Northwest

Micro Mineral

Study Group

# MICRO PROBE

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## I N M E M O R Y O F J O H N C O W L E S

This issue of the Micro Probe, and our Spring meeting at Raymond, are dedicated to the memory of our friend and fellow-member, John Cowles.

### IN MEMORIUM

John G. Cowles, one of the Northwest's earliest micromounters, was killed in an auto accident at Longview, Washington on December 13, 1985. Though born in Nebraska (1907), he spent most of his life in the Northwest, where he worked in the Forrest Products Industries and in agriculture.

John's interest in rocks and minerals began many years before either rockhounds or mineral collectors were well known on the West Coast. He was one of the early members of the Oregon Agate and Mineral Society of Portland, Oregon, collected at many of the locations for agate and petrified wood in Oregon and Washington, and polished more specimens from those locations than would seem possible in his varied and busy life.

His deep interest was for all rocks and minerals, including also fossils, archeological specimens, and unusual geologic formations. Eventually he turned to collecting minerals, and with help and advice from Milton Speckels (whose Complete Guide to Micromounts was published in 1965), he became one of the Northwest's first micromounters. The writer vividly remembers first meeting John Cowles and Milton Speckels at Goble, Oregon, one of the unique zeolite locations of the Northwest. John's enthusiam for viewing tiny crystals under his microscope soon led him to introduce other amateurs to this exciting hobby.

For a number of years a small group of beginning micromounters from Oregon and Washington had the privilege of accompanying John to many of the zeolite locations of this region. His field trips soon led some to become familiar not only with the Thompsonites, Heulandites, Stilbites, Mesolites, etc. of Goble, but also with the Dachiardites of Altoona, Washington, theFerrierites of Altoona and British Columbia, the Analcimes of Mount Solo, and the complex zeolites of New Era, Oregon. Although zeolites became the central interest of this group, they also followed John in collecting filiform Pyrites on the Clackamas River, "curved" Quartz on Young's River near Astoria, Albite on the Columbia River, and Amethyst on Dog Mountain near Stevenson, Washington. John, together with this group of collectors, soon founded the Northwest Micromounters Association. Later they also became the nucleus for the first chapter of the Friends of Mineralogy in the Northwest.

It was at one of the early F.M. meetings that Rudy Tschernich, of Snohomish, Washington, and Dr. William Wise a mineralogist of the University of California, Santa Barbara, announced the discovery of a new zeolite. They named it Cowlesite in recognition of John's influence in awakening so much interest in the collection and study of zeolites. They told us that though Goble, Oregon was the type locality for Cowlesite, Dr. Wise had already received zeolite specimens from a collector in Arizona which turned out to be Cowlesite. It was not long before very fine specimens of Cowlesite were found at Spray, Oregon.

Those of us who knew John Cowles have no question as to the great influence of his work on each of us. Rudy Tschernich, for example, became so dedicated to the study of zeolites that he later collected them in India, Ireland, British Columbia, and the Hawaiian Islands. When Vi and Harold Frazier of California discovered Cowlesite on a forest road near Yacolt, Washington, they arranged for John to join them in collecting there. The Yacolt Cowlesites turned out to be some of the most perfect ever found.

John Cowles had great respect for professional mineralogists. He always tried to learn as much as he could from such persons as Dr. Wise, Rudy Tschernich and Milton Spreckels. As an amateur, however, he also took great pride in the work of untrained micromounters and beginning students of mineralogy. Those of us who are untrained in this field owe a great debt to John for showing us the way.

Gordon Gilbertson

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## STUDYING MINERAL ASSOCIATIONS

Mineral associations play a key role in understanding the order of formation of minerals at a given location. This is particularly true of the zeolites, since there are often many minerals which differ only very slightly in chemical composition present in cavities that are very close to each other. By mineral association I mean the situation where two or more minerals are present in contact in a single cavity.

Some minerals tend to avoid associations. Notable among these are the zeolites Cowlesite and Levyne. Though these two zeolites are present and even locally common in a number of our favorite Northwest zeolite localities, they usually are restricted to being the only mineral in their cavity, though there may be cavities of other zeolites only a few millimeters away.

