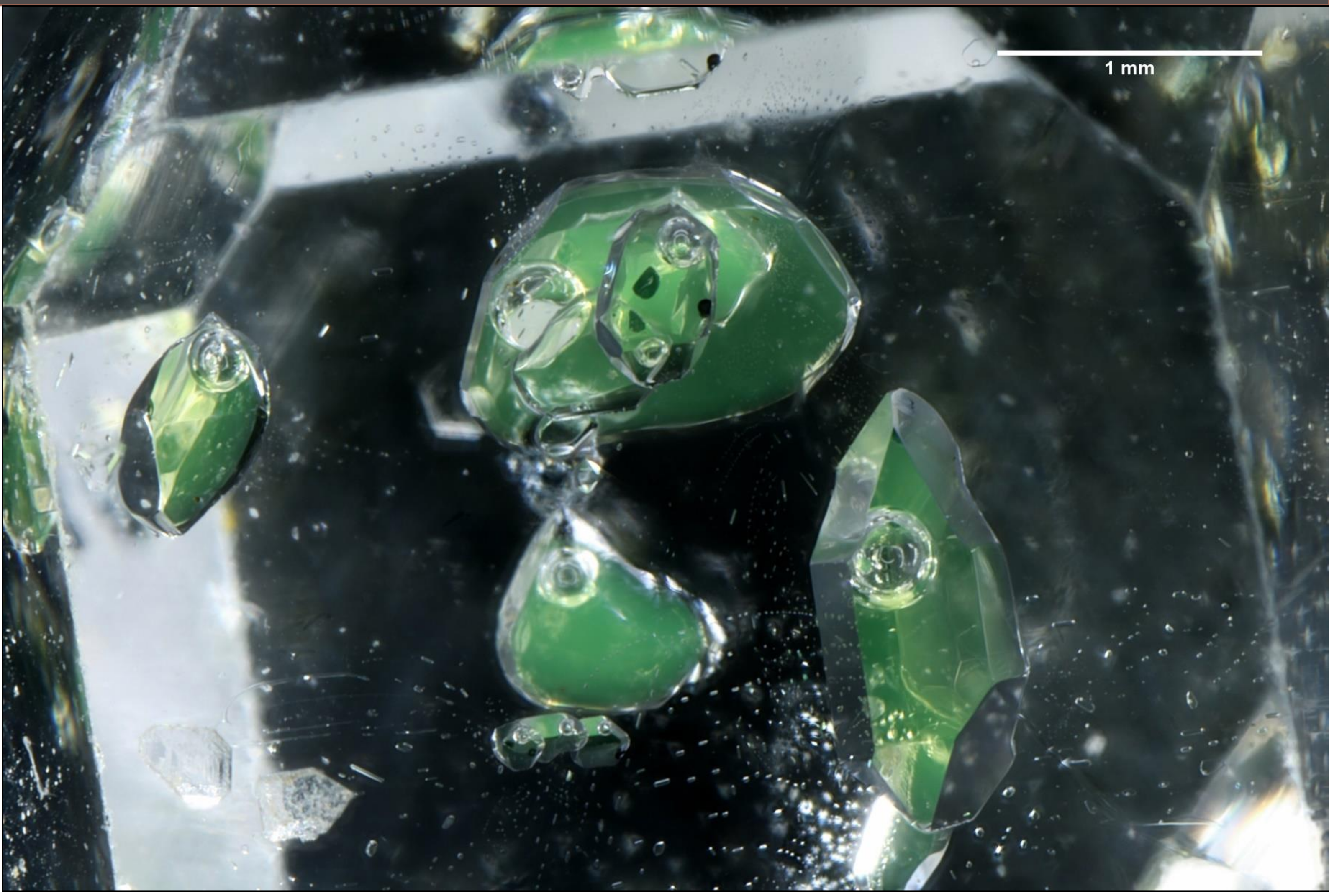
Australia and New Zealand Micromineral News



Issue 13 – March 2017

Editor: Steve Sorrell – steve@crocoite.com

Cover photo:

Quartz Enhydro, Petroleum
Baluchistan, Pakistan
21 images stacked using Zerene Stacker
Taken with Canon 750D and Zhongyi Lens at f16
Photo width 5mm across
Photo and Specimen: Steve Sorrell

In This Issue

Introduction

Happy New Year to you all! Seems I was saying that same thing in the last issue, more than twelve months ago! This is issue number 13. It is a common theme for publications such as this, that articles don't magically appear! Let's hope that this isn't an unlucky 13.

Once again, thanks go to stalwart regular contributors John Haupt and Noel Kennon for their contributions, and also to Pat Sutton for his interesting article on Spring Hill.

Contributions – We Still Need Your Input!

Articles should be submitted to the editor in Word format, and any photos should be of a sufficient quality for publication. If you believe that you can provide a suitable article for the next issue, please advise the editor as soon as possible. Planning for the next issue begins as soon as the current one is published!

Contacts

If you want to find out what's happening with micromounting or microminerals in your region, get in touch with one of the following:

- ⚒ New South Wales: George Laking – bglaking@tech2u.com.au
- ⚒ New Zealand: Jocelyn Thornton – sodalite@paradise.net.nz
- ⚒ Queensland: Russell Kanowski – kanowfam@icr.com.au
- ⚒ South Australia: Peter Keller – gondwanaminerals@yahoo.com.au
- ⚒ Tasmania: Ralph Bottrill – rbottrill@mrt.tas.gov.au
- ⚒ Victoria: John Haupt – john.haupt@bigpond.com
- ⚒ Western Australia: Susan Koepke – minsocwa@hotmail.com

Forward Diary

Please send details of micromounting or micromineral upcoming events (up to six months ahead would be good) for inclusion in the next issue of the Australian and New Zealand Micromineral News.

No details this issue.

Table of Contents

Zoned mimetite, Adelaide Mine, Dundas, Tasmania
37 images stacked using Zerene Stacker
Taken with Canon 750D and Zhongyi Lens at f2
Photo width 3mm across
Photo and Specimen: Steve Sorrell

Tridymite and associated minerals from cavities in icelandite from the Spring Hill area, Victoria, Australia

Pat Sutton
School of Pharmacy and Applied Science, La Trobe Institute for Molecular Science, La Trobe University, Bendigo, Victoria, Australia

Abstract

A suite of minerals from cavities in icelandite, including well-formed crystals and crystal clusters of tridymite, from the Spring Hill area, Victoria is described.

Introduction

For many years small well-formed crystallized specimens of tridymite and associated minerals in icelandite have been collected from road cuttings in the Spring Hill district (37° 18' 51'' S, 144° 21' 2'' E), west of Kyneton, Victoria. The area is part of a series of volcanic flows which has produced mineral specimens from a number of nearby quarries in basic lavas, including Trentham, Tylden, Malmsbury and Kyneton.

Spherical vesicles and long narrow cracks in the groundmass, from a few mm to at least 10 cm across, contain euhedral crystals of a number of mineral species. Specimens containing tridymite crystals in matrix from at least three sites in the area are in the collection of Museum Victoria, as well ilmenite mineral sands from at least two sites.

The geology and petrology of the area was described by Edwards (1935, 1938), and was the subject of theses by Gawith (1977) and Wallace (1990). The minerals described were collected by Jo Price and the author on separate excursions to the area, the most recent in mid-2012.

Geology

The basalts situated near and north of Spring Hill (Figure 1) are part of the Central Highlands Sub-province of the Western Districts Province of Victoria (the Newer Volcanics). Edwards (1938) had described these lavas as trachyandesite, but Joplin (1968) considered that the term was unsatisfactory, mainly on the grounds that it had been loosely described. More recent studies (including Gawith, 1977; Wallace, 1990; Willman *et al*, 2002) have referred to the flows as icelandite, a category which encompasses intermediate extrusive rocks with lower Al, higher Fe and fewer mafic phenocrysts than calc-alkaline andesites (Carmichael, 1964).

The icelandite outcrop which flowed north-east from the Spring Hill volcanic cone (Figure 1) comprises valley flows and small lava fields associated with low angled lava cones over an area approximately 11km long and 4 km across (Edwards, 1938). Borehole data indicates that the flows, the compositions of which included some of the most felsic rocks known in the Central Highlands Sub-province, varied in thickness from 20m to 46 m (Willman, *et al*, 2002). Estimates of the age of the deposit have varied from 3.25 Ma (Wellman, 1974) to 7 Ma (Wallace, 1990).

The icelandite groundmass consists principally of microlites of plagioclase and oligocene An_{25}, flow-banded around microphenocrysts of plagioclase, clinopyroxene and rare olivine (Willman et al, 2002). Three distinct layers have been described: a lower black glassy flow; an upper mottled grey, commonly vesicular flow (Figure 1); and volcanic tuff (Edwards, 1938; Gawith, 1977). The upper mottled grey flow, more crystalline than the black glassy flow, hosted the minerals described.

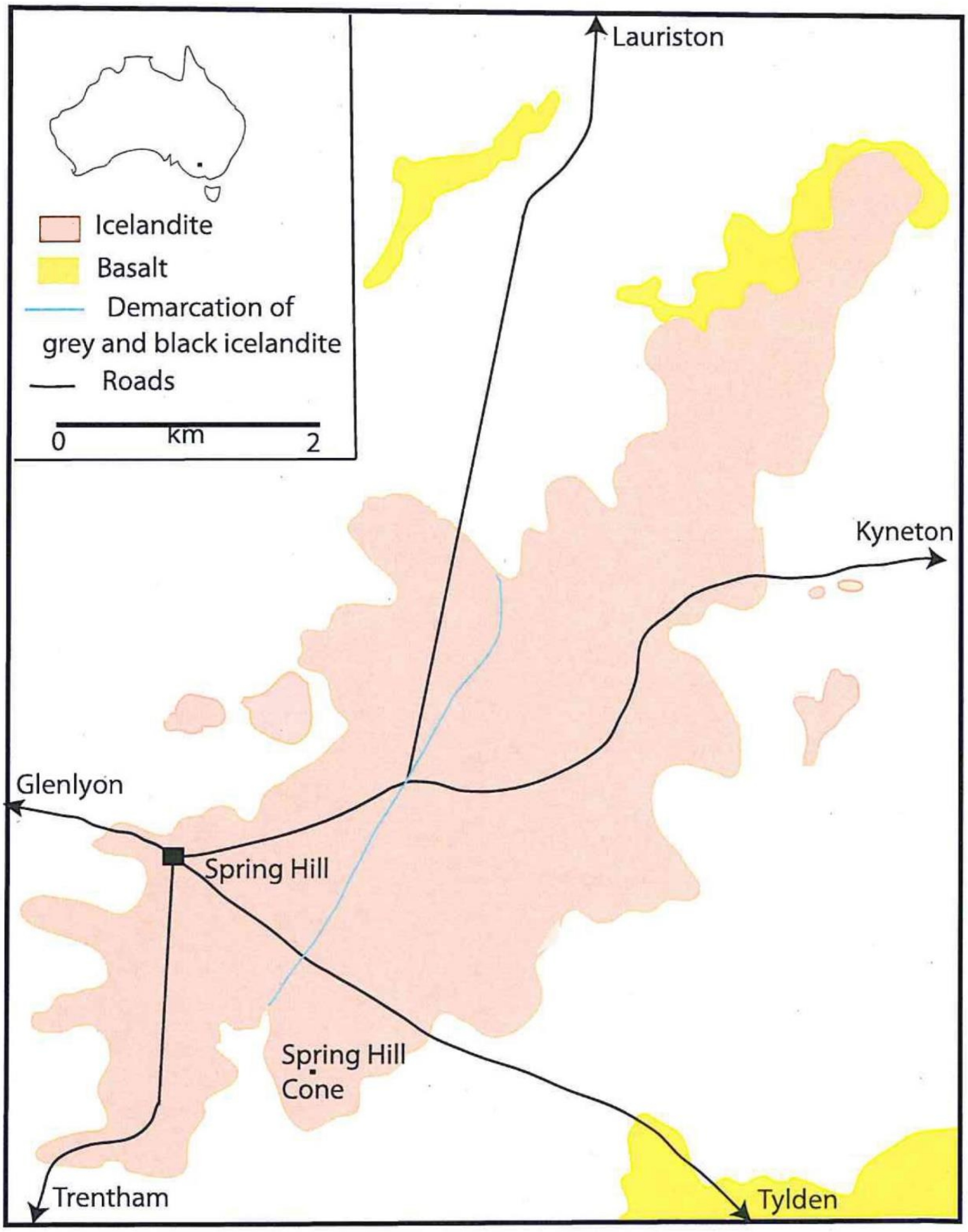


Figure 1: Locality map of the basalts of the Spring Hill district. (After Edwards, 1938; Gawith, 1977; Osborne and Radjkovic, 2002; Willman *et al*, 2002).

Mineralogy

This study focuses primarily on euhedral crystals of the main minerals in vesicles in the mottled grey icelandite. Information is based on the literature, and samples collected from roadside cuttings by the author in August 2012 and Jo Price on earlier occasions. Samples were tested at Latrobe University, Bendigo in 2013 for various elements by an Aspex Explorer Scanning Electron Microscope with 10 mm 2 UTW SDD EDS detector.

Apatite ***CaF***

EDS scans showed well developed thin tabular crystals and groups of apatite crystals, no more than 50 µm long, attached to the pinacoid faces of some of the tridymite crystals (Figure 2).

Figure 2: SEM image of apatite crystals from Spring Hill. Field of view 80 µm across. Image and specimen: P. Sutton.

Augite $(Ca,Na)(Mg,Fe,Al,Ti)(SiO,Al)_2O_6$

Augite is the predominant phenocryst phase mineral in all three flows. In the upper flow it typically occurs as black to brown and dark green columnar to stubby single crystals up to about 1.5 mm in length. Crystals are elongated along **c** (001). Forms include the pinacoids a {100} b {010} and c {001}, prism m {110} and pyramid u {111} (Figures 3 and 4).

