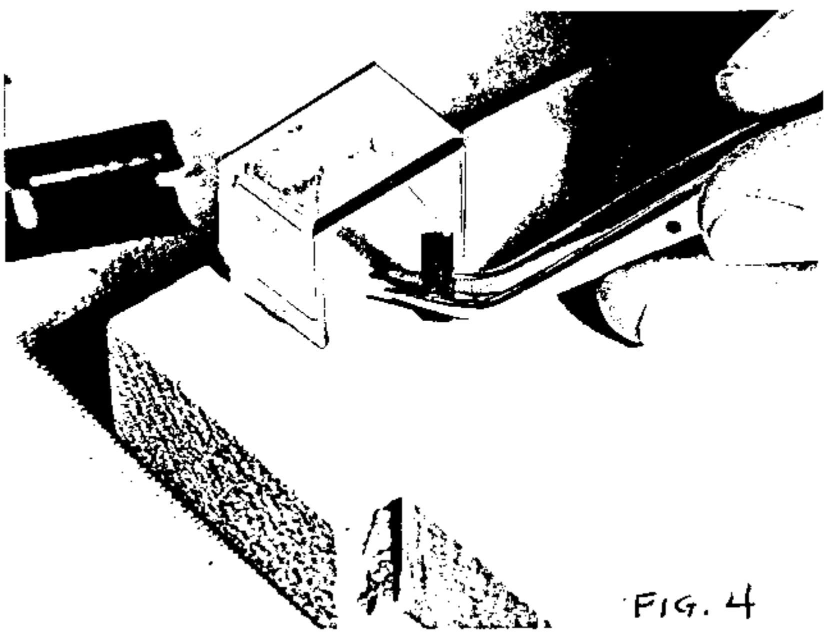


FIG. 4

Another method of cutting the pedestal to the proper length is to use a piece of hardboard with a notch cut into it on the narrow end. The notch should be about 5/16 inch deep. Mounts can be held in the notch with a tweezer and the pedestal cut along the line. (See fig. 5)

There are any number of materials to use as mounts and many ways of mounting the specimen. Only experience will let you decide what techniques suit your particular taste and your pocketbook.

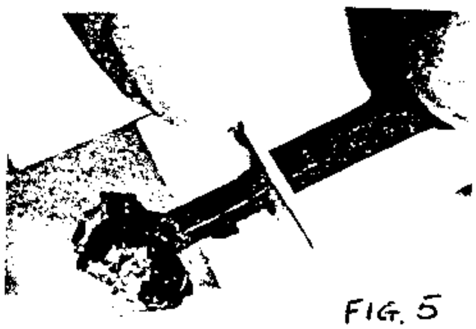


FIG. 5

LABELING

The fact that a label should be kept with the micromount material, and then with the mount as it is prepared, has been emphasized. Now that the micromineral has been placed in the box, the mount is not complete without a permanent label attached to the box.

If you want to enter competitions you should read the uniform rules adopted by the American Federation of Mineralogical Societies prior to making a final decision.

The information placed on a label should contain at least the name of the species and the locality at which it was found. These are the absolute minimum requirements. Some collectors add the chemical description, such as carbonate, arsenate, etc.

The mineral name or names on a label must be spelled correctly. Also, the location should be accurate. Use Fleischer's GLOSSARY OF MINERAL SPECIES or a good mineral book.

The amount of information on a label will be determined by where the label is attached to the box, the type of label, and whether the specimen is intended for entry in competitive displays. A single label with the mineral name on the top of the box plus a label with the name and additional information on the bottom or side of the box is generally used.

Having made the choice of where to place the label or labels on the box, the collector should think of a way in which to prepare the label. Hand-lettered, typed, photostatic, photographic, or printed labels are all used.

Hand-lettered labels are the most widely used. A "crow quill" draftsmen's pen or KOH-I-NOOR pen can be used with black India ink on labels. Painting the bottom of the box with white enamel and then hand-lettering the label in black ink is practiced by a few micromounters. Testors white ink can be used with the "crow quill" pen to print labels directly on the plastic box.

Avery self-adhesive full sheet labels (#5353) can be prepared by plain bond copiers. Labels of the desired size and the mineral information can be drawn in ink to the exact size on bond paper. This master can then be copied on any copier. The label will have to be cut and then attached to the box. This is a very efficient way of preparing and using labels prepared by hand-lettering, typewriter, or computer. This method is very practical when many labels need to be prepared for minerals from one location. In this case, only the location information is put on the label, copies are made, and the rest of the information is added as needed. Initials are sometimes placed on the box along with a number or letter for further identification. Costs for this type of label are minimal because you can get 100 labels per sheet. Also, these self-adhesive labels appear to stick permanently if rubbed on properly.

CATALOGING AND INDEXING

Cataloging your specimens provides a permanent record of your collection. It can also be a means of recording vital information you cannot put on the label. You may want to know if you traded, purchased, or collected this specimen. There may be a certain distinct association of several minerals. These and other data may be useful to you or others in the future.

A bound book is a prefered means of recording a collection. An 8 1/2 x 11 inch ruled notebook can also be used, but the added sheets should be bound together.

Indexing a collection will help you find a specific specimen easier. Generally, only the mineral name, number, location, and a note about unusual traits is all the information that needs to be put into an index. This can be accompanied with cards or a loose-leaf notebook.

For small collections a 3" x 5" or 5" x 7" card can be used for each mineral. For example, all quartz specimens can be recorded on one or more cards. For larger collections the minerals can be recorded under A, B, C, etc. by numerical order on 8 1/2" x 11" sheets in a loose-leaf notebook with alphabetically indexed separators.

The best way to catalog and index your collection is by computer. If you have a computer you should be able to find software that you can use to set up information about your collection. You should be able to index by single mineral, alphabetically, by mine, mining district, and many other ways.

Your local library may have a computer that you can use. Friends who have computers can provide information about ways to catalog and index a collection. You may even be able to find a high-school student willing to catalog the information.

Talk to experienced micromounters about their way of recording vital information concerning their collection. Collectors are usually glad to talk about how they accomplish the many facets of micromounting.

STORAGE

The storage of a micromount collectionn should be a minor problem. In fact, one of the major attributes of micromounting is that the mounts require so little space. Carboard boxes, purchased or hand-made, can be used for storage. As the collection grows, it may be desirable to purchase or construct a cabinet.

Light affects many minerals; therefore it is advisable to keep the micromount boxes in covered storage boxes or in a closed cabinet.

There are numerous ways in which your collection may be stored. Storage can be arranged by mine, alphabetically by single mineral, by mining district, by state, by Dana's System of Mineralogy, and by many other specific ways. One thing to keep in mind is a method of retrieving a specific specimen. One method is to give each mount a number and store them in numerical order.

