THE MINERALOGY OF MONT SAINT-HILAIRE QUEBEC

by

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and

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with notes by Jerry Van Velthuizen, George Y. Chao and Ronald P. Conlon

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Serandite twin, 12.5 cm,
from Mont Saint-Hilaire.
Rod Tyson collection.
Photo by Wendell E. Wilson.

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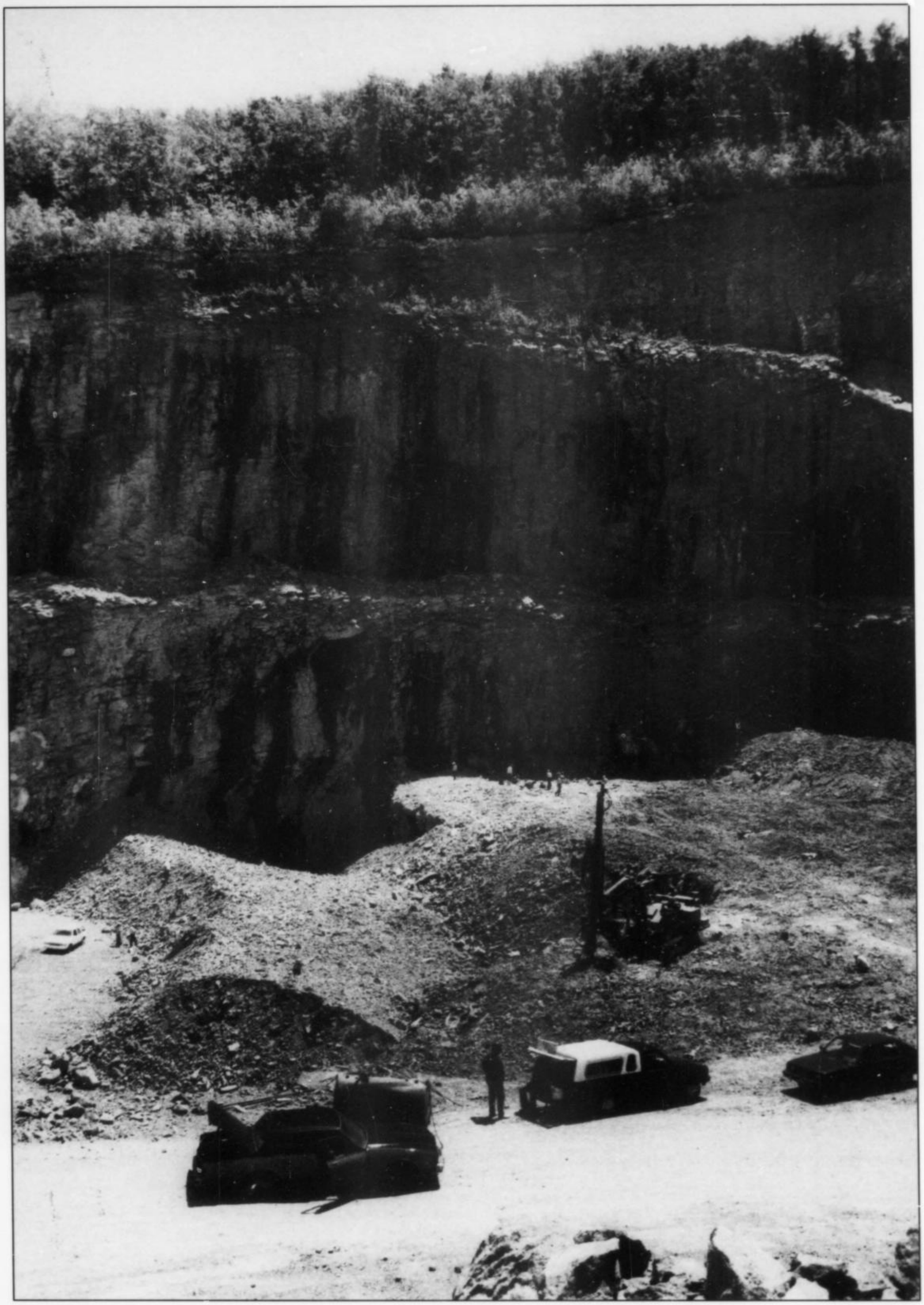


Figure 1. **The Poudrette quarry in the summer of 1988. Photo by L. Horváth.**

INTRODUCTION

In its short history as a mineral locality, Mont Saint-Hilaire has become a contemporary classic and one of the most prolific current sources of rare mineral species. The quarrying operations have been and still are uncovering magnificent specimens of serandite, catapleiite, leucophanite, carletonite, leifite and analcime, along with exquisite microcrystals of many rare species.

To date, 250 species have been identified from Mont Saint-Hilaire (including polytypes), 16 of which are new to science, and research work is proceeding on at least 45 other undetermined minerals, many of which are potentially new species.

While the minerals for which Mont Saint-Hilaire is the type locality have been well-characterized, recent finds have produced information unavailable at the time of the original descriptions. Well-formed crystals of some species have been found for the first time, and new habits and associations have been revealed for many of the others. In recent years a number of rare species have been identified for which Mont Saint-Hilaire is the second known occurrence. Some of these minerals, such as natrophosphate, vitusite-(Ce), ussingite, chkalovite, revdite, daqingshanite-(Ce), sazhinite-(Ce) and others, have been found for the first time as excellent crystals. In addition, important finds of species such as carletonite, leifite, leucophanite, cordylite-(Ce), donnayite-(Y), monteregianite-(Y), elpidite, serandite and eudidymite have been made in recent years.

The past five to six years have been particularly productive at Mont Saint-Hilaire, especially in terms of the rare species collected. Since the spring of 1984, for example, over 100 species have been added to the ever-growing list of minerals known to occur there.

The purpose of this article is to bring the literature up to date and to provide an introduction for those readers unfamiliar with the locality and its complex suite of minerals.

While brief descriptions of all species are included in this article, emphasis is placed on the specimen mineralogy of recent significant finds and descriptive mineralogy of the rare species, to convey the maximum amount of data useful to the collector.

Because it is important for the collector to recognize the various rock units which represent the unique mineralogical environments of the Mont Saint-Hilaire complex, each is described briefly in the discussion on geology, followed by a table listing all species occurring there. The modes of occurrence for the individual species are indicated in the mineral descriptions and significant mineral associations are listed with the descriptions. Quarry maps have not been included because the precise locations of many past finds in the quarry were never recorded, and because the quarry has changed so much over time that such information would, in any case, be useless to collectors.

For additional technical data on Mont Saint-Hilaire species, such as optical properties, X-ray data, chemical analyses, crystallographic parameters, density and hardness, readers are referred to specific literature in the bibliography and particularly to *Monteregian Treasures* by Mandarino and Anderson (1989).

A complete bibliography of Mont Saint-Hilaire mineralogy, geology and extensive related references, including the best English language references, for many of the rare species, is also provided and should prove useful to the student and collector of Mont Saint-Hilaire minerals.

Finally, a photo pictorial of some of the outstanding specimens collected over the years and now preserved in various institutional and private collections will help to illustrate the reason why Mont Saint-Hilaire has become known as a modern day classic locality.

LOCATION

Mont Saint-Hilaire is a conspicuous geographical landmark, 350 meters in height, rising abruptly out of the surrounding flat-lying St. Lawrence lowlands, and is one of ten related plutons known collectively as the Monteregian Hills. It is roughly circular in aspect with a diameter of approximately 3 km. The mountain lies about 40 km east of Montréal in Rouville County, Québec, very close to and clearly visible from the Trans-Canada highway. The picturesque farming and commuter village of the same name lies at its base along the shore of the Richelieu River.

The collecting sites, the Poudrette and Demix quarries, are located on the northeast face of the mountain. Most of the western portion is public parkland, with hiking and ski trails and a nature interpretation center, while the eastern half is a limited access ecological research preserve; both of these areas are managed by McGill University.

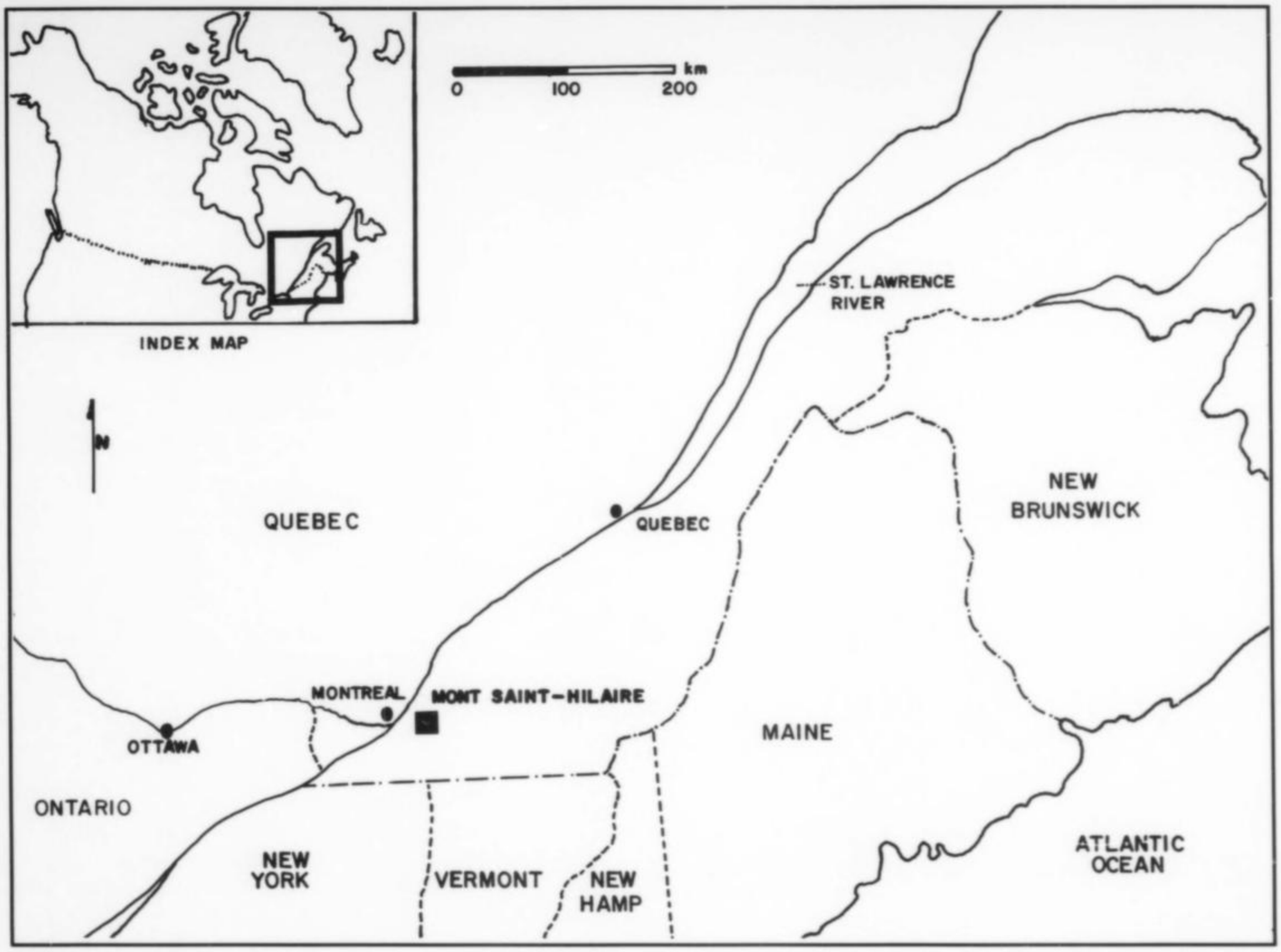


Figure 2. **Location map.**

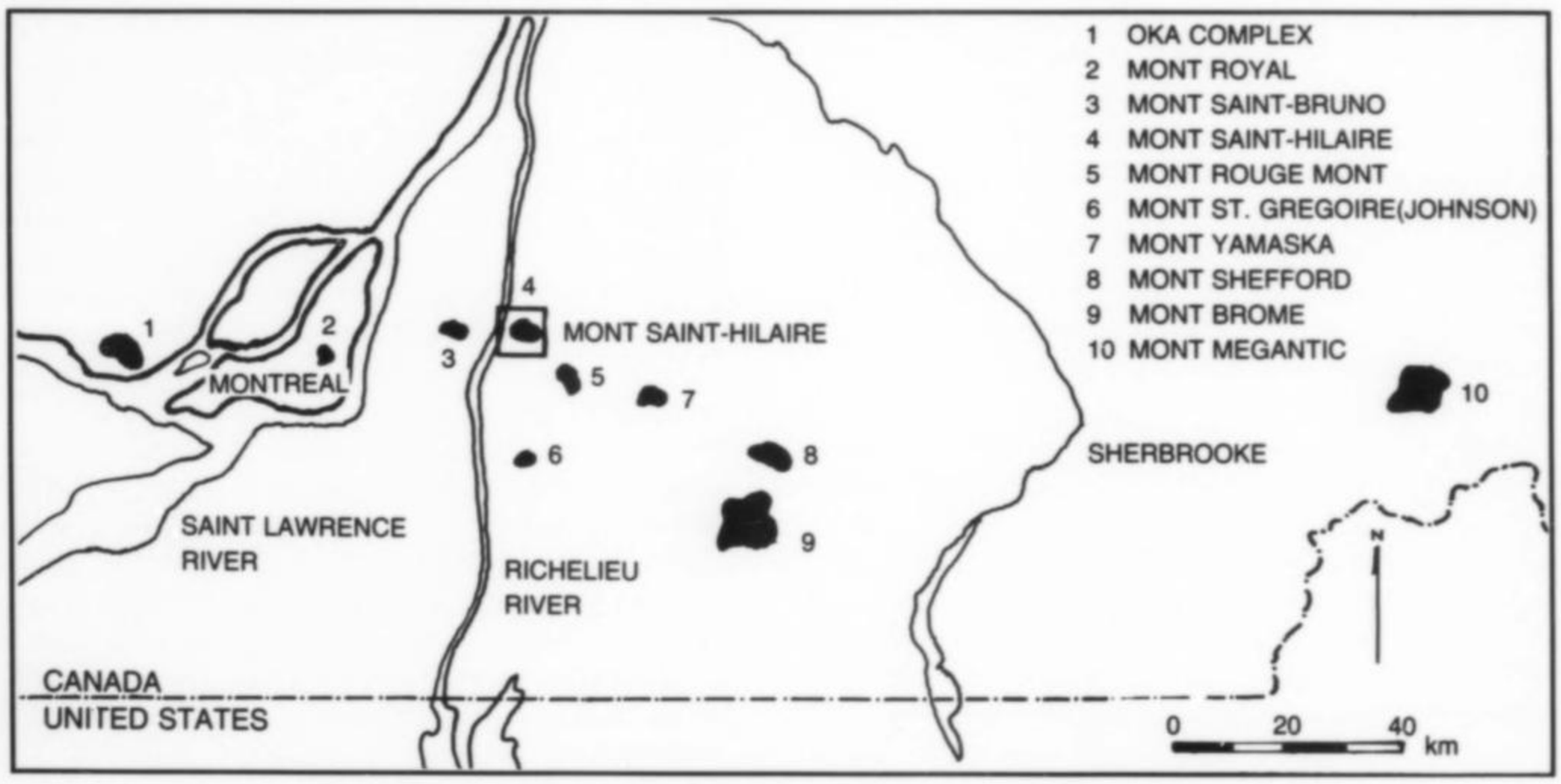


Figure 3. **Intrusive bodies in the Mont Saint-Hilaire area.**

HISTORY

Figure 4. **Mont Saint-Hilaire with the Richelieu River in the foreground. Photo by L. Horváth.**

Unlike many classic localities, the history of Mont Saint-Hilaire is neither very long nor very colorful. Although extensive petrographical studies on the Monteregian Hills have been made since the late 1800's, the earliest mention of unusual minerals from Mont Saint-Hilaire was made by O'Neill (1914). In his report on the petrology of the mountain, he briefly mentioned several rare, accessory, rock-forming minerals including a lavenite-like and a meliphanite-like species. Since the publication of that report, little information regarding rare species was published until the current round of mineralogical investigations began in 1963.

For the collector, Mont Saint-Hilaire held little interest until quarrying operations commenced in 1959 and even then it wasn't until 1963 that the operations revealed the first indication of what was to come. A few cleavage fragments of serandite, collected by a local collector Frank Melanson, were identified during that summer and in rapid succession more and more rare and unusual species were found and identified. Major finds of the more spectacular specimens have been made intermittently since then, notably in the large open pegmatites with superb crystals of catapleiite, serandite, analcime and siderite; however, virtually every visit can produce something of interest.

The Mont Saint-Hilaire locality consists of two contiguous quarries, the Poudrette on the east side, and the Demix, formerly known as the Desourdy and the Uni-Mix quarries, on the west. The once prominent wall of rock dividing the quarries, has been eliminated in recent years by the quarrying operations, and the visible property line will entirely disappear in the near future. R. Poudrette Inc. is the only company operating today. The quarry owned by Demix Inc. has not been in operation since 1980 and the crushing plant equipment has deteriorated to the point where future reactivation by the company is very doubtful. The crushed rock produced by the quarries is used for road metal and for concrete aggregate (Koci, 1966).

Access to the quarries has varied over the years, from a wide-open policy during the early years, with no restrictions on collectors, to a period of complete ban on collecting. Presently, collecting is very strictly limited to the Poudrette quarry, and permitted only on prearranged field excursions organized by the Club de Minéralogie de Montréal, during the May to October period; participation should be arranged with the club.

Quarrying operations in the Poudrette quarry continue at a fast pace and, with the exposure in recent years of an area rich in sodalite and marble xenoliths, much new and interesting material has been found.

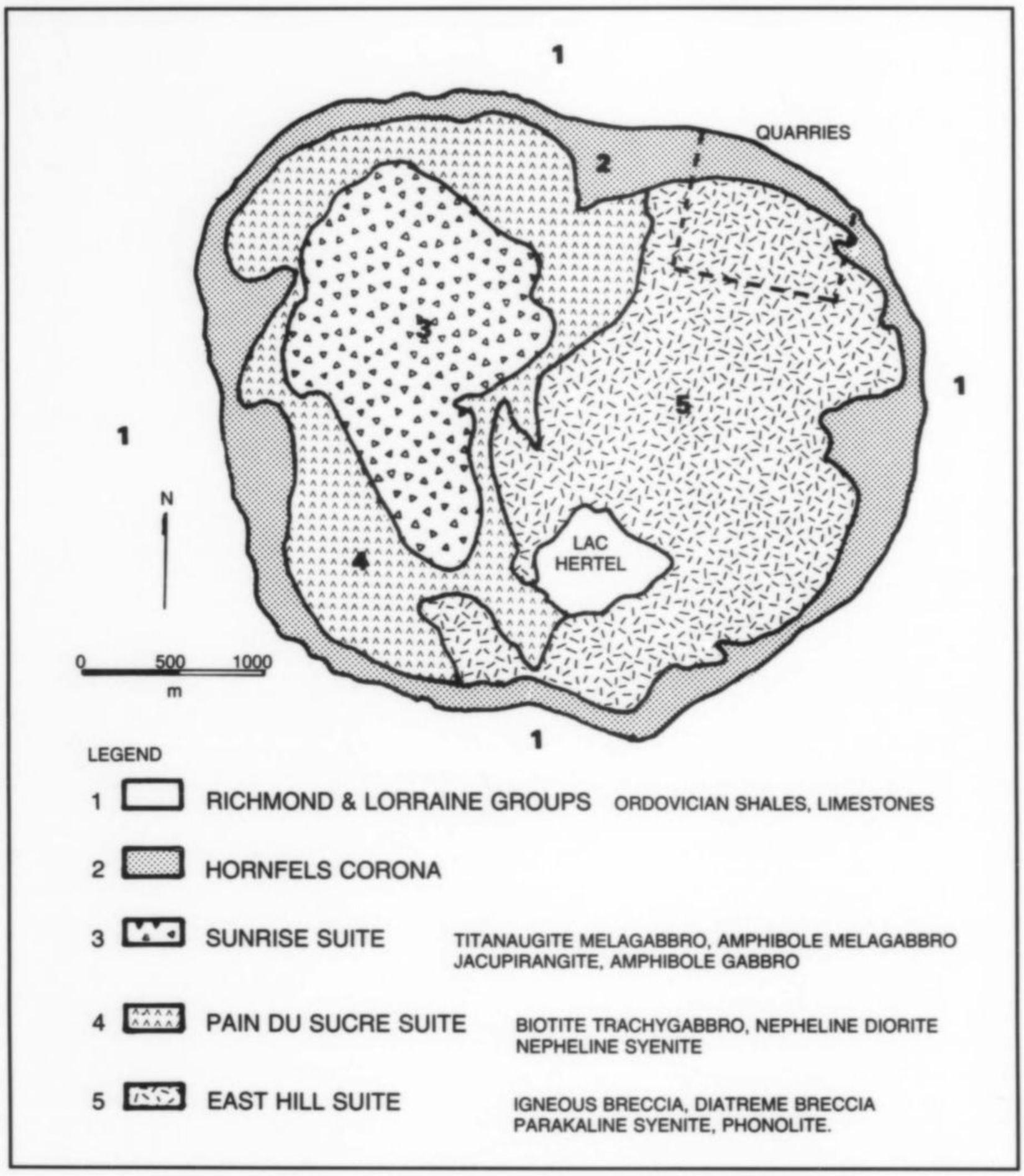


Figure 5. **Geology of the Mont Saint-Hilaire intrusive complex.**

GEOLOGY

Mont Saint-Hilaire is an alkaline intrusive complex containing an abundance of agpaitic syenites. These agpaitic rocks form peralkaline minerals such as sodalite, aegirine, arfvedsonite and other rare sodium silicates with zirconium, titanium and rare earth elements. On a global scale this type of alkaline complex is very rare. Other well-known examples are the Lovozero and Khibiny massifs in the Kola Peninsula of the USSR, the Langesundfjord area of Norway, the Ilímaussaq and Igaliko (Narssârssuk) complexes of southern Greenland and Îsle de Rouma, Los Archipelago, Guinea. These are well-studied complexes, and they will be referenced frequently in this article as the type localities for many of the minerals found at Mont Saint-Hilaire.

The Mont Saint-Hilaire complex intruded the Paleozoic rocks of the St. Lawrence lowlands during the Cretaceous period, approximately 125 million years ago. The upward-flowing column of magma, melting and digesting rocks in its path, eventually solidified to form the circular intrusion. Today the more resistant, mainly igneous rocks of the intrusion rise 350 m above the less resistant surrounding sedimentary rocks. Mont Saint-Hilaire is one of a series of plutons known collectively as the Monteregian Hills, which are strung out in an east-west linear fashion for a distance of approximately 150 km (Fig. 3).

Recent petrographic studies by Currie (1983 and 1989) have shown that Mont Saint-Hilaire consists of three intrusions (Fig. 5). Using Currie's designations, the earliest suite is termed the Sunrise suite and is composed of medium-textured melagabbros and pyroxenites. The Pain du Sucre suite intruded the Sunrise suite in the form of a ring dike. This dark colored suite consists of nepheline gabbros, diorites and monzonites. The East Hill suite forms the eastern half of the mountain and is composed of nepheline and sodalite syenites, porphyries, breccias and large xenoliths of marble, sodalite, hornfels and fragments of the other two suites. The Sunrise suite has been dated at 134 ± 6 Ma while the Pain du Sucre and East Hill suites have been dated at 120 ± 6 Ma (Currie *et al.*, 1986). A hornfels (metasomatized shale and limestone) corona surrounds the intrusive rocks. The Sunrise suite apparently formed a pipe-like structure, indicating the possibility of an extrusive volcanic neck, evidence of which is no longer present, however, it appears likely that the bulk of the intrusion was emplaced below the surface.

The quarries described above are located within the East Hill suite. The dominant rocks are nepheline syenite and sodalite syenite. These peralkaline syenites, rare in the Monteregian plutons, were likely caused by interaction of the magma with a chlorine-brine at relatively high levels in the earth's crust (Mandarino *et al.*, 1986). However, blocks of earlier igneous suites, metamorphosed paleozoic limestone still showing evidence of fossils and marble, presumably Grenvillian in age, are common. Pegmatite dikes, pipes and lenses, breccias, porphyritic syenites and large bodies of hornfels are also common.

One of the most fascinating aspects of a visit to Mont Saint-Hilaire is the opportunity to view the geological features exposed in the quarries. In this respect, the two quarries are quite dissimilar. Hornfels and sodalite xenoliths are virtually absent and marble xenoliths are uncommon in the Demix quarry. On the other hand, hornfels is prevalent in the Poudrette quarry, as are marble and sodalite xenoliths. Zones of breccia and sodalite syenite, as well as pegmatite veins and miarolitic cavities in nepheline syenite are found in both quarries. Of the two quarries, the Poudrette has a greater variety of minerals. An important aspect of collecting at Mont Saint-Hilaire is the ability to recognize the different geological environments, each with its own unique mineral assemblage.

The features of the more important environments, or modes of occurrence are as follows:

Pegmatites

The pegmatites, which are the residual portion of the magma and the last to have crystallized, can take the form of dikes, pipes and lenses. They appear to have no continuation at depth. Many of them pinch and swell irregularly from a few centimeters to a meter or more in width. Where the pegmatites swell, open cavities occur with well-formed crystals growing in the cores. Included under pegmatites are small, coarse-grained patches and segregations in nepheline syenite.

The syenitic pegmatites of Mont Saint-Hilaire generally are rich in sodium silicates and rare element minerals (Table 1). The most common minerals of the pegmatites are microcline and aegirine with local concentrations of analcime, serandite and catapleiite. Many of the pegmatites are altered in varying degrees, probably by hydrothermal action. These are characterized by manganese oxides, chlorites, sulfides and other minerals (Table 2).

Table 1. **Minerals found in unaltered pegmatites at Mont Saint-Hilaire.**

Aegirine	Donnayite-(Y)	Leucophanite	Pyrochlore
Albite	Elpidite	Mangan-neptunite	Pyrophanite
Analcime	Epididymite	Microcline	Pyrrhotite
Anatase	Epistolite	Monteregianite-(Y)	Raite
Ancylite-(Ce)	Erythrite	Mosandrite	Rhabdophane-(Ce)
Annite	Eudialyte	Natrolite	Rhodochrosite
Arfvedsonite	Eudidymite	Neighborite	Senaite
Astrophyllite	Fluorapatite	Nenadkevichite	Serandite
Barylite	Fluorite	Nepheline	Sphalerite
Bastnäsite-(Ce)	Gaidonnayite	Paranatrolite	Steacyite
Behoite	Galena	Parisite-(Ce)	Tetranatrolite
Biotite	Genthelvite	Penkvilksite	Tundrite-(Ce)
Calcio-ancylite-(Ce)	Gobbinsite	Perraultite	Vinogradovite
Calcite	Greigite	Phillipsite	Willemite
Catapleiite	Hedenbergite	Polylithionite	Wurtzite
Cerite-(Ce)	Kupletskite	Pyrite	Xenotime-(Y)
Chamosite	Kutnohorite		
	Leifite		

Table 2. **Minerals found in altered pegmatites at Mont Saint-Hilaire.**

Aegirine	Cordylite-(Ce)	Jarosite	Polylithionite
Albite	Daqingshanite-(Ce)	Kupletskite	Pyrite
Analcime	Datolite	Kutnohorite	Pyrochlore
Anatase	Donnayite-(Y)	Lavenite	Pyrophanite
Ancylite-(Ce)	Doyleite	Lemoynite	Pyrrhotite
Anglesite	Elpidite	Lepidocrocite	Quartz
Ankerite	Epididymite	Lizardite	Rhabdophane-(Ce)
Arfvedsonite	Eudialyte	Löllingite	Rhodochrosite
Arsenopyrite	Eudidymite	Magnesio-arfvedsonite	Rutile
Astrophyllite	Fluorapatite	Marcasite	Sabinaite
Bastnäsite-(Ce)	Fluorite	Mckelveyite-(Y)	Serandite
Behoite	Gaidonnayite	Microcline	Siderite
Berthierine	Galena	Mimetite	Sodalite
Beudantite	Genthelvite	Monazite-(Ce)	Sphalerite
Biotite	Gibbsite	Mosandrite	Synchysite-(Ce)
Birnessite	Goethite	Muscovite	Szomolnokite
Brockite	Gypsum	Natrolite	Tetranatrolite
Burbankite	Halotrichite	Nenadkevichite	Thaumasite
Calcite	Helvite	Neotocite	Thornasite
Carbonate-fluorapatite	Hemimorphite	Nordstrandite	Titanite
Catapleiite	Hilairite	Paranatrolite	Weloganite
Celestine	Hisingerite	Paraumbite	Wulfenite
Cerussite	Hochelagaite	Parisite-(Ce)	Yofotierite
Chabazite	Hydrocerussite	Petarasite	Zircon
Chalcopyrite	Hydrozincite		

Marble Xenoliths

The white to pale green marble xenoliths (inclusions), which are periodically exposed during the quarrying operations, were previously assumed to be reconstituted limestone from the surrounding paleozoic sedimentary formations. However, the thoroughly recrystallized nature of the marbles, the relict bedding and folding (all reminiscent of regionally metamorphosed marbles) and the sharp angular nature of some of the blocks suggest that they were dragged from the Precambrian basement complex by the rising magma, and that they underwent a relatively low degree of thermal metamorphism during transport. They are probably Grenvillian in age, because no later regional metamorphism took place in this region, prior to the Cretaceous intrusion of Mont Saint-Hilaire. Isotope studies have furthermore indicated that there has been at least 15% basement rock or crustal contamination during the genesis of the pluton (Foland *et al.*, 1986).

The marble xenoliths average 1–2 m across, are white to pale green in color and are an obvious feature of the quarry walls where they stand out against the darker nepheline syenite. Some of these xenoliths show dark, distinct metasomatized rims or contact zones, consisting mostly of anhedral to euhedral crystals of vesuvianite, and rarely grossular and miserite.

The composition of the marbles differs from block to block, from almost pure calcite to those rich in sodic and calcic silicates and rare element minerals.

The very interesting suite of minerals found in this environment (Table 3), occur embedded in the marble, or more importantly as free-growing crystals in randomly distributed spherical or oblong-shaped cavities in the marble. The cavities average 5–15 cm in diameter with some oblong-shaped cavities attaining 35 cm in length. Cavities are characteristically lined with intergrown, fibrous pectolite with well-formed pectolite crystals growing into the core. Most other minerals found in these cavities have grown on pectolite.

Table 3. **Minerals found in marble xenoliths at Mont Saint-Hilaire.**

Aegirine	Epidote	Meionite	Riebeckite
Albite	Eudialyte	Microcline	Sanidine
Allanite-(Ce)	Fluorapatite	Milarite	Sepiolite
Analcime	Fluor-apophyllite	Miserite	Serandite
Ancylite-(Ce)	Fluorite	Molybdenite	Shortite
Andradite	Galena	Monteregianite-(Y)	Siderite
Arfvedsonite	Götzenite	Montmoril-lonite	Sodalite
Arsenopyrite	Grossular	Muscovite	Sphalerite
Bastnäsite-(Ce)	Helvite	Narsarsukite	Steacyite
Bavenite	Hornblende	Natrolite	Stillwellite-(Ce)
Biotite	Hydrogrossular	Nenadkevichite	Sugilite
Calcio-ancylite-(Ce)	Hydroxy-apophyllite	Paranatrolite	Tadzhikite-(Ce)
Calcite	Kaolinite	Pectolite	Taeniolite
Carletonite	Lemoynite	Penkvilksite	Tetranatrolite
Catapleiite	Leucophanite	Phlogopite	Thaumasite
Chabazite	Leucosphenite	Polylithionite	Titanite
Chamosite	Lorenzenite	Prehnite	Tremolite
Clinochlore	Magadiite	Pyrite	Tundrite-(Ce)
Datolite	Magnesio-arfvedsonite	Pyrrhotite	Vesuvianite
Diopside		Quartz	Wollastonite
Donnayite-(Y)			Zeophyllite
Elpidite			Zircon

Sodalite Syenite

The sodalite syenite is worthy of note as the source of an interesting mineral assemblage (Table 4). Small cavities rarely exceeding 5 cm in diameter between the sodalite and feldspar crystals yield a wide variety of microminerals. Sodium silicates are abundant; various sulfides and carbonates are also present in small quantities.

Sodalite may be present in excellent crystals lining the cavities. The sodalite syenite can contain local concentrations of cancrinite, nepheline and aegirine. It is a pale gray to beige colored rock by comparison with the more common nepheline syenite, which is uniformly dark gray. Coarse grained sodalite syenite is characterized by sodalite crystals with hexagonal outline set in a finer grained groundmass; such syenite is locally pale to deep blue.

Miarolitic Cavities in Nepheline Syenite

Small, generally spherical miarolitic cavities rarely exceeding 10 cm in diameter, in nepheline syenite, are the mode of occurrence for

Figure 6. **The most exciting find of 1988. A large pegmatite pocket containing fine serandite crystals and large leifite balls. Photo by E. Horváth.**

Table 4. **Minerals found in sodalite syenite at Mont Saint-Hilaire.**

Aegirine	Cancrinite	Kaolinite	Pyrite
Albite	Dawsonite	Kutnohorite	Rutile
Analcime	Donnayite-(Y)	Magnetite	Sabinaite
Anatase	Franconite	Microcline	Siderite
Ancylite-(Ce)	Galena	Molybdenite	Siderophyllite
Annite	Gibbsite	Natrolite	Sodalite
Biotite	Gypsum	Nepheline	Sphalerite
Burbankite	Hematite	Nordstrandite	Steacyite
Calcio-ancylite-(Ce)	Hochelagaite	Paranatrolite	Tetranatrolite
Calcite	Ilmenite	Pectolite	
	Jarosite	Phlogopite	

Table 5. **Minerals found in miarolitic cavities at Mont Saint-Hilaire.**

Aegirine	Burbankite	Hochelagaite	Pyrrhotite
Albite	Calcite	Ilmenite	Rosenbuschite
Analcime	Catapleiite	Labuntsovite	Rutile
Anatase	Donnayite-(Y)	Magnetite	Sanidine
Ancylite-(Ce)	Edingtonite	Microcline	Scheelite
Andradite	Elpidite	Molybdenite	Siderite
Aragonite	Eudialyte	Monteregianite-(Y)	Sodalite
Arsenopyrite	Ewaldite	Mosandrite	Sphalerite
Ashcroftine-(Y)	Fluorapatite	Natrolite	Synchysite-(Ce)
Astrophyllite	Fluorite	Nepheline	Tetranatrolite
Barite	Franconite	Paranatrolite	Thomsonite
Barylite	Gaidonnayite	Parisite-(Ce)	Titanite
Bastnäsite-(Ce)	Galena	Phillipsite	Vinogradovite
Behoite	Gibbsite	Pyrite	Wöhlerite
Biotite	Harmotome	Pyrophanite	Xenotime-(Y)
Brookite	Hematite		Zircon
	Hilairite		

a unique mineral assemblage rich in rare earth silicates and carbonates (Table 5). The nepheline syenite is a dense, medium to dark gray rock, relatively uniform in color, texture and mineralogy. The miarolitic cavities are not uniformly distributed throughout the nepheline syenite, but tend to be concentrated in some areas while other areas are completely devoid of them. The reason for this localization is not well understood. The cavities are characteristically lined with a thin layer of foliated biotite and analcime on which the other minerals occur.

Hornfels

Hornfels, a fine-grained, dark gray, brown or dark green rock resulting from the metasomatic effect of the intrusion on the sedimentary host rocks, forms a corona around the mountain from 10 to several hundred meters in width. Very large blocks of hornfels resulting from slumping of sedimentary rocks into the magma are also encountered, and are among the major rock types of the East Hill suite. Included are blocks of fossiliferous metasomatized limestone, younger than any seen in the host rocks of the complex (Currie *et al.*, 1986). Some hornfels are criss-crossed by thin, mineralized, open veins and tension fractures. These rarely exceed 2–5 cm in width, and contain an assemblage of minerals (Table 6), the most common of which are

Table 6. **Minerals found in hornfels at Mont Saint-Hilaire.**

Aegirine	Dawsonite	Goethite	Neighborite
Albite	Diopside	Gypsum	Prehnite
Allanite-(Ce)	Dolomite	Hematite	Pyrite
Anatase	Donnayite-(Y)	Hochelagaite	Pyrrhotite
Astrophyllite	Dravite	Hypersthene	Quartz
Barite	Elpidite	Löllingite	Riebeckite
Bastnäsite-(Ce)	Epididymite	Lorenzenite	Rutile
Beryl	Epidote	Magnesite	Siderite
Beryllonite	Eudidymite	Marcasite	Spessartine
Brookite	Fluorapatite	Mckelveyite-(Y)	Sphalerite
Calcite	Fluorite	Microcline	Steacyite
Celestine	Franconite	Molybdenite	Strontianite
Chalcopyrite	Gaidonnayite	Muscovite	Thorogummite
Cordierite	Galena	Narsarsukite	Vesuvianite
Cordylite-(Ce)	Gersdorffite		Yofotierite
Corundum	Gmelinite		

calcite, siderite, pyrite, rutile and quartz. Euhedral crystals of pyrite and narsarsukite as well as relict fossils (brachiopods) replaced by vesuvianite are occasionally found imbedded in the hornfels.

Igneous Breccias

The igneous breccias consist of fragments of various rock types, including hornfels, nepheline syenite, gabbros and pyroxenites usually cemented by fine-grained albite. The rock fragments tend to be angular in shape, and vary in size from a few centimeters to nearly 1 m across. Elongated, irregular cavities 5–15 cm in length occur in the albite in the interstices between the fragments, and contain a unique suite of superbly crystallized minerals (Table 7). In some breccia zones the rock fragments exhibit partial melting and reaction rims, and appear more rounded as a result of having been partially digested by the rising magma. Cavities are less common, smaller, or non-existent in this type of breccia.

Table 7. **Minerals found in igneous breccias at Mont Saint-Hilaire.**

Actinolite	Elpidite	Leucosphenite	Richterite
Aegirine	Epididymite	Lorenzenite	Rutile
Albite	Eudialyte	Mangan-neptunite	Sodalite
Analcime	Eudidymite	Microcline	Sphalerite
Anatase	Ewaldite	Millerite	Steacyite
Ancylite-(Ce)	Fluorapatite	Molybdenite	Stillwellite-(Ce)
Arsenopyrite	Fluor-apophyllite	Monteregianite-(Y)	Strontianite
Ashcroftine-(Y)	Fluorite	Narsarsukite	Synchysite-(Ce)
Barite	Gaidonnayite	Natrolite	Tadzhikite-(Ce)
Bastnäsite-(Ce)	Galena	Nenadkevichite	Taeniolite
Biotite	Ganophyllite	Paranatrolite	Tetranatrolite
Brookite	Gismondine	Parisite-(Ce)	Thomsonite
Calcite	Harmotome	Pectolite	Titanite
Carbocernaite	Hornblende	Pyrite	Vinogradovite
Catapleiite	Joaquinite-(Ce)	Pyrophanite	Wulfenite
Cerussite	Kainosite-(Y)	Pyrrhotite	Xenotime-(Y)
Cordylite-(Ce)	Labuntsovite	Quartz	Yofotierite
Donnayite-(Y)	Lead		Zircon

Sodalite Xenoliths

The sodalite xenoliths (inclusions) have produced the largest addition to the growing list of Mont Saint-Hilaire minerals in recent years. These xenoliths were first encountered in a zone of nepheline syenite in the Poudrette quarry in 1982. Since then, the quarrying operations have intermittently exposed parts of the same zone on different levels of the quarry. The nepheline syenite in which the xenoliths occur is generally fine-grained, dense, dark gray to brownish gray in color, significantly different in appearance and texture from most of the nepheline syenite found in Mont Saint-Hilaire, which may be due to its close proximity to fine-grained and dark gray to dark green zones of hornfels.

The xenoliths consist mostly of masses of white to colorless to pale violet (photochromic) coarse grained sodalite with small concentrations of villiaumite, eudialyte, ussingite, pyroxenes and a large array of very rare and unusual minerals. The xenoliths are angular to spherical or oblong in shape, ranging in size from 5 cm to about 1 m across, randomly distributed in the nepheline syenite, and in some areas constituting close to 50% of the volume of the rock.

The minerals occur embedded in massive sodalite or in small, randomly distributed, irregularly-shaped cavities rarely exceeding 1 cm in their largest dimension. The mineralogy of these xenoliths is unique and many of the minerals found in this association have not been encountered in the other modes of occurrence at Mont Saint-Hilaire (Table 8).

Table 8. **Minerals found in sodalite xenoliths at Mont Saint-Hilaire.**

Aegirine	Eudialyte	Mosandrite	Sidorenkite
Alabandite	Fluorapatite	Nahpoite	Sodalite
Albite	Fluorite	Natrite	Spertiniite
Analcime	Galena	Natrolite	Sphalerite
Anatase	Garronite	Natron	Steenstrupine-(Ce)
Ancylite-(Ce)	Gmelinite	Natrophosphate	Terskite
Arsenopyrite	Graphite	Nepheline	Tetrahedrite
Astrophyllite	Griceite	Parakeldyshite	Tetranatrolite
Barytolamprophyllite	Halite	Paranatrolite	Thalcusite
Bismuth	Harmotome	Paraumbite	Thermonatrite
Britholite-(Ce)	Kogarkoite	Pectolite	Thorogummite
Burbankite	Kupletskite	Petarasite	Titanite
Calcite	Lamprophyllite	Phillipsite	Trona
Cancrinite	Löllingite	Pyrochlore	Tugtupite
Catapleiite	Lorenzenite	Pyrophanite	Ussingite
Chabazite	Lovozerite	Raite	Villiaumite
Chkalovite	Lueshite	Rasvumite	Vinogradovite
Cryolite	Makatite	Revdite	Vitusite-(Ce)
Dorfmanite	Mangan-neptunite	Sazhinite-(Ce)	Vuonnemite
Epistolite	Microcline	Searlesite	Wurtzite
Erdite	Molybdenite	Serandite	Yofotierite
		Shortite	

MINERALOGY

At Mont Saint-Hilaire, silicates represent by far the greatest majority (137 species, 55% of the total), followed by carbonates (34), oxides and hydroxides (23), sulfides (20), phosphates and arsenates (15), sulfates (9), halides (6), native elements (3) and the balance (2). Thirteen of the sixteen new species described from Mont Saint-Hilaire are silicates, while halides, carbonates and oxides are represented by one species each. The undetermined species which have been given tentative designations (UK#), pending their investigation are excluded from the various tables and mineral descriptions; these are covered in the accompanying article by G. Y. Chao, *et al.* (1990) in this issue.

Species which contain rare earth elements essential to their crystal structures have been chemically analyzed by electron microprobe to determine the dominant rare earth element present. All minerals listed in the various tabulations and species descriptions have the appropriate Levinson REE suffix designation. When referring to a specimen or associated minerals in the mineral descriptions, which have not been specifically analyzed, this suffix is omitted.

New Species Described from Mont Saint-Hilaire

To date (April 1990), 16 new mineral species have been described from Mont Saint-Hilaire. They are listed in Table 9 at right.

In Table 10 (page 348) the confirmed species are classified by chemical groups (Dana system).

***Table 9.* New species discovered at Mont Saint-Hilaire.**

Mineral	References
Lemoynite	Perrault *et al.* (1969)
Carletonite	Chao (1971)
Hilairite	Chao *et al.* (1974)
Gaidonnayite	Chao and Watkinson (1974)
Yofortierite	Perrault *et al.* (1975)
Monteregianite-(Y)	Chao (1978)
Donnayite-(Y)	Chao *et al.* (1978)
Tetranatrolite	Chen and Chao (1980)
Paranatrolite	Chao (1980)
Petarasite	Chao *et al.* (1980)
Steacyite	Perrault and Szymanski (1982)
Doyleite	Chao *et al.* (1985)
Thornasite	Ansell and Chao (1987)
Poudretteite	Grice *et al.* (1987)
Griceite	Van Velthuizen and Chao (1989)
Perraultite	Chao (in preparation)

Fluorescent Minerals

Many of the minerals found at Mont Saint-Hilaire fluoresce under ultraviolet radiation (Table 11, p. 349), and the fluorescence is a good supplemental, diagnostic feature in their identification.

Mineral Distribution and Rarity

A complete alphabetical listing of the species, showing the distribution and relative rarity of each species for each mode of occurrence, is given in Table 12 (page 350).

The rarity of each species has been estimated on a scale of 1 to 10 on the basis of its representation in major collections, and a consensus of field collecting experience of many collectors. A mineral with a rarity of 1 is ubiquitous in the indicated mode of occurrence, while a mineral with a rarity of 10 has been found only once, or is known in only a few specimens.

Descriptive Mineralogy

All the confirmed species to date (April 1990) are described in this section, at least briefly. Rare species which were previously lacking descriptive and morphological data are emphasized and are accompanied by photographs, SEM photomicrographs and crystal drawings. All species have been confirmed by X-ray powder diffraction methods and by various chemical analytical techniques such as wet chemical analyses and electron microprobe analyses performed at several institutions. The great majority of the published data and new mineral descriptions has been produced by Dr. George Chao of Carleton University in Ottawa over a period of more than 25 years. Considerable data was produced by Dr. Guy Perrault, especially in the period of 1965–75, at École Polytechnique in Montréal, by Dr. Joseph Mandarino of the Royal Ontario Museum in Toronto, and by the staff of the National Museum of Natural Sciences in Ottawa, especially from 1981 to the present. Dr. Chao and the National Museum staff continue to produce a great deal of data and perform many mineral identifications on their own material, and on material sent to them by collectors.

The mineral descriptions, data relating to mode of occurrence and mineral associations in the following section are based on (with a very few exceptions) personal observations and documentation by the authors, through the examination of innumerable specimens in various institutional and private collections, and the combined field collecting experience at Mont Saint-Hilaire of more than 40 years.

As mentioned in the introduction, for specific technical data, readers are referred to the various sources compiled in the bibliography, especially the recently published *Monteregian Treasures* (Mandarino and Anderson, 1989). Since its publication, the following additional mineral species have been identified from Mont Saint-Hilaire, and are covered in this article: alabandite, beryllonite, carbocernaite, cordierite, daqingshanite-(Ce), erdite, halite, hisingerite, hypersthene, kogarkoite, native lead, makatite, meionite, millerite, natrite, neotocite, penkvilksite, rasvumite, revdite, sazhinite-(Ce), searlesite, shortite, siderophyllite, sidorenkite, spertiniite, sugilite, tremolite and tugtupite.

Crystal drawings were computer-generated using *SHAPE* program (Dowty, 1989), except where noted.

A number of minerals from Mont Saint-Hilaire have been faceted into gems, and brief notes on some of these gems are included in the mineral descriptions.

Actinolite $Ca_2(Mg,Fe^{+2})_5Si_8O_{22}(OH)_2$

Actinolite, an amphibole group mineral, occurs as dark green to black acicular crystals to 5 mm in length. It is found associated with brookite, anatase, quartz and calcite, in small cavities in igneous breccia.

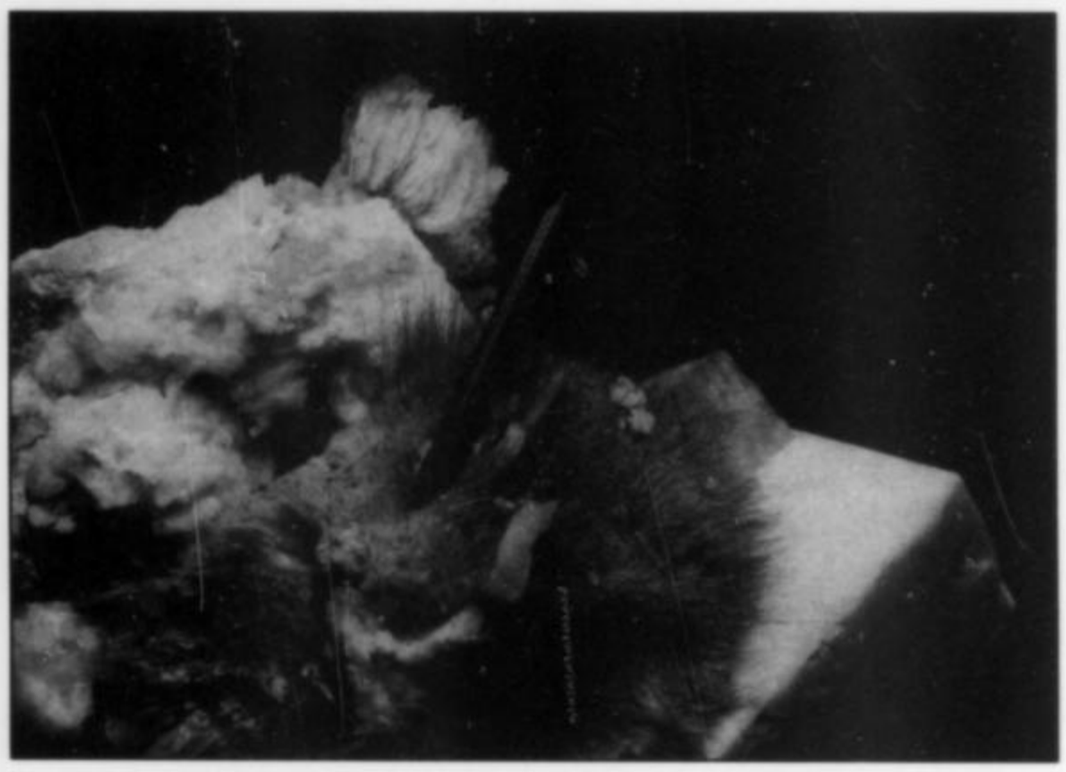


Figure 7. **Aegirine crystal 4 cm in length surrounded by a second generation of aegirine. National Museum of Natural Sciences (Canada) specimen #46268. Photo by G. Robinson.**

Aegirine $NaFe^{+3}Si_2O_6$

Aegirine, a member of the pyroxene group, is one of the most abundant and conspicuous crystallized minerals occurring at Mont Saint-Hilaire. It is a major constituent in the pegmatites and occurs in varying degrees of abundance in most of the other mineral associations.

The crystals range in size from tiny, acicular, millimeter-size crystals to superb, large, prismatic crystals up to 30 cm in length. The crystals are typically well terminated. Color varies from pale to dark hues of green (most common), yellow, brown and red for the acicular crystals, while the larger prisms are invariably black. The luster is vitreous.

Alabandite MnS

Alabandite is extremely rare, found in small cavities in sodalite xenoliths. It occurs as black, poorly formed, blocky crystals to 1 mm across, with submetallic luster. Associated minerals are: sodalite, natrolite, aegirine, serandite, cancrinite, sidorenkite and steenstrupine.

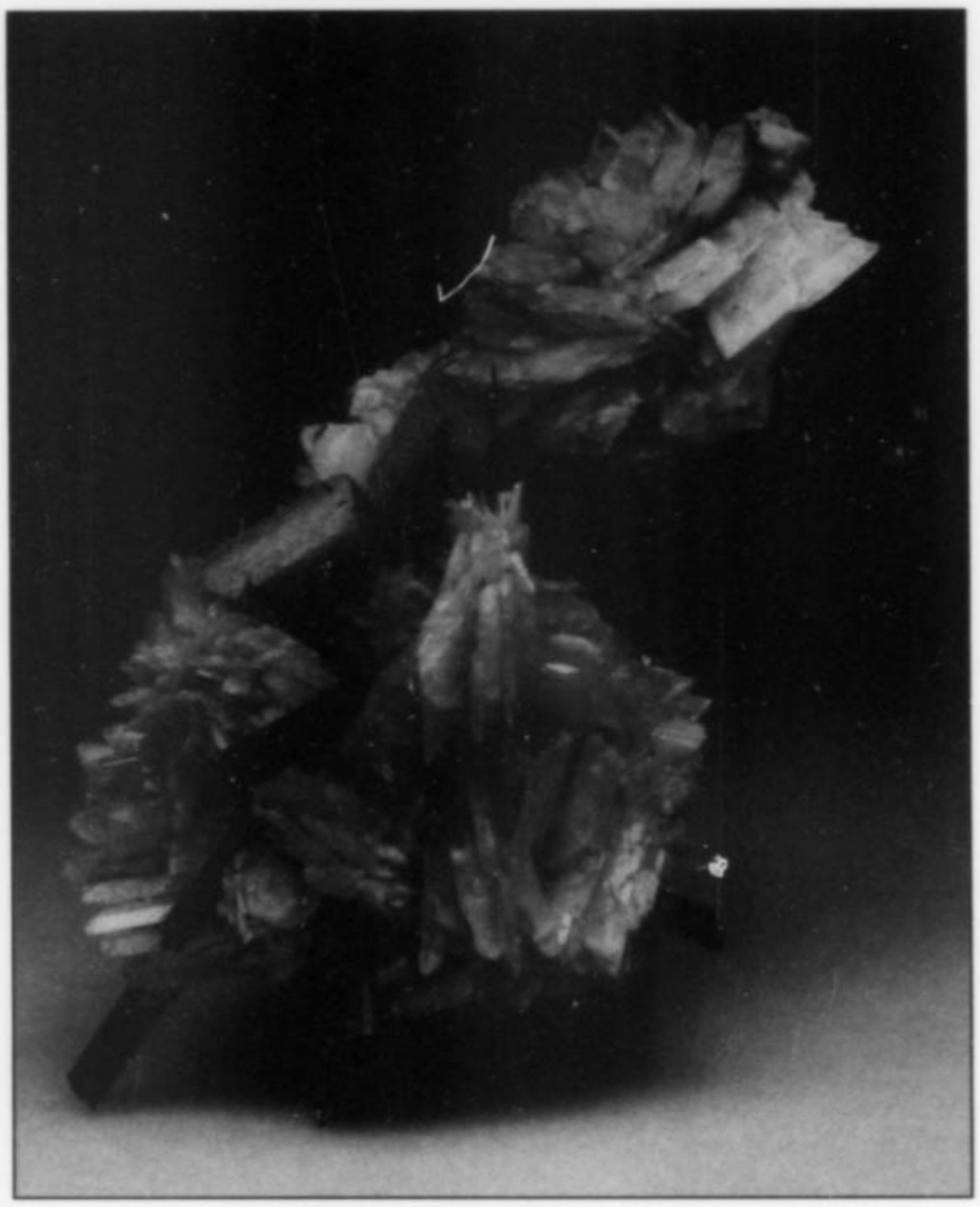


Figure 8. **Albite crystal group with aegirine and serandite. Specimen is 8 cm in height. G. Haineault collection. Photo by G. Robinson.**

Albite $NaAlSi_3O_8$

Albite, a member of the feldspar group, is one of the most common minerals. It occurs most abundantly in carbonate-rich pegmatites and in breccia cavities, as sharp, well-formed, bladed crystals from millimeter size to several centimeters in length, as well as in fine-grained massive form lining the cavities. The color varies from the predominant white, to pale gray, colorless and rarely pink. The most attractive albite specimens are aggregates of colorless or pale pink transparent, bladed crystals up to 2 cm commonly associated with rhodochrosite, elpidite and other minerals. The pink color tends to fade somewhat after extended exposure to natural light.

Allanite-(Ce) $(Ce,Ca,Y)_2(Al,Fe^{+3})_3(SiO_4)_3(OH)$

The occurrence of allanite-(Ce), a member of the epidote group, is extremely rare. It is found as sharp, thin, tabular crystals to 4 mm in length, in fractures in hornfels and as fibrous or acicular crystals, 0.3–3 mm in length in a garnet-rich contact zone between a coarse-grained marble xenolith and fine-grained hornfels. The acicular crystals are beige to dark brown, opaque, with a dull to greasy luster. The tabular crystals are very deep red to dark brown, transparent to translucent with a vitreous luster.

Analcime $NaAlSi_2O_6 \cdot H_2O$

Analcime, a common zeolite, occurs very abundantly in both altered and unaltered pegmatite veins and pipes as well as in miarolitic cavities in nepheline syenite. Rarely it is also found in cavities in the marble, sodalite syenite, breccia and sodalite xenoliths. Some of the largest crystals and perhaps the best specimens of the mineral known are found at Mont Saint-Hilaire. It is found as excellent, colorless, trans-

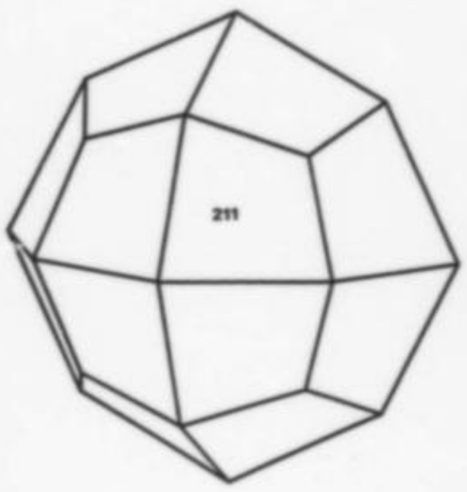


Figure 9. **Analcime, crystal drawing of the common, observed trapezohedron {211}.**

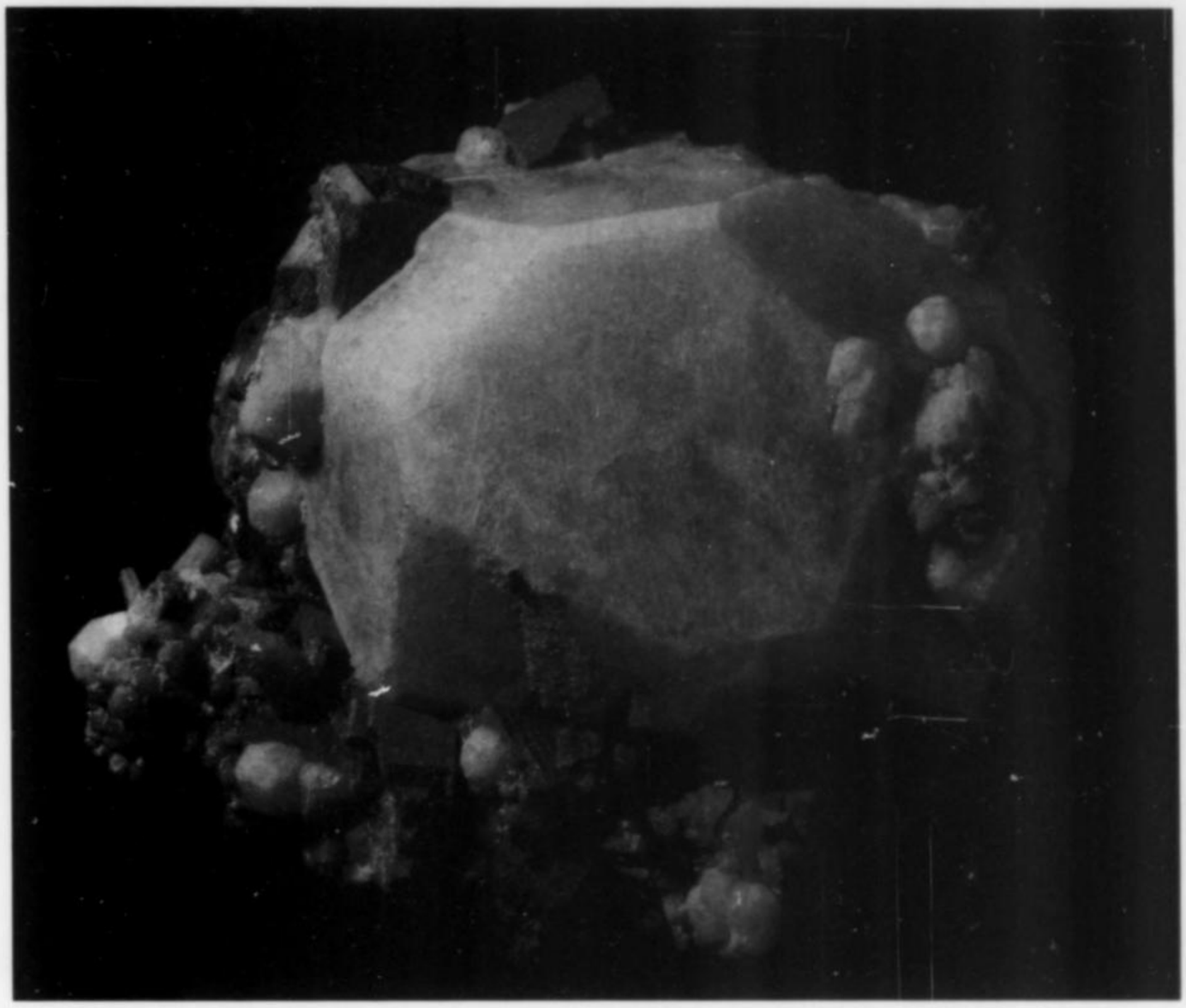


Figure 10. **Analcime, a large, well-formed, modified trapezohedron 16 cm across, associated with blocky, orange serandite crystals. National Museum of Natural Sciences (Canada) specimen #30257. Photo by J. Schekkerman.**

parent 1–2 mm, trapezohedra to very large, up to 25 cm, white or gray, translucent to opaque single crystals and clusters. It is also found as elongated, distorted trapezohedra and as large pseudomorphs up to 15 cm in length, consisting of masses of small crystals of analcime. The pseudomorphs are commonly hexagonal prisms suggesting the possible replacement of such minerals as cancrinite or burbankite. Other pseudomorphs of varied morphology and origin have also been found.

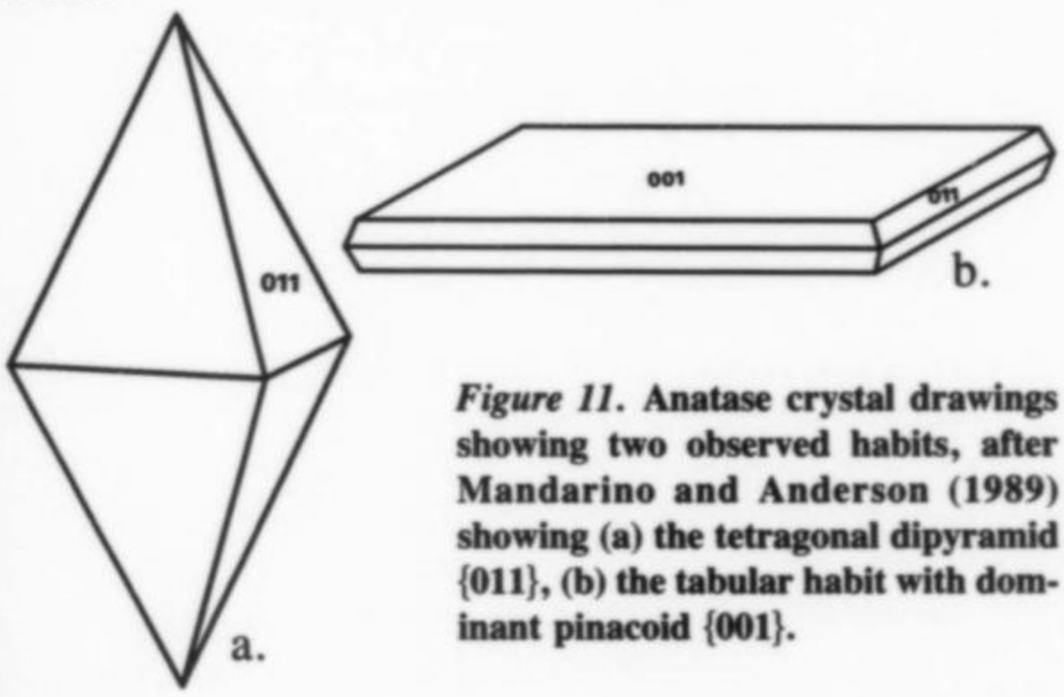


Figure 11. **Anatase crystal drawings showing two observed habits, after Mandarino and Anderson (1989) showing (a) the tetragonal dipyramid {011}, (b) the tabular habit with dominant pinacoid {001}.**

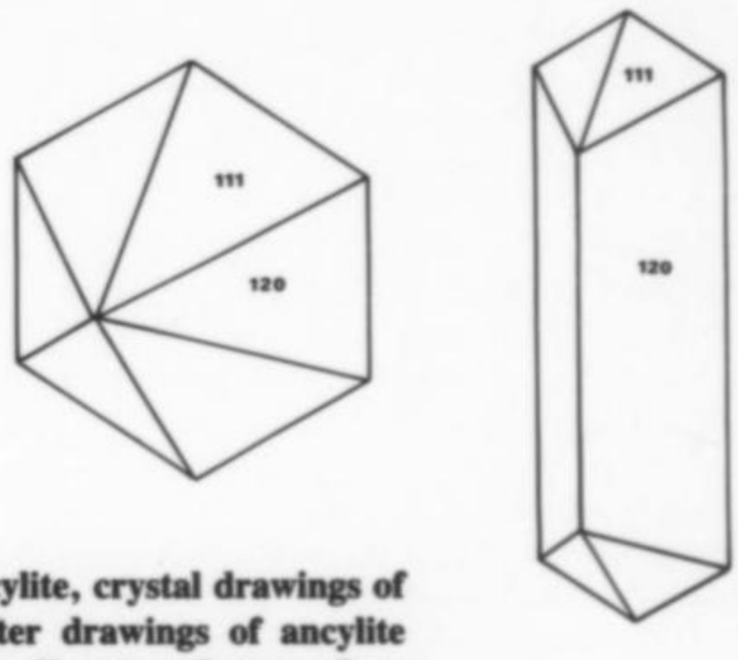


Figure 12. **Ancylite, crystal drawings of two habits (after drawings of ancylite crystals from the Keystone Quarry, Cornog, Pennsylvania (Keidel *et al.*, 1971)).**

Anatase TiO_2

Anatase occurs as a relatively rare accessory mineral in fracture cavities in hornfels and in cavities associated with the breccias. Very rarely it has also been found in pegmatite veins, miarolitic cavities in nepheline syenite, in cavities in sodalite syenite and sodalite xenoliths.

It occurs as 1–5 mm, sharp, well-formed, steep, bipyramidal and tabular crystals of several habits. The color is predominantly black, less commonly brown and rarely dark blue. The black crystals are opaque, while the brown and blue crystals tend to be translucent.

Ancylite-(Ce) $SrCe(CO_3)_2(OH)\cdot H_2O$

Ancylite-(Ce) occurs abundantly as excellent, sharp, single crystals or groups of crystals, frequently in spherical aggregates and druses as well as large pseudomorphs after other minerals. The most frequent occurrence is in altered and unaltered pegmatite veins and pipes, less frequently in miarolitic cavities and very rarely in the cavities of the breccia zones and marble xenoliths.

The most common habit is the elongated {120} rhombic prism terminated by the {111} rhombic pyramid. Less common is the very

short prism with pyramidal terminations, resembling hexagonal dipyramids. Other rare habits are the very thin tabular crystals and compact, dull spheres. Frequently found in the altered pegmatite veins are large, hexagonal, prismatic pseudomorphs up to 15 cm in length, consisting of masses of densely intergrown small crystals of ancylite. Some of the pseudomorphs have solid cores, while others are only hollow, tubular casts. In some of these, traces as well as crystal sections of burbankite have been found.

Individual crystals of ancylite are usually in the 0.5–5 mm size range. Color is predominantly pink (under natural or tungsten light), rarely pale orange and, in larger masses such as the pseudomorphs, pinkish gray. The luster varies from dull to vitreous.

Ancylite-(Ce) is one of the very latest minerals in the paragenetic sequence of the various mineralogical environments mentioned above. On some specimens, more than one distinct generation of the mineral has been noted.

Calcio-ancylite-(Ce) also occurs in Mont Saint-Hilaire and bears a very close resemblance to ancylite, from which it can only be distinguished by chemical analysis.

(See color photos on facing page.)

Andradite $Ca_3Fe_2^{+3}(SiO_4)_3$

Andradite, a member of the garnet group, occurs as sharp, lustrous, simple dodecahedra and small clusters in miarolitic cavities and rarely in the marble xenoliths. The crystals are mainly 3–8 mm in size, but exceptional crystals to 2 cm in diameter have been found. The color is predominantly dark to pale olive-green, brownish green or yellow-green with some crystals exhibiting internal color zoning. The luster is vitreous and crystals are translucent to opaque.

Anglesite $PbSO_4$

Anglesite is an extremely rare secondary mineral, occurring as thin, opaque crusts on galena and as tiny (<1 mm), sharp, green pseudorhombohedra on aegirine and microcline in close proximity to corroded galena, in an altered pegmatite vein. The crystals are translucent with a resinous luster.

Ankerite $Ca(Fe^{+2},Mg,Mn)(CO_3)_2$

Ankerite, a dolomite group mineral, occurs as a pale beige-colored epitactic overgrowth on siderite rhombohedra, in large open cavities in carbonate-rich pegmatites, associated with albite and synchysite. The overgrowth averages 0.5–1.0 mm in thickness.

Annite $KFe_3^{+2}AlSi_3O_{10}(OH,F)_2$

Annite, an uncommon member of the mica group, is very closely related to and visually indistinguishable from biotite. It occurs in large, well-formed, black, pseudohexagonal prisms up to 12 cm across and 15 cm long. It is encountered rarely in random concentration, in coarse-grained sodalite syenite.

Aragonite $CaCO_3$

Aragonite is extremely rare. It has been found as aggregates up to 7 mm across of stacked, tabular crystals averaging 0.5 mm in miarolitic cavities associated with analcime, natrolite and calcite. It has also been found as pinkish yellow, cleavage fragments to several millimeters in size.

Arfvedsonite $Na_2(Fe^{+2},Mg)_4Fe^{+3}Si_8O_{22}(OH)_2$

A common amphibole, arfvedsonite is found in excellent prismatic crystals in pegmatite veins and dikes up to 20 cm in length. It has also been found as 1–5 mm long, dark green to gray and black prisms in marble xenoliths.

Fresh, unaltered crystals are black with a vitreous to dull luster. In altered pegmatites some of the crystals may be partially altered or etched. These crystals tend to be somewhat fibrous, deeply pitted, occasionally hollow with a dull luster.

Magnesio-arfvedsonite also occurs at Mont Saint-Hilaire; the two species are indistinguishable without chemical analysis.

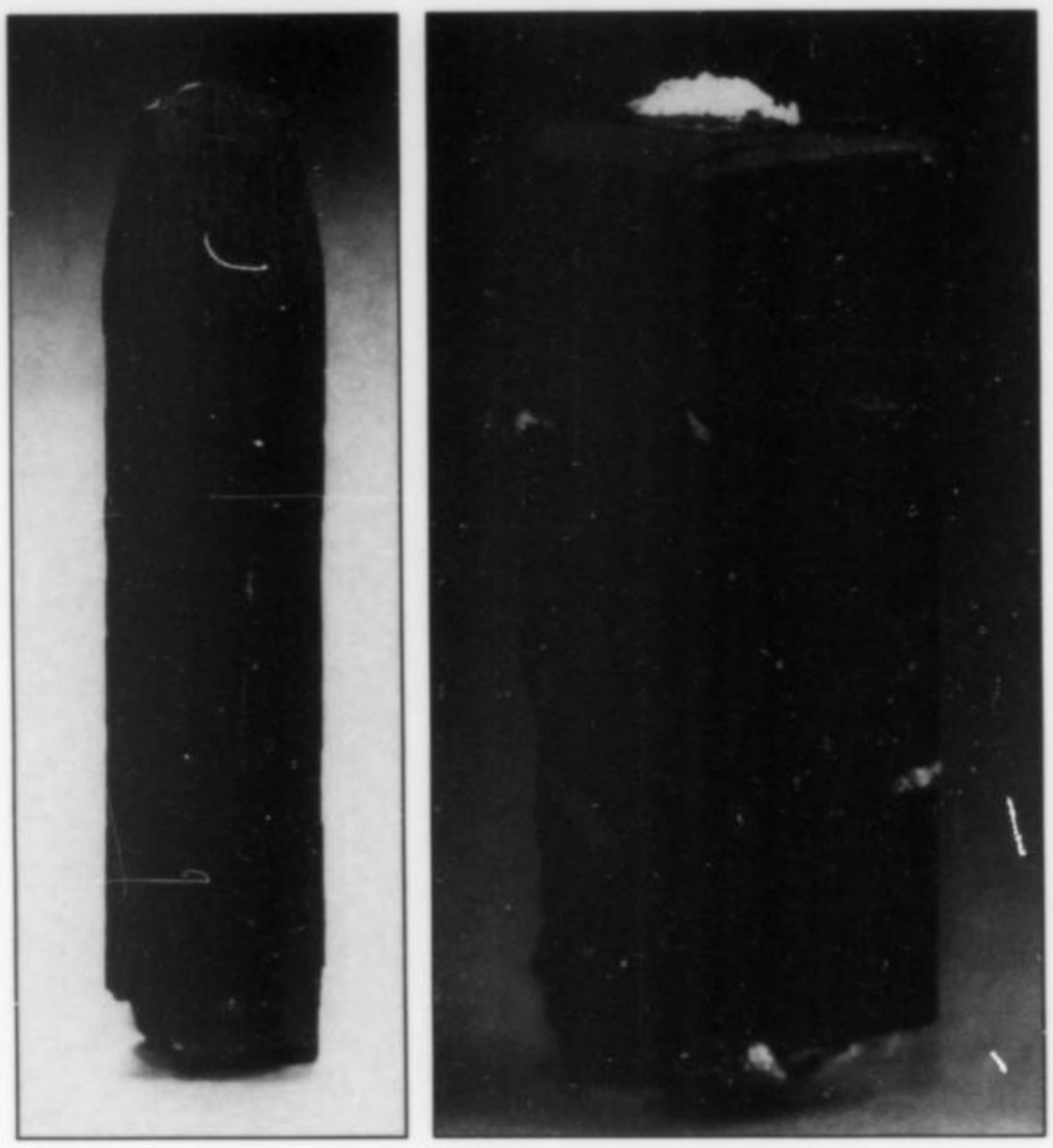


Figure 13. **Arfvedsonite (*left*), a large, single crystal 10.5 cm in length. G. Haineault collection. Photo by G. Robinson.**

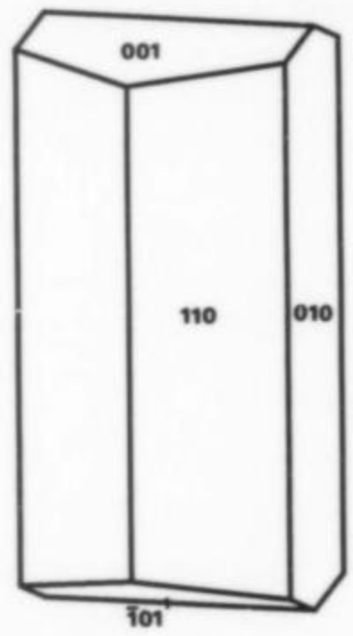


Figure 14. **Arfvedsonite (*right*), a large, single crystal 7.5 cm in length. G. Haineault collection. Photo by G. Robinson.**

Figure 15. **Arfvedsonite crystal drawing showing a common habit, after Mandarino and Anderson (1989).**

Arsenopyrite FeAsS

Arsenopyrite is a relatively rare accessory mineral in pegmatites, marble xenoliths, miarolitic cavities, breccia and sodalite xenoliths.

