Famous Mineral Localities of Canada

Joel D. Grice

Sammendrag på norsk

Canada kan inndeles i fire fysiografiske regioner som hver for seg er resultater av geologiske forhold og dannelser. I den vestlige delen av kontinentet finnes fjellkjeden Cordillererne som utgjøres av sedimenter og vulkanske bergarter som er foldet ved kollisjon mellom to store kontinetalplater for omkring 100 mill. år siden. Innenfor fjellkjeden finnes Plattform-regionen. Dette område består av flatliggende sedimenter med store prærielandskap. Det sentrale Canada utgjøres av det kanadiske skjoldet som består av prekambriske bergarter. Appalachene langs den østlige delen av Canada er en erodert fjellkjede dannet av sedimenter som ble metamorfosert og hevet for 400 millioner år siden. Innen disse fire områdene finnes utallige malm- og mineralforekomster av stor økonomisk og vitenskapelig verdi. Noen mineralforekomster er velkjente blant mineralsamlere.

Ved ***Rapid Creek, Yukon,*** *ble det i 1959 funnet lazulite. Senere ble det i denne lokaliteten funnet mange, tildels svært sjeldne og velkrystalliserte fosfater. Flere av dem var nye for verden, blant andre kulanitt og penikisitt, oppkalt etter de to personene som drev forekomsten, Alan Kulan og Gunar Penikis.*

Mont Saint-Hilaire *er en av ti alkaline plutoner som danner koller og høydedrag i området langs elva Saint Lawrence. Fra 1960-årene og fram til i dag har det ved steinbruddvirksomhet i Mont Saint-Hilaire blitt funnet 340 ulike species, deriblant 30 nye mineraler for verden. I verdensklasse kan nevnes prismatiske krystaller av oransjefarget seranditt opptil 13 cm i lengde, velformede romboedra av sideritt opptil 25 cm, samt fargeløse, heksagonale tavler av catapleiitt.*

Ved ***Bay of Fundy, Nova Scotia,*** *finnes vidstrakte områder med basalt fra trias-perioden, for omkring 200 mill. år siden. Enkelte lavabenker er spesielt rike på zeolitter, særlig heulanditt og stilbitt.*

Geological Regions

Those fortunate people who have traveled part or all of the six thousand kilometers that comprise the breadth of Canada will have noted stunning differences in the surface features of the countryside. Four main physiographic regions divide the country: rough, spectacular mountain ranges of the Cordilleran rim the west side of the Continent; great expanses of flat prairies mark the Interior Platform; rugged country of hard, resistant rock cut by innumerable lakes and rivers comprises the core of the Continent –the Canadian Shield; and worn mountains and hills of the Appalachians extend along the eastern margins of Canada. These physiographic regions depend directly on the underlying geology. Each of the four geological regions has a distinct suite of rocks, differing from each other in age and provenance. Although the details of any region are complex, some general statements may help towers the understanding of the specific mineral localities described in subsequent chapters.

Canadian Shield

The Canadian, or Precambrian, shield constitutes the stable core of the North American Continent. These ancient rocks vary in age from a billion to over

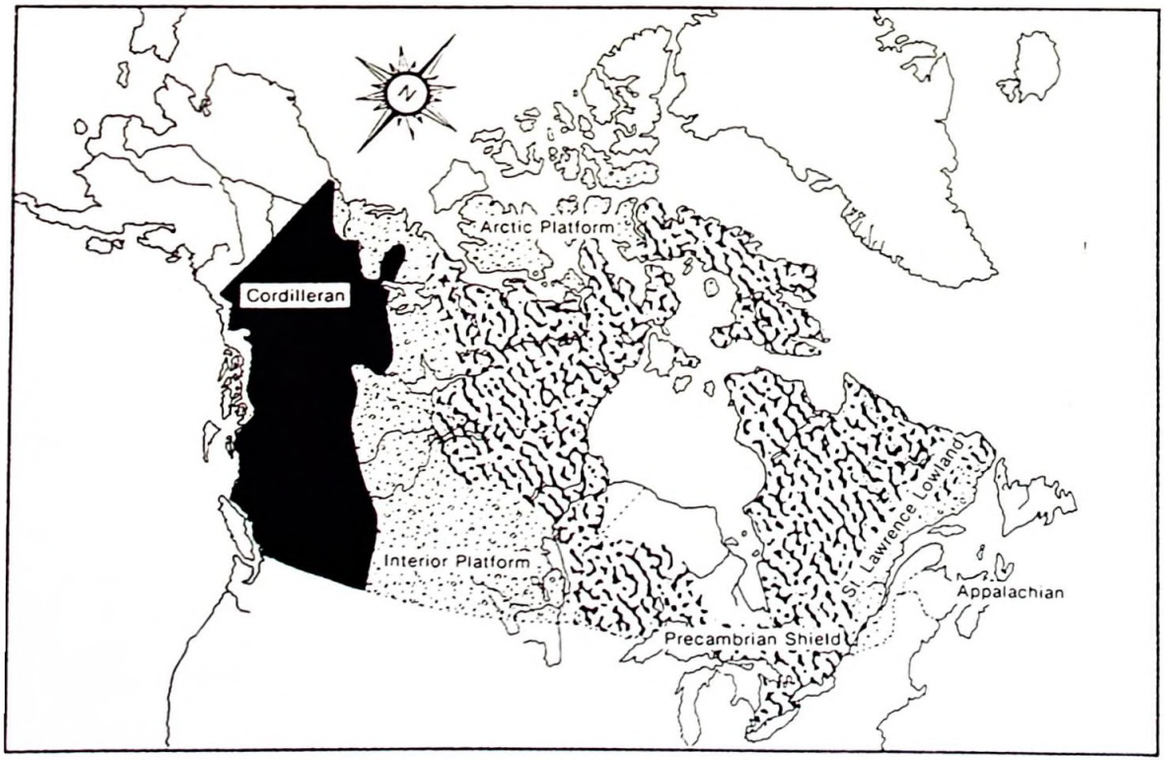
three billion years, making them some of the oldest rocks in the world. They formed deep in the primeval crust of planet Earth and lie exposed today after billions of years of erosion by rain, ice and wind. The original rocks underwent tortuous changes in temperature and pressure, producing a series of highly metamorphosed, coarsely crystalline rocks.