Most of the information in this article has been taken from my book, THE COMPLETE GUIDE TO MICROMOUNTING. Micromounting is an especially enjoyable hobby to me. I hope this information that has been accumulated over a period of 40 years may be of some help to you.

Zeolite associates -- GYROLITE

D. G. Howard

Continuing our series on minerals associated with but not actually zeolites themselves, this issue of the Microprobe features Gyrolite. Like the mineral Apophyllite, which was presented in the previous issue, Gyrolite is a calcium silicate that contains no aluminum, though again it contains a considerable amount of water, some of which is zeolitic in nature (i.e., loosely held). The formula is given as

$$Ca_4 (H_2O)_4 (Si_6O_{15}) (OH)_2$$

Chemically and structurally, it is closely related to Okenite, though slight differences in the calcium content between the two minerals apparently lead to great differences in their morphology.

Like the zeolites, Gyrolite is composed of an interlocking silica network. In this case, the silica tetrahedra are joined by edges into planar nets containing five-sided and eight-sided rings. This leads to a structure that prefers to form in flat sheets. The symmetry seems to be triclinic, but with axes and angles so nearly the same that its is very nearly trigonal. For this reason, it is usually described and indexed in the hexagonal system. The cell parameter in the plane is a = 9.72 A. The stacking of planes is very complex, so that the repeat distance seems to be c = 132.8 A. However, most of the x-ray reflections and all of the observed externally-formed planes correspond to 1/6 of this distance, so for the sake of drawings and indexing in this article, we will use c = 22.13 A.

Individual crystals of Gyrolite are usually extremely thin. For this reason, the edges are often tattered and irregular. Thicker crystals, such as some of those found at Monument, show a hexagonal outline with alternately beveled edges. This amounts to a rhombohedron that is truncated by c-faces as shown in the diagram on the next page. The rhombohedral faces are strongly striated parallel to the c-face. The habit of Gyrolite is to form groups of nearly parallel plates that form rosettes. Thin-bladed groups appear white, or brownish if stained by an iron-containing clay. Thicker blades have a clearer, glassy appearance.

Gyrolite forms in basalts in the Northwest, together with Apophyllite, when the concentrations of aluminum are low. It is often a later mineral in formations where zeolites have already formed. Most of the zeolite locations in Grant Co., Oregon, have Gyrolite and Apophyllite (usually in that order) forming near the end of mineralization. Specimens are readily collected at Big Bend, Kimberly and at Stony Creek, No. Fk. John Day River, where the Gyrolite clusters are on Phillipsite; associated minerals include Analcime, Apophyllite, and Tacharanite. At Stony Creek, Gmelinite is also an associate; sprays of Gyrolite blades often fill the hollow ends of the Gmelinite-Chabazite overgrowths. The best specimens of Gyrolite probably are found at Monument, where the base mineral is Analcime and the associates are Natrolite and Apophyllite.

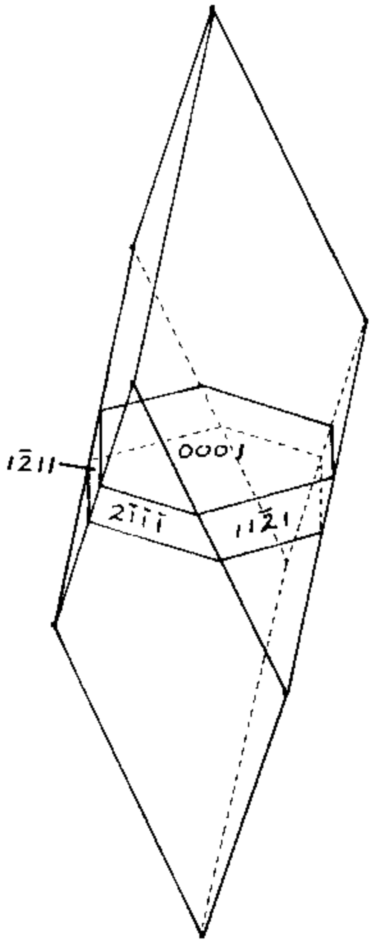
An aluminum-deficient phase may also occur early in the mineralization of a basalt. At Monument and at Pete's Point, Wallowa Co., Oregon, white hemispheres of Gyrolite form a thin patchy crust under clear Analcime. If similar primary Gyrolite forms under less transparent later minerals at other locations, it would be very difficult to detect or identify.

Typical habit of Gyrolite, showing the rhombohedron truncated by hexagonal basal planes. The diagram is drawn and indexed using the parameters for Gyrolite:

$a = 9.72$ A

$c = 22.13$ A

See Micrograph #008 for a view of a group of such crystals in parallel growth.



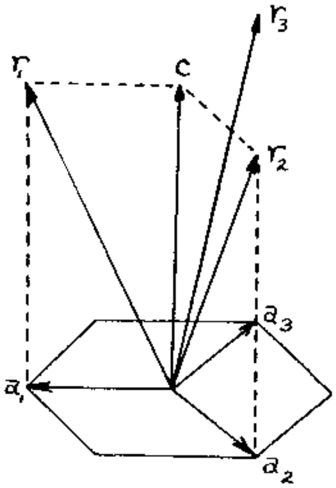
CRYSTAL SYSTEMS: Hexagonal, Trigonal, and Rhombohedral

D. G. Howard

The designation of most crystal systems is rather straightforward, and most authors agree at least on the system even if the parameters describing the unit cell are sometimes different. However, for crystals of basic hexagonal symmetry, the description will sometimes be trigonal or rhombohedral instead, which can be confusing.

To begin with, the words trigonal and rhombohedral are synonyms. They describe a crystal system with three equal axes that make equal angles to each other. (Since cubic is three equal axes at 90° to each other, 90° is excluded.) The basic prism associated with such a system is a rhombohedron. If the angle is only a few degrees away from a right angle (as it is for the mineral Chabazite), the crystals appear pseudo-cubic. As the angle decreases, the rhombohedron appears more elongated (as for instance with calcite). The basic rhombohedron will be very elongated for a mineral like Gyrolite (discussed in a separate article in this issue).

The trigonal system is often used to emphasize the over-all three-fold symmetry of the crystals, while for crystals that exhibit six-fold symmetry, a different set of axes are usually employed. This is the hexagonal system. The six-fold symmetry axis is designated the c-axis. In the plane perpendicular to the c-axis, lie two other axes of equal length, 120° apart, designated the a-axes. Usually a third a-axis is added to accentuate the symmetry, but it is really redundant, since only three axes are necessary to describe three-dimensional space.