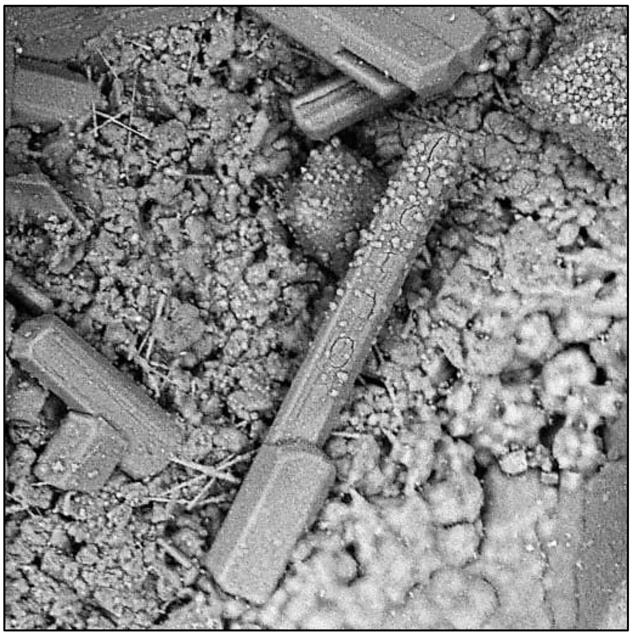


Figure 3: SEM image of augite crystals with clay coating and associated with sanidine, from Spring Hill. Field of view 0.5 cm across. Image and specimen: P. Sutton.

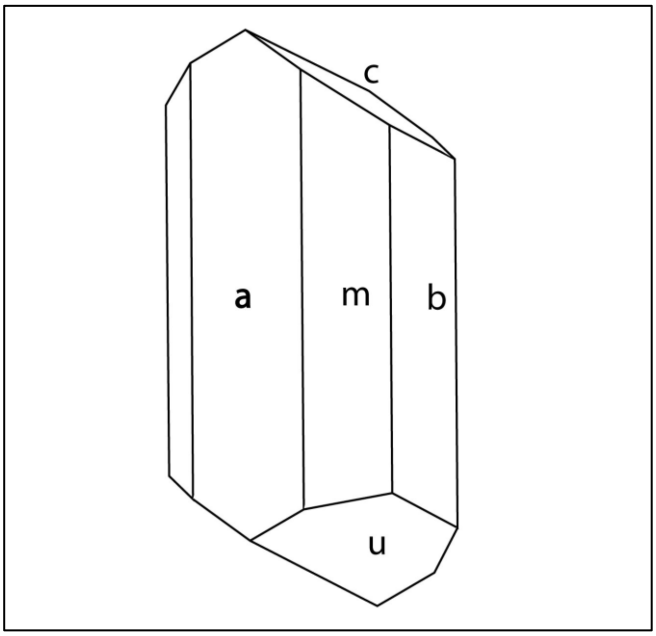


Figure 4: Crystal habits of augite from Spring Hill.

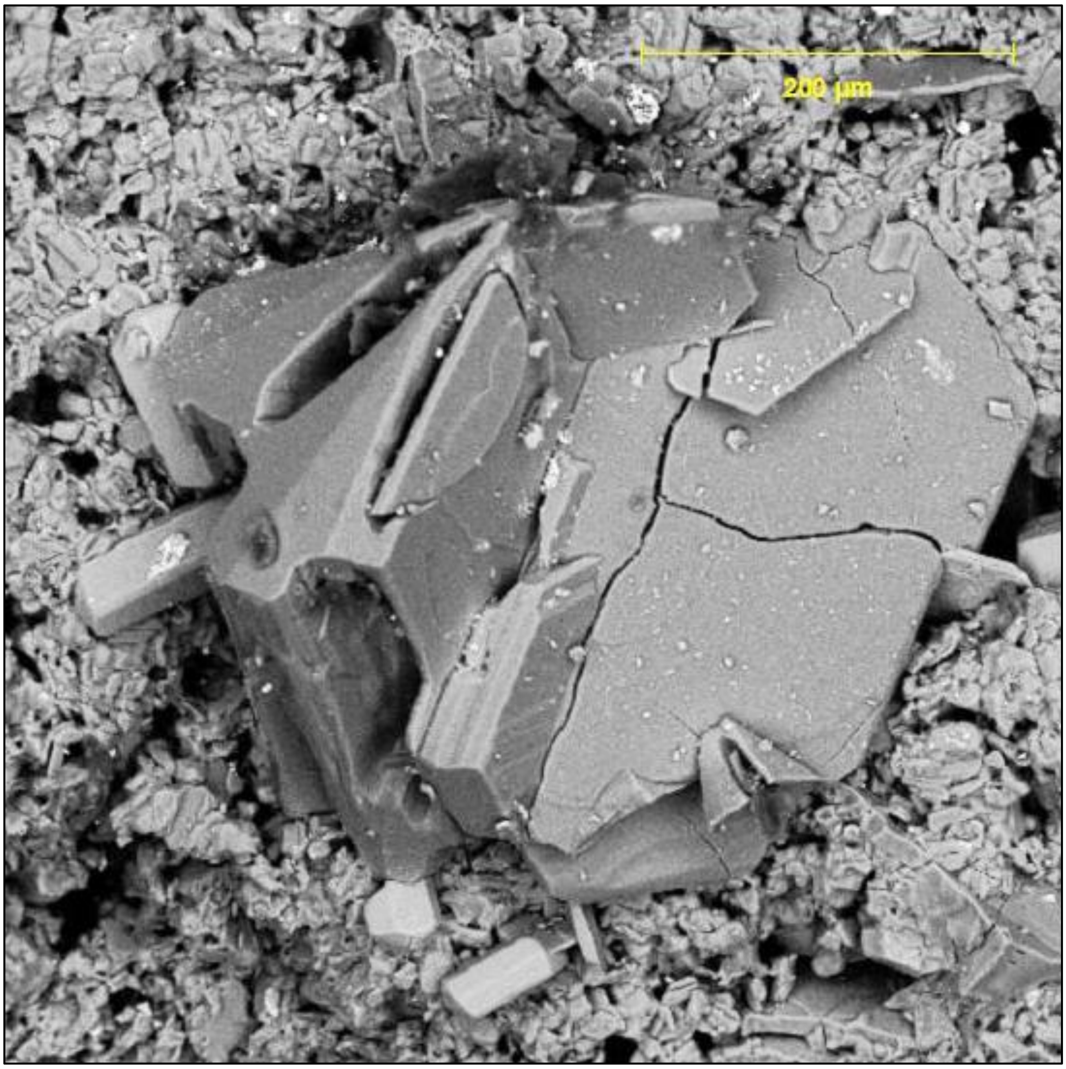


Figure 5: SEM image of aggregate of tridymite crystals, with smaller crystals of augite and sanidine, from Spring Hill. Field of view 0.5 mm across. Pale patches on the tridymite crystal indicate locations of gold, barite and possibly other minerals. Image and specimen: P. Sutton.

Barite $BaSO_4$

EDS scans show small crystals of barite as late stage depositions on the tridymite crystals (Figure 5).

Chromite $Fe^{2+}Cr_2O_4$

Small grains of chromite were found in the groundmass of both icelandite flows (Gawith, 1977).

Feldspars

The feldspars of the groundmasses of both lava flows and the tuff layer vary from labradorite (Ab_{40}) to oligoclase (Ab_{75}) and sanidine (Edwards, 1938; Gawith, 1977).

The margins of the crystals are often corroded owing to reaction with the enclosing magma. Further details of sanidine are described below.

Ferrosilite $(Fe^{2+}Mg)Si_2O_6$

Partially absorbed green to light brown crystals and grains, were described as hypersthene by Edwards (1940) and Gawith (1977) who considered that they represented a major phase in both the black and grey lava flows. EDS analysis indicates that their composition is near the ferrosilite end of the ferrosilite-enstatite series.

Gold Au

EDS scans indicate the presence of small particles of gold on faces of some of the tridymite crystals (Figure 3).

Hypersthene

Discredited species. Refer to ferrosilite, above.

Ilmenite $Fe^{2+}TiO$

Thin six-sided crystals of ilmenite, no more than 300 µm across, are found in some of the cavities, and mineral sands in the streambeds contain ilmenite sands. Crystals recovered from the cavities demonstrate hexagonal prisms a {1120}, either equidimensional or in equal pairs, and the pinacoid c {1101} (Figures 6 and 7).

Magnetite $Fe^{2+}Fe^{3+}{}_2O_4$

Skeletal and well-formed small octahedral crystals of magnetite, up to about .04 mm across, are common associates in the cavities containing tridymite, sanidine and augite. The colour and luster varies from black and shining to dull and grey, varying according to the presence of supplementary faces and/or coatings of clay or other minerals. The most common form is the octahedron o {111} (Figures 8 and 9). Rounded and skeletal crystals of magnetite are also found in the cavities.

Olivine

Remnants of partly iddingsitized olivine (Fo_{50-60}) occur in the mottled grey lava flow (Edwards, 1938; Gawith, 1977).

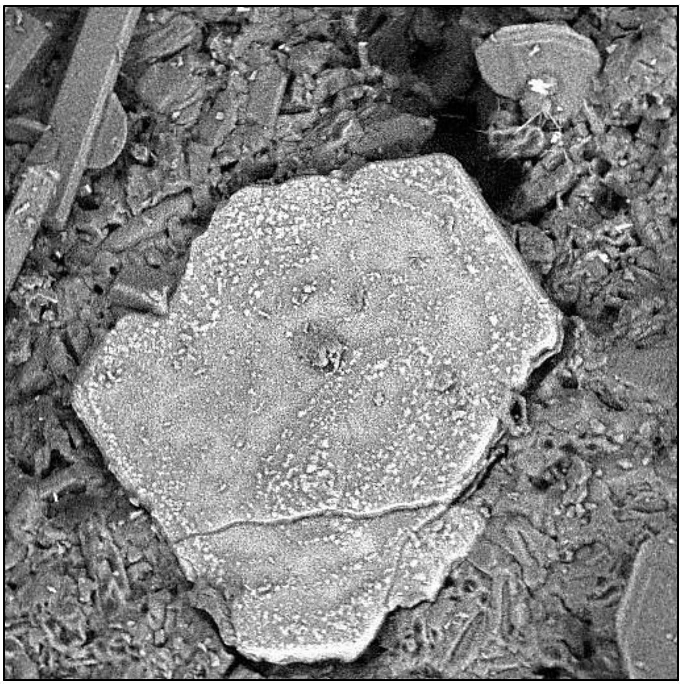


Figure 6: SEM image of ilmenite crystal associated with augite and small sanidine crystals in cavity, from Spring Hill. Field of view 0.4 cm across. Image and specimen: P. Sutton.

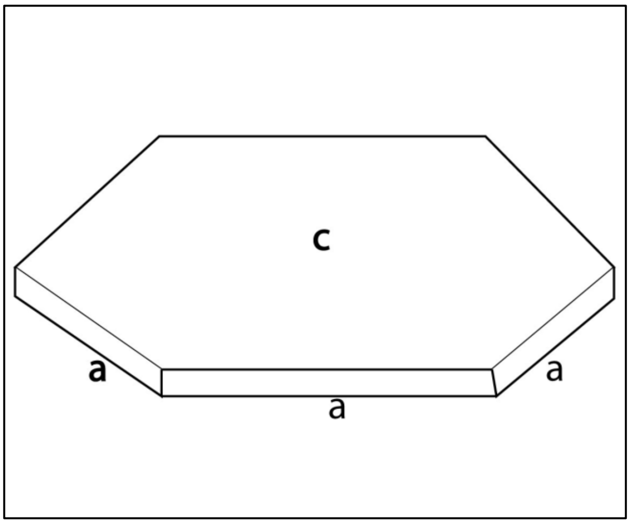


Figure 7: Crystal habit of ilmenite from Spring Hill.

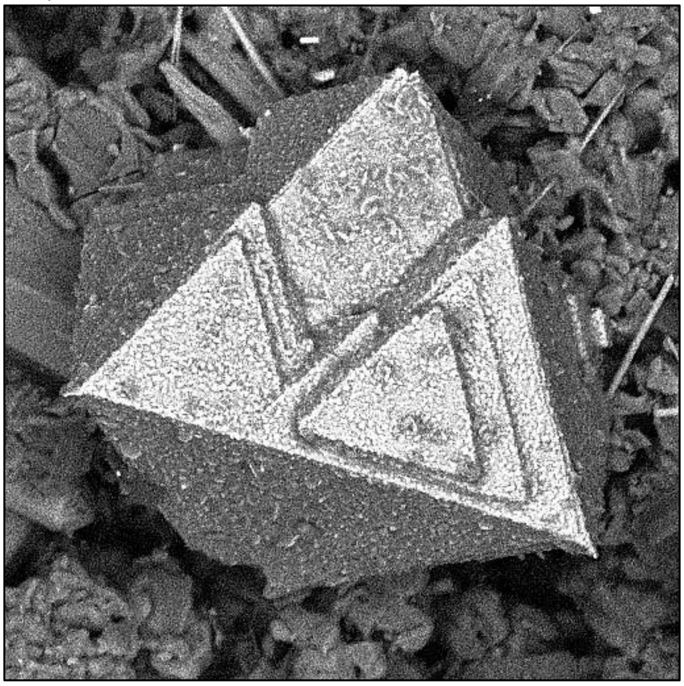


Figure 8: SEM image of magnetite crystal associated with augite and small sanidine crystals in cavity from Spring Hill. Field of view 0.4 cm across. Image and specimen: P. Sutton.