The shield, named in allusion to is shape, constitutes approximately half of Canada's land surface and boasts one of the most productive mining areas in the world. Rich deposit of copper, nickel, iron, lead , zinc, gold, silver, cobalt, uranium, platinum, titanium and molybdenum support Canada's economy.

Platform Regions

The Platform, a series of flat-lying sedimentary rocks, overlies the Canadian Shield in a broad collar around its southern and western rim. This geological feature is evident in the St Lawrence Lowlands, the Interior Plains of the Midwest and the Arctic Lowlands to the north. The sediments, which derived from the Shield, Cordilleran or Appalachian regions and were deposited in seas that formerly covered the Shield, form a thin veneer on the shield, excepting the western prairies where they attain a thickness of several kilometers. The Interior Plains produce most of Canada's petroleum and natural gas as well as potash, salt, gypsum and limestone. During the ice age, soils ground from the Shield were deposited on the Platform. In the southern prairies and the St Lawrence valley, this fragile layer of sediments produced fertile agricultural land; unfortunately much of this is now covered by urban sprawl.

Major geological regions of Canada



Appalachian Region

In North America, the old, worn Appalachian Mountains stretch three thousand kilometers; from Newfoundland to Alabama. They form the eastern coastline from Newfoundland to New York, but further south a flat plain of sedimentary rock separates them from the Atlantic Ocean. Formerly the Appalachian Region consisted of a submerged trough on the edge of the Shield. Over a period of hundreds of millions of years it was filled with sediments derived from the continent and ocean. Approximately four hundred million years ago these sediments uplifted to form a range of mountains, now largely eroded away.

The Appalachian Region, including the Atlantic Provinces and southeastern Quebec, produces a good proportion of the world' asbestos as well as significant amounts of copper and zinc.

Cordilleran Region

Canada's newest mountains are part of the Cordilleran Mountain region which spans half the world - eighteen thousand kilometers from the Aleutian Islands to the tip of South America. This series of sedimentary and volcanic rocks heaved up approximately a hundred million years ago as a result of the collision of two huge continental plates. The theory of continental drift describes the flow of such crustal plates on the melted upper portions of the earth's interior. The interaction resulting from the collision of the American plate and the Pacific Ocean plates remains in evidence today in the activity of the volcanoes and earthquakes along the Pacific Ocean coastline. In Canada the Cordilleran Region displays itself in the spectacular Rocky Mountains and Coast Mountains of British Columbia.

Between the western and eastern mountain ranges the central plateau affords some opportunity for farming. With persistent geological surveying the Cordilleran has yielded important deposits of lead, zinc, silver, copper and gold.