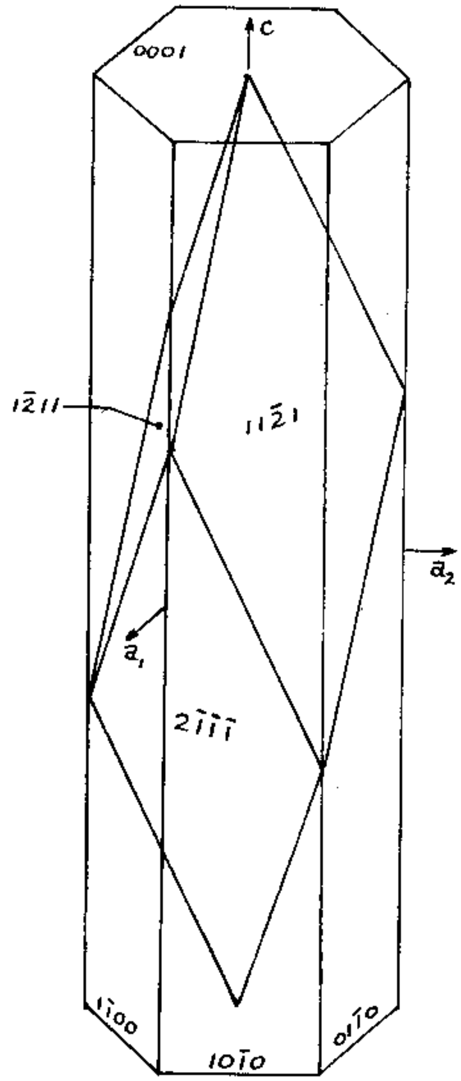


The two systems are, in fact, interchangeable, and the diagram at right shows the relationship of the axes. The vectors marked r_1, r_2, r_3 are the trigonal representation of axes. The hexagonal vector c lies along the three-fold axis equidistant from each of them. The hexagonal vectors a_1, a_2 are the projections of r_1 and r_2 onto the plane perpendicular to c (as shown by the dashed lines).

Minerals which usually form hexagonal prisms, such as Quartz, Apatite, and the zeolites Erionite and Gmelinite, are normally described as being hexagonal. The indices used to name crystal faces are almost always quoted in a hexagonal system for all these minerals, trigonal as well as hexagonal. Because there are three a-axes and a c-axis, four numbers are generally given, in the order a_1, a_2, a_3, c. The basal plane becomes [0001], while the six faces of the hexagonal prism are $[10\bar{1}0]$, $[01\bar{1}0]$, $[\bar{1}100]$, $[\bar{1}010]$, $[0\bar{1}10]$, $[1\bar{1}00]$. The redundancy of a_3 is reflected in the fact that the first three numbers always add to zero, so the third number can easily be determined from the first two. For this reason, hexagonal indices often simply put a dot in place of the third number, such as [00.1], [10.0], [01.0], etc.

The figure below shows the shape of the rhombohedron in relation to the hexagonal prism. The six faces of the rhombohedron shown, given in hexagonal notation, are [1$\bar{2}$11], [11$\bar{2}$1], [2$\bar{1}\bar{1}\bar{1}$], [$\bar{1}$2$\bar{1}\bar{1}$], [$\bar{1}\bar{1}$2$\bar{1}$], [$\bar{2}$111]. A second rhombohedron, rotated 60° from the one shown, would have [2$\bar{1}\bar{1}$1], [$\bar{1}$2$\bar{1}$1], [$\bar{1}\bar{1}$21], [$\bar{2}$11$\bar{1}$], [1$\bar{2}$1$\bar{1}$], [11$\bar{2}\bar{1}$]. Because there are two orientations of figures in trigonal crystals, when numerous faces are present it is possible to have different combinations, such as the case in typical crystals of Calciohilairite; these are then described as right-handed and left-handed. (See the crystal drawings in the article on the Minerals of the Golden Horn in this issue.)

The minerals featured in this issue of the Microprobe are primarily hexagonal or trigonal. Read on for more examples of the complexities that can arise in such systems.



Showing the relationship between the basic hexagonal prism and the rhombohedron, here shown inscribed within. Principal hexagonal axes are shown, and the indices are referred to them.

ZEOLITES AND ASSOCIATES AT MONUMENT, GRANT COUNTY, OREGON

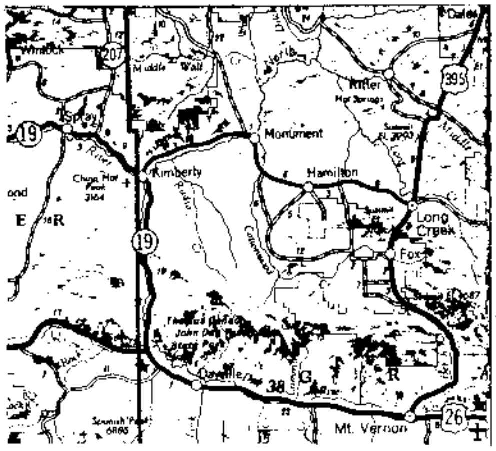
Donald G. Howard

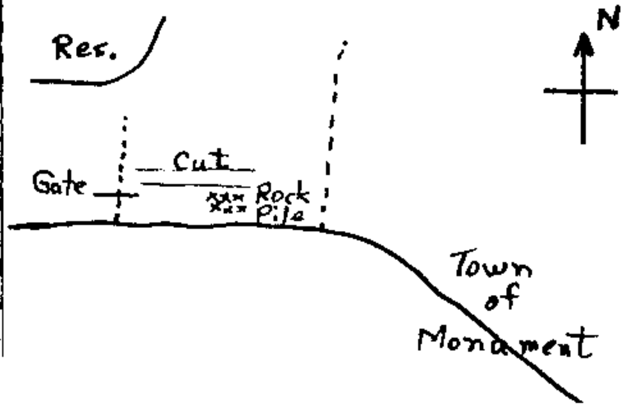
The collecting site at Monument, Oregon, has provided collecting opportunities for many years, but it is still a profitable place for the collector with a large sledge and a lot of enthusiasm. Unlike many of our collecting spots, it is possible to find large, showy specimens as well as fine smaller cavities in the course of an afternoon.

As the map below shows, the collecting site is just west of the settlement of Monument, which is midway between Kimberley and Long Creek on the road joining them. The site is just north of the road as it leaves town through a cut in very black basalt. It is so close to town, in fact, that on a nice day you can hear the calls of children on the school ground as you work. The best place to stop is at the west end of the cut, where a dirt access road goes off toward a small reservoir visible a few hundred feet to the north.