It occurs as very sharp, 1–3 mm, wedge-shaped and short prismatic crystals and as crystalline masses intimately intergrown with other sulfides. Exceptional crystals to 1.5 cm have been found in the marble xenolith association.

Ashcroftine-(Y) $K_5Na_5(Y,Ca)_{12}Si_{28}O_{70}(OH)_2(CO_3)_8 \cdot 3H_2O$

The mineral was originally described from Narssârssuk, Greenland, as "kalithompsonite" (Gordon, 1924), and redefined later as a new species, ashcroftine (Hey and Bannister, 1933). At Narssârssuk it is found as pink, matted, fibrous masses collected from a single pegmatite cavity. Ashcroftine-(Y) has the distinction of having the largest unit cell dimensions of all known species (Moore *et al.*, 1969 and 1987). Mont Saint-Hilaire is the only other known locality for the mineral, and in both localities the occurrence is exceedingly rare.

At Mont Saint-Hilaire ashcroftine-(Y) occurs as very fine, divergent sprays, tufts and small masses of randomly oriented capillary to fibrous crystals in a very small number of cavities in the breccia zones and in some miarolitic cavities in nepheline syenite.

Figure 16. **Ancylite crystal 6 mm in length. Horváth collection and photo.**

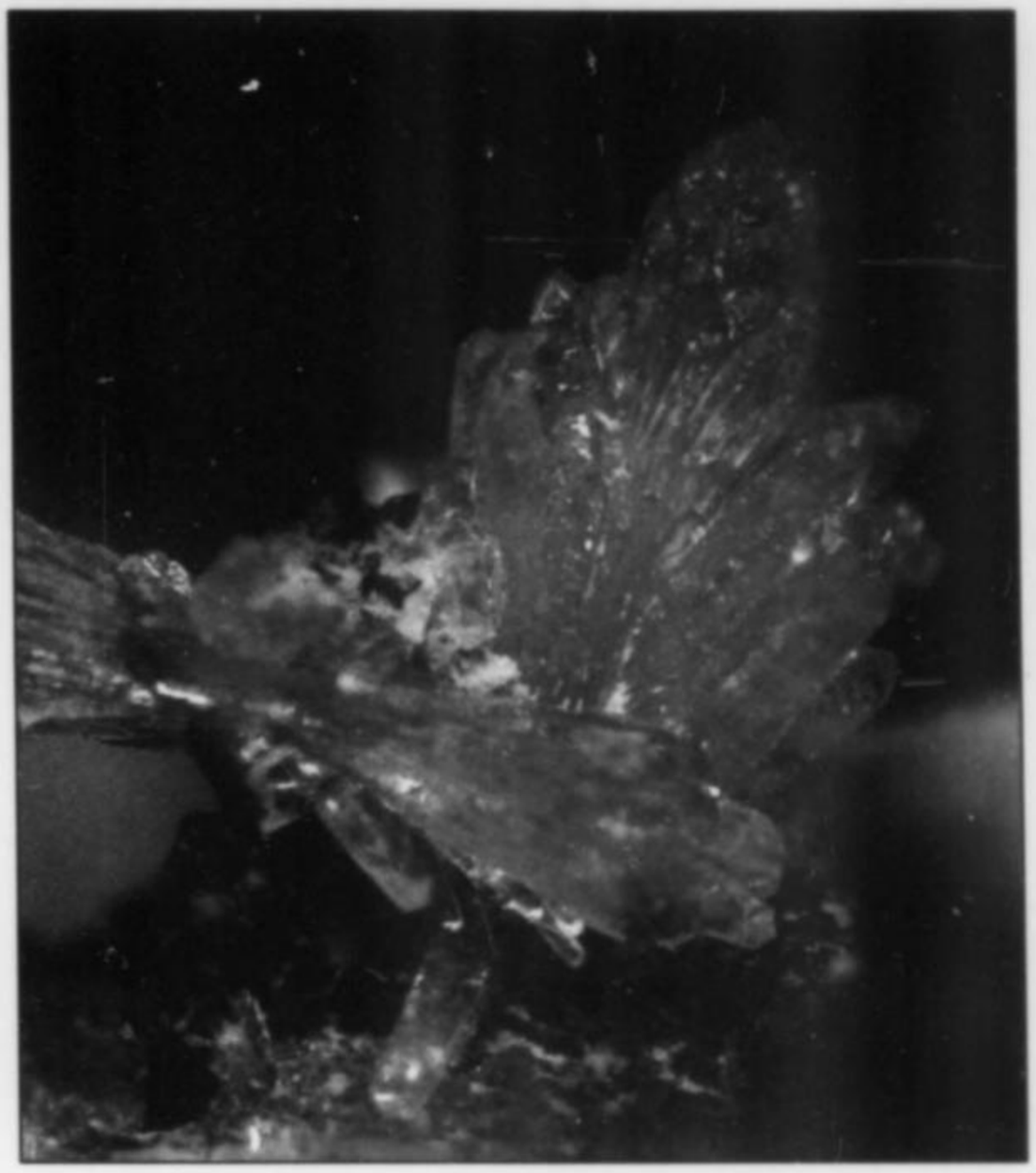


Figure 17. **Ancylite crystal group. The largest crystal is 5 mm in height. Horváth collection and photo.**

Figure 18. **Astrophyllite, a large, tabular, doubly terminated crystal 5.5 cm in height, associated with albite and aegirine. G. Haineault collection. Photo by G. Robinson.**

Individual crystals are very thin (<0.01 mm across), 2–20 mm long, flexible, soft and commonly bent. The luster is silky and the color is very pale violet, pale pink and white. Associated minerals are microcline, albite, aegirine, quartz, bastnäsite, lorenzenite, brookite, elpidite, leucosphenite, cordylite and narsarsukite.

The fine, acicular lorenzenite occurring in the breccia cavities bears a very close resemblance to ashcroftine-(Y) and the two species are sometimes intimately intergrown, making reliable sight identification nearly impossible. Lorenzenite, however, is far more common than ashcroftine-(Y) and fluoresces pale yellow under short wave ultraviolet radiation. Ashcroftine is not fluorescent.

Astrophyllite $(K,Na)_3(Fe^{+2},Mn)_7Ti_2Si_8O_{24}(O,OH)_7$

Astrophyllite, a member of the astrophyllite group, is one of the more common and conspicuous minerals found at Mont Saint-Hilaire. It is found as well-formed, sharp, tabular to bladed crystals to several centimeters in length, as well as bladed and acicular microcrystals, in pegmatite veins and pipes.

It is also found very widely disseminated as flakes and bladed crystals or radiating crystalline masses embedded in nepheline syenite, in close proximity to various pegmatitic structures, and rarely in hornfels, marble xenoliths and miarolitic cavities.

The color of astrophyllite is medium to dark brown, reddish bronze

or brownish red. Some very small crystals are transparent to translucent while the large crystals and the embedded crystalline masses are opaque. The mineral is micaceous, with a greasy to pearly luster.

Astrophyllite is practically identical in color and habit to kupletskite, with which it may be intimately associated; consequently, visual identification is unreliable.

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

Augite, a pyroxene group mineral, was confirmed by chemical analysis from a single specimen; however, the specimen was lost and no other information is available regarding its description or associations. The occurrence of augite may not be as uncommon as the single reported analysis may suggest, as very few pyroxene minerals undergo detailed chemical analysis.

Barite $BaSO_4$

Barite is a very rare, minor accessory mineral found in miarolitic cavities, breccia and in fracture cavities in the hornfels.

The crystals are well-formed, short prisms, 1–2 mm in length, colorless to pale or lemon yellow, transparent and with a vitreous luster.

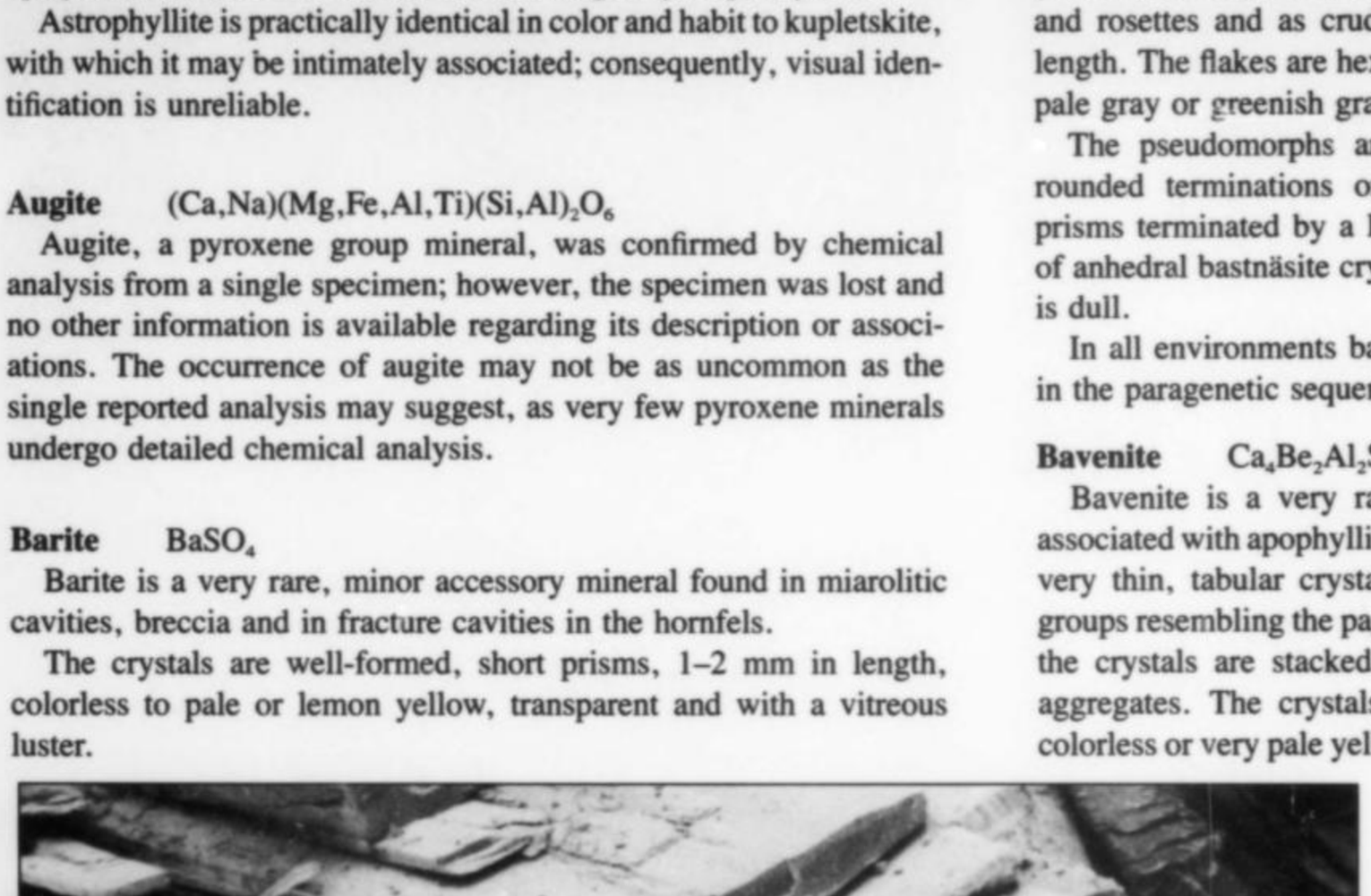


Figure 19. **Barylite, tabular crystals 2 to 4 mm in length. Horváth collection. SEM photo by E. Vadas.**

Barylite $BaBe_2Si_2O_7$

Barylite is exceedingly rare and only a very small number of specimens have been recovered from miarolitic cavities and a pegmatite dike.

It occurs as colorless to white, very thin, elongated, bladed, single crystals and as divergent groups of crystals, 0.5–5 mm long.

In the pegmatite, associated minerals include astrophyllite, microcline, analcime, aegirine, natrolite, catapleiite, ancylite and calcite. In miarolitic cavities it is associated with analcime, aegirine, biotite, burbankite, ewaldite, donnayite, natrolite, zircon, hilairite and barite. Crystals are transparent to translucent with a waxy luster.

In both associations barylite is a late stage mineral in the paragenesis.

Barytolamprophyllite
$(Na,K)_2(Ba,Ca,Sr)_2(Ti,Fe)_3(SiO_4)_4(O,OH)_2$

See lamprophyllite.

Bastnäsite-(Ce) $(Ce,La)(CO_3)F$

Bastnäsite-(Ce) is a relatively rare accessory mineral, occurring in a number of different environments. It has been found in altered and unaltered pegmatites, miarolitic cavities, hornfels, marble xenoliths and in cavities in the igneous breccia.

It is found as minute flakes, commonly in intimate intergrowth with parisite, coating other minerals or as very small (<1 mm) spheres and rosettes and as crude, prismatic pseudomorphs up to 5 cm in length. The flakes are hexagonal or rounded, white, beige, pale pink, pale gray or greenish gray, opaque, and have a dull pearly luster.

The pseudomorphs are usually etched, hexagonal prisms with rounded terminations or (rarely) well-formed, hollow hexagonal prisms terminated by a low pyramid, consisting of compact masses of anhedral bastnäsite crystals. The color is gray to tan and the luster is dull.

In all environments bastnäsite is one of the latest species to form in the paragenetic sequence.

Bavenite $Ca_4Be_2Al_2Si_9O_{26}(OH)_2$

Bavenite is a very rare accessory mineral in marble xenoliths, associated with apophyllite, natrolite and pectolite. It occurs as superb, very thin, tabular crystals, in very attractive concentric, divergent groups resembling the pages of an open book. In many of these groups the crystals are stacked very tightly, forming compact cylindrical aggregates. The crystals are rectangular in shape, 1–5 mm long, colorless or very pale yellowish white. The luster is vitreous to pearly.

Figure 20. **Barylite crystal drawing showing dominant {h00} pinacoid with other {hk0} pinacoids and an {h01} rhombic prism.**

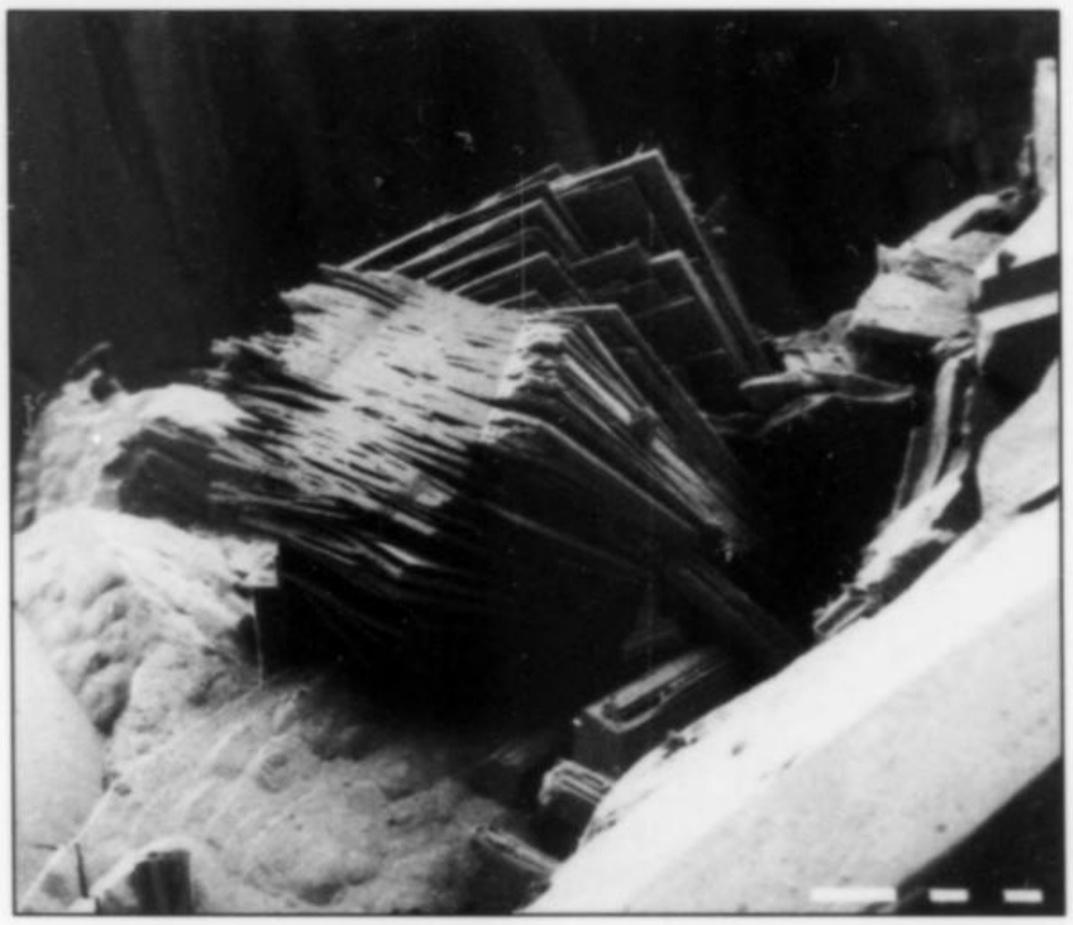


Figure 21. **Bavenite in thin, platy crystals 2 to 3 mm across. Horváth collection. SEM photo by E. Vadas.**

Behoite $Be(OH)_2$

Behoite was originally described from the Rode ranch pegmatite in Llano County, Texas (Ehlmann and Mitchell, 1970). Mont Saint-Hilaire is the second reported locality for the mineral (Chao and Baker, 1979). Recently two others have been reported; a second Texas locality and one in Utah (R. Gaines, personal communication).

At Mont Saint-Hilaire behoite is found as an extremely rare accessory mineral in pegmatite veins and in miarolitic cavities in nepheline syenite. It occurs as well-formed, wedge-shaped crystals, forming radiating, spherical aggregates. The crystals are 0.5–1.5 mm in length and the spherical groups are 2–4 mm in diameter. Some of the spheres have a solid core of behoite, while others have a hollow core. It has also been found as groups of prismatic crystals, 2–7 mm in length, with very steep, wedge-shaped terminations, forming oriented, reticulated aggregates, in an unaltered pegmatite vein. These crystals are exceptionally large for the species. Behoite has also been found as a thin crust on serandite and other minerals occurring in pegmatites.

The crystals are mainly white or colorless and very rarely pale pink to pale gray with a greasy to dull luster. Most crystals are translucent to opaque or very rarely transparent. The crusts are white, and opaque with a dull luster. (See color photo on following page.)

Berthierine $(Fe^{+2},Fe^{+3},Mg)_{2-3}(Si,Al)_2O_5(OH)_4$

Berthierine, a member of the kaolinite-serpentine group, was found as sharp, well-formed, 3–5 mm long, greenish yellow, yellow, pseudohexagonal, prismatic pseudomorphs terminated by a pinacoid in a very heavily altered pegmatite vein consisting largely of natrolite, tetranatrolite, aegirine, ancylite and rhodochrosite. The crystals are pseudomorphs after a mineral with a layered structure, possibly biotite or some other mica. The replacement is partial, with a well-defined, translucent terminal-zone with a greasy luster, consisting of pure berthierine, while the rest of the prism is opaque and dull, and is a mixture of berthierine and the replaced mineral. (See color photo on following page.)

Beryl $Be_3Al_2Si_6O_{18}$

The occurrence of beryl is very rare. It has been found in small fractures in pale gray, fine-grained hornfels, as 1–3 mm long hexagonal prisms terminated by the {0001} pinacoid and small pyramidal faces. The crystals are pale yellow with a vitreous luster. Beryl bears very close resemblance to the very commonly occurring fluorapatite in the hornfels association, from which it is difficult to distinguish visually.

Beryllonite $NaBePO_4$

Beryllonite is an exceedingly rare accessory mineral in the fracture cavities in the hornfels. It has been found as small (<1 mm diameter), dull, white spheres and rosettes associated with quartz, rutile, calcite and analcime.

Beudantite $PbFe_3^{+3}(AsO_4)(SO_4)(OH)_6$

Beudantite is an extremely rare secondary mineral at Mont Saint-Hilaire. It was found as yellow-green to olive-green crusts and druses of tiny (<1 mm), indistinct, translucent crystals with greasy luster, in cavities in etched sphalerite crystals, in an altered pegmatite vein. In addition to sphalerite, it was also closely associated with galena, arsenopyrite and pyrite.

Biotite $K(Mg,Fe^{+2})_3(Al,Fe^{+3})Si_3O_{10}(OH,F)_2$

Biotite, a common mica, is relatively abundant as well-formed, euhedral crystals and as crystalline masses in many of the mineral associations, and as a rock-forming mineral. The crystals are short to long, frequently tapered pseudohexagonal prisms to several centimeters across. The color is black or very dark reddish brown. Biotite is visually indistinguishable from siderophyllite and annite, which are also found at Mont Saint-Hilaire.

Birnessite $Na_4Mn_{14}O_{27}\cdot 9H_2O$

Birnessite occurs as thin, dull coatings and as fine-grained pseudomorphs after serandite ("black serandite") and rhodochrosite. The replacement is usually very shallow on the serandite or rhodochrosite crystals, although some crystals appear to be completely altered.

The color of birnessite is very dark brown or black and the luster is dull to greasy.

The birnessite pseudomorphs after serandite are some of the more spectacular specimens from Mont Saint-Hilaire; some pseudomorphs attain extraordinary sizes of up to 20 cm in length. They commonly form very attractive groups of sharp prismatic to bladed crystals. The best specimens were collected in the early 1970's and in the summer of 1983, in the Demix quarry. Associated with birnessite in the altered pegmatites are analcime, natrolite, leucophanite, rhodochrosite and polylithionite. (See color photo on following page.)

Bismuth Bi

Native bismuth occurs as very small, metallic flakes and blobs embedded in sodalite xenoliths. It is extremely rare and only a few specimens are known.

Figure 22. **Britholite-(Ce), a radiating group of crystals. The needles are 10 to 15 microns in length. National Museum of Natural Sciences (Canada) specimen #53747. SEM photo by I. Wainwright.**

Britholite-(Ce) $(Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$

Britholite-(Ce), an uncommon member of the apatite group (Gay, 1957), is exceedingly rare in sodalite xenoliths, occurring as colorless, transparent, radiating groups of prismatic crystals, embedded or partially embedded in sodalite. The crystals are 0.5–1.5 mm long, less than 0.1 mm across, and very inconspicuous, tending to blend into the colorless to white sodalite matrix. Britholite looks very similar to several other species, such as pectolite, cancrinite and revdite, that occur as colorless prismatic crystals in the same association, and visual identification is impossible.

Brockite $(Ca,Th,Ce)(PO_4)\cdot H_2O$

Brockite, a member of the rhabdophane group (Fisher and Meyrovitz, 1962), is extremely rare at Mont Saint-Hilaire. It was found as small (4–8 mm diameter), white powdery masses, intimately as-

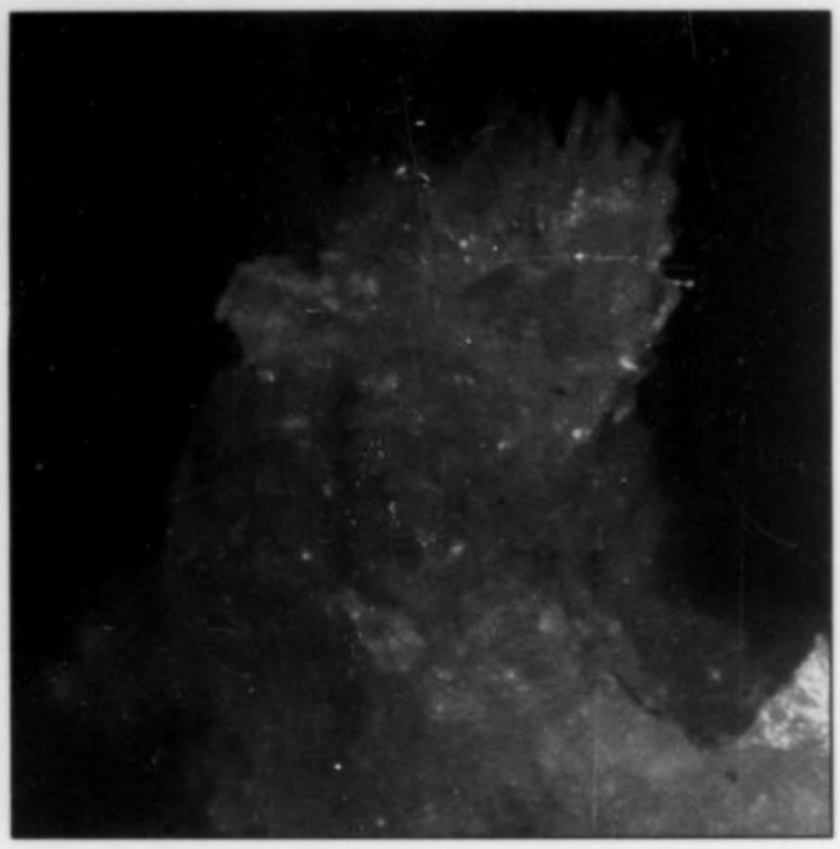


Figure 23. **Behoite, a group of wedge-shaped crystals 2.5 mm in diameter. Horváth collection and photo.**

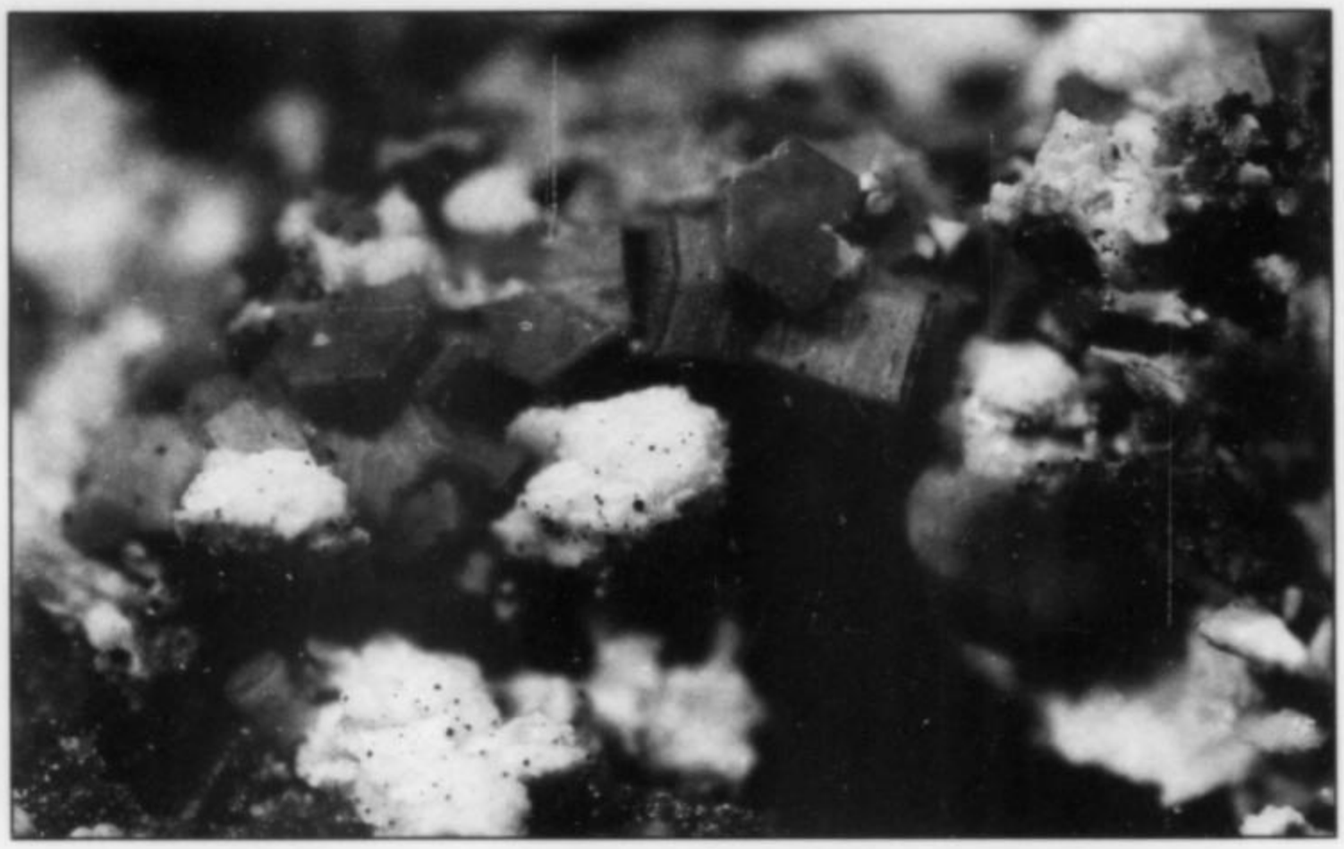


Figure 24. **Berthierine crystals to 0.5 mm. Dan Behnke collection and photo.**

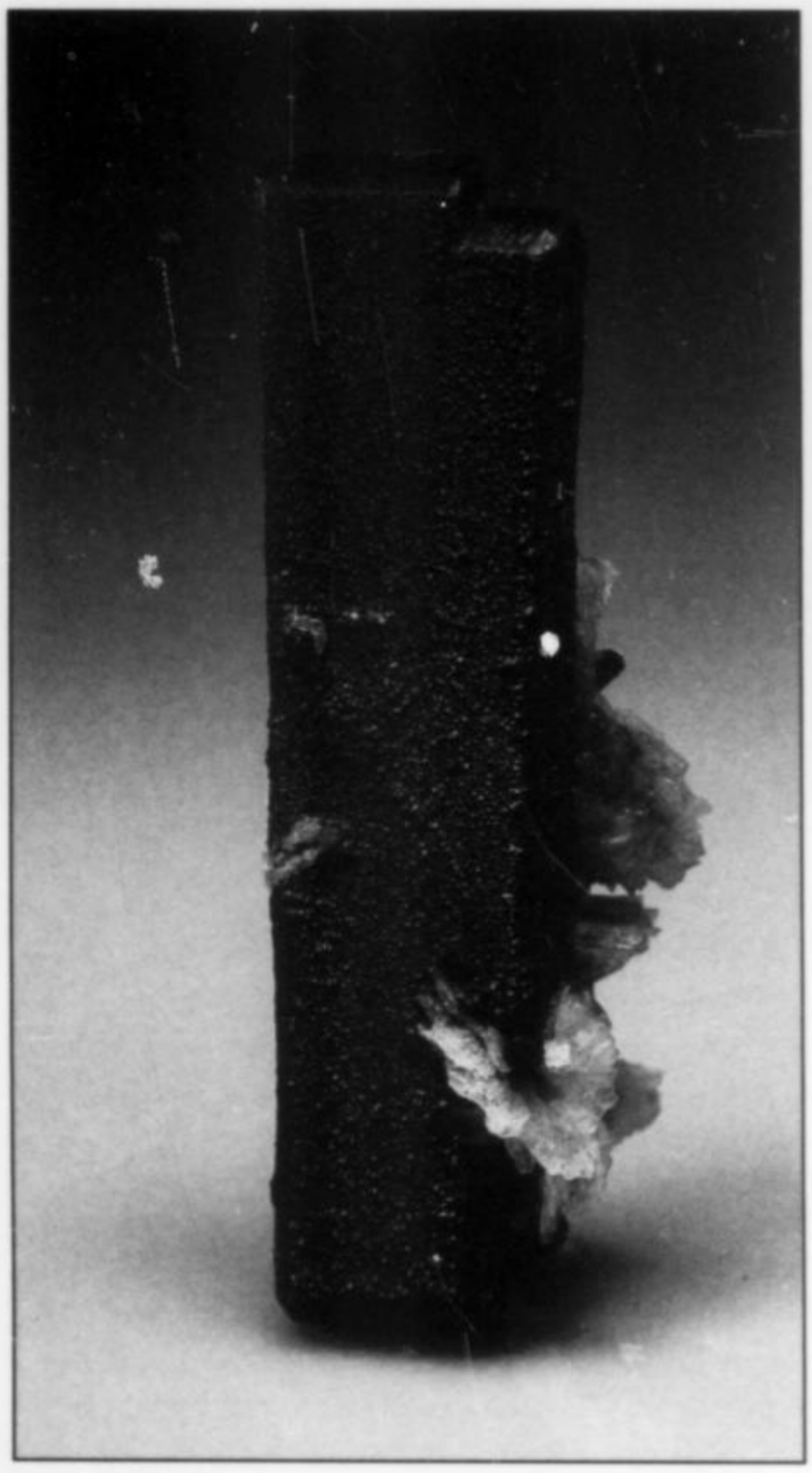


Figure 25. **Birnessite, a fine, sharp pseudomorph after a doubly terminated serandite crystal 4.5 cm in length. Horváth collection. Photo by G. Robinson.**

Figure 26. **Brookite crystals to 1.1 mm. Dan Behnke collection and photo.**

sociated with the new species thornasite in a heavily altered pegmatite dike (Ansell and Chao, 1987). Other associated species are analcime, aegirine, steacyite, yofortierite, eudialyte, mangan-neptunite, epididymite, leifite, natrolite, serandite and polylithionite.

Brookite TiO_2

Brookite is fairly common in miarolitic cavities in nepheline syenite, in breccia cavities and in small fractures and seams in the hornfels. The crystals are typically sharp, well-formed, complex, short prisms; equant, pseudohexagonal dipyramids; and rarely of tabular habit. They range in size from 1–5 mm in length with exceptional crystals to 1 cm. The color is predominantly black; in thin fragments it may be very dark brown to red-brown.

Burbankite $(Na,Ca)_3(Sr,Ba,Ce)_3(CO_3)_5$

Burbankite was originally described from the Bearpaw Mountains, Montana (Pecora and Kerr, 1953). It has also been reported from the Green River Formation (Milton and Fahey, 1960) and from a vein in the Vuojärvi pluton in the Kola Peninsula, USSR (Borodin and Kapustin, 1962). Mont Saint-Hilaire is the fourth reported locality (Chen and Chao, 1974) for the mineral.

At Mont Saint-Hilaire it occurs as a rare accessory mineral in miarolitic cavities in nepheline syenite, in minute amounts in the contact rims between sodalite syenite and hornfels, and very rarely in pegmatites and sodalite xenoliths.

It is found as excellent, sharp, well-formed, hexagonal or dihexagonal prisms, commonly terminated by hexagonal pyramids either

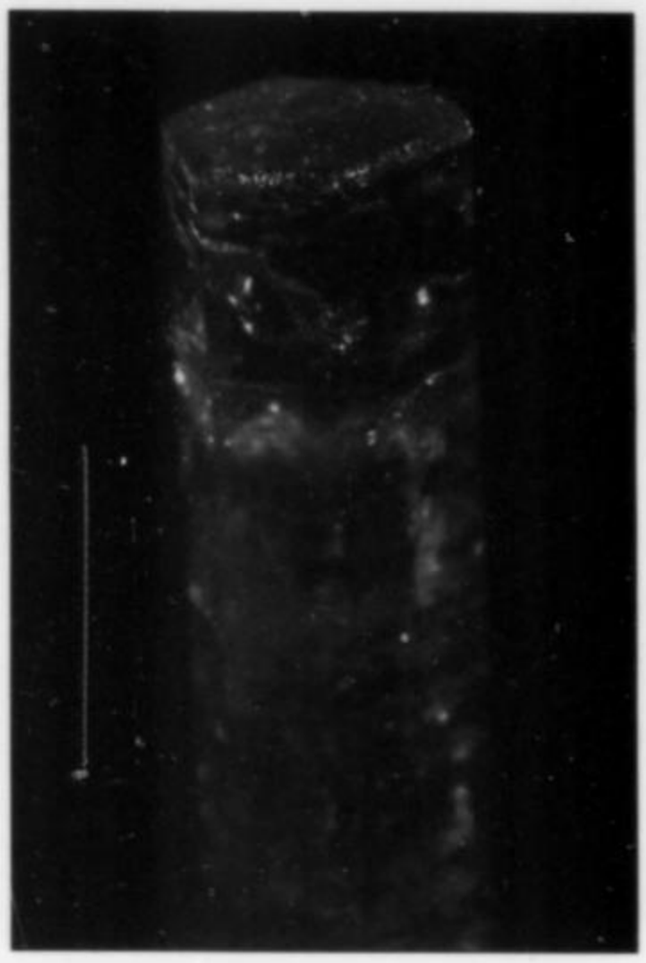


Figure 27. **Burbankite, a terminated, single crystal 6 mm in length. Horváth collection and photo.**

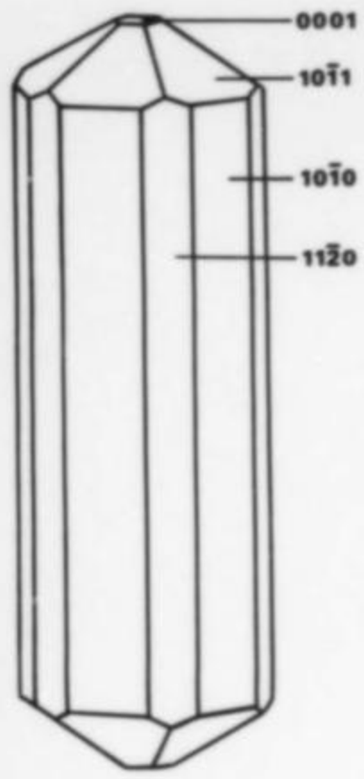


Figure 28. **Burbankite crystal drawing, from measurements made on a reflecting goniometer, showing the more common {10$\bar{1}$1} pyramid.**

the {10$\bar{1}$1} or the {10$\bar{1}$2}, or the combination of a pyramid and a small pinacoid. It is also found as prismatic crystals with etched or fibrous terminations, as compact, spherical aggregates and as pure fibrous masses.

Crystals in the miarolitic cavities average 1–3 mm in length, with exceptional crystals attaining 2 cm. Burbankite crystals are pale to lemon-yellow and orange-yellow and predominantly transparent, with occasional translucent to opaque zones, and with a vitreous to dull luster. The crystals often have an opaque, glaze-like white shell that tends to exfoliate, readily exposing the yellow transparent core. The prisms found in sodalite xenoliths and the fibrous variety are white or beige and opaque, with a silky or dull luster.

Traces of burbankite have also been detected in large (5–10 cm long), hexagonal prismatic pseudomorphs composed of ancylite after an unknown precursor, leading to the supposition that the replaced mineral may have been burbankite.

Calcio-ancylite-(Ce) $(Ca,Sr)Ce(CO_3)_2(OH)\cdot H_2O$

See ancylite-(Ce).

Calcite $CaCO_3$

Calcite is ubiquitous at Mont Saint-Hilaire. It is found as excellent crystals in numerous habits, as large granular masses and as small fine-grained to coarsely cleavable segregations and fillings.

The crystals are tabular, prismatic, columnar, blocky or platy, and range in size from 1 mm to 10 cm across. Most are transparent or have transparent sections; some are translucent, rarely opaque. The predominant color is yellow (pale to lemon); colorless crystals are also very common; less common colors are beige, pale brown and pale green.

Cancrinite $Na_6Ca_2Al_6Si_6O_{24}(CO_3)_2$

Cancrinite, a member of the cancrinite group, is relatively common in sodalite syenite. It is found as pale to dark yellow and pale orange, randomly disseminated, fine-grained and fibrous columnar masses several centimeters across, and very rarely as embedded pale yellow, dull, opaque, crude prisms up to 2 cm long and 1.5 cm across. It has also been found in narrow seams in nepheline syenite, in close proximity to sodalite xenoliths as sharp, 1–20 mm long, intergrown prismatic crystals showing two sets of hexagonal prisms {10$\bar{1}$0} and {11$\bar{2}$0}, terminated by the hexagonal pyramid {10$\bar{1}$1}. The small crystals are colorless to pale violet and transparent with a vitreous luster, while the larger crystals are pale to dark violet and opaque, with a dull to greasy luster. Very rarely, it occurs in sodalite xenoliths as small (2–5 mm diameter), embedded, spherical nodules, consisting of pale violet, concentric, radiating prisms, and in small cavities as sharp, 1–2 mm, colorless to pale violet, transparent and white, opaque, hexagonal prisms.

Carbocernaite $(Ca,Na)(Sr,Ce,Ba)(CO_3)_2$

Carbocernaite is extremely rare. To date, a single cavity in igneous breccia has yielded the only confirmed specimens of the mineral. It occurs as small, yellow, irregular grains associated with donnayite, ancylite, synchysite, albite, parisite, pyrophanite, titanite and other species. It was first found at Mont Saint-Hilaire in 1974 and then designated as UK#40 (Chao and Baker, 1979).

The mineral is chemically similar to burbankite; it was originally described from the Vuorjärvi Massif, Kola Peninsula, USSR (Bulakh *et al.*, 1961).It has also been reported from Vietnam (Bulakh and Izokh, 1966) and northern Ontario (Harris, 1972).

Carbonate-fluorapatite $Ca_5(PO_4,CO_3)_3F$

Carbonate-fluorapatite, a member of the apatite group, is a rare, late-stage accessory mineral in pegmatite veins. It is found as 1–3 mm botryoidal aggregates consisting of transparent, pale brown, tabular, simple hexagonal crystals. It also occurs as beige or gray, flat, tabular crystals 1–5 mm in length; these crystals are sometimes hollow, and appear to be pseudomorphs after an undetermined mineral of orthorhombic symmetry. The luster is vitreous to greasy.

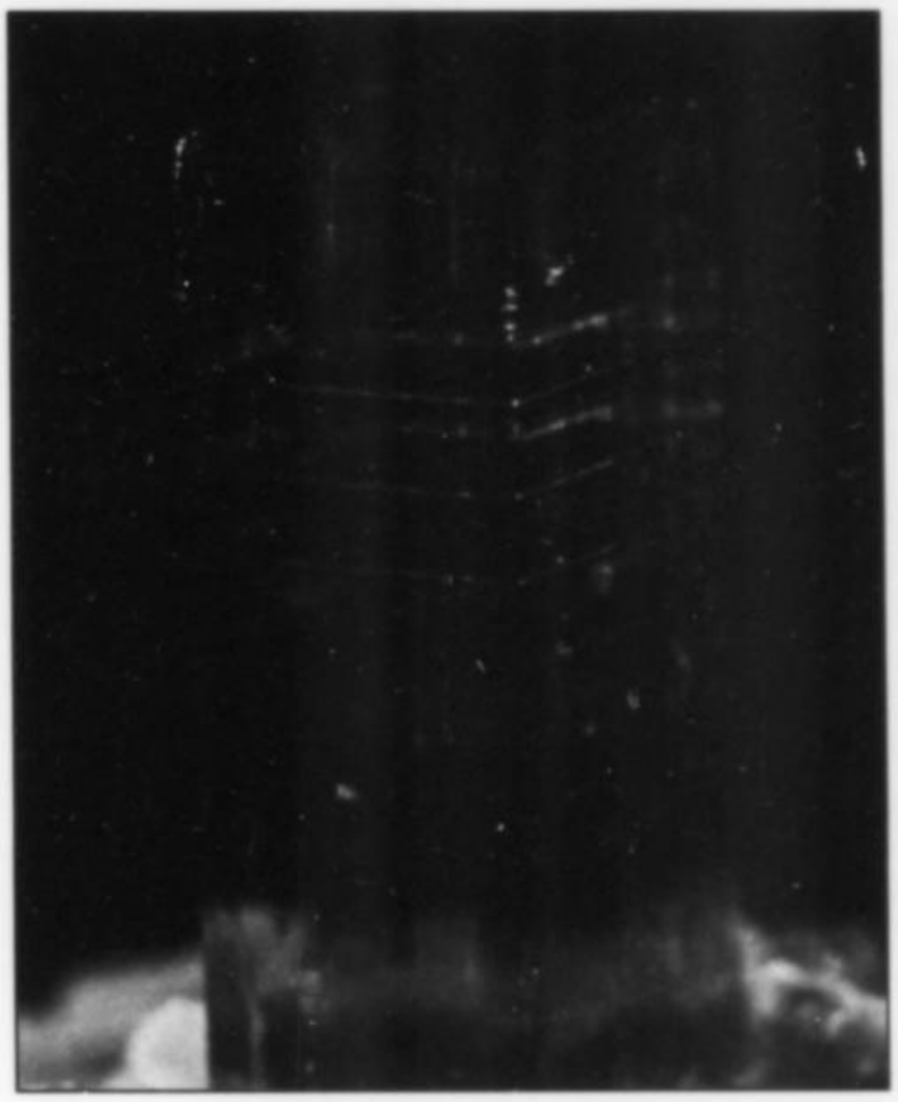


Figure 29. **Carletonite crystal 1.2 cm in height, collected in the spring of 1988. Horváth collection and photo.**

Carletonite $KNa_4Ca_4Si_8O_{18}(CO_3)_4(OH,F)\cdot H_2O$

Carletonite was originally described from Mont Saint-Hilaire (Chao, 1971 and 1972), which remains the only known locality for the species. It occurs exclusively in marble xenoliths, frequently in close proximity to, or in contact with, dark green, fine-grained hornfels and igneous breccia.

Prior to 1982, only small amounts of the mineral were encountered, and essentially all the specimens collected consisted of crystalline masses and cleavages. In the period 1982–87, operations in the Poudrette quarry exposed a number of marble xenoliths which produced

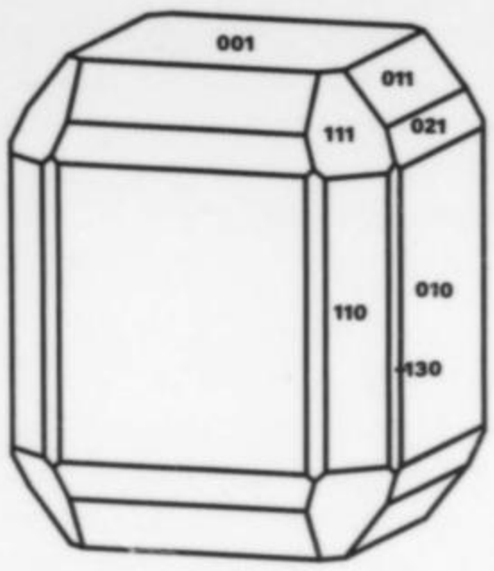


Figure 30. **Carletonite, composite drawing of three crystals measured on a reflecting goniometer.**

the best crystallized specimens, including a number of exceptionally large crystals, some with the most attractive, vivid, cornflower-blue color.

The first major find occurred in the summer of 1983, yielding some large matrix specimens of pale blue crystals to 5 cm in length. Some very fine specimens with crystals of 5–10 mm and excellent color have been found intermittently from 1983 to 1987. The most significant find that produced the finest specimens to date, mostly single crystals of exceptional sharpness and intensity of color, occurred in November of 1987. Very attractive, sharp, color-zoned (pale to deep blue, pink to colorless to white), single crystals to 6 cm were recovered in significant numbers, as well as transparent, deep blue, terminated crystals to 1.5 cm in length.

Carletonite is found as layered crystalline masses embedded in the marble, and in cavities of varying sizes as sharp, well-formed, tetragonal prisms, usually overgrowing a layer of colorless or white crystalline carletonite lining the cavities. Associated minerals include quartz, calcite, pectolite, aegirine, steacyite, leucosphenite, narsarsukite and fluorite.

The crystals are short to long tetragonal prisms, bounded by {100}, {110} and {130} prisms and the {001} pinacoid with variously developed tetragonal dipyramids {011}, {021} and {111}. The size of the crystals ranges from 1 mm to 6 cm in length and up to 2 cm across, however the average size is in the 2–10 mm range.

Cleavage in one direction, {001}, is perfect and {110} is good. The layered structure of the mineral is very prominent, especially on crystals that show evidence of natural etching on the prism faces.

The color of carletonite varies greatly from crystal to crystal or even within the same crystal, ranging from very pale to fairly intense cornflower-blue to deep blue; less commonly from pink to pale violet; and also white and colorless. Color zoning in crystals is very common, and the transition may be gradual or very sharp and irregular. Phantoms occur in many of the smaller transparent blue crystals, with a darker blue core and a colorless to pale blue outer zone. The exterior of large crystals tends to be white or very pale blue and opaque, due mainly to internal flaws and inclusions, while the core is translucent to transparent, and vivid blue. The smaller crystals are most commonly transparent. Some crystals also contain hollow tubular cavities with a square or rectangular cross section, from which some undetermined mineral of prismatic morphology was naturally leached.

The luster ranges from dull (in many cases etched surfaces), to vitreous and silky. The development of a dull, waxy luster after extended exposure to air has been reported, but has not been observed by the authors on specimens in various collections after more than six years.

While very fragile, several small gemstones have been cut from transparent carletonite, the best being a 0.34 carat dark blue emerald cut.

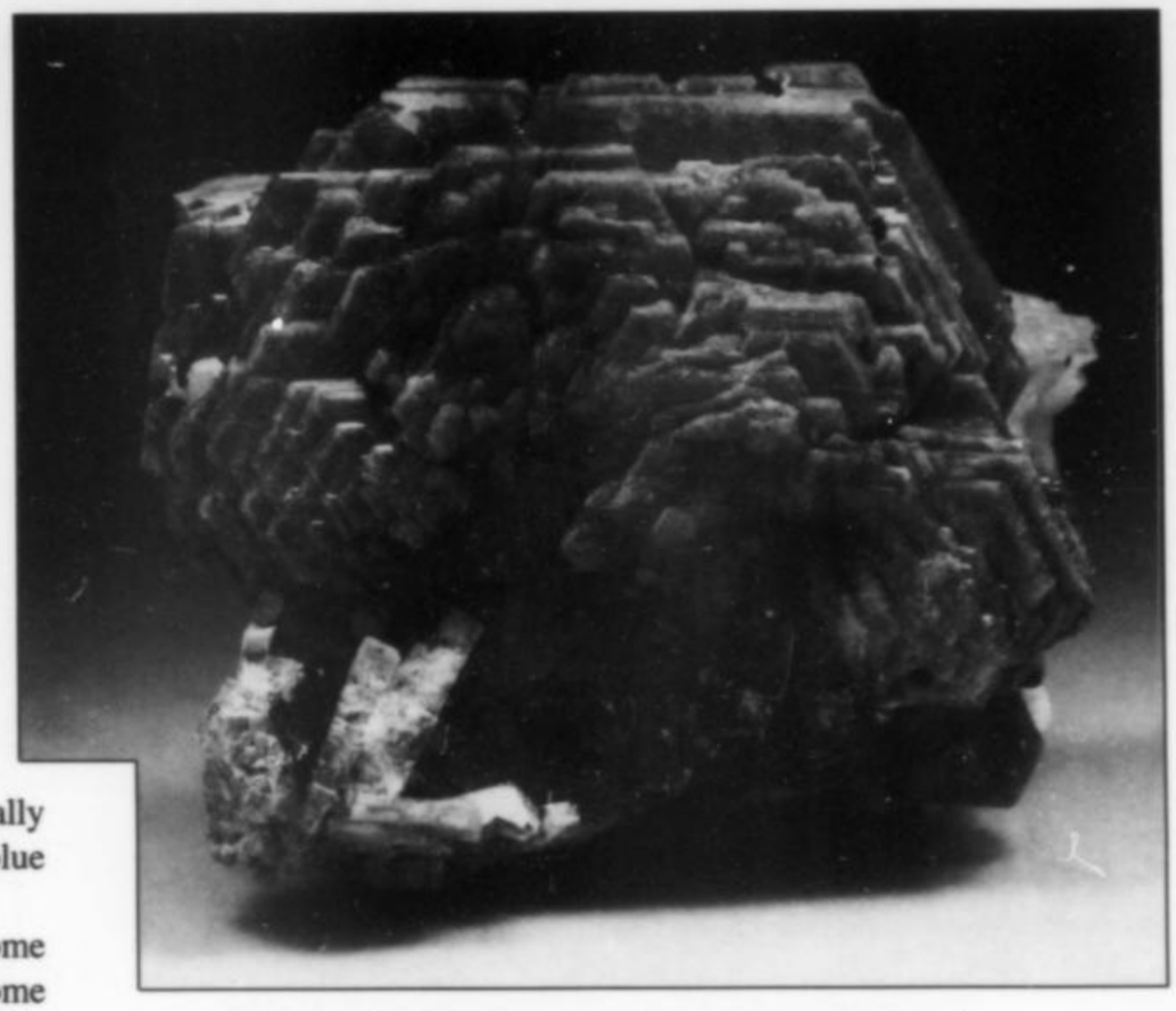


Figure 31. **Catapleiite, a very large rosette of lustrous, tan-colored crystals 9 cm across. National Museum of Natural Sciences (Canada) specimen #51289. Photo by G. Robinson.**

Catapleiite $Na_2ZrSi_3O_9 \cdot 2H_2O$

Catapleiite, a monoclinic (pseudo-orthorhombic, pseudohexagonal) silicate (Chao *et al.*, 1973), is a relatively common species at Mont Saint-Hilaire, occurring mainly in altered pegmatite veins from millimeter-size microcrystals to superb crystal groups and rosettes to 15 cm in diameter. It has also been found less frequently in unaltered pegmatites, miarolitic cavities, marble and sodalite xenoliths and breccia cavities. Mont Saint-Hilaire has over the years produced the best and the largest crystallized specimens of catapleiite, making it, after serandite, perhaps the most sought after species from the locality.

It is found as excellent, sharp, hexagonal-shaped plates commonly forming lustrous, attractive and sometimes spectacular, stacked, rosette-like groups. Individual crystals are relatively rare and tend to be smaller. Crystals are invariably twinned, polysynthetically. At least six twin laws were reported, which singly or combined result in monoclinic symmetry and orthorhombic and hexagonal pseudosymmetries (Chen and Chao, 1973).

The color varies from tan to beige to pale gray to brown to colorless and very rarely in small crystals to pale yellow, pale orange, pink and very pale blue. The crystals are transparent to translucent to opaque. The luster is vitreous, although many crystals are coated with an extremely thin, transparent film that tends to diminish the luster and imparts an attractive iridescence to the crystals. Cleavage in one direction is perfect; two other cleavages are imperfect. Catapleiite forms an isomorphous series with calcium catapleiite (Portnov, 1964), in which catapleiite is the sodium end-member and calcium catapleiite the calcium end-member. The latter has not been found at Mont Saint-Hilaire. (See the color photos on p. 304.)

Celestine $SrSO_4$

Celestine is extremely rare. It has been found as 0.5–1.0 mm, compact, spherical aggregates in small cavities in a contact between altered pegmatite and hornfels. The color varies from white to tan; the luster is dull.

Cerite-(Ce) $(Ce,Ca)_9(Mg,Fe^{+2})Si_7(O,OH,F)_{28}$

Another extremely rare species at Mont Saint-Hilaire, cerite-(Ce)

has been found as 0.5–1 mm transparent, hexagonal plates, forming rosette-like groups, in small cavities in a pegmatite vein contacting a marble xenolith. It is associated with natrolite, fluorite, albite, catapleiite, calcite, helvite, apatite and tundrite. The crystals are rose-red, pale pink and pink, with a vitreous luster. The thin hexagonal plates tend to be rounded on the corners; they resemble catapleiite and an unusual platy habit of rhodochrosite found in the pegmatites, and may be easily confused with those species.

Cerussite $PbCO_3$

Cerussite has been identified as an extremely rare secondary mineral occurring on corroded galena crystals, in heavily altered pegmatitic veins and breccia cavities. It occurs as very small (<0.5 mm), white or off-white acicular crystals, as thin crusts on galena, and in small solution cavities in galena crystals. In some specimens, cerussite is intimately intergrown with yellow, acicular wulfenite.

Chabazite $CaAl_2Si_4O_{12}\cdot 6H_2O$

Chabazite, a zeolite, has been found as a very rare accessory mineral in an altered pegmatite, in marble and sodalite xenoliths. It occurs most often as minute (<1 mm), white or colorless, rounded hexagonal plates, flakes, rosettes and spherical aggregates of flakes in small cavities in sodalite xenoliths. It is also found as white and tan, <1 mm, six-pointed, stellate crystals or groups in marble xenolith cavities, mainly associated with carletonite. Orange-brown, glassy, hexagonal crystals to 1.2 cm in diameter were found in a pegmatite vein. The smaller crystals appear to be somewhat micaceous, opaque to translucent, and have a dull to pearly luster; the large crystals are translucent to transparent with vitreous luster.

Chalcopyrite $CuFeS_2$

Chalcopyrite has been found extremely rarely as sharp, 2–3 mm disphenoids in fracture cavities in hornfels. More commonly it occurs as embedded masses with other sulfide minerals in altered pegmatite veins and hornfels.

Chamosite $(Fe^{+2},Mg,Fe^{+3})_5Al(Si_3Al)O_{10}(OH,O)_8$

Chamosite, a chlorite group mineral, occurs as dark, brownish green, spherical aggregates and micaceous plates with pearly luster, from 0.5 to 15 mm across, in cavities in marble xenoliths and in pegmatite veins.

Chkalovite $Na_2BeSi_2O_6$

Chkalovite was originally described from the Lovozero Massif in the Kola Peninsula (Gerassimovsky, 1939a), where it occurs as crystalline segregations, in sodalite syenite pegmatites. It has also been found at Ilímaussaq (Sørensen, 1960). At Mont Saint-Hilaire, the third reported locality, it is exceedingly rare, found as 0.5–3 mm, complex, equant crystals, with somewhat rounded appearance, in tiny cavities in sodalite xenoliths, associated with villiaumite, ussingite, lovozerite, vuonnemite, serandite, lueshite, steenstrupine and others. The crystals, the first reported for the species, are colorless, transparent with vitreous luster and conchoidal fracture. They may be easily confused with similar crystals of sodalite and natrophosphate, which occur in the same association.

Clinochlore $(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$

Clinochlore, a member of the chlorite group, occurs as aggregates of very minute (0.1–0.5 mm) plates forming rosettes on crystals of taeniolite in cavities in marble xenoliths. It is brown, pale tan, colorless or white.

Cordierite $Mg_2Al_4Si_5O_{18}$

Cordierite has been found as embedded, white to pale gray, minute anhedral grains in hornfels.

Cordylite-(Ce) $Ba(Ce,La)_2(CO_3)_3F_2$

The type locality for cordylite-(Ce) is Narssârssuk, Greenland,

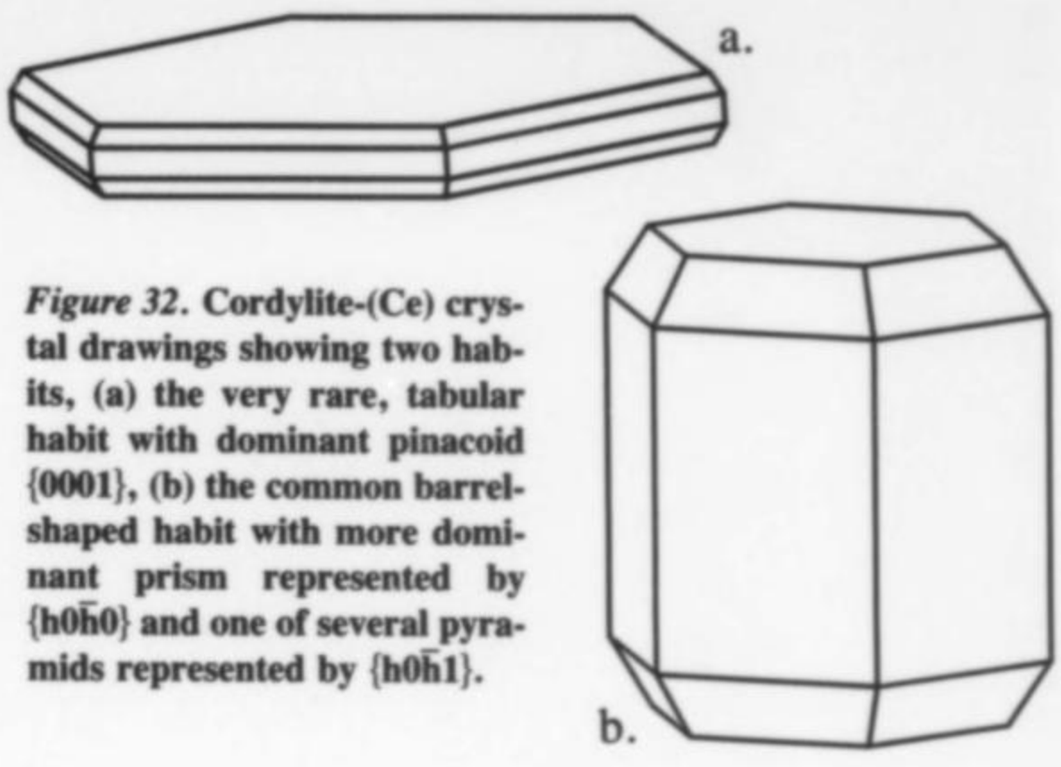


Figure 32. **Cordylite-(Ce) crystal drawings showing two habits, (a) the very rare, tabular habit with dominant pinacoid {0001}, (b) the common barrel-shaped habit with more dominant prism represented by {h0$\bar{h}$0} and one of several pyramids represented by {h0$\bar{h}$1}.**

where it occurs in good 1–3 mm, hexagonal, hemimorphic crystals in pegmatitic cavities in nepheline syenite (Bøggild, 1953). Mont Saint-Hilaire is the only other known locality for the mineral (Chen and Chao, 1975), where it is encountered very rarely, in cavities associated with breccia zones, in altered pegmatite veins and in mineralized tension fractures in the hornfels.

A number of different crystal habits have been noted. Hexagonal prisms 2–10 mm in length, terminated by the combination of a {0001} pinacoid and small hexagonal pyramid, were found in a heavily altered pegmatite vein, associated with microcline, biotite, fluorapatite, calcite, donnayite, siderite, rutile, sphalerite and pyrite. The prisms are yellow, gray and grayish brown and opaque, with dull to greasy luster on the prism faces and vitreous on the pinacoid and pyramidal faces.

Thin hexagonal plates dominated by a {0001} pinacoid, with very minor pyramidal and prism face development, forming attractive complex rosette-like groups, were found in small cavities in breccia, associated with donnayite, parisite, synchysite, ancylite, titanite, apatite, tadzhikite and carbocernaite. The crystals are 1–3 mm in diameter, lemon-yellow to orange-yellow, and transparent to translucent with vitreous luster.

In the breccia and the hornfels associations, cordylite-(Ce) has also been found as short or elongated, tapering, hemimorphic, hexagonal crystals, associated with albite, aegirine, quartz, elpidite, brookite, lorenzenite, leucosphenite, narsarsukite, ashcroftine, calcite and bastnäsite. Some of these crystals are of superb quality and clearly the best and the largest for the species, with exceptional crystals up to 1.5–2 cm in length. The color is yellow, to brownish yellow and orange-yellow. The luster varies from dull to greasy to vitreous. Crystals are transparent to translucent and opaque. Many of the crystals have a transparent interior, even when appearing dull and opaque on the exterior. The layered structure and perfect basal cleavage is evident in all crystal habits. (See the color photo on the following page.)

Corundum Al_2O_3

Corundum, a member of the hematite group, has been found as small, pale brown, granular masses embedded in albite patches in fine-grained hornfels, associated with albite, siderite, ancylite, beryl and molybdenite. The occurrence is extremely rare and only a few specimens are known.

Cryolite Na_3AlF_6

Cryolite occurs as 1–2 mm, sharp, pseudo-octahedral crystals, in small cavities in sodalite xenoliths, associated with sodalite, villiaumite, natrolite, eudialyte, lovozerite, chabazite and aegirine. It is extremely rare and only a few specimens have been recovered to date. The crystals are colorless to white, and have a greasy luster.

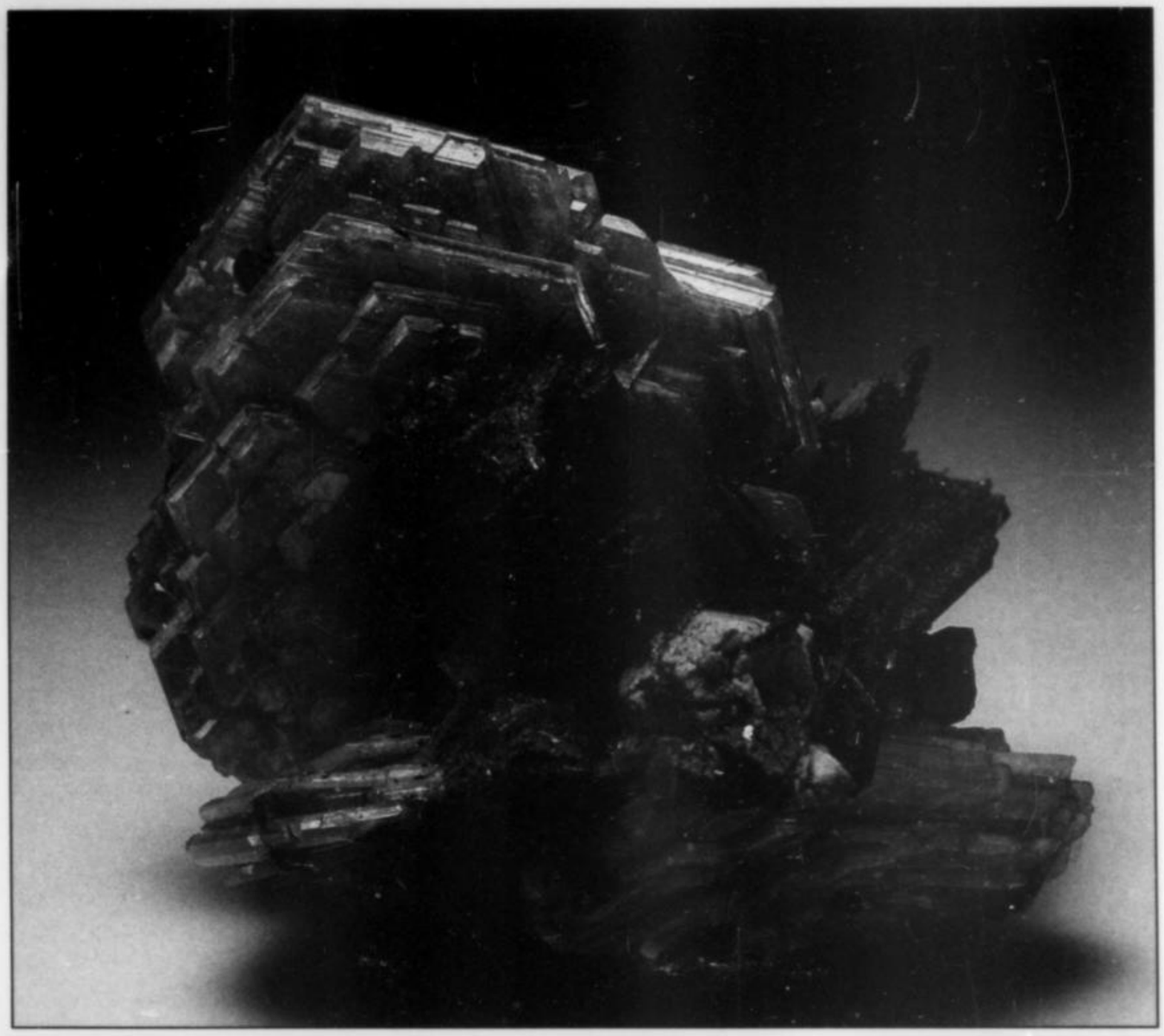


Figure 33. **Catapleiite crystal group 4 cm across. G. Haineault collection. Photo by G. Robinson.**

Figure 35 (*below*). **Cordylite crystal, 5 x 9 mm. G. Haineault collection. Photo by L. Horváth.**

Figure 34. **Catapleiite group of transparent crystals. The specimen measures 3.5 cm across. National Museum of Natural Sciences (Canada) specimen #37369. Photo by G. Robinson.**

Daqingshanite-(Ce) $(Sr,Ca,Ba)_3(Ce,La)(PO_4)(CO_3)_{3-x}(OH,F)_x$

Daqingshanite-(Ce) was first found at Mont Saint-Hilaire in 1976, and was recognized as a potential new species and designated as UK#44 (Chao and Baker, 1979). Due to the scarcity of the mineral and difficulties with the definition of the crystal structure, no progress was made after 1979. The mineral was found in 1980 at the Bayan Obo iron ore deposit, near Mount Daqingshan in China, where it occurs as platy aggregates and crude rhombohedra, and was later described as a new species (Yingchen *et al.*, 1983, and Lulu and Zhizhong, 1985).

At Mont Saint-Hilaire the mineral was found, in what may be a single occurrence, in small cavities in the margin of an altered pegmatite dike, associated with albite, ancylite, pyrite, anatase and a green "chlorite-like" mineral. It occurs as 0.2–1 mm diameter, sharp, pale yellow, transparent, hemimorphic crystals displaying trigonal pyramids and concave (due to twinning) pedions, and complex twinned aggregates. All crystals examined are reported to be polysynthetically twinned along at least three directions (Chao and Baker, 1979). The crystals bear some resemblance to, and could be easily confused with the small, trigonal, saucer-shaped donnayite crystals. The luster is greasy to vitreous, and many of the crystals contain inclusions of and a thin coating of a green, powdery "chlorite-like" mineral. In the paragenetic sequence of the particular altered pegmatite environment in which it was found, daqingshanite-(Ce) appears to be the latest mineral to form.

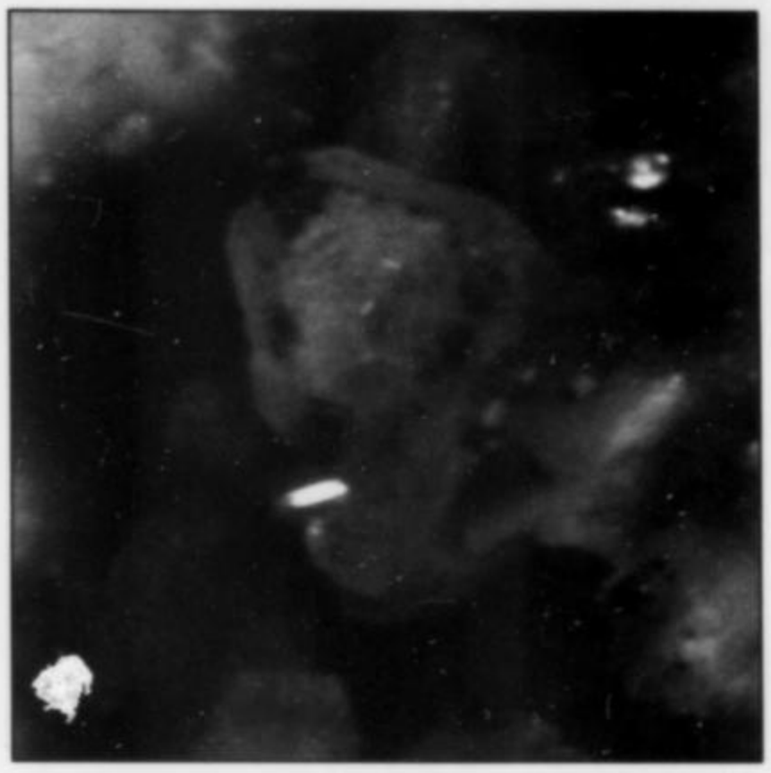


Figure 36. **Daqingshanite-(Ce) twin 1 mm across. Horváth collection. Photo by R. Gault.**

Figure 37. **Daqingshanite-(Ce) crystal group in parallel growth, approximately 1 mm across. Horváth collection. SEM photo by E. Vadas.**

Datolite $CaBSiO_4(OH)$

The occurrence of datolite, a member of the gadolinite group, is rare. It has been found in marble xenolith cavities, associated with pectolite, as excellent crystals 2–20 mm in length, and as <1 mm diameter compact spheres. The crystals are short prismatic, very sharp, transparent, pale yellow or greenish yellow with a vitreous luster. The spheres are white, dull on the exterior, exhibiting radiating internal structure and porcellaneous luster on broken surfaces. Datolite is also known as colorless, botryoidal micro-crusts on tetranatrolite from an altered pegmatite.

Dawsonite $NaAl(CO_3)(OH)_2$

Dawsonite is found as embedded crystalline masses and rarely as sharp, prismatic, longitudinally striated crystals, 2–35 mm in length on fracture surfaces and in cavities in sodalite syenite and very rarely in hornfels. The mineral is relatively rare, although it appears to be very widely disseminated, in both the Demix and the Poudrette quarries, in small quantities. Crystals are predominantly colorless to white prisms, terminated by a pinacoid. The luster is silky.

Diopside $CaMgSi_2O_6$

Diopside, a member of the pyroxene group, occurs relatively rarely, as masses of small (<1 mm long) green, prisms and pale pink tabular crystals in marble xenoliths, and as 2–5 mm long color-zoned (red-yellow-green) prisms in hornfels.

Dolomite $CaMg(CO_3)_2$

Dolomite is moderately common in mineralized seams and fractures in the hornfels, occurring as sharp, commonly curved rhombohedra or as zoned, short, hexagonal prisms and plates. The crystals are 2–12 mm long, translucent to opaque, with a color ranging from white to pale pink to beige, brown, yellow, pale to apple-green and colorless. The hexagonal crystals exhibit interesting color zoning, with alternating colorless and yellow or light and dark brown zones. The most attractive specimens are the apple-green, transparent rhombohedra to 1.2 cm in size found in 1987–88.