The significance of associations lies in trying to determine the order in which the minerals have formed. This would be easy if all minerals were formed in order, one on top of the other, in a single cavity. Usually, however, a single cavity has at most two or three minerals, and one must seek out a variety of cavities in order to determine order of formation. We must therefore make the assumption (not always justified) that the conditions for forming each mineral occur only once for the locality under study.

Though Cowlesite is notoriously a "loner" mineral, limited associations occur at several locations. Analcime has been found with Cowlesite at Goble, for instance. However, the small size of many of the mineralized cavities at Goble make such an association study difficult. Groups of Stilbite occur with the Cowlesite in the material from Yacolt, but the scattered nature of the zeolites on the diabantite there do not allow us to see which mineral is "on top".

To better illustrate the ordering

of mineral formation, we will look in detail at two locations where there are a large number of minerals present, and where extensive associations have been observed.

PETE'S POINT

At least twelve zeolites occur in a rather small basalt tower on the crest of the ridge running north from the summit of Pete's Point. The location has been documented in "The Ore Bin" (State of Oregon, Dept. of Geology and Mineral Resources 40, 117 (1978) ). The most common minerals are Gyrolite, Cowlesite, Levyne, Garronite, Thompsonite, and Chabazite. Those minerals for which associations have been observed are shown in the accompanying table.

The first mineral to form here was apparently a brown Calcite. This was followed by crusts of small spherical masses of Gyrolite. Though there is some traces of a brownish clay mineral intergrown with some of the Gyrolite, clay or chlorite minerals are in general not common at this location. Many cavities remain with only a Gyrolite filling.

Cowlesite appears to have formed next, both in previously unmineralized cavities and over the Gyrolite already formed. The Cowlesite is usually in balls, some up to three millimeters in diameter, which often have parallel line on their surface. (These are similar to the markings on Thomsonite from Beech Creek. The Thomsonite from Pete's Point is more fine-grained and does not show such markings.)

Analcime occurs as small, glassy-clear crystals only a millimeter or two across. They appear whitish if growing over Gyrolite, and dark if there is no mineral beneath. They are clear enough to be hard to see when growing over the Cowlesite.

Garronite usually completely fills the cavities that it occupies, showing its characteristic set of concentric and radiating cracks. The Gyrolite, analcime, and cowlesite can often be seen embedded around the edge of the Garronite mass. Less commonly, the Garronite forms spherules that do not completely fill a cavity. Of course, Garronite never forms free surfaces -- these surfaces are always altered to Phillipsite, usually very fine-grained, occassionally with coarser crystals showing visible faces. The Phillipsite on such surfaces usually show a great deal of parallel orientation. Also, Phillipsite forms individual crystals and cross-shaped twins. For the sake of ordering the minerals, we will assume that all Phillipsite, whether associated with Garronite or not, has formed at the same time.

The Levyne crystals from this locality are not as thin as often found elsewhere. They are usually clear, but some show a surface coating of Offretite (the only occurrance of this mineral). A specimen of Levyne crystals on an exposed Garronite/Phillipsite sphere has been used to deduce the order of mineralization here. On other specimens, the Levyne and Garronite are beside each other in such a way that it is difficult to tell if the Levyne was always formed after the Garronite. It is possible that the two minerals were forming at the same time, or alternately.

The next mineral in order to form appears to be Thomsonite. Most of the Thomsonite from this locality is in the form of very fine-grained hard spherules occassionally with the characteristic curved "extrusions". Thomsonite is occassionally bluish, but more commonly is white in color with a satiny texture on broken edges. There are a few specimens with matted tangles of individual crystals, but these are not particularly bladed and do not show the usual parallel growth habit. Again, some specimens suggest that the Thomsonite may actually preceed the Garronite, so the same comment about parallel or alternate formation should include Levyne, Garronite, Phillipsite, and Thomsonite.

Thomsonite forms the normal base material for several other minerals. The only other of these that is at all common at this location is Chabazite, which almost always forms clear, simple pseudo-cubes. Chabazite appears to be the last mineral to form.

Apophyllite has been found as small white pseudo-dodecahedrons mounted on fine-grained Thomsonite.

Finally, a few specimens show simple, clear tabular Stilbite crystals on a fine-grained Thomsonite base. These crystals are unusual in that they show no tendency to form the normal parallel growth habit, but have faces that are sharp and distinct. Stilbite crystals are usually mixed with Chabazite in such a way that it is clear that the Stilbite was formed first. One specimen has been found that has fine hairs, probably Natrolite, on top of the stilbite.