Just in from the road there is another cut through the knoll. I have no idea what its purpose might have been. It is only about ten feet wide, and runs parallel to the road. The rock walls toward the center of the cut show cavities, often a foot or more in length, lined with the remnants of a Natrolite lining. This region could probably produce some fine specimens if enough effort was expended, but time is probably more profitably spent in the boulder pile between the cut and the road toward the east side of the knoll. Here chunks of all sizes lie jumbled together just waiting for a hammering.

The basalt is very tough and breaks only very reluctantly, so points and heavy hammers are the tools to use. The rock is dense enough that any cavity not already open will most likely have fresh material inside it. Most of the cavities are filled with a fine, hairlike lining of natrolite, often with other minerals embedded within it. Cavities without natrolite usually are lined with very clear analcime, which glitters and looks black from the basalt beneath, there being very little smectite lining in most cavities. Unfortunately, many cavities are nearly filled with a late, heavy mass of montmorillonite that effectively ruins the specimens, as it is not easy to clean off.





Minerals present, in the order of formation, are:

SMECTITE -- is not common as cavity-linings. In the specimens where it is present, it usually only partially lines the cavity, and sometimes shows a gravity terrace at one side. In color, it is a rusty brown.

PHILLIPSITE -- is a rare zeolite at Monument, and only recently recognized. It forms as an extremely fine-grained clear layer lining cavities. Since the crystals are clear, it has a black, glittery appearance much like the analcime, and close observation at a reasonably high magnification is required to identify it. Apophyllite, when found on it, has the unusual {100} and {210} faces described in the Fall, 1990 issue of the Microprobe. In cases where analcime may have formed over the top, the layer of phillipsite is very hard to discern.

GYROLITE(first generation) -- occurs as small radial hemispheres of white, fine-grained blades, almost always covered by clear analcime. This material is usually directly on the cavity wall, or on an extremely thin smectite layer. In one specimen it has formed between the phillipsite layer and the analcime.

ANALCIME -- is the primary drusy mineral lining cavities. It is extremely clear, so that it takes on the color of the backing material: creamy white with gyrolite underneath, otherwise black. Individual crystals are of the standard trisoctahedral (scalenohedral) habit, and vary considerably in size. Separate individuals are not observed; they are always intergrown to line the cavity.

NATROLITE -- grows in radial tufts from the walls. Crystals vary from very fine hairs to individuals up to 1 mm across. Natrolite clearly grew on the analcime; when a crystal intersects the analcime lining, it end abruptly. None of the analcime show inclusions of natrolite, only the white gyrolite layer underneath. This location is unusual in that there is no evidence of mesolite or scolesite intergroth, nor is their any thomsonite at the base of the natrolite tufts.

GYROLITE(second generation) -- forms the lovely rosettes, such as the one shown in the micrographs in the issue. The clusters are often several millimeters in diameter, and the thicker platelets have a clear appearance and discernable hexagonal outline. Groups occur scattered on analcime, or deeply buried in the natrolite lining with individual natrolite needles emerging from them.

APOPHYLLITE -- forms clear, rather tabular crystals. In cavities that are filled with analcime or natrolite, the habit is the normal one of prism with corners bevelled by octahedral faces. Modified cubes of this type have been found up to a centimeter across. Like the secondary gyrolite, they form over the natrolite, so that the needles come bristling out of the surface. Crystals found on the phillipsite lining are of the unusual, almost round habit described in the last issue.

MONTMORILLONITE -- is a whitish, clay mineral with a somewhat greasy feel to it. In some cavities it forms a very light dusting on the faces of the analcime, while in others it nearly fills the cavity, effectively ruining them as specimens, as it is not easy to remove.

In addition to the above, two late minerals represented by one specimen each have been observed:

CALCITE -- is not at all common at Monument. One crystal, beer-bottle brown in color, has been found on a phillipsite lining, leaning against an apophyllite crystal.

TACHARANITE or TOBERMORITE -- again, in one specimen, has been found as small, white porcelain-like masses on an analcime lining. Not enough material exits to sacrifice for testing to find out which member of the group it might be.

The basalt at Monument is interesting in a number of ways. To date, the list of minerals identified is much smaller than at the other Grant County zeolite locations. This basalt appears to lie below the John Day Formation, while all the other locations are just above. It is possible that Monument represents feeder-dikes to the basalts above, and that for that reason has a slightly different composition or has cooled slower and therefore presents a different environment for zeolite formation.

MINERAL ASSOCIATIONS OBSERVED AT MONUMENT, OREGON

base mineral

	Smectite	Phillipsite	Gyrolite (#1)	Analcime	Natrolite	Gyrolite (#2)	Apophyllite	Montmorillonite	Tacharanite (?)	Calcite
Phillipsite		•								
Gyrolite (#1)	✓	✓	•							
Analcime	✓	✓	✓	•						
Natrolite				✓	•					
Gyrolite (#2)			?	✓	✓	•				
Apophyllite		✓		✓	✓	✓	•			
Montmorillonite				✓	✓	✓	✓	•		
Tacharanite (?)				✓					•	
Calcite		✓					✓			•

Minerals of the GOLDEN HORN Batholith -- Part III

Donald G. Howard

This issue, we feature two new minerals that were found and named from the miarolitic cavities of the granites at Washington Pass, Okanogan County, Washington.

CALCIOHILAIRITE

This mineral is a hydrated calcium zirconium silicate:

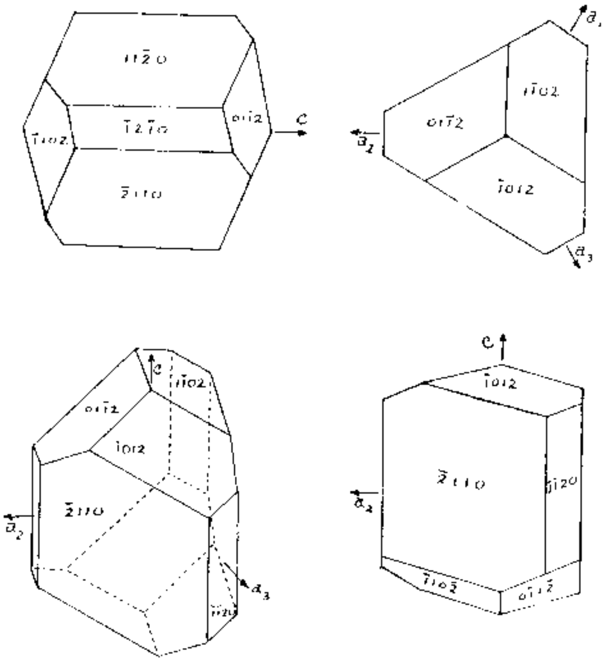
$$Ca\ Zr\ Si_3\ O_9 \cdot 3\ H_2O$$

As the name implies, it is the calcium analogue of the mineral Hilairite, from St. Hilaire, Quebec, which is the corresponding hydrated sodium zirconium silicate.