Phosphate Minerals from Rapid Creek, Yukon Territory

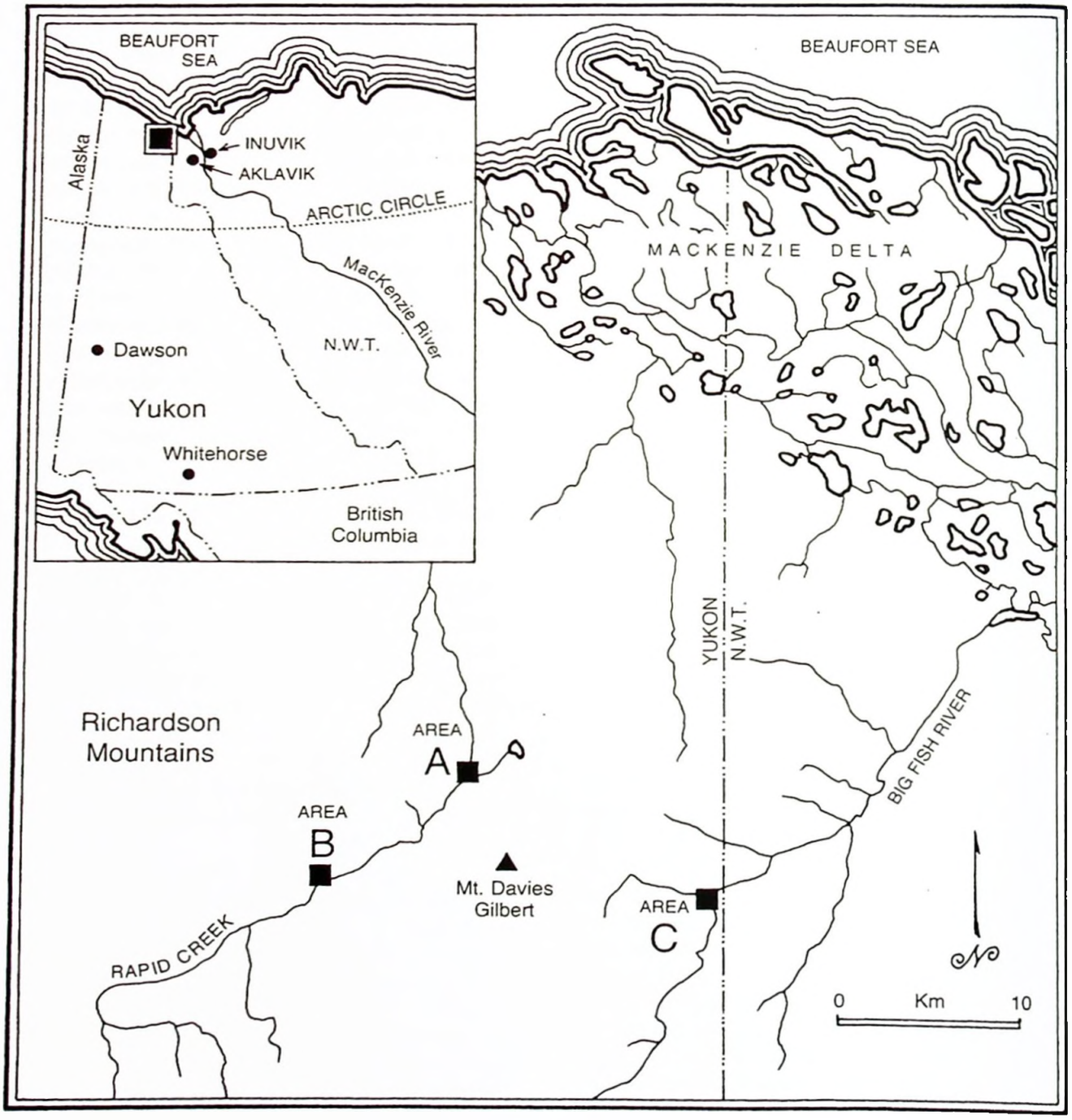
The Arctic, Canada's final frontier, offers prospectors hug areas of potential mineral reserves. The area lay undisturbed by explorers until 1789 when Alexander Mackenzie appeared with his voyageurs and Indians. Leaving Great Slave Lake in late June they canoed down the river now bearing his name and paddled into the Arctic Ocean about two weeks later.

Two hundred kilometers from this ocean the Mackenzie River spreads out into a delta covering thousands of square kilometers. Many of the innumerable lakes and meandering channels lead nowhere. The marshlands abound with greyling, trout, ducks, moose and the inevitable hoards of mosquitoes and blackflies. The delta supports a number of Inuit fishermen and occasionally one spies a hut secreted in a remote part of this vast wilderness.

The natives of this area located their village, Aklavik, in the western portion of the area on a main channel leading to the sea. This provided them with ready access to the best fishing and hunting grounds. In 1964 the Diefenbaker Government decided this site was unsuitable. So it created Inuvik, complete with the airstrip, which "modern man" seems so desperately to require.

To the west the Richardson Mountains rise abruptly above the flat, featureless plain of the Mackenzie Delta. These mountains form a remarkable scarp over seven hundred meters in height. This far north the Richardson Mountains are not rugged but round, with river gorges cut deeply into the gentle landscape. The upland tundra vegetation comprises grasses, sedges

Location map: Rapid Creek and Big Fish River, Yukon
(after Robinson *et al.* 1992. Mineralogical Record)



lichens, mosses, dwarf birches and willows. Caribou, grizzly bear, wolf, bald eagle and the prevalent Richardson ground squirrel still roam this secluded land.

Lazulite, "Gemstone" of the Yukon

During the summer of 1959 Bruce Cameron, a geologist working for Triad Oil company, collected a few blue, water-worn, mineral chips while conducting an oil exploration program in the Blow River area of northeastern Yukon. Researchers identified the beautiful, azure-blue mineral as lazulite, a very rare magnesium aluminum hydrous phosphate.