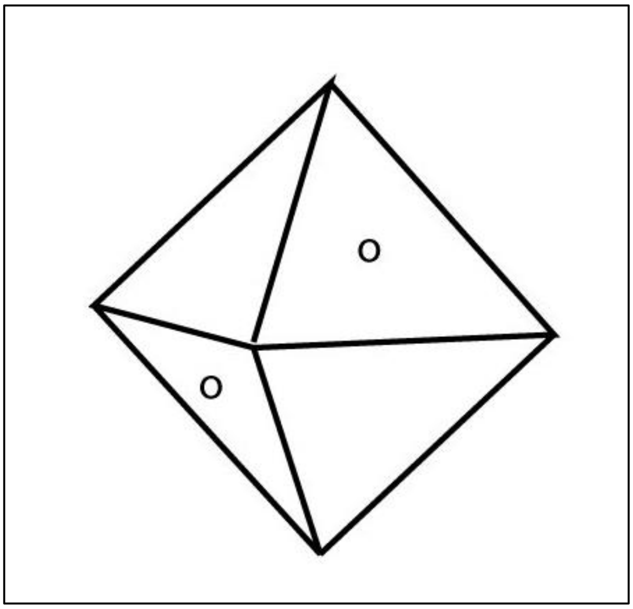


Figure 9: Crystal habits of magnetite from Spring Hill.

Opal $SiO^2.2H_2O$

Hyalitic opal is common as a later stage coating of the other minerals, usually in clear, glassy botryoidal growths. The presence of iron and/or underlying sanidine in some specimens causes the colour to be brownish.

Phlogopite $KMg_3AlSi_3O_{10}(OH)_2$

Thin tabular yellowish-brown crystals and crystal groups of phlogopite, up to 2.5 mm across and usually almost filling the cavity, are present in the mottled grey icelandite.

Sanidine $(K,Na)AlSi_3O_8$

Brown to colourless and partially transparent single and twinned phenocrysts, and grains, of sanidine, up to 1mm long, occur in the cavities (Figures 10, 11 and 12). Crystals are tabular, parallel to **c** (010) with prism m {110} and pinacoid b {010} and c {001} faces. Some crystals are acicular, elongated parallel to **c** (100), with dominant faces b (010) and c (001) and orthodomes p (101) and y (201). Often the faces are poorly developed and the process of melting and resolution has left only skeletal crystals and/or aggregates of skeletal crystals, which Edwards and Crawford (1940) referred to as a 'brain structure of feldspar' (Figure 3).

Figure 10: Brown crystals of sanidine in matrix from Spring Hill. Field of view 10 mm across. Photo and specimen: P. Sutton.

Figure 11: Cluster of sanidine crystals from Spring Hill. Field of view 3 mm across.
Photo and specimen: P. Sutton.

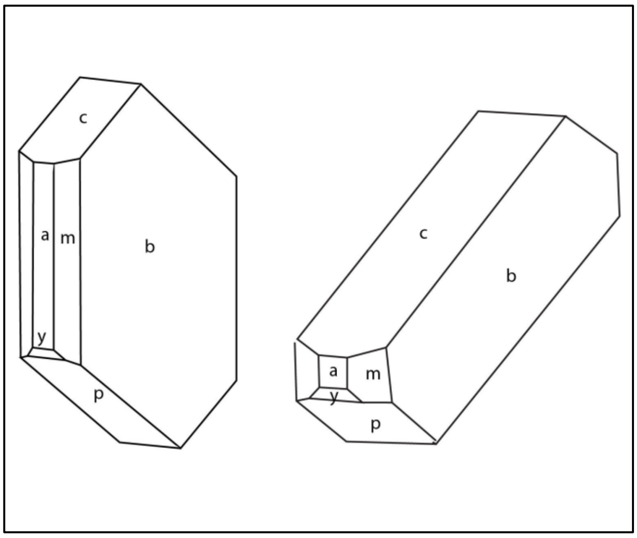


Figure 12: Crystal habits of sanidine from Spring Hill (after Hentschell, 1975).

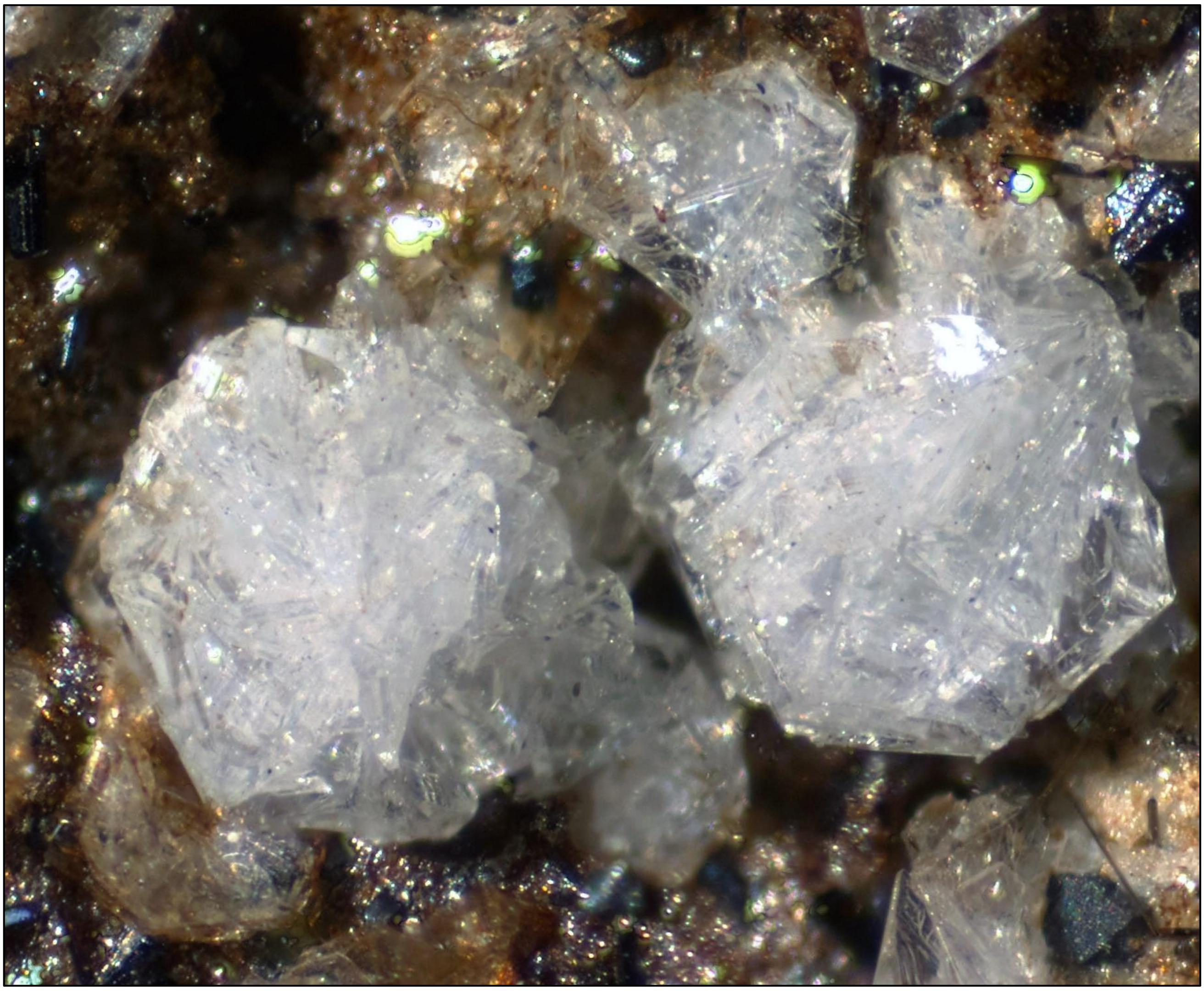


Figure 13: Clusters of tridymite crystals associated with smaller crystals of augite, magnetite and sanidine, from Spring Hill. Field of view 4 mm across.
Photo and specimen: P. Sutton.

Tridymite SiO_2

Excellent thin pseudohexagonal crystals and groups of tridymite crystals, tabular on **c** (0001) and comprising pinacoid b {0001} and prism m {1010} faces, are common in vesicles, in the mottled grey icelandite (Figures 13, 14, 15, 16). The crystals, up to 2 mm across, and groups of crystals are colourless and transparent when fresh, white and dull as a result of minor cracks or rough faces. Single crystals are present, but the mineral more typically occurs as penetration twins, trillings, or “rosette-like” or irregularly oriented aggregates.

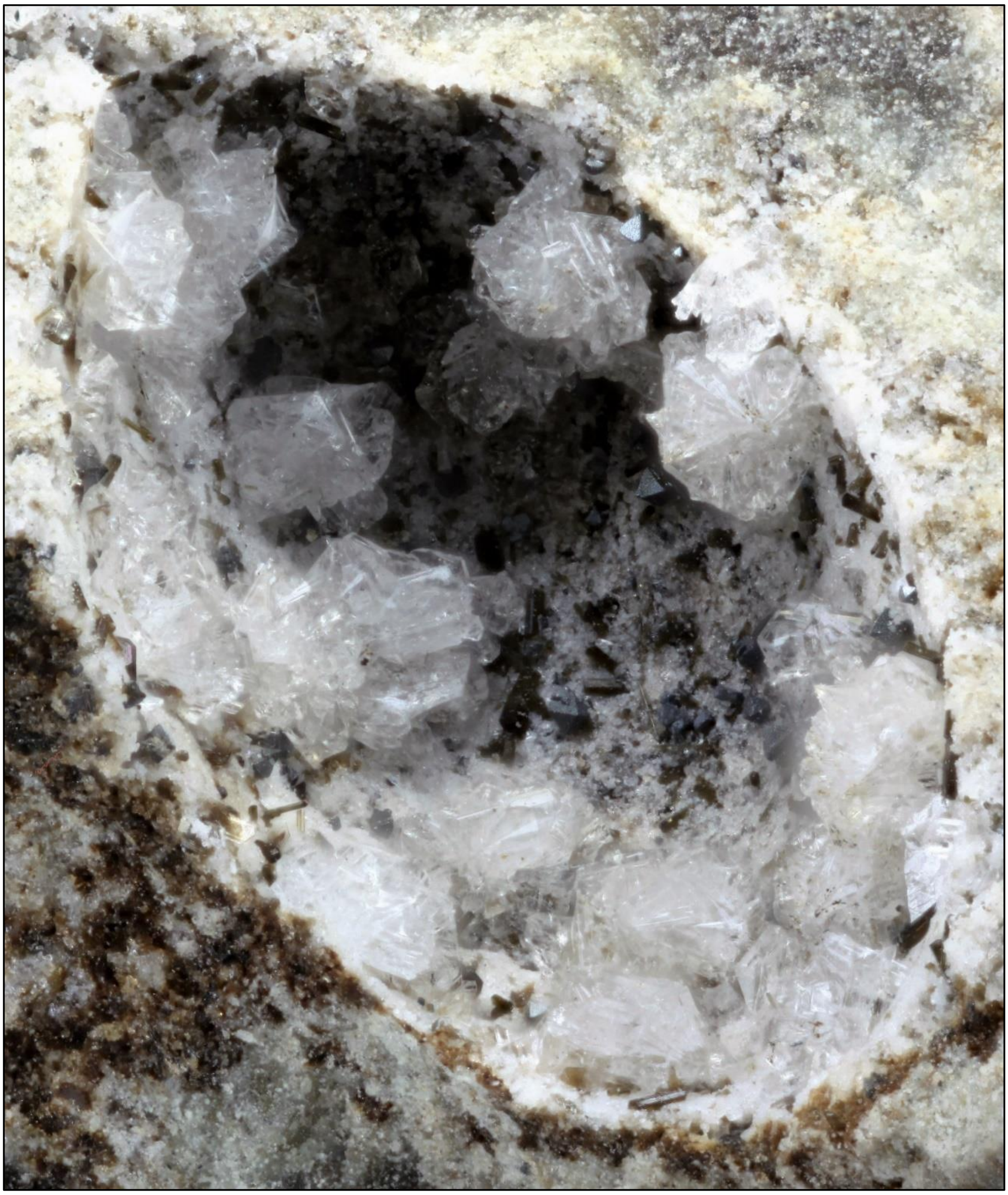


Figure 14: Tridymite crystals in cavity in icelandite. Field of view 7 mm across. Photo and specimen: P. Sutton.

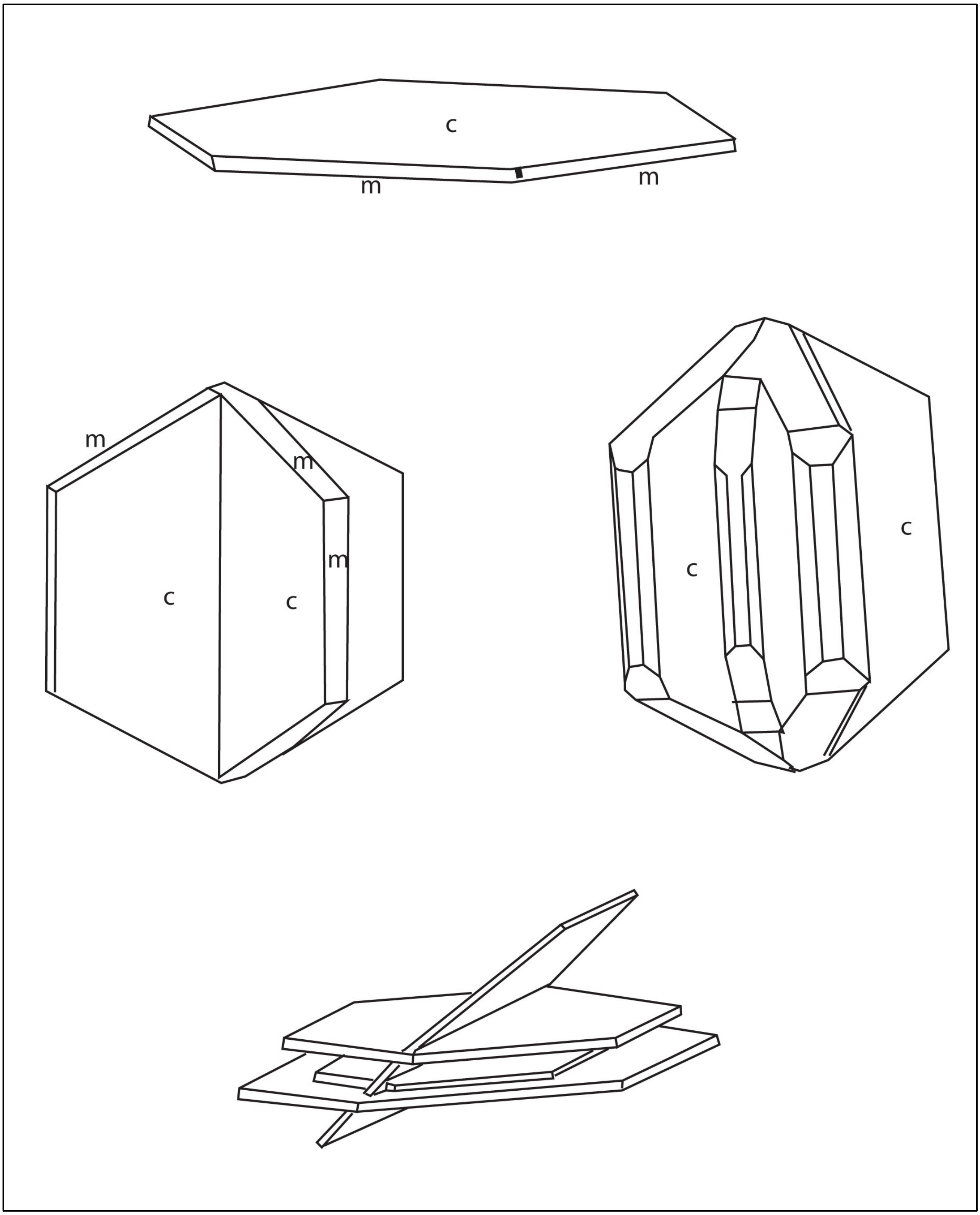


Figure 15: Crystal habits of tridymite from Spring Hill (after Goldschmidt, 1913).