Calciohilairite is basically a white mineral, but can be colored pale blue if copper replaces a part of the calcium. It forms as trigonal prisms with terminations composed of rhombohedral faces of the class $\{1\bar{1}02\}$. The basic crystal shape is shown in the diagram below, and is well illustrated in photograph #1 in the illustrations accompanying this issue.

Notice that in general, the two sets of prism faces are not equally developed, as they would be in a hexagonal crystal. As a result, there are no mirror planes in the symmetry elements for this material. Thus, the mirror image of the diagram below cannot be rotated to coincide with it. Thus, two distinct forms exist for this material, called right-handed and left-handed. The diagram below illustrates a left-handed crystal similar to the one shown in the photograph. The right-handed crystal would be the mirror image of this.

Calciohilairite has been found in miarolitic cavities in the border granite phase at Washington Pass. The crystals are normally growing on Microcline or Quartz and are in association with Clinochlore, Zircon, Bastnaesite, and Malachite.



Crystal habit of Calciohilairite

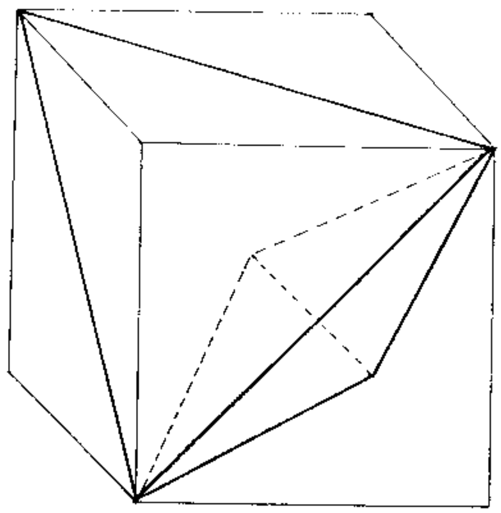
OKANOGANITE

Okanoganite is a rare earth boro-fluoro-silicate:

$(Na,Ca)_3\ (Y,Ce,Nd,La)_{12}\ Si_6\ B_2\ O_{27}\ F_{14}$

The crystals are yellow to tan to pinkish in color. The mineral is found as small tetraheda in miarolitic cavities in the arfvedsonite granite phase at Washington Pass, growing on Microcline and Quartz and in association with Zircon, Arfvedsonite, Bastnaesite, Zektzerite, Astrophyllite, and Polylithionite.

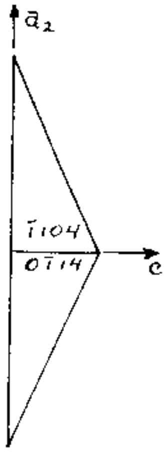
Interestingly, Okanoganite is not cubic at all, but trigonal. To see how this comes about, consider the diagram at right, showing the relationship of the cube to the tetrahedron in an isometric system. Broken lines, connecting the center of the cube to three adjacent corners define a small, flat pyramid with a triangular base.

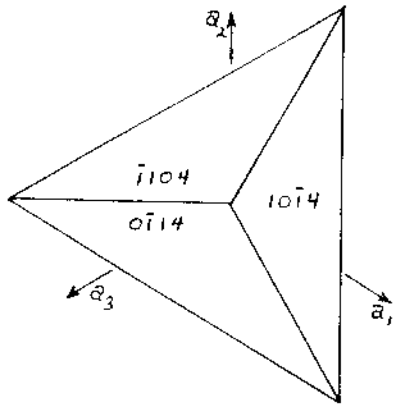


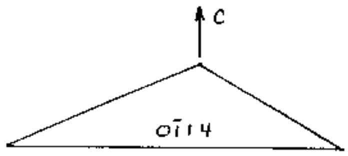
Relationship of the tetrahedron to the cube.

For such a pyramid to form in trigonal system, the ratio of the c-axis length to the a-axis length needs to be 0.6124. The same ratio for Okanoganite is 2.523 ± 0.010. One fourth of the Okanoganite ratio, 0.631, is apparently close enough to the ideal ratio that the corresponding rhombohedron, truncated by the basal plane, forms the basic building block for crystals of Okanoganite. The diagram below shows such a pyramid.

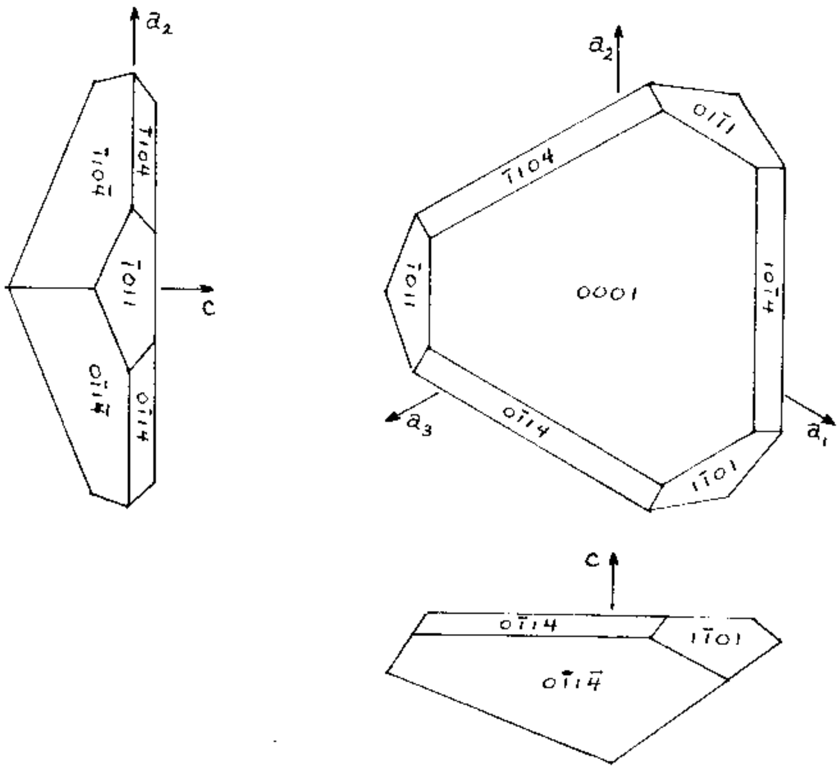
The crystal of Okanoganite is thus composed of four such pyramids with tips touching at a common point. Rarely, other faces, primarily the rhombohedral faces of order {$\bar{1}$104} are present as bevels along the edges of the tetrahedra. Very rarely, the corners may be beveled by the lower order of rhombohedron {$\bar{1}$011}. Micrograph #038 in this issue's photos shows such a crystal, though only one of the {$\bar{1}$104} faces is present. The basic building block to