Fifteen years after this, while prospecting for iron, Al Kulan stumbled onto the lazulite source along Rapid Creek. At the same time he collected a number of other odd-looking crystals, which his business partner, Gunar Penikis, sent to the Royal Ontario Museum, Toronto for identification. Curators Joe Mandarino and Darko Sturman reported these specimens as extremely fine examples of rare phosphate minerals, some of which were new discoveries in the mineral "kingdom".

Although the iron occurrences proved uneconomical for mining at the time, the efforts of Kulan and Penikis were not wasted. Good crystals of lazulite are rare, occurring at only a few other localities in the world, notably Austria, Sweden, Brazil and the United States. On 16 February 1976 the Commissioner of the Yukon declared lazulite the official gemstone of the Yukon Territory; hopefully a legislation that will protect this natural resource from excessive prospecting.

Gemstones are usually cut and polished, but lazulite proves too soft for fashioning. Yet a good specimen of this mineral fetches a high price because of its rarity and beauty. However, the lazulite, now widely distributed throughout the world, attracts less attention from collectors than do some of the later discoveries.

Beautiful octahedral crystals of wardite excel any in the world. The rare phosphate arrojadite, previously found only as ugly masses, occurs as excellent crystals on a ridge just above Rapid Creek. Similarly, collinsite, kryzhanovskite and whiteite had been found only as grains and crusts in remote reaches of the world until the work of Kulan and Penikis unearthed amazing specimens of these minerals in the Yukon.

The efforts of Alan Kulan and Gunar Penikis in discovering and developing this mineral occurrence received acknowledgment with the dedication of two new mineral species: kulanite and penikisite. Unfortunately, neither man lived long after the bestowal of this honor: Penikis died after a long and tragic illness while Kulan met a violent death in his home town of Ross River, Yukon.

Mont Saint-Hilaire, Québec : Canada's Most Diverse Mineral Locality

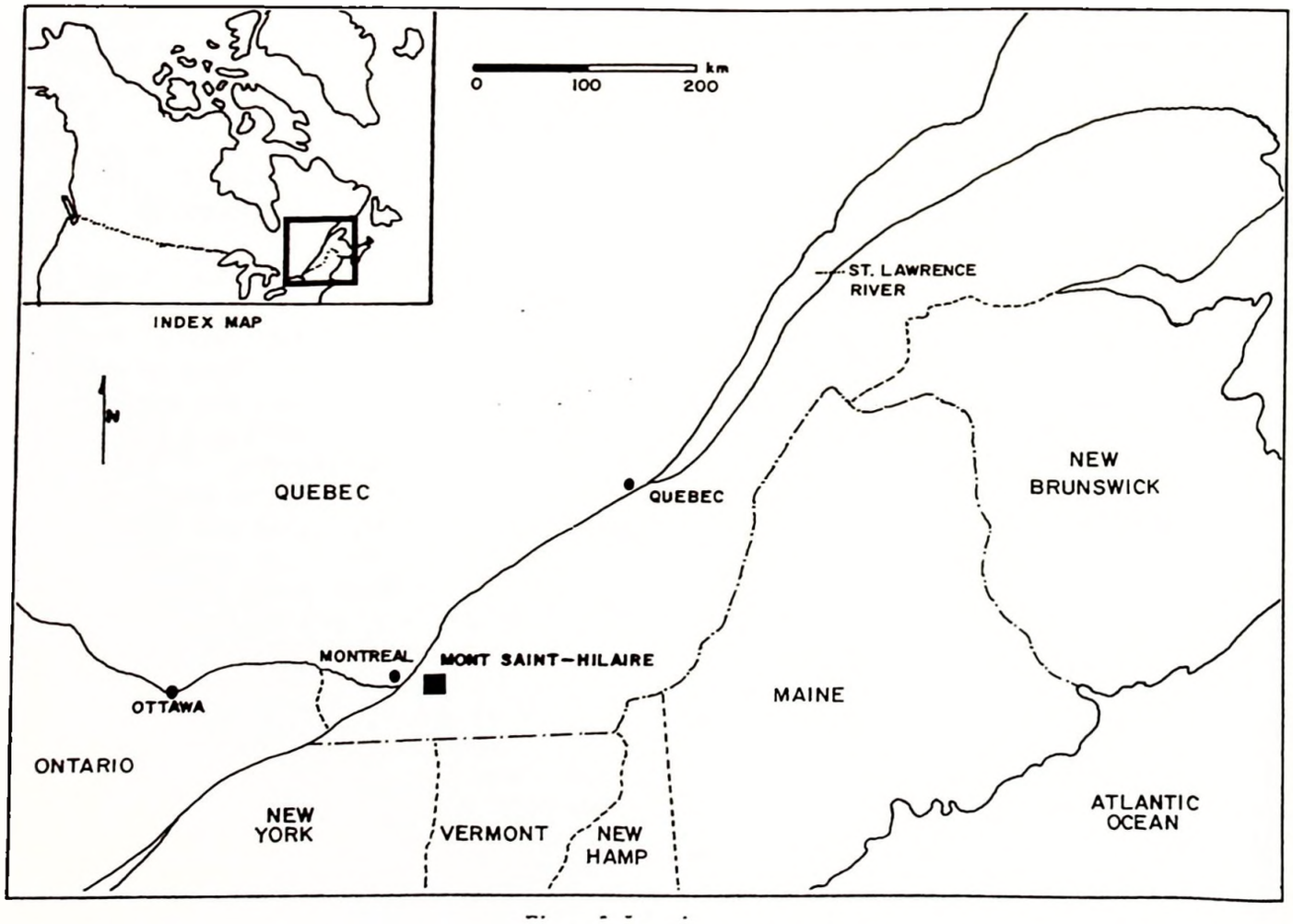
Brigadier Andrew Hamilton Gault chose an elegant setting for his manor beside Lac Hertel, atop Mont Saint-Hilaire. The surrounding mature trees remain as rare vestiges of the huge forests that covered southwestern Quebec long ago. Upon receiving Gault's bequest in 1958, McGill University divided his estate into a restricted research zone and a public recreational zone. Now anyone can enjoy the woodland paths, the cross-country ski trails and the spectacular view across the Richelieu River towards Mount Saint Bruno and Mount Royal on the far horizon.