Zeolites

Patches of zeolites occur throughout the matrix of the mottled grey lava flow (Gawith, 1977).

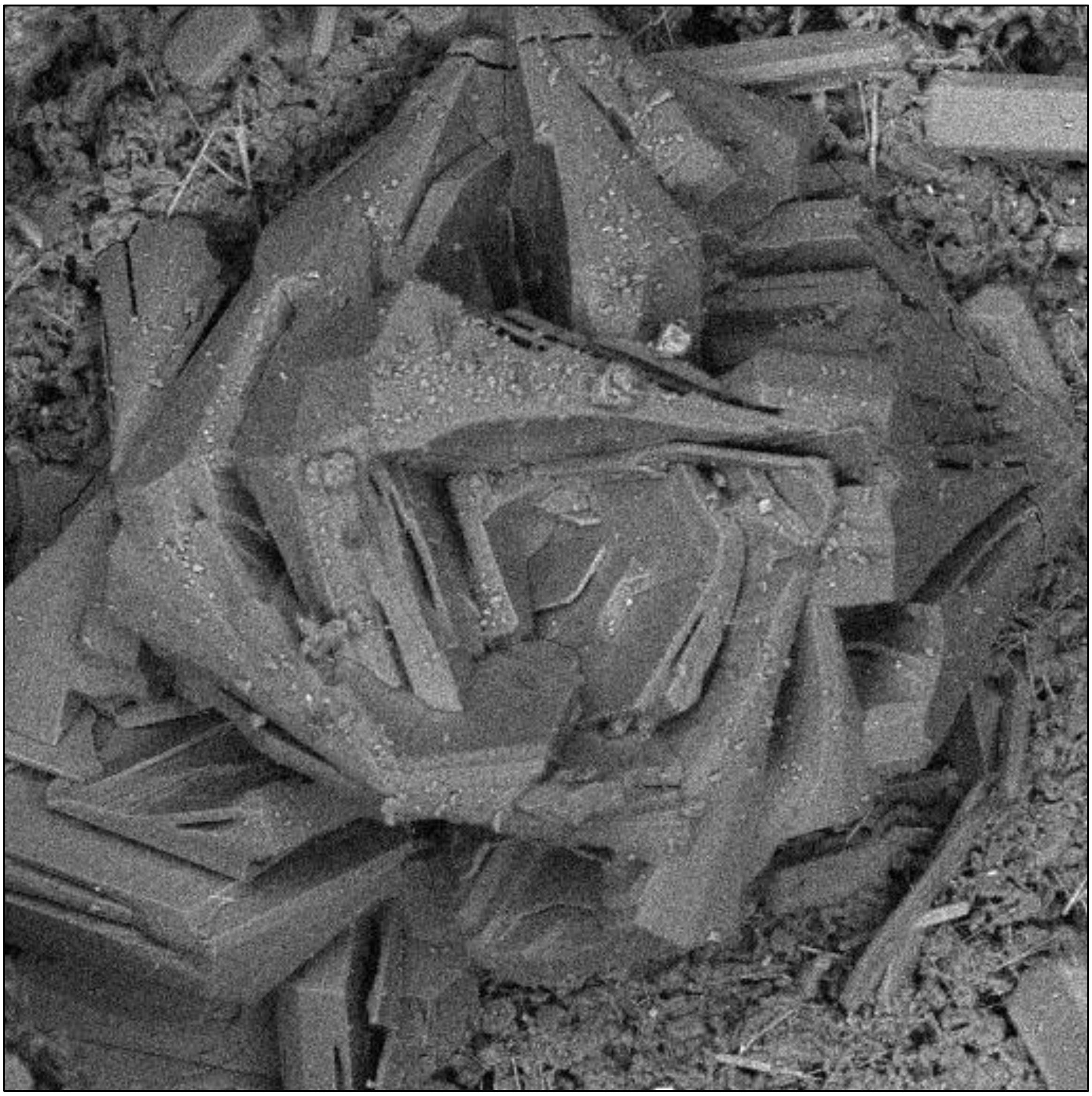


Figure 16: SEM image of tridymite “rosette” of crystals from Spring Hill. Field of view is 7 mm across. Image and specimen: P. Sutton.

Discussion

Icelandite has a high silica content, Edwards (1935) reporting as much as 63% in the glassy “trachyandesite” at Coliban, at the northern end of the lava flow. Gawith (1977) described oligoclase (An25) as a significant constituent of the ground mass of both lava flows and the tuff layer and asserted that, with augite, hypersthene and minor amounts of olivine, it represented the major phases of the grey mottled lava groundmass. Sanidine was the major feldspar component of the cavities. Edwards (1938) reported that orthorhombic pyroxenes (hypersthene/ferrosilite) were not prevalent in the grey mottled lava and that they were unstable, dissolving while monoclinic lime-rich pyroxene was forming.

Two oxide phases, magnetite and ilmenite are present in cavities but are less common than the other minerals, and are often thinly coated by them. Ilmenite weathered from the host rock is deposited in beds of ilmenite sands.

Tridymite and hyalitic opal crystallized from silica-rich hydrothermal groundwater dissolving existing and re-depositing new minerals. Tridymite is the most common variety of high-temperature silicon dioxide mineral in the locality. Hyalitic opal was a later stage development and can be found coating all of the other minerals in a cavity.

Small quantities of other minerals, including apatite, barite and gold were deposited on some of the tridymite crystals. Groups of small ubiquitous needles of apatite are part of the ground mass of the mottled grey icelandite flow (Gawith, 1977; Edwards, 1938), and leaching of these would have provided the PO for the crystallization of later stages of the mineral.

Acknowledgements

My thanks to Jo Price for her gift of specimens from the locality.

References

Carmichael I.S.E., 1964: The Petrology of Thinginuli, a Tertiary Volcano in Eastern Iceland. *Journal of Petrology*, 5:3 435-460.

Edwards, A.B., 1935: Three Olivine Basalt-Trachyte Provinces and Some Theories of Petrogenesis. Proceedings of the Royal Society of Victoria, 48:1, 13-26.

Edwards, A.B., 1938: The Tertiary Volcanic Rocks of Central Victoria. *Quarterly Journal of the Geological Society*, London, 92:2, 243-320.

Edwards, A.B., and Crawford, W., 1940: The Cainozoic Volcanic Rocks of the Gisborne District. *Proceedings of the Royal Society of Victoria*, 52, 281-311.

Gawith, P.F., 1977: *Geochemistry and Petrography of the Tertiary Volcanics from the Spring Hill-Tylden area, Central Victoria*. B. Sci (Hons) thesis, La Trobe University, Melbourne, unpublished.

Goldschmidt, V., 1913: Atlas der Kristallformen. Carl Winters, Heidelberg.

Hentschell, G., 1975: Die Mineralien der basaltische Gesteine im Laacher Vulcangebiet. *Der Aufschluss*, 26, 65-87.

Joplin, G.A., 1968: *A Petrography of Australian Igneous Rocks*. Angus and Robertson, second edition, 214 pp.

Osborne, C.R. and Radojkovic, A.M., 2002: Trentham, 1:50,000 geological map. Geological Survey of Victoria.

Wallace, D.A., 1990: *Petrology and Geochemistry of the Newer Volcanics of the Western Highlands of Victoria, Australia*. M.Sci. thesis, La Trobe University, unpublished.

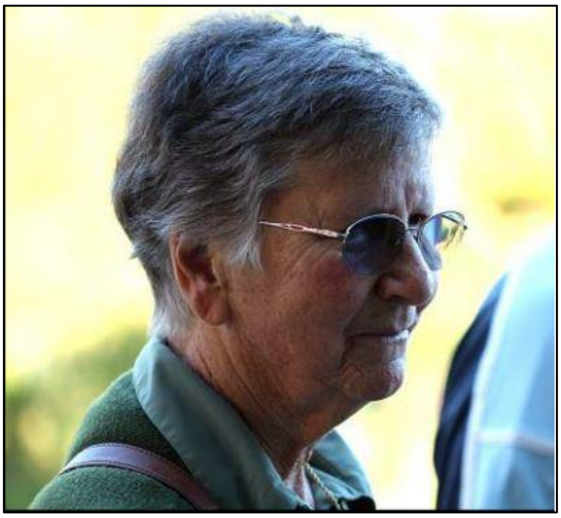
Wellman, P., 1974: Potassium-argon ages on the Cainozoic volcanic rocks of eastern Victoria, Australia. Journal of the Geological Society of Australia, 21, 359-376.

Willman, C.E., Bibby, L.M., Radojkovic, A.M., Maher, S., Haydon, S.J., Hollis, J.D., and Osborne, C.R., 2002: *Castlemaine*. Geological Society of Victoria, Report 121, 170 pp.

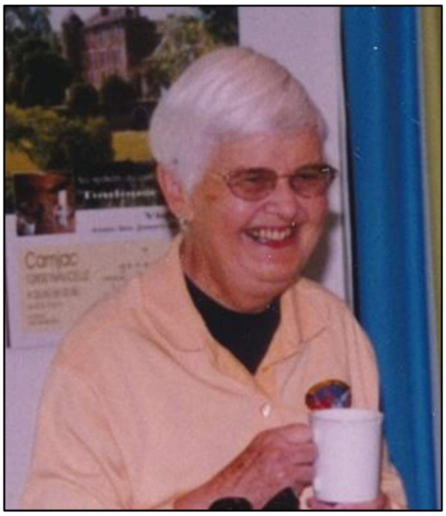
Micromineral news from Victoria

John Haupt

Last year (2016) was a sad year for the Victorian Micro Group, with the passing of Judy Rowe and Val Hannah. Both were enthusiastic collectors of micro minerals and were stalwarts of the micro group for many years contributing numerous specimens for the group to study. Judy was particularly keen on photographing specimens and has placed almost 1500 images on Mindat. Val was a keen collector of Australian thumbnail and micro minerals. They are both greatly missed by the group.



Judy Rowe (1933-2016)



Val Hannah (1932-2016)

Our group now has 5 regular members, unfortunately all are of mature age. We continue to meet monthly when we have a quorum of 4 attendees. Our topics are usually location based, it seemingly being easier to get together specimens out of our collections to bring along to the meetings.

Our recent topics have been minerals from Western Australia, the USA, Queensland, Broken Hill (revisited) and Africa (except Namibia). Images of some of the more interesting specimens we saw are shown below. All images ©J. Haupt.

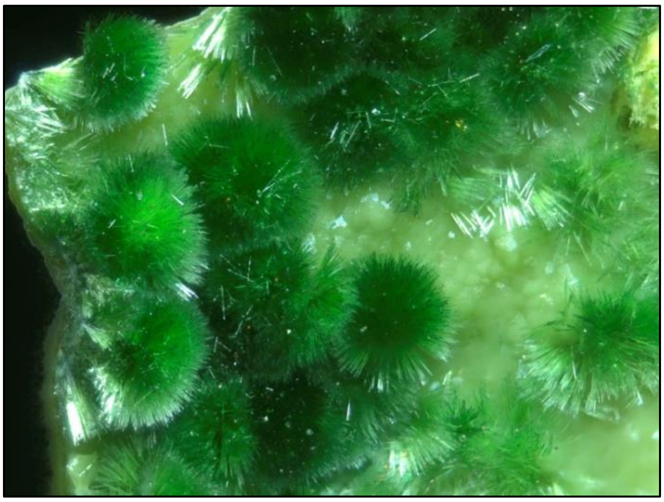
Western Australia:

There are many rare and uncommon minerals that have come from Western Australia. Mindat lists 671 species with 57 having Western Australia as their type locality. The Whim Creek Copper Mine has arguably produced the most attractive wulfenite specimens from Australia with fine specimens being in most people's collections. The 132 North mine at Widgiemooltha has produced a number of uncommon nickel minerals and is the type locality for gillardite and widgiemoolthalite. A more recent find was the new mineral putnisite from the nearby Armstrong mine.


A 2mm bipyramidal crystal of wulfenite from Whim Creek.


Fornacite and wulfenite from Whim Creek. 1.5mm FOV.


Glaukosphaerite 'balls' on gaspeite from the 132 North mine. 2mm FOV. The very small light yellow crystals on the glaukosphaerite are unidentified.


Sprays of widgiemoolthalite (unconfirmed) from the 132 North mine. 2mm FOV.