The Natrolite, Apophyllite, and Offretite are rare enough at Pete's Point that it is not possible to firmly fix their place in the order of formation. Clearly, all three formed very late in the mineralization of this basalt.

Pete's Point, Wallowa Co., Oregon

| Secondary Mineral \ Base Mineral | Calcite | Gyrolite | Cowlesite | Analcime | Garronite | Phillipsite | Levyne | Thomsonite | Stilbite | Chabazite |
|---|---|---|---|---|---|---|---|---|---|---|
| Gyrolite | X | 0 | | | | | | | | |
| Cowlesite | X | X | 0 | | | | | | | |
| Analcime | | X | X | 0 | | | | | | |
| Garronite | | X | X | X | 0 | | ? | ? | | |
| Phillipsite | | X | X | X | X | 0 | | | | |
| Levyne | | X | X | X | * | X | 0 | | | |
| Thomsonite | | X | X | X | * | X | X | 0 | | |
| Stilbite | | | | | | | | X | 0 | |
| Chabazite | | X | X | X | | | X | X | X | 0 |
| Offretite | | | | | | | X | | | |
| Apophyllite | | | | | | | | X | | |
| Natrolite | | | | | | | | | X | |

## BURNT CABIN CREEK

At least twelve minerals also have been identified from this basalt roadcut near Spray. The most common minerals here are Chabazite, Thomsonite, and Mesolite. Associations here are common, but they tend to be limited to certain fixed groupings. Based on a much smaller experience, the accompanying table shows the associations of which I am aware.

The first mineral to form appears to be a black, satiny Smectite (clay). This is followed in a few cavities by clear, colorless Calcite crystals, generally six-sided and showing terminations.

The Cowlesite forms next in very small (one millimeter or less) spherules with rough surfaces. Normally it fills cavities that have not been mineralized or which have a thin Smectite surface (which gives many of the Cowlesite specimens a grayish color). Cowlesite has been found coating clear Calcite.

Both Levyne and Chabazite have been found as clear crystals mounted of a base of Cowlesite. In other specimens, clear crystals of Levyne covered by Chabazite and Thomsonite serve to establish the order here. Associated Levyne crystals are rather thick and are uncoated, in contrast to the thinly bladed Levyne which is generally covered by a layer of Offretite. The bladed Levyne is on a background of black Smectite and usually has no other minerals present in the same cavity.

Analcime is fairly common, occuring as small, glassy crystals, usually on the earliest minerals formed. Other minerals have not been observed to form on top of it. We have tentatively put it in the list to follow Levyne. Phillipsite (much less common) also appears to follow Levyne, and definitely preceeds Chabazite. A specimen with both Analcime and Phillipsite would be very useful in establishing the order at this point.

Chabazite, which is probably the most common zeolite at this location, has followed the Levyne. The crystals are usually clear when fresh but shatter easily. A considerable variety of faces and forms are present.

Thomsonite takes on the form of

bundles of flat blades radiating from a growth center on the Chabazite, and forming in turn the nucleation site for the radiating, hairlike tufts of Mesolite.

Less common minerals include Gyrolite (tiny white balls on Cowlesite), Offretite (white crusts on blades of Levyne), and Apophyllite (small. clear crystals of Chabazite and Thomsonite). Heulandite and Stilbite are very uncommon and are as yet unplaced in the order of mineralization.

My limited collecting at Burnt Cabin Creek has in turn limited the table of associations, leaving the order of mineralization incomplete. Please bring your prize specimens from this location to the Raymond meeting so that we can add to our understanding of the order of formation of this excellent and complex collecting area.

Also, suggestions of other localities where a study of associations might be interesting and rewarding will be most welcome.

In conclusion, we can see from the study of these two complicated sites that Cowlesite is one of the earlier zeolites to form. Unlike Thomsonite, it appears to provide a poor nucleation surface for other minerals, so associations become rather unusual. Levyne is intermediate in formation, and again is not a good surface for later mineralization (except for Offretite, which must be very late in the formation order). The needle-like minerals of hhe Natrolite-Mesolite group seem to be among the last minerals that form.