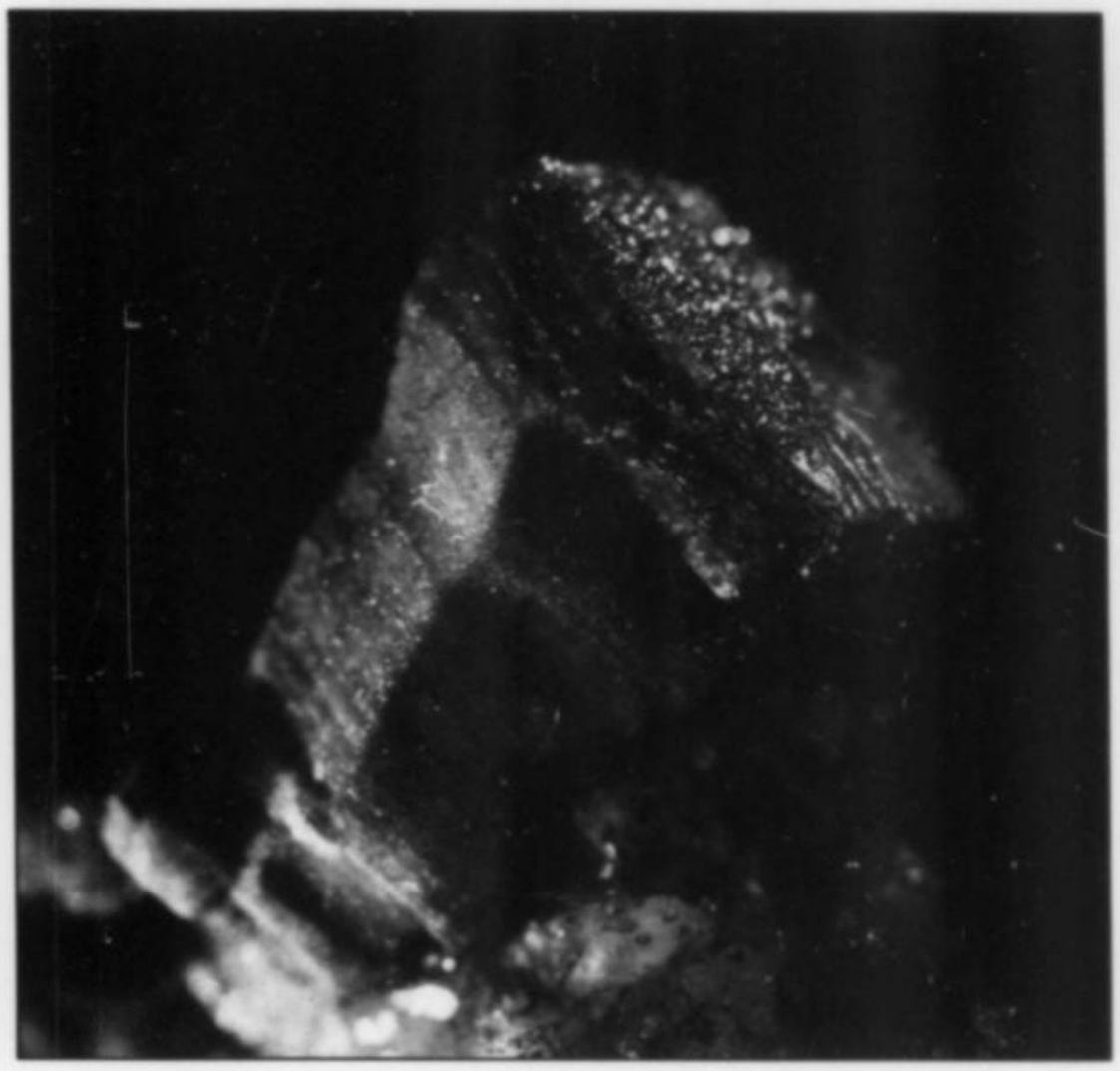


Figure 38. **Donnayite-(Y) crystal, 1.4 cm in height, collected in 1987. The termination is coated with pyrite crystals. G. Haineault collection. Photo by L. Horváth.**

Donnayite-(Y) $Sr_3NaCaY(CO_3)_6 \cdot 3H_2O$

Donnayite-(Y) was described as a new species from Mont Saint-Hilaire (Chao *et al.*, 1978), which remains the only known locality. It is a member of an isomorphous series which includes mckelveyite-(Y) and weloganite; it is the Sr-analog of ewaldite and the Y-bearing analog of weloganite.

It is a relatively common species, occurring in a number of different mineralogical environments. It has been found in altered and unaltered pegmatites, miarolitic cavities, marble xenoliths, hornfels, sodalite syenite cavities and in breccia cavities.

Donnayite-(Y) is triclinic but displays trigonal and hexagonal pseudosymmetry. It occurs in a multitude of crystal habits, including syntactic intergrowth with ewaldite, mckelveyite, synchysite and weloganite. The crystals are tabular, barrel-shaped, pagoda-shaped, saucer-shaped, columnar, "trigonal" and "hexagonal" hemimorphic, and platy. The crystal faces are invariably curved, rounded and uneven, and interfacial angles are only rarely measurable. Most crystals are twinned, and tend to occur in complex, multiple, epitactic stacked groups and clusters. The crystals are 0.5–3 mm in length but some exceptional crystals attaining 3 cm in length have been collected. Small crystals are transparent to translucent, while the larger crystals are invariably opaque.

The color varies from pale yellow to lemon-yellow, orange, pale green, gray, gray-green, pale brown, white and colorless. The luster

is vitreous on small hemimorphic crystals, waxy to dull on the larger crystals and resinous on fractured surfaces. Donnayite-(Y) is difficult to distinguish from some of the other rare earth carbonates, such as mckelveyite, ewaldite and daqingshanite, but it is far more common than the others.

In the paragenetic sequence, in all associations, donnayite-(Y) appears to be one of the very last minerals to form.

The most impressive specimens of donnayite were collected in the winter of 1987–88; most are matrix specimens with some exceptional crystals exceeding 3 cm in length (Fig. 38).

Dorfmanite $Na_2HPO_4 \cdot 2H_2O$

Dorfmanite was originally described from the Lovozero massif (Kapustin *et al.*, 1980). Mont Saint-Hilaire is the second reported locality for the mineral.

It has been found as white, powdery fillings and as compact blobs in small cavities, 2–8 mm in diameter, in the sodalite xenoliths, associated with sodalite, villiaumite, eudialyite, lovozerite and ussingite. It is identical in appearance to several other white, powdery minerals such as thermonatrite, trona and nahpoite, which occur in the same environment, and proper identification requires chemical and X-ray diffraction analysis. The stability range for dorfmanite is 25–61% relative humidity at 25°C. Below 25% it loses two H_2O molecules and converts to nahpoite. Above 61% it converts to a higher hydrate, known as a synthetic compound but as yet not found in nature (Waller, 1987).

Figure 39. **Doyleite group of tabular crystals 0.5 mm in width. Carleton University (Ottawa) specimen. SEM photo by L. Ling.**

Doyleite $Al(OH)_3$

Doyleite was described as a new species from Mont Saint-Hilaire (Chao *et al.*, 1985). It was earlier designated as UK#45 pending its investigation (Chao and Baker, 1979). The mineral is a polymorph of $Al(OH)_3$ and as such, structurally and chemically related to gibbsite, nordstrandite and bayerite. Doyleite has also been found at the Francon quarry in Montréal, Québec.

At Mont Saint-Hilaire the mineral is extremely rare, from a single find, and only a few confirmed specimens are known to exist. It occurs as small (<1 mm), square, tabular crystals with a layered, micaceous structure, forming rosettes in an altered and very heavily weathered pegmatite vein in the Demix quarry, associated with albite and minor amounts of siderite, zircon, pyrite, molybdenite and fluorite.

The crystals are colorless to partially white or beige and transparent to translucent to opaque with a vitreous to pearly or dull luster.

Dravite $NaMg_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$

Dravite, a member of the tourmaline group, was found as up to 10 cm long, dark reddish brown to black, crude prisms embedded in a narrow, mineralized seam in fine-grained hornfels.

Edingtonite $BaAl_2Si_3O_{10} \cdot 4H_2O$

Edingtonite, a relatively rare zeolite, is found at Mont Saint-Hilaire as an extremely rare accessory mineral in the miarolitic cavities as very small (<0.1 mm), hollow, tetragonal prisms with somewhat fibrous terminations. The crystals are colorless and form small groups encrusting ilmenite crystals. Associated minerals include ilmenite, analcime, natrolite, calcite and aegirine.

Figure 40. **Elpidite crystal spray 11.5 cm in length with a surface sprinkling of pyrite. G. Haineault collection. Photo by G. Robinson.**

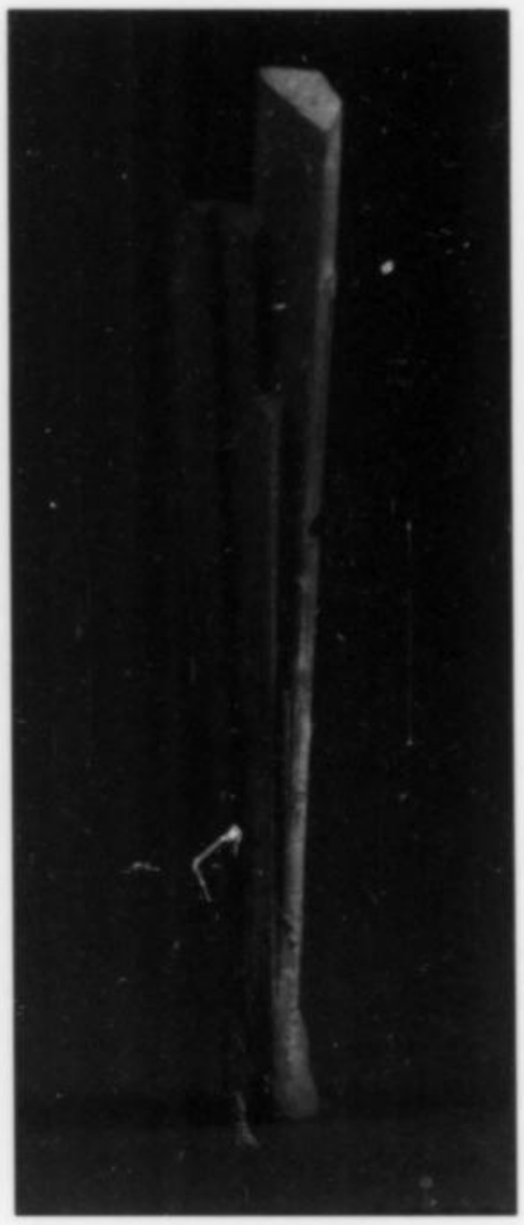


Figure 41. **Elpidite group of terminated crystals 5 cm in height, collected in the fall of 1989. G. Haineault collection. Photo by G. Robinson.**

Elpidite $Na_2ZrSi_6O_{15} \cdot 3H_2O$

Elpidite is a moderately common mineral in altered pegmatites and in cavities in the igneous breccia, less common in unaltered pegmatites. It has also been noted as a rare accessory mineral in marble xenoliths, and very rarely in hornfels and miarolitic cavities.

In altered pegmatites it occurs as 1–5 mm, sharp, terminated, short prismatic crystals, as elongated, needle-like prisms forming very attractive sprays to 15 cm in length and as divergent to jack-straw-like groups and crude aggregates of prismatic crystals to 20 cm. It is also found as 5--20 cm long pseudomorphs after divergent groups of bladed serandite crystals, usually coated by a very fine, dark green, powdery chlorite-group mineral.

In other associations, elpidite is found as elongated prisms 1–10 mm in length. The prisms are occasionally fibrous and rarely terminated. In the breccia cavities it has been found as an epitactic intergrowth with labuntsovite.

The color is tan, greenish gray to white or colorless; crystals are opaque, rarely translucent, with a vitreous to greasy or silky luster. Two good cleavages are noted parallel to the *c*-axis.

Figure 42. **Elpidite pseudomorph after a fan-shaped group of serandite crystals 13 cm in height. National Museum of Natural Sciences (Canada) specimen #36961. Photo by R. Gault.**

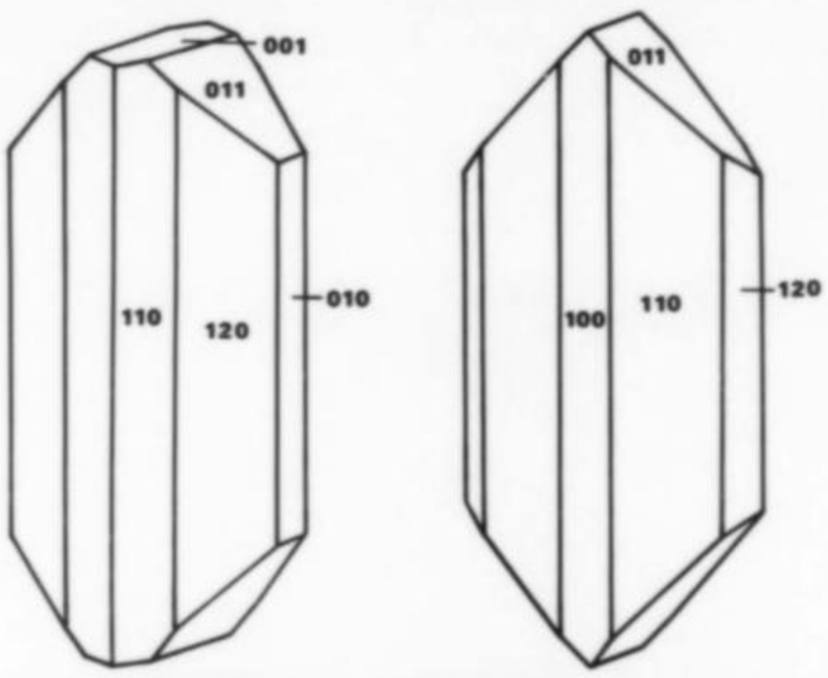


Figure 43. **Elpidite crystal drawings of two habits (modified from crystal drawings of elpidite from Narssârssuk, Greenland, after Goldschmidt (1918)).**

In the summer of 1989, large quantities of jack-straw elpidite was exposed in an altered pegmatite. Densely intergrown masses to 50 cm in diameter of dull, gray prisms up to 20 cm in length were collected. The specimens were rather unattractive, with most crystals broken and without terminations. Later in the same year, the best crystallized specimens of elpidite known, were collected from a large pegmatite cavity (Fig. 71). They were single, very sharp, greenish gray, lustrous prisms with excellent terminations (Fig. 41); most were in the 1–3 cm range, with a few exceptional prisms to 10 cm in length and 1 cm across.

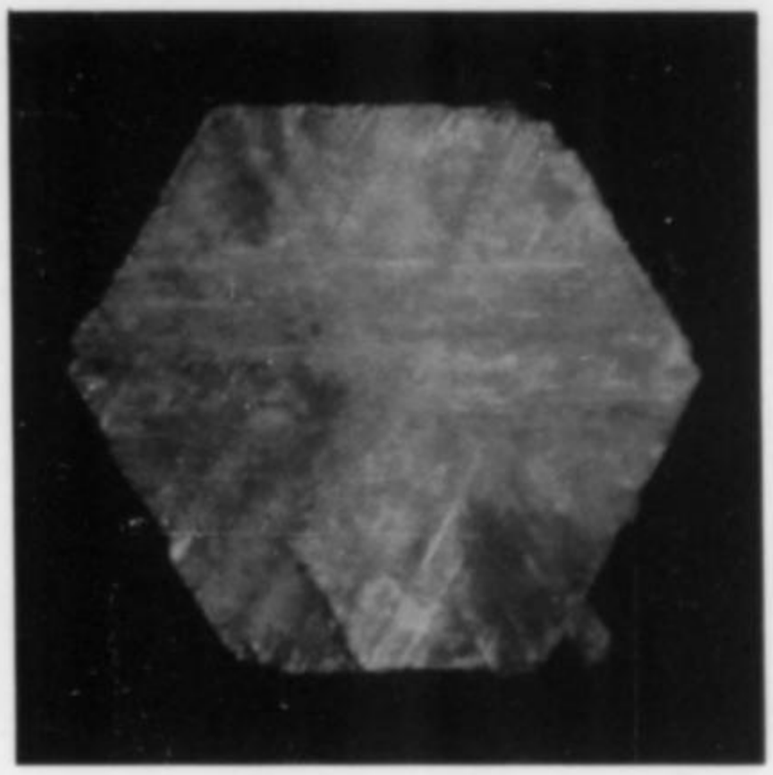


Figure 44. **Epididymite trilling twin 7 mm in diameter. National Museum of Natural Sciences (Canada) specimen #47302. Photo by R. Gault.**

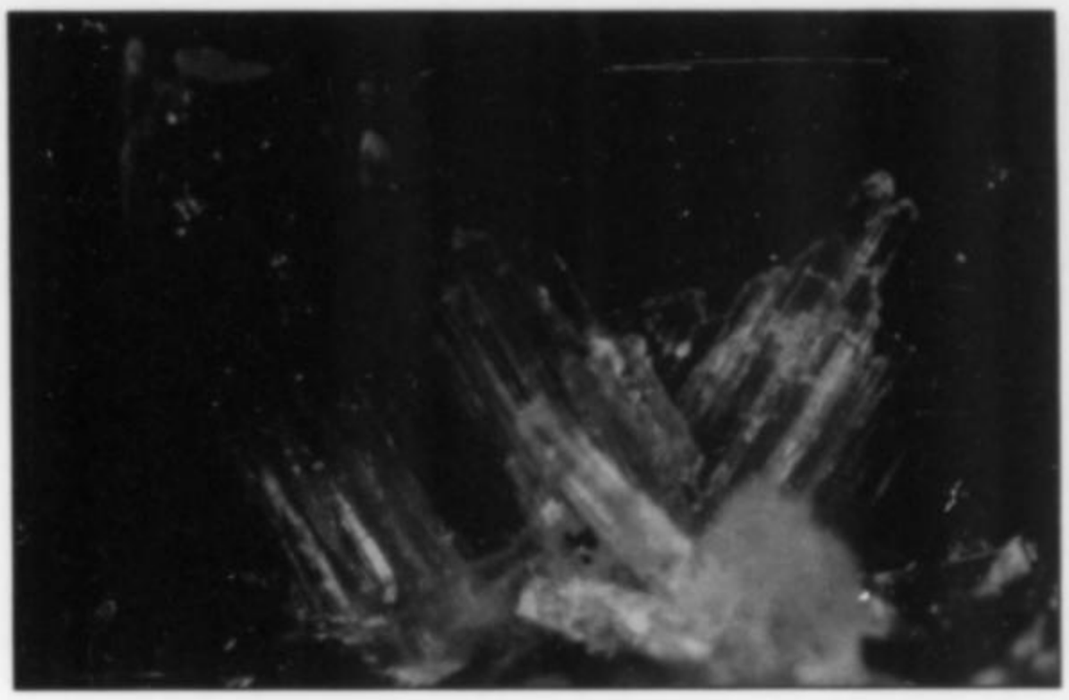


Figure 45. **Epididymite group, 8 mm across, of colorless, transparent, twinned crystals. Horváth collection and photo.**

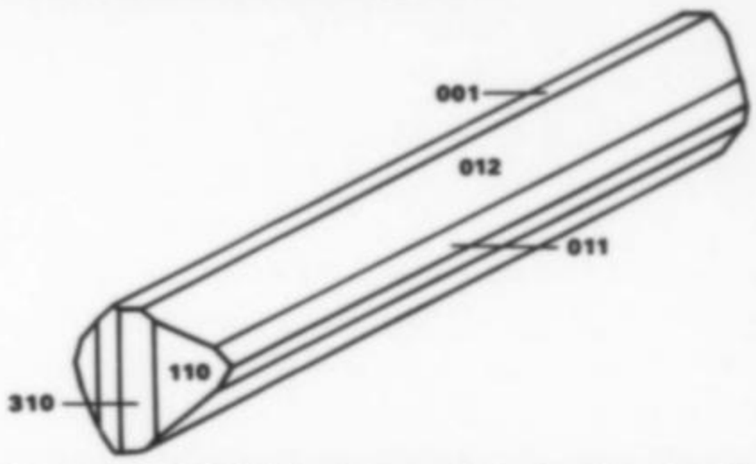


Figure 46. **Epididymite crystal drawing (modified from a crystal drawing of epididymite from Narssârssuk, Greenland, after Goldschmidt (1918)) showing the most common habit.**

Epididymite $NaBeSi_3O_7(OH)$

Epididymite is relatively common in both altered and unaltered pegmatite veins. It also occurs very rarely in cavities in the igneous breccia and extremely rarely in hornfels.

It is found in a great variety of habits, from fibrous to acicular, bladed, long prismatic to blocky and equant prisms and is very frequently twinned. Reticulate twins of acicular to prismatic crystals are perhaps the most common, forming very attractive, stellate, spherical and "barrel-shaped" groups and aggregates. Superb trillings, forming

tabular or columnar pseudohexagonal crystals up to 1 cm across have been encountered in the pegmatites. Transparent, blocky crystals to 2 cm across were found encased in rounded, tan-colored aggregates of catapleiite crystals, which appear to have overgrown the epididymite in an epitactic relationship.

Single crystals are colorless while the fibrous and twinned crystals tend to be white and translucent to opaque. The luster is vitreous to silky, and some crystal faces are selectively frosted.

Epididymite is dimorphous with eudidymite, a much rarer species at Mont Saint-Hilaire, and the two minerals are very similar in appearance, both occurring in the pegmatites.

Epidote $Ca_2(Al,Fe^{+3})_3(SiO_4)_3(OH)$

Epidote, a member of the epidote group, has been found as sharp, lustrous, short, prismatic crystals 0.3–3 mm in length, in a garnet-rich skarn zone, between marble xenoliths and dark brown and green, fine-grained hornfels. They occur as complex parallel clusters on orange-red, well-formed grossular crystals lining fissures and cavities completely filled with massive white calcite. Other associated minerals are titanite, prehnite, allanite-(Ce), fluorite, microcline, aegirine and pyrrhotite.

The crystals are dark brown to red-brown to black and opaque, with a vitreous to greasy luster.

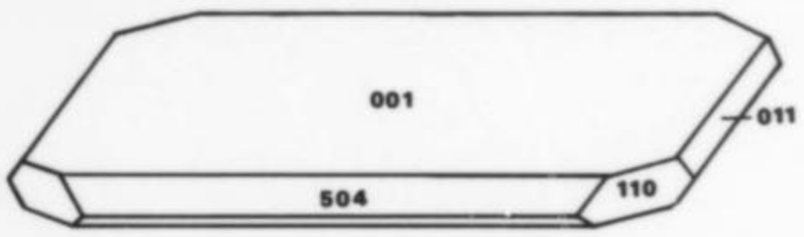


Figure 47. **Epistolite crystal drawing (after a crystal drawing of epistolite from Julianehaab district, Greenland, after Goldschmidt (1918)).**

Epistolite $Na_2(Nb,Ti)_2Si_2O_9 \cdot nH_2O$

Epistolite was originally found by Flink in 1897 and described by Bøggild in 1901 from Ilímaussaq, in southern Greenland (Bøggild, 1953). It has also been found in the Lovozero Massif, Kola Peninsula, USSR (Semenov *et al.*, 1961). Mont Saint-Hilaire is believed to be the third locality for the species, where it occurs as sharp, well-formed, platy crystals to 5 cm in length and more commonly as lamellar to micaceous masses embedded in massive sodalite in sodalite xenoliths. Very rarely it has also been found in eudialyte-rich pegmatite lenses, sometimes partially altered to nenadkevichite.

The crystal lamellae are opaque with a pearly or silky luster. The color is tan, silvery, pinkish beige and yellow-gray. Perfect {001} cleavage is very distinct and two other good cleavages are also present.

Epistolite occurring in the sodalite xenoliths is believed to be an alteration product of vuonnemite, which occurs in the same association. The two species are very similar in morphology, and some crystals of epistolite are only partially altered, retaining a core of vuonnemite. Epistolite also bears very close resemblance chemically and morphologically to murmanite, and many of the known epistolite specimens had been tentatively identified as murmanite-like or UK#46 (Chao and Baker, 1979). Murmanite has not been found at Mont Saint-Hilaire to date. It is also similar in physical appearance to tabular sazhinite-(Ce).

Erdite $NaFeS_2 \cdot 2H_2O$

Erdite, the first sodium-bearing sulfide found in nature, was originally described from Coyote Peak, California (Czamanske *et al.*, 1980). It has also been reported from the Lovozero pluton in the Kola Peninsula (Khomyakov *et al.*, 1979). At Mont Saint-Hilaire, the third

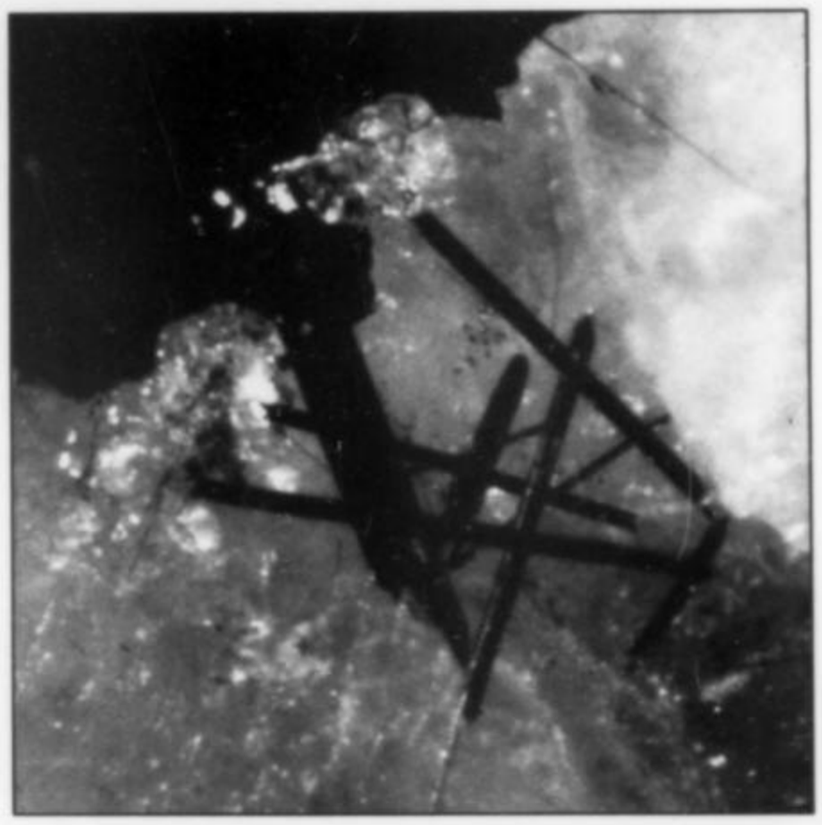


Figure 48. **A group of acicular erdite crystals. The longest crystal is 1 mm in length. National Museum of Natural Sciences (Canada) specimen #54812. Photo by R. Gault.**

reported locality for the mineral, the occurrence is exceedingly rare in sodalite xenoliths, where it is found in small cavities, associated with sodalite, ussingite, natrolite, rasvumite, tugtupite, sidorenkite, vuonnemite and lovozerite.

It is found as short (0.2–1 mm), dark copper-red to bronze, flattened, twisted and curled, bright, very thin (<0.1 mm in diameter) wire-like crystals with metallic luster. Crystals resemble short copper wires, and erdite is unlike any other species found at Mont Saint-Hilaire; sight identification is reasonably easy.

Erythrite $Co_3(AsO_4)_2 \cdot 8H_2O$

Erythrite has been found in a single specimen as a pale purple crust of very small crystals, in a pegmatite vein, associated with aegirine, analcime and calcite. It was identified by X-ray diffraction and electron microprobe analysis, and is believed to be a secondary mineral after some cobalt containing precursor. Interestingly, no other cobalt bearing species have been identified to date.

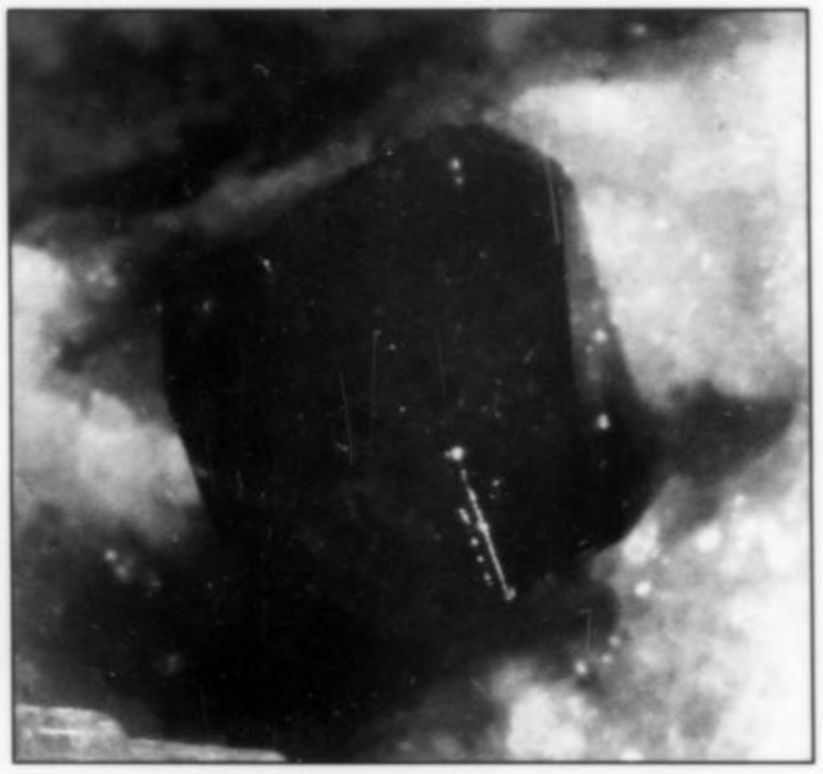


Figure 49. **Eudialyte crystal 1.5 mm across. Horváth collection and photo.**

Eudialyte $Na_4(Ca,Ce)_2(Fe^{+2},Mn,Y)ZrSi_8O_{22}(OH,Cl)_2$

Eudialyte is a very common species, occurring most frequently as dark brown or red-brown, subhedral crystals to 5 cm in diameter and

as crystalline masses embedded in the feldspar lining of pegmatite veins and pipes. Less frequently it is found as superb, free-growing, 1–15 mm, carmine-red, orange-red, orange and pink crystals in cavities associated with pegmatitic veins and segregations. It is also found as excellent, 1–6 mm, red or pink crystals in small cavities in sodalite xenoliths. Very rarely it has also been encountered in breccia and miarolitic cavities, and in at least one cavity in a marble xenolith.

Crystals are generally pseudo-octahedral, sometimes flattened and distorted, with a multitude of small crystal faces, transparent when small and tending to become translucent to opaque with increasing size. Larger crystals contain many internal fractures and inclusions. The luster is vitreous for small crystals and vitreous to greasy for larger crystals. Earlier references also used the now discontinued name, eucolite.

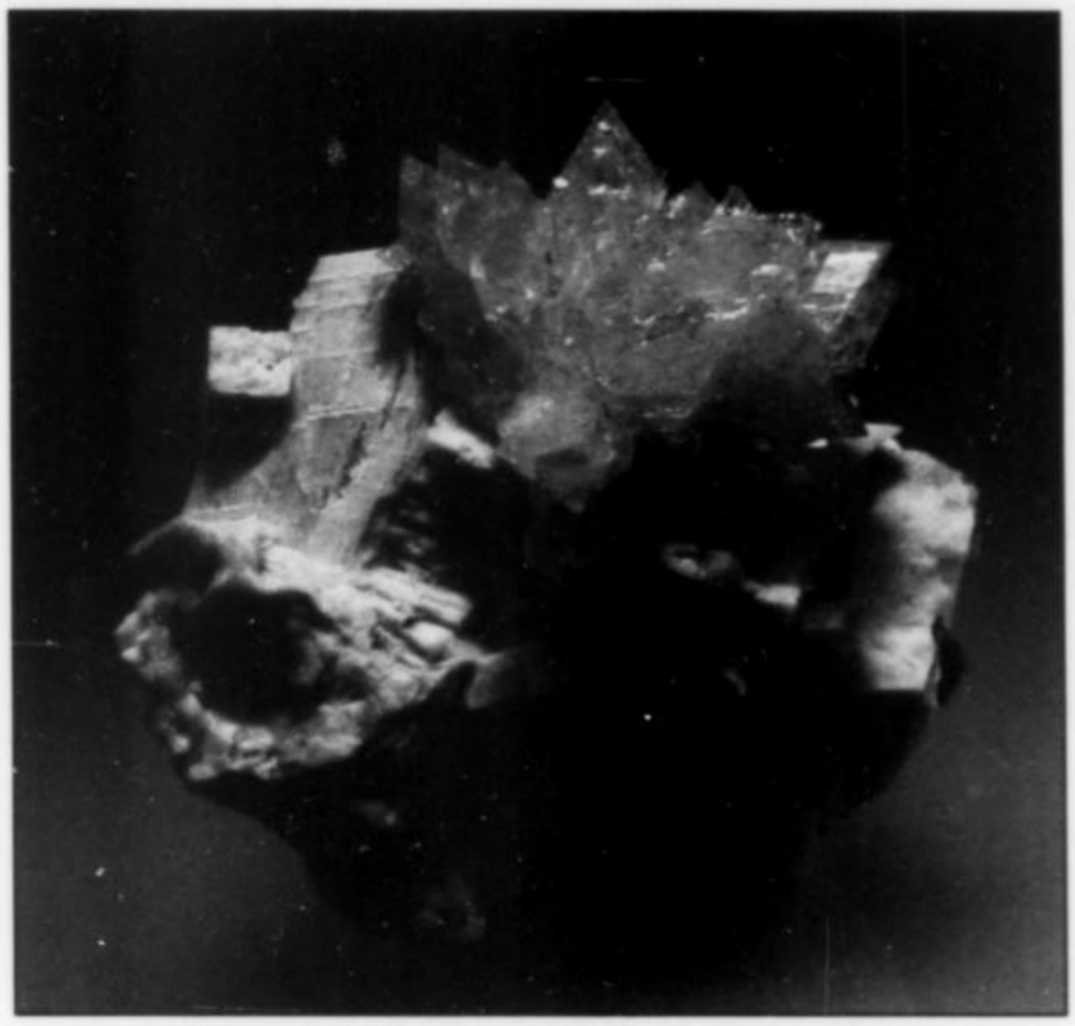


Figure 50. **Eudidymite, a stellate group of crystals on microcline. The specimen measures 2 cm across. G. Haineault collection. Photo by G. Robinson.**

Eudidymite $NaBeSi_3O_7(OH)$

Eudidymite is a monoclinic dimorph of epididymite. It is a very rare species, known to occur only in a small number of localities worldwide and in very small quantities. Known localities include the alkali pegmatites of southern Greenland, Norway and the Kola Peninsula, USSR.

Eudidymite is much rarer that epididymite at Mont Saint-Hilaire. It has been found as excellent, sharp, euhedral crystals in pegmatite veins, and very rarely in breccia cavities. In a very rare and unusual occurrence, it has also been found as small crystalline masses embedded in hornfels.

The crystals are thin, tabular, colorless to white, transparent to translucent, generally twinned, similar in habit and appearance to twinned albite crystals. The twinned crystals are V-shaped, occasionally forming very attractive stellate groups to 2 cm in diameter on microcline. Some of the stellate groups bear strong resemblance to trillings of epididymite, which are also found in the pegmatites. Many crystals exhibit very characteristic uneven, linear etch pits, as well as peculiar oriented, parallel grooves and notches (re-entrant angles), that are very useful features for identification. The luster is vitreous to silky, and the crystal surfaces tend to have a very faint bluish iridescence.

Ewaldite $Ba(Ca,Y,Na,K)(CO_3)_2$

Ewaldite was originally described from core samples from the Green River Formation, in Wyoming, where the mineral occurs as hexagonal crystals in syntactic intergrowths with mckelveyite (Donnay and Donnay, 1971, and Donnay and Preston, 1971).

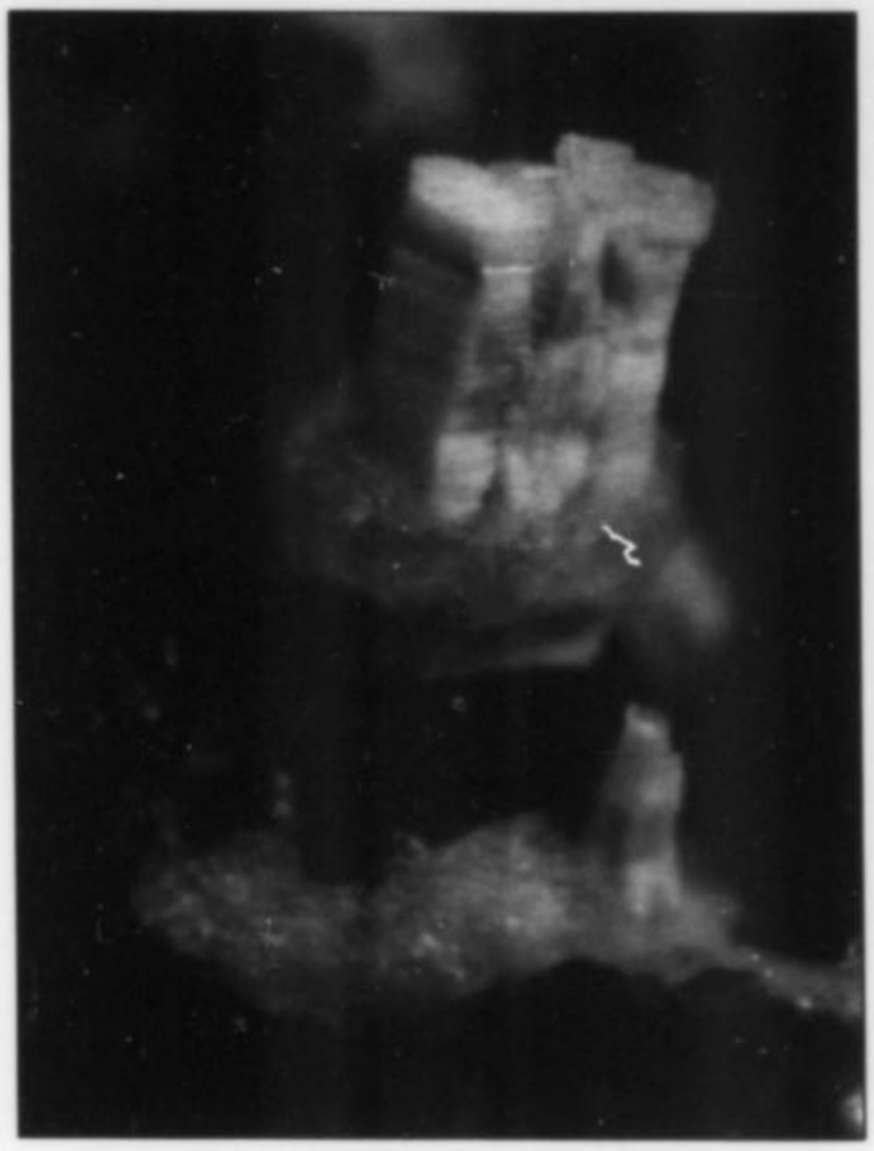


Figure 51. **Ewaldite, a group of "pagoda-shaped" crystals with epitactic "caps and belts" of yellow donnayite. The crystals are 5 mm in height. Horváth collection and photo.**

Mont Saint-Hilaire is the only other known locality for both of these species (Chao and Baker, 1979; McDonald, 1989). Ewaldite occurs as a very rare accessory mineral in miarolitic cavities and exceedingly rarely in cavities associated with the igneous breccias. It is found as excellent, sharp, hexagonal, tapering, hemimorphic crystals, invariably associated with donnayite which forms an epitactic overgrowth on the ewaldite crystals. The morphology of the crystals shows a very strong resemblance to many other rare-earth carbonates from which it cannot be readily distinguished visually. The crystals occur individually or in very intricate and complex pagoda-like groups. Generally the crystals are 2–3 mm in length but some exceptional crystals and groups to 8–10 mm in length have been observed.

The color varies from off-white, beige, yellowish brown, yellow-green, greenish gray to dark bluish gray. The luster is greasy or dull and all the crystals observed have been opaque. Some degree of color zoning is visible on some crystals as well as striations parallel to the {0001} pinacoid, which may be indistinct on most crystals due to the donnayite overgrowth.

One of the most interesting and useful features for visual recognition is the characteristic epitactic overgrowth of donnayite. In some cases donnayite may be an integral part of the ewaldite crystal, appearing only as a distinct, well-defined color zoned layer on the termination, or it may appear as caps on the terminations, or as a belt-like cluster around the ewaldite crystal. The caps and belt-like clusters may consist of aggregates of rather crude, rounded and indistinct crystals or sharp, trigonal hemimorphic crystals.

In the paragenesis of the miarolitic and the igneous breccia cavities, ewaldite appears to be one of the very latest minerals.

Fluorapatite $Ca_5(PO_4)_3F$

Both fluorapatite and carbonate-fluorapatite have been identified at Mont Saint-Hilaire. Fluorapatite is the much more abundant of the two species and is very widespread, occurring in pegmatites, miarolitic

cavities, hornfels, breccia cavities and marble and sodalite xenoliths. It occurs as well-formed, simple, hexagonal prisms, from 1 to 6 mm in length, terminated by basal pinacoids. The crystals are transparent to translucent, most commonly colorless, but also pale yellow, pale green, pink, light to medium red, white and gray.

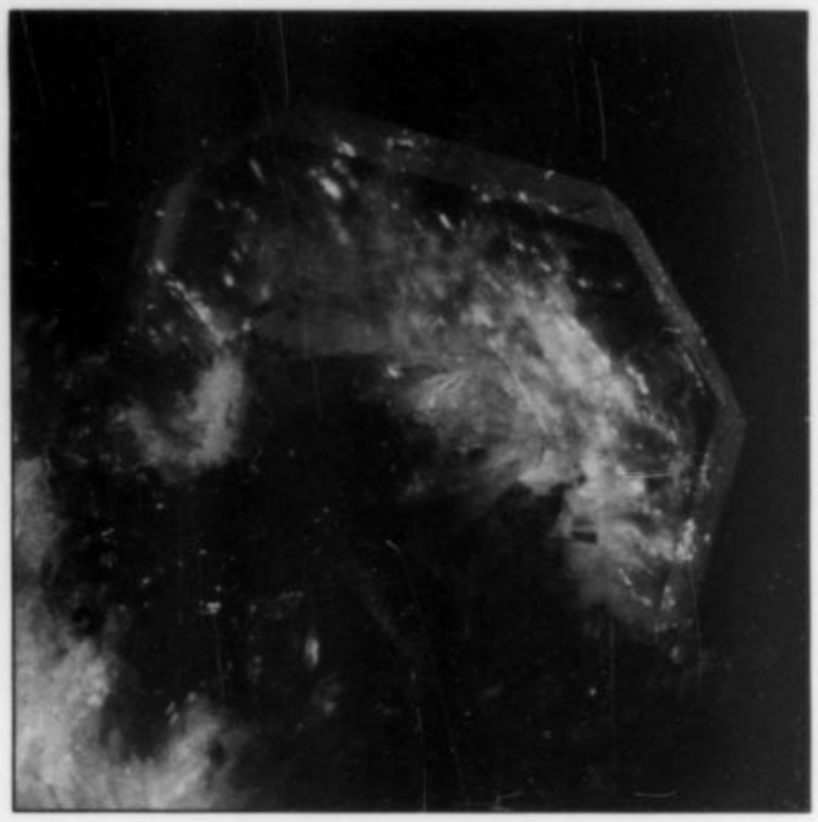


Figure 52. **Fluorapophyllite crystal 3 cm across. Horváth collection and photo.**

Fluorapophyllite $KCa_4Si_8O_{20}(F,OH)\cdot 8H_2O$

Two members of the apophyllite series, fluorapophyllite and hydroxyapophyllite have been identified from Mont Saint-Hilaire. Fluorapophyllite is the dominant member present. It occurs as well-formed crystals, commonly in cavities associated with marble xenoliths and as a relatively rare accessory mineral in some breccia cavities.

The crystals are up to 6 cm across, although the majority are in the 1–6 mm range. A square tabular habit is most common in the large crystals and a pseudo-octahedral habit in the smaller crystals. Small elongated prismatic crystals have also been found.

The crystals are generally colorless, less frequently white, pale gray, pale green, pale yellow (rare) and pale pink (very rare). The luster is vitreous, except for selectively etched and dull {001} pinacoids. Some crystals fluoresce bright green under shortwave and pale yellow under longwave ultraviolet radiation.

Fluorite CaF_2

Fluorite is a very common species occurring in almost all the modes of occurrence. It has been found in the marble xenoliths as excellent, pale purple to colorless octahedra to 2.5 cm on an edge, and as millimeter-size cubes, octahedrons, dodecahedrons and various combinations of these forms, in a great variety of color. In the hornfels it is found as cubic and octahedral crystals to 1 cm, including one 8-mm pink octahedral crystal similar to the Alpine pink fluorites. In the pegmatites it occurs as 1–25 mm mostly green crystals, including several fine dodecahedra. In the other modes of occurrence it is found most commonly as 1–2 mm crystals.

The color ranges from pale to very dark purple, pale to very intense green, pink, pale blue, pale to lemon-yellow, and white to colorless.

In addition to euhedral crystals, cleavage masses of fluorite have been found in the marble, carbonate-rich pegmatites and the hornfels. Some patches of massive fluorite found in the hornfels exceeded 1 meter in diameter.

Franconite $Na_2Nb_4O_{11}\cdot 9H_2O$

Franconite, a hydrated Na-Nb oxide, was originally described from the Francon quarry in Montréal, Québec (Jambor *et al.*, 1984). At Mont Saint-Hilaire, the second known locality, the mineral had been recognized as a new species and designated for a number of years as UK#43 (Chao and Baker, 1979).

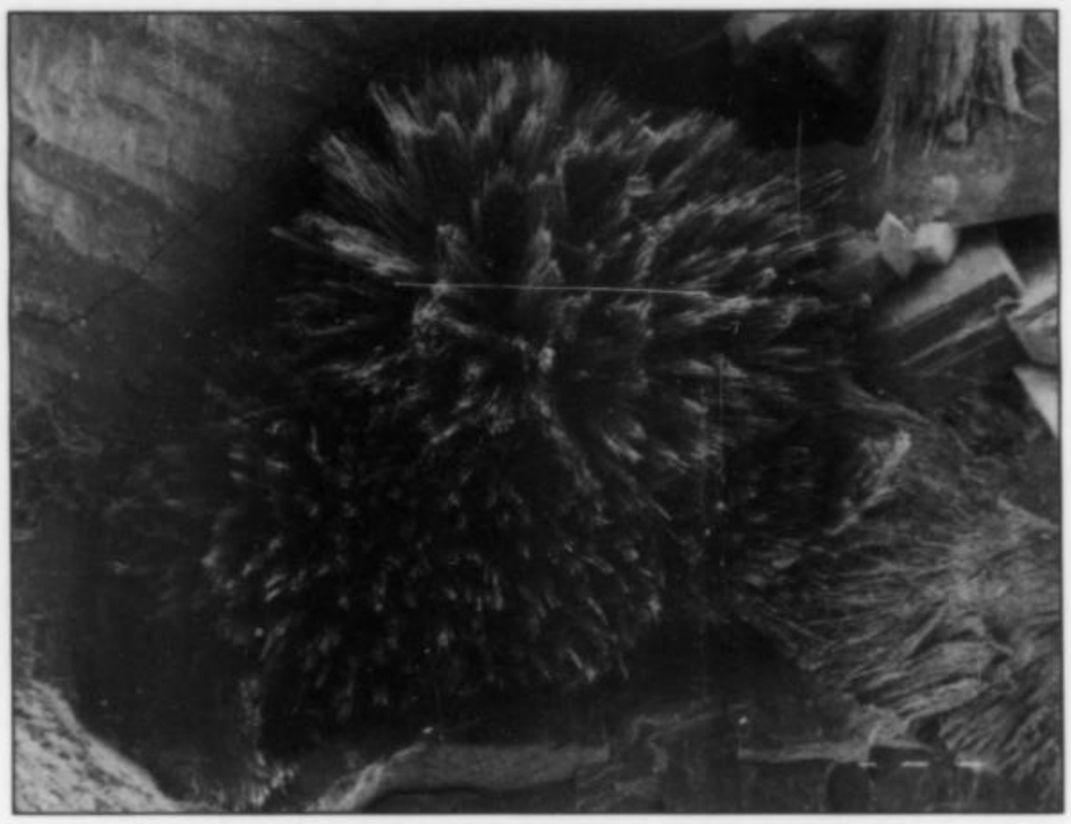


Figure 53. **Franconite, spherical aggregates of fibers. Spheres are 1 to 2 mm in diameter. Horváth collection. SEM photo by E. Vadas.**

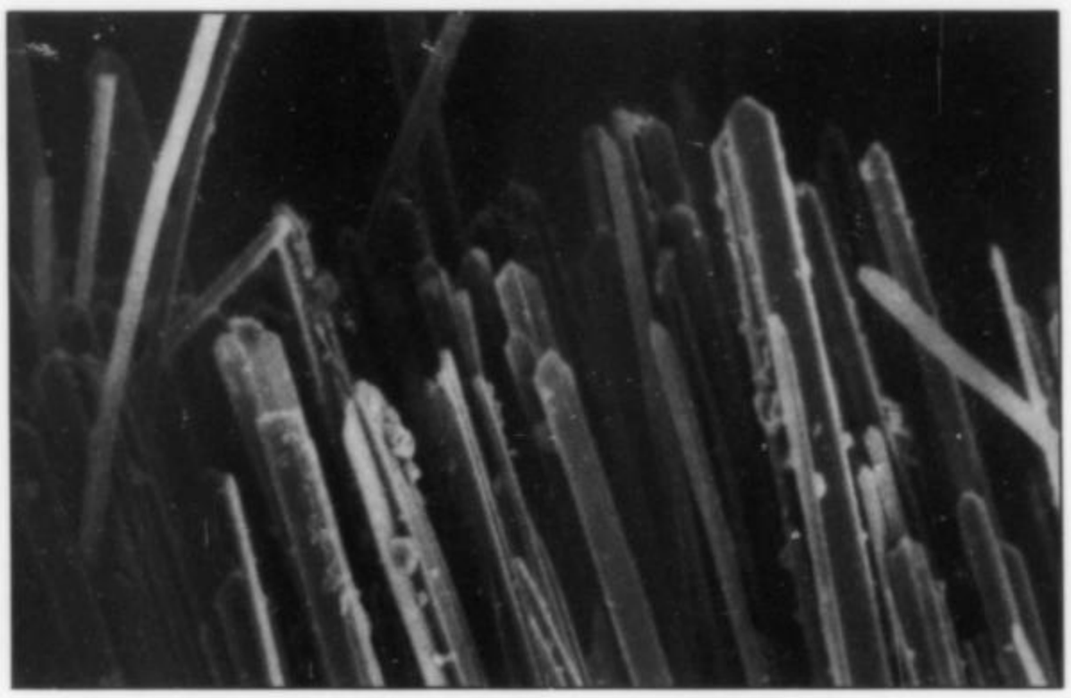


Figure 54. **Franconite in thin, bladed, terminated crystals 0.5 mm in length. Horváth collection. SEM photo by E. Vadas.**

It occurs as extremely fine, short, white, capillary crystals radiating from a solid core and forming compact spheres approximately 1–2 mm in diameter, in small seams and fractures in fine-grained pale gray hornfels, rarely in miarolitic cavities in the contact between hornfels and nepheline syenite and in small cavities in sodalite syenite. Under high magnification the individual crystals appear to be thin blades, with pointed terminations. The mineral is pure white and opaque with a silky luster. Franconite fluoresces bright yellow-white under shortwave and dull yellow-white under longwave ultraviolet radiation.

Visual recognition is unreliable, as a number of other minerals at Mont Saint-Hilaire bear a very close resemblance to franconite, particularly the species hochelagaite, which is the calcium-analog of franconite. The fluorescence of franconite is a reasonably good diagnostic feature to distinguish it from hochelagaite.

In the paragenetic sequence in all the modes of occurrence, franconite appears to be one of the latest minerals formed.

Gaidonnayite $Na_2ZrSi_3O_9\cdot 2H_2O$

Gaidonnayite, an orthorhombic dimorph of catapleiite, was described as a new species from Mont Saint-Hilaire (Chao and Watkinson, 1974, and Chao, 1973, and 1985). The mineral was subsequently found to be identical to the incompletely characterized α-catapleiite, described from Narssârssuk, Greenland (Gordon, 1924, and Mandarino and Sturman, 1978). In addition to Narssârssuk and Mont Saint-

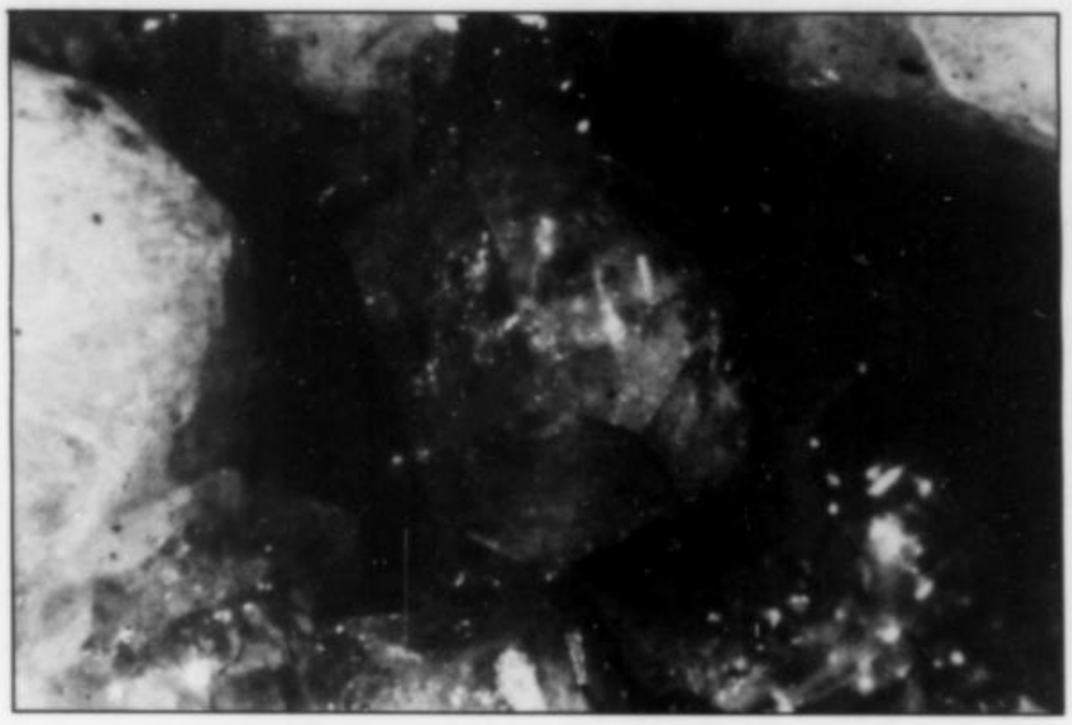


Figure 55. **Gaidonnayite, a single, colorless crystal 5 mm across. Horváth collection and photo.**

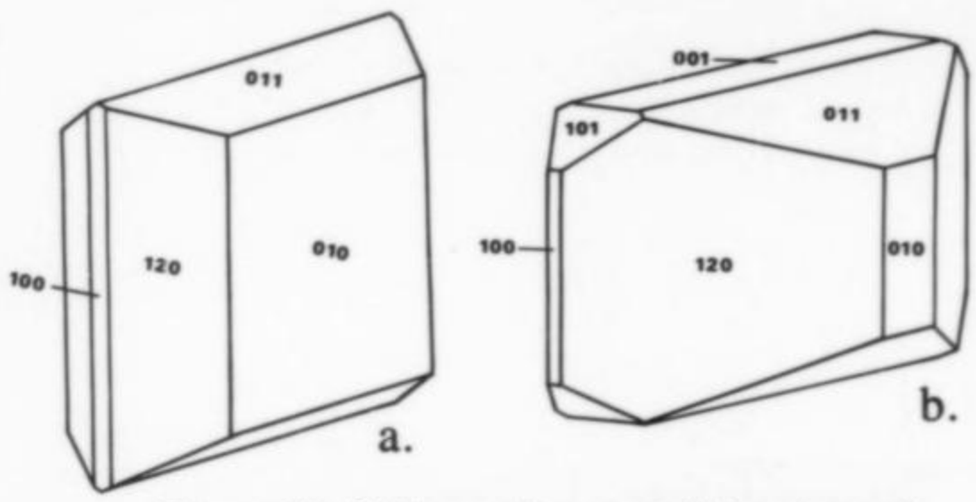


Figure 56. **Gaidonnayite, crystal drawings of two habits, modified after Chao *et al.* (1974) (a) showing {010} as dominant form, (b) showing {120} and {011} as dominant forms.**

Hilaire, the mineral has also been reported from the Lovozero Massif in the Kola Peninsula, and was found as excellent crystals in an igneous sill in a limestone quarry, in Montréal, Québec.

At Mont Saint-Hilaire gaidonnayite occurs in altered pegmatites as a relatively rare species; very rarely it has also been found in miarolitic cavities in nepheline syenite and breccia cavities, and exceedingly rarely in hornfels.

It is found as equant, blocky, tabular and wedge-shaped crystals most frequently forming complex, very closely intergrown, intricately stacked spherical groups and druses. Individual crystals from 1 to 4 mm in diameter have been encountered but these are very rare.

The color ranges from pale yellow, very pale brown, pale gray and gray-green to colorless. Some crystals are coated with a very fine chlorite-like mineral, causing the grayish or greenish color. They are predominantly transparent, occasionally translucent to opaque with an adamantine to vitreous luster.

It fluoresces bright green under longwave and shortwave ultraviolet radiation. A non-fluorescent variety of gaidonnayite has also been found; the reason for the absence of fluorescence is not known.

Galena PbS

Galena is a fairly common mineral in altered pegmatites, where it occurs mostly as crystallized masses to several centimeters across, embedded in the microcline lining of the pegmatite veins. It also occurs in all the other mineralogical environments, as a rare to very rare accessory mineral in small crystallized masses and as 1–10 mm sharp cubes or cuboctahedrons.

The most interesting aspect of the Mont Saint-Hilaire galena is that it forms the substrate for a number of secondary minerals such as cerussite, wulfenite, hydrocerussite and anglesite.

Ganophyllite $(K,Na)_2(Mn,Al,Mg)_8(Si,Al)_{12}O_{29}(OH)_7 \cdot 8–9H_2O$

The occurrence of ganophyllite is very rare. It has been found as 1–2 mm, acicular crystals of roughly rectangular cross section, in randomly oriented groups in breccia cavities.

The crystals are transparent to translucent, orange-red or brown, with vitreous or greasy luster. The layered mica-like structure is clearly evident. Ganophyllite is similar in appearance to labuntsovite and the acicular variety of astrophyllite; visual identification therefore is unreliable.

Garronite $Na_2Ca_5Al_{12}Si_{20}O_{64} \cdot 27H_2O$

Garronite, a very rare zeolite (Walker, 1962), is exceedingly rare in small cavities in sodalite xenoliths, as minute <0.2 mm prisms, forming globular and crude aggregates of tetragonal dipyramids to 2 mm across, associated with sodalite, natrolite, aegirine, eudialyte and villiaumite. The aggregates are compact, and the color is pale yellow, orange-yellow and yellowish brown, with a dull to greasy luster.

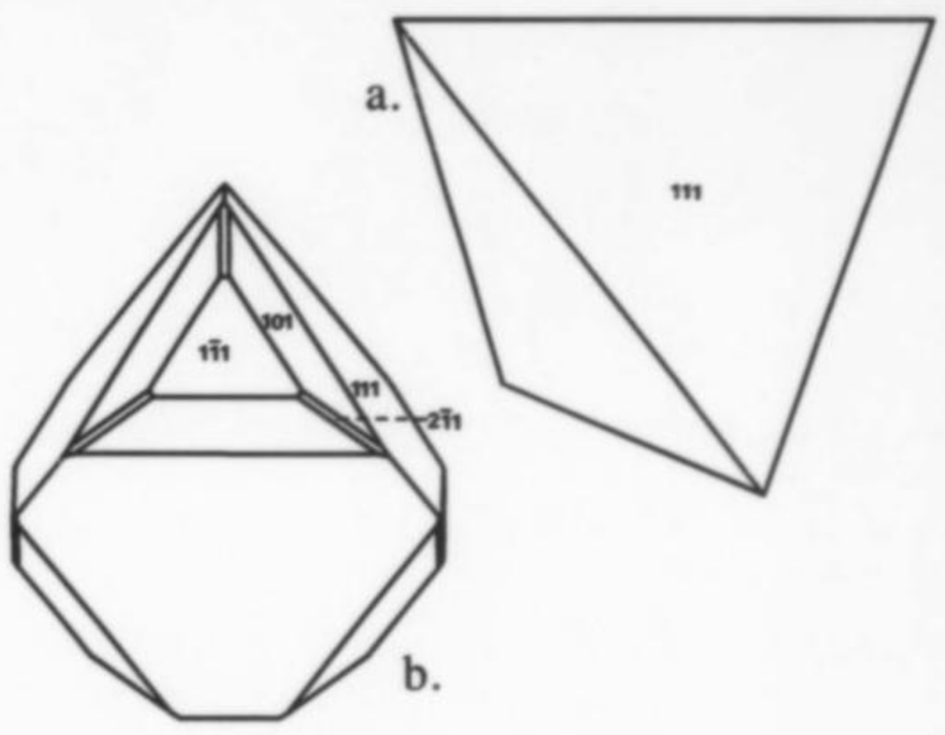


Figure 57. **Genthelvite crystal drawings showing two observed habits: (a) the most common habit, the tetrahedron {111}, (b) the negative tetrahedron $\{1\bar{1}1\}$ modified by the positive tetrahedron {111}, the tristetrahedron {101} and the rhombic dodecahedron $\{2\bar{1}1\}$, rotated around the *z*-axis to better illustrate the modifying faces.**

Genthelvite $Zn_4Be_3(SiO_4)_3S$

Mont Saint-Hilaire genthelvite is reported to be the pure Zn endmember of the danalite-helvite-genthelvite series (Dunn, 1976). It is found infrequently, and exclusively in pegmatites. It occurs as individual crystals or in complex, parallel, intergrown groups, commonly impaled on aegirine crystals. The crystals are sharp, simple tetrahedra, often with minor modifications at the apices of the tetrahedron. It has also been found as randomly disseminated grains or small masses embedded in the microcline lining of pegmatite veins.

The genthelvite crystals are generally 1–10 mm on an edge but some exceptional crystals up to 5 cm have been found, which are undoubtedly the finest and largest crystals of the mineral ever found.

Small crystals are colorless, white or pale yellow and are transparent to translucent. The larger crystals are white, pale to lemon-yellow, greenish yellow, very pale green and pale brown and are generally opaque.

The luster is vitreous on clean crystal faces with a resinous or greasy luster on broken surfaces. Some of the larger crystals have a well-defined, opaque central core and a transparent to translucent outer zone, resulting in very attractive "phantoms" in the crystals.

The mineral fluoresces intense green under both longwave and

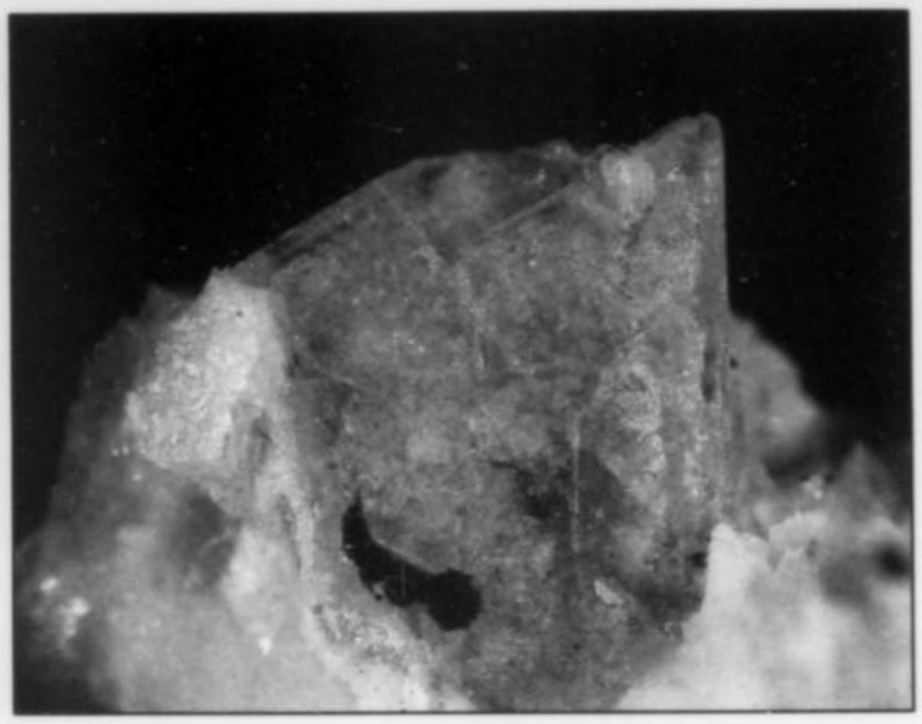


Figure 58. **Genthelvite crystal, 4.2 mm. Dan Behnke collection and photo.**

Figure 59. **Genthelvite crystal group 3 cm across, collected in the fall of 1989. G. Haineault collection. Photo by G. Robinson.**

shortwave ultraviolet radiation, and retains strong phosphorescence for short periods.

Gersdorffite NiAsS

Gersdorffite, a member of the cobaltite group, has been found as small metallic grains intimately intergrown with löllingite and calcite, embedded in dark gray, fine-grained hornfels. The mineral was identified by X-ray and electron microprobe analysis from specimens collected in 1986.

Gibbsite $Al(OH)_3$

Gibbsite, the monoclinic trimorph of nordstrandite and bayerite, is very rare at Mont Saint-Hilaire. It is found as white, compact, powdery masses as well as in sharp, euhedral crystals in the contact zones of altered pegmatite veins, rarely in carbonate-rich miarolitic cavities and in small cavities in sodalite syenite. The crystals are 1–2 mm, equant, blocky or wedge-shaped, ranging from colorless to pale pink, and transparent to white opaque, with a greasy to vitreous luster.

In appearance, gibbsite is similar to some habits of nordstrandite, which is more abundant than gibbsite at Mont Saint-Hilaire; the two species are visually indistinguishable. Gibbsite found in the sodalite syenite is believed to be an alteration product of dawsonite.

Gismondine $Ca_2Al_4Si_4O_{16}\cdot 9H_2O$

Gismondine, a zeolite group mineral, is extremely rare. It was found as colorless to very pale pink, transparent, pseudo-octahedral crystals to 1 mm, in a cavity in igneous breccia. Only one or two confirmed specimens are known to exist.

Gmelinite $(Na_2,Ca)Al_2Si_4O_{12}\cdot 6H_2O$

Gmelinite is a relatively common zeolite in seams and fractures in the hornfels, and very rare in sodalite xenoliths. It occurs as excellent, 2–5 mm, thin, hexagonal plates, or as complex groups of plates forming very attractive rosettes and spherical aggregates. Less frequently it has been found as short hexagonal prisms, terminated by hexagonal pyramids and basal pinacoids.

The crystals are colorless, pale yellow, lemon-yellow, orange and pale green. The luster varies from dull to vitreous.

Gobbinsite $Na_4(Ca,Mg,K_2)Al_6Si_{10}O_{32}\cdot 12H_2O$

Gobbinsite, a very rare zeolite, was found in small cavities, in a eudialyte-rich pegmatite lens in nepheline syenite as 0.5–1 mm, white to tan, crude, spike-like, four-sided pyramids with a dull to greasy luster. It is associated with eudialyte, serandite, aegirine, natrolite and microcline, and has an overgrowth of phillipsite crystals. Only a few specimens are known.

The mineral was originally described from County Antrim in Northern Ireland (Nawaz and Malone, 1982); Mont Saint-Hilaire is the second known locality for the species and the first for crystallized specimens.

Goethite $\alpha\text{-Fe}^{+3}O(OH)$

Goethite is found as earthy, powdery masses and as pseudomorphs

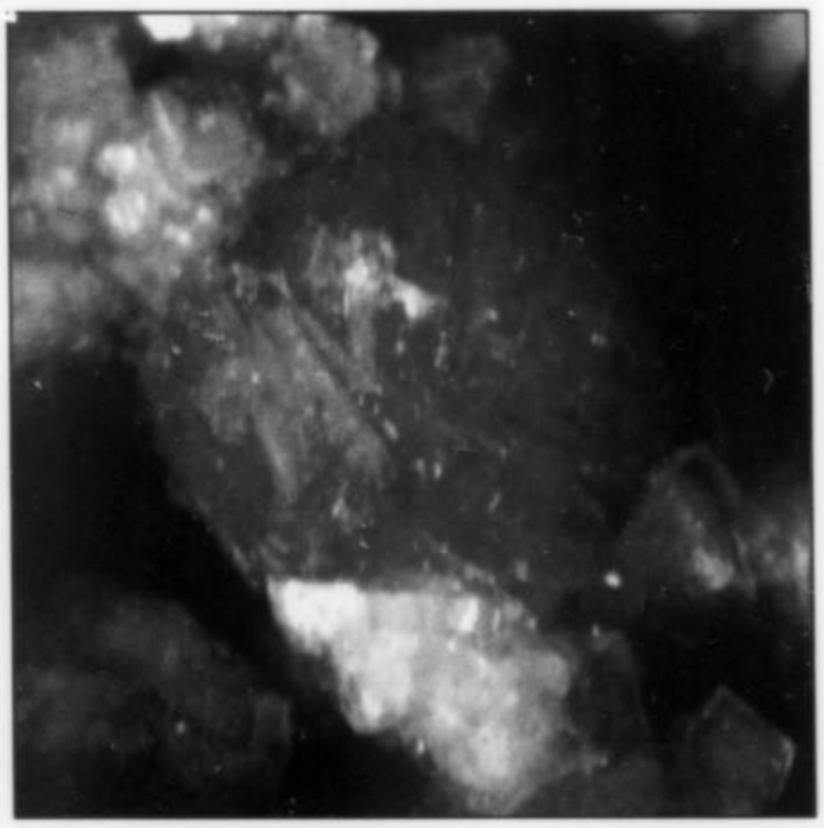


Figure 60. **Gmelinite crystals, a spherical aggregate 2 mm in diameter. National Museum of Natural Sciences (Canada) specimen #54515. Photo by R. Gault.**

after siderite, in very heavily oxidized pegmatite veins and in fractures in hornfels. The color varies from brown to reddish brown and black.

Götzenite $(Ca,Na)_3(Ti,Al)Si_2O_7(F,OH)_2$

Götzenite was originally described from Mount Shaheru, Zaire (Sahama and Hytonen, 1957), where it occurred in minute crystals, in nephelinite lava. It has also been reported from pegmatites in the Langesundfjord area, in Norway as up to 10 cm long, crude crystals (Eldjarn, 1983). Götzenite is extremely rare at Mont Saint-Hilaire, being limited exclusively to marble xenolith cavities. It occurs as

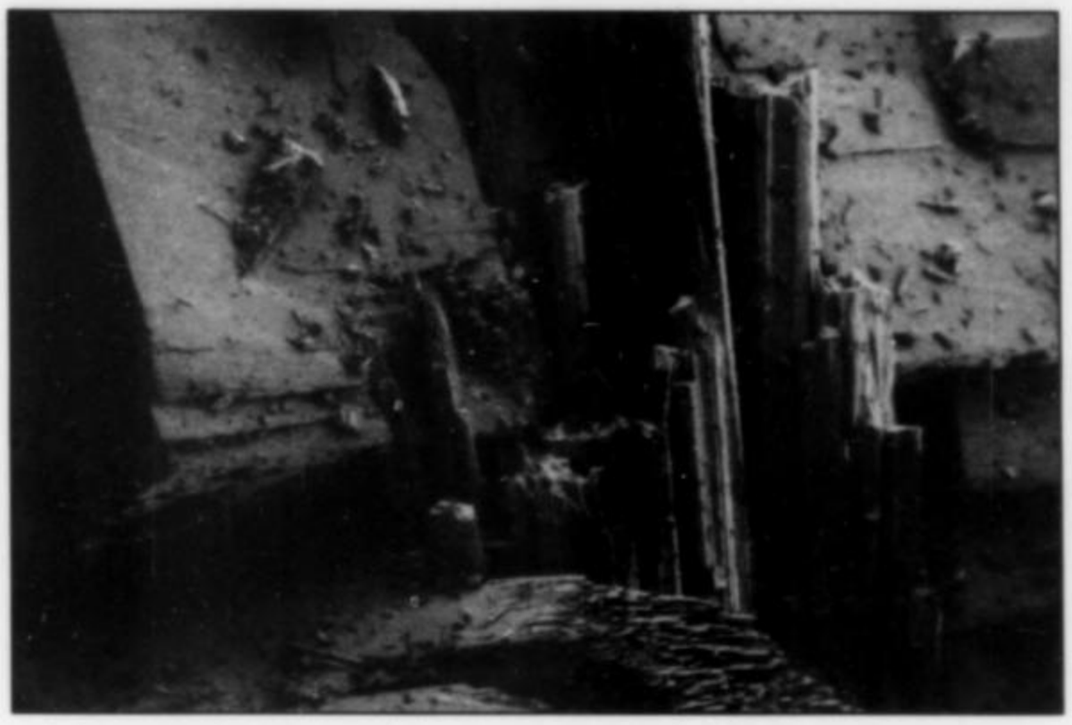


Figure 61. **Götzenite in acicular crystals on pectolite. The longest crystal is 3 mm in length. Horváth collection. SEM photo by E. Vadas.**

elongated tablets and fine acicular crystals 1–3 mm long, with exceptional individual crystals attaining 1 cm. The crystal faces are striated and no distinct terminations have been observed. The terminations may be naturally etched, and appear somewhat fibrous. The crystals are free-standing, or intimately intergrown with other minerals, especially with pectolite, in cavities as well as embedded in the marble around the cavities. Associated minerals are pectolite, fluorapophyllite, calcite, fluorite, fluorapatite, natrolite, tadzhikite, hydrogrossular, datolite, vesuvianite and ancylite. Götzenite is opaque, very pale yellow, tan or off-white, and the luster varies from greasy to dull to vitreous.