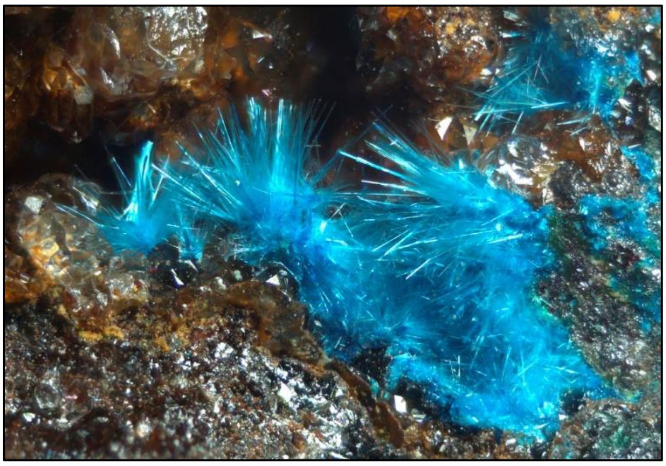

A 0.1 mm crystal of putnisite from the Armstrong Ni mine, Widgiemooltha.


A group of gillardite crystals from the 132 North mine. 1mm FOV.

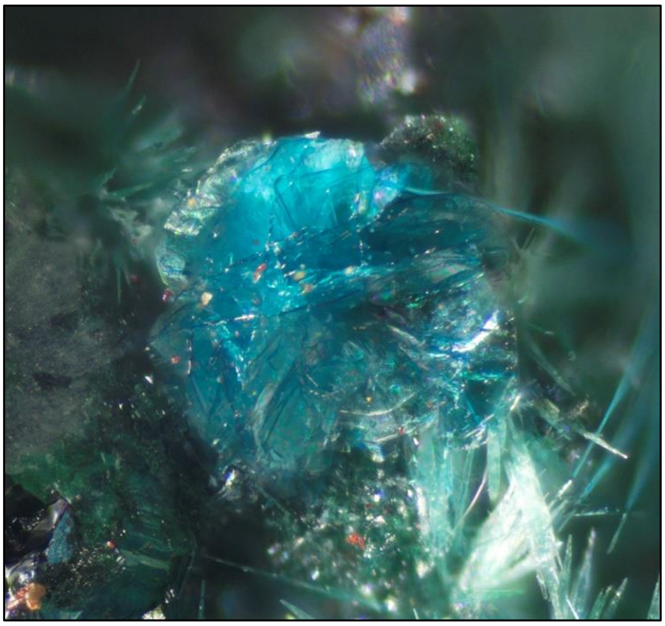
Queensland:

Like Western Australia, Queensland has also produced many uncommon and rare minerals. Mindat lists 390 species and 10 with Queensland as their type locality. The Mt Isa-Cloncurry region has produced many interesting copper minerals with probably the most popular locality for micro collectors being the Great Australia mine at Cloncurry. This locality was featured in 1995 article by Day & Beyer in the Australian Mineralogist (V1, No1).

Acicular sprays of cloncurryite with atacamite from the Great Australia mine. 2mm FOV.



Connellite from the Great Australia mine. 5mm FOV.



Tabular crystals of barlowite, 0.5mm across, from the Great Australia mine. Ex B&M Day collection.

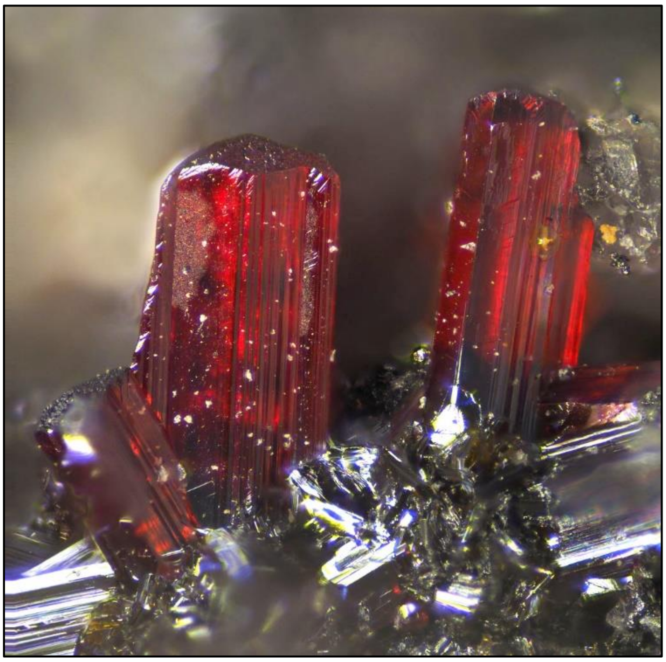
Barite crystals with inclusions of native copper from the Black Rock lode of the Mt Isa mine. The specimen is 15mm tall.

Africa (excluding Namibia)

Namibia was excluded from this topic as this country could be a considered separately because of its famous locality - Tsumeb. There were 2 countries which produced most of the members' specimens - Morocco and South Africa. The High Atlas Mountains in Morocco have produced many great mineral specimens, perhaps the best being from Bou Azzer (Refer Mineralogical Record Sept-Oct 2007 (V38, No5). The Kalahari Manganese Field in South Africa also needs little introduction. The Jan-Feb 2017 issue of the Mineralogical Record (V48, No1) features the beauty of minerals from the N'Chwaning Mine. A few of the specimens we observed were:

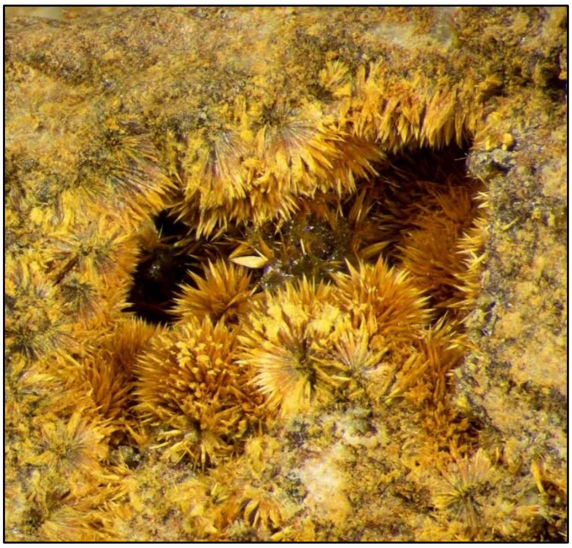
From Morocco:

Erythrite from Bou Azzer. 10mm FOV.



Proustite from the Imiter mine. 2mm FOV.

Roselite from Bou Azzer. 12mm FOV.



Karibibite from the Oumilil mine, Bou Azzer. 5mm FOV.

From the Kalahari Manganese Field in South Africa:

Sugilite from the Wessels mine, 6mm FOV.

Tan coloured olmiite crystals with acicular bultfonteinite from the N'Chwaning II mine. 10mm FOV.

Crystallography for Micromounters, Part IV – Symmetry

Noel Kennon (annoelk@gmail.com)

In Part III of this series we saw that a crystal is a pattern in three dimensions and comprises two parts. The first part is the motif which can be one or more atoms or molecules and the second is the scheme of repetition which describes the way in which the motif occurs by repetition in three dimensions. In this Part IV, we are concerned with the geometry of crystals and the fundamental concepts here relate to the properties of the space lattice of points showing the sites where the atoms or molecules are located in a crystal.

Having now examined the compositions of mineral crystals, the nature of the crystalline state and several concepts concerning space lattices and unit cells, we turn to one of the most fundamental properties of all crystals – symmetry, and see what it means.

First let us consider symmetry itself. If any two dimensional, or three dimensional body existing in one particular form or state can be changed by some action to another form or state which is indistinguishable from the first, then that body has symmetry of some kind. The action that accomplished this change is called a *symmetry operation* and the first and final forms or states of the body are said to be *self-coincident* or in *self-coincidence*.

In the specific case of minerals, there are two kinds of symmetry operations; one is called macroscopic symmetry and the other is microscopic symmetry. Macroscopic symmetry is evident in the shapes of naturally formed crystals and was first deduced from studies of crystal form or habit or morphology. There are four such symmetry operations and these are called rotation, reflection, inversion and rotary inversion. On the other hand, microscopic symmetry is evident only in the detailed array of atoms in the unit cell of a crystal. There are two such symmetry operations and individually they have no influence on crystal shape being detectable only by x-ray diffraction methods. They are called glide and screw.

First, let us examine macroscopic symmetry. Refer to Figure 1 which shows a square ABCD with an *axis* xy at right angles through the centre p. Note that an *axis* is any line through a body of any kind that serves a useful purpose in explaining properties of that body. Figure 1 shows the initial state of the square. Imagine now the square to be rotated about the axis through 90° in an anticlockwise direction. This rotation moves corner A to B, B to C, C to D and D to A. The new state (position) of the square is clearly indistinguishable from the first. So, the 90° rotation is a *symmetry operation* and has changed the square to *self-coincidence*. The axis xy is a *symmetry element* called a *rotation axis*.

Should the square be rotated an additional 90°, self-coincidence is attained again and so on. Rotation of the square through 360°, brings it to self-coincidence at 90°, 180°, 270° and finally at 360°. That is, there are four positions of self-coincidence during a full 360° rotation. The axis xy about which the rotation occurs is said therefore to be a four-fold axis of rotational symmetry.

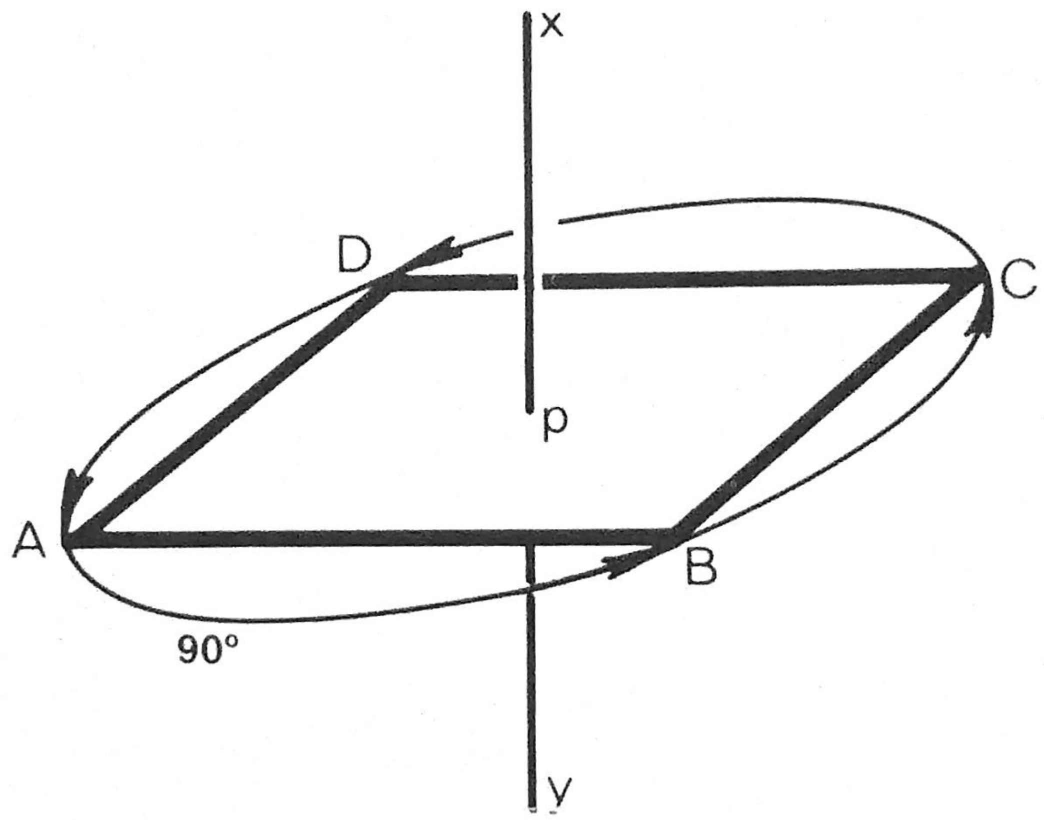


Figure 1: Diagram showing that the square ABCD is transformed to self-coincidence by rotations through 90°, 180°, 270° and 360° about the line (axis) xy at right angles through the centre p of the square.

There are only five kinds of rotational symmetry axes that can occur in crystalline materials. These are 1-fold, 2-fold, 3-fold, 4-fold or 6-fold axes called the symmetry elements 1, 2, 3, 4 and 6. Other axes such as 5-fold or 7-fold (and higher orders) are not possible because of the geometry of space lattices we looked at in Part III. For the 1-fold axis, the only state of self-coincidence is attained after the full 360° of rotation and essentially this means that the body has no rotational symmetry at all.

A second kind of symmetry operation is *mirror reflection*. Figure 2 shows a square ABCD which is intersected along the diagonal AC by a perpendicular plane m. If this plane functions as a mirror, corners A and C are unchanged but B is reflected to D and D is reflected to B. The initial state of the plane ABCD, shown in the Figure, is indistinguishable from the final state after reflection. The symmetry operation is called *reflection* and the symmetry element is the *mirror plane* m.

It is worth noting that the only symmetry of the human body is a mirror plane bisecting it vertically.

The third kind of symmetry is called *inversion* which is best illustrated with reference to the irregular polygon containing the point p shown in Figure 3. In this polygon, the points a and a’ are equidistant from p, that is, the lengths ap and a’p are the same. This is also true for bp and b’p, cp and c’p, dp and d’p, and ep and e’p. Because of these equalities, point a can be moved through point p to a’ and similarly b can be moved to b’, c to c’, d to d’ and e to e’ to generate a new state of the polygon. This new state is indistinguishable from the first and so the two states are in self-coincidence by the symmetry operation called *inversion*. This operation is possible if and only if, the two or three dimensional body that is acted upon, has a point p which is a symmetry element called a *centre of symmetry* I.