Burnt Cabin Creek, Spray, Oregon

| Secondary Mineral | Base Mineral: Smectite | Calcite | Cowlesite | Levyne | Analcime | Phillipsite | Chabazite | Thomsonite |
|---|---|---|---|---|---|---|---|---|
| Calcite | X | O | | | | | | |
| Cowlesite | X | X | O | | | | | |
| Levyne | X | | X | O | | | | |
| Analcime | X | X | | X | O | | | |
| Phillipsite | X | X | X | X | | O | | |
| Chabazite | | | X | X | | X | O | |
| Thomsonite | | X | | X | | X | X | O |
| Mesolite | | | | | | | | X |
| Heulandite | X | X | | | | | | |
| Gyrolite | | | X | | | | | |
| Offretite | | | | X | | | | |
| Apophyllite | | | | | | | X | X |
| Stilbite | | | | | | | | |

Though the formation of both of these locations is similar in overall structure, there are some significant differences (the reversed order of Gyrolite-Cowlesite; the reversed order of Thomsonite-Chabazite). Extending these studies of associations to other locations should prove very interesting in disclosing the normal order of zeolite formation. They may also help in identifying "where to look" for the more unusual minerals that occur only rarely in many of our collecting areas.

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The editor wishes to give special thanks to:
Gordon Gilbertson
Rudy Tschernich
for their excellent contributions to this special issue of the Microprobe. All contributions for future issue enthusiastically accepted.

D. G. Howard
President and Microprobe editor
356 S.E. 44 th Ave.
Portland, Oregon 97215

## P H O T O  C R E D I T S

7. Cowlesite coating a Calcite crystal (x13)
Burnt Cabin Creek, Spray, Oregon

8. Levyne crystal on Cowlesite (x6)
Burnt Cabin Creek, Spray, Oregon

9. Garronite (showing the pattern of radial and concentric cracking) (x8)
Phillipsite (small crystals covering the free surface of the Garronite sphere)
on Cowlesite (small spheres, including one that is embedded in the Garronite)
Pete'e Point, Wallowa Co., Oregon

10. Phillipsite (cross-shaped twins) on Cowlesite (x8)
Pete's Point, Wallowa Co., Oregon

11. Thomsonite (large sphere) on Cowlesite (some of which is embedded in the Thomsonite) (x8)
Pete's Point, Wallowa Co., Oregon

12. Chabazite on Cowlesite (x8)
Pete's Point, Wallowa Co., Oregon

Specimens #7 and #8 from the collection of Gordon Gilbertson.
All other specimens and all photos courtesy of D. G. Howard.

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Dear Micro Members,

I have been away from meetings for some time but am looking forward to seeing you all again this spring. The zeolite book I have been intending to write for many years is underway and has been expanded from zeolites of the Northwest to cover the entire world. This is a much larger undertaking but is much more interesting to write for I am able to cover all of the zeolite species and delve into areas I have never fully understood.

The following information on COWLESITE, in memory of John, is an example of what I am covering for each zeolite with crystal drawings and photos to be included plus sections on how zeolites crystalized, the major zeolite-producing areas of the world. and tables for zeolite identification and cleaning.

I hope we can take time at the spring meeting to study several zeolite species of special interest to all of us: Cowlesite and Gismondine. Please bring specimens of Cowlesite in association with other minerals for study at the meeting. Also bring Gismondine specimens from the Clackamas River and other locations worldwide for comparison. I have never collected at the Yacolt location and would appreciate seeing samples from that location. If you have extras for trade, bring them along as I will have trading material along.

I will give a zeolite update at the meeting on the reclassification of the zeolite group and information on zeolites that I have found interesting during my search of the zeolite literature.

Sincerely, Rudy W. Tschernich
526 Ave. A #A
Snohomish, Washington 98290
206-568-2857 or 568-5369

TEXT FROM ZEOLITES OF THE WORLD (in prep.) by Rudy W. Tschernich
526 Ave. A #A
Snohomish, Washington
98290

# COWLESITE

$Ca(Al_2Si_3O_{10}).5\text{-}6H_2O$    Z = 52

Named in 1975 by William S. Wise and Rudy W. Tschernich

Named after John Cowles of Rainier, Oregon, amateur mineralogist and enthusiastic zeolite collector. His deep interest in zeolite mineralogy led him to discover new locations for the rare zeolites ferrierite, dachiardite, erionite, and the mineral cavansite.