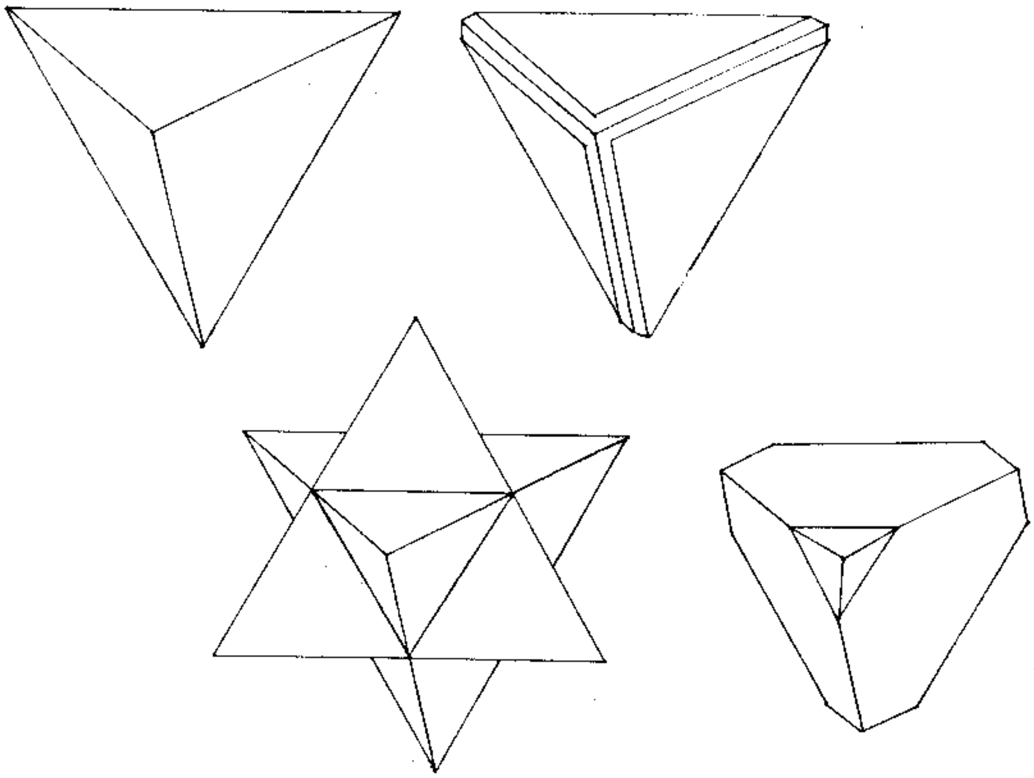




such a tetrahedron is shown in the diagram at the right.



Another possible twin that can form is based on a complete central rhombohedron with three twins to the top apex and another three twins to the bottom apex. Such a "penetration twin" is shown in the lower left illustration below and in the small penetrating crystal in the center of the group illustrated in Micrograph #003.



Various forms of crystals for Okanoganite.
Upper left: The normal fourling twin
Upper right: Edges beveled by {1104} rhombohedra
Lower left: Penetration twin sevenling
Lower right: Corners modified by {1011} rhombahedra

CAPTIONS TO THE PICTURES ACCOMPANYING THIS ISSUE

Note: Numbers are on the back for optical photographs, in the lower right corner for electron micrographs.

#1 Calciohilairite on Clinochlore (x 30)
Washington Pass, Okanogan Co., Washington
Optical photograph of a group of intergrown trigonal prisms. The text article explains the orientation.

#003 Okanoganite and Euxenite on Microcline (x 45)
Washington Pass, Okanogan Co., Washington
A group of typical tetrahedra fourlings. The small crystal in the center of the group is a penetration twin. Other small crystals with rough faces on the right edge are Euxenite.

#038 Okanoganite on Microcline (x 80)
Washington Pass, Okanogan Co., Washington
An unusual crystal showing rhombohedral {$\bar{1}011$} faces truncating a corner. A single rhombohedral {$\bar{1}104$) face is visible at the top of the crystal beveling the edge of the left member of the twin group.

#2 Apophyllite on Natrolite (x 4)
Monument, Grant Co., Oregon
Natrolite needles come bristling out of a single clear Apophyllite crystal of the normal habit -- prism with small beveled corners.

#008 Gyrolite on Analcime (x 43)
Monument, Grant Co., Oregon
Parallel growth of thickened blades. The alternating slopes on the edges of the hexagonal plates show the rhombohedral influence. Some much thinner blades are visible at lower left.

#044 Boulangerite on Quartz (x300)
Van Silver Claim, Whistler, British Columbia
One of the tiny hollow tubes perched on the termina-tion of a Quartz crystal. Boulangerite is normally a hairlike mineral. Here the hairs seem to wind around for some reason into a tiny coil.

#764 Erionite on Smectite (x 80)
Moeraki, North Otago, New Zealand
A spray of perfectly clear hexagonal prisms on a background of cracked, black smectite.

#760 Analcime on Cowlesite (x111)

Neer Rd., Goble, Columbia Co., Oregon

Numerous small crystals growing exitaxially on an original Analcime crystal. The shape of the face of the original crystal is still discernable. Parallel growths of this type generally result when the surface of a crystal becomes sufficiently contaminated that only a few scattered points can continue to grow, each becoming an individual crystal on its own but retaining the general over-all orientation of the parent.

CREDITS:

#1 Photograph and specimen: Robert Boggs
#2 Photograph: Genie Howard
All Micrographs: Donald Howard
specimens 003 and 038 provided by: Randy Becker
specimen 044 provided by Ty Balacko
specimen 764 provided by: Jocelyn Thornton