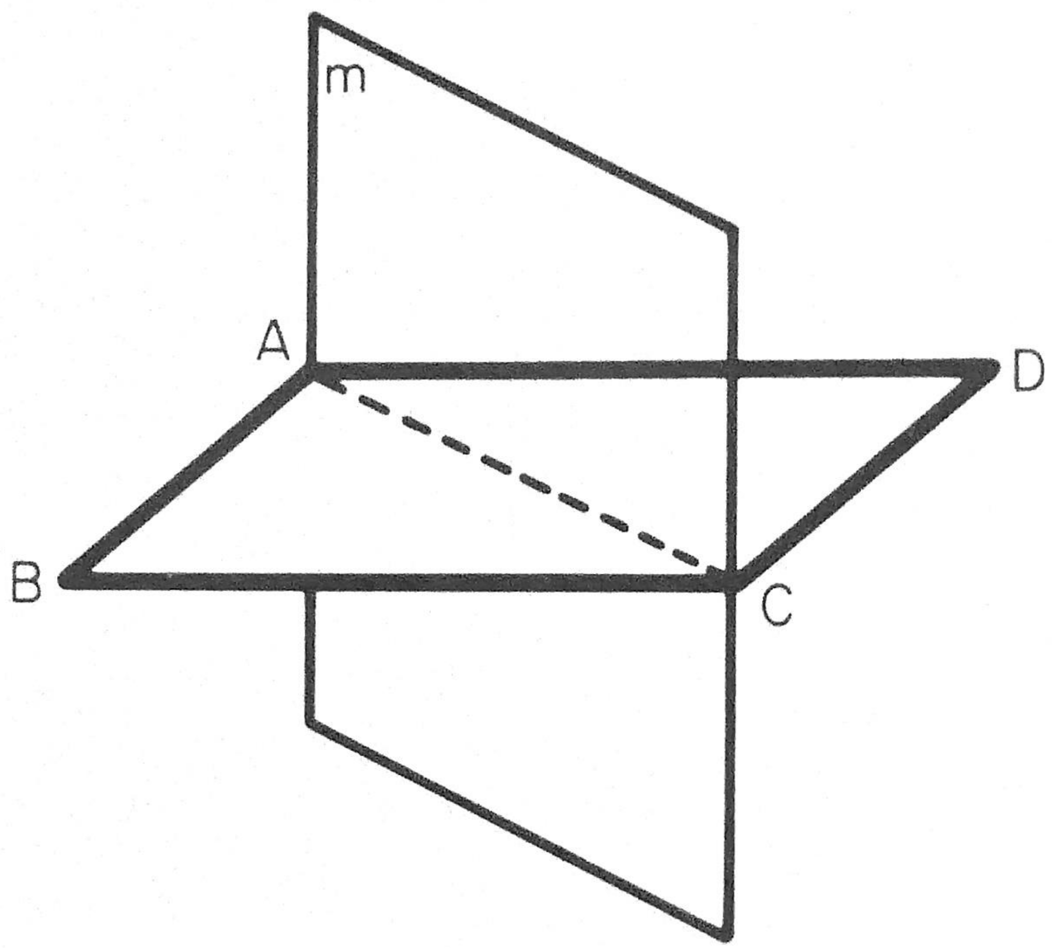


Figure 2: Diagram showing that the plane m divides the square ABCD into two mirror imaged halves.

The fourth kind of macroscopic symmetry is a combination or rotation and inversion called *rotary inversion*. This symmetry operation involves rotation about a rotation axis combined with inversion through a centre of symmetry located on that axis. As there are five kinds of rotation axis, there are a possible five kinds of *rotary inversion axis* as it is called.

$1 + \mathrm{I} \rightarrow \mathrm{I}$

$2 + \mathrm{I} \rightarrow \bar{2}$

$3 + \mathrm{I} \rightarrow \bar{3}$

$4 + \mathrm{I} \rightarrow \bar{4}$

$6 + \mathrm{I} \rightarrow \bar{6}$

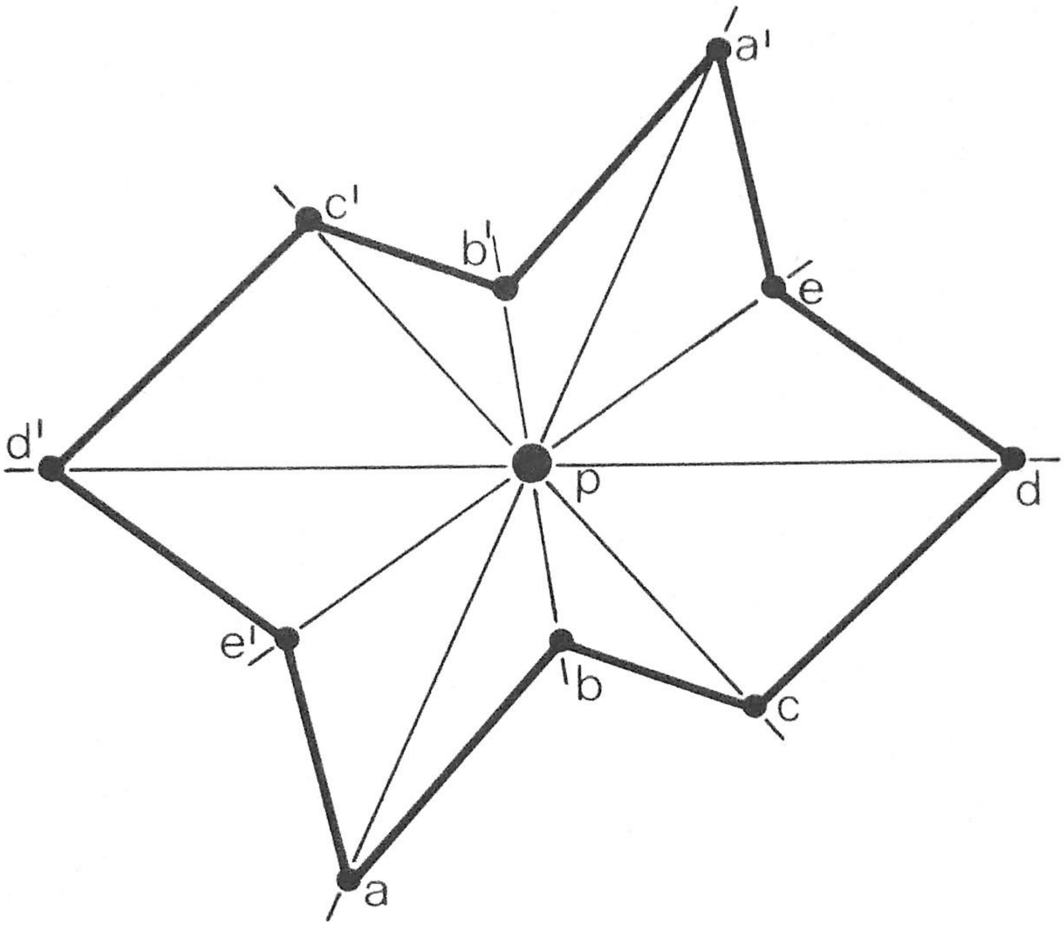


Figure 3: An irregular polygon with a centre of symmetry located at the point p.

The following comments may be made about these five possible rotary inversion axes.

(a) a $\bar{1}$ -fold rotary inversion axis is identical with a centre of symmetry and is not a new element.

(b) a 2-fold rotary inversion axis can be shown to be identical with a mirror plane and so is not a new element either.

(c) only the 3-fold, 4-fold and 6-fold rotary inversion axes are recognised as new elements.

Consequently, we see that there are ten macroscopic symmetry elements.

Rotation	1, 2, 3, 4, 6
Reflection	m
Inversion	$\bar{1}$
Rotary inversion	$\bar{3}$, $\bar{4}$, $\bar{6}$

Let us now consider microscopic symmetry. As pointed out earlier microscopic symmetry cannot be detected from the external shapes of crystals or any other property excepting for how x-ray diffraction is affected. It is not appropriate to consider this matter in any detail here and so we will simply look at the two types of microscopic symmetry operation – glide and screw.

Glide is closely associated with mirror reflection and describes the relationship between like groups of atoms that do not exactly correspond across the mirror plane, see Figure 4. The two groups are separated relative to one another by a fraction of the unit translation parallel to the mirror plane (called the *glide plane*). Should a glide plane be part of the microsymmetry of a crystal, it will appear in the external shape of the crystal as a mirror plane. Correspondingly, a mirror plane in the macrosymmetry of a crystal may in fact be a glide plane. There are five possible glide planes of symmetry generally labelled a, b, c, n, and d.

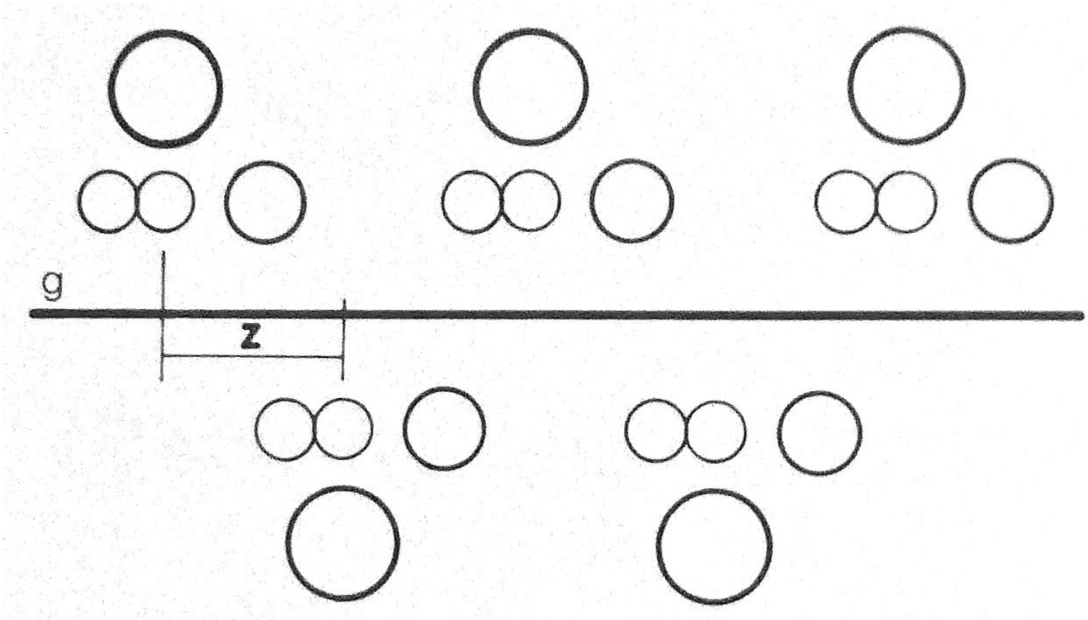


Figure 4: Diagram looking edge on at a glide plane g. Reflection of the four-circle group above the plane to below the plane together with translation of z parallel to the plane results in self-coincidence. This is the microscopic symmetry operation called glide.

The other microscopic symmetry operation is screw which is closely associated with rotation. In this case the locations of groups of atoms do not correspond exactly around the rotation axis but are separated relative to one another by a fraction of the unit translation in the direction of the axis (called the *screw axis*). Should a screw axis be part of the microscopic symmetry of a crystal it will appear in the external shape of the crystal as a rotation axis. Correspondingly, a rotation axis in the macroscopic symmetry of a crystal may in fact be a screw axis. There are 11 different screw axes related to four of the rotation axes. They are labelled as follows: 2_1, 3_1, 3_2, 4_1, 4_2, 4_3, 6_1, 6_2, 6_3, 6_4 and 6_5. The main number, 2, 3, 4 or 6, refers to the '-fold' of the screw axis. The subscript number refers to the displacement as a fraction of the unit translation parallel to the screw axis. Thus for the screw axis 3_1, the displacement is ⅓ of the unit translation, while for 3_2 it is ⅔ of the unit translation, and so on.

These 11 symmetry elements together with the 5 glide planes mean that there are 16 microscopic symmetry elements. In turn and with the 10 macroscopic elements, this means that there are a total of 26 symmetry elements that may occur in the structures of all crystals. There are no others.

Every mineral (or non-mineral) crystal must have at least one of these 26 elements of symmetry - even if that element is 1 – which means no symmetry at all. Some symmetry elements can occur in combination, others cannot. For example, it is possible for a crystal to have both 4-fold and 3-fold rotation axes. But on the other hand it is not possible for a crystal to have both 4-fold and 6-fold rotation axes. In Part V we will look at the possible combinations and how they can be used to classify all crystalline materials.

New Zhongyi Mitakon Super Macro Lens

Steve Sorrell

In November 2016, Zhongyi Optics, a Chinese lens manufacturer, announced the release of a new Zhongyi Mitakon 20mm f/2.0 4.5X Super Macro Lens. They were inundated with orders from around the world, and had to limit supply of the first batch. I was fortunate to be able to receive mine in February.

The manufacturer states "the lens is capable of creating unbelievable macro images ranging from 4x to 4.5x magnification. Users no longer need to DIY or use any extension tubes to reach high magnification shooting. It incorporates a 6pcs of elements in 4 groups structure which delivers impressive resolution from corners to corners. Weighing merely 0.5 lbs (230g) and 6cm long, it is a perfect companion for wildlife and outdoor shooting. The wide angle of view and close focusing distance allows you to compose creative images with more information included into the frame. Greater magnification (up to 13:1) can also be achieved by stacking extension tubes or bellows. The high magnification is also extremely useful for scientific purposes".

It took me a little while to get used to it. Camera shake was very evident, particularly with the camera on a tripod, and I had to ensure a stable surface for camera and specimen. Once that was achieved, it was time to have fun! I now regularly take photos either with or without extension tubes. I use a Canon camera body (EOS 750D) and end up with a photo width of either 5mm or 3mm with tubes.

I am mostly using it at f2 but there is very minimal depth of field with this setting so stacking is a must. I prefer Zerene Stacker for this. You can get more depth of field with the setting at f16, but this creates much longer exposure times, and the possibility of introducing more camera shake.