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STRUCTURE:

Crystal System: Orthorhombic
Space Group: possibly $P222_1$ (Nawaz,1984)
Crystal axes: a = 23.17
b = 30.58
c = 24.92 (Nawaz, 1984)

Typical unit cell content: $Ca_{52}[Al_{104}Si_{156}O_{520}].{}_{208}H2O$

(Nawaz, 1984)

Type of structure: This mineral has a unique composition and x-ray powder pattern. Because of the extreme thinness of individual crystals, a single crystal of cowlesite with required thickness needed for complete structural determination has not been found.

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PHYSICAL PROPERTIES:

Color: colorless to white
Streak: white
Luster: vitreous, greasy
Transparent
Hardness: very low, 2 to 3
Fracture: unknown
Cleavage: 010, perfect, very easy
Density: 2.12-2.14 g/cc measured
2.05-2.10 calculated

OPTICAL PROPERTIES:

Refractive Index:
a = 1.512
b = 1.515
c = 1.517
parallel extinction
2V = 44° to 53°
negative sign
very low birefringence

Morphology: Crystals are very small simple blade-shaped laths, with broad {010}, very narrow {100}, and terminated by {101}. Crystals commonly exceed 0.3 mm in length and 0.1 mm in width, but are extremely thin being less than 2 um (millimicron). Crystal morphology can only be seen with 100x magnification or with SEM microscope. Ball-like aggregates of cowlsite reach a maximum of 2 mm diameter.

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ANALYSIS:

General formula: $Ca[Al_2Si_3O_{10}].5\text{-}6H_2O$ Z = 52 (Nawaz, 1984)

Goble, Columbia Co., Oregon (Type location)
(Wise and Tschernich, 1975)
$Ca_{.96}Na_{.10}[Al_{2.00}Si_{2.99}O_{10}].5.6H_2O$

Superior, Pinal Co., Arizona (Wise and Tschernich, 1975)
$Ca_{1.04}Na_{.10}K_{.01}[Al_{1.96}Si_{2.98}O_{10}].5.0H_2O$

Monte Lake, British Columbia (Wise and Tschernich, 1975)
$Ca_{1.04}Na_{.07}K_{.01}[Al_{2.08}Si_{2.90}O_{10}].xH_2O$

Capitol Peak, Thurston Co., Washington
(Wise and Tschernich, 1975)
$Ca_{.92}Na_{.12}K_{.01}[Al_{2.18}Si_{2.88}O_{10}].xH_2O$

Beech Creek Quarry, Mount Vernon, Grant Co., Oregon
(Wise and Tschernich, 1975)
$Ca_{.96}Na_{.14}[Al_{1.98}Si_{3.00}O_{10}].xH_2O$

Burnt Cabin Creek, Spray, Wheeler Co., Oregon
(Wise and Tschernich, 1975)
$Ca_{1.01}Na_{.10}[Al_{2.09}Si_{2.90}O_{10}].xH_2O$

Table Mountain, Golden, Colorado (Wise and Tschernich, 1975)
$Ca_{.82}Na_{.08}[Al_{1.98}Si_{3.08}O_{10}].xH_2O$

Ballyclare, Co. Antrim, Northern Ireland (Nawaz, 1984)
$Ca_{.91}Na_{.09}[Al_{1.97}Si_{3.08}O_{10}].3.94H_2O$

Dunseverick, Co. Antrim, Northern Ireland (Nawaz, 1984)
$Ca_{.87}Na_{.11}K_{.02}Mg_{.03}[Al_{2.02}Si_{3.00}O_{10}].3.95H_2O$

Kingsburgh, Island of Skye, Scotland
(Rinaldi in Gottardi and Galli, 196
$Ca_{.84}Na_{.07}K_{.03}Mg_{.01}[Al_{1.98}Si_{3.08}O_{10}]\cdot 4.99H_2O$

Variation in composition: Very little variation from the ideal formula. Always Ca dominate with small amounts of Na. $H_2O$ content varies with freshness of samples and method of analysis.

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IDENTIFICATION: Cowlesite is very consistant in chemical, physical, and optical properties. At all locations the size and form of the crystals are generally the same. Cowlesite is colorless to white but appears gray to blue-gray in cavity linings due to the color of the vug walls showing through transparent crystals.