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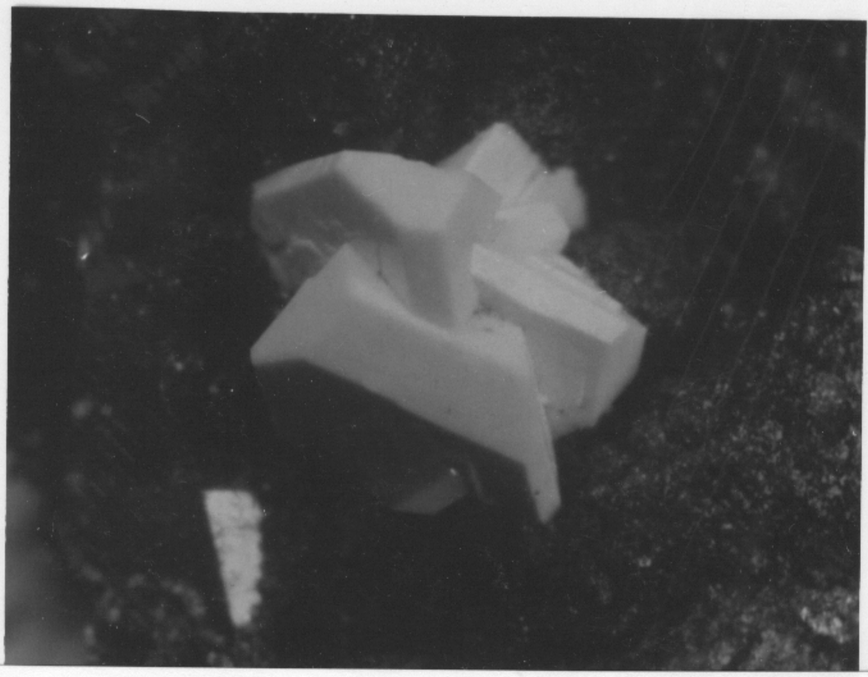
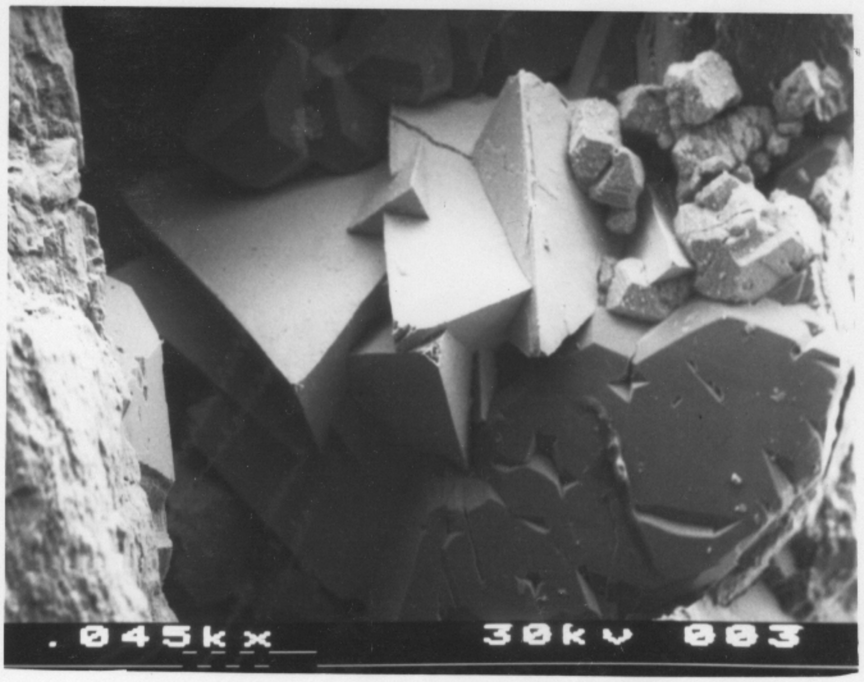
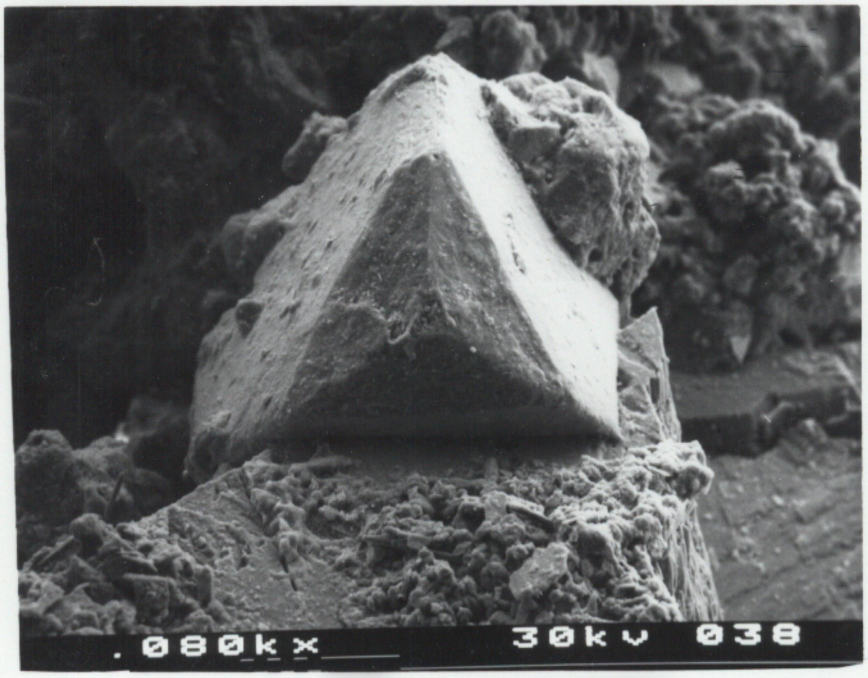


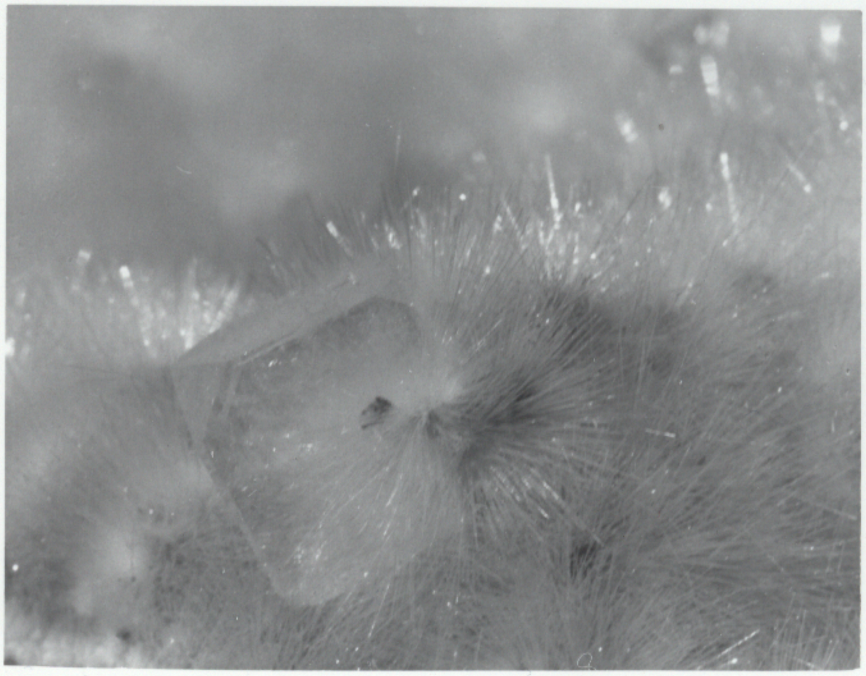
#1 – CALCIOHILAIRITE – WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 30X