The lens costs US$199 plus postage and comes with a lens mount for your nominated camera. It supports Canon, Nikon, Sony, Pentax or Fuji cameras.

Is it worth the wait time for delivery, and the price? Absolutely!

The photo on the front cover and the photo on page 2 were taken using this lens.

Adding a Scale Bar to Micro Photos

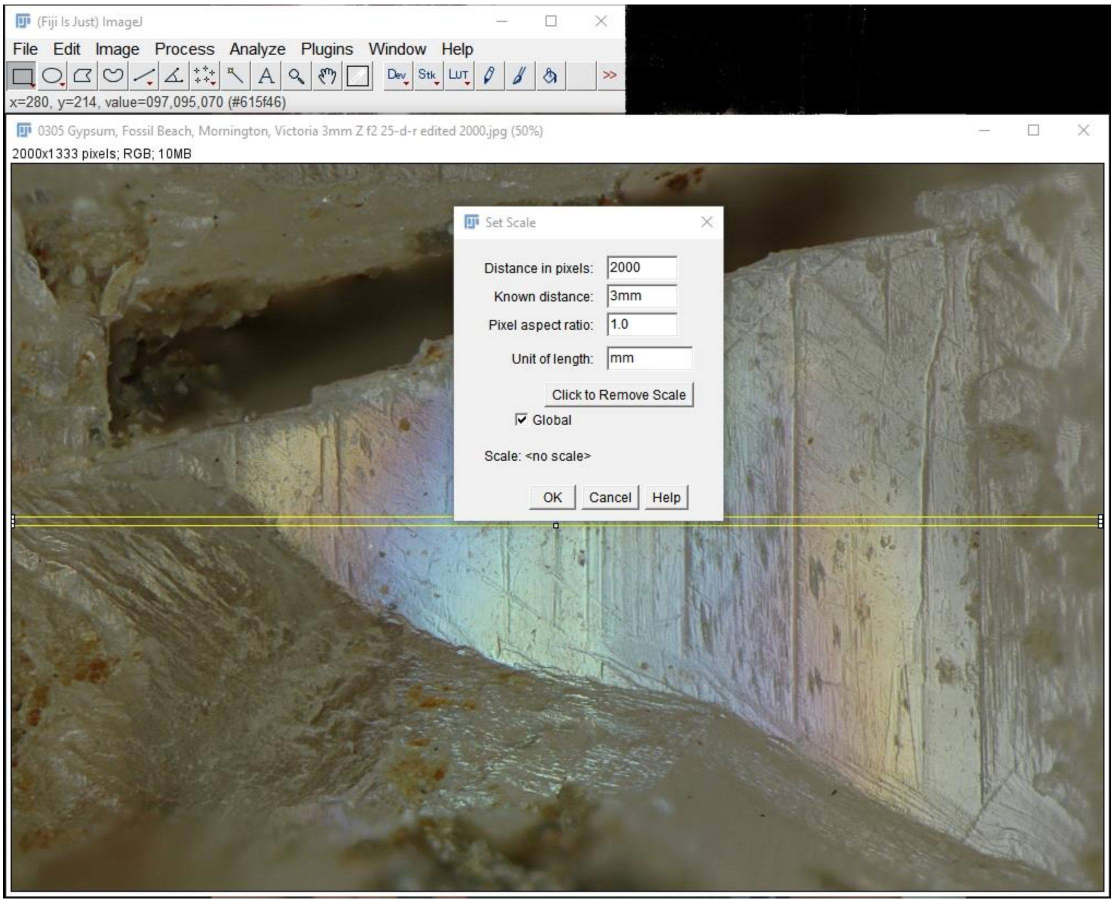
Steve Sorrell

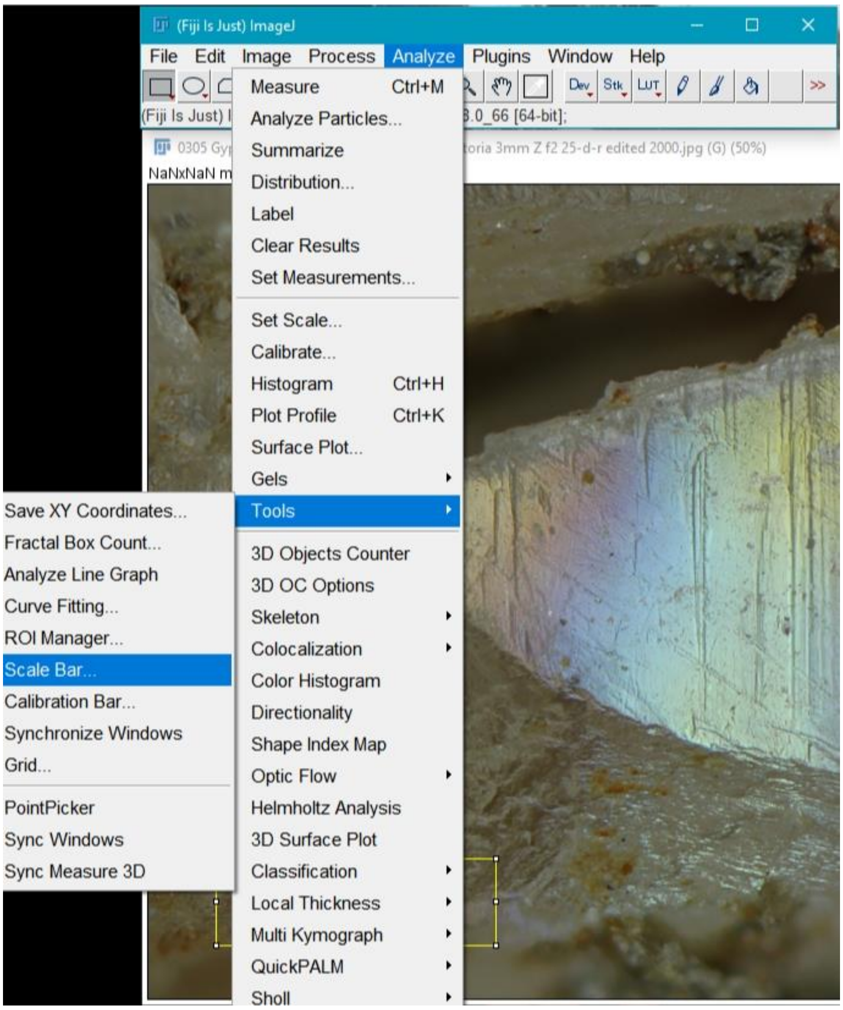
In January, Rod Martin posted on the New Zealand Micro-Mineral Group Facebook page about adding scale bars to photos. The software is called ImageJ and is available as a free download. Unfortunately, that version wouldn't work for me as I am on Windows 10. However, there is a version available that does work. You can get it here – https://imagej.net/Fiji/Downloads.

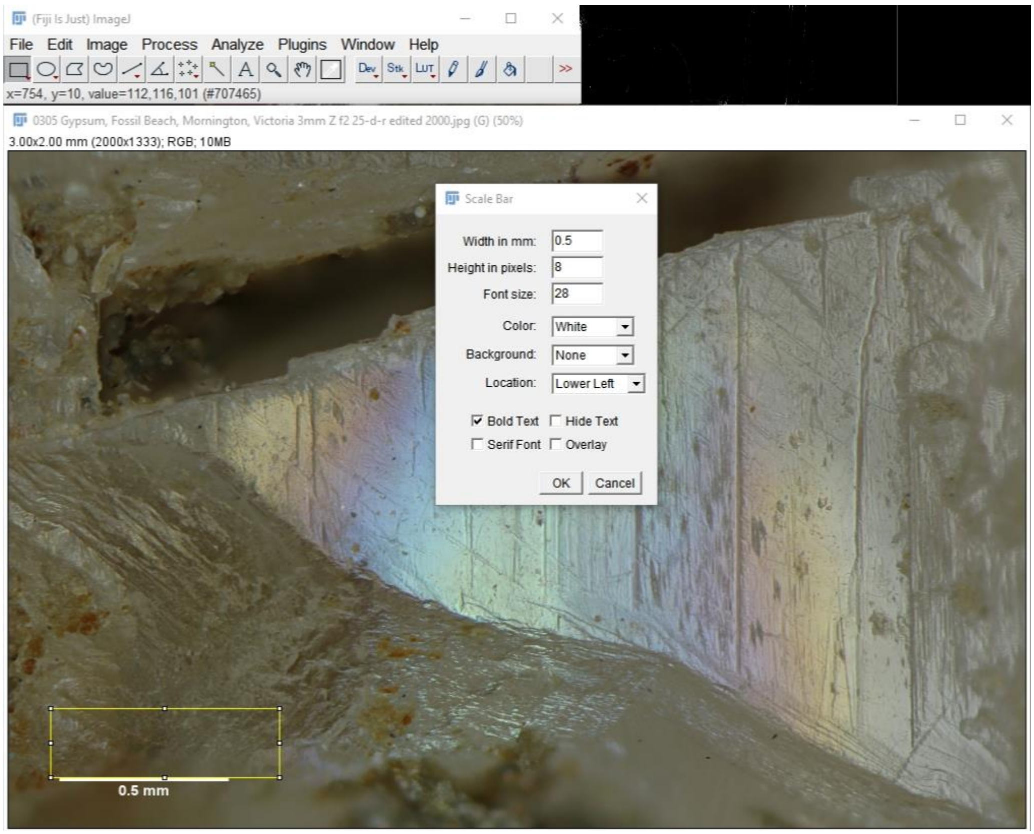
This software can do a lot more than just scale bars, however, that's all I use it for.

The process is quite easy once you get the hang of it. After you have opened your image file, first draw a line across the image. Then select Analyze, Set Scale. You enter in the width of your photo in pixels, then the known width in mm (of course you need to have determined this prior!). The best way to do this is take a photo of a ruler or other measuring device, and use the same settings for your photos.

Once the scale has been set, it is a simple matter of either drawing a box where you want your scale bar to appear, or using one of the pre-defined areas (eg: top left, etc), then selecting Analyze, Tools, Scale Bar. Done!




(Fiji Is Just) ImageJ
File Edit Image Process Analyze Plugins Window Help
Measure Ctrl+M
Analyze Particles...
Summarize
Distribution...
Label
Clear Results
Set Measurements...
Set Scale...
Calibrate...
Histogram Ctrl+H
Plot Profile Ctrl+K
Surface Plot...
Gels
Tools
3D Objects Counter
3D OC Options
Skeleton
Colocalization
Color Histogram
Directionality
Shape Index Map
Optic Flow
Helmholtz Analysis
3D Surface Plot
Classification
Local Thickness
Multi Kymograph
QuickPALM
Sholl
Save XY Coordinates...
Fractal Box Count...
Analyze Line Graph
Curve Fitting...
ROI Manager...
Scale Bar...
Calibration Bar...
Synchronize Windows
Grid...
PointPicker
Sync Windows
Sync Measure 3D


(Fiji Is Just) ImageJ
File Edit Image Process Analyze Plugins Window Help
x=754, y=10, value=112,116,101 (#707465)
0305 Gypsum, Fossil Beach, Mornington, Victoria 3mm Z f2 25-d-r edited 2000.jpg (G) (50%)
3.00x2.00 mm (2000x1333); RGB; 10MB
Scale Bar
Width in mm: 0.5
Height in pixels: 8
Font size: 28
Color: White
Background: None
Location: Lower Left
Bold Text
Hide Text
Serif Font
Overlay
OK
Cancel
0.5 mm

Rare bismuth minerals from Morass Creek, Benambra, Victoria

John Haupt

A small prospect at Morass Creek, a remote location near Benambra in the Victorian highlands has produced several rare bismuth minerals. The deposit was identified in the late 1970s during mineral exploration by Essex Minerals and named the Wombat Hole Copper Prospect due to colourful copper stained rocks thrown out by a wombat. The locality was visited by Museum Victoria personnel 1994 and the various species were then identified. All are of micro size. The minerals occur in a small vesuvianite-andradite skarn and have been described by Birch *et al* (1995). Only a brief description of the minerals is given here. The locality is within the Alpine National Park.

Mrázekite $Bi_2Cu_3(PO_4)_2.O_2(OH)_2.2H_2O$

Usually occurs as royal blue spheres of radiating crystals to 1mm within chrysocolla. Less common are groups of prismatic transparent crystals up to 0.5mm with a wedge-shaped termination (Birch *et al*).

Namibite $Cu^{(}BiO)_2VO_4(OH)$

Seemingly rarer than mrázekite, namibite occurs sparingly as pistachio-green to nearly black hemispheres of minute tabular crystals up to 5mm across.

Pucherite $BiVO_4$

Was found as honey-brown to orange-brown micro crystals up to 0.2mm long. They have an elongated ‘dog tooth’ habit with an adamantine lustre.

Schumacherite $Bi_3O(VO_4)_2(OH)$

Forms yellow-brown to pale green spheres and globular coatings with a waxy appearance.

Opal-AN (*hyalite*) $SiO_2.nH_2O$

Water clear botryoidal ‘hyalite’ commonly covers many of the other species.

Vesuvianite $(Ca,Na)_{19}(Al,Mg,Fe)_{13}(SiO_4)_{10}(Si_2O_7)_4(OH,F,O)_{10}$

One of the skarn minerals, honey-brown vesuvianite can form as individual crystals up to 3mm long with chrysocolla.