Cowlesite crystals are often confused with thomsonite. Both zeolites form lath-shaped crystals and are similar in appearance, for this reason cowlesite has gone unnoticed even in actively collected zeolite localities. The criteria used to distinguish between them involve surface characteristics, hardness, and cleavage.

The surface of thomsonite vug linings appears relatively smooth from flat crystal terminations, but cowlesite linings appear rough (under 30x magnification) from the sharply pointed blades. Thomsonite intergrowths are extremely tough for a zeolite and have a hardness of 5 to 5.5. In contrast cowlesite intergrowths are easily cleaved and have a hardness and mechanical behavior much like gypsum. Use a needle and run it across the broken side of the thomsonite-cowlesite unknown. If it is very easy scratched it is cowlesite; if it is scratched with difficulty or is not scratched then it probably is thomsonite. Be sure not to run the needle across the terminations of the crystals for it will only break crystal terminations and not test hardness. Specimens from new locations should be X-rayed for positive ID.

Mineral association is also a valuable aid in identification of cowlesite. Cowlesite is a low-silica zeolite usually found alone in vugs. When it is found with other zeolites, cowlesite is usually the first zeolite to crystallize, rarely preceded by analcime or calcite and closely followed by levyne with offretite or erionite overgrowth. Less commonly, cowlesite is found covered with chabazite, thomsonite, analcime, gyrolite, garronite, and phillipsite in the same pocket. The fibrous zeolites mesolite, natrolite, and scolecite plus gismondine often occur at the same location but not in the same pockets. Cowlesite is never found with high silica zeolites ferrierite, dachiardite, clinoptilolite, yugawaralite, mordenite, or with quartz.

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CLEANING: Usually only water is needed to clean specimens. Use acedic acid to remove calcite. Oxalic acid to remove iron stains and Vitamin C for Mn removal. Do not brush specimens while cleaning as cowlesite is very soft and terminations of the crystals are very easily damaged. Be sure to test all chemicals on lesser quality samples to be sure the cowlesite or associated minerals are not damaged.

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OCCURRENCE: For a new zeolite, cowlesite is unusual that it is found in over 20 locations in the Western U.S., Northern Ireland, Iceland, Faroe Islands, Scotland, and Japan. Cowlesite is commonly found in silica-poor basalts at locations containing levyne. Search of all levyne producing locations should produce more cowlesite occurrences.

NORTHWEST LOCATIONS:

TYPE LOCATION: Goble, Columbia Co., Oregon, produces cowlesite in vesicles 1 mm to 6 cm in diameter where it forms thin gray, blue-gray, and white radially oriented cavity linings commonly 0.5 mm thick, and a few blades up to 2 mm long and only 2 um thick. Cowlesite is generally found alone but has been found with each of the following minerals in the sequence: apophyllite > analcime > cowlesite > garronite > phillipsite > levyne > offretite > thomsonite. Other minerals present at Goble but not found in association with cowlesite include; stilbite, heulandite, chabazite, mesolite, mordenite, and okenite (Wise and Tschernich, 1975, Tschernich, 1973).

Cowlesite occurs at the Beech Creek Quarry, near Mount Vernon, Grant Co., Oregon usually alone lining small 2 mm to 3 cm vesicles. Although analcime, phillipsite, thomsonite, heulandite, stilbite, chabazite, and mesolite are found at the location, cowlesite has been found only with levyne (with an offretite overgrowth).

Burnt Cabin Creek, Spray, Wheeler Co., Oregon has a similar zeolite assemblage to the Beech Creek Quarry with the addition of apophyllite and gyrolite. This location produces the largest and finest specimens of cowlesite known. Most cowlesite pockets are small, under 13 mm, lined with only cowlesite or contain crystal sprays of sharply terminated crystals scattered on smectite clay balls (Wise and Tschernich, 1975). Larger pockets up to 5 to 8 cm are often found lined with cowlesite with some exceptional pockets attaining 16 cm (Tschernich, 1978). Cowlesite is associated only with calcite which precedes all the zeolites, with levyne and its offretite overgrowth, and very rarely with small white balls of gyrolite on the surface of cowlesite. Although large pockets of thomsonite-chabazite-mesolite are abundant, cowlesite is never present.