In the paragenetic sequence of the marble xenolith cavities, götzenite is one of the earliest species to form. It appears to have a strong affinity for tadzhikite and hydrogrossular in addition to pectolite.

Graphite C

Graphite-2H polytype has been identified from sodalite xenoliths, occurring as minute (<1 mm) flakes, embedded in sodalite, and associated with ussingite, villiaumite, eudialyte and others. It is exceedingly rare and only a few specimens are known.

Greigite $Fe^{+2}Fe_2^{+3}S_4$

Greigite, a rare member of the linnaeite group (Skinner *et al.*, 1964), was found as tiny, dull black anhedral crystals 0.5 to 2 mm in diameter, in tiny cavities and embedded in pale orange rhodochrosite in a pegmatite vein. It is extremely rare.

Griceite LiF

Griceite (Van Velthuizen and Chao, 1989), is a new mineral species from Mont Saint-Hilaire, and the first known natural occurrence of lithium fluoride.

It is found as pure white to pale yellow to very pale greenish yellow, compact, powdery to botryoidal masses lining and sometimes filling cavities in sodalite xenoliths. It is also found as masses of tiny cubes, stacked to form tapering, prismatic aggregates 2–3 mm in length, and as tiny plates and blobs embedded in villiaumite. Griceite is transparent when freshly exposed, turning very rapidly translucent to opaque. Its

Figure 62. **Griceite group of crystal aggregates on a sodalite crystal. Each aggregate is composed of tiny cubes. The largest aggregate is 1 mm in height. National Museum of Natural Sciences (Canada) specimen #52814. Photo by R. Gault.**

luster varies from porcellaneous to waxy to dull.

Griceite is a late stage mineral in the sodalite xenoliths, most commonly associated with sodalite, villiaumite, ussingite, lovozerite, vuonnemite and eudialyte. It may be confused with some other species occurring in the same environment such as thermonatrite, trona and dorfmanite. Some griceite displays weak, pale yellow fluorescence under shortwave ultraviolet radiation.

Grossular $Ca_3Al_2(SiO_4)_3$

Grossular, a member of the garnet group, is relatively rare at Mont Saint-Hilaire. It has been found as very sharp trapezohedrons, 1–10 mm in size, in calcite-filled seams in a contact zone between a marble xenolith and hornfels, associated with aegirine, epidote, allanite, prehnite, titanite, fluorite, pyrrhotite and microcline, in addition to calcite. The crystals are transparent to translucent, bright orange to orange-brown or reddish brown. Pale grayish green 1 mm dodecahedrons have been found in marble xenolith cavities.

Gypsum $CaSO_4 \cdot 2H_2O$

Gypsum occurs rarely in small, 5–10 mm cavities, in altered pegmatite veins and sodalite syenite, as sharp, colorless, transparent, thin, elongated prisms and blades 1–5 mm long. It has also been found as drusy microcrystals coating fracture surfaces in weathered hornfels.

Halite NaCl

Halite has been found as pure white, flaky alteration up to 0.5 mm thick on the surface of crystals of UK#81 (Chao *et al.*, 1990). The white material consists of halite, UK#81 and an undetermined sodium sulfate mineral. It was found in sodalite xenoliths, associated with sodalite, serandite, vuonnemite, ussingite and aegirine. The occurrence is exceedingly rare.

Halotrichite $Fe^{+2}Al_2(SO_4)_4 \cdot 22H_2O$

Halotrichite, a member of the halotrichite group, is extremely rare, occurring as pure white, bent silky fibers to 2 mm in length, on pyrite

pseudomorphs after pyrrhotite, associated with siderite and albite in a carbonate-rich altered pegmatite.

Harmotome $(Ba,K)_{1-2}(Si,Al)_8O_{16}\cdot 6H_2O$

A late stage accessory mineral, harmotome, a zeolite, is fairly wide spread in very small quantities, in miarolitic and breccia cavities, pegmatitic lenses and in sodalite xenoliths.

It is found as very small (usually <1 mm), colorless crystals in attractive clusters of cruciform twins or prismatic crystals on other minerals. Phillipsite also occurs in the same environment and the two species are indistinguishable without detailed analysis.

Hedenbergite $CaFe^{+2}Si_2O_6$

Hedenbergite, a member of the pyroxene group, occurs very rarely as 1–3 mm, colorless to pale yellow, transparent, radiating prisms with a vitreous luster, on albite and microcline in pegmatite veins.

Helvite $Mn_4Be_3(SiO_4)_3S$

Helvite, a member of the danalite-helvite-genthelvite series is found very rarely, while genthelvite, the other member present at Mont Saint-Hilaire, is far more abundant.

Helvite occurs as small, sharp, simple tetrahedra 1–3 mm on an edge, with minor faces truncating the apices of the tetrahedra. It is found as free-growing crystals and lemon-yellow, granular inclusions in altered pegmatites, and as embedded crystals in contact zones between marble xenoliths and pegmatite veins. The crystals are orange-yellow, transparent or translucent with a vitreous luster. The granular helvite is opaque with a resinous luster. Helvite fluoresces intense deep red under both longwave and shortwave ultraviolet radiation. The red fluorescence is a good diagnostic feature to differentiate helvite from genthelvite.

Hematite α-Fe_2O_3

Hematite occurs very rarely as deep red, thin, lamellar, hexagonal plates and as black, lustrous, blocky crystals to 3 mm across, in miarolitic cavities, and in tiny cavities in or embedded in sodalite syenite and hornfels.

Hemimorphite $Zn_4Si_2O_7(OH)_2\cdot H_2O$

Hemimorphite has been found as an extremely rare secondary mineral, associated with sphalerite and galena in altered pegmatite veins. It occurs as 0.5–1.0 mm, dull, white, opaque, compact spheres and as thin crusts on altered sphalerite crystals.

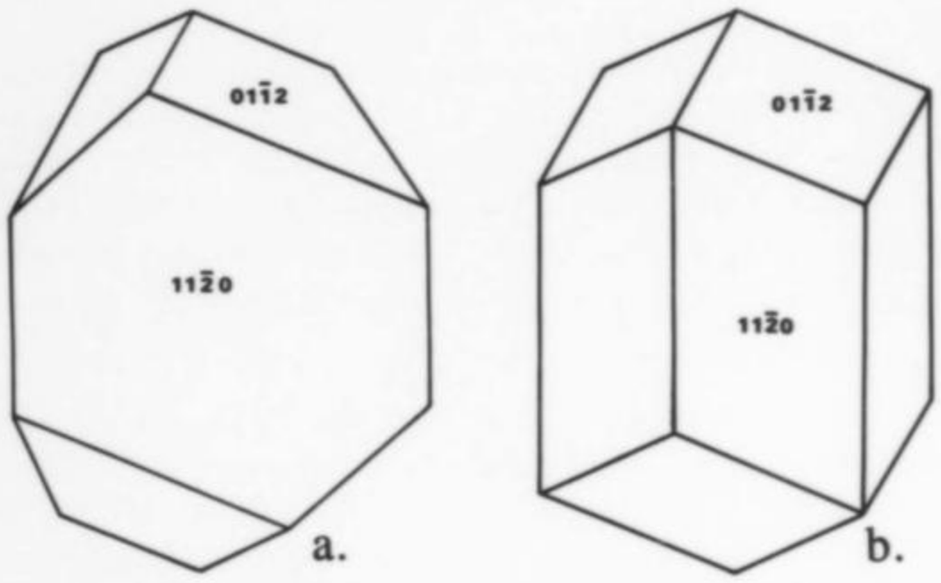


Figure 63. **Hilairite crystal drawings modified after Chao *et al.* (1974), (a) with dominant {11$\bar{2}$0} form, (b) blockier habit with less dominant {11$\bar{2}$0} form (the more common habit).**

Hilairite $Na_2ZrSi_3O_9\cdot 3H_2O$

Hilairite was described as a new species from Mont Saint-Hilaire (Chao *et al.*, 1974). The mineral has since been reported from a pegmatite in the Langesundfjord area of Norway (Eldjarn, 1983), and the calcium analog, calciohilairite, was described from the Northern Cascades, Washington (Boggs, 1988).

At Mont Saint-Hilaire, hilairite occurs as 0.5–4 mm, transparent, pale to dark brown and pink or rose-colored crystals. The crystals are short to elongated, trigonal or hexagonal {11$\bar{2}$0} prisms terminated by the {01$\bar{1}$2} rhombohedron. Most crystals are doubly terminated and frequently twinned, commonly forming complex groups. The luster is vitreous to waxy.

Hilairite is a very rare accessory mineral in miarolitic cavities and in some altered pegmatite veins, usually associated with gaidonnayite, elpidite, natrolite, microcline, aegirine, pyrite, rutile and zircon. Many crystals have elpidite inclusions and exhibit an affinity to cluster around, or to grow on gaidonnayite and less frequently on zircon crystals. The rose or pink crystals tend to be larger, more elongated and more transparent than the brown crystals, but are much rarer, occurring with calcite, ancylite, albite, rhodochrosite, fluorite, polylithionite and quartz.

The bulk of the brown hilairite specimens were found in a single altered pegmatite vein that was exposed in 1974–75 in the Demix quarry. Intermittent smaller finds have been made since, notably in 1988–89 in the Poudrette quarry. In the summer of 1989, the richest specimens of pale pink hilairite, with crystals to 4 mm were collected from an altered pegmatite vein, in the Poudrette quarry. (See color photo on p. 316.)

Hisingerite $Fe_2^{+3}Si_2O_5(OH)_4\cdot 2H_2O$

Hisingerite and its Mn-analog, neotocite (Clark *et al.*, 1978), occur as dark brown to black, resinous masses with vitreous to resinous luster, on freshly broken surfaces, and conchoidal fracture, to several centimeters across in altered pegmatite veins. The physical appearance of both species is nearly identical and both have very poorly defined crystalline structures. Both the hisingerite and neotocite phases were confirmed by electron microprobe analysis. Hisingerite also occurs as pseudomorphs after aegirine prisms in the same environment.

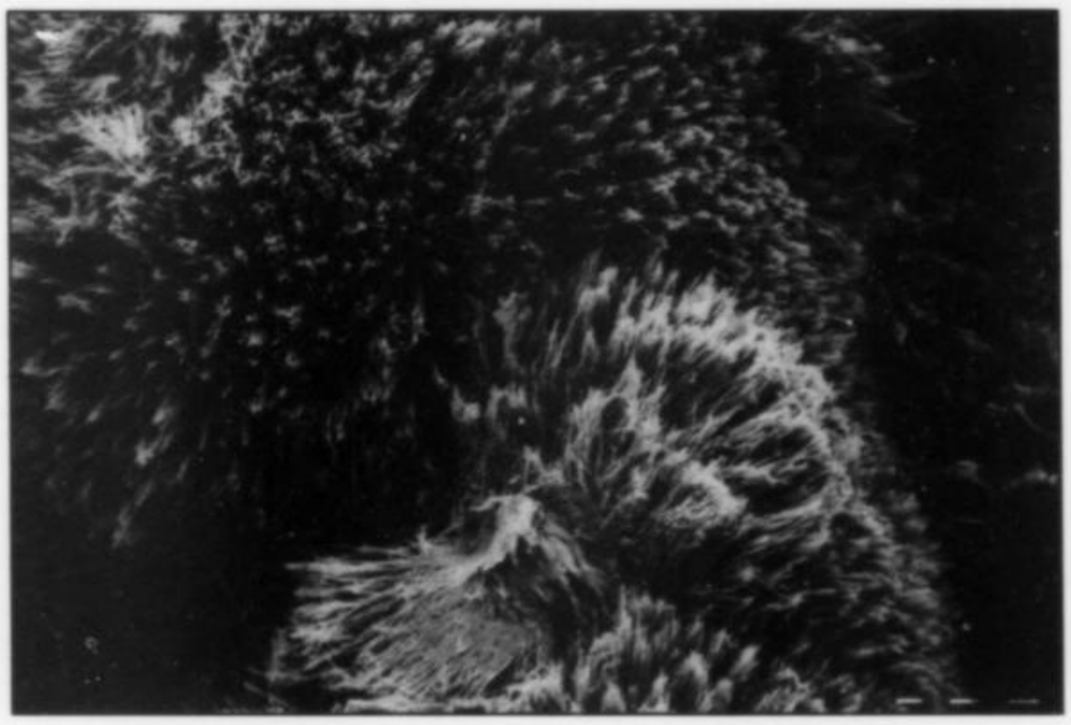


Figure 64. **Hochelagaite, spherical aggregates of capillary crystals. Spheres are 1 to 2 mm in diameter. Horváth collection. SEM by E. Vadas.**

Hochelagaite $(Ca,Na,Sr)Nb_4O_{11}\cdot 8H_2O$

Hochelagaite was originally described from the Francon quarry in Montréal (Jambor *et al.*, 1986), which is situated approximately 35 km west-northwest of Mont Saint-Hilaire. The mineral had been known from Mont Saint-Hilaire, the only other known locality for the mineral, for a number of years, and was designated as UK#50 (Chao and Baker, 1979). Hochelagaite is the calcium analog of franconite, which also occurs at both localities.

Hochelagaite occurs as silky, pure white, spherical aggregates of extremely fine capillary crystals or matted fibrous masses, in small cavities in altered pegmatite dikes, in light-colored, fine-grained hornfels, in sodalite syenite cavities and in some miarolitic cavities. It is

most common in the altered pegmatite veins and dikes. In all mineralogical environments it is one of the very latest minerals to form. Individual crystals are soft and flexible. Hochelagaite and franconite are practically identical in appearance and visual recognition is unreliable. Franconite however, fluoresces yellow-white under ultraviolet radiation (more intense under shortwave), while hochelagaite does not fluoresce.

Hornblende $Ca_2(Mg,Fe^{+2})_4Al(Si_7Al)O_{22}(OH,F)_2$

Edenitic hornblende, a member of the amphibole group, occurs as brown, dark green and black prisms to several millimeters in length, with other amphiboles, in marble xenoliths and in igneous breccia.

Hydrocerussite $Pb_3(CO_3)_2(OH)_2$

Hydrocerussite is exceedingly rare, and has been found as milky, thin crusts and as white, less than 0.5 mm opaque prisms on altered galena. The galena was closely associated with sphalerite, arsenopyrite and pyrite in an altered pegmatite vein.

Figure 65. **Hydrogrossular crystals to 3 mm across showing typical, step-like growth features. Horváth collection. SEM photo by E. Vadas.**

Hydrogrossular $Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$

Hydrogrossular, a group name for the hibschite-katoite hydrous garnet series, is very rare and limited to cavities in marble xenoliths. These garnets are found as well-formed 0.5–6 mm single crystals, or as crystal groups, most commonly on pectolite or vesuvianite crystals and in close association with such rare species as tadzhikite and götzenite. The crystals are predominantly octahedrons and infrequently dodecahedrons. Penetration twins are common.

Most crystals observed have a frosty appearance, due to a large number of very fine, step-like growth features on the crystal faces. Color is pale greenish or grayish white, pale yellowish brown. Crystals are translucent to opaque with a dull to greasy luster.

Hydroxyapophyllite $KCa_4Si_8O_{20}(OH,F)\cdot 8H_2O$

Hydroxyapophyllite has been identified from cavities in the marble xenoliths. In physical appearance and association it is identical to the more common fluorapophyllite.

Hydrozincite $Zn_5(CO_3)_2(OH)_6$

Hydrozincite occurs as white or grayish blue, powdery to porcellaneous material filling interstices in an altered pegmatite, and forming rings around decomposing sphalerite. It displays weak, white fluorescence under shortwave and longwave ultraviolet radiation.

Hypersthene $(Mg,Fe^{+2})_2Si_2O_6$

Hypersthene, a member of the pyroxene group, has been found as 1–2 mm, brown to gray-green prisms in hornfels.

Ilmenite $Fe^{+2}TiO_3$

A relatively common species in miarolitic cavities in nepheline syenite, ilmenite is found as splendid, complex, hexagonal plates and rosettes from 1 to 20 mm in diameter. It has also been found as 1–2 mm crystals in cavities in sodalite syenite. The crystals are black and opaque with a metallic luster.

Jarosite $KFe_3^{+3}(SO_4)_2(OH)_6$

Jarosite, a member of the alunite group, has been found as a thin, yellow, powdery coating on feldspar crystals in a highly oxidized, altered pegmatite and on fracture surfaces in weathered sodalite syenite.

Joaquinite-(Ce) $Ba_2NaCe_2Fe^{+2}(Ti,Nb)_2Si_8O_{26}(OH,F)\cdot H_2O$

Only a few specimens of joaquinite-(Ce) are known to exist. It was found as 1–2 mm, equidimensional, yellow to pale orange, striated crystals in a breccia cavity. The crystals are transparent with a vitreous luster.

Kaersutite $NaCa_2(Mg,Fe^{+2})_4Ti(Si_6Al_2)O_{22}(OH)_2$

Kaersutite is one of the rock-forming amphiboles in the nepheline syenite, where it occurs as lustrous, dark brown to black phenocrysts up to several centimeters in length. It is readily identifiable by its perfect prismatic cleavage and red internal reflections.

Kainosite-(Y) $Ca_2(Y,Ce)_2Si_4O_{12}(CO_3)\cdot H_2O$

Kainosite-(Y) has been found in at least one breccia cavity, as divergent sprays of orthorhombic prisms 3–5 mm in length. The crystals are bounded by the pinacoids {001}, {100} and {010}, and on some crystals by the {110} prism. The color varies from pale yellowish brown to brown and grayish brown. Crystals are transparent to translucent or opaque, with a vitreous luster. The species is extremely rare and only a few specimens, from what may be a single find, are known to exist.

Kaolinite $Al_2Si_2O_5(OH)_4$

Occurring as small, white, powdery, foliated masses filling interstices, kaolinite, a member of the kaolinite-serpentine group, is found in marble xenoliths in contact with sodalite syenite.

Kogarkoite $Na_3(SO_4)F$

Kogarkoite was first described as chlorine-free schairerite (Kogarko, 1961) from the Lovozero Massif in the Kola Peninsula; later the mineral was confirmed as a new species (Pabst, 1973). At Mont Saint-Hilaire kogarkoite is very rare, occurring as very pale blue, transparent to translucent, embedded grains and crude crystals 1–10 mm in diameter in sodalite xenoliths, associated intimately with villiaumite. Other associated minerals are sodalite, eudialyte, fluorite, vuonnemite, rasvumite, revdite, apatite, ussingite, thermonatrite and sidorenkite.

The luster varies from vitreous on freshly broken surfaces, exhibiting conchoidal fracture, to waxy after some months of atmospheric exposure. It is slightly water soluble. Kogarkoite fluoresces strong pale blue under shortwave and dull white under longwave ultraviolet radiation. The strong fluorescence and the blue color are the best clues in visual identification.

Kupletskite $(K,Na)_3(Mn,Fe^{+2})_7(Ti,Nb)_2Si_8O_{24}(O,OH)_7$

Kupletskite, a member of the astrophyllite group, occurs as tabular and acicular crystals in cavities and as micaceous or fibrous masses embedded in pegmatite veins, and very rarely in sodalite xenoliths. Its mode of occurrence and physical appearance, except for subtle color variations, is practically identical to that of astrophyllite.

Kutnohorite $Ca(Mn,Mg,Fe^{+2})(CO_3)_2$

Kutnohorite, a relatively rare dolomite group mineral, has been found as very pale green sprays of tiny prismatic crystals to 1 mm in length in small cavities in sodalite syenite, and as small (<0.5 mm), gray, equant crystals in druses coating rhodochrosite in a pegmatite.

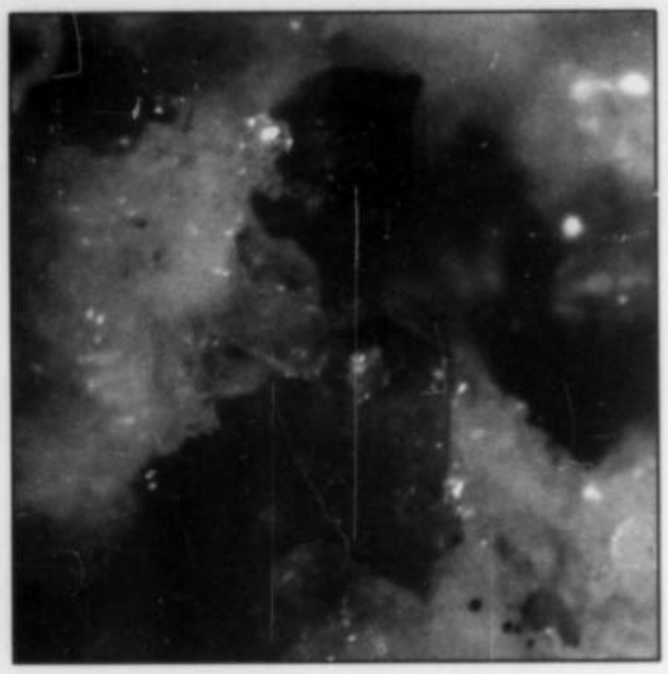


Figure 66. **Hilairite crystal group 8 mm in length. Horváth collection and photo.**

Figure 67. **Labuntsovite, a group of crystals 3 mm in length. Horváth collection and photo.**

Labuntsovite $(K,Ba,Na)(Ti,Nb)(Si,Al)_2(O,OH)_7 \cdot H_2O$

Labuntsovite forms an isomorphous series with nenadkevichite (Semenov, 1959), in which labuntsovite is the Ti end-member and nenadkevichite is the Nb end-member. Both species occur at Mont Saint-Hilaire, nenadkevichite being considerably more abundant than labuntsovite.

Labuntsovite occurs as sharp, brilliant, pale to deep orange, transparent prisms, 1–10 mm in length, as splendid single crystals or in radiating clusters, and occasionally as epitactic overgrowth on elpidite. It has high indices of refraction and adamantine luster. Its occurrence is very rare in small cavities associated with igneous breccia zones, and extremely rare in miarolitic cavities in nepheline syenite and in hornfels.

Labuntsovite was discovered in the Khibiny Massif, Kola Peninsula and described as a titanoelpidite (Labuntsov, 1926); later it was shown to be a new species, and renamed labuntsovite (Semenov and Burova, 1955).

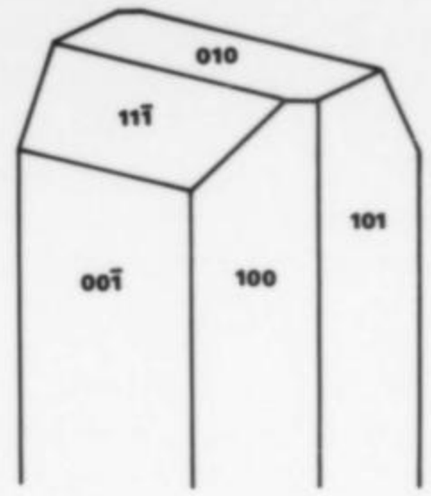


Figure 68. **Labuntsovite crystal drawing, from measurements made on a reflecting goniometer and drawn from a gnomonic projection.**

Lamprophyllite $Na_2(Sr,Ba)_2Ti_3(SiO_4)_4(OH,F)_2$

Both lamprophyllite and its analog barytolamprophyllite, have been found in sodalite xenoliths, where they occur together as intimately intergrown zones in single crystals. They were identified by electron microprobe analysis.

They occur as fine fibrous, and foliated, thin, strips 1–2 mm in length forming compact spheres, and as sharp, 1–4 mm, randomly oriented, bladed crystals in small cavities or as embedded blades and prisms to 1.2 cm in length in sodalite xenoliths and in the contact rims enveloping the xenoliths. The bladed crystals are rarely terminated and appear to be more abundant than the fibrous habit. The color is pale yellow, orange, orange-yellow and brownish yellow. The crystals are translucent to opaque with vitreous to waxy or dull luster.

Lavenite $(Na,Ca)_2(Mn,Fe^{+2})(Zr,Ti)Si_2O_7(O,OH,F)$

Lavenite is very rare; it has been found in a biotite-rich xenolith and in the contact of eudialyte-rich altered pegmatite veins. In the xenolith it occurred as crystalline masses filling interstices between biotite crystals; in the pegmatite it occurred as small prismatic crystals forming divergent sprays embedded in microcline and nepheline syenite, and extremely rarely, as free-growing acicular crystals, 1–2 mm in length in small cavities. The color is brownish yellow to brown with a vitreous luster.

Lead Pb

Native lead was found as irregular patches intimately mixed with galena and a wurtzite-like mineral. These patches are up to 5 x 2 mm in size and occur on microcline crystals in a breccia cavity, associated with natrolite, sodalite, aegirine and nenadkevichite. The lead has an iridescent surface tarnish but on freshly broken surfaces it is black with a metallic luster. The occurrence is exceedingly rare.

Leifite $Na_2(Si,Al,Be)_7(O,OH,F)_{14}$

Leifite was originally described from the alkali pegmatites of Narssârssuk, Greenland (Bøggild, 1915 and 1953). It was also found and described as a new mineral karpinskyite in pegmatites in the Lovozero Massif (Shilin, 1956). Subsequently karpinskyite was shown to be a mixture of leifite impregnated with a Zn-bearing clay and the name was discredited (Micheelsen and Petersen, 1972). Some of the literature on Mont Saint-Hilaire published prior to 1972 lists both species.

The finest specimens and largest crystals of leifite found to date are undoubtedly those from Mont Saint-Hilaire. While not common, it has been found regularly in varying quantities in unaltered pegmatite veins since the commencement of the quarrying operations in the early 1960's.

The most common crystal habit is fibrous or acicular, in groups of colorless to pure white, randomly-oriented or radial sprays from 1 mm to 7 cm in length, occasionally forming attractive spherical aggregates.

Leifite also forms white, simple hexagonal prisms, terminated by

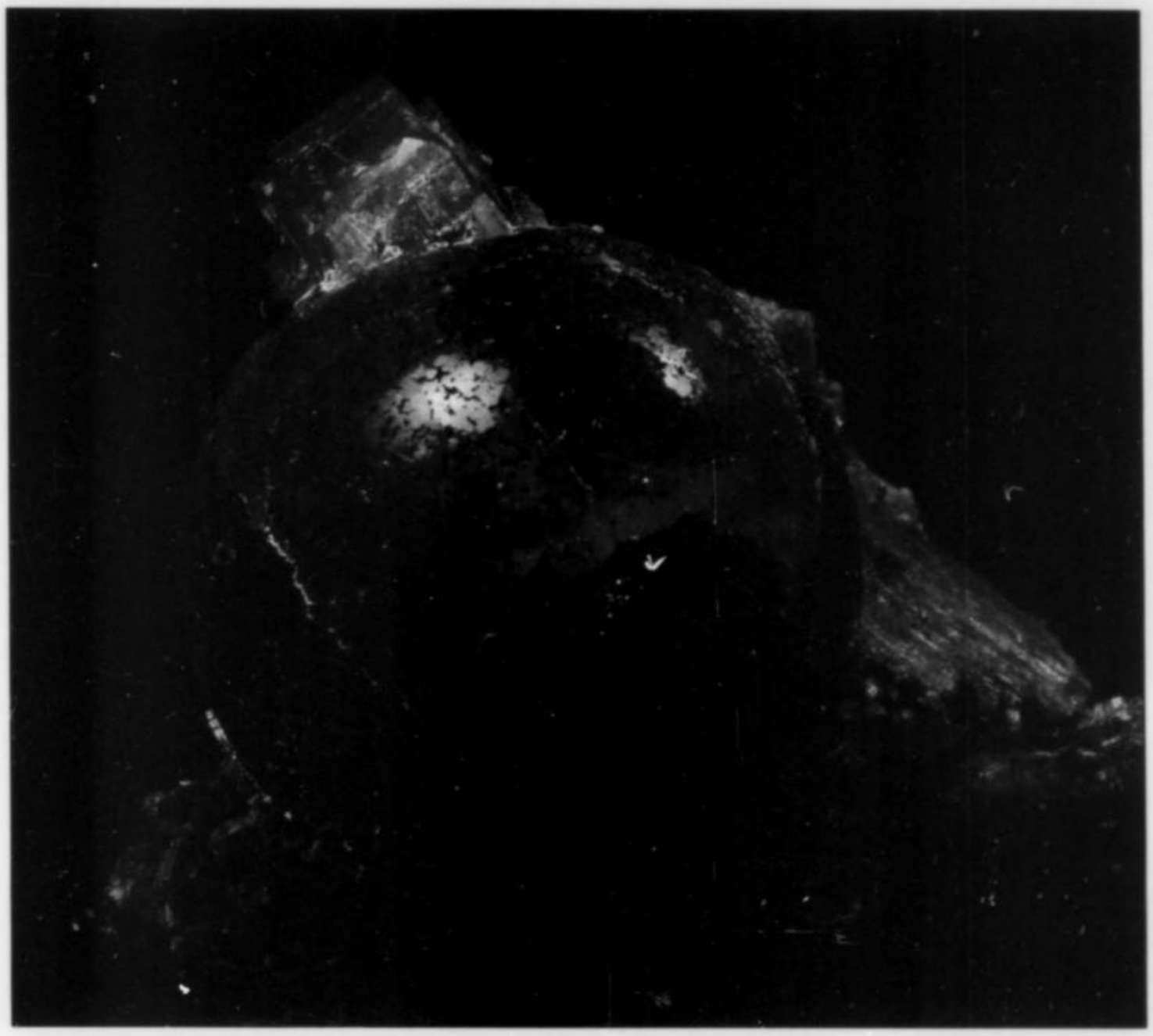
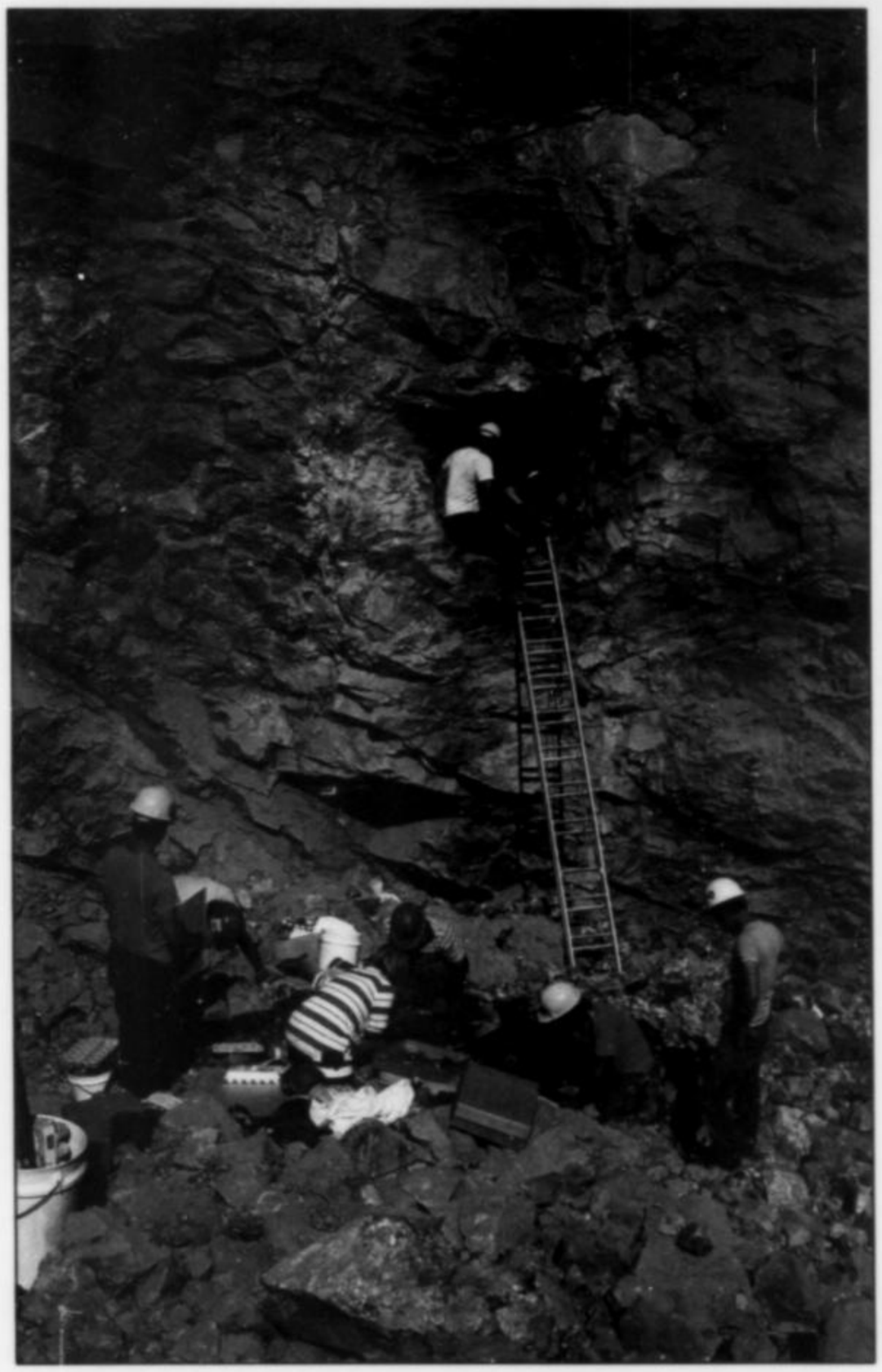


Figure 69. **Leifite, a ball of crystals 3.5 cm in diameter, with serandite, collected in 1988. G. Haineault collection. Photo by G. Robinson.**

Figure 70. **Leifite (white), in large crystals associated with catapleiite (pale brown). The largest leifite crystal measures 3 cm across. National Museum of Natural Sciences (Canada) specimen #37122. Photo by G. Robinson.**



the {0001} pinacoid and rarely showing minor pyramidal faces. The prisms are heavily striated parallel to the *c* axis, imparting a silky appearance to the crystals.

Superb crystal aggregates with individual prisms to 3 cm across have been found associated with microcline, catapleiite, rhodochrosite, willemite and epididymite in the late 1960's. In 1988, in a spectacular find, what is arguably the most attractive leifite specimens to date were found in a large pegmatite. The specimens consist of very sharp, colorless, lustrous prisms forming compact spherical aggregates to 6 cm in diameter perched on superb serandite crystals. The crystal terminations on some aggregates form a near perfect, lustrous spherical surface with a pale violet color. In 1989, very attractive matrix specimens of superb sharp, white, prisms up to 2 cm long and 1 cm across on deep red rhodochrosite, pink albite and green-gray elpidite were found in a pegmatite vein.

Figure 71. **Pegmatite pocket exposed in the summer of 1989 which contained fine leifite and elpidite crystals. Photo by L. Horváth.**

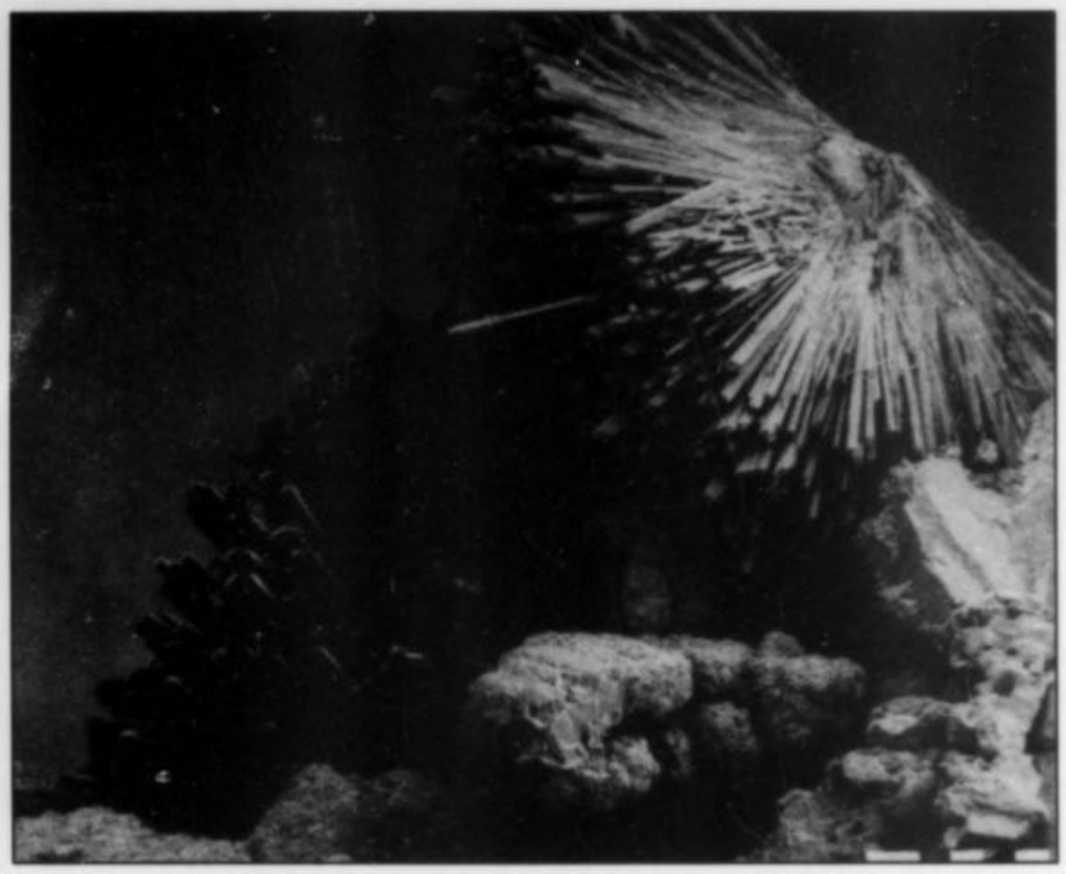


Figure 72. **Lemoynite in groups of radiating, prismatic crystals. The spherical groups are 2 to 3 mm in diameter. Horváth collection. SEM photo by E. Vadas.**

Figure 73. **Lemoynite, a group of terminated crystals 1 to 2 mm in length. Horváth collection. SEM photo by E. Vadas.**

Lemoynite $(Na,K)_2CaZr_2Si_{10}O_{26}\cdot 5–6H_2O$

Lemoynite was originally described (Perrault *et al.*, 1969) from Mont Saint-Hilaire, which remains the only known locality for the species. The occurrence is very rare and appears to be confined to a heavily altered pegmatite dike cutting nepheline syenite, from which very small quantities were recovered in 1964–65. In the fall of 1985, the dike was again intersected by the quarrying operations on the upper levels of the Poudrette quarry and a good number of excellent (the best to date) specimens were collected.

Lemoynite is found in or around the interstices between large intergrown crystals of microcline in the central zone of the pegmatite, typically forming compact, 3–8 mm spheres and spherical aggregates of individual prisms or blades radiating from a common center. Associated minerals are: microcline, albite, quartz, pyrite, sphalerite, calcite, siderite, galena, zircon, fluorite, rutile, donnayite and a heavy coating of dark brown iron oxide and a reddish brown resinous material. The elongated, prismatic or bladed crystals are terminated by the steep, basal pinacoid {001} or the combination of {001} and prism {111}. Forms noted are pinacoids {100}, {010}, {001}, {102}, {101} and $\{\bar{1}02\}$ and prisms {011} and {111}.

A very fine, acicular, almost fibrous habit has also been noted. The crystal aggregates are most commonly embedded in massive microcline; however, very rarely the spherical groups are found free-growing in small cavities of 5–25 mm size.

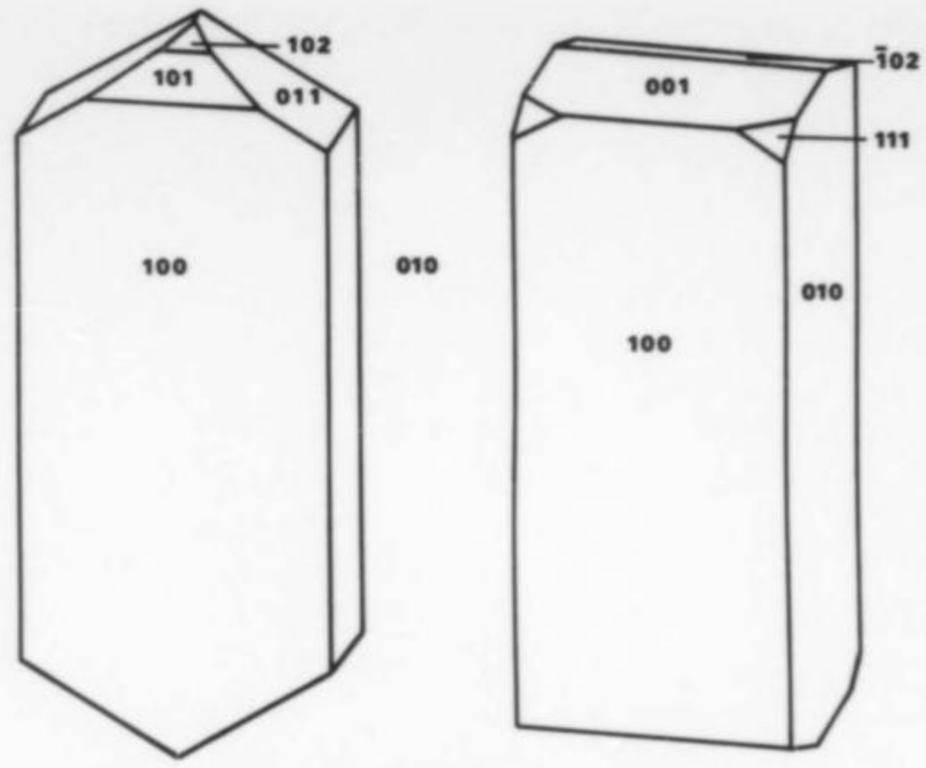


Figure 74. **Lemoynite crystal drawings of two crystals showing different habits. The crystals were measured on a reflecting goniometer and drawn from gnomonic projections.**

Lemoynite is white to tan (most common), pale yellowish white, colorless (very rare), pale brown, pale gray and pale greenish gray. Most crystals are opaque and dull, but the colorless crystals are transparent and have a vitreous luster. Minor color zoning (white to colorless to pale brown) has been observed in some crystals. Two perfect cleavages, {010} and {100}, have been noted. Recently, in an exceedingly rare occurrence, lemoynite was also found in a marble xenolith as 1–2 mm, colorless prisms, associated with pectolite, calcite and fluorite.

Lepidocrocite $\gamma\text{-Fe}^{+3}O(OH)$

Lepidocrocite has been identified from an altered pegmatite vein, as brick-red, granular to powdery fillings in interstices of microcline crystals.

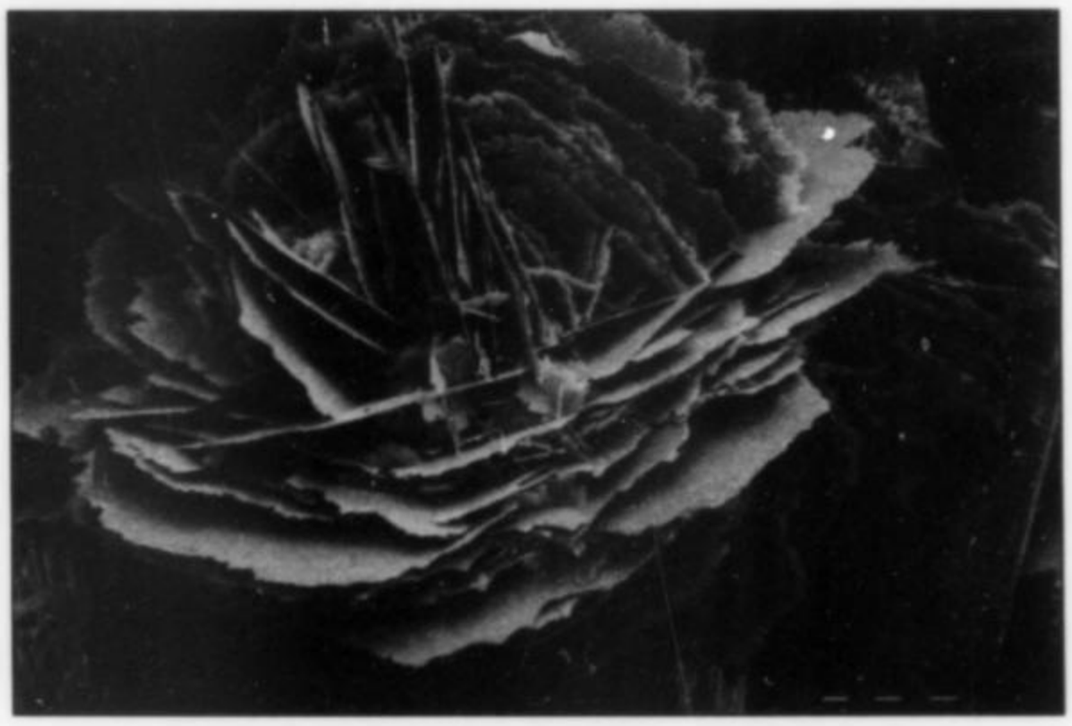


Figure 75. **Leucophanite showing a very rare and unusual rosette-like habit. The rosette is 2 mm across. Horváth collection. SEM photo by E. Vadas.**

Leucophanite $(Na,Ca)_2BeSi_2(O,OH,F)_7$

Leucophanite, an orthorhombic mineral structurally related to the melilite group (Grice and Hawthorne, 1989), is known from a number of localities. From the pegmatites of the Langesundfjord area (type locality), from Narssârssuk, Greenland, from the Lovozero Massif, Kola Peninsula and Mont Saint-Hilaire. To date Mont Saint-Hilaire

has been the source of the finest crystallized specimens, and possibly the largest crystals, of leucophanite.

It occurs almost exclusively in the pegmatites, as sharp, pseudocubic, 2–5 mm, crystals, as twinned, elongated, prismatic crystals 3–12 mm in length; as superb, twinned, square tabular crystals to 4 cm across; and as 1–2 mm rounded flakes and rosettes. It has also been found very rarely in marble xenoliths as small 2–4 mm rosette-like groups of tabular crystals and tan compact spheres.

The most spectacular specimens are the large, transparent, tabular crystals, impaled on aegirine prisms or partially embedded in serandite crystals or birnessite pseudomorphs after serandite. The color is predominantly pale to lemon-yellow but white, beige, yellow-green and pale green crystals have also been observed. Tabular and prismatic crystals tend to be transparent, usually with inclusions of other minerals and internal flaws, whereas the pseudocubic crystals, rosettes and the compact spheres are opaque. The luster is vitreous to dull. (See color photos on following page.)

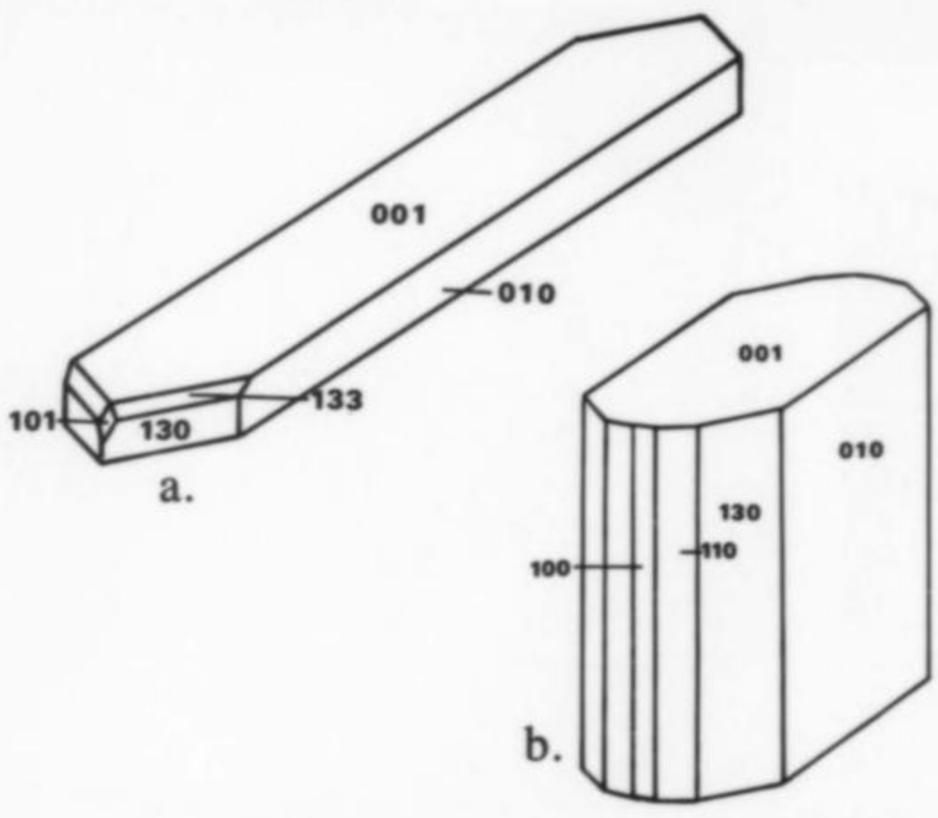


Figure 76. **Leucosphenite crystal drawings (modified from crystal drawings of leucosphenite from Narssârssuk, Greenland, after Goldschmidt (1918)), showing (a) the rare, elongate tabular habit, (b) the more common blocky, prismatic habit.**

Leucosphenite $BaNa_4Ti_2B_2Si_{10}O_{30}$

Leucosphenite is considered a very rare species. It was originally described by Flink in 1897 from Narssârssuk, Greenland (Bøggild, 1953), and has been found in only a few other localities since then. Other localities are: an unnamed locality in the Green River Formation (Milton *et al.*, 1954, and Milton, 1977), the Inaglia alkaline massif in South Yakutia, USSR (Efimov and Katayeave, 1959), and Mont Saint-Hilaire.

Leucosphenite crystals from Mont Saint-Hilaire are undoubtedly the finest and the largest for the species, occurring as sharp, very lustrous, free-standing crystals to 25 mm in length, in cavities associated with the igneous breccia zones. It has also been found embedded in fine-grained, white, granular albite associated with narsarsukite, and as small (<1 mm), round blobs embedded in etched smoky quartz in breccia. Associated minerals in the breccia include albite, microcline, lorenzenite, narsarsukite, quartz, monteregianite, brookite, elpidite, molybdenite, calcite, donnayite, cordylite, vinogradovite and ashcroftine. It has been encountered very rarely in cavities in the marble xenoliths, near contacts with the igneous breccia.

The crystals are blocky, tabular (rare) or prismatic, and characteristically striated on prism faces. Short pseudohexagonal prism, terminated by pinacoids, is the most common habit. Contact twinning is evident on some crystals. The majority of the crystals are 1–6 mm long, with very few of the elongated prisms attaining 1–2.5 cm in length. Smaller crystals are colorless or very pale blue and transparent; the larger crystals tend to grade from translucent to opaque, pale blue to grayish blue and white. In at least one exceptional cavity, a group of very unusual, lemon-yellow, tabular crystals to 5 mm in length was found. The luster varies from adamantine to vitreous. It fluoresces yellowish white under shortwave ultraviolet radiation. (See color photo on the following page.)

Lizardite $Mg_3Si_2O_5(OH)_4$

The polytype, lizardite-1M (Mandarino and Anderson, 1989), a member of the kaolinite-serpentine group, occurs very rarely in altered pegmatites, as tapering hexagonal, 1 mm crystals terminated by basal pinacoids. The crystals are most likely pseudomorphs after some undetermined mineral likely of trigonal symmetry. The color is pale greenish gray, except the pinacoid terminations which are tan to white. The crystals are opaque with a dull to greasy luster.

Löllingite $FeAs_2$

Löllingite is very rare, occurring in altered pegmatite veins and hornfels as small grains, crystalline masses intimately intergrown with various sulfides, crude elongated plates 5–15 mm across, and as prismatic crystals 0.5–1 mm in length. It also occurs as small masses embedded in siliceous marble and as sharp, 1–2 mm long, bladed crystals in small cavities in sodalite xenoliths. The crystals are silvery-white when fresh, tarnishing to pale bronze and steel-gray with metallic luster.

Lorenzenite $Na_2Ti_2Si_2O_9$

Lorenzenite is a relatively common species locally, occurring as superb, sword-shaped, bladed crystals, 2–10 mm in length, and as very thin, fibrous, acicular crystals to 1.5 cm in length, forming splendid divergent sprays in breccia cavities. Rarely, the fibrous variety has also been found in small fractures in the hornfels, and very rarely in marble and sodalite xenolith cavities. The color is pale violet, pink, grayish pink, white to colorless and dark reddish brown. The luster is vitreous to silky on the bladed crystals and silky on acicular crystals. The silky luster is due to numerous longitudinal striations. It fluoresces pale yellowish white under shortwave ultraviolet radiation.

Lorenzenite is very similar in morphology and color to vinogradovite, in both the bladed and fibrous habits and to ashcroftine in the fibrous habit. All three species occur in the same or similar association. Visual identification is very unreliable; however, lorenzenite is far more abundant than the other two species and its fluorescence is very helpful in identification.

For many years there was uncertainty concerning the validity of lorenzenite and ramsayite as two distinct species. This was resolved when the two species were found to be identical (Sahama, 1947), and the name ramsayite was dropped. However, the use of the ramsayite name persisted, including in some early publications on Mont Saint-Hilaire. (See color photos on the following page.)

Lovozerite $Na_2Ca(Zr,Ti)Si_6(O,OH)_{18}$

Lovozerite, a member of the lovozerite group, was originally described from the Lovozero Massif in the Kola Peninsula (Gerassimovsky, 1939b), and has also been found in Ilímaussaq in southern Greenland (Petersen and Secher, 1985). At Mont Saint-Hilaire it occurs rarely, in sodalite xenoliths, associated with a wide range of minerals, including sodalite, villiaumite, vuonnemite, serandite, eudialyte, steenstrupine, ussingite, griceite, lueshite, terskite and many others.

It is found as well-formed pseudo-dodecahedra, 1–3 mm in diameter, and as spherical aggregates in cavities, as 1–2 mm blades and as grains and subhedral to anhedral crystals embedded in sodalite. Practically all the crystals we observed form penetration twins. The crystals are brown, orange-brown, reddish brown, beige, tan and very rarely yellow or pink. It is predominantly opaque with translucent to

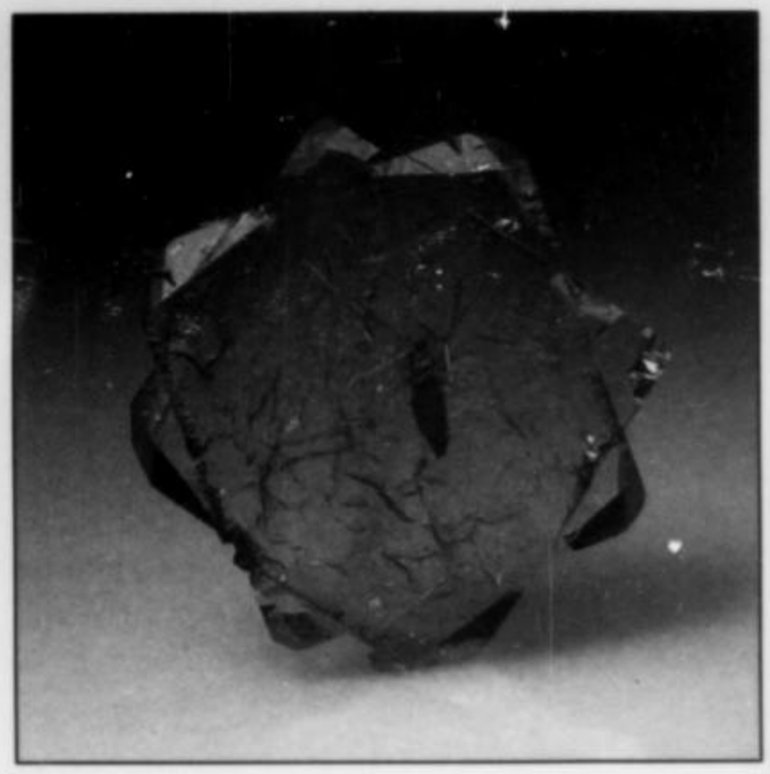


Figure 77. **Leucophanite, a transparent, twinned crystal 1.5 cm across. G. Haineault collection. Photo by G. Robinson.**

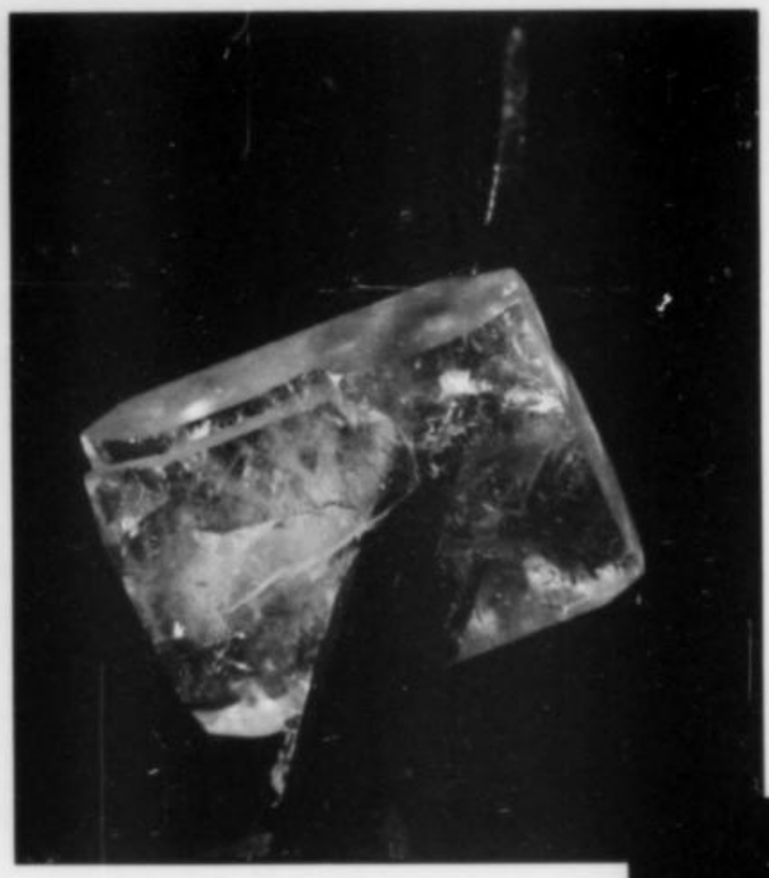


Figure 78. **Leucophanite crystal impaled on a prismatic crystal of aegirine. The leucophanite is 8 x 6 mm. G. Haineault collection. Photo by L. Horváth.**

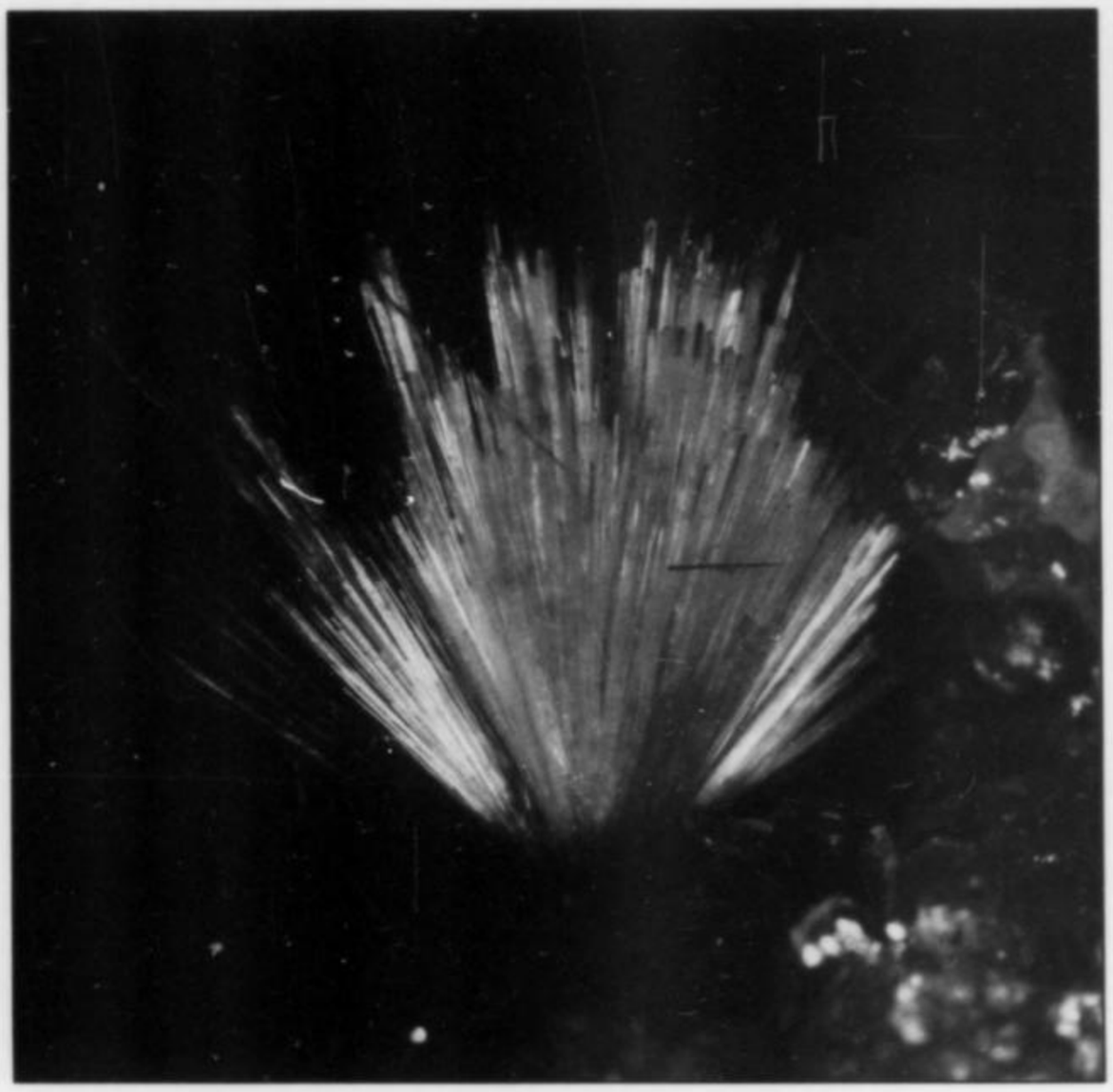


Figure 79. **Lorenzenite crystal spray 4 mm in height. National Museum of Natural Sciences (Canada) specimen #52160. Photo by R. Gault.**

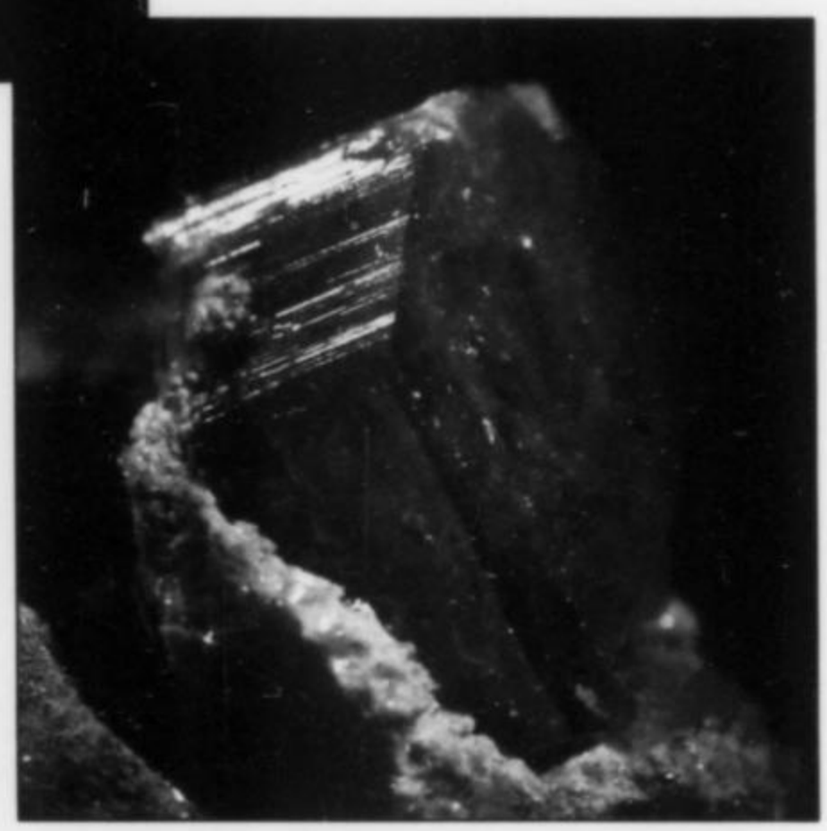


Figure 80. **Leucosphenite crystal *(below)*, 1 cm, of an unusually intense blue color. Horváth collection and photo.**

Figure 81. **Lovozerite-group mineral, twinned crystal 3 mm across. Horváth collection and photo.**

transparent zones. Many of the crystals appear to be altered; they are rather crude, crumbly, poorly-formed and generally lighter in color than the unaltered crystals. The luster varies from vitreous to resinous on the unaltered crystals, and is generally dull on the altered crystals.

Electron microprobe analyses of the altered and unaltered lovozerite indicate that they are identical in composition and the alteration is possibly due to a loss of water. While X-ray powder diffraction and electron microprobe analyses have been performed on this material, further work is in progress to determine the identity and the presence of other members of the lovozerite group at Mont Saint-Hilaire.

Some of the lovozerite yields a white, powdery efflorescence after prolonged exposure to air; the reason for this is under investigation. The crystals of terskite found in the same association bear a marked morphological resemblance to lovozerite, and are believed to be pseudomorphs after lovozerite.

Figure 82. **Lovozerite-group mineral, a twinned crystal 1 mm across. National Museum of Natural Sciences (Canada) specimen #52787. Photo by R. Gault.**

Lueshite $NaNbO_3$

Lueshite, a rare member of the perovskite group (Saffianikoff, 1959), occurs as very small (0.2–1.5 mm), black, pseudocubic crystals and as deformed pseudo-octahedra in small cavities in sodalite xenoliths. The crystals have a submetallic luster and some crystal faces appear to be rough or etched. Penetration twins are relatively common. It is most commonly associated with sodalite, ussingite, villiaumite, steenstrupine, griceite, eudialyte and lovozerite.

Magadiite $NaSi_7O_{13}(OH)_3 \cdot 4H_2O$

Magadiite, a hydrous sodium silicate (Eugster, 1967), occurs very rarely as small masses of pure white powdery aggregates in interstices between pectolite and apophyllite crystals, in cavities in marble xenoliths. The xenoliths in which the magadiite was found consisted of very fine-grained, dark gray, unusually hard siliceous marble. The cavities were notable for their very fine bavenite crystal clusters.

Magnesio-arfvedsonite $Na_3(Mg,Fe^{+2})_4Fe^{+3}Si_8O_{22}(OH)_2$

Magnesio-arfvedsonite, a member of the amphibole group, occurs as blue-green to black, vitreous to dull, prismatic crystals to 9 cm in length, in a contact zone between marble and syenite. It also occurs as fine-grained matrix material enclosing richterite phenocrysts in the same environment. In appearance it is practically identical to arfvedsonite which occurs more abundantly at Mont Saint-Hilaire. The two cannot be differentiated without full chemical analysis.

Magnesite $MgCO_3$

Magnesite, a member of the calcite group, is much rarer at Mont Saint-Hilaire than siderite, the Fe-rich member of the magnesite-siderite series. It has been found as pale grayish green, transparent, modified rhombohedra to 2 mm in length in narrow seams and fractures in hornfels.

Magnetite $Fe^{+2}Fe_2^{+3}O_4$

Magnetite, a member of the spinel group, is extremely rare, as small (<1 mm), sharp, black, lustrous cubes and octahedra on pyrrhotite crystals in miarolitic cavities. It has also been found in sodalite syenite cavities.

Makatite $Na_2Si_4O_8(OH)_2 \cdot 4H_2O$

Makatite was originally described from Lake Magadi, Kenya (Sheppard *et al.*, 1970), Mont Saint-Hilaire is believed to be the only other locality for the mineral.

It is very rare at Mont Saint-Hilaire, found in sodalite xenoliths intimately associated with vuonnemite. Other associated minerals are sodalite, ussingite, aegirine, steenstrupine, molybdenite, eudialyte and lovozerite. It occurs as thin, striated prisms to 3 mm in length with blunt terminations. Crystals are colorless, transparent with a vitreous luster. Under ultraviolet radiation no fluorescence has been noted.

Mangan-neptunite $KNa_2Li(Mn,Fe^{+2})_2Ti_2Si_8O_{24}$

Mangan-neptunite occurs as well-formed, elongated, commonly twinned, monoclinic prisms and equant pseudorhombohedra, as a fairly frequent late stage accessory mineral in pegmatite veins. Splendid, deep red prisms to 5 cm in length, associated with large serandite, analcime and natrolite crystals, were found in 1973 in a pegmatite pipe. Very rarely it has been encountered in small cavities in breccia and in sodalite xenoliths as sharp, 1–5 mm, twinned, tabular crystals. The color ranges from reddish brown to orange and very deep carmine-red to black. Color zoning is often present and is dependent on the Mn:Fe ratio. Some crystals are etched, cavernous and crumbly. Smaller crystals are transparent to translucent and tend to be more opaque with increasing size. The luster is vitreous to waxy to dull on external surfaces and resinous on broken internal surfaces.

Neptunite, the Fe end-member of the neptunite-mangan-neptunite series, has not been found at Mont Saint-Hilaire.

Figure 83. **Mangan-neptunite group of twinned crystals to 2 mm across. M. Picard collection. Photo by R. Gault.**

Marcasite FeS_2

Marcasite is found very rarely, as 2–3 mm, thin, bladed single crystals and oriented crystal groups. It occurs in narrow fracture cavities and fissures in hornfels, or in nepheline syenite close to the hornfels contact.

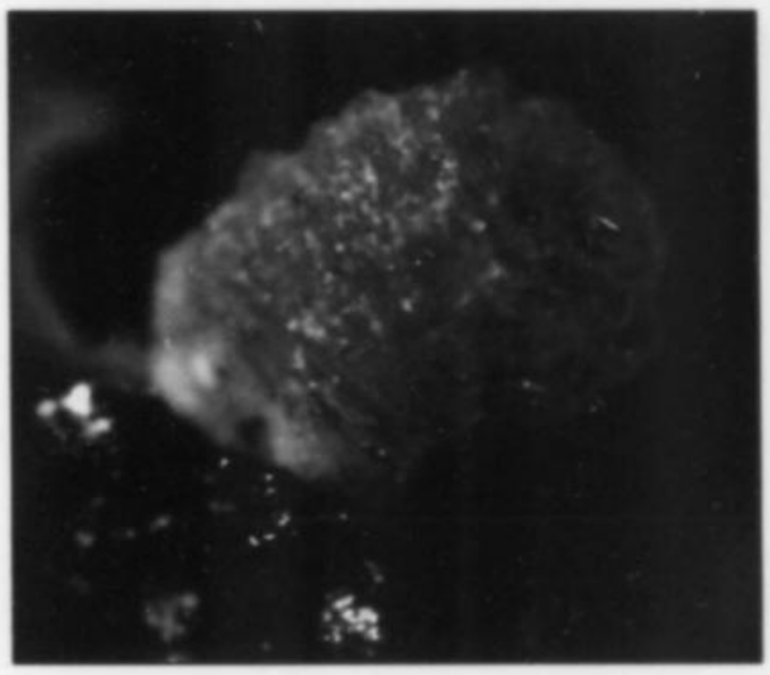


Figure 84. **Mckelveyite-(Y) crystal aggregate 5 mm across. Horváth collection and photo.**

Mckelveyite-(Y) $Ba_3Na(Ca,U)Y(CO_3)_6 \cdot 3H_2O$

Mckelveyite-(Y) was described as a new species in 1965 from the Green River formation in Wyoming (Milton *et al.*, 1965, and Desautels, 1967), where it was found in drill cores as very small (<1 mm) crystals, in syntactic intergrowths with ewaldite.

At Mont Saint-Hilaire, which is the only other known locality for the species, the occurrence is exceedingly rare as 0.5–3 mm, transparent to translucent, yellow, orange-yellow to brown, complex, rounded (cone-shaped), hemimorphic crystals in small (1–2 cm) cav-

ities on the periphery of an altered pegmatite, associated with donnayite, calcite, natrolite, microcline and biotite. It has also been found as 1–2 mm, dull, greenish brown to gray spherical aggregates in a seam of hornfels, associated with quartz, dolomite and neighborite.

The crystals appear to be complex twins, stacked in intricate groups, syntactically intergrown with donnayite. Individual crystals resemble rounded cones, with the top of the inverted cone (most likely a {001} pedion) forming the only well-defined crystal face. All other crystal faces are very poorly developed and curved. This face has a vitreous luster while all other surfaces are dull, occasionally frosty and uneven. The luster on broken surfaces tends to be greasy or resinous. Color zoning, from the transparent, yellow to orange-yellow outer zone to the opaque, tan to brown crystal core is evident in some crystals. The cone-shaped crystals are identical to and are habitually intergrown with donnayite crystals of the same habit; there is no reliable visual clue to distinguish the two species.

Meionite $3CaAl_2Si_2O_8 \cdot CaCO_3$

Meionite, the Ca end-member of the scapolite group occurs relatively rarely as pale pink to brownish red, fine-grained masses to several centimeters across, embedded in some marble xenoliths. It fluoresces yellowish white under shortwave and red under longwave ultraviolet radiation.