Mont Saint-Hilaire, one of ten prominent hills, protrudes above the flat plains of the Saint Lawrence Lowlands. This series of geologically related monadnocks extends for approximately

two hundred kilometers. Then ten hills from west to east are Oka (30 kilometers west of Montreal), Mount Royal, Saint Bruno, Saint-Hilaire, Johnson, Rougemont, Yamaska, Shefford, Brome and Megantic (50 kilometers east of Sherbrooke). In 1903, Frank Dawson Adams collectively named them the Monteregian Hills, taking the name from Mount Royal (Mons Regius) in Montreal, the best-known member of the group.

Geological evidence suggests the Monteregian Hills all derived from the same giant magma chamber, which flowed into overlying rocks along a deep fracture in the earth's crust, now marked by the Saint Lawrence Valley. The portion of these pipes presently exposed would have crystallized approximately three kilometers below the surface a hundred million years ago. Since that time the sedimentary layers of rock above the intrusions have gradually eroded due to eons of relentless weather and grinding ice, leaving the resistant, harder magmatic rocks as a series of circular mounds. Mont Saint-Hilaire measures almost four kilometers in diameter and rises four hundred meters above the valley floor.

Location map: Mont Saint-Hilaire



In addition to the recreational facilities there have been some economic incentives: associated with the Monteregian plutons exist intrusions known as kimberlites. These rocks originate deep in the earth's crust and those found in South Africa, Siberia and Arkansas contain diamonds. Spurred on by this knowledge men, longing to find another source of the world's most coveted gem, have crushed and searched tones of rock, unfortunately to no avail. More mundane but still important, syenite rock quarried at Mont Saint-Hilaire constitutes the major portion of a special concrete used in construction.

Mineral Collecting at Mont Saint-Hilaire

In the early 1960s the wealth of mineral specimens at Mont Saint-Hilaire became known. During operations at the Poudrette and Demix quarries, cavities containing fascinating crystals were exposed. Shortly afterwards scientific articles written by various Canadian authors appeared in the journals. Spectacular prismatic crystals of orange serandite measuring as much as thirteen centimeters in length were first to attract attention. Well-formed rhombs of siderite up to twenty-five centimeters filled large vugs. Clear, colourless, hexagonal plates of the very rare mineral, catapleiite, certainly rate highly with collectors. Single, white crystals of analcime, as large as a dinner plate, have been collected. Yet many of the most beautiful and spectacular finds require magnification.

Micro-mounts, as they are termed, form a separate section of mineral collecting. A whole new world of perfect crystals unfolds with the aid of a microscope; shiny black pyramidal crystals of brookite, dark green needles of acmite, cruciform steacyite, dode-cahedra of bright blue sodalite and colorless snowflakes of epididymite.

Table 2 lists over 340 minerals known to occur at Saint-Hilaire. The geology, mineralogy and chemistry of the locality is so complex that a number of collectors and investigators have devoted most of their effort to its study. They have formed their own club and publish a regular newsletter entitled *The St. Hilaire News*.

The famous site has attracted people from around the world in such numbers that the quarry owners restrict entrance to special groups on specific days. Few localities anywhere can surpass the expectations of Mont Saint-Hilaire.

Zeolites from Ancient Lavas, Bay of Fundy, Nova Scotia

Some two hundred million years ago, during the Triassic period, a long series of tension gashes opened up along what is now the eastern margin of the North American Continent. These deep-reaching channels allowed molten rock to rise, intruding the existing rock as dikes and sills and in some areas pouring out onto the surface as lava flows. These flows can be found sporadically all the way from the Bay of Fundy to North Carolina.

Fissure lava flows cannot be thought of as the classic volcanoes typified by Vesuvuis or Mount Saint Helens, cones which spew forth lava or wash; such volcanoes, although spectacular, would appear negligible when compared to the Triassic flood basalt. Here, fissures or volcanic vents extending for many kilometers opened and a highly fluid lava poured out in enormous quantities. A single flow might have been meters thick and have covered several thousand square kilometers.