Cowlesite also occurs with levyne along the North Fork of the John Day River and in quarries near Ritter, Grant Co., Oregon; with levyne Drews Reservour, Lake Co., Oregon; and alone at Capitol Peak, Thurston Co., Washington.

Logging roads south of Monte Lake, British Columbia intersect a vesicular red basalt flow which contains 5 mm to 10 mm vugs lined with 0.5 mm thick gray crystals of cowlesite. Other zeolites found at the location are analcime, thomsonite, levyne, stilbite, heulandite, and chabazite (Wise and Tschernich, 1975).

Talus slopes and basalt cliffs along the Douglas Lake road, west of Westwold, British Columbia contain an abundance of light gray cowlesite lining vesicles up to 10 mm. Cowlesite has not been found associated with any of the other zeolites present at the location which include thomsonite, levyne with a thick offretite overgrowth, phillipsite, stilbite, heulandite, chabazite, and mesolite.

Beautiful sparkling isolated aggregate balls of colorless cowlesite on greenish-black diabantite are found in small vugs at Yacolt, Clark Co., Washington. The freshness and contrast of cowlesite and diabantite make micro specimens of cowlesite from this location the best in the world. Cowlesite is found alone in the vesicles although many other zeolites are present including; heulandite, chabazite, stilbite, thomsonite, epistilbite, phillipsite, laumontite, levyne, mesolite, and calcite.

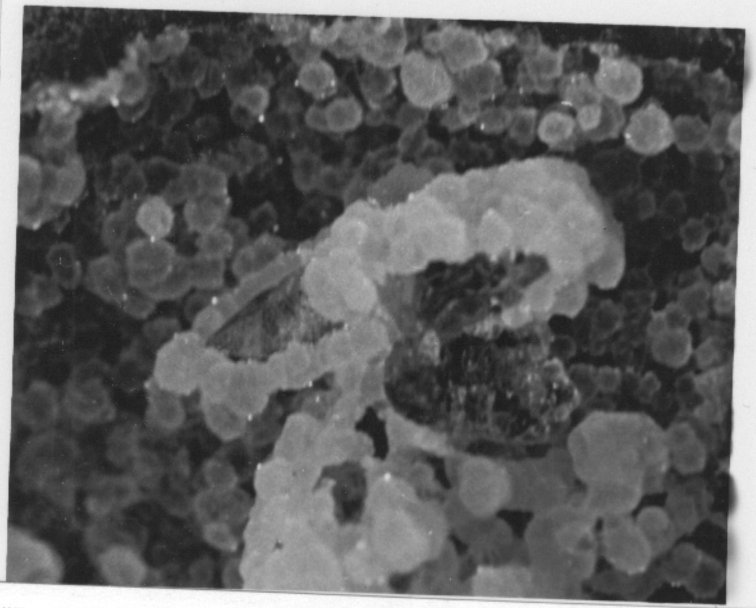
Pete's Point, west of Aneroid Lake, near Joseph, Wallowa Co., Oregon contains cowlesite either alone in vugs or covered with either thomsonite, garronite, levyne, phillipsite or chabazite (Howard, 1978).

WORLDWIDE LOCATIONS:

UNITED STATES: Cowlesite is found alone as small rosettes in zeolite-bearing shoshonite at Table Mtn, near Golden, Colorado. Other minerals present at Table Mountain include laumontite, stilbite, thomsonite, chabazite, analcime, apophyllite,mesolite, natrolite, scolecite, levyne-offretite, and garronite (Wise and Tschernich, 1975).

At Superior, Pinal Co., Arizona cowlesite is found in 1 mm to 2 cm vesicles in the outer margins of gray-colored olivine basalt bombs and scoria fragments in an exhumed, middle Tertiary cinder cone. In the lower part of the cone, cowlesite is abundant and closely associated with thomsonite, chabazite, analcime, garronite, and calcite. Higher in the exposure the main zeolites are mordenite, thomsonite, and chabazite (Wise and Tschernich, 1975).