Figure 85. **Microcline, a large Baveno-twinned crystal 14 cm in height. National Museum of Natural Sciences (Canada) specimen #51582. Photo by G. Robinson.**

Microcline $KAlSi_3O_8$

Microcline, a member of the feldspar group, is one of the most common minerals and is found in virtually all associations. It is the first mineral along with aegirine to crystallize out during the formation of the pegmatite veins and pipes, and well-formed crystals commonly line the walls. These crystals form the matrix for crystals of many species. The crystal habit varies from blocky to tabular to elongated. The color varies from white to tan to gray and very rarely pale pink, the luster from waxy to dull. Enormous, sharp, tabular crystals to 30 cm in length have been encountered in large pegmatite cavities, and magnificent Baveno twins to 15 cm in length have also been found.

Milarite $K_2Ca_4Al_2Be_4Si_{24}O_{60} \cdot H_2O$

Milarite, a member of the osumilite group, occurs exceedingly rarely as aggregates of 2–3 mm, crude, hexagonal prisms in parallel growth on pectolite crystals in marble xenoliths also associated with fluorapophyllite, calcite, fluorite and poudretteite. The crystals are white to colorless and translucent to opaque with a vitreous luster on some faces and a silky to dull luster on others. The silky appearance is probably due to numerous striations on the prism faces. Blue-white fluorescence has been noted under shortwave ultraviolet radiation. The mineral bears a very close resemblance to pectolite and is very easily overlooked.

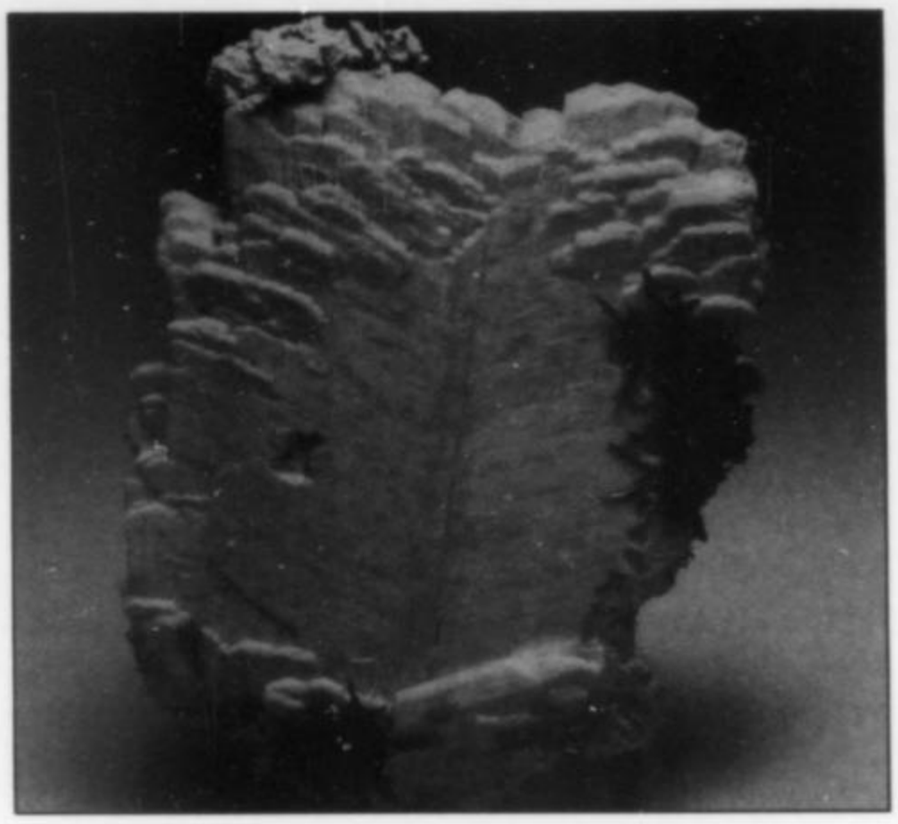


Figure 86. **Microcline twin 6 cm in height. G. Haineault collection. Photo by G. Robinson.**

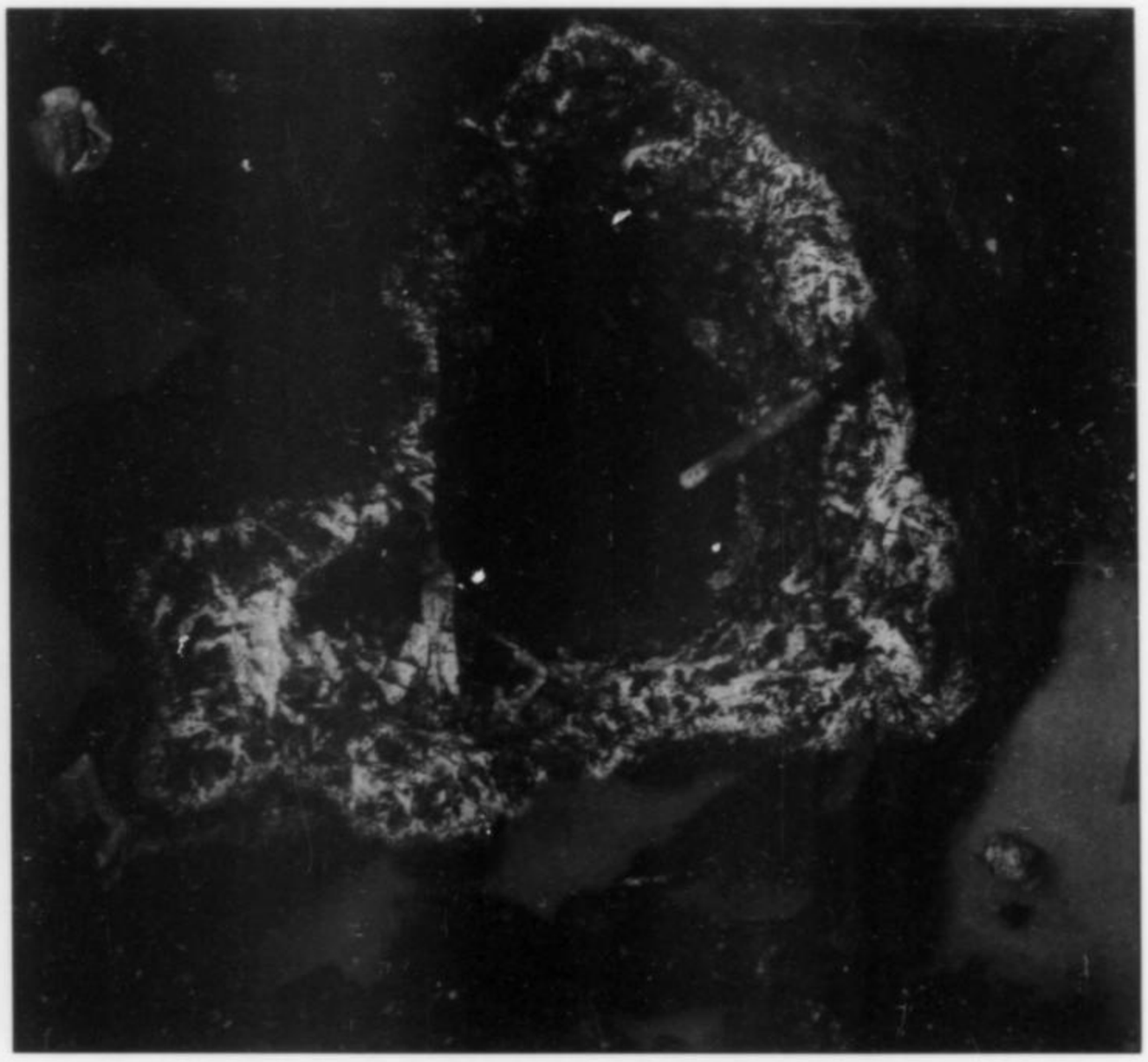


Figure 87. **Cross-section of a pegmatite dike exposed in 1973, showing crystals of microcline, aegirine and serandite. Photo by G. Runnells.**

Millerite NiS

Millerite has been found as an exceedingly rare accessory mineral in breccia cavities. It occurs as 2–3 mm long, brassy, metallic, very thin, flexible, striated acicular crystals forming divergent sprays.

Mimetite $Pb_5(AsO_4)_3Cl$

Mimetite occurs as an extremely rare secondary mineral in altered pegmatites, as minute (<1 mm), white and beige needles in solution cavities in sphalerite. It is closely associated with galena, arsenopyrite and other sulfides, and other secondary minerals such as beudantite.

Miserite $K(Ca,Ce)_6Si_8O_{22}(OH,F)_2$

Miserite was originally described from Potash Sulphur Spring, Arkansas (Schaller, 1950). It also occurs in the Kipawa Lake area in northern Québec (Berry *et al.*, 1972). At Mont Saint-Hilaire it was found in the early 1970's and for a time designated as UK#36 (Chao and Baker, 1979). It occurs as individual crystals and groups of crystals in dense, fine-grained nodules and veins consisting of pectolite, calcite and wollastonite in marble xenoliths. The species is relatively rare, but it is found in locally high concentrations in some marble xenoliths.

Crystals are elongated, 5–12 mm, pseudohexagonal, longitudinally striated and of pale to medium reddish violet color. Most show no discernible terminations, and occur embedded in the marble matrix. They grade from transparent to translucent to opaque, with a vitreous luster. Cleavage is very good in at least one direction, along the length of the crystal.

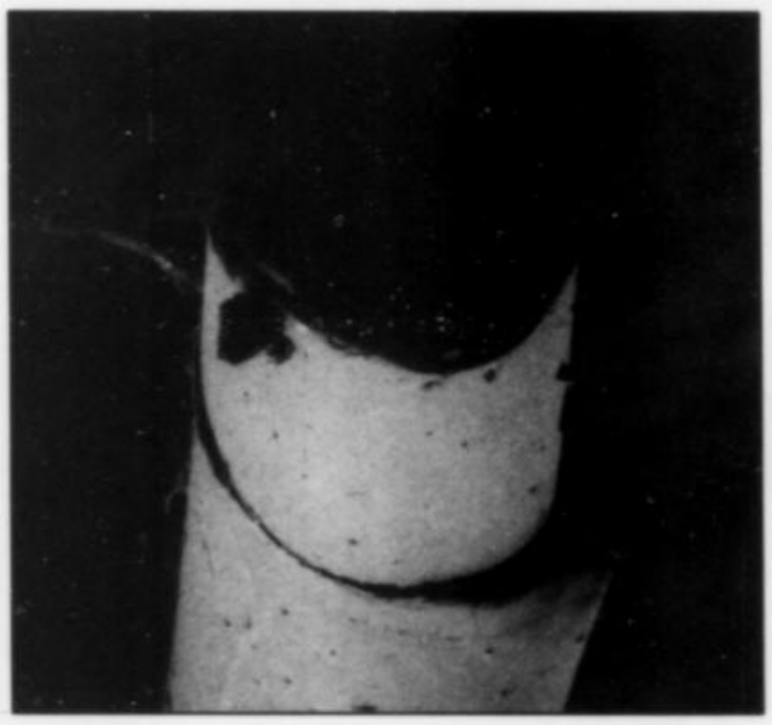


Figure 88. **A mineralogical curiosity—tubular molybdenite. The tube is approximately 0.5 mm in diameter and 4 mm in length. National Museum of Natural Sciences (Canada) specimen #48756. SEM photo by E. Vadas.**

Molybdenite MoS_2

Molybdenite is a common mineral in practically all the mineralogical environments, although found in very small quantities. Both molybdenite-2H and molybdenite-3R polytypes (Mandarino and Gait, 1970) have been found as 1–4 mm, sharp, hexagonal, thin foil-like plates commonly forming attractive rosettes or spherical aggregates, and as fine to coarse-grained masses to several centimeters across, embedded in marble xenoliths. A mineralogical curiosity of hollow, cylindrical, molybdenite tubes to 5 mm in length and 0.2 mm in diameter has been found in a miarolitic cavity (Fig. 88). This is an interesting addition to the minerals with cylindrical morphology (Bideaux, 1970).

Monazite-(Ce) $(Ce,La,Nd,Th)PO_4$

Monazite-(Ce) has been found rarely, as 1–2 mm, tabular and wedge-shaped crystals forming complex groups associated with albite and siderite, in carbonate-rich pegmatite veins. It has also been found as hexagonal, tabular pseudomorphs to 3 mm in diameter, in rosette-like groups, in an altered pegmatite pipe, replacing some undetermined precursor, associated with elpidite, albite, catapleiite, epididymite, aegirine and a green, powdery chlorite-like mineral. The tabular pseudomorphs are partially metamict. The monazite-(Ce) crystals are green to greenish brown and opaque with a vitreous to greasy luster. The pseudomorphs are brown, dull and opaque.

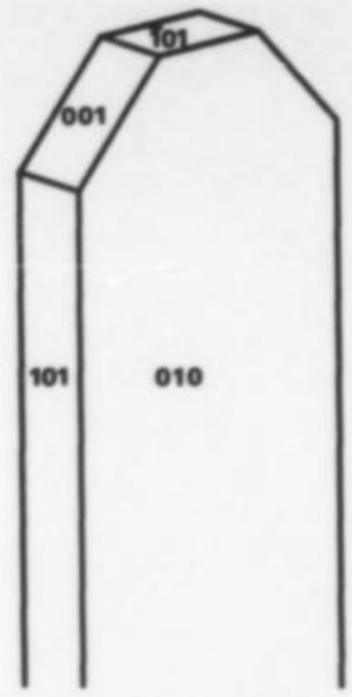


Figure 89. **Monteregianite-(Y) crystal drawing using the cell parameters reported by Ghose *et al.* (1987), and reindexing the faces reported by Chao *et al.* (1978) (Chao, personal communication).**

Monteregianite-(Y) $(Na,K)_6(Y,Ca)_2Si_{16}O_{38}\cdot 10H_2O$

Monteregianite-(Y) was described from Mont Saint-Hilaire (Chao, 1978), which remains the only known locality. The mineral is monoclinic (Ghose *et al.*, 1987) (pseudo-orthorhombic) and is structurally related to delhayelite, rhodesite and macdonaldite.

It is relatively widespread in small quantities, most commonly found in cavities in the igneous breccia and in marble xenoliths, rarely in carbonate-rich miarolitic cavities and exceedingly rarely in pegmatites.

Monteregianite-(Y) occurs as well-formed, sharp, tabular or lath-shaped crystals forming attractive radiating sprays, parallel stacked groups and randomly oriented aggregates. Less frequently it is found as fibrous or foliated sprays and masses. Most crystals are in the 1–5 mm range but crystals of 8–10 mm in length are encountered occasionally. One exceptional cavity in a marble xenolith produced a tabular crystal of 2.5 cm in length and 1.5 cm in width—believed to be the largest for the species—and a number of other crystals in the 1–1.5 cm range. Most crystals are simple, elongated, tabular crystals bounded by {001}, {100} and {010} pinacoids and rarely by $\{\bar{1}01\}$ prisms.

Monteregianite-(Y) has perfect cleavage on {010}, very good on $\{\bar{0}01\}$ and fair on {100}. The color ranges from colorless, pale to dark gray, pale rose or violet, and white to nearly black; some crystals are zoned pink and green. The colorless, rose and violet crystals tend to be transparent with a vitreous luster, while the others are translucent to opaque with a greasy to silky luster. It fluoresces intense green under shortwave ultraviolet radiation. (See color photos on the following page.)

Montmorillonite $(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2\cdot nH_2O$

Montmorillonite, a member of the smectite group, has been identified from marble xenoliths, as white to tan-colored, compact, powdery fillings in interstices between crystals in cavities, and as embedded grains in marble.

Mosandrite $(Na,Ca,Ce)_3TiSi_2O_7(F,OH,O)_2$

Mosandrite is uncommon and occurs in unaltered or altered eudialyte-rich pegmatites, sodalite xenoliths and nepheline syenite.

It has been found as sharp, elongated, pseudohexagonal prisms to 3.5 cm, most commonly embedded in matrix rock or in the associated minerals, such as eudialyte, sodalite, analcime, natrolite and microcline. Rarely free-growing crystals have been found in tiny cavities in pegmatite lenses and sodalite xenoliths, as sharp, 1–6 mm prisms. The prismatic crystals, characteristically exhibit poor terminations and are striated on the prism faces. They are transparent, colorless to

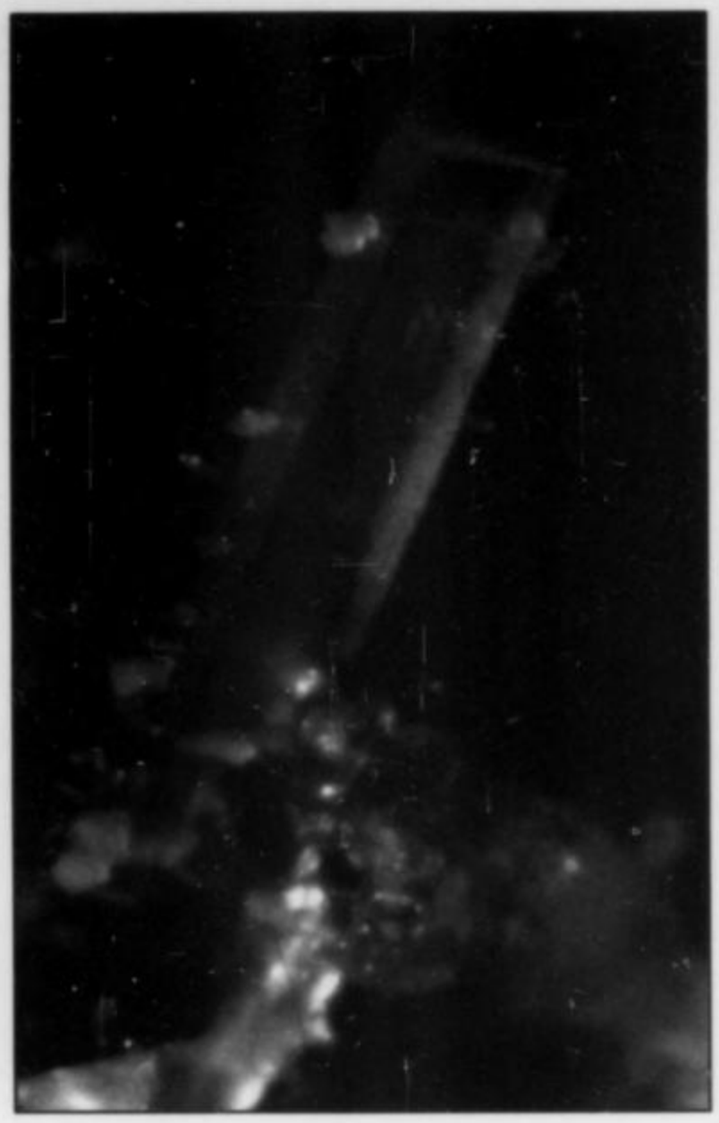


Figure 90. **Monteregianite crystal 4 mm in length, with epitactic tetranatrolite. Horváth collection and photo.**

Figure 91. **Monteregianite in very unusual, pale violet crystals. The crystals are 5 mm in height. Horváth collection and photo.**

lemon-yellow and pale orange-yellow with a vitreous luster; also rarely tan to pale gray, opaque and dull. The crystals commonly contain inclusions and internal flaws. It has also been found (exceedingly rarely) in pegmatites as very thin, small (<1 mm), beige to pale yellow, dull and opaque bladed crystals forming radiating clusters. In some earlier literature the name rinkite, now discontinued, was also used for mosandrite.

Muscovite $KAl_2(Si_3Al)O_{10}(OH,F)_2$

Muscovite, a member of the mica group, is relatively uncommon, occurring in altered pegmatites, hornfels and sodalite syenite. It occurs as small plates and short pseudohexagonal prisms, commonly in intergrown clusters, globular aggregates and masses, in small cavities and as masses embedded in rock. The crystals are 0.5–1.5 mm in diameter and the color ranges from pale yellow to pale green (most common), colorless and light brown.

Nahpoite Na_2HPO_4

Nahpoite was described as a new species from the Big Fish River area, Yukon Territory, Canada (Coleman and Robertson, 1981). It has also been reported from the Lovozero Massif. Mont Saint-Hilaire is the third reported locality for the species.

Nahpoite has been identified from sodalite xenoliths where it occurs as white, powdery masses lining small (2–10 mm) cavities. The mineral is very rare, and is difficult to distinguish from dorfmanite, thermonatrite, halite and trona, all occurring in the same environment.

Narsarsukite $Na_2(Ti,Fe^{+3})Si_4(O,F)_{11}$

Narsarsukite is relatively common at Mont Saint-Hilaire, where the finest specimens and the largest crystals known for the species have been found. It occurs in both quarries and in outcrops of weathered hornfels on the north flank of the mountain.

It is usually found as sharp, pale to dark yellow, greenish yellow, dark green, grayish brown to dark brown tabular crystals 2–6 mm on an edge, with exceptional crystals up to 2.5–3 cm, commonly embedded in fine-grained hornfels and in igneous breccia. It is also found rarely as free-growing, colorless, pale pink, lemon-yellow to orange-

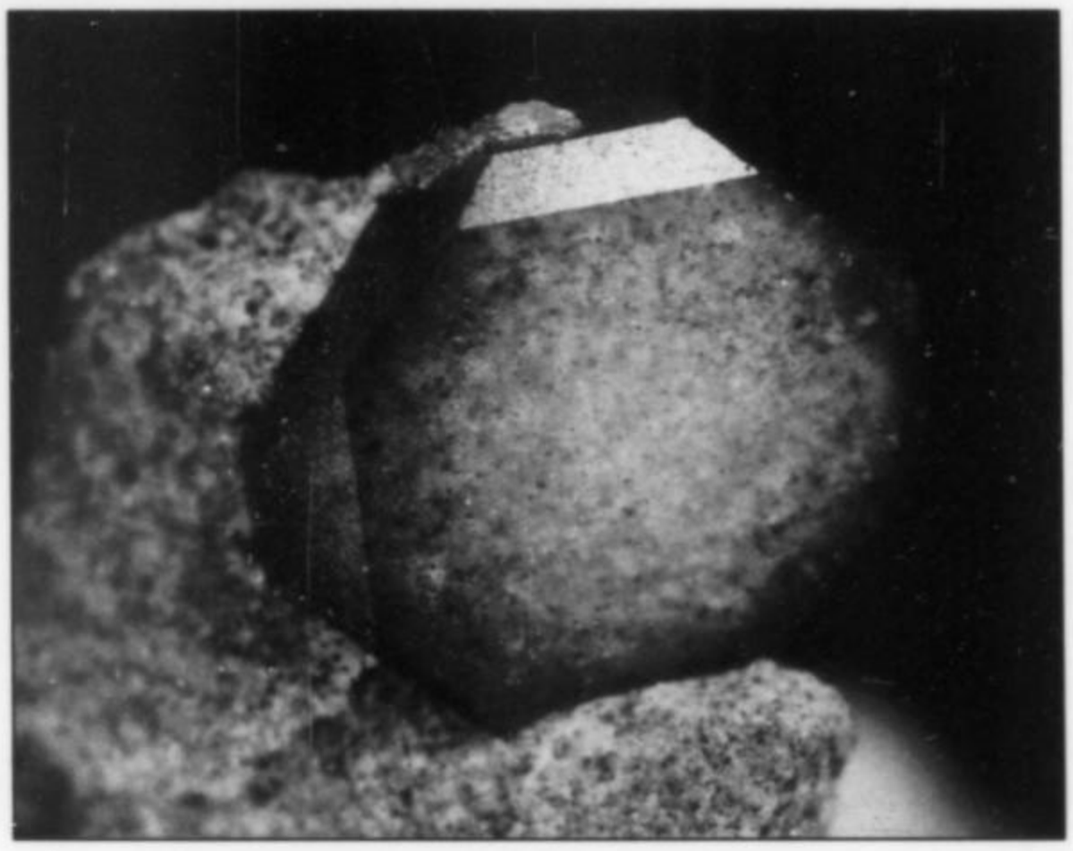


Figure 92. **Narsarsukite, a tabular crystal 5 mm across. Horváth collection and photo.**

yellow, 1–4 mm (exceptionally up to 2.5 cm) tabular crystals, and exceedingly rarely as 2–10 mm, lemon-yellow to orange-yellow tetragonal prisms, forming attractive divergent, radiating groups in breccia cavities. Tabular crystals show the dominant {001} pinacoid, small {100} and {110} prisms, and the small {101} pyramid. The elongated tetragonal prisms show the {100} and {110} prisms, terminated by either the {001} pinacoid or a combination of small {101} pyramid and the {001} pinacoid. Pseudomorphs of quartz and other minerals after tabular narsarsukite crystals have been encountered in the hornfels.

Most embedded tabular crystals are opaque and typically color zoned: medium to dark yellow in the center, grading progressively to dark green towards the prism faces. The green color zoning is due to numerous, minute inclusions of green amphiboles. The luster is vitreous to dull or greasy. The free-growing tabular and prismatic crystals tend to be transparent to translucent with vitreous to adamantine luster.

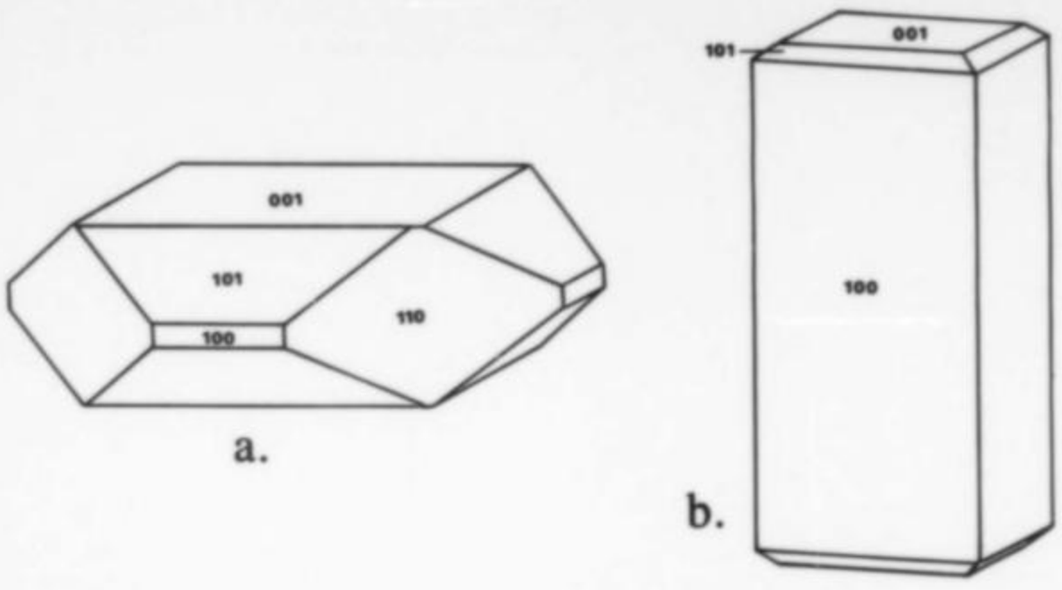


Figure 93. **Narsarsukite crystal drawings showing two of its observed habits, (a) the more common tabular habit with prominent {110} and {101} forms, (b) the rare, elongated tetragonal prism.**

Natrite Na_2CO_3

Natrite was originally described from the Khibiny and Lovozero massifs, Kola Peninsula (Khomyakov, 1983). At Mont Saint-Hilaire it is extremely rare, and is found in sodalite xenoliths exclusively. It occurs as white, translucent, irregular grains to 2 mm across in small cavities, associated with sodalite, vuonnemite, ussingite, eudialyte, lovozerite, aegirine, serandite, pyrite and steenstrupine. Some specimens were coated with nail polish shortly after having been collected; others rapidly hydrated to thermonatrite. Natrite is soluble in water.

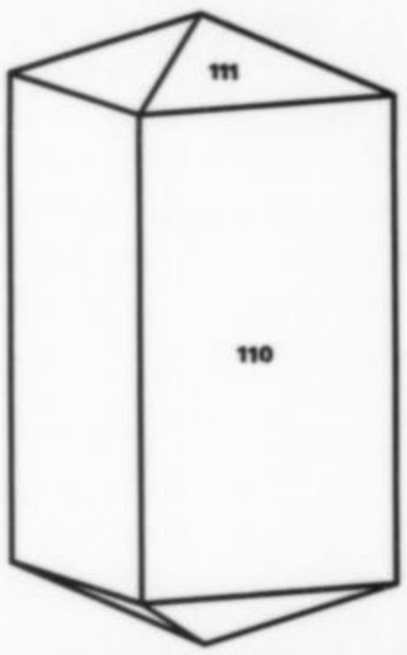


Figure 94. **Natrolite crystal drawing showing the most common observed habit.**

Natrolite $Na_2Al_2Si_3O_{10}\cdot 2H_2O$

Natrolite, a zeolite, is one of the most abundant constituents of the pegmatite veins and miarolitic cavities; it also occurs commonly in most other associations.

Crystals are normally elongate, pseudotetragonal prisms and range from millimeter size to exceptionally large crystals. Some of the most impressive specimens of natrolite are large groups of pale pink, transparent to translucent crystals to 15 cm in length and to 1–2 cm across, and also superb, waterclear, transparent prisms up to 10 cm in length. Masses of radiating or randomly oriented, intergrown prisms filling some of the pegmatite pipes are relatively common; rarely these masses exceed 1 m across. Natrolite is also found as fibrous, divergent sprays, crystalline masses and spherical aggregates. It is most commonly colorless, white or gray, rarely pale pink or very pale bluish gray. The luster is vitreous to silky, greasy or dull.

Freshly exposed natrolite crystals are translucent to transparent but often develop a white, opaque, flaky overgrowth of tetranatrolite shortly after being exposed to air. This tetranatrolite coating results from the dehydration of paranatrolite, a common epitactic overgrowth on natrolite. The fibrous variety of natrolite is opaque.

A number of flawless gemstones of colorless natrolite have been cut from Mont Saint-Hilaire material including a 9.65 carat rectangular step cut.

Natron $Na_2CO_3\cdot 10H_2O$

A very unusual occurrence of natron was encountered in a sodalite xenolith rich in pectolite and villiaumite. This is the first reported occurrence of the mineral from an alkaline intrusive complex.

The natron formed as crystalline masses to 4 cm across, filling cavities in the xenolith. Some euhedral crystals have also been found. The mineral is colorless and transparent with a rather dull luster probably due to surface etching and alteration. The fracture is conchoidal.

On exposure to air, natron alters (dehydrates at 76% humidity and 25°C) very rapidly to white powdery thermonatrite. It deliquesces at 87% humidity and 25°C and may absorb CO_2 to form trona (Waller, 1987). It appears to remain stable and may be preserved in hermetically sealed containers, stored below 32°C.

The Mont Saint-Hilaire natron was collected during the winter, very shortly after the quarrying operation had exposed the xenolith, and the very cold temperature and the availability of snow for packing facilitated its preservation.

Natrophosphate $Na_7(PO_4)_2F\cdot 19H_2O$

Natrophosphate was described from the Khibiny alkali Massif (Kapustin *et al.*, 1972), where it occurs as crystalline masses associated with pegmatite veins.

Mont Saint-Hilaire is the second reported locality for the species and the first occurrence of well-formed crystals. These are found exceedingly rarely as 0.5–2 mm, colorless to frosty-white, transparent to turbid, highly modified octahedra and dodecahedra, in small cavities in sodalite xenoliths. Some of the crystals exhibit a very large number of faces, giving it a rounded appearance. The luster of freshly exposed crystals is vitreous. Some crystals have a milky appearance and waxy luster; a thin, dull, opaque film which develops after extended exposure to air coats some faces.

Associated minerals include villiaumite, ussingite, vuonnemite, lovozerite, eudialyte, steenstrupine, chkalovite, lueshite, serandite, griceite and kogarkoite. When fresh, natrophosphate crystals are very similar in appearance to chkalovite and colorless sodalite crystals.

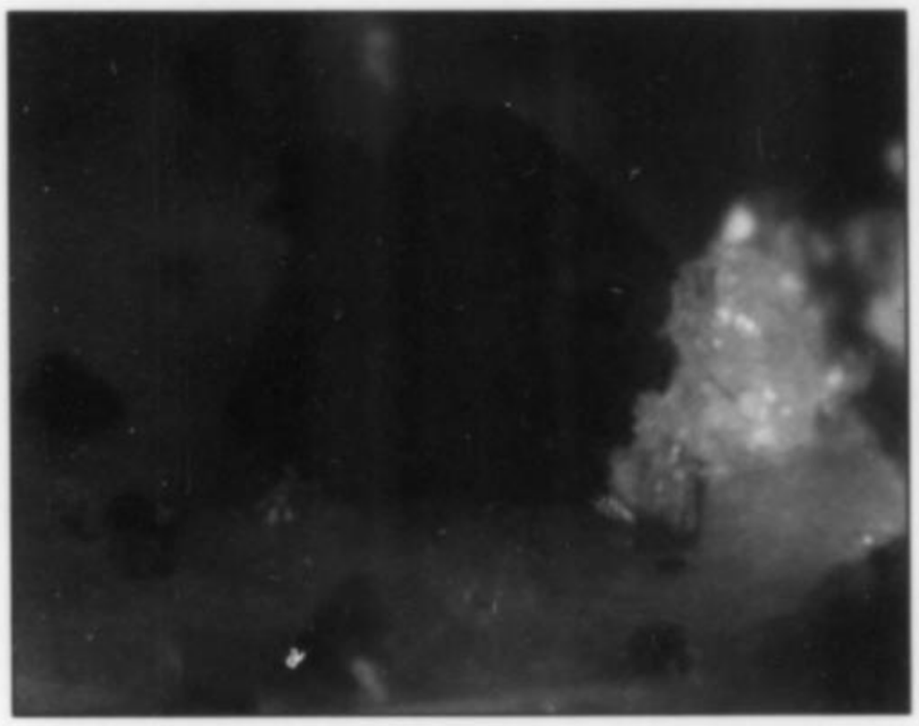


Figure 95. **Neighborite crystal 0.5 mm across. National Museum of Natural Sciences (Canada) specimen #52545. Photo by R. Gault.**

Neighborite $NaMgF_3$

Neighborite was originally described from dolomitic oil shales of the Green River formation, at South Ouray, Uintah County, Utah

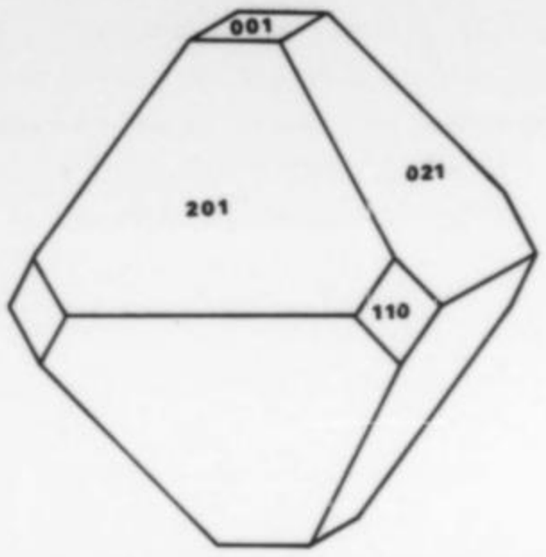


Figure 96. **Neighborite crystal drawing, from measurements made on a reflecting goniometer, showing a dominant set of equally developed rhombic prisms {201} and {021}.**

(Chao *et al.*, 1961), where it occurs as rounded grains and as 0.1–0.5 mm, clear, twinned pseudo-octahedral crystals. The mineral is orthorhombic. It has also been reported from a hydrothermal deposit in the western Ural Mountains in the USSR (Efimov *et al.*, 1967), and from a soda granite in the Lake Gjerdingen area near Oslo, Norway (Raade and Haug, 1980).

At Mont Saint-Hilaire, the fourth reported locality for neighborite, it has been found in small pegmatite cavities as sharp, dark red and reddish brown, pseudo-octahedral and pseudocuboctahedral crystals. The crystals are 1–2 mm in size, translucent to transparent with a vitreous luster, and commonly exhibit distinct color zoning, grading from a transparent red outer zone to a reddish brown translucent to opaque inner core. Twining is evident in some crystals.

Neighborite has also been found in a vein in hornfels, in close proximity to its contact with nepheline syenite, as translucent to opaque, dark red to orange-red, dull to greasy, somewhat etched, pseudocubic crystals 1–3 mm on an edge. Associated minerals in the hornfels were: smoky quartz, dolomite, rutile, brookite, calcite, epididymite and mckelveyite.

The occurrence in both associations appears to be extremely rare.

Figure 97. **Nenadkevichite, compact "wagon wheel" aggregates of crystals. The group is approximately 3 mm across. Horváth collection. SEM photo by E. Vadas.**

Nenadkevichite $(Na,Ca,K)(Nb,Ti)Si_2O_6(O,OH)\cdot 2H_2O$

Nenadkevichite, the Nb end-member of the labuntsovite-nenadkevichite series (Semenov, 1959), was first described from an unnamed locality in the Lovozero alkali Massif, in the Kola Peninsula, USSR (Kuz'menko and Kazakova, 1955). No euhedral crystals have been

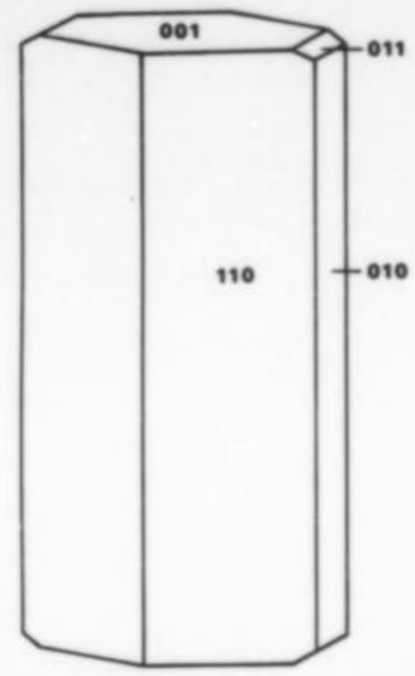


Figure 98. **Nenadkevichite crystal drawing, from measurements made on a reflecting goniometer. The {011} rhombic prism is rare.**

reported from the type locality. Mont Saint-Hilaire is the second reported occurrence (Perrault and Gélinas, 1969, Perrault *et al.*, 1969, and 1973) and the first for well-crystallized specimens. In recent years nenadkevichite has also been reported from Gjerdingen, Norway (Karup-Møller, 1986), and Ilímaussaq, Greenland (Petersen and Secher, 1985).

At Mont Saint-Hilaire the mineral occurs most commonly as pseudomorphs after serandite, consisting of masses to several centimeters across of intergrown small crystals. It is also found as superb, 1–8 mm, prismatic and very thin tabular single crystals, as randomly or preferentially oriented stacked clusters and as compact spherical aggregates. It is found most commonly in altered and unaltered pegmatites, and very rarely in cavities in marble xenoliths and igneous breccia.

The color varies from almost colorless to pale pink, rose-pink, orange and brownish red. Some brown-red crystals have a white opaque core and peculiar white bands on two of the pinacoid faces. Crystals are translucent to transparent. The compact aggregates and serandite pseudomorphs tend to be mainly opaque. The luster is vitreous to pearly or dull, and many of the crystals are coated by a thin iridescent film.

The crystals are pseudohexagonal prisms bounded by the rhombic prism {110}, the {010} and {001} pinacoids, and rarely the rhombic prism {011}.

Nenadkevichite crystals bear a very close resemblance to serandite crystals, and are difficult to distinguish visually. (See color photo on p. 328.)

Neotocite $(Mn,Fe^{+2})SiO_3\cdot H_2O$ (?) See hisingerite.

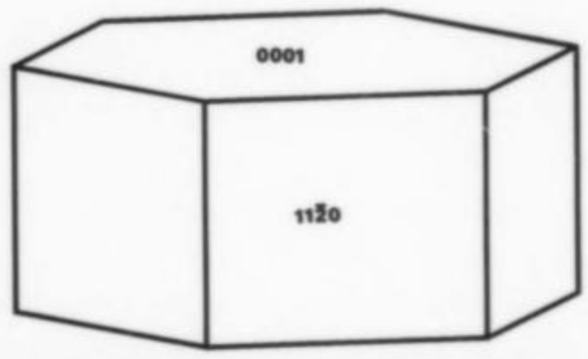


Figure 99. **Nepheline crystal drawing of a short, hexagonal prism {11$\bar{2}$0}, after Mandarino and Anderson (1989).**

Nepheline $(Na,K)AlSiO_4$

Nepheline, a major rock-forming constituent of the nepheline syenite, is rarely found in good euhedral crystals. Isolated crystals and crystal groups are occasionally encountered in miarolitic cavities, in pegmatites and in sodalite xenoliths.

The crystals are simple, short, hexagonal prisms to 3.5 cm in length, with pinacoidal terminations. The color is gray, pale greenish gray or yellowish white with a greasy to dull or silky luster. The silky luster on some crystals is due to surface alteration to natrolite. (See color photo on following page.)

Nordstrandite $Al(OH)_3$

Nordstrandite is a relatively rare species, occurring in small cavities in biotite-rich xenoliths, in some altered pegmatite dikes, and very rarely in sodalite syenite cavities.

It is found as aggregates of blocky, tabular or wedge-shaped 0.5-2 mm crystals most commonly associated with natrolite and tetranatrolite. The color ranges from pale pink to white, beige, pale green and colorless. The crystals are transparent to translucent with vitreous to pearly luster.

Parakeldyshite $Na_2ZrSi_2O_7$

Parakeldyshite was described from the pegmatites of the Lovozero and Khibiny massifs, Kola Peninsula (Bussen *et al.*, 1972, Khomyakov *et al.*, 1975) and from Lågedalen, Norway (Raade and Mladeck, 1977).

At Mont Saint-Hilaire it occurs as 1–6 mm diameter, irregular grains and masses embedded in massive sodalite in sodalite xenoliths, also associated with eudialyte, zircon, aegirine and green amphiboles. The grains are colorless, with a vitreous luster on freshly cleaved surfaces. The cleavage is excellent to very good in three directions. It fluoresces orange-white under shortwave ultraviolet radiation.

Due to its inconspicuous nature, it is very easy to overlook the species; the fairly intense fluorescence may be helpful in locating the small masses, providing they can be isolated from the more intensely fluorescent sodalite matrix.

Paranatrolite $Na_2Al_2Si_3O_{10}\cdot 3H_2O$

Paranatrolite, a member of the zeolite group, was described as new species from Mont Saint-Hilaire (Chao, 1980). It has since been reported from a number of other localities.

It occurs abundantly as epitactic overgrowths on natrolite crystals and as prismatic crystals to 5 cm, in miarolitic cavities, pegmatite veins, sodalite syenite, uncommonly in cavities in igneous breccia, and very rarely in marble and sodalite xenoliths.

Paranatrolite is identical in physical appearance to natrolite, but on exposure to air it dehydrates rapidly to tetranatrolite. The dehydration process is irreversible; however, specimens can be preserved by permanent immersion in water immediately after being collected. Paranatrolite is predominantly colorless, grayish, very pale yellowish white and rarely pale pink. The luster is greasy.

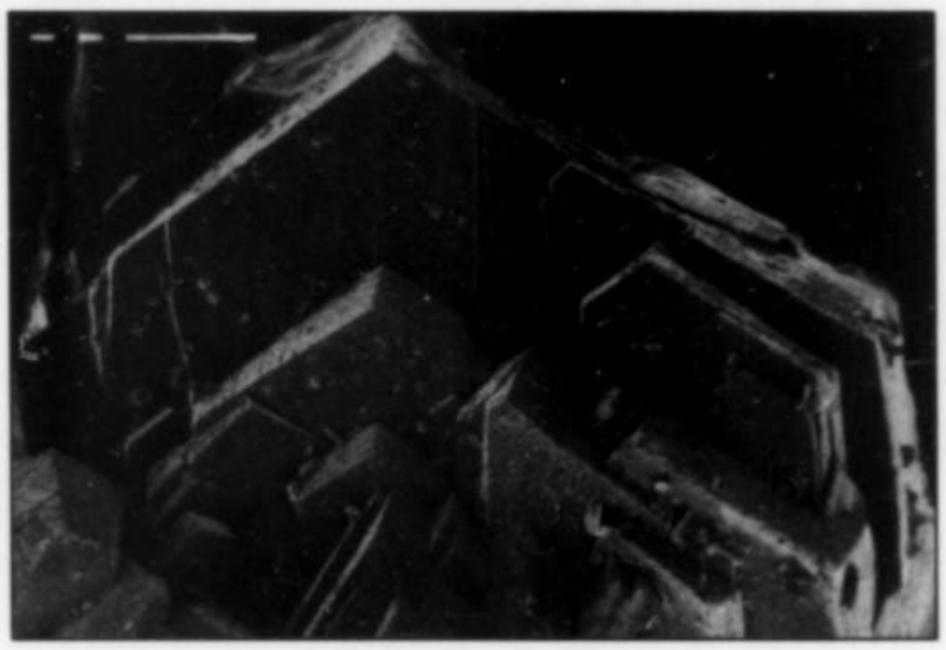


Figure 100. **Paraumbite aggregate of crystals 2 mm in diameter. Horváth collection. SEM photo by E. Vadas.**

Paraumbite $K_3Zr_2HSi_6O_{18}\cdot nH_2O$

Paraumbite was described from an alkalic pegmatite on Mt. Eveslogchorr in the eastern part of the Khibiny Massif in the Kola Peninsula, USSR (Khomyakov *et al.*, 1983b).

Mont Saint-Hilaire is the second reported locality, and the first for well-formed crystals of the mineral. It occurs exceedingly rarely as 0.1–1.0 mm, transparent, colorless to very pale yellow, pseudohexagonal plates with vitreous luster forming stacked, rosette-like aggregates in a pegmatite dike which was remarkable for the extraordinary abundance of gaidonnayite.

Other associated minerals include albite, siderite, microcline, analcime, rutile, calcite, natrolite and pyrite. The crystals are inconspicuous due to their small size and lack of color contrast, and can be easily overlooked. It has also been found as white to tan, 1–2 mm equant, opaque crystals with greasy to dull luster in sodalite xenoliths, associated with sodalite, aegirine, eudialyte, ussingite and serandite. The physical appearance and morphology of the paraumbite found in sodalite xenoliths is similar to lovozerite and terskite, and they may be pseudomorphs after lovozerite.

Parisite-(Ce) $Ca(Ce,La)_2(CO_3)_3F_2$

Parisite-(Ce) occurs as a very rare accessory mineral in some altered pegmatite veins, in miarolitic cavities and (extremely rarely) in breccia cavities. Two trigonal polytypes parisite-(Ce)-18T and parisite-(Ce)-72T, have been identified from Mont Saint-Hilaire (Cheang, 1977).

In the pegmatites and miarolitic cavities it has been found as microscopic flakes and rosettes to 1 mm in size, commonly as a replacement mineral and usually intimately associated with bastnäsite-(Ce). In the breccia cavities, parisite-(Ce) was found in a syntactic intergrowth with synchysite-(Ce) to form multilayered, hexagonal, tabular crystals 1–4 mm size. The color is white, beige or very pale pink and the luster is dull.

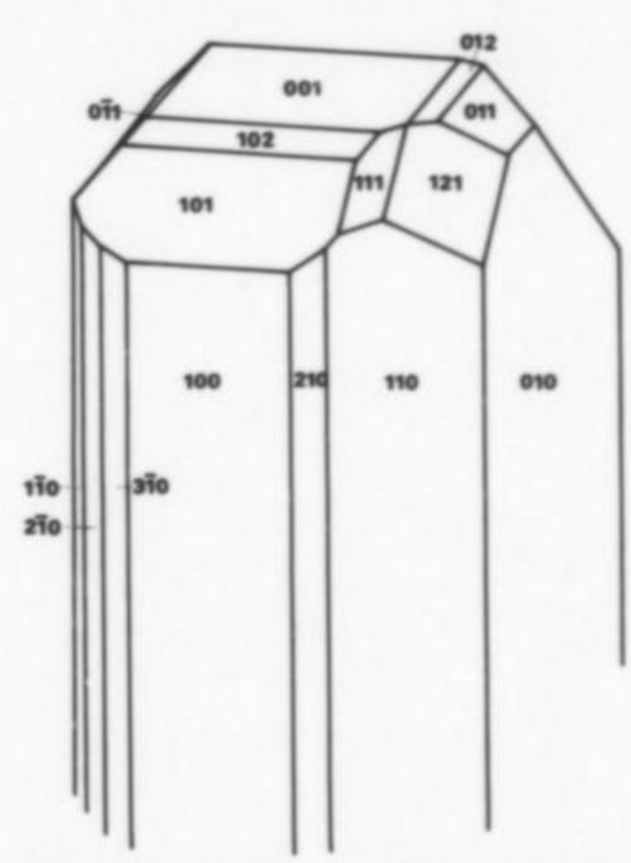


Figure 101. **Pectolite, composite crystal drawing of three crystals measured on a reflecting goniometer and drawn from a gnomonic projection.**

Pectolite $NaCa_2Si_3O_8(OH)$

Pectolite is the most common mineral in the marble xenoliths, forming spherical to lens-shaped nodules of radiating fibrous aggregates. The core of the nodules is frequently an open cavity containing well-formed crystals of pectolite and associated minerals. It is also found as a relatively common mineral in sodalite syenite, breccia and sodalite xenoliths. Some of the very finest crystallized specimens (unsurpassed in quality and size) of pectolite have been found at Mont Saint-Hilaire.

The crystals are most commonly elongated, some with complex terminations (often doubly terminated), with other habits ranging from

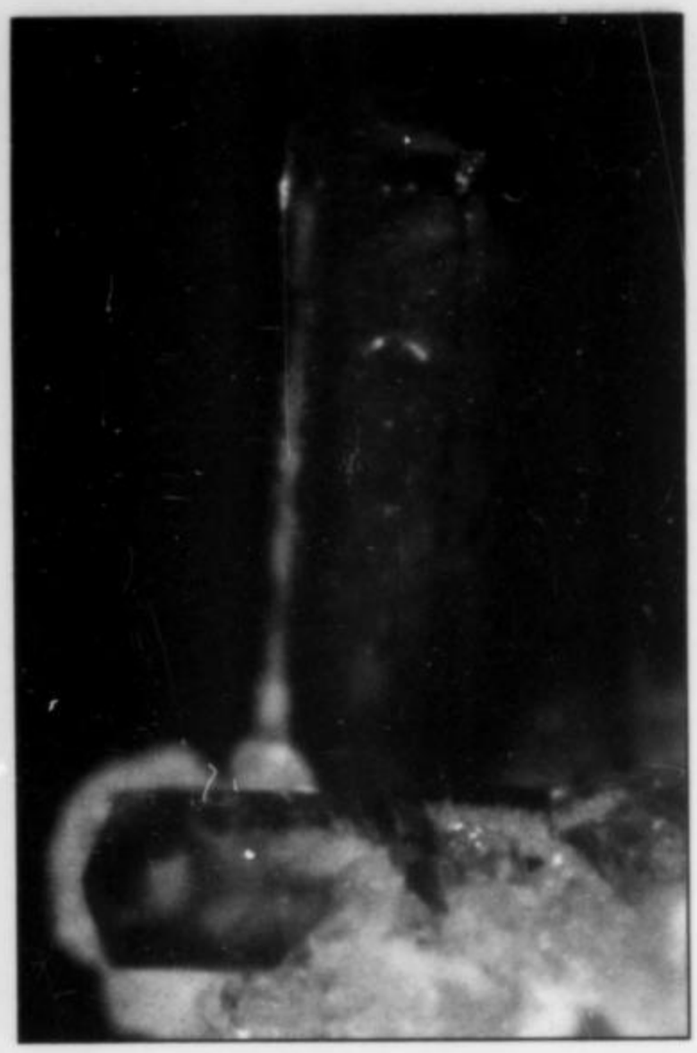


Figure 102. **Nenadkevichite, a prismatic crystal 3 mm in length. Horváth collection and photo.**

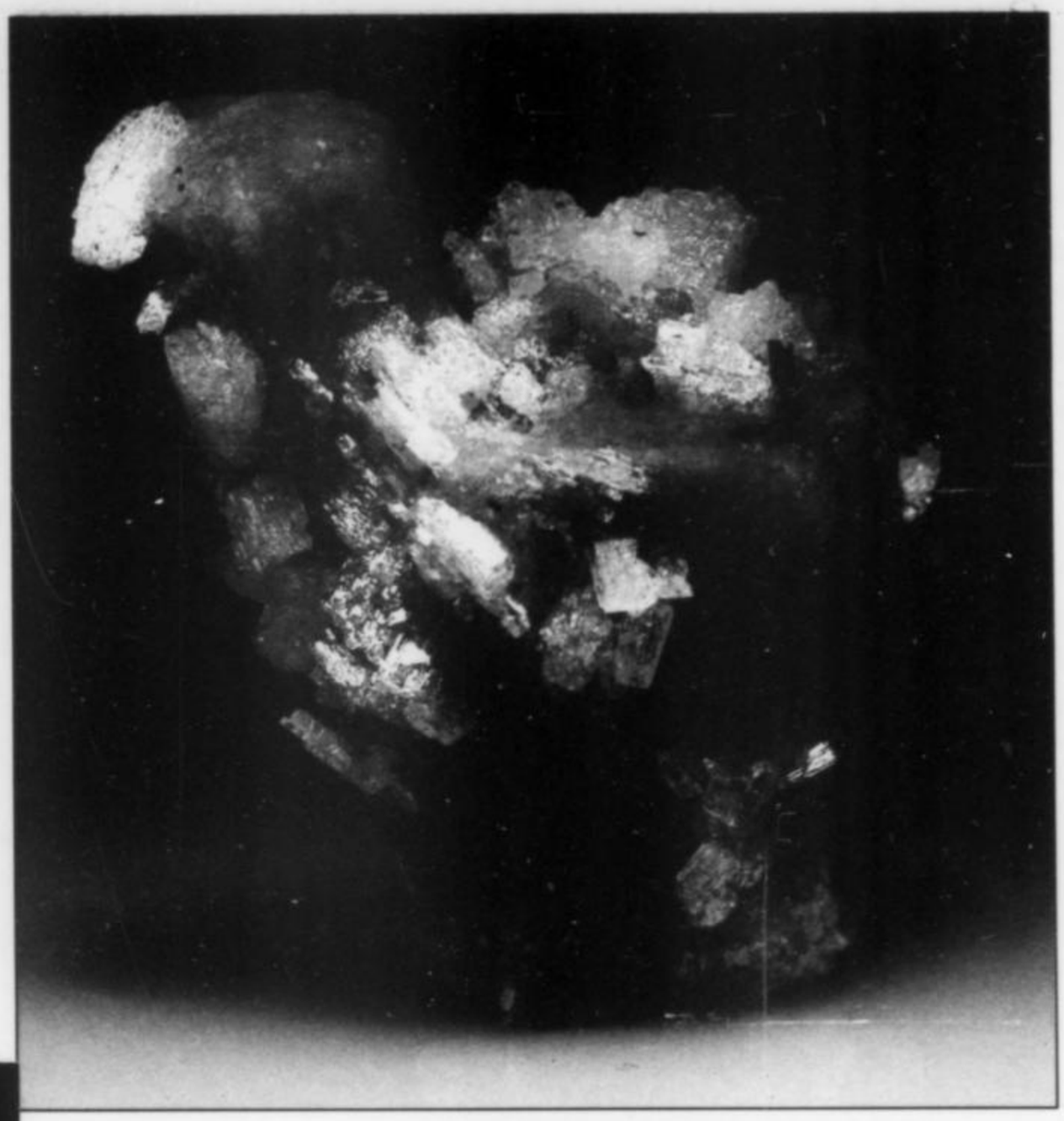


Figure 103. **Nepheline crystal 4 cm in height, associated with pectolite. G. Haineault collection. Photo by G. Robinson.**

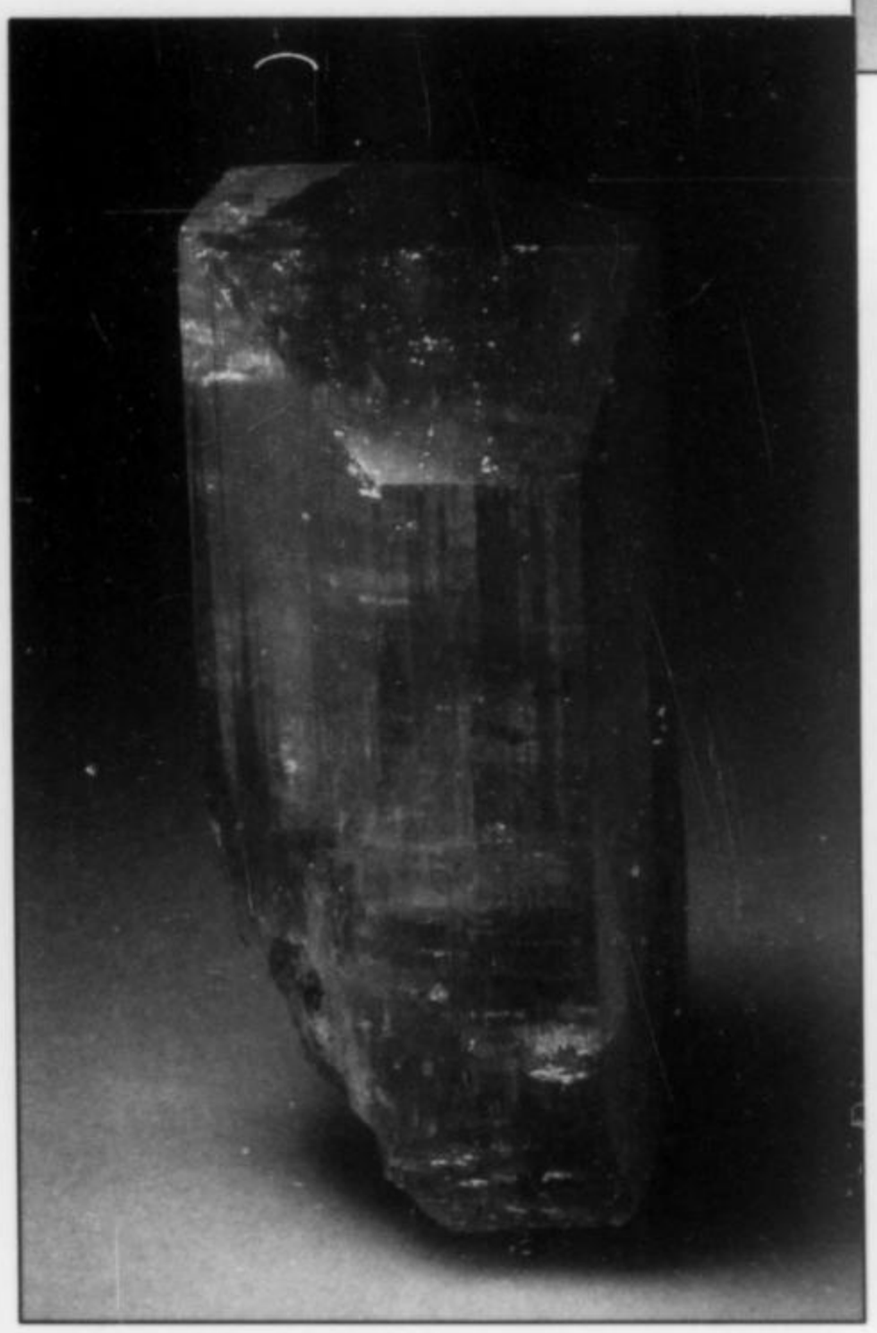


Figure 104. **Pectolite, a very large crystal 4.5 cm in height, collected in the fall of 1989. G. Haineault collection. Photo by G. Robinson.**

Figure 105. **Pectolite, a well-formed crystal 1 cm in length in a cavity in a marble xenolite. Horváth collection. Photo by G. Robinson.**

fibrous to acicular to stout, almost equant. The elongated crystals are transparent to translucent, frequently with frosted terminal faces, mostly colorless to pale gray; less frequently they are opaque white or pale blue-green due to a very large number of amphibole inclusions. The acicular and fibrous varieties are white to gray, and are found most commonly embedded in marble and to a lesser extent in sodalite syenite and breccia cavities. Crystals range in size from less than 1 mm to 5 cm in length, and are found lining the walls of the marble xenolith cavities. Studies on the reflecting goniometer have shown a very large number of forms, which are illustrated in the composite crystal drawing (Fig. 101). As the earliest mineral in these cavities, pectolite forms the substrate for a very interesting and very wide range of mineral species.

Electron microprobe analysis indicates Mont Saint-Hilaire pectolite to be very pure, with only trace amounts of fluorine and manganese.

Serandite, the manganese end-member of the pectolite-schizolite-serandite series (Schaller, 1955) is also common in Mont Saint-Hilaire but occurs in different mineralogical environments.

Penkvilksite $Na_4Ti_2Si_8O_{22}\cdot 5H_2O$

Penkvilksite was originally described from a pegmatite in the Lovozero Massif, Kola Peninsula (Bussen *et al.*, 1974), where it occurs as small, white clotted masses.

At Mont Saint-Hilaire, the second reported locality for the species, it was found in 1975 in a small pegmatite vein, as a single, 1–1.5 mm diameter cluster of colorless to white tabular, prismatic crystals, and was tentatively designated as UK#41 (Chao and Baker, 1979). It is associated with microcline, aegirine, catapleiite, ancylite and nenadkevichite. Subsequently, it was also found in a marble xenolith cavity as 0.5–1 mm diameter, rosettes and spherical aggregates consisting of compact, lamellar clusters, on pectolite crystals and embedded in calcite. Here it is associated with pectolite, calcite, apophyllite, monteregianite, vesuvianite and tadzhikite. The aggregates are

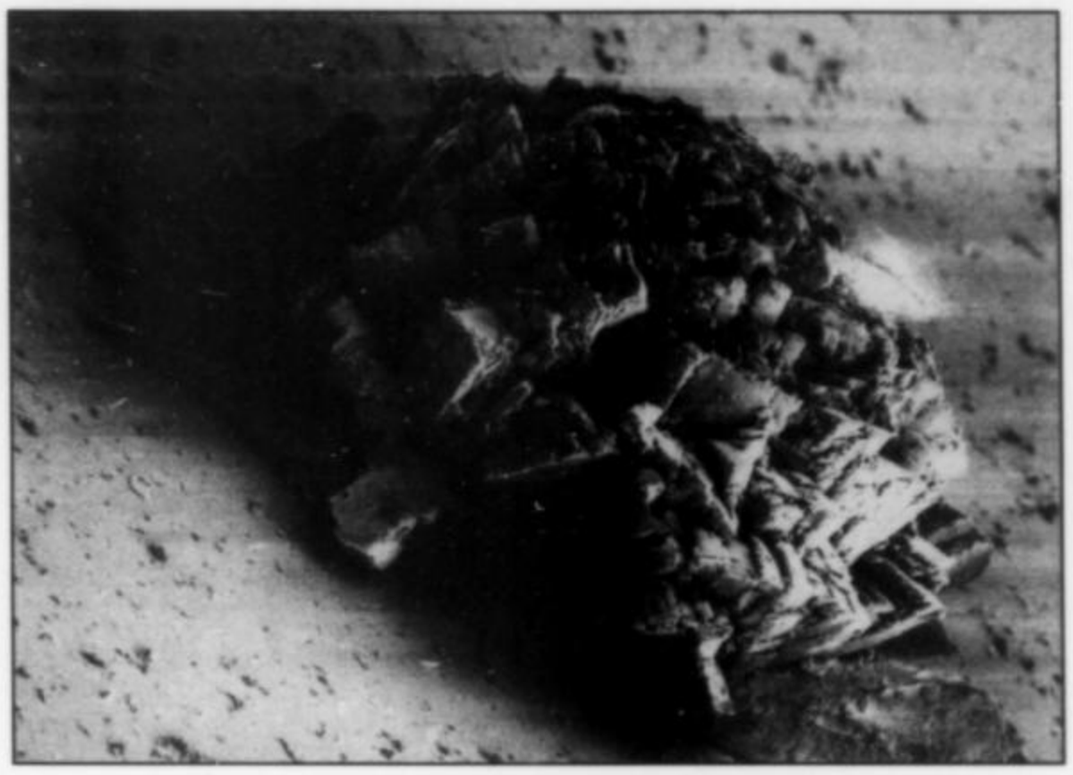


Figure 106. **Crystal group of penkvilksite. Group is 1 mm long. Horváth collection; SEM photo by E. Vadas.**

pale gray to white, having a frosty appearance and dull luster on the exterior, pale brown to brownish green with a greasy luster on the broken interior surfaces. In both associations, it is an exceedingly rare late-stage mineral in the paragenetic sequence.

Figure 107. **Perraultite, twinned crystals approximately 0.2 mm in length. Carleton University (Ottawa) specimen. SEM photo by L. Ling.**

Perraultite $Na_2KBaMn_8(Ti,Nb)_4Si_8O_{32}(OH,F)_7\cdot 7H_2O$

Perraultite (Chao, publication pending) is a new, monoclinic, silicate species from Mont Saint-Hilaire. The mineral name was approved by the International Mineralogical Association in 1988 and the perraultite description is presented here with the kind permission of G. Y. Chao. The type specimen and the small number of confirmed specimens were all collected from the same pegmatite in the mid 1960's. Prior to full characterization the mineral was tentatively designated as UK#17 (Chao *et al.*, 1967, and Chao and Baker, 1979). Perraultite is found as orange-brown, prismatic to tabular crystals to 1 mm, with wedge-shaped terminations. The crystals are transparent to translucent, with a vitreous luster. It is extremely rare occurring in a pegmatite associated with microcline, aegirine, albite, astrophyllite, analcime, rhodochrosite, catapleiite, natrolite, tetranatrolite, ancylite and pyrochlore. It is very inconspicuous in the complex association of the pegmatites and may easily be overlooked or mistaken for other minerals of similar color and morphology, especially rhodochrosite.

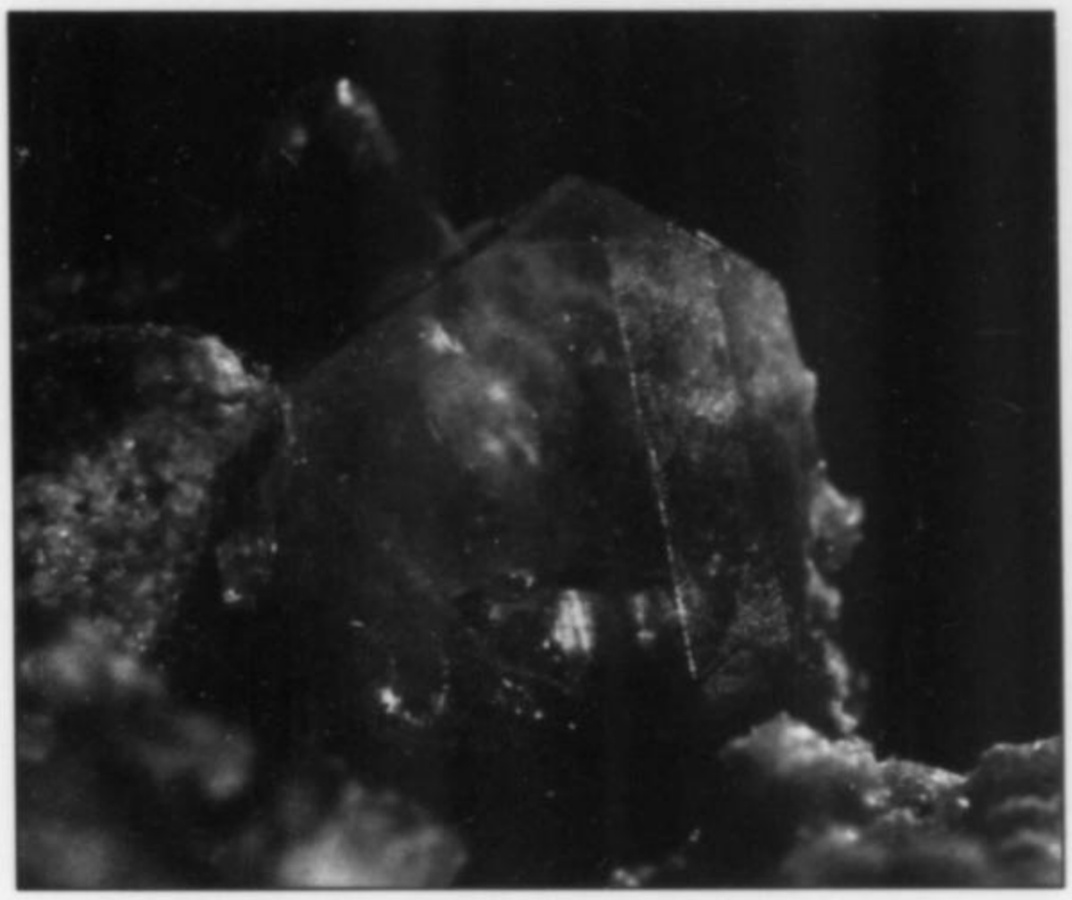


Figure 108. **Petarasite crystal 6 mm across. Horváth collection and photo.**

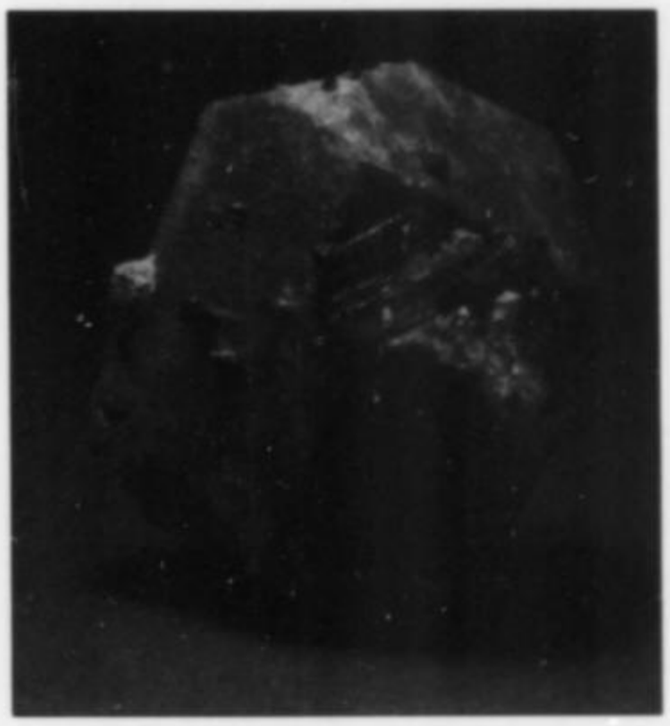


Figure 109. **Petarasite, a very large crystal 6.5 cm in height with a thin catapleiite overgrowth. National Museum of Natural Sciences (Canada) specimen #51766. Photo by G. Robinson.**

Petarasite $Na_5Zr_2Si_6O_{18}(Cl,OH)\cdot 2H_2O$

Petarasite, a new, monoclinic member of the lovozerite group of minerals, was described from Mont Saint-Hilaire (Chao *et al.*, 1980, and Ghose *et al.*, 1980). Mont Saint-Hilaire remains the only known locality for the species. It has been found in a biotite-rich xenolith in nepheline syenite in the Demix quarry, as irregular grains filling the interstices of biotite crystals (UK#42, Chao and Baker, 1979), as

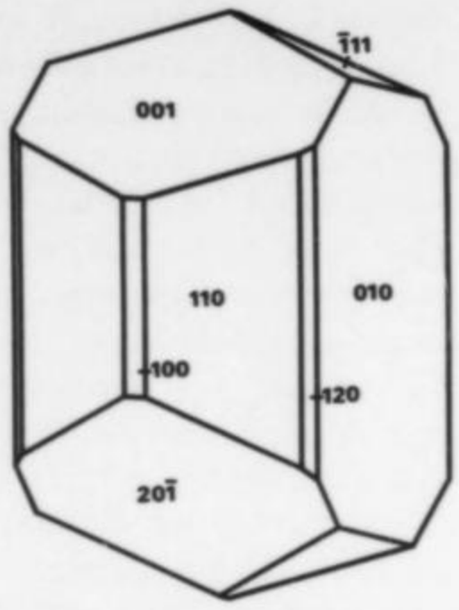


Figure 110. **Petarasite crystal drawing modified after Perrault *et al.* (1981).**

crude to well-formed prisms embedded in microcline, and rarely as superb, short to elongated prismatic crystals (Perrault *et al.*, 1981) in cavities in a pegmatite dike cutting nepheline syenite, associated with microcline, albite, biotite, aegirine, large quantities of naturally broken catapleiite crystals, arfvedsonite, rhodochrosite, ancylite, fluorite, large (6–10 cm long), crude sodalite crystals, analcime and pyrochlore. In addition to the more common elongated prisms, some crystals of equant, blocky and tabular habit have also been noted. Crude, brownish yellow, opaque petarasite pseudomorphs up to 2 cm across after an unknown precursor of octahedral morphology have also been found. The pseudomorphs are dull with granular structure. Crystals typically range from 5 mm to 5 cm in length, with one exceptional crystal reaching 6.5 cm. Many crystals are doubly terminated, most are opaque to translucent, rarely transparent, and with a vitreous to greasy luster. The large petarasite crystals are occasionally covered by a thin layer of pale gray, opaque catapleiite. The color is orange to orange-yellow, greenish yellow and brown. In an exceedingly rare occurrence it has also been found as rose to violet colored, transparent, 1–2 mm, wedge-shaped crystals in cavities in a sodalite xenolith associated with eudialyte, sodalite and aegirine. Petarasite has perfect {110}, very good {010} and good {001} cleavages.

Phillipsite $(K,Na,Ca)_{1-2}(Si,Al)_8O_{16}\cdot 6H_2O$

Phillipsite, a zeolite, occurs rarely as small (1–3 mm) colorless single prisms or clusters of cruciform twinned crystals in eudialyte-rich pegmatite veins and in sodalite xenoliths. Visual identification is not reliable due to the identical appearance of the more common harmotome.

Phlogopite $KMg_3Si_3AlO_{10}(F,OH)_2$

Phlogopite is much less common than the other mica group minerals, such as biotite, muscovite and polylithionite. It is found in well-formed pseudohexagonal crystals to 5 mm in diameter in marble xenoliths, and as small flakes embedded in sodalite syenite rock. The color is tan to gray and brown.