When basaltic lava reaches the surface of the earth it chills quickly, immediately forming a crust. The resulting igneous rock consists mainly of dark-colored glass and a fine-grained

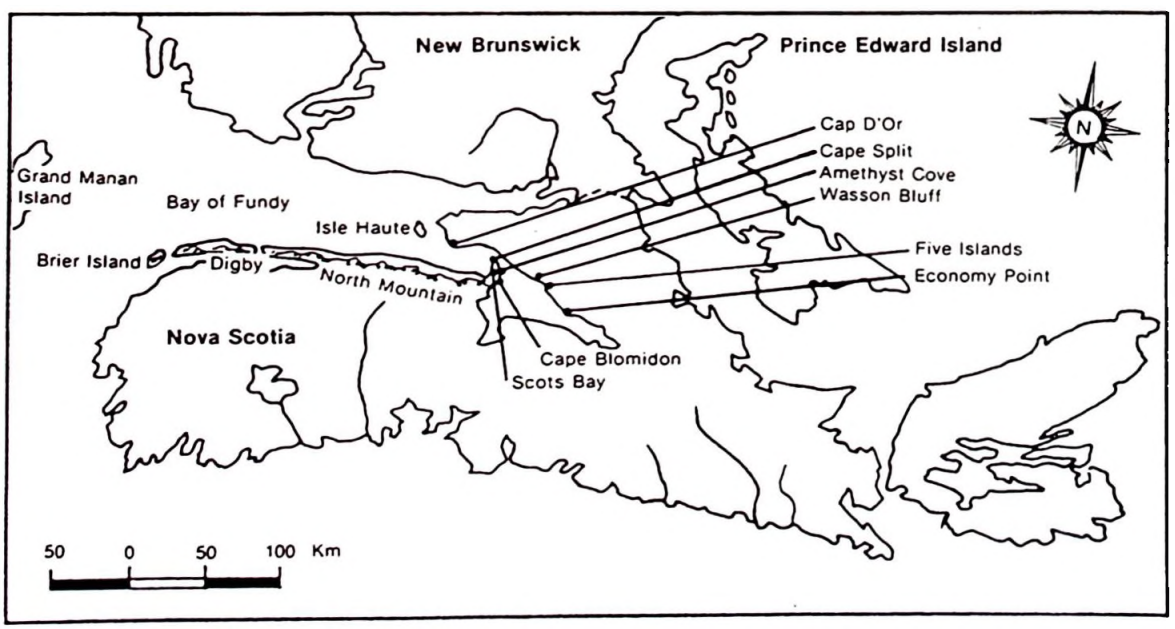
mass of plagioclase feldspar and pyroxene crystals. Large amounts of water and other volatiles keep these lavas fluid on their ascent to the surface. Once free of the confining pressure of surrounding rock the gases bubble off creating centimetric oval or spherical cavities, called vesicles, in the upper portions of the plastic lava. Water separating from the congealing lava concentrates a number of soluble ions, notably calcium, sodium, potassium, silicon and aluminum, which combine to form low-temperature minerals such as quartz and members of the zeolite group. These late minerals crystallize in the vesicles or fractures of the basalt.

The Bay of Fundy, originally a basin above sea level, experience four or five flows, the first flow being half the total thickness, which measures approximately two hundred meters. Today the basin, covering an area of about thirty thousand square kilometers, is largely submerged with only small areas exposed along the north coast of the Bay of Fundy: at Grand Manan Island, Isle Haute, Cape d'Or and Five Islands and on the south shore along the North Mountain ridge (which measures approximately seven kilometers in width and extends for two hundred kilometers from Cape Split to Brier Island in the southwest). Since their emplacement the flows have remained relatively undisturbed with only a slight tilting of a few degrees to the northwest and minor local faulting.

Zeolite: the Stone that Boils

Zeolites from the North Mountain cliffs comprise a small number of a large group of minerals with over forty species, all having structural and chemical similarities. In 1756 Freiherr Axel Fredrick Cronstedt, a Swedish mineralogist, submitted a number of crystals to the heat of a blowpipe for chemical testing and noted their peculiar frothing characteristics. He named these minerals, zeolites, from the Greek word for boiling stones.

Location map: North Mountain, Nova Scotia



This fascinating boiling feature of zeolites results from their unique, porous crystal structure. Unlike other crystal structures, the framework has cages or holes large enough to accommodate ions of calcium, sodium and potassium or a molecule of water. The zeolitic-water may be easily driven off with a little heat. In fact some zeolites dehydrate at room temperature in a low relative humidity. This leaves voids in the crystal structure, which lead to some important uses for these minerals.