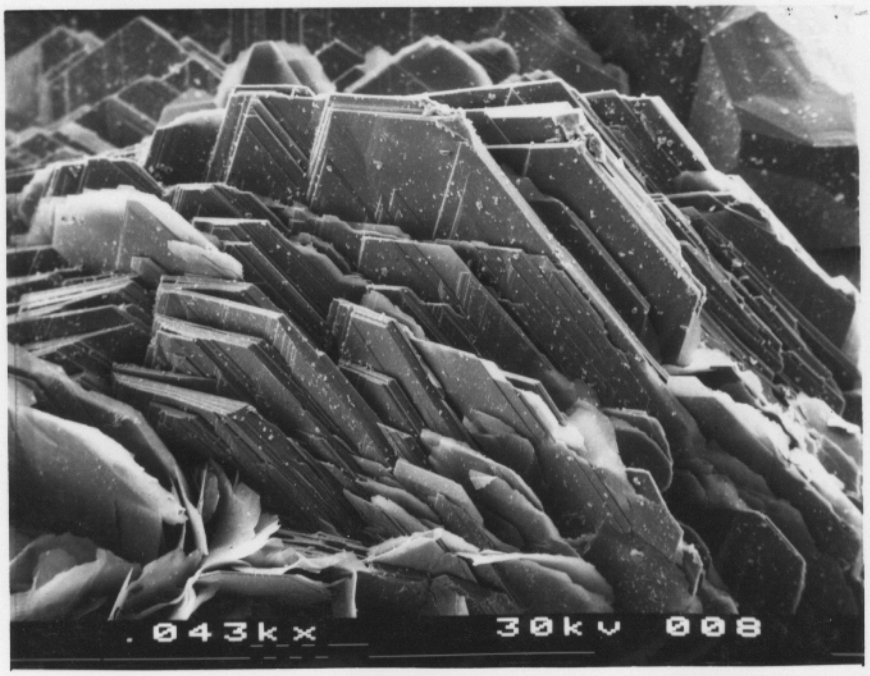
#003 – OKANOGANITE, EUXENITE – WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 45X



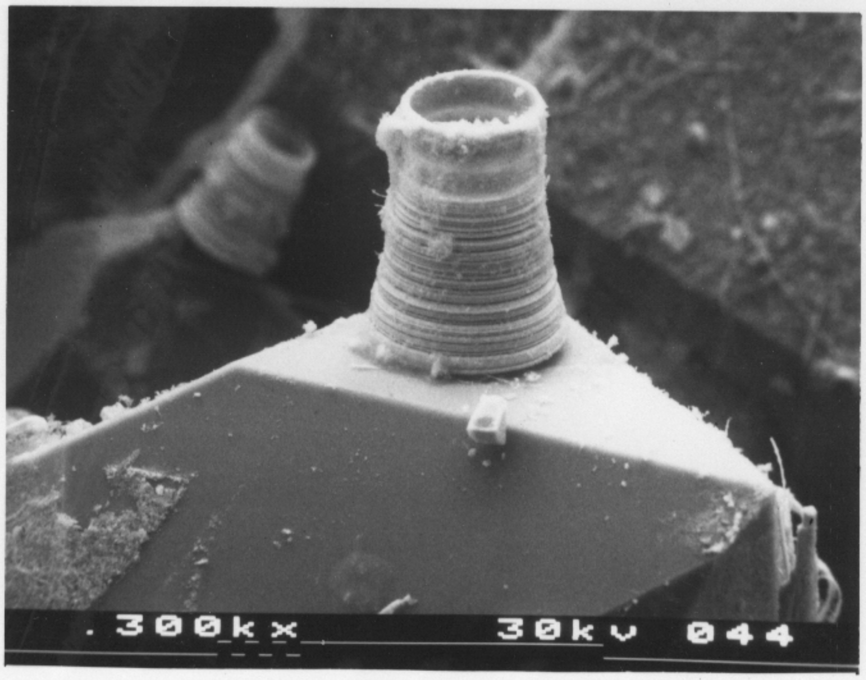
#038 – OKANOGANITE – WASHINGTON PASS, OKANOGAN COUNTY, WASHINGTON – 80X



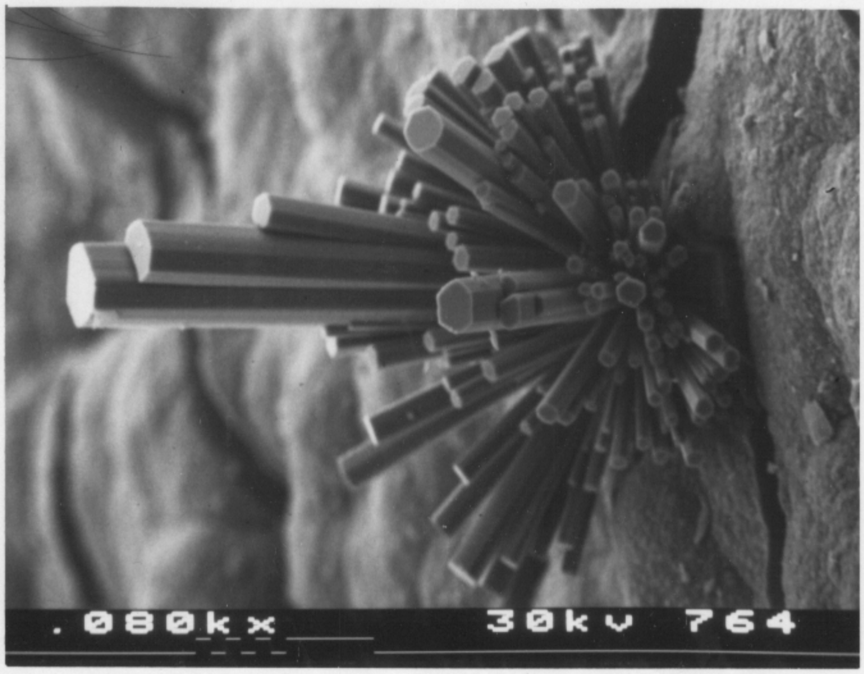
#2 – APOPHYLLITE, NATROLITE – MONUMENT, GRANT COUNTY, OREGON – 4X



#008 – GYROLITE, ANALCIME – MONUMENT, GRANT COUNTY, OREGON – 43X



#044 – BOULANGERITE – VAN SILVER CLAIM, WHISTLER, BRITISH COLUMBIA, CANADA – 300X



#764 – ERIONITE – MOERAKI, NORTH OTAGO, NEW ZEALND – 80X

#760 – ANALCIME, COWLESITE – NEER ROAD, GOBLE, COLUMBIA COUNTY, OREGON – 111X