Polylithionite $KLi_2AlSi_4O_{10}(F,OH)_2$

Polylithionite, a rare mica group mineral, is relatively abundant at Mont Saint-Hilaire in the pegmatite pipes and veins, occurring as masses to several centimeters across and as superb pseudohexagonal crystals forming attractive rosettes to 4 cm across. Rarely it has also been found in cavities in the marble xenoliths.

Some of the crystals are tightly packed pseudohexagonal books, while others consist of a very large number of very thin and fairly loose lamellae. Polylithionite also forms masses of loose aggregates of randomly intergrown lamellae. Small crystals and thin plates are transparent while the larger crystals and masses are translucent to opaque. The crystals are typically colorless to silvery; in larger crystals the color may be pale brown to pale yellow-brown. The luster is pearly. It fluoresces bright lemon-yellow under shortwave ultraviolet radiation.

Taeniolite, another closely related mica-group species bearing a strong resemblance to polylithionite, is also found at Mont Saint-Hilaire but it is much rarer, non-fluorescent and the mode of occurrence and mineral association is different. (See the color photos on p. 332.)

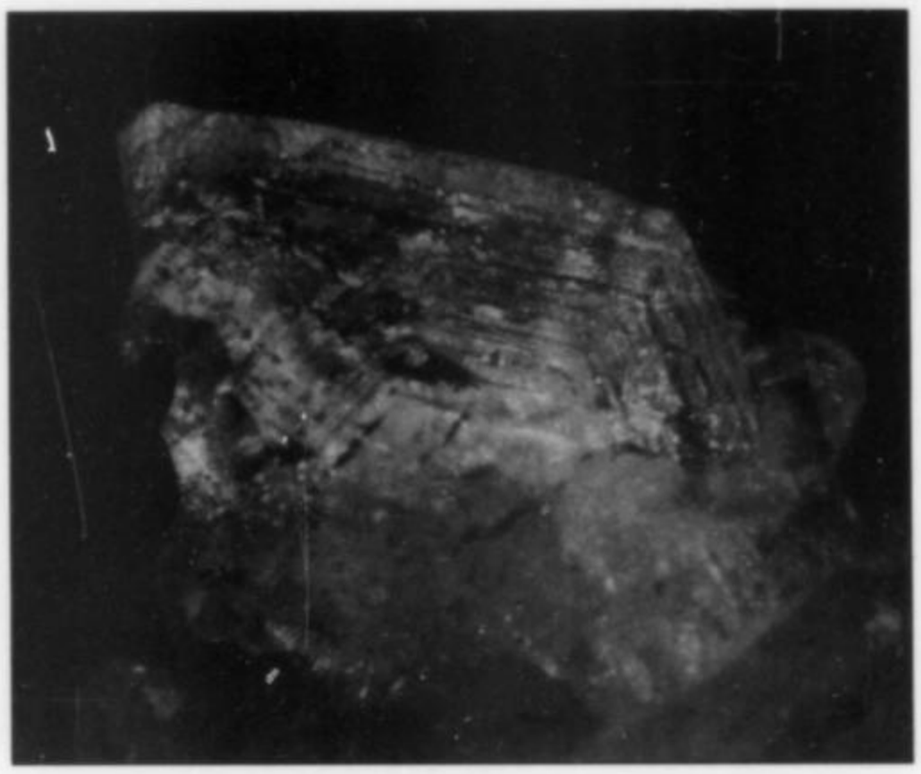


Figure 111. **Poudretteite, an etched, roughly hexagonal, transparent crystal 3 mm across. National Museum of Natural Sciences (Canada) specimen #51792. Photo by R. Gault.**

Poudretteite $KNa_2B_3Si_{12}O_{30}$

Poudretteite, a new member of the osumilite group, was described from Mont Saint-Hilaire (Grice *et al.*, 1987), which is currently the only known locality for the mineral.

Poudretteite occurs as colorless to very pale pink, transparent, roughly hexagonal and equant, deeply etched, barrel-shaped prisms to 5 mm in length. It is very similar in appearance to, and difficult to distinguish from, etched quartz and fluorapophyllite. It has a vitreous luster, white streak and does not fluoresce under ultraviolet radiation. It has no apparent cleavage, and has splintery to conchoidal fracture. Mohs hardness is about 5.

The mineral was found in cavities in marble xenoliths in nepheline syenite associated with pectolite, apophyllite and minor aegirine. It is exceedingly rare and, as of this writing, it has been confirmed in only a small number of specimens. The type specimen and most of the confirmed specimens were collected in the late 1960's and early 1970's in the Poudrette quarry.

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

Prehnite has been identified as compact radiating aggregates to 1 cm across, and as crude, blocky crystals to 0.5 mm across, in narrow calcite-filled fractures in a grossular-rich skarn between coarse-grained marble and hornfels. The color is white or tan to beige.

Pyrite FeS_2

Pyrite is by far the most abundant sulfide mineral, occurring in virtually all mineral associations. It is most abundant in the hornfels and altered pegmatites, as well-formed crystals of many habits and as masses intermixed with other sulfides.

The crystals are predominantly simple cubes ranging from 1 mm to 5 cm on an edge; pyritohedrons and other forms are less common. The crystals tend to be very small (1–2 mm) in size. Very rarely filiform pyrite 5–10 mm long has been found in mineralized fractures in the hornfels. (See the color photos on p. 332.)

Pyrochlore $(Ca,Na)_2Nb_2O_6(OH,F)$

Pyrochlore is relatively common in very small quantities in the

altered and unaltered pegmatites, and is extremely rare in sodalite xenoliths. It is found as sharp, 0.5–1 mm octahedra sprinkled on various minerals, most commonly aegirine, in the pegmatite cavities, and very rarely as small rosettes (possibly pseudomorphs) and as irregular grains and embedded granular masses to several centimeters across. The color is brown, reddish brown and orange-yellow. The luster is vitreous to greasy.

Pyrophanite $MnTiO_3$

Pyrophanite, the Mn end-member of the ilmenite-geikielite-pyrophanite series is a fairly common accessory mineral in miarolitic cavities, less frequent in pegmatites, rare in breccia cavities and extremely rare in sodalite xenoliths. It has been found as superb rosette-like aggregates to 2 cm in diameter, as individual thin hexagonal plates, and as complex blocky crystals. The color is very deep carmine-red in the thin, transparent to translucent plates and smaller rosettes, and black in the larger, opaque rosettes and blocky crystals. Pyrophanite is also found as orange-yellow grains and small, partially altered, foliated masses in altered pegmatites.

Ilmenite, the Fe end member of the ilmenite-geikielite-pyrophanite series has also been found at Mont Saint-Hilaire, and along with hematite bears a very close resemblance to pyrophanite. Geikielite has not been reported to date. (See the color photo on p. 333.)

Pyrrhotite $Fe_{1-x}S$

A fairly common sulfide in virtually all modes of occurrence, pyrrhotite-4C is found as sharp, tabular to short prismatic hexagonal crystals to 1.5 cm in diameter, and as masses intermixed with other sulfides.

Very large, crude, hexagonal pseudomorphs of pyrite after pyrrhotite have been found in the carbonate-rich pegmatites, associated with siderite and albite. Such pseudomorphs reach up to 15 x 12 cm in size.

Quartz SiO_2

Quartz is fairly common and widely disseminated in small quantities. It is most abundant in seams and fractures in the hornfels, less abundant in breccias and marble xenoliths, and rare in altered pegmatites.

Quartz has been found as colorless, 1–20 mm crystals in marble, as colorless to smoky, opaque crystals to 20 cm in length in hornfels, as translucent, 2–25 mm smoky crystals in breccia, and as smoky, dull, gray opaque crystals to 15 cm in length in altered pegmatites. In the marble xenoliths some small Dauphiné twins have been observed. Very rarely small Japan-law twins, and very unusual $(01\bar{1}3)$ rhombohedrons (Rykart, 1989) have also been encountered. Scepters are very common.

Some of the large smoky crystals found in the pegmatites are cavernous, skeletal, etched and deformed; some are concentrically color-zoned (alternating colorless to smoky zones) and some have fluorescent zones (bright yellow under both shortwave and longwave ultraviolet radiation; the cause of the fluorescence has not been investigated).

Raite $Na_4Mn_3Si_8(O,OH)_{24}\cdot 9H_2O$

Raite was originally described from pegmatites in the Lovozero Massif, Kola Peninsula, USSR (Mer'kov *et al.*, 1973). Mont Saint-Hilaire is the second reported locality (Chao and Baker, 1979) where it occurs as an exceedingly rare mineral in the pegmatites, usually closely associated with rhodochrosite, serandite, nenadkevichite, natrolite, aegirine and others. It has also been found in sodalite xenoliths, associated with villiaumite, sodalite, eudialyte, serandite, ussingite, lueshite, steenstrupine, vuonnemite and lovozerite. It occurs as radiating, short, extremely thin fibers forming spherical aggregates 1–2 mm in diameter. The color is reddish brown, red, reddish violet and brown.

Rasvumite KFe_2S_3

Rasvumite was first described from the Khibiny Massif in the Kola Peninsula (Sokolova *et al.*, 1970). At Mont Saint-Hilaire it is exceedingly rare, occurring in small cavities in the sodalite xenoliths as dark brown to black, massive, dull to vitreous crusts coating the other minerals in the cavities. The crusts are peculiarly cracked, similar in appearance to a crackled ceramic glaze. It is associated with ussingite, villiaumite, sodalite and sidorenkite.

Revdite $Na_2Si_2O_5\cdot 5H_2O$

Revdite was described from Mt. Karnasurt, Lovozero Massif, Kola Peninsula (Khomyakov *et al.*, 1980). Mont Saint-Hilaire is the second locality for the species and the first reported occurrence of the mineral as excellent crystals.

Revdite is found very rarely in cavities and fractures in some sodalite xenoliths as small, spherical, white fibrous masses covered by aggregates of random acicular crystals. The crystals are 1–2 mm long, colorless with sharply pointed terminations. The crystal faces are longitudinally striated giving the crystals a fibrous silky luster somewhat similar to dawsonite or leifite. It is associated with sodalite, ussingite, villiaumite, kogarkoite, lovozerite, eudialyte and aegirine.

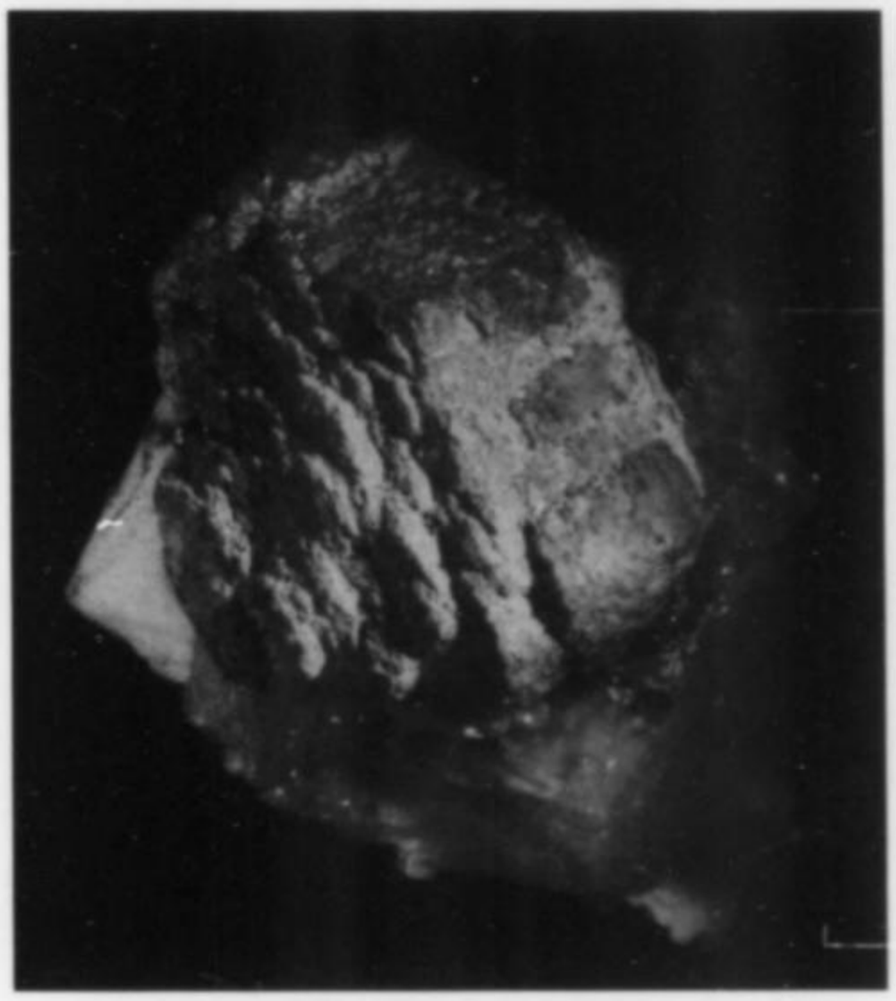


Figure 112. **Rhabdophane-(Ce), hexagonal crystal measuring 1.5 cm across. National Museum of Natural Sciences (Canada) specimen #49265. Photo by R. Gault.**

Rhabdophane-(Ce) $(Ce,La)PO_4\cdot H_2O$

Rhabdophane-(Ce) is a rare, late-stage mineral in the pegmatites and altered pegmatites. It is found as pale yellow-brown, tan, beige and brown, short to elongate hexagonal prisms to 6 mm in length, and as botryoidal aggregates and interstitial fillings in the pegmatites. The terminations are generally poorly formed, rounded and very often color-zoned, giving some crystals a peculiar matchstick appearance. The crystals are very often hollow, some appear to be pseudomorphs after an undetermined mineral. One pegmatite pipe that produced some very fine serandite crystals also produced a number of fresh, sharp, tan-colored crystals, including an exceptional group of hexagonal crystals in parallel growth, 1.5 cm across. All rhabdophane crystals observed have been opaque, with a dull to greasy luster.

Figure 113. **Polylithionite crystal group with aegirine. The specimen is 3 cm across. G. Haineault collection. Photo by G. Robinson.**

Figure 114. **Polylithionite rosettes on a pseudomorph of rhodochrosite after serandite. The overall specimen is 6.5 cm in height. Horváth collection. Photo by G. Robinson.**

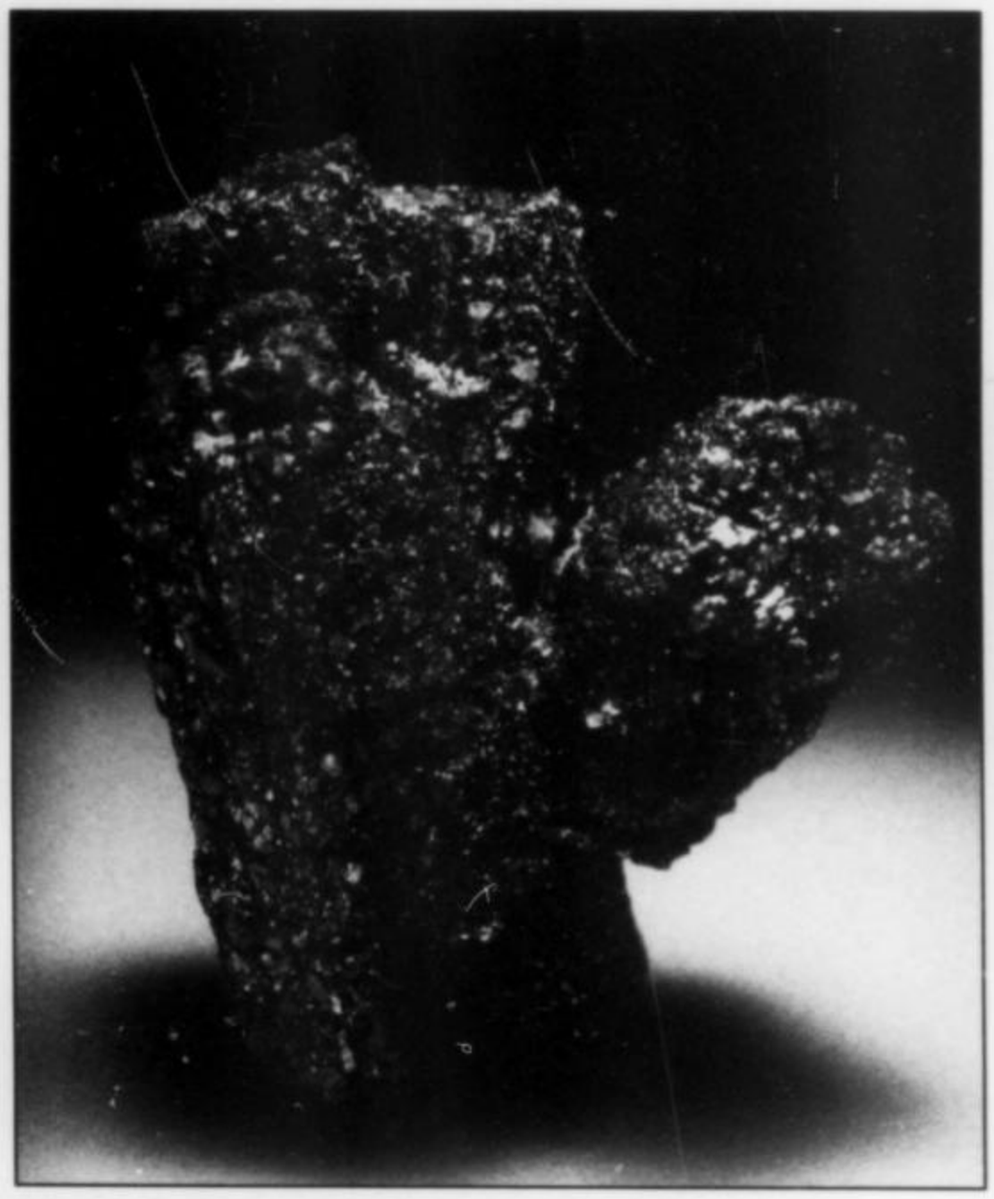


Figure 115. **Pyrite pseudomorph after pyrrhotite measuring 6 cm in height. G. Haineault collection. Photo by G. Robinson.**

Figure 116. **Pyrite, a group of cubic crystals 4.5 cm across. G. Haineault collection. Photo by G. Robinson.**

Rhodochrosite $MnCO_3$

Rhodochrosite is a common late stage mineral of the pegmatites and altered pegmatites. It is found in a wide variety of habits and colors and is much sought after by collectors. Many excellent specimens of the mineral have been collected over the years, some with crystals as large as 10 cm across; however, the very large crystals are generally lacking attractive coloration and transparency.

Rhodochrosite occurs most commonly as simple rhombohedra, and as aggregates of curved rhombohedra forming druses, balls and rosettes. Less frequently it is found as thin, twinned, triangular plates, scalenohedra, thin hexagonal plates and botryoidal aggregates. Rhodochrosite is also found as pseudomorphs after serandite to 20 cm across and as pseudomorphs after other minerals.

The best specimens were collected in the period of 1970 to 1981 in the Demix quarry, including some very attractive, deep red, translucent, flattened and twinned triangular plates to 6 cm across. Since 1984, some very large but rather unattractive crystals have also been collected in the Poudrette quarry.

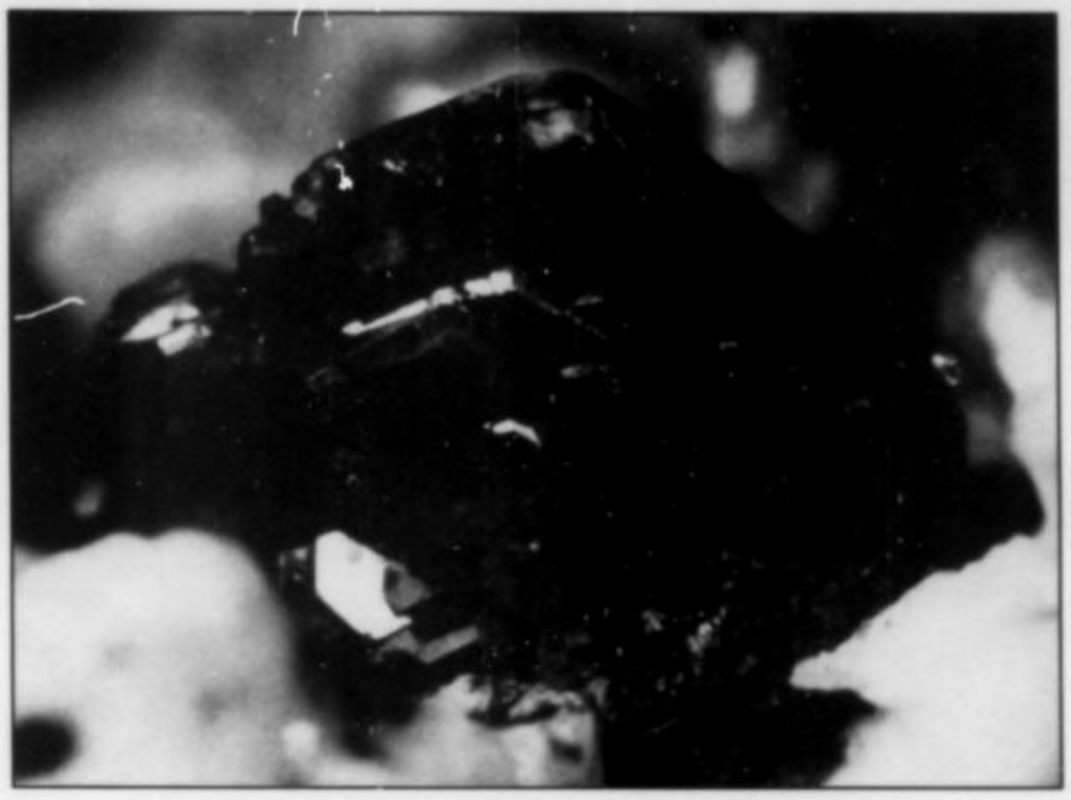


Figure 117. **Pyrophanite rosette 1 cm in diameter. Horváth collection and photo.**

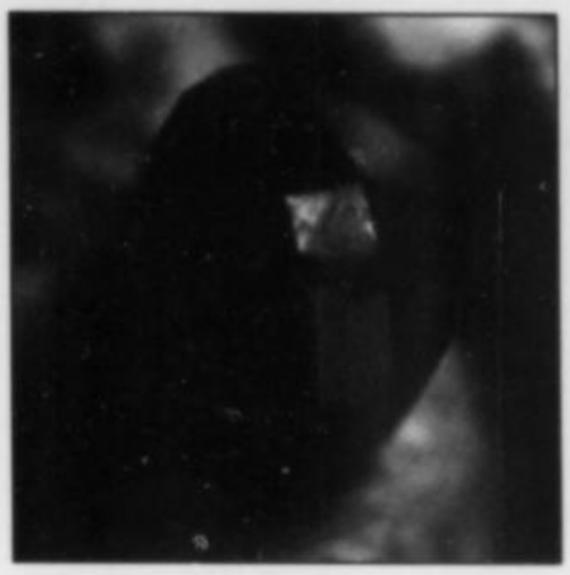


Figure 118. **Rutile crystal 3 mm across. Horváth collection and photo.**

been observed. The crystals bear some resemblance to elpidite in physical appearance. They are translucent to opaque and the luster is vitreous.

Rutile TiO_2

Rutile, a member of the rutile group, is a relatively common accessory mineral in hornfels, altered pegmatites and sodalite syenite.

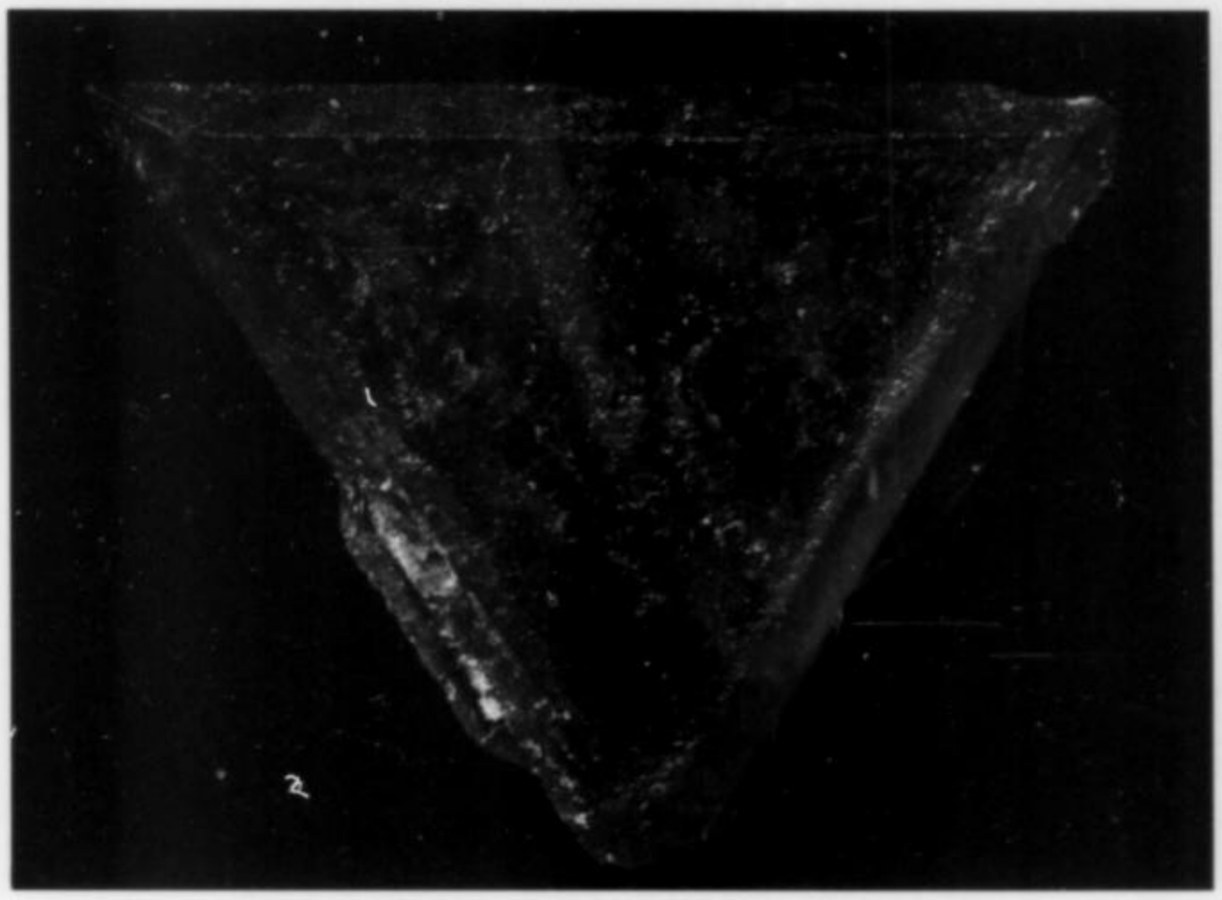


Figure 119. **Rhodochrosite crystal, 6.5 mm, from the Demix quarry. Dan Behnke collection and photo.**

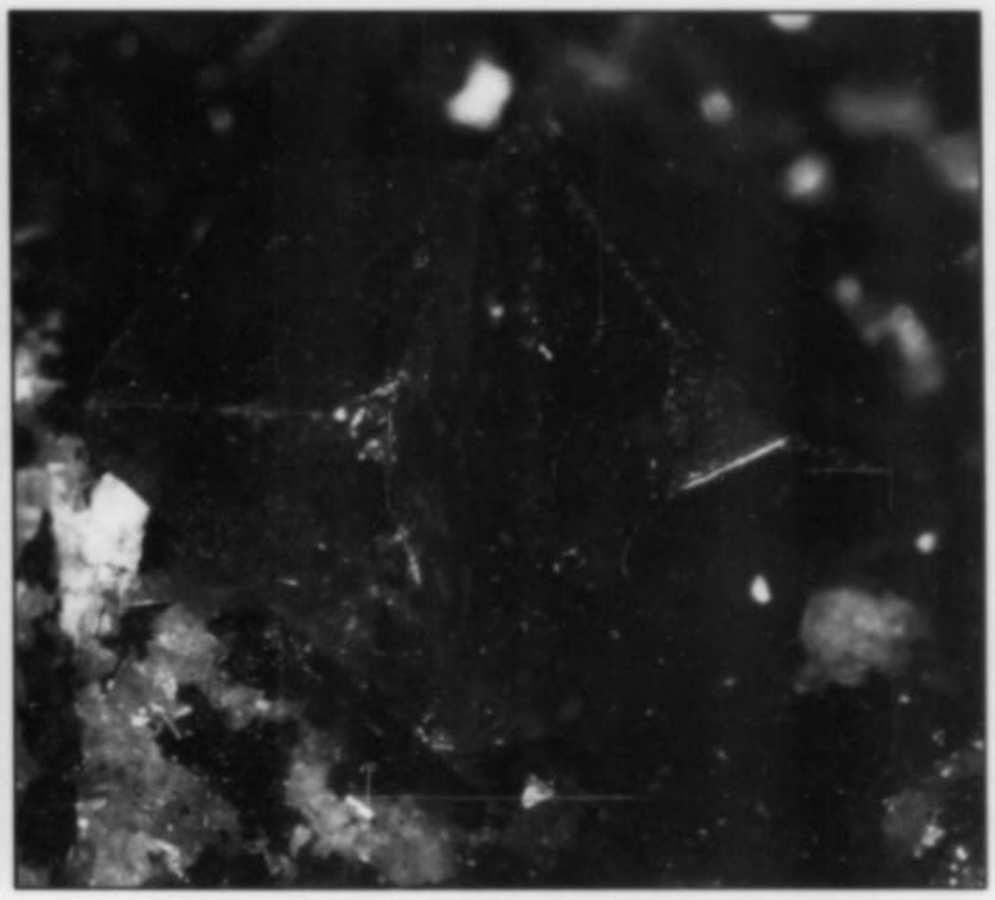


Figure 120. **Rhodochrosite in twinned rhombohedra to 7 mm across. National Museum of Natural Sciences (Canada) specimen #36586. Photo by J. Schekkerman.**

Color varies from very pale pink, pale to deep red, orange-red, brownish red, orange-brown, pale to dark brown and black. The dark brown and black color is due to partial alteration to birnessite. Small crystals are transparent to translucent while the larger crystals, with few exceptions, are opaque, with luster varying from vitreous to greasy to dull.

Richterite $Na_2Ca(Mg,Fe^{+2})_5Si_8O_{22}(OH)_2$

Richterite, a member of the amphibole group, has been found in breccia cavities as pale green, transparent prisms to 2 mm in length.

Riebeckite $Na_2(Fe^{+2},Mg)_3Fe_2^{+3}Si_8O_{22}(OH)_2$

Riebeckite, an amphibole group mineral, occurs in seams and fractures in hornfels and in cavities in the marble xenoliths as matted or radiating, bluish green, grayish blue or grayish green fibers to 5 cm in length. The fibers are flexible and have a silky luster.

Rosenbuschite $(Ca,Na)_3(Zr,Ti)Si_2O_8F$

Rosenbuschite is an exceedingly rare accessory mineral in miarolitic cavities in nepheline syenite. It is found as pale yellow to beige, 1–3 mm, acicular crystals forming divergent sprays on analcime lining the cavities. Other associated minerals are: natrolite, paranatrolite, calcite, wöhlerite, zircon and aegirine. No distinct terminations have been observed. The crystals bear some resemblance to elpidite in physical appearance. They are translucent to opaque and the luster is vitreous.

Rarely it has also been found in breccia and miarolitic cavities.

It occurs as splendid, sharp, blocky or short prismatic crystals to 6 mm across; as 1–2 mm, equant, curved crystals; as elongate prisms to 1.2 cm in length; and as oriented, acicular crystals forming reticulated aggregates. Twinned crystals are relatively common.

The color is most commonly black (often with a bluish iridescent coating), very rarely red or brown. The crystals are opaque except for the deep red prisms, some of which are translucent. The luster is adamantine to submetallic.

Sabinaite $Na_4Zr_2TiO_4(CO_3)_4$

Sabinaite was originally described from the nearby Francon quarry in Montréal (Jambor *et al.*, 1980); Mont Saint-Hilaire is the only other known locality for the species, and the first occurrence of the mineral as well-formed crystals (Chao and Gu, 1985).

Sabinaite is very rare, occurring as sharp, colorless, tabular crystals to 1.5 mm across in small cavities in sodalite syenite. It has also been found in a very heavily altered pegmatitic vein in nepheline syenite as sharp, colorless to pale yellow and pale gray, translucent to opaque, 2–6 mm tabular crystals and stacked micaceous plates.

Figure 121. **Sabinaite, a group of tabular crystals 2 mm across. Horváth collection. SEM photo by E. Vadas.**

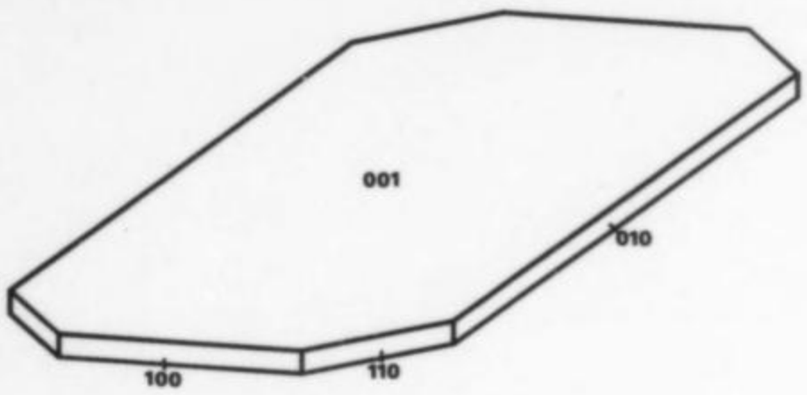


Figure 122. **Sabinaite crystal drawing of a platy crystal, drawn using the cell parameters and symmetry elements reported by Chao *et al.* (1985).**

The crystals are generally intergrown in complex groups and some twinning is evident. The most prominent form is the {001} pinacoid. Other forms present are the {010} pinacoid, and {100} and {110} prisms (Chao and Jiexiang, 1985). Sabinaite has perfect basal cleavage, and its luster is vitreous to pearly.

Sanidine K-Na feldspar with disordered Al-Si arrangement

Sanidine occurs as sharp, blocky, wedge-shaped crystals to 0.5 mm in cavities in marble xenoliths. The crystals are white, colorless or pale pink and very transparent.

Sazhinite-(Ce) $Na_2CeSi_6O_{14}(OH)\cdot nH_2O$ (n ca. 5)

Sazhinite-(Ce) was originally described from a pegmatite at Mt. Karnasurt, Lovozero Massif, Kola Peninsula (Es'kova *et al.*, 1974), where it occurs as small tabular crystals and as irregular grains, associated with natrolite, neptunite and steenstrupine.

At Mont Saint-Hilaire, the only other known locality, it was first found in the fall of 1989, in cavities in sodalite xenoliths as well-formed, sharp crystals, associated with vuonnemite, serandite, ussingite, sodalite, aegirine, sphalerite, eudialyte, halite, an unidentified sodium sulfate mineral, UK#81 (Chao *et al.*, 1990) and an unidentified silicate UK#38 (Chao and Baker, 1979, and Chao *et al.*, 1990). The crystals are white to pale yellowish gray, opaque, thick, tabular prisms with a vitreous to pearly luster. There are numerous very fine striations across the length of the prism. Crystal sections up to 1.7 cm in length by 1 cm in width by 6 mm in thickness were found. One perfect and one very good cleavage was noted. Electron probe microanalyses have shown lanthanum-dominant zones in the sazhinite-(Ce) crystals. Sazhinite-(Ce) bears a very marked morphological resemblance to epistolite, also occurring in the sodalite xenoliths, but the surface features

Figure 123. **Two large sazhinite-(Ce) crystals, 1.5 cm in length. Associated species in the field of view are serandite (orange), vuonnemite (pale green) and ussingite (pale violet). National Museum of Natural Sciences (Canada) specimen #54525. Photo by G. Robinson.**

(fine striations), color and luster are different. The mineral is exceedingly rare and only a few specimens are known.

Scheelite $CaWO_4$

Scheelite has been identified on a single specimen from a miarolitic cavity in nepheline syenite (Chao and Baker, 1979). It occurs as colorless, 1–2 mm, irregular grains which fluoresce strong whitish blue under shortwave ultraviolet radiation.

Searlesite $NaBSi_2O_5(OH)_2$

Searlesite was found in the fall of 1989 in small cavities in sodalite xenoliths. It occurs as sharp, tabular and prismatic crystals averaging 3 x 1 x 0.1 mm, striated along the length of the prisms. The crystals are colorless and transparent with a vitreous to slightly waxy luster. They fluoresce green with a bluish tint under shortwave ultraviolet radiation. Associated minerals are sodalite, natrolite and aegirine with minor steenstrupine-(Ce) and eudialyte. The occurrence is extremely rare.

Figure 124. **Senaite, a complex group of trilling twins. The group is approximately 1.5 mm across. National Museum of Natural Sciences (Canada) specimen #52280. SEM photo by E. Vadas.**

Senaite $Pb(Ti,Fe,Mn)_{21}O_{38}$

Senaite, a member of the crichtonite group (Grey *et al.*, 1976), has been found in a pegmatite vein as sharp, black, equant crystals 0.5–

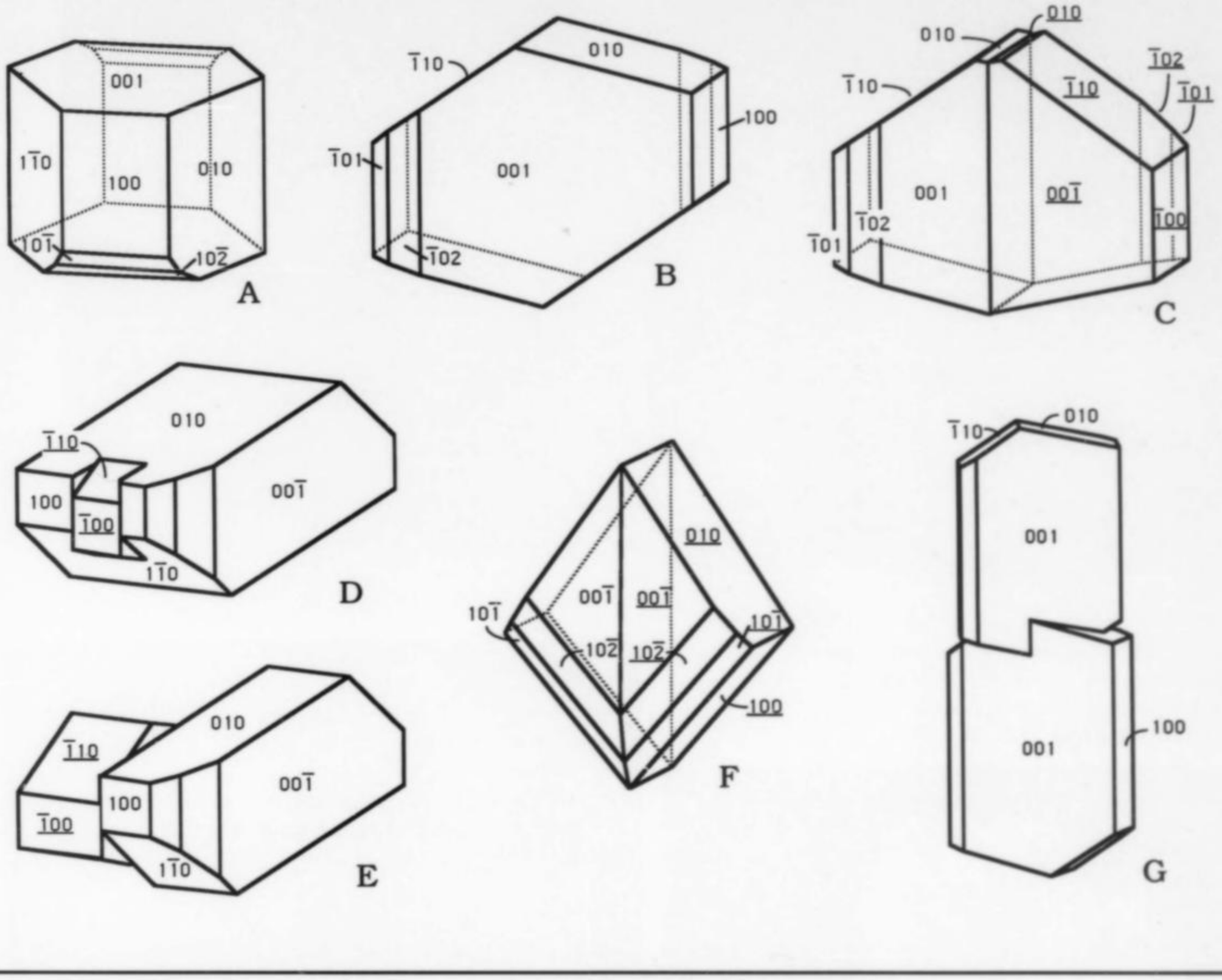


Figure 125. **Twinned and untwinned serandite crystals. One twin member is indicated by underscored Miller indices. A-E: Microcrystals of serandite from the pipe opened in May 1988. A: An untwinned blocky serandite of typical habit, drawn in normal crystallographic orientation. B: The same crystal, rotated into an orientation to permit easier comparison with the twins. C: A similar crystal twinned by a rotation of 180° about the b crystallographic axis, which is vertical in this drawing. The composition plane is (100). This was the most common twin among those in the pipe. D: A "penetration" twin by rotation of 180° about the b axis. The surface expression of the twinned portion is limited to the "tab" at one end of the main crystal, which shows surface traces of apparent contact planes (100) and (001). Crystals with sections twinned in this manner were common, but are easy to overlook. E: A hypothetical twin by rotation about the *b* axis, with composition plane (001). While twins with only (001) composition planes have not been observed, on some twins (001) is a much more important composition plane than (100). F: A contact twin by reflection across (110), with (110) as the composition plane. Twins of this sort were found among larger crystals from a pipe opened in 1973. G. Two crystals with parallel *b* axes, the upper one rotated with respect to the lower. Such associations are common, but the angle of rotation differs from example to example. These are not twins; they are the results of imperfect parallel growth.**

1 mm across, forming cyclic twins (trillings). The mineral is exceedingly rare. The luster is submetallic to adamantine.

Sepiolite $Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$

Sepiolite occurs as very pale green to white fibrous aggregates in marble xenoliths. The individual fibers are 2–5 mm long and have a silky luster.

Serandite $Na(Mn^{+2},Ca)_2Si_3O_8(OH)$

Above all the other species, serandite is the preeminent mineral for which Mont Saint-Hilaire has become famous. It was previously known only as cleavage fragments from the island of Rouma, Los Archipelago, Guinea (Lacroix, 1931); more recently it has been found as microcrystals at several lesser-known localities. Serandite is the Mn end-member of the isostructural pectolite-schizolite-serandite series (Schaller, 1955), and the Mont Saint-Hilaire serandite is very

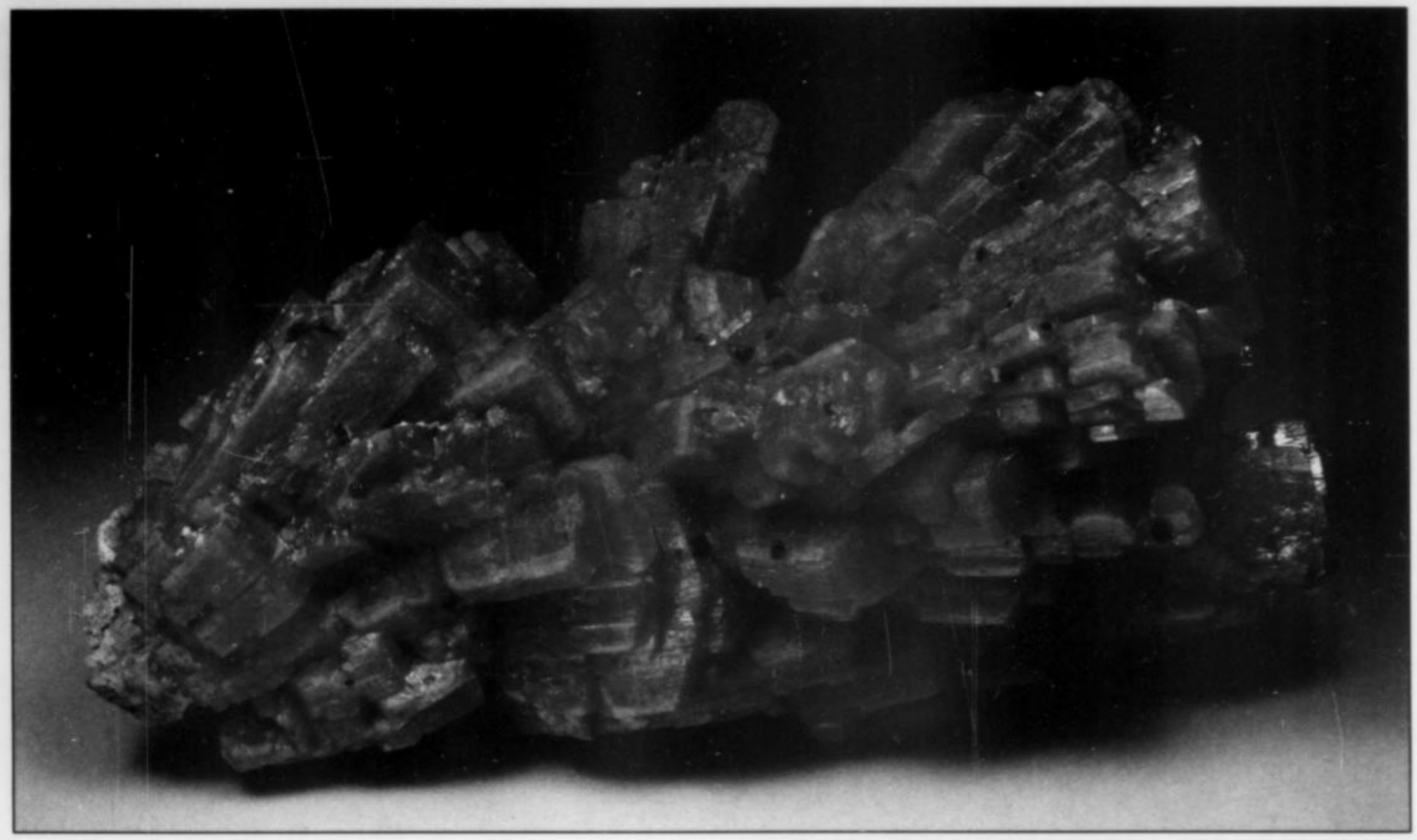


Figure 126. **Serandite group of lustrous, pink crystals collected in the spring of 1988. The specimen measures 17 cm in length. G. Haineault collection. Photo by G. Robinson.**

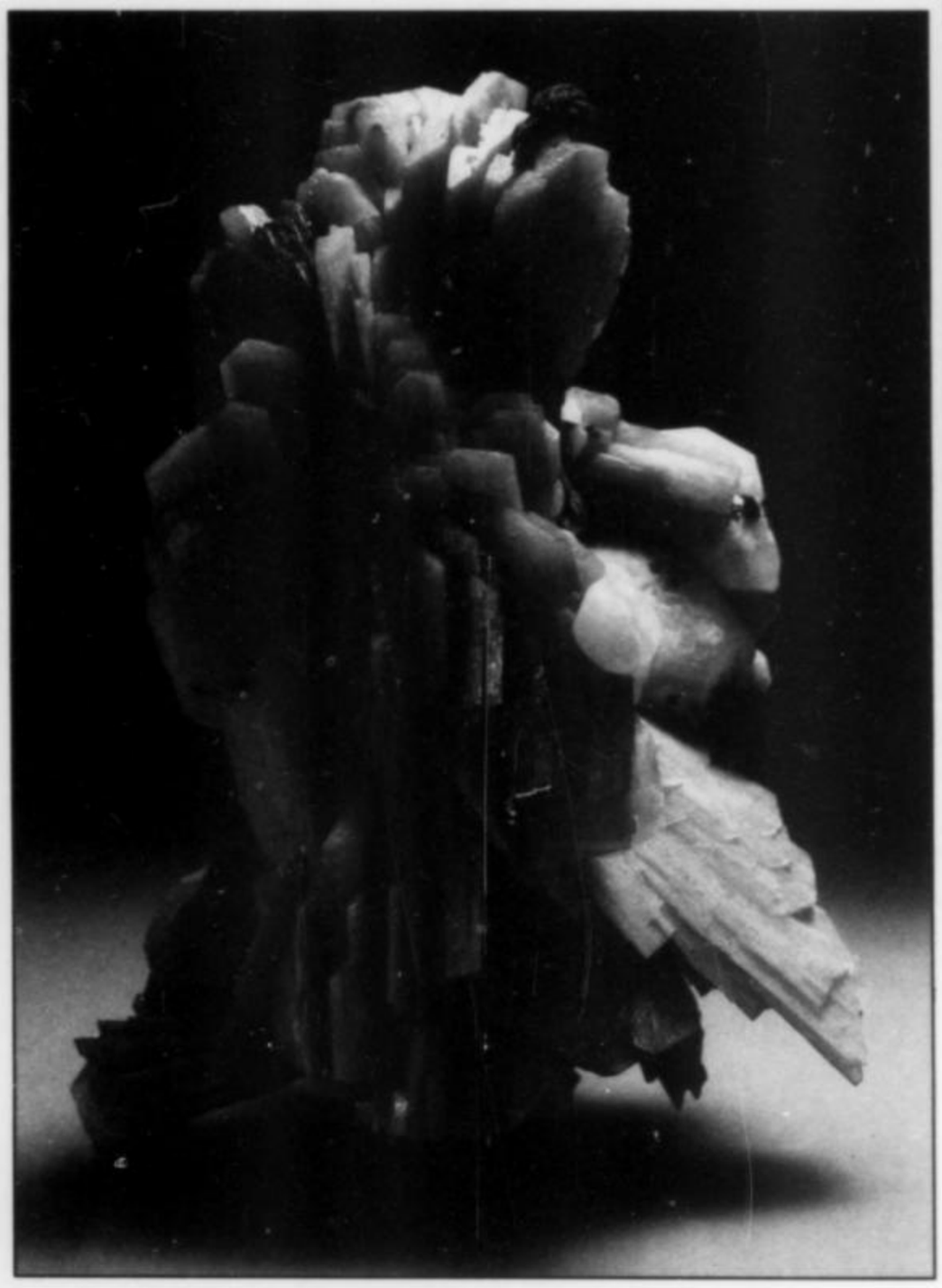


Figure 127. **Serandite group of pink, bladed crystals measuring 11 cm in height. National Museum of Natural Sciences (Canada) specimen #46263. Photo by G. Robinson.**

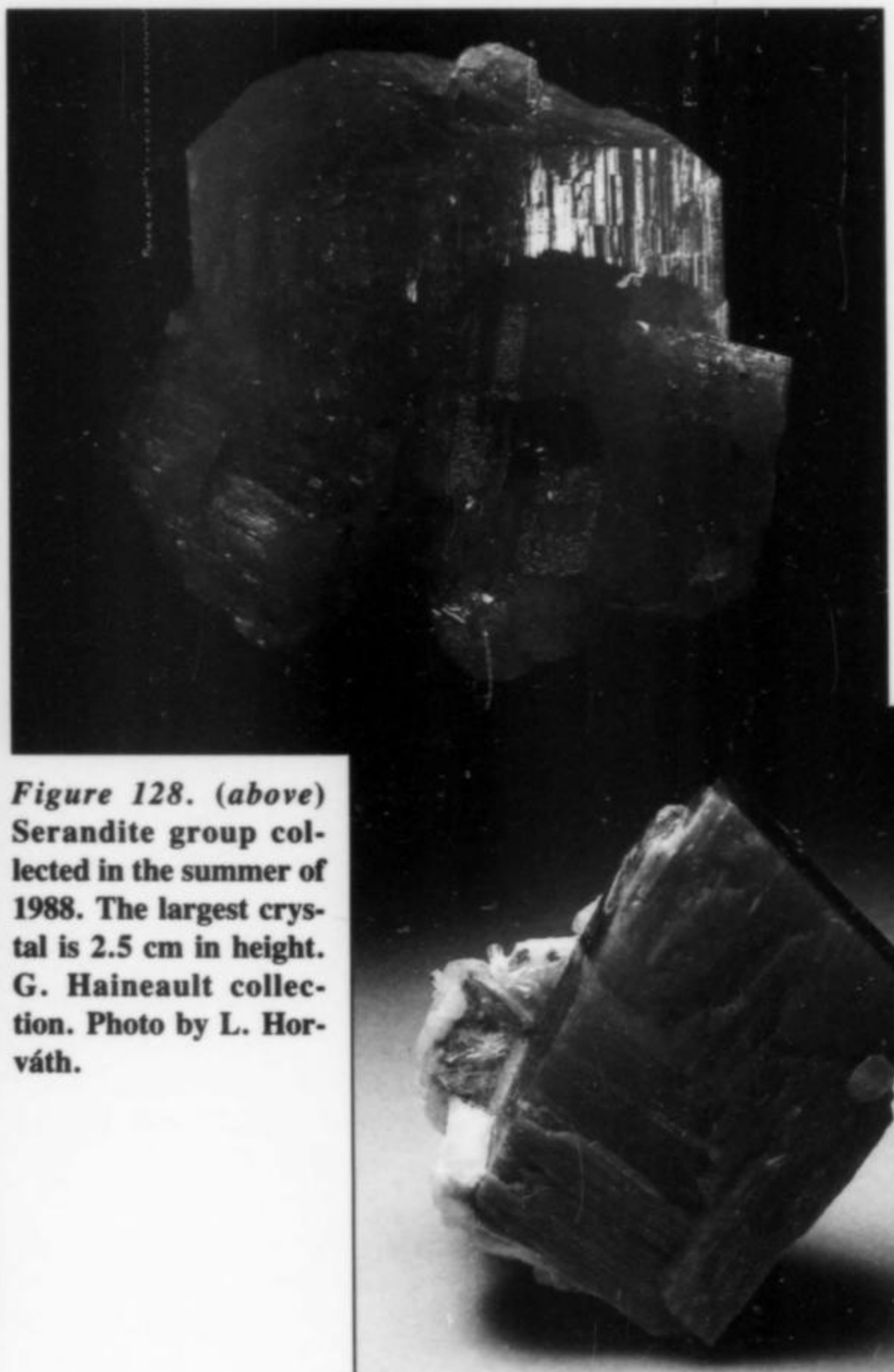


Figure 128. (*above*) **Serandite group collected in the summer of 1988. The largest crystal is 2.5 cm in height. G. Haineault collection. Photo by L. Horváth.**

Figure 129. **Serandite crystal, twinned, measuring 8 cm in height. G. Haineault collection. Photo by G. Robinson.**

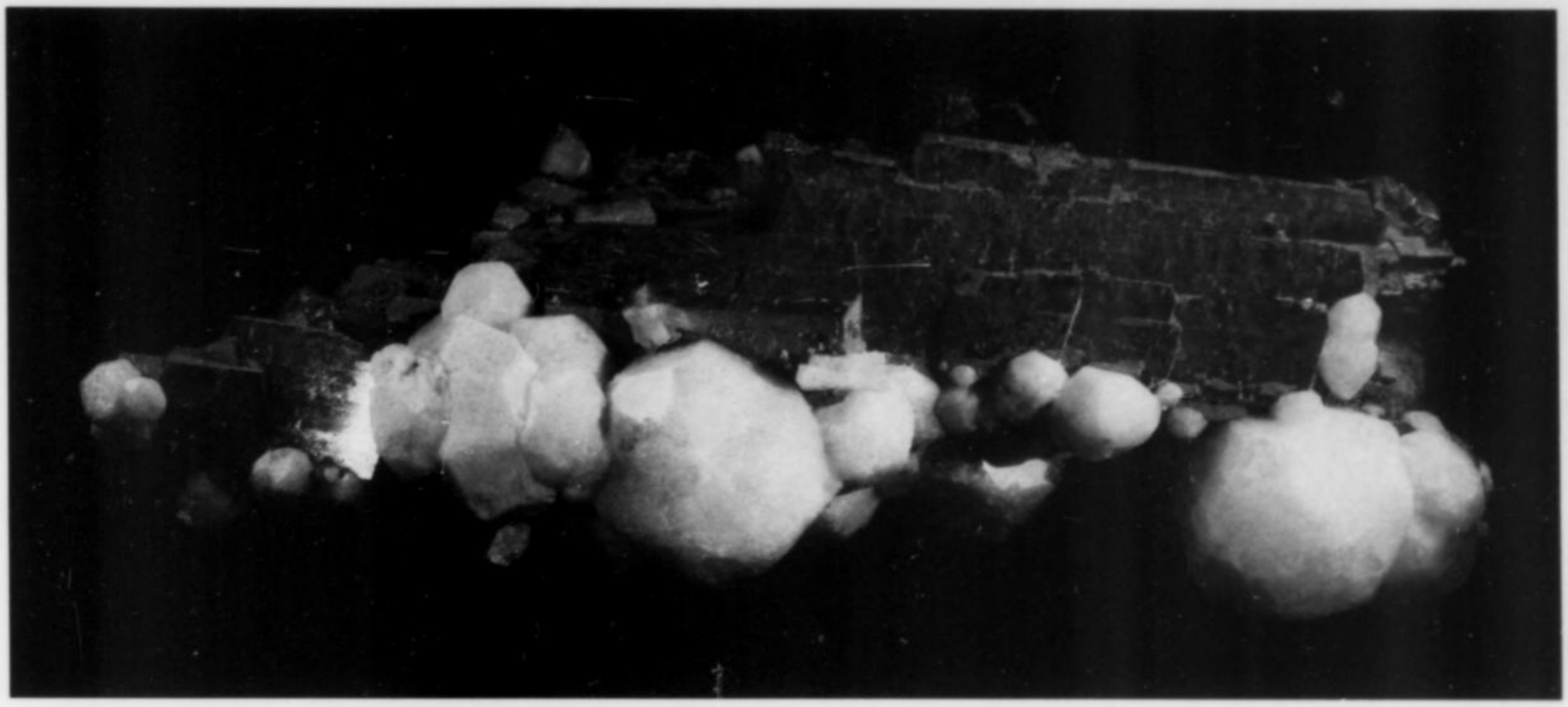


Figure 130. **Serandite, a superb crystal on a group of analcime trapezohedra. The overall length of the specimen is 22.5 cm. National Museum of Natural Sciences (Canada) specimen #37124. Photo by J. Schekkerman.**

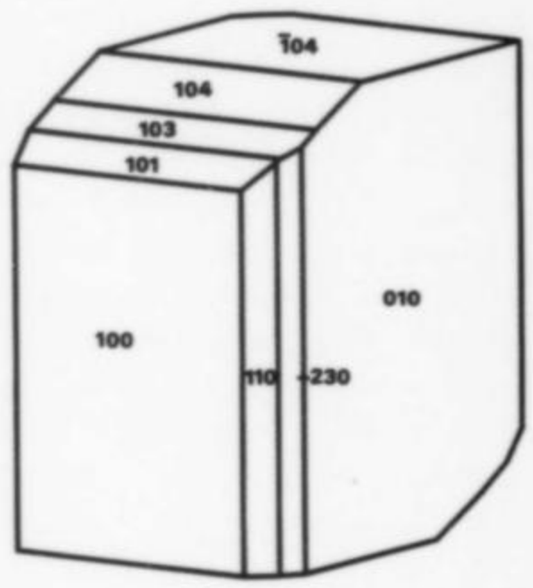


Figure 131. **Serandite, composite crystal drawing of three crystals measured on a reflecting goniometer.**

Figure 132. **A view of the inactive Demix quarry. The famous 1973–1974 pegmatite dike which contained large orange serandite crystals is currently buried about 30 meters from the wall in the central part of the photograph. Photo by L. Horváth.**

close to being the pure end-member (Boissonnault, 1966). The Ca end-member, pectolite, is also very common at Mont Saint-Hilaire.

At Mont Saint-Hilaire serandite occurs in splendid, large crystals up to 20 cm in length and 7 cm across, and is a common constituent of the pegmatite pipes and veins. It has also been found in sodalite xenoliths, but only as small crystals (1–10 mm long).

The crystal habit ranges from acicular to blocky, to bladed; the bladed and blocky crystals often form splendid radiating clusters. Rarely serandite has also been found as fibrous aggregates. The color ranges from pale pink to salmon-red, rose-red, deep orange, brown and black; very rarely in small crystals it is colorless to tan or white. Large crystals are translucent to opaque, containing numerous internal flaws, and the luster varies from vitreous to greasy to dull. The fibrous aggregates are white to tan and opaque with a dull to silky luster. The brown and black crystals—the so-called "black serandite"—are partially altered to birnessite.

Large pseudomorphs of elpidite, nenadkevichite and rhodochrosite after serandite to 25 cm in length and 15 cm across have also been found.

Two twin laws, based on goniometric measurements, have been reported on serandite from Mont Saint-Hilaire (Richards, 1990) (Fig. 125). Richards reports that one common twin law is rotation through 180° about the *b*-axis. Usually the composition surface is nearly planar and parallel to (100). A variant of this twin law involves interpenetration, with small blocks of twinned orientation set into a host crystal, with somewhat irregular composition surfaces approximated by (001) and (100). Rarely, twins of this type have (001) as the main composition plane. The variant with (100) composition plane has also been observed on pectolite, the isomorph of serandite, from Union

Hill, New Jersey (Peacock, 1935). Richards also reports that a second, less common twin law is contact twinning by reflection, with (110) the twin plane and composition plane. There have been several magnificent specimens found illustrating this twin law, including a large, 10 x 9 cm deep orange crystal from the famous pegmatite exposed in 1973, and smaller crystals found in 1988. He also states that several relationships he has examined, originally thought to be twins, have proved to be complex sub-parallel groups.

There have been many significant finds of serandite over the years. Probably the most spectacular occurred over a several-month period in 1973, when a vertical pegmatite pipe up to 1 meter in diameter was exposed in the Demix quarry (Fig. 87); this produced hundreds of superb, medium to deep orange crystals some of which attained 20 cm in length. The serandite is associated with outstanding analcime and mangan-neptunite crystals in some truly magnificent specimens. Since then, several more finds have been made, including one in 1981 that produced a large number of pink, bladed crystals in very aesthetic combinations with analcime, aegirine and microcline. In 1988 a large cavity produced large and small clusters of crystals and several magnificent specimens, which are arguably the most attractive in color and unsurpassed in luster. The crystals are salmon-pink to pale carmine-red, translucent, equant, blocky and 3–5 cm across, forming very aesthetic aggregates, some overgrown by splendid leifite crystal groups and spherical aggregates. Other less significant finds in both quarries have produced outstanding serandites, but none surpassed the color, sharpness and luster of the 1988 find or the size of the crystals found in 1973.

There are probably 25–30 large, outstanding specimens in various collections. Miniature and cabinet specimens of excellent quality probably number around 200–300.

A small number of gemstones have been faceted from transparent sections of large crystal fragments, the best being intense pinkish orange colored 1.65 and 0.95 carat, rectangular emerald-cut stones.

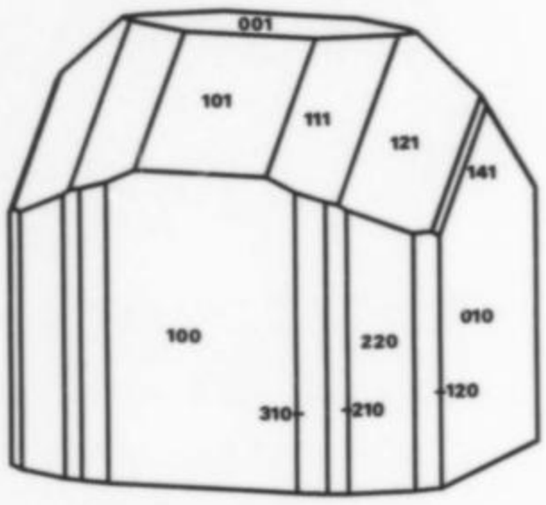


Figure 133. **Shortite, crystal drawing of a complex crystal measured on a reflecting goniometer.**

Shortite $Na_2Ca_2(CO_3)_3$

Shortite, a rare sodium and calcium carbonate (Fahey, 1939), has been found as pale yellow to lemon yellow masses and as small (<1 mm), well-formed, lemon yellow, transparent, short, prismatic crystals with a vitreous luster embedded in marble xenoliths, in close proximity to the contact of marble and hornfels. Associated minerals are pectolite, calcite and fluorite. The occurrence is very rare. Due to its inconspicuous appearance and similarity to calcite, occurring in the same environment, it may be very easily overlooked. Shortite has also been found in a sodalite xenolith (McDonald, 1989).

Siderite $Fe^{+2}CO_3$

Siderite is a very common mineral occurring in pegmatites, less common in sodalite syenite, miarolitic cavities in nepheline syenite and in seams and fractures in the hornfels.

Figure 134. **Siderite crystal, twinned, 11 cm in height. G. Haineault collection. Photo by G. Robinson.**

In the carbonate-rich pegmatites it has been found in enormous crystals to 25 cm on an edge, associated with albite, calcite, zircon, sphalerite and synchysite. Ankerite occasionally forms an epitactic overgrowth on the siderite crystals. Most siderite crystals are, however, in the microscopic to 1–2 cm size range.

The crystals are most commonly simple rhombohedra; however, modified rhombohedra, flat, tabular crystals, and curved aggregates are not uncommon. Twinning is also common. The color is tan to beige or orange-yellow in small, transparent crystals and brown to grayish brown in the large, translucent to opaque crystals.

Large numbers of superb siderite crystals have been collected over the years and fine specimens reside in many collections throughout the world. The most spectacular find of large siderites occurred in 1966, when a large cave-like cavity was exposed in the wall of the Poudrette quarry. Over a period of two weeks, hundreds of specimens were removed by collectors from the so-called "siderite cave." (See the photo of the site on p. 340.)

Siderophyllite $KFe_2^{+2}Al(Al_2Si_2)O_{10}(F,OH)_2$

Siderophyllite, a rare member of the mica group, is found as dark green to black foliated masses and as pseudohexagonal prisms. It is visually indistinguishable from biotite and annite and occurs in the same associations, possibly intergrown with those species.

Sidorenkite $Na_3Mn(PO_4)(CO_3)$

Sidorenkite was first described from a pegmatite in the Lovozero Massif, Kola Peninsula (Khomyakov *et al.*, 1979). Mont Saint-Hilaire is the second reported locality for the mineral, where its occurrence is extremely rare. Sidorenkite is found as small (<1 mm), colorless to pale pink, globular grains in small cavities; as dull, pale brown to reddish brown, crude, rectangular or irregular, etched embedded crystal sections with a peculiar woody-fibrous appearance, in some sodalite xenoliths. The globular grains found in cavities may be etched crystals; they are very inconspicuous, and are occasionally covered by a crackled crust of rasvumite. It is associated with sodalite, ussingite, rasvumite, villiaumite, kogarkoite, tugtupite, vuonnemite, cancrinite, serandite, lovozerite, terskite and eudialyte.

Sodalite $Na_8Al_6Si_6O_{24}Cl_2$

Sodalite is one of the most abundant species at Mont Saint-Hilaire; it is the prime constituent of sodalite syenite, one of the principal rock types. It was commonly encountered in extensive zones as nearly pure, blue masses, in the upper (now mined out) levels of the Poudrette quarry; the sodalite there was heavily stained and rather pale in color and as such was unsuitable for lapidary work. In recent years, sodalite has been found in xenoliths of varying size consisting almost entirely of colorless to pale violet (rapidly changing to colorless to white), massive or crystallized sodalite in nepheline syenite. Sharp euhedral crystals are found in cavities in sodalite syenite, in marble, in the sodalite xenoliths and in miarolitic cavities. Large, crude crystals occur in some altered pegmatites.

The crystals are most commonly dodecahedra, rarely octahedra or very distorted and elongated dodecahedra. They range in size and color from 1–2 mm colorless to pink and pale violet crystals; pale to dark blue microcrystals; large, 1–2.5 cm pale to dark blue and violet, translucent dodecahedra; crude, gray, opaque, 6–10 cm crystals. The luster is vitreous to greasy or dull. Several remarkable crystals, unsurpassed in size and quality, have been found, including a deep blue, 1 cm dodecahedron, a pink to violet, 2.5 cm dodecahedron, and a twinned group of dodecahedra 3.5 cm in diameter.

Sodalite fluoresces intense orange to orange-red under shortwave and longwave ultraviolet radiation and retains strong yellowish white phosphorescence for a short duration. Much of the colorless to violet sodalite is photochromic (Peterson, 1983), pale to intense violet when freshly broken but quickly fades on exposure to sunlight. The process is reversible by exposure to ultraviolet radiation, and some sodalite will also regain its color in the dark. Some very deep violet, massive sodalite remained completely unchanged for several years.

In the fall of 1988, large, transparent crystal sections of sodalite were collected which afforded sufficient material to facet a small number of fine quality gemstones (Wight, W., 1989, and Koivula and Kammerling, 1989). The largest stone cut weighed 15.33 carats. Gemstones of 6.41, 3.23 and 3.25 carats were of the highest quality and practically flawless. These gems turn a deep, rich pink color under exposure to ultraviolet radiation, fading within minutes to a very pale yellow, under natural or incandescent light. (See the color photos on the following page.)

Spertiniite $Cu(OH)_2$

Spertiniite was originally described from the Jeffrey mine, Asbestos, Québec (Grice and Gasparrini, 1981). Mont Saint-Hilaire is the second known locality for the species.

It is extremely rare, occurring as pale blue, dull, opaque, 0.5–1 mm plates and thin crusts on an undetermined copper sulfide, UK#55 (Chao *et al.*, 1990), in small cavities in sodalite xenoliths associated with ussingite, villiaumite and eudialyte.

Spessartine $Mn_3Al_2(SiO_4)_3$

Spessartine has been found as beige to brown, concentrically color-zoned (beige-pale brown-dark brown), crude, rounded crystals, 1–5 cm in diameter, embedded in fine-grained hornfels. The crystals are encased in a thin shell of massive sulfides, including pyrite and pyrrhotite.

Sphalerite (Zn,Fe)S

Sphalerite is very common in virtually all associations. It is most abundant, and is found in the largest crystals, in the carbonate-rich pegmatites associated with albite, siderite and pyrite pseudomorphs after pyrrhotite.

It has been found as simple tetrahedra to 7 cm across, as tetrahedra, pseudo-octahedra, dodecahedra and modified dodecahedra, as extremely complex "stretched" twins showing repeated twinning and forming elongate, somewhat skeletal crystals to 6 cm, and as flat, twinned, pseudohexagonal crystals to 6 cm. The color may be yellow, green, brown, red, orange, black or colorless. While many crystals exhibit some surface etching and have a dull luster, some have adamantine luster and, with the exception of the black crystals, most are transparent.

Several superb gemstones have been cut from Mont Saint-Hilaire sphalerite, including a flawless 24.74 carat pale yellowish green pear-shaped brilliant. (See the color photo on the following page.)

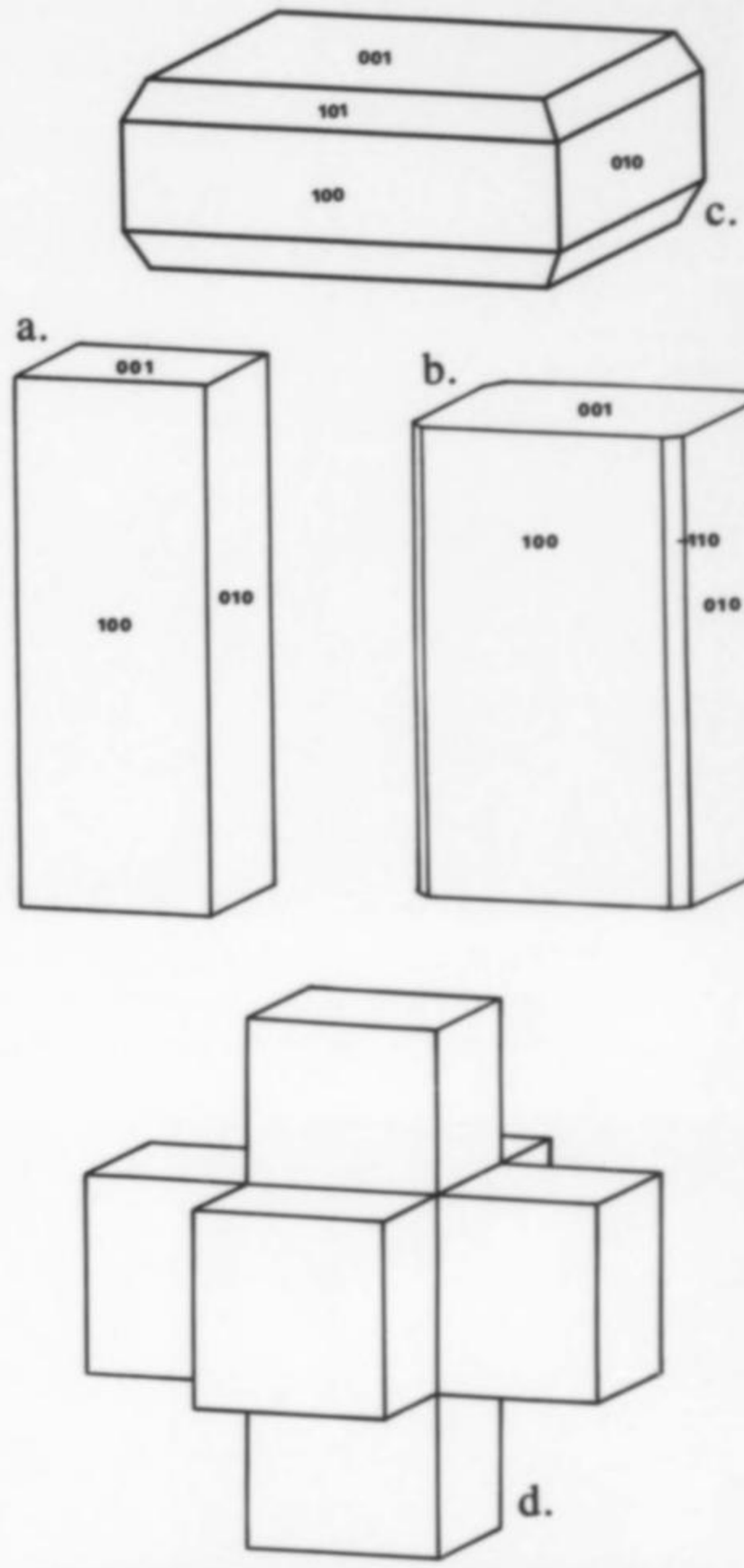


Figure 135. **Steacyite crystal drawings using the symmetry elements and cell parameters reported by Perrault *et al.* (1973), (a) simple tetragonal prism (most common habit), (b) tetragonal prism showing {110} modification, (c) the very rare, tabular habit with {001} pinacoid dominant, (d) the cruciform twin.**

Steacyite $Th(Ca,Na)_2K_{1-x}Si_8O_{20}$ $(x = 0.2–0.4)$

Mont Saint-Hilaire is the type and only known locality for steacyite. The mineral was characterized, and was thought to be a new species (Perrault and Richard, 1970a & 1970b), but after recognizing its close match to ekanite found in the USSR (Ginzburg *et al.*, 1965, and Mokeyeva and Golovastikov, 1966), with some apprehension Perrault and Richard decided to call it ekanite (Richard, 1971, Richard and Perrault, 1972, and Perrault and Richard, 1973). The ekanite name was in common use for the Mont Saint-Hilaire mineral until 1982, when it was redefined and renamed as steacyite (Perrault and Szymanski, 1982, and Szymanski *et al.*, 1982).