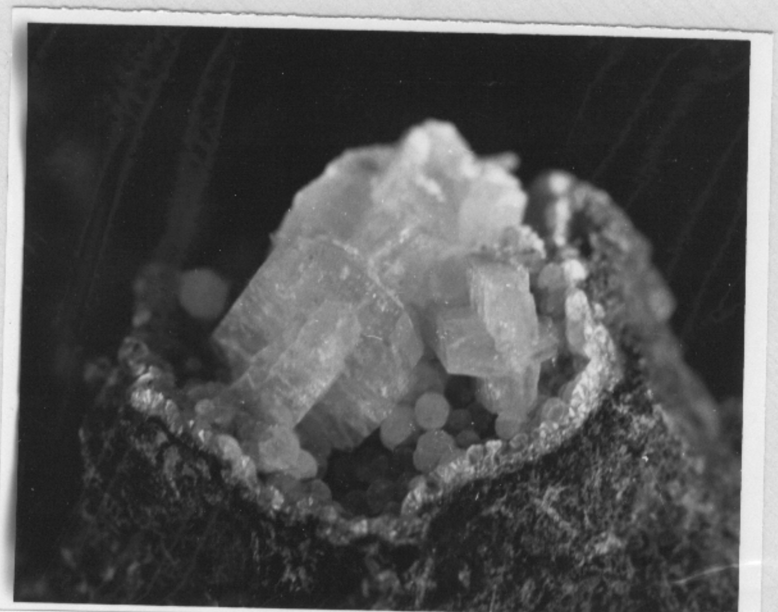
NORTHERN IRELAND: Cowlesite is common in County Antrim and is often associated with other zeolites. It is very abundant along the sea coast of Dunseverick in altered boulders on the beach which have fallen from the cliffs. This location contains more cowlesite than any other known location in the world although it is not as clean and fresh as specime found in active quarries. Vesicles range from 1 to 5 cm lined with cowlesite rarely associated with levyne-erionite, chabazite, or phillipsite. Two kilometers further up the beach cowlesite is found covered with clay and levyne with thick overgrowths of erionite. The Green Road Quarry, Ballyclare is an active quarry where fresh cowlesite is common in vesicles up to 4 cm and is usually covered with chabazite thomsonite, or levyne-erionite. Levyne-gismondine rich rock at the Parkgate Quarry, Templepatrick produces small amounts of cowlesite.



#7 – COWLESITE – BURNT CABIN CREEK, SPRAY, OREGON – 13X

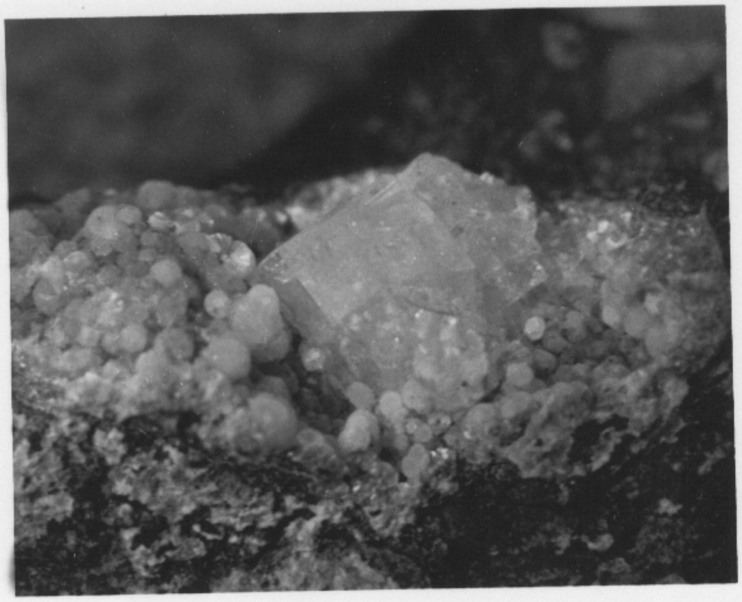
#8 – LEVYNE, COWLESITE – BURNT CABIN CREEK, SPRAY, OREGON – 6X

#9 – GARRONITE, PHILLIPSITE, COWLESITE – PETE'S POINT, WALLOWA COUNTY, OREGON – 8X



#11 – THOMSONITE, COWLESITE – PETE'S POINT, WALLOWA COUNTY, OREGON – 8X

#10 – PHILLIPSITE – PETE'S POINT, WALLOWA COUNTY, OREGON – 8X



#12 – CHABAZITE, COWLESITE – PETE'S POINT, WALLOWA COUNTY, OREGON – 8X