Another feature of the zeolite structure, important in differentiating species, is now the basic building blocks of the structure join together. These building blocks consist of a silicon or aluminum atom bonded to four oxygen atoms in a tetrahedral configuration. If tetrahedral link in one direction, forming chains, the zeolite has a fibrous habit; such as mesolite, natrolite and scolecite. Strong linkages in two directions result in a planar structure and crystals of this type tend to be platy; such as heulandite and stilbite. The last possibility, equal linkage in all three directions, gives a three-dimensional framework structure which results in equant crystals like analcime, chabazite and mordenite. Although the habit, or crystal form, may give some indication of the species of zeolite it usually requires specialized equipment to obtain a precise identification.

Heulandite and stilbite may be found in vesicles and fractures in any exposure of zeolites in the lavas of Nova Scotia. Both minerals are white, but often stilbite tends to be colored in shades of yellow, orange and brown. These platy minerals so resemble each other it requires close scrutiny to differentiate the lozenge-shaped outline of heulandite and the double-edged sword form of stilbite.

In 1925 chabazite became the first zeolite used in adsorption studies. Observation showed that dehydrated crystals would retain or adsorb small organic molecules and reject larger ones. This phenomenon, described as "molecular sieving", instigated a new industry. Nowadays a large number of different natural and synthetic zeolites are used for the following: removal of radioactive elements from low-level waste streams of nuclear installations; treatment of sewage by removing toxic ammonia compounds that kill fish and promote algae growth; pollution control as an adsorbed in oil-spill cleanup; purification of sour natural gas or gas produced from sewage and decaying garbage; energy production through the incorporation of zeolites as "boosters' on solar panels or hear reservoirs; blood purification in dialysis machines; and for household water softening in the ion exchanger tank.

Several countries including the United States, Japan, Italy and Hungary mine natural deposits of zeolites to support the rising demand for these minerals. Canada has not fully explored her occurrences in Nova Scotia or central British Columbia but this may be essential soon, due to the expense of manufacturing synthetics. Who knows but what was originally observed a local curiosity along the Fundy coast may one day lead to a new mining industry for Canada.

Table 2. Mont Saint-Hilaire, Confirmed Species, January 18, 2002

* denotes TYPE locality

Abenakiite-(Ce)*
Acanthite
Actinolite
Adamsite-(Y)*
Aegirine
Alabandite
Albite
Allanite-(Ce)
Almandine
Analcime
Anatase
Ancylite-(Ce)
Andesine
Andradite
Anglesite
Ankerite
Annite
Anorthoclase
Antimony
Aragonite
Arfvedsonite
Arsenopyrite
Ashcroftine-(Y)
Astrophyllite
Augite
Barite
Barylite
Barytolamprophyllite
Bastnäsite-(Ce)
Bavenite
Behoite
Berthierine
Beryl
Beryllonite
Beudantite
Biotite series
Birnessite
Bismuth
Bonshtedtite
Bradleyite
Britholite-(Ce)
Brochantite
Brockite
Brookite
Burbankite
Calcio-ancylite-(Ce)
Calcioburbankite*
Calciohilairite
Calcite
Cancrinite
Carbocernaite
Carbonate-fluorapatite
Caresite-3T*
Carletonite*
Catapleiite
Celestine
Cerite-(Ce)
Cerussite
Chabazite-Ca
Chabazite-Na
Chalconatronite
Chalcopyrite
Chamosite
Charmarite - 2H & 3T*
Chkalovite
Chlormagaluminite
Clinochlore
Cordierite
Cordylite-(Ce)
Corundum
Cryolite
Daqingshanite-(Ce)
Datolite
Dawsonite
Digenite
Diopside
Djurleite
Dolomite
Donnayite-(Y)*
Dorfmanite
Doyleite*
Dravite
Edenite
Edingtonite
Ekanite
Elpidite
Enstatite
Epididymite
Epidote
Epistolite
Erdite
Erythrite
Eudialyte
Eudidymite
Ewaldite
Faujasite-Na
Ferroceladonite
Ferrocolumbite
Fluorapatite
Fluorapophyllite
Fluorbritholite-(Ce)
Fluorite
Franconite
Gaidonnayite*
Galena
Ganophyllite
Garronite
Gaultite*
Genthelvite
Gersdorffite
Gibbsite
Gismondine
Gmelinite-Na
Gobbinsite
Goethite
Gonnardite
Gotzenite
Graphite
Greigite
Griceite*
Grossular
Gypsum
Halite
Halotrichite
Harmotome
Hedenbergite
Helvite
Hematite
Hemimorphite
Hercynite
Hessite
Hibschite
Hilairite*
Hiortdahlite
Hisingerite
Hochelagaite*
Horváthite-(Y)*
Hydrocerussite
Hydroxyapophyllite
Hydrozincite
Ilmenite
Ilmenorutile
Jarosite
Joaquinite-(Ce)
Kaersutite
Kainosite-(Y)
Kaolinite