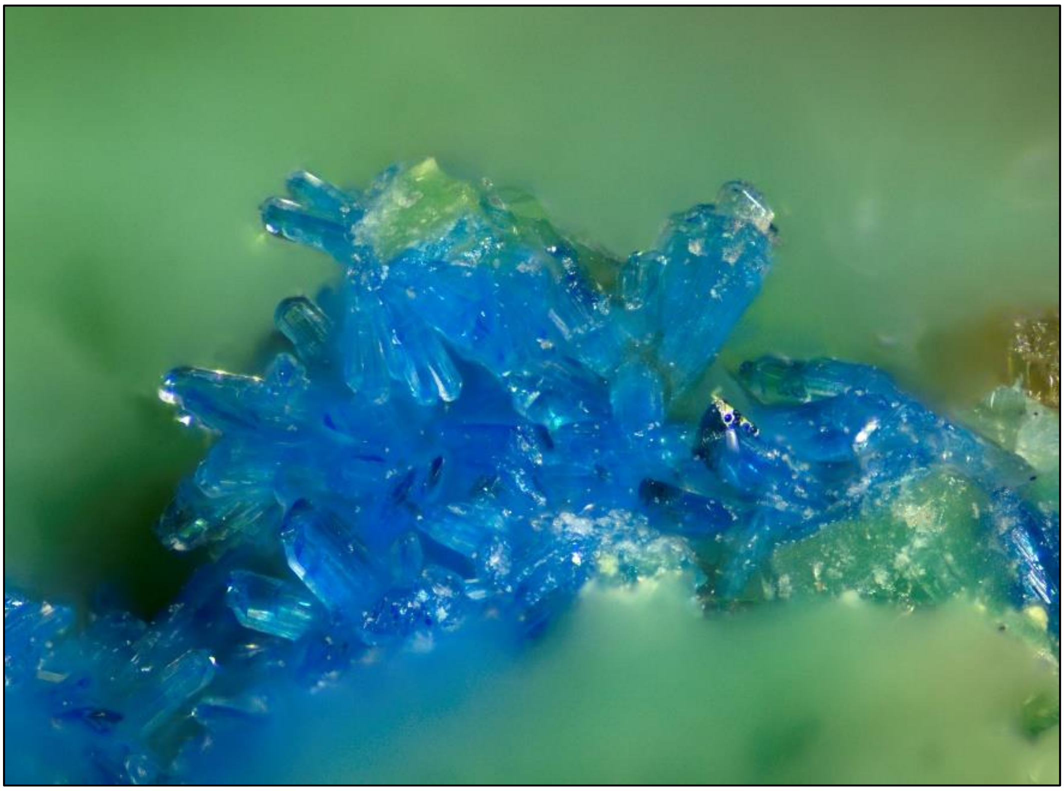
Other minerals recorded from the deposit are azurite, bismite, bismutite, bornite, chalcopyrite, eulytine, gold, grossular, hechtsbergite, malachite, wittichenite and wulfenite as well as the following tellurium bearing metallic minerals: hedleyite, rucklidgeite, sulphotsumoite, and tsumoite. (Ref: D. Henry presentation at M&M 5 conference (unpublished)).

The specimens photographed have been visually identified under the microscope and compared to published photographs. There is visual similarity between eulytine and schumacherite and pucherite and hechtsbergite which would require XRD analysis for positive identification.

References:

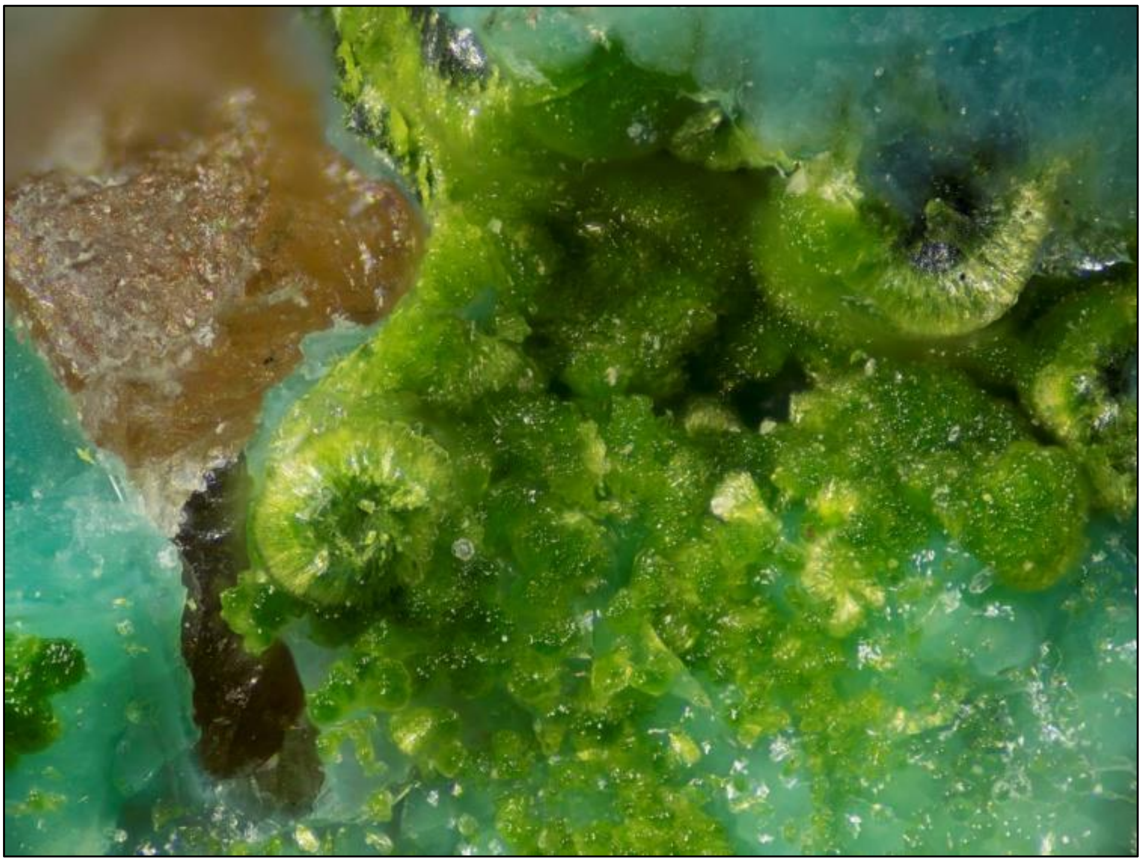
Birch, W.D., Henry D. A., & Pring A.; 1995: A new occurrence of Mrázekite from Benambra, Victoria, Australia. The Mineralogical Record, 26 (2), 107-113.

Haupt, J.C.; 2014: Some mines and minerals of Eastern Victoria, Part 17, Morass Creek, Benambra, The Mineralogical Society of Victoria Newsletter, 223, 11-14.

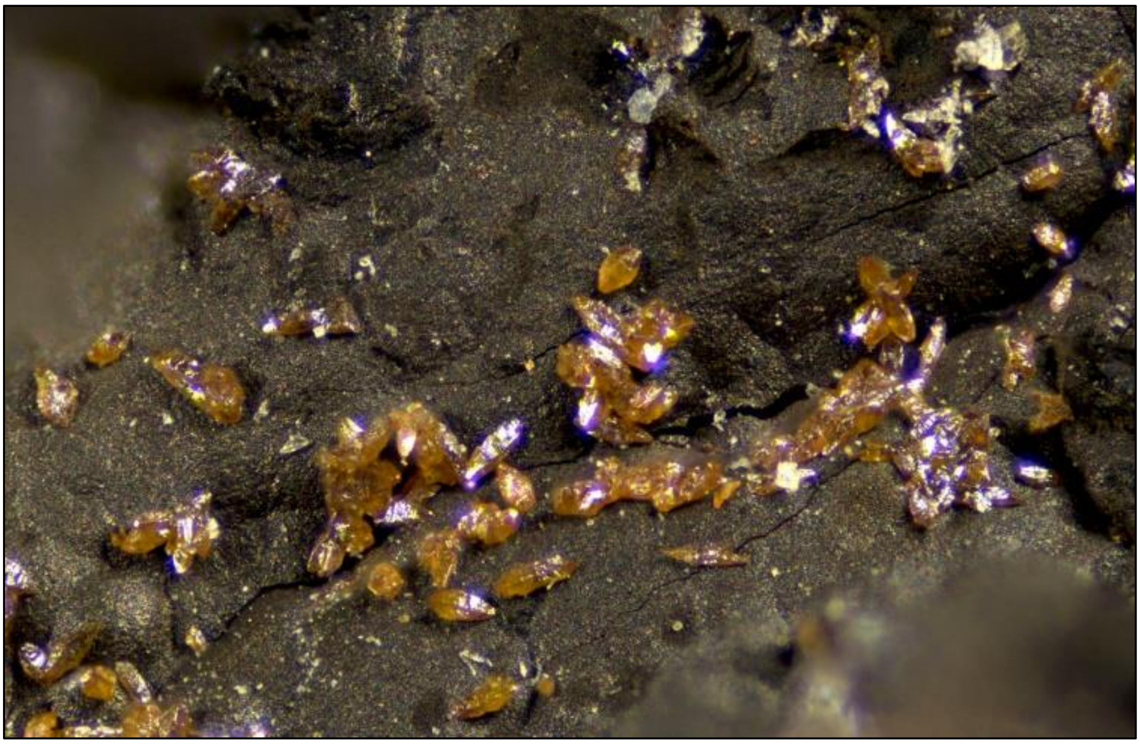


Mrázekite crystals, 2mm FOV.

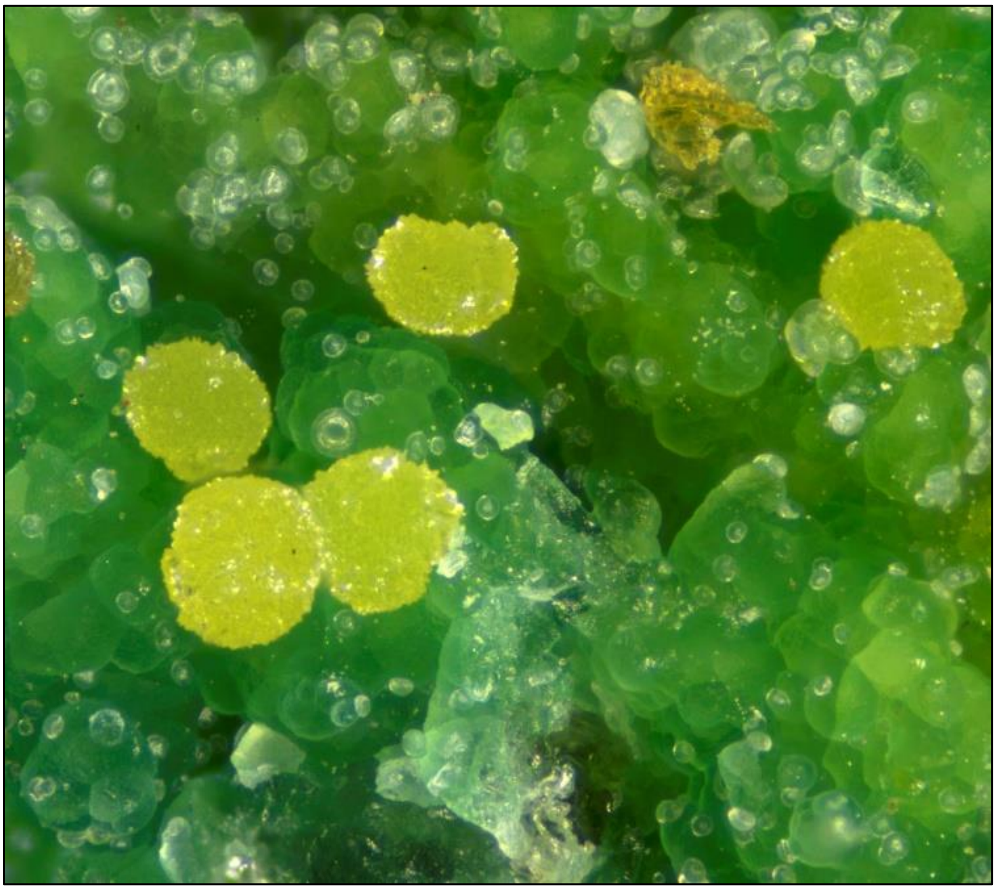
Prismatic crystals of mrázekite, 1.5 FOV.



Radiating hemispheres of namibite crystals, 2mm FOV.



'Cigar' shaped honey-brown pucherite crystals. 1mm FOV.



Hemispheres of schumacherite crystals on 'hyalite' 1mm FOV.

Schumacherite crystals 2mm FOV.

Vesuvianite crystal on chrysocolla 4mm tall.

Facebook Micro Groups

Steve Sorrell

There are a number of Facebook Groups that have been established specifically for those interested in micromounts or microminerals. These include:

The Micromount Club – https://www.facebook.com/groups/388243031331809
New Zealand Micro-Mineral Group – https://www.facebook.com/groups/135096486590519
British Micromount Society – https://www.facebook.com/groups/880501085293712

Classifieds

Want to advertise something related to micromounting or microminerals? You can do so here. Willing to trade or sell, want lists, etc. Simply email the editor: steve@crocoite.com to get your listing in the next issue. Please keep ads as short as possible.

Mineral Paradise – Richard Bell

Periodic listings of mainly British micro and thumbnail-sized mineral specimens made available for sale or swap. To view, go to http://www.mineral-paradise.net

Sauktown Sales – Jim Daly

Periodic listings of micro mineral specimens for sale. Jim also sells micromounting supplies. To view, go to http://www.sauktown.com

Comparethemineral – Steve Sorrell

Minerals for sale, many micro-material specimens regularly listed. To view, go to https://www.minsane.com

Purple Sky Minerals – David Hospital

New webshop dedicated to systematic minerals /rare minerals/ micromounts from worldwide for serious collectors. Specimens always with crystals. Have a look! http://www.purple-sky-minerals.com

Facebook Groups for buying and selling minerals

If you are on Facebook, there are a number of options for the buying and selling of minerals. These are some that have interesting items: “Sell Some Rocks!”, “Australian Crystals and Minerals – For Sale”, “Stones to Sell…”, “Cool Rocks Minerals Buy Swap Sell”. Each have rules, but they are pretty easy to abide by.

Wanting to Trade – Stefano Del Magro

I'm experiencing considerable difficulty finding Australians collectors who may be interested to exchange and sell me. I have several lists of minerals and waste from all over the world, ranging in size from Micromount in Miniature. I am interested also in rare Australian minerals.