Steacyite is found as a rare accessory mineral in some pegmatite

Figure 136. **A view of the eastern portion of the Demix quarry showing the wall (left) which separates the Poudrette and Demix quarries. Most of the large siderite pockets were found near this wall. The wall is currently being removed by Poudrette Inc. Photo by L. Horváth.**

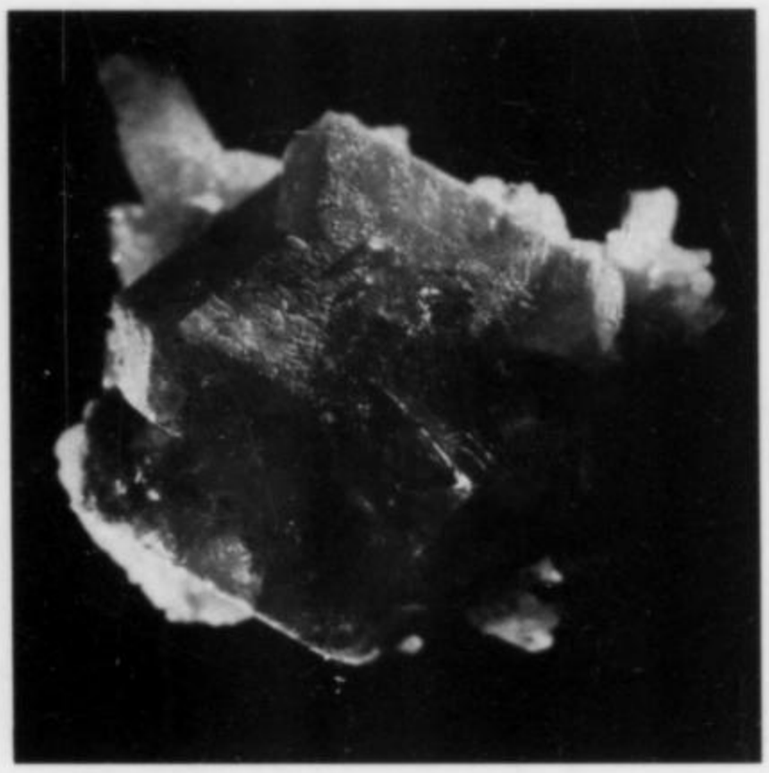


Figure 137. **Sodalite (hackmanite), a superb group of twinned crystals. The specimen is 4 cm in diameter. B. Poudrette collection. Photo by L. Horváth.**

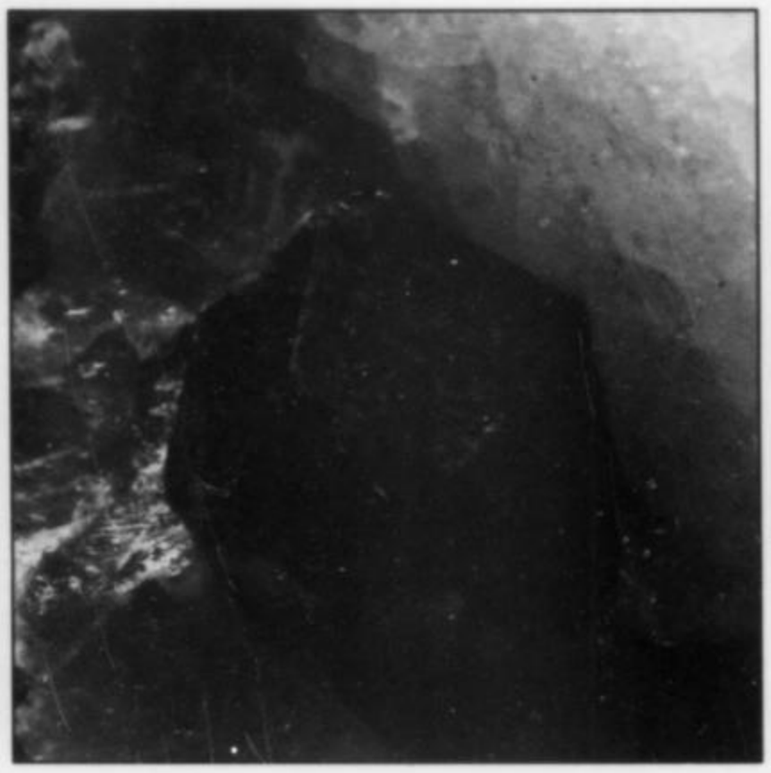


Figure 138. **Sodalite, a well-formed dodecahedron, 1 cm across, in analcime. Royal Ontario Museum specimen #M36651. Photo by G. Robinson.**

Figure 139. **Sphalerite crystals to 1.1 mm. Dan Behnke collection and photo.**

veins, in marble xenoliths, in hornfels and in cavities in the igneous breccia. It occurs as sharp, tetragonal, 1–3 mm prisms, sometimes forming very attractive cruciform twins; very rarely it is found as embedded crude prisms and as square tabular crystals. The crystals are dark gray, grayish brown and occasionally off-white or beige. Hollow and etched crystals are relatively common. Steacyite is also found as dark brown, foliated, 1–3 mm spherical aggregates and as pale brown to beige, compact, chalky, spherical aggregates.

The crystals as well as the spherical aggregates are opaque. The luster varies from dull to greasy to vitreous. Well-defined color zoning is evident in some crystals, where the crystal core is darker and the outer zone is lighter. It is radioactive, emitting low energy α and β particles. No γ-radiation has been detected.

Steenstrupine-(Ce)

$Na_{14}Ce_6Mn^{+2}Mn^{+3}Fe_3^{+2}Zr(Si_6O_{18})_2(PO_4)_7(OH)_2 \cdot 3H_2O$

Steenstrupine-(Ce) occurs very rarely as 0.5–3 mm, sharp, tabular hexagonal crystals with dominant {0001} pinacoids, and as rounded,

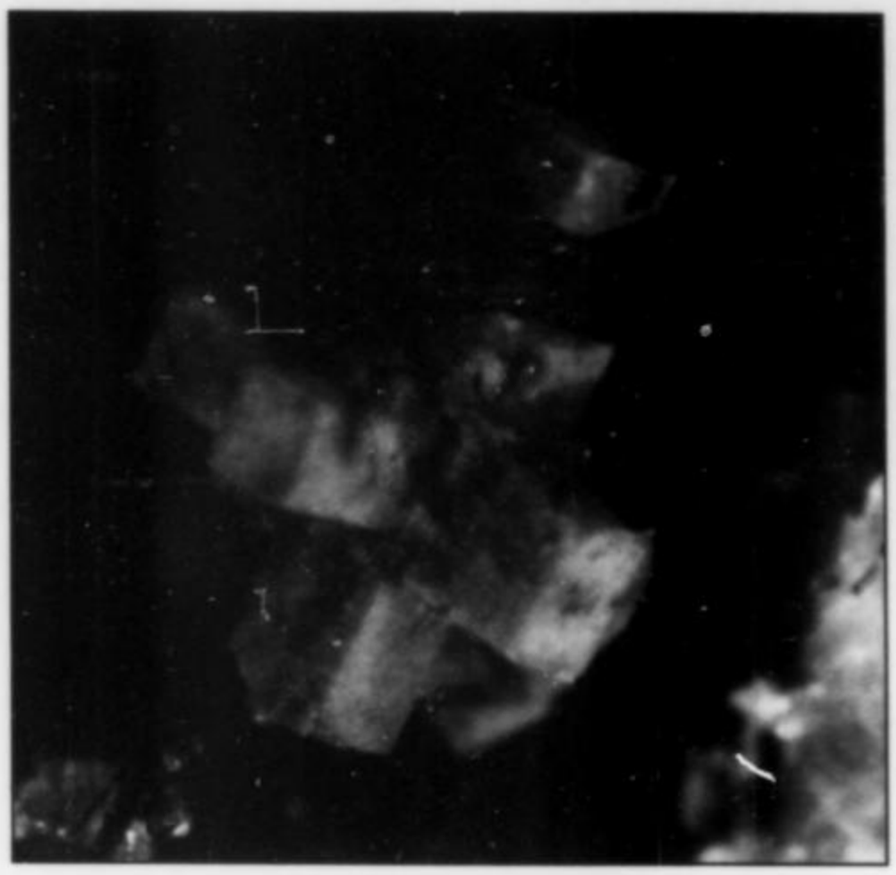


Figure 140. **Steacyite in cruciform twins. The group is 3 mm across. Horváth collection and photo.**

glassy plates and blobs in sodalite xenoliths. It is associated with sodalite, villiaumite, vuonnemite, ussingite, lueshite, natrophosphate and a number of other minerals in tiny cavities or embedded in the sodalite.

The color is dark red or reddish brown. The crystals are transparent to translucent with vitreous luster and a conchoidal fracture. Many of the crystals are coated with a thin, dull, black, opaque crust. The Mont Saint-Hilaire steenstrupine is metamict and X-ray amorphous.

Figure 141. **Stillwellite-(Ce) crystal drawing (from a drawing of a stillwellite crystal from Tadzhikistan, U.S.S.R., after Dusmatov *et al.*(1963)).**

Stillwellite-(Ce) (Ce,La,Ca)BSiO$_5$

Stillwellite-(Ce) was originally described from a locality near Mt. Isa, Queensland, Australia (McAndrew and Scott, 1954). At Mont Saint-Hilaire, it is an exceedingly rare accessory mineral in cavities in marble xenoliths and igneous breccia.

It is found as sharp, pale pink, 0.5–2 mm hexagonal prisms, terminated by rhombohedra, bearing a very close resemblance to rose quartz crystals. The forms noted are {11$\bar{2}$0} prism and the {10$\bar{1}$1} rhombohedra. Crystals are transparent to opaque; some have transparent pink exterior zones and terminations and opaque white cores and bases. The luster is vitreous to dull. In the breccia it is associated with microcline, albite, aegirine, fluorapatite and titanite. In marble xenoliths associated minerals are pectolite, fluorite, fluorapophyllite, natrolite, zircon, tadzhikite, datolite and vesuvianite.

Strontianite $SrCO_3$

A rare mineral in breccia cavities and mineralized seams in hornfels, strontianite occurs as very sharp, colorless, tabular, twinned crystals, and as radiating sprays of white, opaque, acicular crystals. The tabular crystals are 2–4 mm long, and the acicular crystals range from 4–12 mm in length. Some strontianite fluoresces weak white under shortwave and longwave ultraviolet radiation.

Sugilite $KNa_2(Fe^{+2},Mn^{+2},Al)_2Li_3Si_{12}O_{30}$

Sugilite, a member of the osumilite group of minerals, was originally described from Iwagi Islet, in southwest Japan (Murakami *et al.*, 1976). At Mont Saint-Hilaire, sugilite was found in a single cavity in a marble xenolith, as poorly-developed, intergrown, striated prismatic crystals. Crystals are up to 1 cm long and 2 mm across, transparent, pale pink with vitreous luster. No cleavage and no fluorescence under ultraviolet radiation were observed. Associated species are poudretteite (a new member of the osumilite group from Mont Saint-Hilaire), quartz, polylithionite and pectolite. Mont Saint-Hilaire is the fourth reported locality for sugilite (Armbruster and Oberhänsli, 1988).

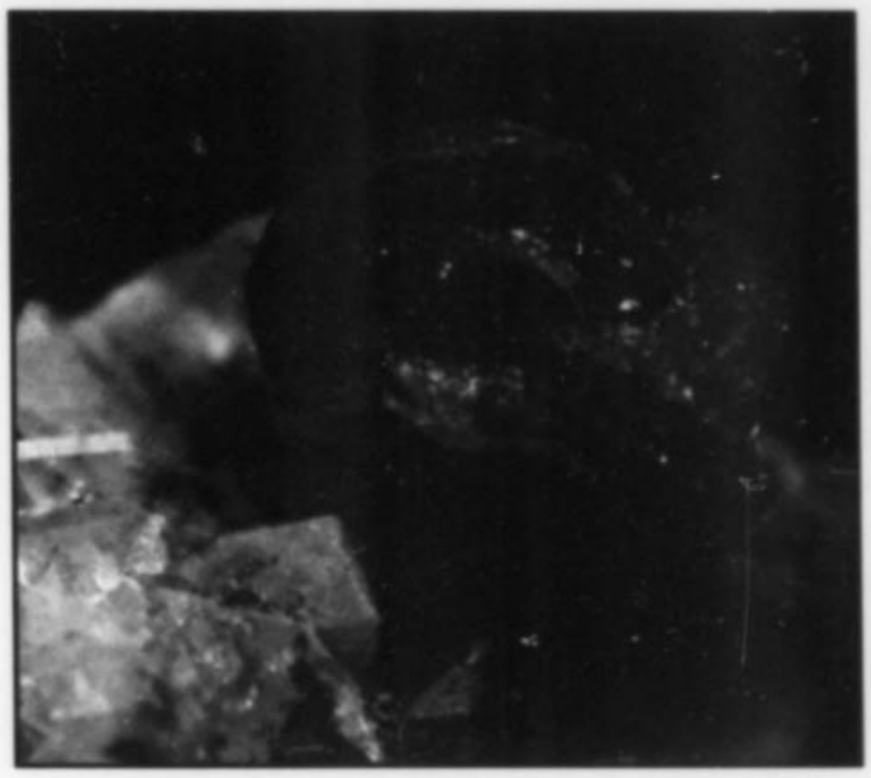


Figure 142. **Synchysite-(Ce) crystal group 8 mm across. Horváth collection and photo.**

Synchysite-(Ce) Ca(Ce,La)$(CO_3)_2F$

Synchysite-(Ce) is rare in carbonate-rich pegmatites, very rare in miarolitic cavities and exceedingly rare in breccia cavities. In one notable find in the 1960's, large numbers of well-crystallized specimens were collected from a carbonate-rich pegmatite, but since that find the mineral has appeared very sporadically and in very small amounts. Two polytypes, synchysite-(Ce)-12T and synchysite-(Ce)-24T, have been reported (Cheang, 1977).

Synchysite-(Ce) occurs as 1–4 mm diameter, tabular hexagonal crystals with somewhat rounded corners, frequently twinned, or as minute, thin, hexagonal plates occasionally forming spherical aggregates and rosettes. It has also been found as syntactic intergrowths with parisite with alternating layers of parisite and synchysite, forming rounded, rough, hexagonal plates and pagoda-shaped aggregates in breccia cavities.

Color varies from tan to beige, pale green, yellow and brown. The luster varies from dull to vitreous externally, to resinous on freshly broken surfaces. Most crystals are opaque, rarely translucent. Larger crystals found in the carbonate-rich pegmatites have a frosty appearance and are typically sprinkled with minute pyrite cubes.

Szomolnokite $Fe^{+2}SO_4 \cdot H_2O$

Szomolnokite, a member of the kieserite group, is found as a thin, white crust and coating on weathered pyrrhotite crystals in altered pegmatites.

Figure 143. **Thin tadzhikite plates forming compact rosettes. The rosette is approximately 1.5 mm in diameter. Horváth collection. SEM photo by E. Vadas.**

Tadzhikite-(Ce) $Ca_3(Ce,Y)_2(Ti,Al,Fe^{+3})B_4Si_4O_{22}$

Tadzhikite-(Ce) was originally described from alkali pegmatites in Tadzhikistan, USSR (Efimov *et al.*, 1970). At Mont Saint-Hilaire the mineral was first found in 1974 and was designated as UK#39 (Chao and Baker, 1979). In recent years it has also been reported from the Langesundfjord area pegmatites in Norway (Eldjarn, 1983).

Tadzhikite-(Ce) is a very rare accessory mineral in marble xenolith cavities, where it is associated with pectolite, vesuvianite, fluorite, götzenite and hydrogrossular. It is extremely rare in igneous breccia cavities, where it has been found associated with donnayite, parisite, synchysite, carbocernaite, ancylite, titanite, cordylite, penkvilksite and pyrophanite.

It occurs as small rosettes, and as compact, 1–3 mm spherical aggregates with a radiating lamellar structure; as foliated, botryoidal masses; and as rounded and irregular, thin flakes.

The mineral is soft and the lamellae are flexible. Color ranges from yellowish brown to tan, beige, very pale pink and white. Luster varies from dull to pearly.

Taeniolite $KLiMg_2Si_4O_{10}F_2$

Taeniolite-1M, a member in the mica group, is a relatively rare species that occurs in breccia cavities and marble xenoliths as colorless to tan or silvery, transparent, thin, lamellae to 1 cm in length, forming random or oriented aggregates. It has also been found as opaque, gray-brown, tapering pseudohexagonal prisms to 1 cm in length. The luster is vitreous to pearly.

Taeniolite is similar in appearance to polylithionite and to a lesser degree to muscovite, however polylithionite is strongly fluorescent (yellow-green) under ultraviolet radiation.

Terskite $Na_4ZrSi_6O_{15}(OH)_2 \cdot H_2O$

Terskite was first described (Khomyakov *et al.*, 1983a) from Mt. Aluaiv, Lovozero alkali massif, Kola Peninsula, USSR. At Mont Saint-Hilaire, which is the only other known locality for the species, terskite was first found in 1984.

It occurs very rarely in small cavities in sodalite xenoliths, as dull, opaque, white, powdery to porcellaneous, hollow pseudomorphs measuring 0.5–2.5 mm, replacing lovozerite crystals. The pseudomorphs are crude, twinned dodecahedra or pseudododecahedra associated with sodalite, aegirine, gmelinite, polylithionite, epistolite, natrolite, villiaumite, tetranatrolite, wurtzite-4H, ussingite, cancrinite and an unknown Na,Ca,Mn silicate, UK#38 (Chao and Baker, 1979, and Chao *et al.*, 1990).

Terskite displays weak yellowish white fluorescence under short-wave and longwave ultraviolet radiation.

Tetrahedrite $(Cu,Fe)_{12}Sb_4S_{13}$

Tetrahedrite, a member of the tetrahedrite group, is found extremely rarely as gray-black, metallic, fine-grained aggregates to 1 mm in diameter, embedded in sodalite xenoliths; and as crude, black, metallic aggregates of crystals with blue iridescence, associated with galena, sodalite, serandite and lovozerite in small cavities in sodalite xenoliths.

Tetranatrolite $Na_2Al_2Si_3O_{10} \cdot 2H_2O$

Mont Saint-Hilaire is the type locality for tetranatrolite, a tetragonal dimorph of natrolite and a member of the zeolite group (Chen and Chao, 1980). The mineral was first reported (Andersen *et al.*, 1969) from Tugtup agtakôrfia, Greenland, but was not fully characterized and named at that time.

Tetranatrolite is abundant at Mont Saint-Hilaire, in virtually all mineralogical environments, intimately associated with natrolite on which it is found as thin powdery coatings and crusts. It also occurs as small prisms and fibrous sprays, commonly forming an epitactic overgrowth on natrolite and other minerals, notably monteregianite. The mineral is white, mostly opaque and rarely translucent, with a silky to dull luster.

Tetranatrolite is the end-product of the dehydration of paranatrolite, which forms epitactic overgrowths on natrolite crystals. The rate of dehydration is normally very rapid (depending on the ambient temperature and humidity), beginning almost immediately on exposure to air and lasting from several minutes to several hours. The resulting tetranatrolite is very brittle; smaller crystals tend to fall apart, and the crusts often exfoliate when handled.

Thalcusite $Tl_2(Cu,Fe)_4S_4$

Thalcusite was originally described from the Talnakh copper-nickel deposit in the USSR (Kovalenker *et al.*, 1976). It has also been found at Ilímaussaq, Greenland (Petersen and Secher, 1985); Mont Saint-Hilaire is the third reported locality for the species.

It is exceedingly rare, known only as a single specimen from a small cavity in a sodalite xenolith, as very small, 0.5–1 mm, thin, elongated, dark gray to black metallic blades. It is associated with sodalite, lovozerite, ussingite, villiaumite, vuonnemite and eudialyte.

Thaumasite $Ca_3Si(CO_3)(SO_4)(OH)_6 \cdot 12H_2O$

Thaumasite occurs very rarely as extremely fine, fibrous, radiating or matted masses, in altered pegmatite veins and in cavities in the marble xenoliths. Individual fibers may attain 5 mm in length. The color is pure white and the luster is silky or dull.

Visual identification is unrealiable because thaumasite closely resembles fibrous pectolite.

Thermonatrite $Na_2CO_3 \cdot H_2O$

Thermonatrite has been found in sodalite xenoliths as white, powdery, interstitial fillings and crusts, and as compact pseudomorphs after an undetermined mineral. It is very intimately associated with villiaumite, and closely associated with sodalite, ussingite, serandite, lovozerite, vuonnemite, lueshite and steenstrupine. It is very similar to and difficult to distinguish from other white powdery minerals found in the same assemblage, such as dorfmanite, nahpoite and trona.

Thomsonite $NaCa_2Al_5Si_5O_{20} \cdot 6H_2O$

Thomsonite, a member of the zeolite group, is a very rare late-stage mineral in igneous breccia and miarolitic cavities. It occurs as dull, white, compact, radiating fibers forming balls to 8 mm in diameter.

Thornasite $(Na,K)ThSi_{11}(O,F,OH)_{25} \cdot 8H_2O$

Thornasite (Ansell and Chao, 1987) is a new mineral species from Mont Saint-Hilaire. The type specimen was collected in the mid 1960's and the species was for a time designated as UK#27 (Chao and Baker, 1979; Ansell, 1985). It is exceedingly rare, occurring in altered pegmatites, as anhedral crystals and irregular grains to 0.7 mm, embedded in small grains of brockite and associated with yofortierite, eudialyte,

albite, serandite, polylithionite, mangan-neptunite, steacyite, natrolite, catapleiite and epididymite. It is slightly metamict.

Thornasite is colorless and transparent to translucent with a vitreous to waxy luster. It fluoresces very bright green under shortwave and longwave ultraviolet radiation.

Thorogummite $Th(SiO_4)_{1-x}(OH)_{4x}$

Thorogummite has been identified as very rare, pale brown to greenish brown, radiating, acicular crystals 2–3 mm long, associated with dolomite, quartz and calcite in fractures in hornfels. It has also been found as red-brown grains to 1 mm embedded in sodalite xenoliths, and as larger metamict masses (to 1 cm) embedded in nepheline syenite.

Titanite $CaTiSiO_5$

Titanite is a relatively common accessory mineral in breccia cavities, fairly rare in miarolitic cavities and marble xenoliths and very rare in altered pegmatites. It occurs most commonly as superb, very sharp, transparent, elongate prisms to 1 cm in length; as equant wedge-shaped crystals; and as small embedded granular masses. The most prominent form on the prismatic crystals is the {110} prism, less prominent is the {111} prism; the small {001} pinacoid is rare.

The color ranges from lemon-yellow to pale green, greenish yellow, bright orange, pink and pale violet. Most crystals are transparent, and some are color-zoned with turbid, translucent areas. The luster is adamantine. (See the color photo on the following page.)

Tremolite $Ca_2(Mg,Fe^{+2})_5Si_8O_{22}(OH)_2$

Tremolite, an amphibole, has been found in marble xenoliths as zoned, 1–2 mm prismatic crystals, grading in color from colorless to blue and dark green, and intimately intergrown with other amphiboles. The colorless zones in these crystals have been identified as tremolite by electron microprobe analysis.

Trona $Na_3(CO_3)(HCO_3)\cdot 2H_2O$

Trona has been found as dull, white, powdery aggregates and interstitial fillings in sodalite xenoliths. It is likely that the mineral is an alteration product of natron. Trona is practically identical in appearance to other species, such as nahpoite, thermonatrite and dorfmanite, which occur in the same environment and cannot be reliably identified by visual examination.

Tugtupite $Na_4AlBeSi_4O_{12}Cl$

Tugtupite was discovered at Mt. Sengischorr and Mt. Punkaruaiv, Lovozero Massif, Kola Peninsula and Tugtup agtakôrfia, Ilímaussaq, Greenland, and reported from these localities simultaneously; from Kola as beryllosodalite (Semenov and Bykova, 1960), and from Greenland as beryllium sodalite (Sørensen, 1960 and 1962). The mineral was fully characterized and named in 1965 (Danø, 1966).

At Mont Saint-Hilaire tugtupite is very rare, found in sodalite xenoliths, associated with sodalite, aegirine, terskite, sidorenkite, steenstrupine, cancrinite, serandite, natrolite and vuonnemite. It occurs as dull, pale pinkish white to pink, 1–3 mm, globular aggregates and as very pale pink to reddish pink, crude, 1–2 mm pseudo-octahedra in small cavities lined with sodalite. Tugtupite is photochromic, intense reddish pink in freshly opened cavities, slowly fading to pale pink on exposure to natural light, but unlike photochromic sodalite, it retains its paler pink color. The process is reversible, and exposure to ultraviolet radiation for short periods will restore or increase the color intensity. It also fluoresces intense deep red under shortwave and longwave ultraviolet radiation and exhibits weak pink phosphorescence for a short period. The slow fading of its color after exposure to ultraviolet radiation and the red fluorescence are excellent diagnostic characteristics to differentiate tugtupite from sodalite.

Tundrite-(Ce) $Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4(OH)\cdot 2H_2O$

Tundrite-(Ce) is a very rare species worldwide. It was originally described from the Lovozero Massif, Kola Peninsula (Semenov, 1963); later it was also found at Ilímaussaq, Greenland (Semenov *et al.*, 1967). At Mont Saint-Hilaire, the third reported locality for the mineral, it was found about 1965, and was tentatively designated as UK#18 (Chao *et al.*, 1967). It occurs very rarely, as sharp, lemon-yellow or orange-yellow, elongated, bladed crystals up to 1.5 cm in length, forming divergent sprays in pegmatite cavities and marble xenoliths. In the pegmatites it is associated with microcline, aegirine, rhodochrosite, polylithionite, mangan-neptunite, analcime, natrolite and cerite. In marble xenoliths it is found associated with pectolite, calcite, fluorite, natrolite and helvite.

The crystals are mostly transparent, exhibiting longitudinal striations on the dominant pedion face and perfect cleavage parallel to (010). The following forms have been noted: {100}, {010}, {001}, {101} and {201}. Terminations are rare, with a number of additional forms present; however, some of the terminal faces are rough or curved and goniometric measurements have been only partially successful.

The luster is vitreous on fresh crystal surfaces and cleavages; on some crystals it is dull or greasy.

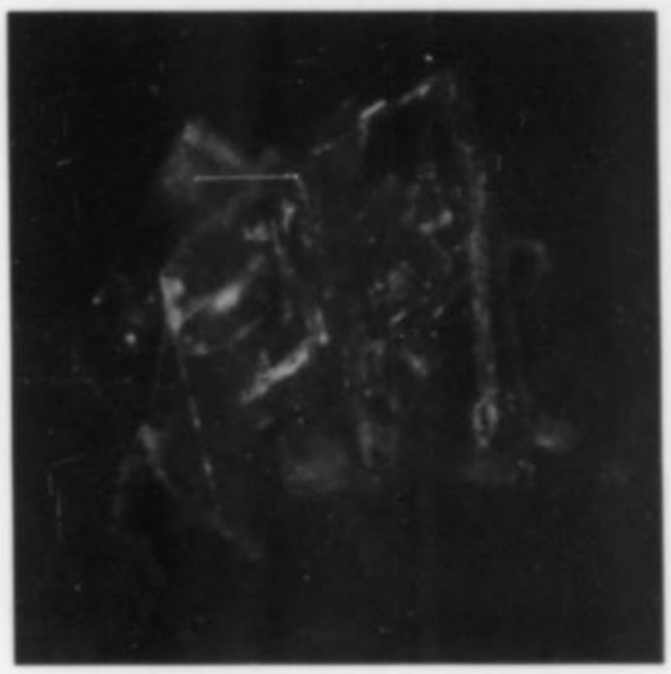


Figure 144. **Ussingite group of tabular crystals 2 mm in height. National Museum of Natural Sciences (Canada) specimen #52776. Photo by R. Gault.**

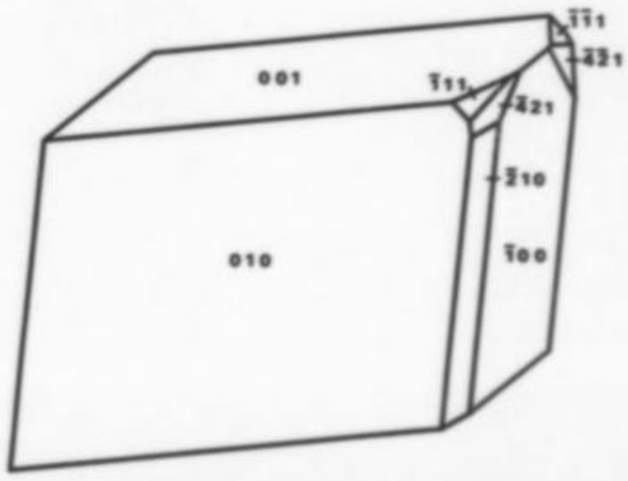


Figure 145. **Ussingite crystal drawing of a crystal measured on a reflecting goniometer and rotated to better show the modifying faces.**

Ussingite $Na_2AlSi_3O_8(OH)$

Ussingite was originally described by Bøggild in 1914 from a locality near Kangerdluarssuk fjord, Ilímaussaq alkaline intrusion, Greenland (Bøggild, 1953) where it occurs abundantly as fine-grained aggregates and masses. It has also been found in various pegmatites in the Khibiny and Lovozero massifs, Kola Peninsula, USSR, as masses, and very rarely as poorly-formed crystals (Ilyukin and Semenov, 1959). Mont Saint-Hilaire is the third reported locality and the first occurrence for the mineral as excellent crystals.

At Mont Saint-Hilaire ussingite occurs as masses and as sharp, parallel, stacked, tabular or blocky crystals exclusively in sodalite

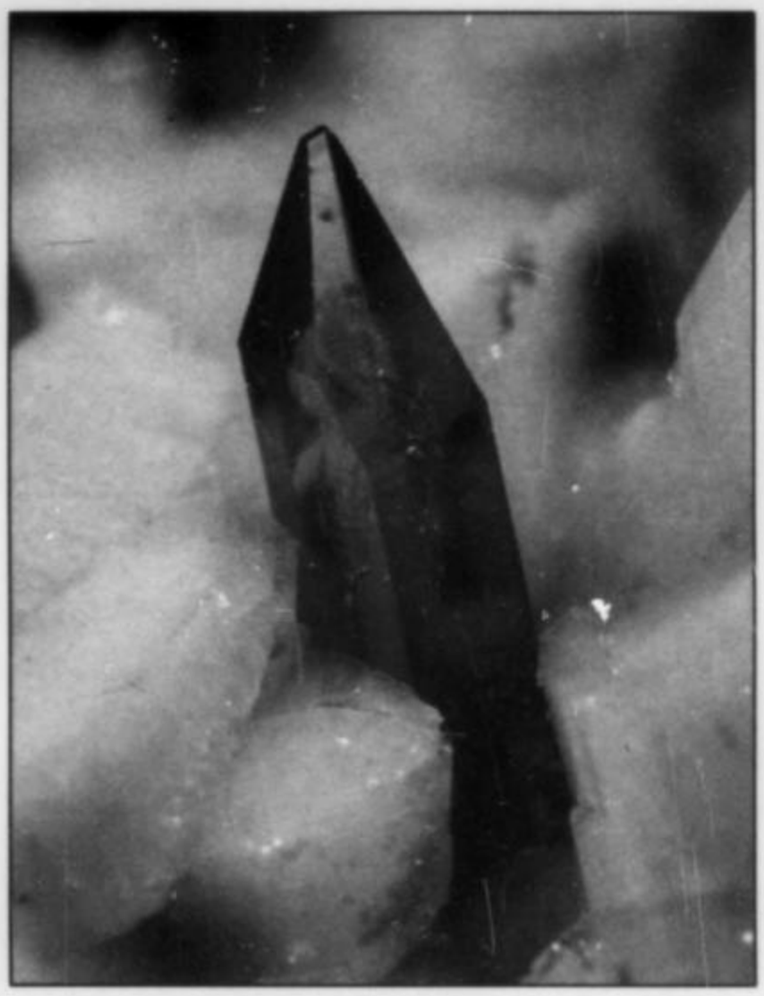


Figure 146. **Titanite crystal, 2.9 mm. Dan Behnke collection and photo.**

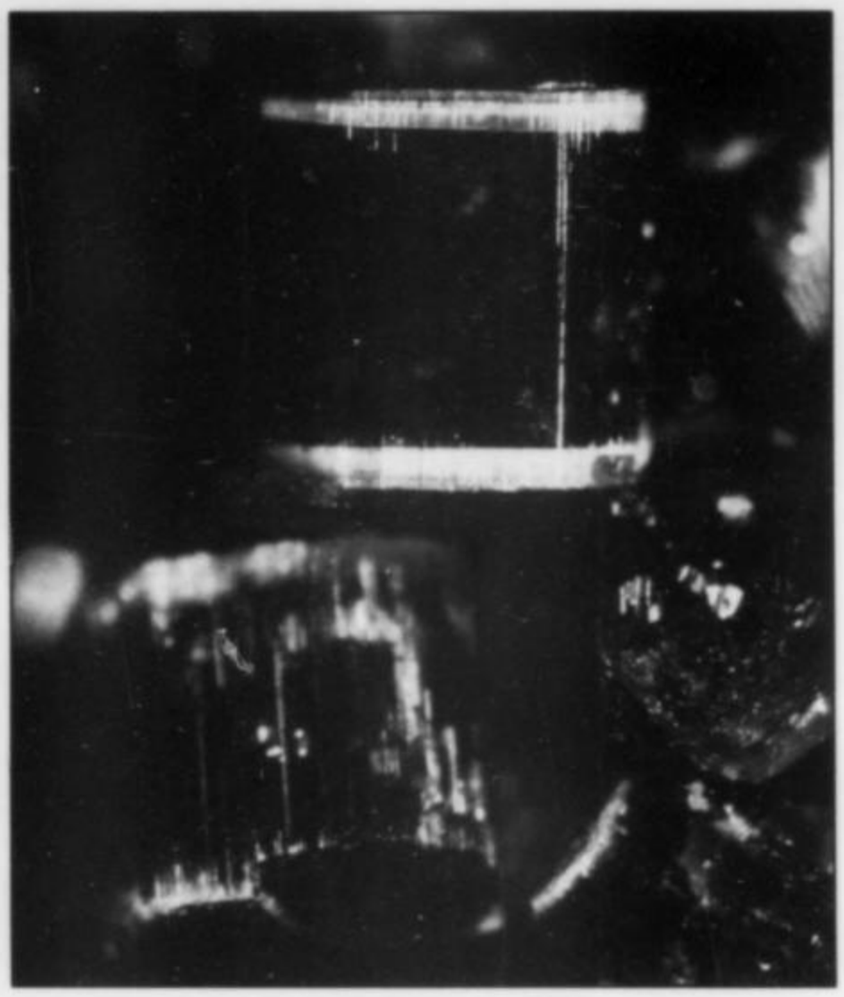


Figure 147. **Vesuvianite, a short, prismatic crystal with frosted terminations; 1.5 mm in length. National Museum of Natural Sciences (Canada) specimen #37008. Photo by R. Gault.**

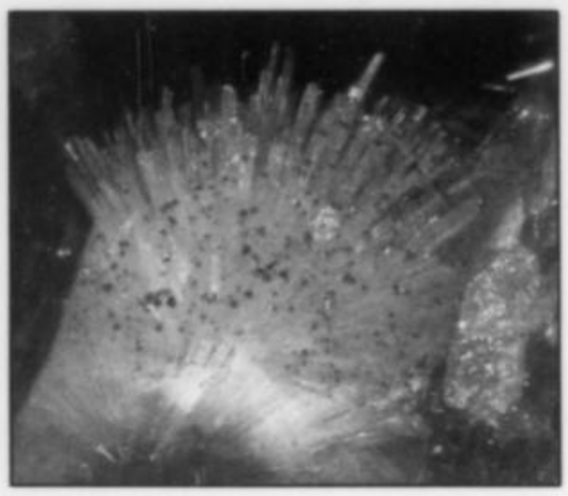


Figure 148. **Vesuvianite in radiating, prismatic crystals to 1 cm in length. Horváth collection and photo.**

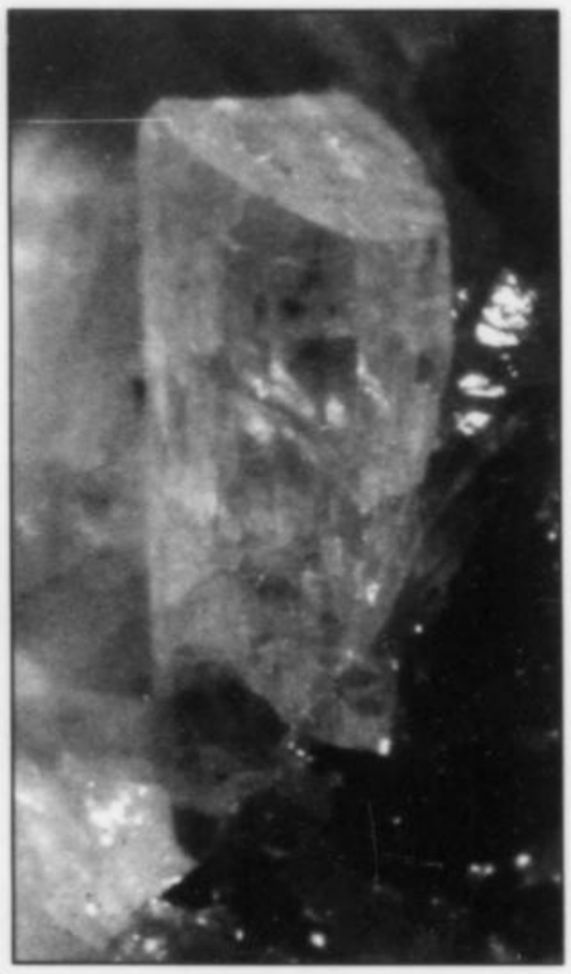


Figure 151. **Vitusite-(Ce), a prismatic crystal 5 mm in length on sodalite. Horváth collection and photo.**

Figure 149. **Villiaumite, a 2-mm cube on a pectolite crystal. Horváth collection and photo.**

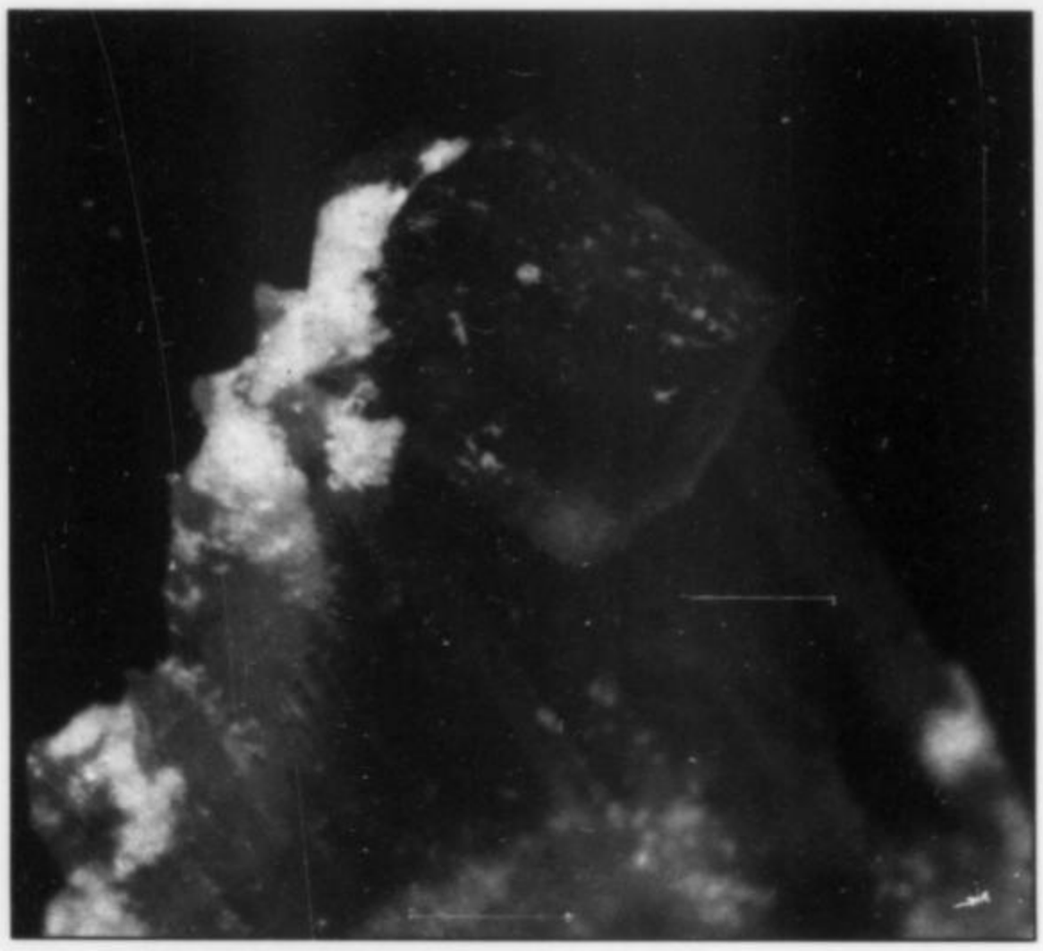


Figure 150. (*below*) **Wöhlerite crystal 4 mm in length. Horváth collection and photo.**

xenoliths associated with sodalite, villiaumite, lovozerite, eudialyte, vuonnemite, steenstrupine, lueshite, natrophosphate, chkalovite, vitusite, griceite, tugtupite, natrolite, epistolite, sazhinite and others. Massive ussingite forms spherical pods several centimeters in diameter in the sodalite. Small cavities in the center of the pods are lined with ussingite crystals. These are 1–5 mm across, colorless or very pale pink and transparent with a vitreous to greasy luster.

Massive ussingite appears very similar in color and texture to the massive sodalite in which it is found, but the lack of fluorescence under ultraviolet radiation will help in distinguishing the two. The very characteristic parallel growth of crystals and their triclinic morphology facilitates visual identification.

Vesuvianite $Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$

Vesuvianite is relatively common in marble xenolith cavities. It occurs as equant to elongated tetragonal prisms to 4 cm in length; as tabular crystals to 1.5 cm across; and as acicular to fibrous crystals to 1.5 cm in length. The radiating, acicular crystals often form very

attractive spherical aggregates to 2.5 cm in diameter.

Vesuvianite has also been found as embedded crystals or irregular grains in contacts between the hornfels and marble, and as a replacement of relict fossil brachiopods in the hornfels corona surrounding the pluton.

The color ranges from very pale yellow to lemon-yellow, orange-yellow, brown and greenish brown. The luster varies from vitreous to resinous. Small crystals tend to be transparent to translucent, while large crystals are invariably opaque.

Villiaumite NaF

Prior to 1982, villiaumite was considered to be a very rare species at Mont Saint-Hilaire, seldom encountered by collectors in more than small cleavage fragments. Since 1982, however, quarry operations have exposed villiaumite-rich sodalite xenoliths in nepheline syenite at the Poudrette quarry.

The villiaumite occurs as fillings or partial fillings, in small cavities in the sodalite and in surrounding nepheline syenite, associated with a very interesting and extensive suite of minerals. The size of the cavities ranges from 1–10 cm in diameter, and the villiaumite masses are similar in size, resulting in some spectacularly rich specimens, possibly some of the best for the mineral. Very rarely, sharp, cubic or octahedral crystals, 2–10 mm across, showing various combinations of the forms {001}, {101} and {111}, have also been found. In 1988, a crystal exceeding 15 cm across was reported in a cavity in solid villiaumite. This crystal, which was undoubtedly the largest ever found

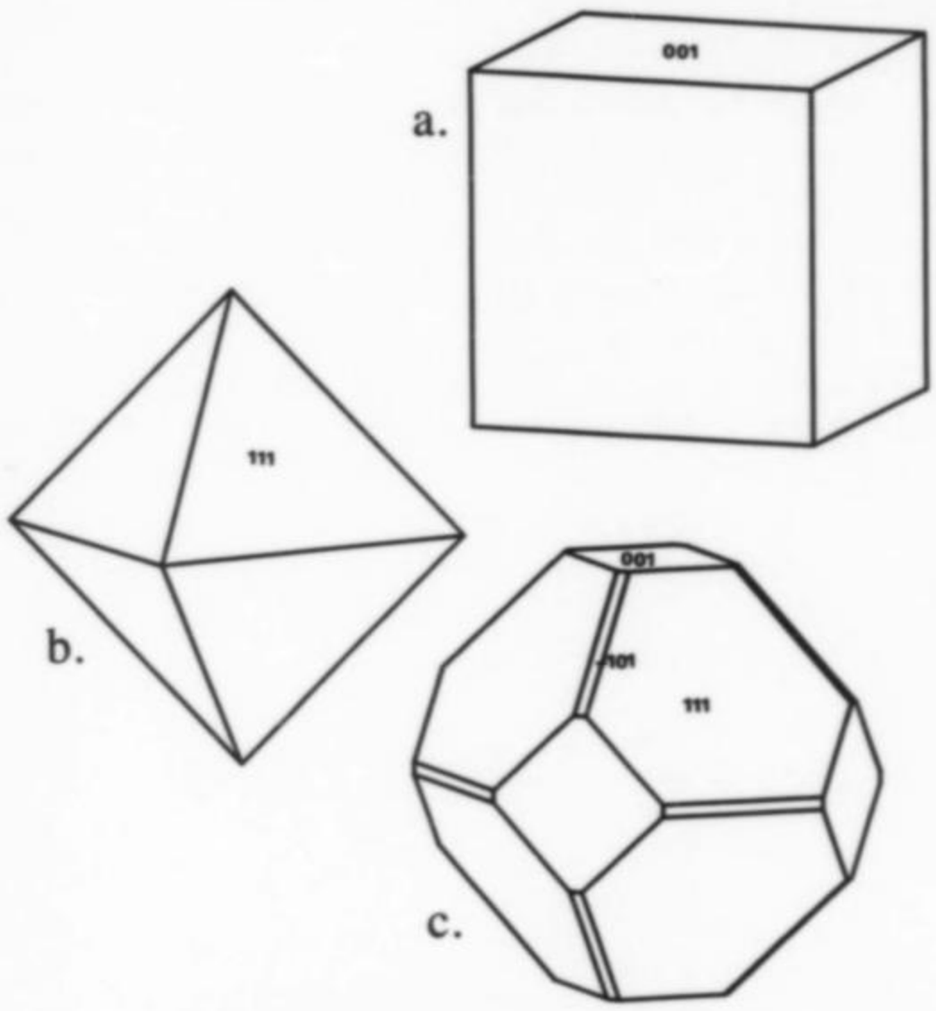


Figure 152. **Villiaumite crystal drawings of several observed forms: (a) the cube, (b) the octahedron, (c) the rarest habit showing the octahedron {111} modified by the cube {001} and the dodecahedron {101}.**

for the species, did not survive the process of removal. The only other known occurrence of euhedral crystals of villiaumite is the Kvanefjeld area of the Ilímaussaq alkaline intrusion in Greenland, where a very small number of 0.1–0.4 mm crystals were found (Petersen, 1981).

The color varies from pale orange-red to very deep carmine-red. The mineral is invariably transparent but contains various mineral inclusions, notably blobs, as well as crystals of the new species griceite. Liquid inclusions, some enclosing gas bubbles, have also been observed. The cleavage is perfect in three directions. The luster is vitreous on cleavages, and varies from vitreous to waxy to frosty on crystal faces. The crystal faces commonly exhibit numerous growth features (square hillocks and pits). Villiaumite displays weak red fluorescence under shortwave ultraviolet radiation.

Although villiaumite is very soft (2–2.5 Mohs) and cleaves very easily, gemstones up to 12.10 carats have been faceted from Mont Saint-Hilaire material. Gems under 1 carat are generally the best quality. One exception is a fine, bicolored, red to colorless emerald cut, 5.01-carat stone.

Vinogradovite $(Na,Ca,K)_4Ti_4AlSi_6O_{23}(OH)\cdot 2H_2O$

Vinogradovite was originally described from the Kola Peninsula, USSR (Semenov *et al.*, 1956). It has also been found at an unspecified locality of the Green River Formation (Milton, 1977) and recently at Ilímaussaq, Greenland (L. H., personal communication; Petersen, O. V., 1988). At Mont Saint-Hilaire, the third reported locality (Chao and Baker, 1979), it has been found as sharp, sword-shaped, bladed, 1–3 mm crystals forming radiating clusters; as 1–2 mm acicular crystals; and as 2–4 mm, spherical, foliated, micaceous masses embedded in analcime. It is very rare, occurring in cavities associated with the igneous breccia, unaltered pegmatite veins, miarolitic cavities and sodalite xenoliths. Associated minerals in breccia cavities are: microcline, albite, aegirine, elpidite, titanite, lorenzenite, leucosphenite, narsarsukite, monteregianite and quartz; in miarolitic cavities: analcime, natrolite, aegirine and calcite; in pegmatites: microcline, analcime, calcite, aegirine, ancylite and pyrochlore; in sodalite xenoliths: sodalite, eudialyte, natrolite, aegirine, thermonatrite and villiaumite.

Bladed crystals are transparent to translucent with a vitreous luster, and the acicular crystals and micaceous masses are opaque with silky to pearly luster. The color varies from pale violet to pink, pinkish brown and white.

Vinogradovite found at Mont Saint-Hilaire bears a very close resemblance to the more common lorenzenite and, to a lesser extent, to ashcroftine. All three occur in similar associations, and visual recognition is unreliable.

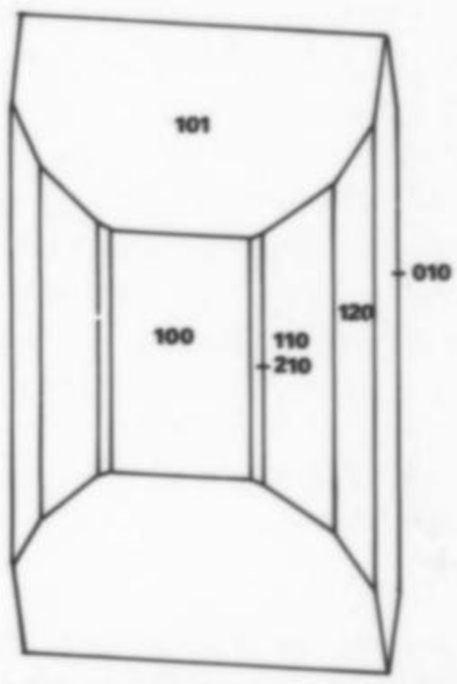


Figure 153. **Vitusite-(Ce) crystal drawing of a crystal measured on a reflecting goniometer.**

Vitusite-(Ce) $Na_3(Ce,La,Nd)(PO_4)_2$

Vitusite-(Ce) was described as a new species (Rønsbo *et al.*, 1979) from pegmatites in Ilímaussaq, Greenland, and the Lovozero alkaline massif, Kola Peninsula, USSR. At Mont Saint-Hilaire, which is the only other known locality, vitusite-(Ce) occurs very rarely in sodalite xenoliths as very sharp, pale yellow, transparent prisms to 4 mm in length terminated by the {101} prism, to 4 mm in length, associated with vuonnemite, sodalite, eudialyte, steenstrupine, kogarkoite, sidorenkite, rasvumite and other species. This is the first reported occurrence of the mineral as excellent crystals. In the same association, it is also found as pinkish tan to gray and black, translucent to opaque,

poorly-defined, radiating prisms to 5 mm in length, embedded in sodalite. The luster is vitreous to greasy. Good cleavage is apparent in three directions.

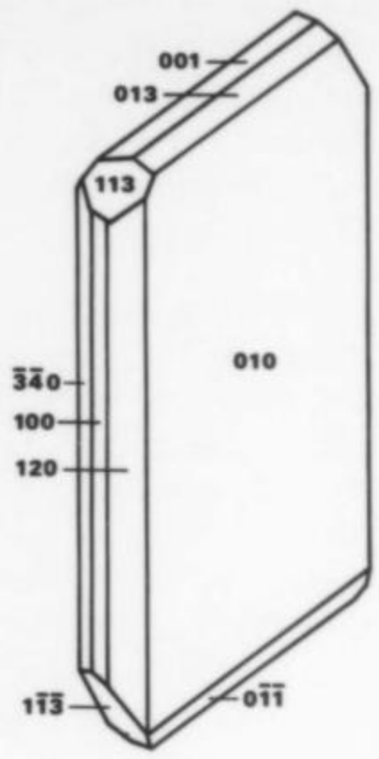


Figure 154. **Vuonnemite crystal drawing, from measurements made on a reflecting goniometer and drawn from a gnomonic projection.**

Vuonnemite $Na_5Nb_2Ti^{+3}(Si_2O_7)_2O_2F_2 \cdot 2Na_3PO_4$

Vuonnemite was originally described from the valley of the Vuonnemi River, Kola Peninsula, USSR (Bussen *et al.*, 1973). The mineral was also reported from the Ilímaussaq alkaline intrusion in Greenland (Rønsbo *et al.*, 1983).

At Mont Saint-Hilaire vuonnemite occurs exclusively in sodalite xenoliths, as well-formed, tabular crystals up to 2 cm in length and cleavage masses embedded in massive sodalite, or very rarely as free-standing crystals up to 6 mm long in small cavities. The crystals are very thin, tabular, square to rectangular, with dominant {010} pinacoids, often twinned and forming parallel, stacked aggregates. The color is pale yellow to lemon-yellow; crystals are predominantly transparent grading to translucent, with a vitreous to greasy luster. Vuonnemite is very brittle, with excellent to very good cleavage in three directions. Some crystals fluoresce intense greenish yellow under shortwave, and pale yellow under longwave ultraviolet radiation, retaining a faint bluish green phosphorescence for a short period.

Vuonnemite often alters to epistolite, with the pseudomorphs retaining the crystal morphology of the vuonnemite. The alteration is frequently incomplete, with residual vuonnemite remaining in the core of the epistolite pseudomorphs. These pseudomorphs are silvery gray and opaque with a pearly luster. Vuonnemite is relatively common in the sodalite xenoliths and the associated species include practically all the minerals found in this association. Good specimens with undamaged crystals are exceedingly rare, except for the free-growing, small crystals found in cavities.

Weloganite $Sr_3Na_2Zr(CO_3)_6 \cdot 3H_2O$

Weloganite was first described (Sabina *et al.*, 1968) from the Francon Quarry in Montréal, which is approximately 35 km northwest of Mont Saint-Hilaire. It has also been found in a limestone quarry in Montréal 15 km east of the type locality. At both localities weloganite occurs in igneous sills, believed to be related to the Monteregian alkaline intrusives. The mineral is triclinic (Chen and Chao, 1975; Grice and Perrault, 1975).

At Mont Saint-Hilaire weloganite is exceedingly rare, known only from a few specimens. It occurs as yellow, glassy fragments 1–2 mm across in large (1–2 cm) cavernous donnayite crystals in a large altered pegmatite cavity in a contact zone between igneous breccia and sodalite syenite. In addition to donnayite, it is also associated with strontianite, albite, siderite and pyrite.

Willemite Zn_2SiO_4

Willemite occurs as an extremely rare accessory mineral in some pegmatite veins and pipes. The crystals are usually very small, 1–3 mm in length, but some exceptional crystals up to 10 cm in length have also been found. The crystals are simple hexagonal prisms, generally poorly terminated by small pyramids and a basal pinacoid, and sometimes highly corroded. Small crystals are generally colorless and transparent, but most are covered by a dull, reddish, non-fluorescent coating. The larger crystals are beige, pale gray or pale blue and translucent to opaque with a dull to greasy luster. In the late 1960's, several superb, gemmy blue crystals up to 2.5 x 1.5 cm were found. From crystal fragments a few fine quality, pale blue gems up to 1.01 carats in weight have been cut.

Figure 155. **Willemite, a large, blue-gray, hexagonal prism measuring 7.5 cm in length. National Museum of Natural Sciences (Canada) specimen #37370. Photo by G. Robinson.**

Mont Saint-Hilaire willemite fluoresces brilliant green under shortwave and longwave ultraviolet radiation and displays a strong dull green phosphorescence for short periods.

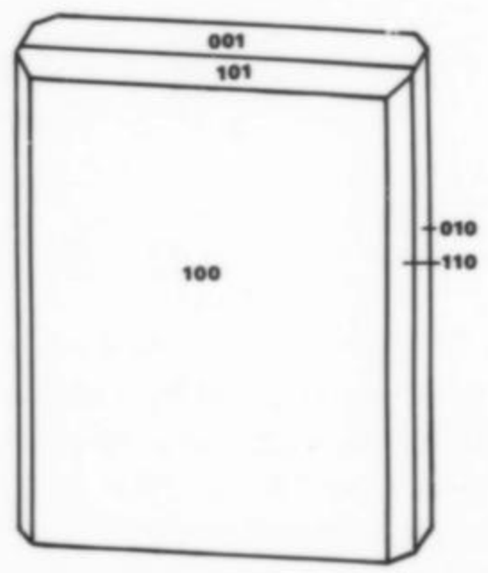


Figure 156. **Wöhlerite crystal drawing (modified from a crystal drawing of wöhlerite from Skudesundskjar, Norway, after Goldschmidt (1918)).**

Wöhlerite $NaCa_2(Zr,Nb)Si_2O_7(O,OH,F)_2$

Wöhlerite is a very rare mineral, occurring in miarolitic cavities in nepheline syenite as pale yellow to orange-yellow, thin, tabular crystals 1–5 mm in length, associated with analcime, natrolite, biotite, titanite, aegirine, eudialyte, astrophyllite and zircon. The crystals have frosty,

poorly defined terminations, and are transparent to translucent, except for etched crystals which are opaque. They commonly form aggregates of parallel growth crystals. Striations parallel to the *c*-axis are evident on the dominant {100} pinacoids and {110} prisms. the luster is greasy to vitreous.

In the paragenetic sequence of the miarolitic cavities wöhlerite is one of the earliest minerals to form.

Wollastonite $CaSiO_3$

Wollastonite-1T is a relatively uncommon constituent of the marble xenoliths, where it occurs as white to pale gray, fine-grained to granular or fibrous aggregates and small phenocrysts averaging 2 mm across, intimately intergrown with fibrous pectolite.

Wulfenite $PbMoO_4$

Wulfenite has been found as a very rare secondary mineral on galena crystals, in altered pegmatite veins, as druses and thin crusts of yellow to pale orange-yellow, dull, tapering, acicular, 0.5–2 mm crystals and as sharp, tetragonal prisms with very steep pyramidal terminations.

Wurtzite (Zn,Fe)S

Wurtzite occurs very rarely as very sharp, equant or elongate, hexagonal, hemimorphic, often etched, 0.5–3 mm skeletal crystals in pegmatites and in sodalite xenoliths. It has also been found as tetrahedral-shaped pseudomorphs to 1 cm, after an unknown mineral. The polytypes wurtzite-2H and the very rare wurtzite-4H have been identified from the sodalite xenoliths, while only the wurtzite-2H has been found in the pegmatite association.

The color ranges from yellow to orange-yellow, pink, pale green and reddish brown. The luster varies from dull to resinous. Weak fluorescence under longwave ultraviolet radiation has been noted; wurtzite-2H fluoresces red, while wurtzite-4H displays orange fluorescence.

Xenotime-(Y) YPO_4

Xenotime-(Y) is extremely rare, known from a single specimen from a miarolitic cavity, as sharp, lustrous, colorless to white, short tetragonal prisms 1–2 mm in length. It has also been reported from a pegmatite as white to gray radiating spherical aggregates.

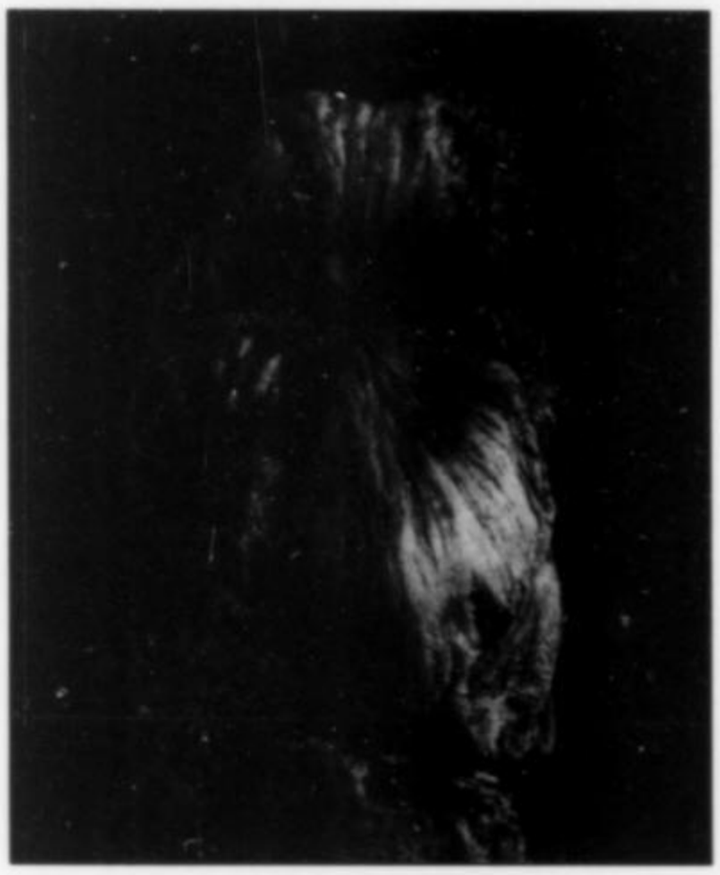


Figure 157. **Yofortierite in compact, radiating fibers. The specimen measures 7 cm in height. National Museum of Natural Sciences (Canada) specimen #36671. Photo by G. Runnells.**

Yofortierite $(Mn,Mg)_5Si_8O_{20}(OH)_2 \cdot 8–9H_2O$

Yofortierite, the manganese analog of palygorskite, was originally described from Mont Saint-Hilaire (Perrault *et al.*, 1975), which remains the only known occurrence for the mineral. It is found as fine, matted aggregates of random or radiating, extremely thin, capillary and fibrous crystals up to 3 cm in length in pegmatites and very rarely in igneous breccias. Fibrous masses often fill interstices between crystals of other minerals in the cavities. Yofortierite is very rare, but large quantities were collected from a single pegmatite vein in the late 1960's and most specimens originate from that single find. In pegmatites it is associated with analcime, aegirine, serandite, polylithionite, eudialyte, microcline, albite, brockite-(Ce) and the new mineral, thornasite. In breccias, associated minerals include microcline, aegirine, lorenzenite, elpidite, leucosphenite, narsarsukite and steacyite.

The color is pink to pale violet, violet and brown, with a silky to dull luster.

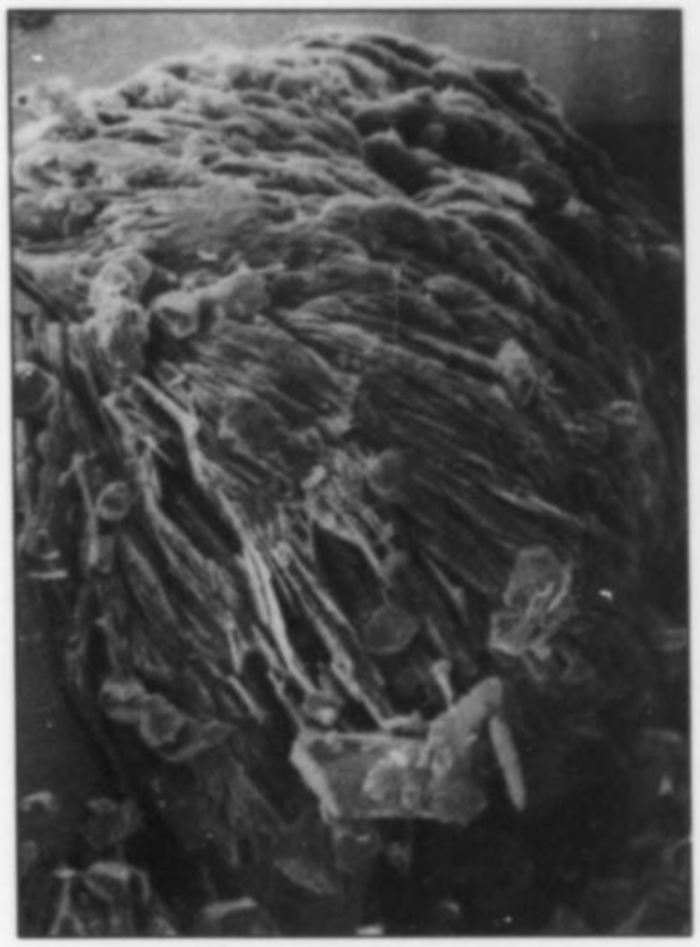


Figure 158. **Zeophyllite, a compact, spherical aggregate of foliated crystals approximately 1 mm in diameter. Horváth collection. SEM photo by E. Vadas.**

Zeophyllite $Ca_4Si_3O_8(OH,F)_4 \cdot 2H_2O$

Zeophyllite, a very rare silicate mineral (Chalmers *et al.*, 1958), is an exceedingly rare accessory mineral in cavities of the marble xenoliths at Mont Saint-Hilaire. It is found as very small, rounded, thin, radiating, foliated plates forming 0.1–1 mm spherical aggregates. The mineral is pure white and opaque with a silky luster.

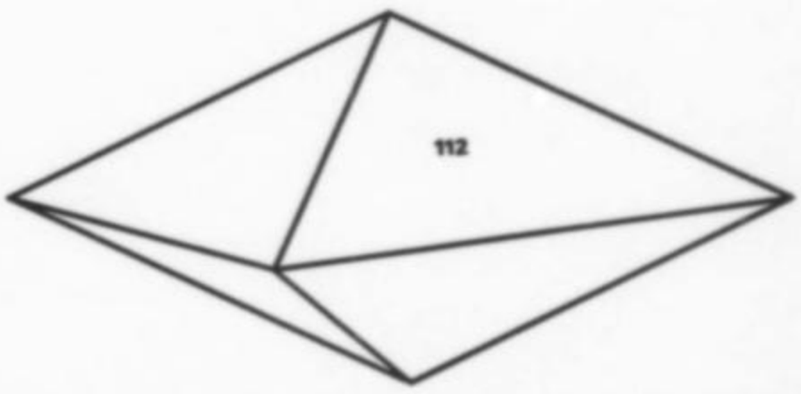


Figure 159. **Zircon crystal drawing showing the most common observed form, the tetragonal dipyramid {112}.**

Zircon $ZrSiO_4$

Zircon is fairly common in altered and carbonate-rich pegmatites, occurring as sharp, lustrous, tetragonal bipyramids, up to 2 cm across, and less frequently as 1–5 mm crystals of varied habits in miarolitic cavities, marble xenoliths and breccia cavities.

The dominant form is the {101} pyramid. Some crystals exhibit well-developed {110} and less prominent {100} prisms and uncommonly a {111} or {211} pyramid.

The color ranges from pale brown (most common), yellow, pink, orange and almost colorless, with distinct color zoning and phantoms apparent in some crystals. The luster is dull to vitreous. Most crystals are opaque with translucent zones; it is rarely transparent in smaller crystals. Most crystals exhibit internal as well as external fractures and some zircons are slightly metamict. Some crystals fluoresce intense yellow-orange under shortwave ultraviolet radiation.