Kellyite
Kentbrooksite
Khomyakovite*
Kogarkoite
Korobitsynite
Kukharenkoite-(Ce)*
Kupletskite
Kutnohorite
Labuntsovite
Lamprophyllite
Lanthanite-(Ce)
Langite
Låvenite
Lead
Leifite
Lemoynite*
Lepidocrocite
Leucophanite
Leucosphenite
Lintisite
Lizardite
Löllingite
Loparite-(Ce)
Lorenzenite
Lovozerite Grp
Lueshite
Lukechangite-(Ce)*
Magadiite
Magnesio-arfvedsonite
Magnesiohornblende
Magnesite
Magnetite
Makatite
Manganokhomyakovite*
Mangan-neptunite
Manganocolumbite
Manganotychite
Marcasite
Mckelveyite-(Y)
Meionite
Melanterite
Micheelsenite*
Microcline
Milarite
Millerite
Mimetite
Miserite
Molybdenite (2H & 3R)
Monazite-(Ce)
Monteregianite-(Y)*
Montmorillonite
Mosandrite (Rinkite)?
Muscovite Willemite
Nahpoite
Nalipoite*
Narsarsukite
Natrite
Natrolemoynite*
Natrolite
Natron
Natrophosphate
Natrosilite
Neighborite
Nenadkevitchite
Neotocite
Nepheline
Neptunite
Nickeline
Niobokupletskite*
Nontronite
Nordite-(Ce)
Nordstrandite
Normandite*
Oneillite*
Opal
Orthoclase
Orthojoaquinite-(Ce)
Parakeldyshite
Paranatrolite- dubious status*
Paraumbite
Parisite-(Ce)
Pectolite
Penkvilksite
Perraultite*
Petarasite*
Petersenite-(Ce)*
Phillipsite-K
Phillipsite-Na
Phlogopite
Phosinaite-(Ce)
Pirssonite
Polylithionite
Posnjakite
Poudretteite*
Prehnite
Pyrite
Pyrochlore
Pyrophanite
Pyrrhotite
Quartz
Quintinite-3T*
Raite
Rasvumite
Reederite-(Y)
Remondite- (Ce)
Revdite
Rhabdophane-(Ce)
Rhabdophane-(La)
Rhodochrosite
Richterite
Riebeckite
Rinkite (Mosandrite)?
Röntgenite-(Ce)
Rosenbuschite
Rouvilleite*
Rozenite
Rutile
Sabinaite
Sanidine
Saponite
Sazhinite-(Ce)
Sazykinaite-(Y)
Schairerite
Schorl
Scheelite
Searlesite
Senaite
Sepiolite
Serandite
Sheldrickite*
Shigaite
Shomiokite-(Y)
Shortite
Siderite
Siderophyllite
Sidorenkite
Silinaite*
Sodalite
Spertiniite
Spessartine
Sphalerite
Steacyite*
Steenstrupine-(Ce)
Stillwellite-(Ce)
Strontianite
Struvite
Sugilite
Sulfur
Synchysite-(Ce) (12T & 24T)
Szomolnokite
Tadzhikite-(Ce)
Tainiolite
Tennantite
Terskite
Tetrahedrite
Thalcusite
Thaumasite
Thenardite
Thermonatrite
Thomasclarkite-(Y)

Thomsonite
Thorbastnäsite
Thorite
Thomasite*
Thorogummite
Titanite
Tremolite
Trona
Tsepinite-Na
Tugtupite
Tumchaite
Tundrite-(Ce)
Tuperssuatsiaite
Ussingite
Vaterite
Vermiculite
Vesuvianite
Villiaumite
Vinogradovite
Vitusite-(Ce)
Vuonnemite
Vuoriyarvite
Wadeite
Wagnerite
Weloganite
Willemite
Wöhlerite
Wollastonite
Wulfenite
Wurtzite (2H, 4H & 8H)
Xenotime-(Y)
Yofortierite*
Zakharovite
Zeophyllite
Zircon

Table 1. Minerals of the Rapid Creek and Big Fish River area, Yukon

*denotes TYPE locality

Alluaudite
Aluminite
Anatase
Aragonite
Arrojadite
Augelite
Baricite*
Barite
Bjarebyite (?)
Bobierite
Brazilianite
Brushite
Carbonate-fluorapatite
Celestine
Chalcopyrite
Childrenite
Collinsite
Diadochite
Dolomite
Dorfmanite
Dypingite
Eosphorite
Ernstite (?)
Epsomite
Ferroalluaudite
Fluorapatite
Fluorite
Garyansellite*
Georgiosite
Goethite
Gorceixite
Gordonite
Gormanite*
Goyazite
Gypsum
Hagendorfite
Halotrichite
Hexahydrite
Hydromagnesite
Jarosite
Kryzhanovskite
Kulanite*
Lazulite
Ludlamite
Maghagendorfite
Maricite*
Messelite
Meta-aluminite
Metavivianite
Metawitzerite
Nahpoite*
Natrojarosite
Nesquehonite
Penikisite*
Phosphosiderite
Pyrite
Quartz
Rapidcreekite*
Sasaite
Satterlyite*
Siderite
Souzalite
Sphalerite
Strengite (?)
Switzerite
Varulite (?)
Vivianite
Wardite
Whiteite-(CaFeMg)
Wicksite*
Whitlockite
Wolfeite