Table 10. **The minerals of Mont Saint-Hilaire.**

Elements
Bismuth
Graphite-2H
Lead

Sulfides
Alabandite
Arsenopyrite
Chalcopyrite
Erdite
Galena
Gersdorffite
Greigite
Löllingite
Marcasite
Millerite
Molybdenite-2H
Molybdenite-3R
Pyrite
Pyrrhotite-4C
Rasvumite
Sphalerite
Tetrahedrite
Thalcusite
Wurtzite-2H
Wurtzite-4H

Oxides
Anatase
Behoite
Birnessite
Brookite
Corundum
Doyleite
Franconite
Gibbsite
Goethite
Hematite
Hochelagaite
Ilmenite
Kaolinite
Lepidocrocite
Lueshite
Magnetite
Nordstrandite
Pyrochlore
Pyrophanite
Quartz
Rutile
Senaite
Spertiniite

Halides
Cryolite
Fluorite
Griceite
Halite
Neighborite
Villiaumite

Carbonates
Ancylite-(Ce)
Ankerite
Aragonite
Bastnäsite-(Ce)
Burbankite
Calcio-ancylite-(Ce)
Calcite
Carbocernaite
Cerussite
Cordylite-(Ce)
Daqingshanite-(Ce)
Dawsonite
Dolomite
Donnayite-(Y)
Ewaldite
Hydrocerussite
Hydrozincite
Kutnohorite
Magnesite
Mckelveyite-(Y)
Natrite
Natron
Parisite-(Ce)-18T
Parisite-(Ce)-72T
Rhodochrosite
Sabinaite
Shortite
Siderite
Strontianite
Synchysite-(Ce)-12T
Synchysite-(Ce)-24T
Thermonatrite
Trona
Weloganite

Sulfates
Anglesite
Barite
Beudantite
Celestine
Gypsum
Halotrichite
Jarosite
Kogarkoite
Szomolnokite

Phosphates and Arsenates
Beryllonite
Britholite-(Ce)
Brockite
Carbonate-fluorapatite
Dorfmanite
Erythrite
Fluorapatite
Mimetite
Monazite-(Ce)
Nahpoite
Natrophosphate
Rhabdophane-(Ce)
Sidorenkite
Vitusite-(Ce)
Xenotime-(Y)

Tungstates
Scheelite

Molybdates
Wulfenite

Silicates
Actinolite
Aegirine
Albite
Allanite-(Ce)
Analcime
Andradite
Annite
Arfvedsonite
Ashcroftine-(Y)
Astrophyllite
Augite
Barylite
Barytolamprophyllite
Bavenite
Berthierine
Beryl
Biotite
Cancrinite
Carletonite
Catapleiite
Cerite-(Ce)
Chabazite
Chamosite
Chkalovite
Clinochlore
Cordierite
Datolite
Diopside
Dravite
Edingtonite
Elpidite
Epididymite
Epidote
Epistolite
Eudialyte
Eudidymite
Fluorapophyllite
Gaidonnayite
Ganophyllite
Garronite
Genthelvite
Gismondine
Gmelinite
Gobbinsite
Götzenite
Grossular
Harmotome
Hedenbergite
Helvite
Hemimorphite
Hilairite
Hisingerite
Hornblende
Hydrogrossular
Hydroxyapophyllite
Hypersthene
Joaquinite-(Ce)
Kaersutite
Kainosite-(Y)
Kupletskite
Labuntsovite
Lamprophyllite
Lavenite
Leifite
Lemoynite
Leucophanite
Leucosphenite
Lizardite-1M
Lorenzenite
Lovozerite
Magadiite
Magnesio-arfvedsonite
Makatite
Mangan-neptunite
Meionite
Microcline
Milarite
Miserite
Monteregianite-(Y)
Montmorillonite
Mosandrite
Muscovite
Narsarsukite
Natrolite
Nenadkevichite
Neotocite
Nepheline
Parakeldyshite
Paranatrolite
Paraumbite
Pectolite
Penkvilksite
Perraultite
Petarasite
Phillipsite
Phlogopite
Polylithionite
Poudretteite
Prehnite
Raite
Revdite
Richterite
Riebeckite
Rosenbuschite
Sanidine
Sazhinite-(Ce)
Searlesite
Sepiolite
Serandite
Siderophyllite
Sodalite
Spessartine
Steacyite
Steenstrupine-(Ce)
Stillwellite-(Ce)
Sugilite
Tadzhikite-(Ce)
Taeniolite-1M
Terskite
Tetranatrolite
Thaumasite
Thomsonite
Thornasite
Thorogummite
Titanite
Tremolite
Tugtupite
Tundrite-(Ce)
Ussingite
Vesuvianite
Vinogradovite
Vuonnemite
Willemite
Wöhlerite
Wollastonite-1Tr
Yofortierite
Zeophyllite
Zircon

Table 11. **Fluorescent minerals at Mont Saint-Hilaire.**

Abbreviations: Int = intensity S = strong W = weak

Mineral	Ultraviolet Fluorescence				Phosphorescence		Remarks
	Shortwave		Longwave				
	Int	Color	Int	Color	Int	Color	
Albite	W	cherry red	—	— — —	—	— — —	
Analcime	W	green	W+	green	—	— — —	not all fluorescent
Burbankite	W	pink	—	— — —	—	— — —	not all fluorescent
Calcite	S-W	white & red	S-W	white & red	—	— — —	
Catapleiite	W	green	W	green	—	— — —	not all fluorescent
Cerussite	W	pink-yellow	W+	pink-yellow	—	— — —	
Elpidite	W	yellow & green	—	— — —	—	— — —	not all fluorescent
Fluorapatite	W	blue	W	pinkish blue	—	— — —	
Fluorapophyllite	S	green	W	yellow	—	— — —	not all fluorescent
Fluorite	W	violet blue	S	violet blue	—	— — —	not all fluorescent
Franconite	S	yellowish white	W	yellow-white	—	— — —	
Gaidonnayite	S	green	S	green	—	— — —	some non-fluorescent
Genthelvite	S	green	S	green	S	yellow-green	
Griceite	W	pale yellow	—	— — —	—	— — —	not all fluorescent
Helvite	S+	deep red	S	deep red	—	— — —	
Hydrozincite	W	white	W	white	—	— — —	
Kogarkoite	S	pale blue	W	white	—	— — —	
Leucophanite	S	pink	S	pink	—	— — —	
Leucosphenite	S	yellowish white	—	— — —	—	— — —	
Lorenzenite	S	pale yellow	—	— — —	—	— — —	
Meionite	S	yellow-white	S	red	—	— — —	
Milarite	W	bluish white	—	— — —	—	— — —	
Monteregianite-(Y)	S	green	—	— — —	—	— — —	
Natrolite	S	pale green	W	greenish white	—	— — —	not all fluorescent
Parakeldyshite	S	orange-white	—	— — —	—	— — —	
Pectolite	W	pink	S	orange-pink	—	— — —	
Polylithionite	S	lemon yellow	—	— — —	—	— — —	
Quartz	S	yellow-orange	S	yellow-orange	—	— — —	fluoresc. zones in some
Scheelite	S	whitish blue	—	— — —	—	— — —	
Searlesite	W	bluish green	—	— — —	—	— — —	
Sodalite	S	orange	S	orange	S	yellowish white	reversible photochromic
Sphalerite	W	yellow-orange	W	yellow-orange	—	— — —	
Terskite	W	yellowish white	W	yellowish white	—	— — —	
Tetranatrolite	S	pinkish white	S	pinkish white	—	— — —	
Thornasite	S	apple green	S	apple green	—	— — —	Ansell and Chao, 1987
Strontianite	W	white	W	white	—	— — —	
Tugtupite	S	red	S	red	W	pink	reversible photochromic
Villiaumite	W	red	—	— — —	—	— — —	
Vuonnemite	S	greenish yellow	W	pale yellow	W	bluish green	not all fluorescent
Willemite	S	green	S	green	S	green	
Wurtzite-2H	—	— — —	W	red	—	— — —	
Wurtzite-4H	—	— — —	W	orange	—	— — —	
Zircon	S	yellow-orange	—	— — —	—	— — —	not all fluorescent

Table 12. **Mineral distribution and rarity at Mont Saint-Hilaire.**

Mode of occurrence:
PE = Pegmatites
AP = Altered pegmatites
MX = Marble xenoliths
SS = Sodalite syenite
MC = Miarolitic cavities
HF = Hornfels
BR = Igneous breccia
SX = Sodalite xenoliths
RF = Rock forming minerals

Rarity: Common <–1, 2 . . . . 9, 10–> Rare

Distribution of species and rarity at MSH and in mode of occurrence

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Actinolite	8							8		
Aegirine	1	1	1	5	2	2	8	2	5	4
Alabandite	10								10	
Albite	2	2	2	4	1	1	3	1	3	
Allanite-(Ce)	9			10			10			
Analcime	2	2	2	8	3	1		8	8	
Anatase	6	9	9		5	6	4	7	10	
Ancylite-(Ce)	4	3	3	6	9	7		7	10	
Andradite	7			7		5				
Anglesite	10		10							
Ankerite	8		7							
Annite	6	8			5				10	
Aragonite	10					10				
Arfvedsonite	3	3	3	7						
Arsenopyrite	7		7	7		7		10	10	
Ashcroftine-(Y)	9					10		9		
Astrophyllite	3	2	2			8	9		7	6
Augite	10									
Barite	9					9	10	10		
Barylite	10	10				10				
Barytolampro-phyllite	10								9	
Bastnäsite-(Ce)	6	7	7	9		6	8	6		
Bavenite	9			8						
Behoite	9	9	9			10		10		
Berthierine	9		9							
Beryl	10						10			
Beryllonite	10						10			
Beudantite	10		10							
Biotite	4	4	4	3	3	2		5		3
Birnessite	6		5							
Bismuth	10								10	
Britholite-(Ce)	10								10	
Brockite	10		10							
Brookite	6					5	7	4		
Burbankite	7		10	10	9	6			10	
Calcio-ancylite-(Ce)	8	9		10	10					
Calcite	2	6	5	1	2	2	1	3	9	
Cancrinite	4				5				9	7
Carbocernaite	10							10		
Carbonate-fluor-apatite	9		9							
Carletonite	7			6				10		
Catapleiite	4	4	3	8		7		9	8	
Celestine	9		10				9			
Cerite-(Ce)	9	9								
Cerussite	9		10					10		
Chabazite	9		10	9					9	
Chalcopyrite	9		8				10			
Chamosite	9	10		9						
Chkalovite	10								10	

Distribution of species and rarity at MSH and in mode of occurrence

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Clinochlore	9			9						
Cordierite	10						10			
Cordylite-(Ce)	8		9				9	8		
Corundum	10						10			
Cryolite	10								10	
Daqingshanite-(Ce)	10		10							
Datolite	8		10	7						
Dawsonite	7				5		9			
Diopside	8			10			9			
Dolomite	6						5			
Donnayite-(Y)	6	9	6	10	6	5	9	8		
Dorfmanite	10								10	
Doyleite	10		10							
Dravite	9						9			
Edingtonite	10					10				
Elpidite	5	7	4	9		8	7	4		
Epididymite	5	5	5				9	7		
Epidote	9			9			9			
Epistolite	8	9							6	
Erdite	10								10	
Erythrite	10	10								
Eudialyte	3	4	7	9		7		8	3	
Eudidymite	8	7	9				10	10		
Ewaldite	9					8		9		
Fluorapatite	5	7	5	4		4	3	5	9	
Fluorapophyllite	5			2				4		
Fluorite	3	5	4	2		6	4	7	4	
Franconite	7				8	10	10			
Gaidonnayite	5	8	5			8	8	9		
Galena	4	6	4	6	6	5	6	6	7	
Ganophyllite	10							10		
Garronite	10								10	
Genthelvite	7	6	8							
Gersdorffite	10						10			
Gibbsite	9		9		10	10				
Gismondine	10							10		
Gmelinite	5						3		8	
Gobbinsite	10	10								
Goethite	5		5				5			
Götzenite	9			9						
Graphite	10								10	
Greigite	10	10								
Griceite	8								6	
Grossular	8			8						
Gypsum	8		9		10		9			
Halite	10								10	
Halotrichite	10		10							
Harmotome	6					6		5	6	
Hedenbergite	10	10								
Helvite	9		9	10						
Hematite	8				10	10	10			

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Hemimorphite	10		10							
Hilairite	8		8			9				
Hisingerite	7		7							
Hochelagaite	7		7		8	10	10			
Hornblende	7			8				8		
Hydrocerussite	10		10							
Hydrogrossular	9			9						
Hydroxy-apophyllite	7			7						
Hydrozincite	10		10							
Hypersthene	10						10			
Ilmenite	6				6	3				
Jarosite	8		9		10					
Joaquinite-(Ce)	10							10		
Kaersutite	6									6
Kainosite-(Y)	10							10		
Kaolinite	9			9	10					
Kogarkoite	9								9	
Kupletskite	7	6	7							
Kutnohorite	8	9	9		10					
Labuntsovite	8					9		7		
Lamprophyllite	9								9	
Lavenite	8		8							
Lead	10							10		
Leifite	7	7								
Lemoynite	8		8	10						
Lepidocrocite	10		10							
Leucophanite	6	5		10						
Leucosphenite	7			10				5		
Lizardite	10		10							
Löllingite	9		9				10		10	
Lorenzenite	6			8			7	5	10	
Lovozerite	9								8	
Lueshite	9								9	
Magadiite	10			10						
Magnesio-arfvedsonite	9			9						
Magnesite	9						8			
Magnetite	9				9	9				
Makatite	10								10	
Mangan-neptunite	7	6						9	10	
Marcasite	8		9				8			
Mckelveyite-(Y)	10		10				10			
Meionite	8			7						
Microcline	1	1	1	4	2	1	5	1	8	3
Milarite	10			10						
Millerite	10							10		
Mimetite	10		10							
Miserite	7			6						
Molybdenite	4	9	8	5	4	4	4	4	4	
Monazite-(Ce)	9		9							
Monteregianite-(Y)	6	10		6		8		7		
Montmorillonite	10			10						
Mosandrite	7	9	7			5			9	
Muscovite	7		9	9	9		10			
Nahpoite	10								10	
Narsarsukite	5			9			5	5		
Natrite	10								10	
Natrolite	1	1	1	6	1	1		7	3	
Natron	9								9	

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Natrophosphate	10								10	
Neighborite	9	10					10			
Nenadkevichite	6	5	6	9				9		
Neotocite	6		6							
Nepheline	1	8			6	5			6	1
Nordstrandite	7		8		8					
Parakeldyshite	10								10	
Paranatrolite	2	2	2	8	2	2		4	9	
Paraumbite	10		10						10	
Parisite-(Ce)	8	8	7			10		9		
Pectolite	2			1	4			4	4	
Penkvilksite	10	10		10						
Perraultite	10	10								
Petarasite	8		8						10	
Phillipsite	7	9				9			6	
Phlogopite	7			7	7					6
Polylithionite	5	3	5	9						
Poudretteite	10			10						
Prehnite	10			10			10			
Pyrite	4	7	5	4	4	4	2	6		
Pyrochlore	5	5	5						10	
Pyrophanite	5	6	6			3		7	10	
Pyrrhotite	4	8	5	5		4	3	3		
Quartz	3		6	4			1	2		
Raite	9	10							10	
Rasvumite	10								10	
Revdite	10								10	
Rhabdophane-(Ce)	9	9	9							
Rhodochrosite	4	3	4							
Richterite	8							8		
Riebeckite	8			8			8			
Rosenbuschite	10					10				
Rutile	5		4		4	6	3	6		
Sabinaite	9		10		10					
Sanidine	9			8						
Sazhinite-(Ce)	10								10	
Searlesite	10								10	
Scheelite	10					10				
Senaite	10	10								
Sepiolite	8			6						
Serandite	4	3	5	10					5	
Shortite	10			10					10	
Siderite	3		2	8	4	9	3			2
Siderophyllite	9				9					
Sidorenkite	10								10	
Sodalite	2		8	6	1	5		9	1	2
Spertiniite	10								10	
Spessartine	9						9			
Sphalerite	5	5	4	5	4	5	4	6	4	
Steacyite	8	9		8			10	7		
Steenstrupine-(Ce)	9								9	
Stillwellite-(Ce)	9			10				10		
Strontianite	7						5	8		
Sugilite	10			10						
Synchysite-(Ce)	7		7			10		10		
Szomolnokite	10		10							
Tadzhikite-(Ce)	9			8				10		
Taeniolite	8			8				9		
Terskite	9								9	
Tetrahedrite	10								10	

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Tetranatrolite	3	3	5	8	4	3		4	7	
Thalcusite	10								10	
Thaumasite	8		10	8						
Thermonatrite	9								7	
Thomsonite	9					10		10		
Thornasite	10		10							
Thorogummite	9						10		10	
Titanite	6		8	6		8		4		
Tremolite	9			9			9			
Trona	10								10	
Tugtupite	10								10	
Tundrite-(Ce)	8	9		10						
Ussingite	7								6	
Vesuvianite	5			3						

Mineral	MSH	PE	AP	MX	SS	MC	HF	BR	SX	RF
Villiaumite	7								3	
Vinogradovite	9	10				10		9	10	
Vitusite-(Ce)	10								10	
Vuonnemite	8								6	
Weloganite	10		10							
Willemite	8	8								
Wöhlerite	10					10				
Wollastonite	6			5						8
Wulfenite	9		9					10		
Wurtzite	9	9							10	
Xenotime-(Y)	10	10				10				
Yofortierite	8		8					9	10	
Zeophyllite	10			10						
Zircon	4		4	7		3		6		

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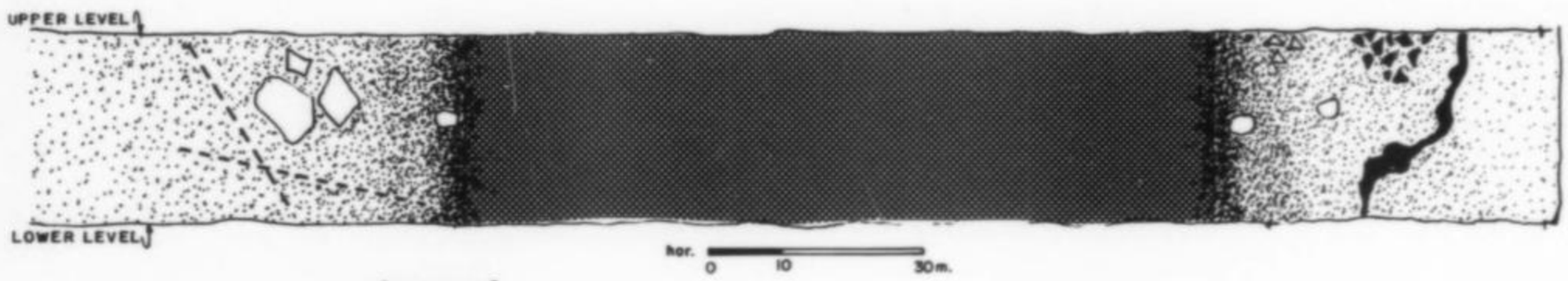
Hornfels Unit



Legend

- Hornfels
- Nepheline Sodalite Syenite
- Sodalite Inclusions
- Marble Xenolith
- Vugs
- Hornfels Breccia
- Pegmatite
- Vents
- Altered Marble Xenolith

Figure 1. **Horizontal and longitudinal sections through the hornfels unit.**

A HORNFELS UNIT IN THE POUDRETTE QUARRY

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The Poudrette quarry on Mont Saint-Hilaire continues to be a source of rare mineral species not previously known from similar agpaitic complexes in Russia, Greenland and elsewhere. The recovery of well-crystallized, rare species at the Poudrette quarry has been prolific between 1984 and the present.

Staff members of the National Museum of Natural Sciences, Mineral Sciences Division, have characterized a unique occurrence in the Poudrette quarry. A massive hornfels unit, contact zone and accompanying inclusions and xenoliths, were initially identified late in 1985. The aureole surrounding the hornfels is host to more than half of the identified species known from the quarry. Approximately 25 species previously unreported from Mont Saint-Hilaire including several unknowns, have been found in the aureole. During removal of the hornfels unit and surrounding aureole, well-crystallized specimens were collected from six principal modes of occurrence.

GEOLOGY

The petrogenesis of Mont Saint-Hilaire has been described by Currie (1983), Currie *et al.* (1986) and others with a comprehensive summary by Mandarino *et al.* (1986). Clark (1955) suggested that upper Ordovician sediments were hornfelsed, thus forming a contact aureole around the mountain. Apatite fission-track age determination (Currie *et al.*, 1986) demonstrated there were two periods of igneous activity, resulting in the formation of three principal suites of igneous rock.

The hornfels unit and accompanying xenoliths represent a large block of Ordovician and earlier sediments which was detached at depth during igneous activity, initially rising with the magma and then slumping into the magma. Subsequent contact metamorphism, the escape of volatiles, and the chemistry of Ordovician sediments contributed to the diverse and unique mineral assemblages present in the aureole and hornfels unit.

Mandarino *et al.* (1986) stated that a chloride-rich brine may have been present during mountain-building processes.

The relationship and position of the hornfels unit, marble xenolith and inclusions (Fig. 1) suggest convectional transport. The hornfels unit probably acted as a heat sink, (R. Herd, personal communication 1986), contributing to increased viscosity of the magma surrounding the hornfels, and trapping the xenoliths at its periphery.

Quarry operation in the late 1960's, early 1970's and 1987/88 exposed carbonate vents in close proximity to this hornfels unit and may represent vents that permitted volatile components such as carbon dioxide to escape.

Directional forces caused by and including upward transport, subsequent slumping, and possible later igneous activity below the unit were likely contributing factors causing extensive fracturing, particularly near the northwest side and near the periphery of the hornfels mass. A 10-meter fragment of hornfels was observed in nepheline-sodalite syenite in close proximity to the carbonate vents mentioned below. Chemical nutrients and volatiles likely migrated from enveloping magma and from below the hornfels mass into these fractures, resulting in the formation of a diverse assemblage of euhedral microminerals, including beryllonite, fluorapatite, gmelinite and rare phillipsite. Corundum, dravite, rutile, hypersthene and albite likely originated from the hornfels mass. However, all the above mentioned minerals were dominated by the early crystallization of siderite, calcite and quartz. Sulfides appeared late in this sequence.

The contact between the hornfels and the aureole is sharp. Gradational effects are apparent where nepheline, albite, altered clay and mica-group minerals are observed in a few samples collected in a close proximity (<2 m) from the contact.

X-ray, optical, and semiquantitative energy dispersion electron microprobe analysis enabled characterization of samples collected between 1984 and the present, from the hornfels unit in the quarry. For comparative purposes, samples were collected from the hornfels corona which dips into and surrounds the base of the mountain. Quartz (50%), + biotite (10%), + muscovite (10%), ± paragonite, minnesotaite? (<5%) were determined in samples collected from the hornfels unit in the quarry. Samples collected from the corona are compositionally similar, but quartz is greater than 50%. However, samples collected towards the center of the hornfels unit in the quarry revealed quartz 40%, cordierite 30%, biotite 15%, muscovite 10% and andesite 5%. Percentages of individual minerals were estimated visually with the aid of a scanning electron microscope.

As has been shown for similar assemblages, conditions of medium temperatures (>500°) and relatively low pressures (1–4 kb) probably prevailed during the formation of the above assemblage (Winkler, 1974; Turner, 1968). Lorraine and Richmond Group sediments composed of shale and argilliceous limestones surround the mountain.

MINERAL OCCURRENCES

Sodalite Inclusions

This type of inclusion, which is similar in appearance to breccia fragments, but is termed an inclusion, probably formed during earlier igneous activity. Fragments were subsequently caught up and suspended in ensuing magma during later igneous activity. Isolated and small groups of these inclusions, to about 1 meter in size, were observed throughout the main nepheline-sodalite mass in the quarries but were relatively devoid of any exotic species. However, concentrations of sodalite inclusions, characterized by the presence of sodalite + zeolites (major analcime, minor natrolite), villiaumite and ussingite, were observed *in situ* on the periphery of the contact zone sur-

rounding the hornfels unit. These inclusions host an unusual number of rare and new species not previously encountered at the locality. In a single inclusion measuring in part, 25 x 50 x 100 cm, in nepheline-sodalite syenite, 37 species were identified. Thirteen of these species were previously unreported for the locality, and there remain several unknowns. Most associated zeolites, phosphates, sulfides and oxides crystallized in micro-voids in subhedral crystal masses of sodalite. Very rare species identified in this inclusion include thalcusite, nahpoite, chklovite and griceite (Van Velthuizen and Chao, 1989).

Marble Xenolith

This type of xenolith is an important component of the aureole. Large angular fragments, up to 3 meters across and composed primarily of coarse-grained calcite, were observed *in situ* in the aureole. Mandarino *et al*. (1986) suggested that these xenoliths may have developed from Precambrian sediments. The xenoliths are characterized by pectolite, sodic amphiboles, apophyllite and vesuvianite as the dominant phases present. In early spring of 1986, quarry operations exposed a concentration of marble xenoliths located in the aureole. Many fine specimens of carletonite, pectolite and apophyllite were collected in cavities that were 10 to 20 cm in size. A highly altered xenolith found on top of the hornfels unit in the fall of 1987 was host to perhaps the world's finest specimens of carletonite crystals, to more than 4 cm in size, associated with carbonates, fluorite and epididymite crystals (to about 1 cm). In the spring of 1988 a cavity measuring about 10 x 25 cm, with individual pectolite crystals to 6 cm, fibrous yellow-green vesuvianite to over 1 cm and apophyllite crystals to over 2 cm was found. Other rare species present include tadzhikite, milarite, sugilite and poudretteite (Grice *et al*., 1987).

Partially altered marble xenoliths characterized by the presence of fine-grained feldspars, disseminated crystals of euhedral pyrite to 2 cm with dominant {210} and {100} faces, and occasional garnet and vesuvianite were observed rarely close to the contact between the hornfels unit and the aureole.

Vugs

Vugs in the aureole may represent voids that were created by escaping volatiles reacting with components in the magma when the hornfels unit was slumping into the magma. The majority of vugs are characterized by the presence of nepheline, sodalite, pectolite, amphiboles and mica-group minerals as the dominant phases present. The crystallization sequence of 2-meter vugs exposed during quarry operations, December 1986, observed *in situ* and described from the outside edge of the vug towards its center, is: fine-grained nepheline-sodalite syenite → a rim of fine grained villiaumite + arfvedsonite surrounding the outside edge of the vug, → vug wall → massive nepheline → euhedral nepheline crystals to 4 cm → possible contemporaneous development of millimetric anhedral thermonatrite observed on and in villiaumite cleavages to 8 cm → natron fragments to 2.5 cm.

Of interest is the presence of natron in these vugs. Upon exposure to air at room temperature, natron, $Na_3Co_3 \cdot 10H_2O$, very rapidly dehydrates to thermonatrite, $Na_2CO_3 \cdot H_2O$. Natron is similar to ice in appearance. Preliminary X-ray diffraction study using a powder mount indicated major thermonatrite with very minor natron. Employing a different method where a gandolfi mount was prepared at 5°C and sealing the grain with silicone grease to prevent loss of water, and employing a short exposure time, revealed a sharp X-ray diffraction pattern which was in excellent agreement with published X-ray data for natron (P.D.F. 15-800). Other rare species found in these vugs, which developed late in the paragenetic sequence, include terskite, vinogradovite, dorfmanite and vuonnemite.

Exceptional millimetric, bright orange labuntzovite crystals displaying pseudohexagonal morphology, 1-cm ilmenite rosettes, 1-cm lemon-yellow to orange burbankite crystals, millimetric brown hiortdahlite crystals associated with fibrous light yellow rosenbushite sprays to 2 mm, 0.2-mm edingtonite crystals and other species were observed as late-forming minerals on analcime crystals (and analcime overgrown on cancrinite crystals to 2 cm) in a rarely encountered vug type in nepheline syenite in the aureole.

A second group of meter-scale vugs was encountered in 1986 adjacent to the hornfels unit in nepheline-sodalite syenite and contained several anhydrous and hydrous species. One vug contained natrolite with individual euhedral prisms to 15 cm. A group of natrolite crystals 60 cm across, and ancylite pseudomorphs after an unknown species to 10 cm were collected. Other species present include fluorite, zircon and rhodochrosite.

Vents

The exposure of a vent in the quarries on Mont Saint-Hilaire generates much interest, as tons of exceptional well-formed specimens have been excavated from such vents in the past. Perhaps the most famous of these vents was located adjacent (northeast side) to the hornfels unit and was about 20 meters in height and 1 meter in diameter, with a chamber at the bottom which attained a size of 2 meters in all directions. Perhaps as much as 2 tons of siderite crystals to 30 cm in size on albite associated with lesser amounts of synchisite, zircon, sphalerite, rutile and other species were collected. Three different mineral groups, sodic and potassic feldspars, zeolites and carbonates are consistently present in all observed vents in the quarries; however, the accessory species are diverse in assemblage and include serandite, bastnaesite, fluorite, sphalerite, pyroxenes, amphiboles and astrophyllite-group minerals.

In the late fall of 1987 a vent was exposed during quarry operations in close proximity to the hornfels unit. This vent in sodalite syenite was erratic in course, pinched and swelled to more than 30 meters in height and was highly mineralized. The dominant phases present were feldspars, zeolites and carbonates. Most species present in this vent had been altered. Individual analcime crystals attain dimensions of 30 cm and siderite crystals to 20 cm were collected; zoned weloganite (?) crystals to 2.5 cm were also found. Alternating zones of donnayite and strontianite around a core of weloganite were identified by X-ray powder diffraction, and confirmed by semi-quantitative electron microprobe analyses. Accessory species present are hilarite, as exceptional microcrystals in altered analcime, natrolite (rare), rutile, sphalerite, calcite, quartz and fluorite. Large 5-cm pseudomorphs of pyrite after pyrrhotite (?) were also found. A 1-meter marble xenolith observed *in situ* adjacent to the chamber was host to a 20-cm mass of monazite.

Two smaller vents were exposed in the early spring of 1988 that angled toward the aureole from below the hornfels unit. Good analcime and natrolite crystals as well as pyroxenes, amphiboles and zeolites were collected. Of interest, during recent drilling operations (Spring 1988) a drill steel passed through a void that is at least the length of the drill steel. This void is below the floor of the first level and possibly below the hornfels unit.

Hornfels Breccia

Large 50-cm unaltered fragments of hornfels breccia were commonly observed in the aureole and likely originated from the main hornfels unit during slumping. In most areas of brecciation, fragments were cemented by quartz; however, in one brecciated section of hornfels, the filling between fragments is dolomite. Exceptional pale to lime-green translucent crystals to 1 cm in size, associated with less than 1-mm anatase, sphalerite and rutile were found. Partially altered hornfels breccia found in the aureole is host to well-crystallized specimens of narsarsukite to about 1 cm, leucosphenite, elpidite and carbonates.

Pegmatites

The presence of pegmatites and vents located along the top of the

(continued on p. 368)

MONT SAINT-HILAIRE UNKNOWNS

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INTRODUCTION

Mont Saint-Hilaire has been an abundant producer of minerals new to science ever since the occurrence was first brought to the attention of mineralogists by Frank Melanson in 1963. So many problematical species were recovered that it soon became necessary to assign temporary code names to the unknowns. By the time the first list of unknowns was published (Chao *et al.*, 1967), code names from UK1 to UK19 had been assigned, ten of which were still unidentified or uncharacterized at that time. The second list, published 12 years later (Chao and Baker, 1979), included code names up to UK47, 22 of which remained unidentified.

Since that time, work has proceeded; many unknowns have been formally described as new species, and many newly discovered unknowns have been assigned code names. At present the list is up to UK84, and includes at least 44 species still to be identified or described.

For this special issue of the *Mineralogical Record*, the editor requested an up-to-date account of all the Mont Saint-Hilaire unknowns that have ever been assigned code names, including those subsequently identified or characterized. For those "UK" minerals which remain unnamed, brief descriptions of their properties, occurrences and associations are provided to facilitate their recognition. For references on the named "UK" species please see the principal article in this issue by Horváth and Gault.

UK1 Lorenzenite.
UK2 Narsarsukite.
UK3 Ancylite-(Ce).
UK4 Steacyite.
UK5 Labuntsovite.
UK6 Monteregianite-(Y).
UK7 Lorenzenite.
UK8 Leucosphenite.
UK9 Mixture of pyrophanite and rutile.
UK10 Ancylite-(Ce).
UK11 Apophyllite group.
UK12 Cordylite-(Ce).
UK13 Lemoynite.
UK14 Epididymite.
UK15 Carletonite.
UK16 Lorenzenite.
UK17 Perraultite.
UK18 Tundrite-(Ce).
UK19 Nenadkevichite.
UK20 Hilairite.
UK21 Vesuvianite.
UK22 Britholite-(Ce).
UK23 Gaidonnayite.
UK24 Mixture of götzenite and another phase.
UK25 Yofortierite.
UK26 Mixture of parisite and albite.
UK27 Thornasite.
UK28 Vinogradovite.

UK29 **Chemistry:** $(Na,K,Ca)_{0.35-0.45}(Fe^{+2},Mg,Al,Mn,Ti)_{3.10-3.23}(Si,Al)_4O_{10}\cdot NH_2O$, a Fe^{+2} member of trioctahedral smectite.
Strongest X-ray Lines (dÅ(I)): 12.4(100), 2.636(20), 2.508(15), 2.309(10), 1.537(15), 1.528(10).
Properties: Black, dark reddish brown balls (1 mm) and golden yellow to reddish brown flakes in irregular patches encrusting microcline, analcime, natrolite, and others.

Occurrence and Associated Minerals: Pegmatites, altered pegmatites, silicate cavities, marble xenoliths. Microcline, analcime, natrolite, aegirine, chlorite, and others.

UK30 Mckelveyite-(Y).

UK31 Yofortierite.

UK32 **Chemistry:** Hydrous carbonate of Ca, Y and Al.
Symmetry: Hexagonal, P6/mmm, P622, P6mm, $P\bar{6}m2$ or $P\bar{6}2m$, $a = 10.830(2)$, $c = 10.516(5)$Å.
Strongest X-ray Lines (dÅ(I)): 9.38(100), 4.58(65), 3.77(45), 3.358(50), 2.491(70), 2.143(50)
Optics: Uniaxial (–), $\epsilon = 1.501(1)$, $\omega = 1.532(1)$.
Properties: White, silky fibrous aggregates, rarely colorless, hexagonal, acicular crystals with striations along the length. Good basal cleavage. D(meas.) = 2.15(1) g/cm³. Strong effervescence in HCl.
Occurrence and Associated Minerals: Pegmatite and silicate cavities. Microcline, albite, natrolite, aegirine, monteregianite-(Y), serandite, catapleiite, rhodochrosite, ancylite-(Ce), and others.

UK33 Donnayite-(Y).

UK33A **Chemistry:** $Sr_2Na_2(Ce,La)Y(CO_3)_6 \cdot 3H_2O$ (?), rare earth analogue of donnayite-(Y).
Symmetry: Pseudo trigonal, probably triclinic by analogy to donnayite-(Y).
Strongest X-ray Lines (dÅ(I)): 4.27(90), 3.207(50), 2.827(100), 2.023(60), 1.976(60), 1.916(60).
Properties: Not distinguishable from donnayite-(Y) in hand specimens.
Occurrence and Associated Minerals: Silicate and carbonate cavities(?). Similar association as for donnayite-(Y). Also as zoned polycrystals with weloganite in altered pegmatites.

UK34 Rhabdophane group.

UK35 Mixture of chabazite and another phase.

UK36 Miserite.

UK37 Ewaldite.

UK37A **Chemistry:** $Sr_3NaCaY(CO_3)_6 \cdot 3H_2O$ (?). Sr analogue of ewaldite.
Symmetry: Hexagonal, $P6_3mc$, $a = 5.193(1)$, $c = 12.25(1)$Å.
Strongest X-ray Lines (dÅ(I)): 4.50(60), 4.23(80), 3.023(100), 2.596(70), 2.391(50), 1.976(90).
Properties: White, gray, greenish gray, brown barrel-shaped and pagoda-shaped crystals, not distinguishable from donnayite-(Y), ewaldite and mckelveyite-(Y) in hand specimens.
Occurrence and Associated Minerals: Silicate and carbonate cavities, igneous breccia and pegmatites. Often as syntactic overgrowth and intergrowth with donnayite-(Y), mckelveyite-(Y) and ewaldite.

UK38 **Chemistry:** $(Na,K)_2(Mn,Fe,Ca,Ti,Al)_3(Si,Al)_8O_{20} \cdot 8H_2O$ (?), water assumed and by difference.
Symmetry: Trigonal P3 or $P\bar{3}$, $a = 14.659(3)$, $c = 12.667(2)$Å.
Strongest X-ray Lines (dÅ(I)): 12.65(100), 8.96(50), 4.01(50), 3.166(50), 2.839(60), 2.646(70).
Optics: Uniaxial (–), $\epsilon = 1.534(1)$, $\omega = 1.550(1)$.
Properties: Canary-yellow patches of minute flakes, rarely in small tabular hexagonal crystals. Also as pseudomorphs after a pseudo-dodecahedral mineral.
Occurrence and Associated Minerals: Sodalite xenolith. Terskite, lovozerite, ussingite, natrolite, microcline, and others. Also silicate cavities with yofortierite, analcime, albite, natrolite, polylithionite, and others.

UK39 Tadzhikite-(Ce).

UK40 Carbocernaite.

UK41 Penkvilksite.

UK42 Petarasite.

UK43 Franconite.

UK44 Daqingshanite-(Ce).

UK45 Doyleite.

UK46 Epistolite (previously murmanite).

UK47 Mixture of chabazite and natrolite.

UK48 **Chemistry:** $CaY_{2-x}(Si,Be,B)_4(O,OH)_{10} \cdot 2H_2O$.
Symmetry: Monoclinic $P2_1/m$ or $P2_1$, $a = 9.965(4)$, $b = 7.692(2)$, $c = 4.822(2)$Å, $\beta = 90.01(1)°$.
Strongest X-ray Lines (dÅ(I)): 6.09(50), 4.83(50), 3.778(30), 3.593(30), 2.882(100), 2.580(60).
Optics: Biaxial (+), $\alpha = 1.701(3)$, $\beta = 1.706(3)$, $\gamma = 1.715(3)$, $2V = 74(1)°$, $b = Y$, $c\Lambda X = 9.5°$.
Properties: Small (0.2 mm), beige, prismatic crystals, often in clusters.
Occurrence and Associated Minerals: Silicate cavities (?). Aegirine, biotite, albite, fluorapatite, analcime, pyrophanite, and others.

UK49 Mixture of terskite and UK38.

UK50 Hochelagaite.

UK50A Like hochelagaite with a slightly different X-ray pattern.

UK51 **Chemistry:** $Al(OH)_3$ (?)
Strongest X-ray Lines (dÅ(I)): 4.81(100), 4.34(60), 4.18(60), 3.90(30), 2.394(50), 2.293(40), very close to the pattern of nordstrandite.
Properties: White, translucent to opaque balls or irregular powdery patches.
Occurrence and Associated Minerals: Silicate cavities and pegmatites. Microcline, albite, nordstrandite, analcime, polylithionite, pyrite, sphalerite, and others. Also in cavities in sodalite syenite with albite and sphalerite.

UK52 **Chemistry:** Compositions vary, best represented by $(K,Na)_{4-x}(Mn,Fe)_{4-y}Si_8O_{20} \cdot nH_2O$, $x = 0–1.5$, $y = 0–0.5$, $n \approx 4$, water assumed and by difference.
Strongest X-ray Lines (dÅ(I)): 12.23(100), 5.10(30), 4.34(40), 2.823(50), 2.625(50), 1.674(30).
Properties: Red to reddish brown platy crystals forming spherical aggregates, also irregular grains with curved crystal faces.
Occurrence and Associated Minerals: Pegmatite. Microcline, aegirine, analcime, vinogradovite, pyrite, albite, calcite, ancylite-(Ce), steacyite, and others.

UK52A **Chemistry:** $(Na,K)_3Ti_2(Fe,Mn)_{2-3}Si_8O_{20} \cdot nH_2O$, $n \approx 4$, water assumed and by difference.
Strongest X-ray Lines (dÅ(I)): Same as for UK52.
Properties: Not distinguishable from UK52.
Occurrence and Associated Minerals: Same as for UK52.

UK53 **Chemistry:** $NaBSiO_4$.
Symmetry: Monoclinic $P2_1/n$, pseudo hexagonal, $a = 8.001(1)$, $b = 7.693(2)$, $c = 13.885(6)$Å, $\beta = 89.80(2)°$.
Strongest X-ray Lines (dÅ(I)): 4.34(60), 3.848(70), 2.778(100), 2.314(50), 2.217(60), 1.926(40).
Properties: Colorless, white, pink, pale blue, vitreous transparent to translucent, hexagonal crystals with striations along *c*, botryoidal aggregates, balls and radiating cluster of prismatic individuals, heavily twinned under polarizing microscope. $D_{meas} = 2.86$ g/cm³.
Occurrence and Associated Minerals: Sodalite xenoliths. Ussingite, villiaumite, serandite, steenstrupine, albite, cancrinite, vuonnemite, makatite, erdite, sidorenkite, rasvumite, tugtupite, terskite, UK38, UK53A, UK63, UK64, UK74, UK81, and others.

UK53A **Chemistry:** $NaBSiO_4$.
Symmetry: Hexagonal P6/m, P6, or $P\bar{6}$, $a = 8.036(3)$, $c = 7.709(3)$Å.
Strongest X-ray Lines (dÅ(I)): 4.02(40), 3.858(60), 3.564(50), 2.782(100), 2.321(50), 2.222(70).
Optics: Uniaxial (–), $\epsilon = 1.578(1)$, $\omega = 1.588(1)$.
Properties: Similar to those for UK53.
Occurrence and Associated Minerals: Similar to those for UK53.

UK54 Griceite.

UK55 **Chemistry:** $Cu_{2-x}S$, $x = 0.12$–0.37.
Strongest X-ray Lines (dÅ(I)): X-ray patterns vary; may be classified into four major structural groups, one of which is close to anilite Cu_7S_4.
Properties: Irregular grains, submetallic, black with a violet tint.
Occurrence and Associated Minerals: Sodalite xenoliths. Villiaumite, lovozerite, griceite, ussingite, analcime, and three unidentified secondary efflorescent phases.

UK56 **Chemistry:** $CaNb_4O_{11} \cdot 12H_2O$ (?), water assumed and by difference.
Strongest X-ray Lines (dÅ(I)): 10.28(100), 6.16(20), 4.78(60), 4.70(60), 2.680(30), 2.058(50).
Properties: White balls (0.5 mm) of silky fibers.
Occurrence and Associated Minerals: In veins in albite-quartz-hornfels. Albite, quartz, muscovite, siderite, ancylite-(Ce), beryl, and pyrrhotite.

UK57 **Chemistry:** $(Na,Ca,K)_6Si_{10}O_{24}(F,OH,Cl) \cdot 4H_2O$ (?), water assumed and by difference.
Symmetry: Triclinic P1 or $P\bar{1}$, $a = 9.62$, $b = 9.61$, $c = 12.10$Å, $\alpha = 86.99$, $\beta = 99.51$, $\gamma = 120.04°$.
Strongest X-ray Lines (dÅ(I)): 11.80(80), 5.94(70), 3.110(50), 2.978(30), 2.887(100), 1.819(60).
Properties: Pearly, white, micaceous.
Occurrence and Associated Minerals: Breccia (?). Narsarsukite, microcline, clinoamphibole.

UK58 group **Chemistry:** $M_4Al_2(OH)_{12}CO_3 \cdot 4H_2O$ (?), M = Mg, Fe, and Mn.
Symmetry: **Group-1,** hexagonal, $a = Nx5.3$, where $N = 1$ or 2, $c = 15$Å.
Group-2, trigonal, $a = 11.0$, $c = 22.8$Å.
Strongest X-ray Lines (dÅ(I)):
Group-1, 7.56(100), 3.774(70), 2.576(50), 2.218(50), 1.854(50), 1.554(40).
Group-2, 7.56(100), 3.774(70), 2.668(50), 2.344(30), 1.969(30), 1.586(20).
Optics: Uniaxial (–), $\epsilon = 1.531$–1.548, $\omega = 1.531$–1.587, birefringence = 0–0.039. Mn and Fe members are strongly pleochroic from light brown to brown.
Properties: Colorless and white (Mg), pale brown, brown, and pale blue (Mn,Fe). Hexagonal, tabular to prismatic and barrel-shaped crystals.
Occurrence and Associated Minerals: Pegmatite, carbonate and silicate cavities and rarely hornfels. Microcline, analcime, albite, smectite, kupletskite, chamosite, calcite, ancylite-(Ce), and others.

UK59 **Chemistry:** $NaCa(Mn,Fe)(Ti,Nb,Zr)Si_2O_7(O,F)_2$, Ca-analog of janhaugite and Ti-analog of lavenite.
Symmetry: Monoclinic $P2_1/a$, $a = 10.828(7)$, $b = 9.790(7)$, $c = 7.054(2)$Å, $\beta = 108.21(3)°$.
Strongest X-ray Lines (dÅ(I)): 3.945(20), 3.234(30), 2.859(100). 2.807(70), 1.762(20), 1.741(20).
Optics: Biaxial (–), $\alpha = 1.743(2)$, $\beta = 1.785(2)$, $\gamma = 1.810(5)$, $2V = 72$–$84°$. Y = b, $c\Lambda X = 15°$ in obtuse β. Dispersion moderate, r>v. Pleochroic, X = pale greenish yellow, Y = yellow, Z = brownish red to deep red.
Properties: Yellow fibrous to orange-brown crystals fattened on {100}, elongate along *c*. {100} cleavage distinct.
Occurrence and Associated Minerals: Nepheline syenite, silicate cavities. Microcline, aegirine, catapleiite, kupletskite, and donnayite-(Y).

UK60 **Chemistry:** Carbonate of Sr, Ba, Ca, rare earths, probably hydrous, Sr>Ba.
Strongest X-ray Lines (dÅ(I)): 4.45(100), 3.012(60), 2.563(30), 2.420(15), 2.211(40), 1.975(40).
Properties: Small (0.1 mm) pearly white, hexagonal plates or flakes in rosettes or irregular clusters.
Occurrence and Associated Minerals: Mainly in silicate cavities with microcline, eudialyte, aegirine, mosandrite, natrolite, fluorapatite, albite, clinoamphibole, and others. Also in sodalite xenolith with serandite, pyrochlore, mosandrite, microcline, aegirine, catapleiite, pyrite, pyrrhotite, goethite, fluorite, tetranatrolite, and others.

UK60A **Chemistry:** Similar to UK 60 with Ba>Sr.
Strongest X-ray Lines (dÅ(I)): 4.43(100), 4.05(20), 3.102(30), 2.557(70), 2.206(30), 2.163(30).
Properties: Similar to those for UK60.
Occurrence and Associated Minerals: Similar to those for UK60.

UK61 **Chemistry:** $Na_{1-2}Ca_2Ti_3Si_8O_{24}(OH)_{1-2} \cdot 5H_2O$ (?), water assumed and by difference. Ca-analog of zorite.
Symmetry: Orthorhombic Bmmm, Bmm2 or B222, $a = 23.19$, $b = 6.955$(x2), $c = 7.192$(x2)Å.
Strongest X-ray Lines (dÅ(I)): 11.59(100), 6.93(100), 5.27(30), 3.069(50), 2.984(30), 2.588(30).
Optics: Biaxial (+), $\alpha = 1.599(1)$, $\beta = 1.610(1)$, $\gamma = 1.696(1)$, $2V = 38(1)°$. X = *a*, Y = *b*, Z = *c*.

Properties: Off-white to pale tan, orange-brown prismatic crystals. Cleavages {001}, {100}, and {010} good.

Occurrence and Associated Minerals: Breccia (?). Calcite, microcline, analcime, aegirine, albite, eudialyte, sphalerite. Also quartz, calcite, aegirine, labuntsovite, and UK75.

UK62 **Chemistry:** $Na_3(Ca,Mn)_2(CO_3)_3(F,OH)$

Symmetry: Monoclinic C2/c or Cc, $a = 8.043(4)$, $b = 15.812(5)$, $c = 7.030(3)$Å, $\beta = 101.16(3)°$.

Strongest X-ray Lines (dÅ(I)): 7.081(70), 2.895(100), 2.711(80), 2.637(60), 2.039(60), 1.869(60).

Optics: Biaxial (–), $\alpha = 1.472(1)$, $\beta = 1.562(1)$, $\gamma = 1.569(1)$, $2V = 25(1)°$, $Y = b$, $X \Lambda c = 6°$ in acute β.

Properties: Vitreous, colorless, tan to brown, transparent to translucent masses and blocky to prismatic crystals (0.3 mm). Fracture conchoidal, cleavages {001} good, {010} imperfect. H about 3, $D_{meas} = 2.67(2)$ g/cm³. Dissolves rapidly in HCl with strong effervescence.

Occurrence and Associated Minerals: Sodalite xenoliths. Villiaumite, microcline, cancrinite, analcime, thermonatrite, steenstrupine, kogarkoite, shortite, burbankite, cryolite, and others.

UK63 **Chemistry:** $NaLi_2PO_4$

Symmetry: Orthorhombic Pmnb or $P2_1nb$, $a = 6.874(2)$, $b = 9.971(4)$, $c = 4.9281(5)$Å.

Strongest X-ray Lines (dÅ(I)): 4.02(100), 3.512(100), 3.440(100), 2.489(90), 2.462(90), 1.719(40).

Optics: Biaxial (–), $\alpha = 1.533(1)$, $\beta = 1.540(1)$, $\gamma = 1.541(1)$, $2V = 49(1)°$, $X = a$, $Y = c$, $Z = b$.

Properties: Vitreous, white, pale yellow, pale blue irregular grains with good {100}, {010}, {001}, and {110} cleavages. Fracture conchoidal.

Occurrence and Associated Minerals: Sodalite xenoliths. Ussingite, microcline, aegirine, analcime, vitusite, vuonnemite, terskite, rasvumite, chkalovite, revdite, UK38, UK53, UK53A, UK64, UK74, and others.

UK64 **Chemistry:** $Na_8Ca_2Ce(PO_4)_4(SiO_2)_4(OH,F)_3 \cdot 4H_2O$ (?), water assumed and by difference.

Symmetry: Orthorhombic $P22_12_1$, $a = 12.297(2)$, $b = 14.660(3)$, $c = 7.2454(4)$Å.

Strongest X-ray Lines (dÅ(I)): 9.42(80), 6.56(40), 6.29(40), 4.72(50), 3.948(60), 2.722(100), 2.577(70).

Optics: Biaxial, refractive indices≈1.52–1.64, (±) elongation. $X = b$, $Y = c$, $Z = a$.

Properties: Vitreous, brown to reddish brown, irregular grains to prismatic crystals, coated with a film of an amorphous substance; {001} and {110} cleavages good.

Occurrence and Associated Minerals: Sodalite xenoliths. Microcline, analcime, albite, natrolite, villiaumite, eudialyte, astrophyllite, vitusite, revdite, vuonnemite, ussingite, thermonatrite, natrophosphate, UK63, and others.

UK65 **Chemistry:** $Ba_4Ce(CO_3)_5F$ (?), CO_2 by difference.

Symmetry: Monoclinic $P2_1/m$ or $P2_1$, a = 13.18(1), b = 5.073(1), c = 6.724(4)Å, $\beta = 102.16(3)°$.

Strongest X-ray Lines (dÅ(I)): 4.02(100), 3.272(90), 2.539(30), 2.143(40), 2.007(50), 1.636(30).

Optics: Biaxial (–), $\alpha = 1.594(1)$, $\beta = 1.710(5)$, $\gamma = 1.715(5)$, $2V = 16(1)°$, $b = Y$, $c\Lambda Z = 26°$ in obtuse β.

Properties: Very small (0.1 mm) white to silvery gray, vitreous to dull crystals, often in dendritic and stellate groups. Effervescent in HCl.

Occurrence and Associated Minerals: Hornfels. Calcite, siderite, albite, quartz, pyrrhotite, pyrite, rutile, cordylite, and others.

UK66 Makatite.

UK67 **Chemistry:** Silicate of Zr, Na, K, Mn, Ca, and Fe, with low analytical total, probably not homogeneous.

Strongest X-ray Lines (dÅ(I)): 6.97(100), 6.47(90), 3.051(20), 2.702(30), 1.844(30), 1.744(30). Intensity and sharpness of lines vary.

Properties: White translucent balls (0.1 mm).

Occurrence and Associated Minerals: Breccia. Calcite, pectolite, hilairite, eudialyte, microcline, aegirine, fluorite, pyrite, and others.

UK68 **Chemistry:** Na, Mn, Nb oxide or hydroxide (?).

Strongest X-ray Lines (dÅ(I)): 10.30(100), 8.49(70), 7.83(60), 7.56(60), 2.911(60), 2.848(60).

Properties: Thin, bright yellow plates when fresh. Alters to red crumbly masses of splintered pieces of poor crystallinity.

Occurrence and Associated Minerals: Silicate cavities. Eudialyte, fluorapatite, aegirine, tetranatrolite, fluorite, rhabdophane-(Ce), and others.

UK69 **Chemistry:** $Na_2Zr_2Si_7O_{18}(OH,F)_2 \cdot 8H_2O$ (?), water assumed and by difference.

Strongest X-ray Lines (dÅ(I)): 6.47(70), 5.69(50), 3.954(70), 3.754(70), 3.122(80), 2.743(100).

Properties: White, gray, pale green, hexagonal crystals (0.5 mm). Some crystals are color-zoned, due to inclusions, dark green on the rim to pale green to gray near the core. Also rosettes of small (0.1 mm), brown, hexagonal, tabular crystals. X-ray single-crystal study showed the mineral to be strongly mosaic with an overall hexagonal symmetry.

Occurrence and Associated Minerals: Breccia. Microcline, analcime, biotite, clinoamphibole, calcite, albite, pyrrhotite, titanite, donnayite-(Y), burbankite, and others. Also in silicate cavities (?) with microcline and aegirine.

UK70 **Chemistry:** Siliicate of Ca, K, Mn, Nb, Al.

Strongest X-ray Lines (dÅ(I)): 9.93(100), 7.72(40), 7.48(40), 7.09(50), 3.633(20), 2.929(60).

Properties: Pink, earthy to porcelaneous alteration product. Also pseudomorphs after an unknown mineral.

Occurrence and Associated Minerals: Sodalite xenoliths. Analcime, microcline, aegirine, eudialyte, loellingite, steenstrupine, lovozerite, and others.

UK71 Mixture of astrophyllite and natrolite.

UK72 **Chemistry:** Ca silicate with minor Al and Fe.

Strongest X-ray Lines (dÅ(I)): 16.9(100), 3.410(40), 3.105(90), 2.930(50), 1.983(50), 1.876(70).
Properties: White irregular patches and balls of powder or very fine fibers.
Occurrence and Associated Minerals: Marble xenoliths. Wollastonite, pectolite, calcite, pyrrhotite, titanite, and others.

UK73 group
Chemistry: Probably hydrous Na carbonates, **three members.**
Strongest X-ray Lines (dÅ(I)): For one member, 9.76(100), 8.40(70), 3.931(80), 3.411(50), 2.792(90), 2.465(70).
Properties: White, powdery, silky, fibrous efflorescence. Soluble in water, effervescent in HCl. The three members give distinct X-ray patterns.
Occurrence and Associated Minerals: Sodalite xenoliths. Villiaumite, lovozerite, aegirine, albite, and others.

UK74
Chemistry: Silicate of Na, Ca, Ti with minor Fe and Nb.
Symmetry: Monoclinic C2/c, $a = 28.67(3)$, $b = 8.619(3)$, $c = 5.215(1)$Å, $\beta = 90.98(2)°$.
Strongest X-ray Lines (dÅ(I)): 14.32(100), 4.77(30), 2.995(50), 2.738(30), 2.149(20), 2.134(20).
Properties: White, fibrous aggregates, vitreous, white to colorless, acicular crystals.
Occurrence and Associated Minerals: Sodalite xenoliths. Ussingite, natrolite, serandite, aegirine, steenstrupine, sidorenkite, rasvumite, eudialyte, terskite, vuonnemite, vitusite, UK38, UK63, UK53, UK53A, and others.

UK75
Chemistry: $(Na,K)CaTi_2Si_{10}O_{25}(OH)\cdot 6H_2O$ (?), water assumed and by difference. Ti analogue of lemoynite.
Symmetry: Monoclinic C2/m, $a = 10.197(3)$, $b = 15.885(7)$, $c = 9.118(3)$Å, $\beta = 104.51(2)°$.
Strongest X-ray Lines (dÅ(I)): 8.85(80), 7.93(100), 6.85(50), 4.34(60), 3.509(90), 3.421(80).
Optics: Biaxial (+), $\alpha = 1.567(1)$, $\beta = 1.591(1)$, $\gamma = 1.618(1)$, $2V = 87°$, $X = b$, $Y \Lambda c = 15°$, $Z \Lambda a = 0°$.
Properties: Vitreous, brown, irregular grains (0.5 mm) in a carbonate matrix. Brittle with conchoidal fracture.
Occurrence and Associated Minerals: Breccia or marble xenoliths (?). Calcite, quartz, pectolite, biotite, clinoamphibole, labuntsovite, fluorite, UK61.

UK76
Chemistry: $Mn_6Al_3(SO_4)_2(CO_3)_x(OH)_{17-2x}\cdot yH_2O$ (?), y = 5–6, x unknown, water and CO_2 assumed and by difference.
Symmetry: Trigonal, $a = 3x3.1$, $c = 11.14$Å.
Strongest X-ray Lines (dÅ(I)): 11.05(100), 5.52(80), 3.684(50), 2.460(80), 2.204(80), 1.949(70).
Optics: Uniaxial (–), $\epsilon = 1.506(1)$, $\omega = 1.535(1)$.
Properties: Rosettes of pale brown, tabular, hexagonal crystals. Soluble in HCl with mild effervescence.
Occurrence and Associated Minerals: Pegmatite (?). Kupletskite, microcline, UK58 group, and others.

UK77 group
Chemistry: $NaCaSi_3O_7(F,OH)\cdot 2–3H_2O$ (?), water assumed and by difference. Analytical totals vary, suggesting variations in hydration states.
Strongest X-ray Lines (dÅ(I)): For one member, 14.97(100), 7.61(20), 4.16(30), 3.814(30), 3.045(50), 1.823(60). The most intense line varies between 14–15Å.
Properties: White, pale green, massive, botryoidal, radiating clusters of fibers and small elongate plates. An emerald-green variety discolored completely under laboratory conditions in a few months.
Occurrence and Associated Minerals: Silicate cavities. Eudialyte, mosandrite, microcline, fluorapatite, albite, aegirine, pectolite, nepheline, villiaumite.

UK78
Chemistry: Na, Mn silicate.
Strongest X-ray Lines (dÅ(I)): 10.06(100), 6.91(10), 3.576(10), 3.008(10), 2.795(50), 2.658(10).
Properties: Colorless to white needles.
Occurrence and Associated Minerals: Sodalite xenoliths. Microcline, analcime, natrolite, natron, thermonatrite, serandite, catapleiite, steenstrupine, pyrrhotite, fluorite, aegirine, UK79, UK80.

UK79
Chemistry: Na, Fe, Mn silicate.
Strongest X-ray Lines (dÅ(I)): 8.39(80), 7.15(30), 6.18(20), 3.307(70), 2.808(100), 2.160(20).
Properties: Pale green fibers.
Occurrence and Associated Minerals: Same as for UK78.

UK80
Chemistry: Na, Mn, Al silicate.
Strongest X-ray Lines (dÅ(I)): 10.72(100), 7.34(20), 3.144(20), 2.806(80), 1.931(20), 1.719(20).
Properties: Dark brown, massive patches grading into fine yellowish brown fibers.
Occurrence and Associated Minerals: Same as for UK78 and UK79.

UK81
Chemistry: $NaLiSi_2O_5\cdot 2H_2O$
Symmetry: Monoclinic A2/n, $a = 5.061(1)$, $b = 8.334(2)$, $c = 14.383(3)$Å, $\beta = 96.67°$.
Strongest X-ray Lines (dÅ(I)): 7.14(100), 4.24(80), 4.15(100), 4.02(80), 2.852(100), 2.703(50).
Optics: Biaxial (+), $\alpha = 1.515(1)$, $\beta = 1.516(1)$, $\gamma = 1.518(1)$, $2V = 64(1)°$, $Z \Lambda a = 23°$, $Y \Lambda c = 16°$, $X = b$.
Properties: Colorless, vitreous, transparent, tabular crystals, with perfect {001} and distinct {010} cleavages, and conchoidal fracture. Also colorless needles and silky white fibrous groups. $D_{meas} = 2.24$ g/cm³.
Occurrence and Associated Minerals: Sodalite xenoliths. Ussingite, terskite, eudialyte, steenstrupine, microcline, natrolite, thermonatrite, aegirine, serandite, vuonnemite, lovozerite, villiaumite, vitusite, tugtupite, chkalovite, erdite, sidorenkite, UK38, UK64, and others.

UK82
Chemistry: $Cu_3FeS_4\cdot 4H_2O$ (?), water assumed and by difference.
Symmetry: Trigonal P3m1, $P\bar{3}m1$, or P321, $a = 3.866(1)$, $c = 6.831(7)$Å.
Strongest X-ray Lines (dÅ(I)): 6.84(100), 3.349(50), 3.005(100), 2.390(80), 1.933(80), 1.882(50).

Properties: Metallic, reddish brown, hexagonal crystal with a perfect basal cleavage.
Occurrence and Associated Minerals: Similar to those for UK81.

UK83 **Chemistry:** Silicate of Th, Ca, Na, Mn and Ti.
Strongest X-ray Lines (dÅ(I)): 12.68(100), 9.24(50), 5.17(40), 4.24(50), 3.651(25), 3.077(30).
Properties: Yellow needles.
Occurrence and Associated Minerals: Similar to those for UK81, and UK82.

UK84 **Chemistry:** $Na_4(Zn,Mn)_2Si_7O_{18}\cdot 5H_2O$.
(NMNS23) **Symmetry:** Orthorhombic F2dd, $a = 10.211$, $b = 39.88$, $c = 10.304$Å.
Strongest X-ray Lines (dÅ(I)): 10.00(100), 6.35(10), 4.96(30), 3.240(60), 3.167(40), 3.140(40).
Optics: Biaxial (+), $\alpha = 1.520$, $\beta = 1.521$, $\gamma = 1.524$, $2V = 61.3(4)°$.
Properties: Colorless to mauve, vitreous, equant, pseudo hexagonal crystals. Cleavages {101}, {010} perfect, {120} poor, fracture conchoidal. H = 6.5, $D_{meas} = 2.52$ g/cm³. Bright apple-green fluorescence in shortwave ultraviolet.
Occurrence and Associated Minerals: Sodalite xenoliths. Ussingite, serandite, makatite, and others.

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hornfels unit may indicate that the unit tilted slightly to the southeast during slumping, although its exact position and thickness may never be known. The sequence of crystallization and viscosity of the magma enhanced by residual migrating volatiles during slumping, as shown by the presence of zeolites and carbonates, probably resulted in the angular positioning of the pegmatites away from the hornfels unit. These pegmatites are characterized by the consistent presence of pyroxenes, feldspars and carbonates with a myriad of associated species. What are perhaps the world's finest catapleiite and leucophanite specimens were collected in the late fall of 1987.

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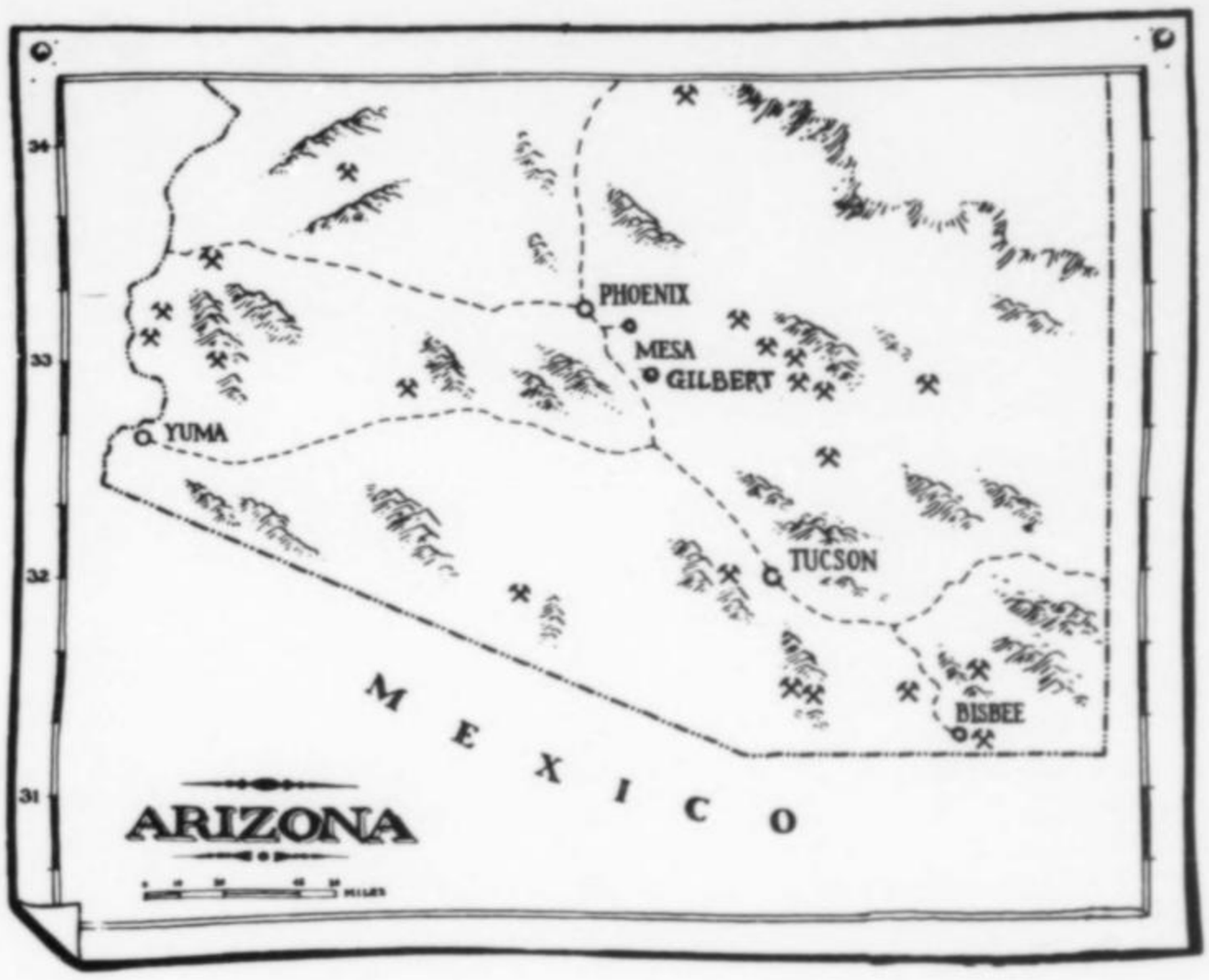

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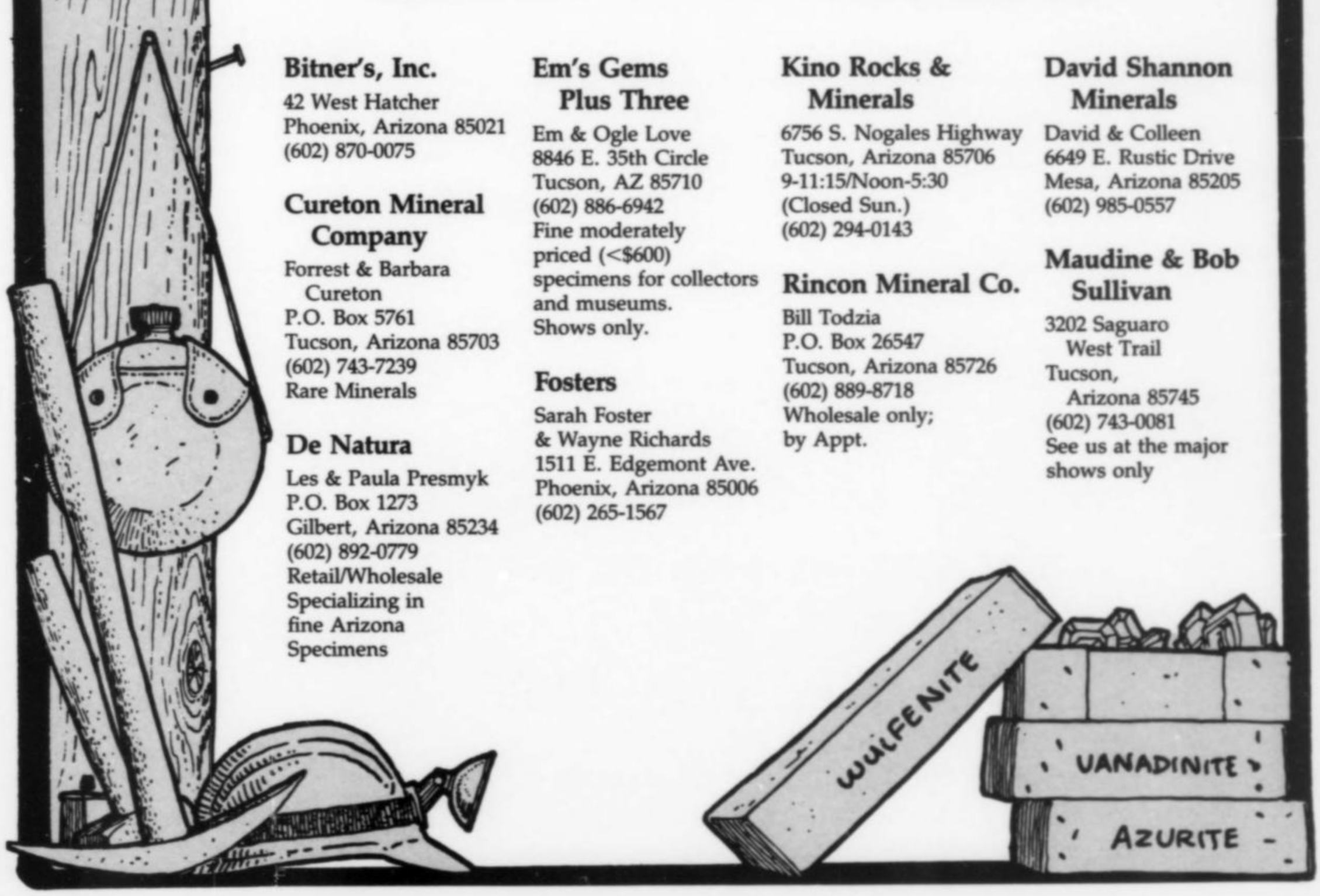

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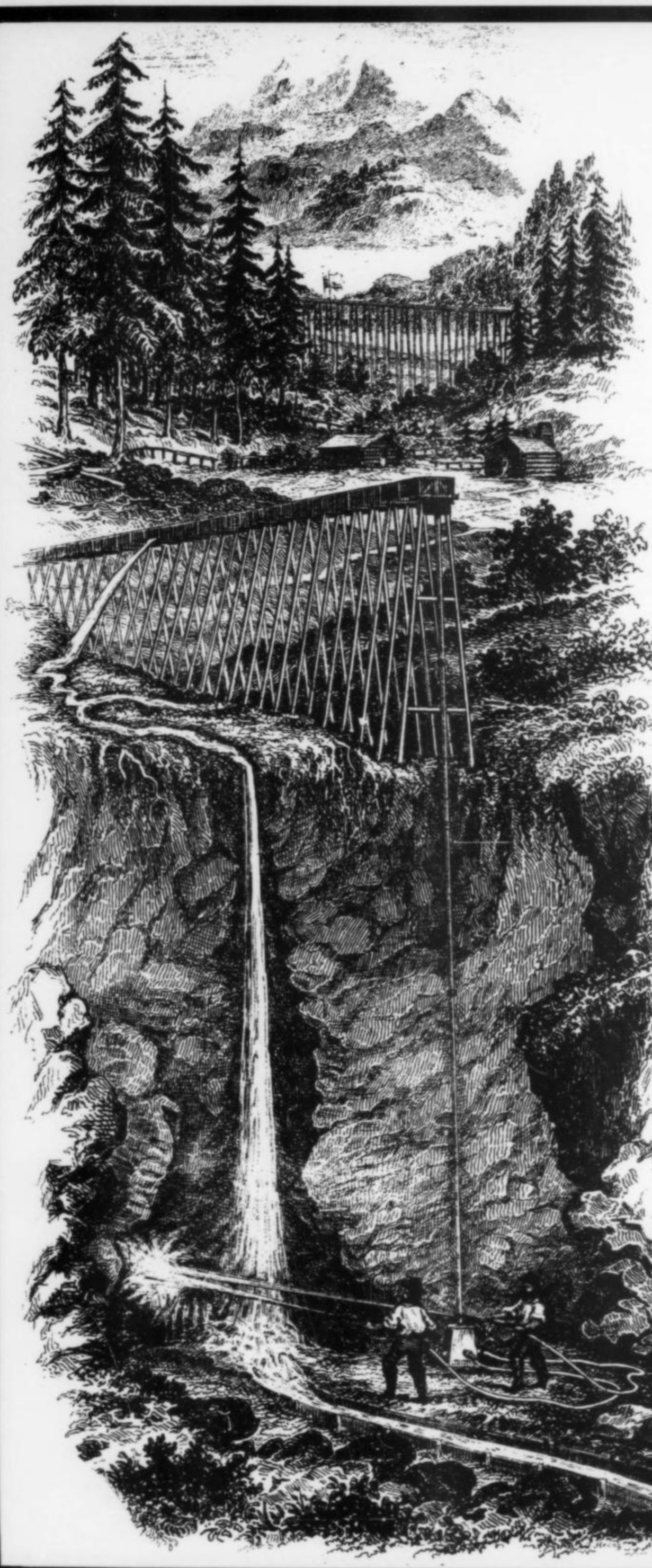

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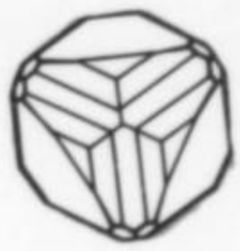

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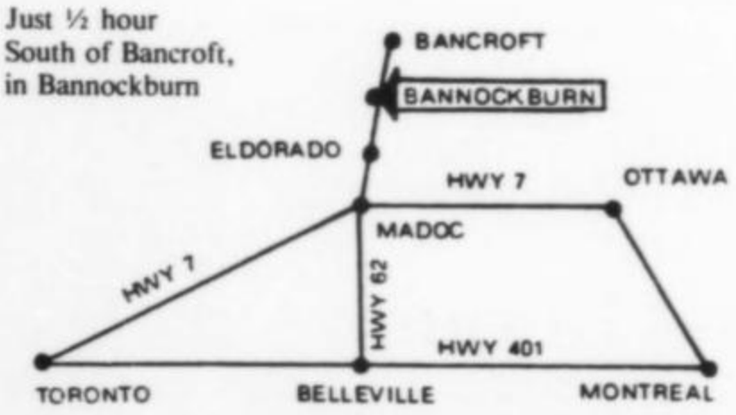

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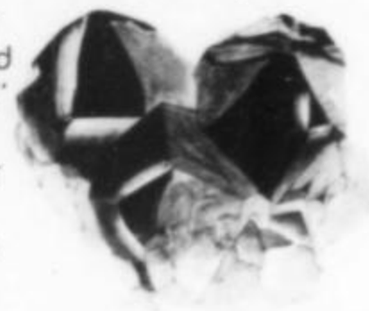

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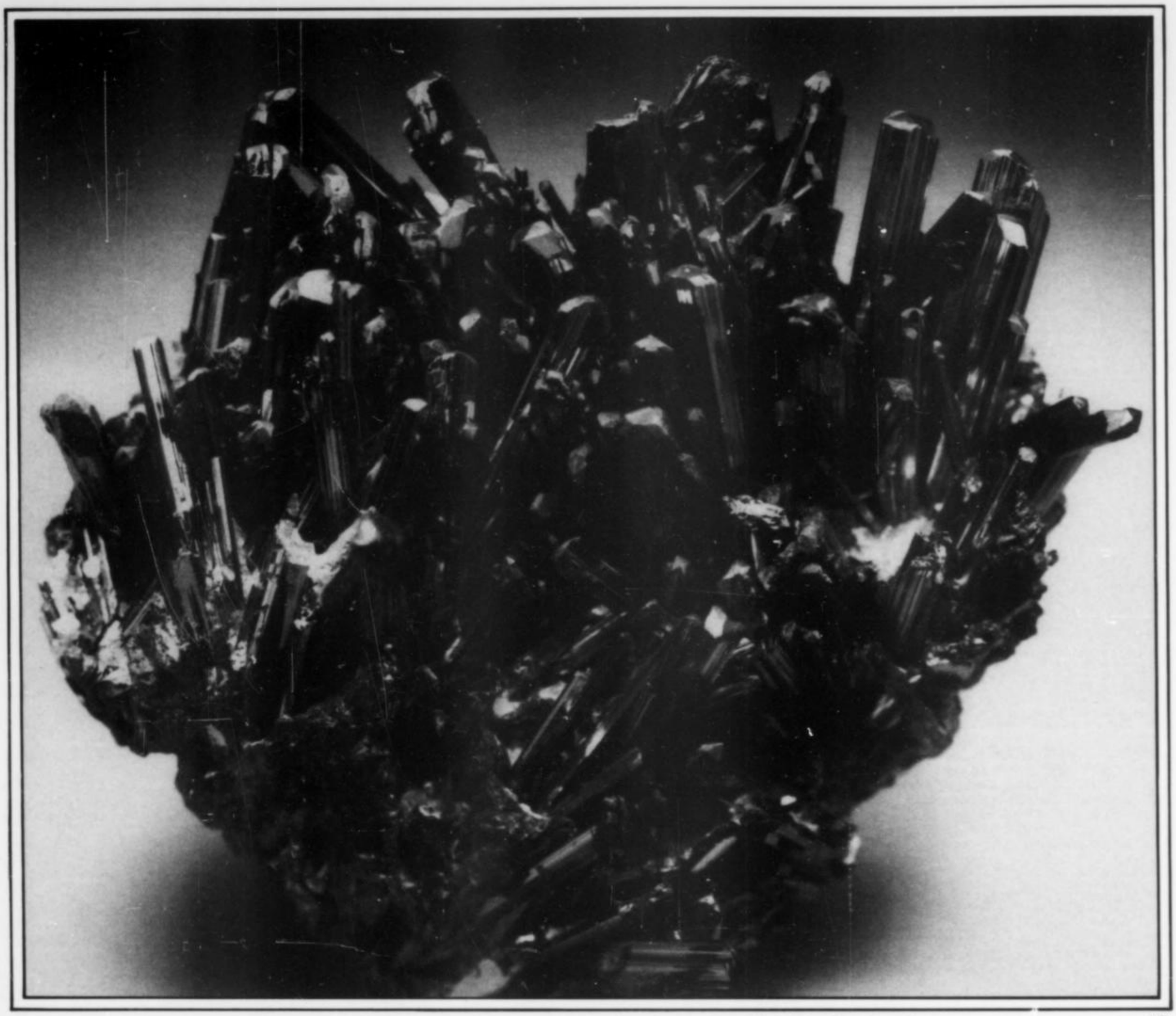

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