Hidden Beneath Our Feet: Minerals and

By Beth Gilhespy | Photos by Mike Davis

The Niagara Escarpment is formed from a wide variety of minerals and fossils.

Fossils of the Niagara Escarpment

With its towering cliffs, ancient oceans, and a hidden world beneath your feet, the Niagara Escarpment is more than just a dramatic backdrop to southern Ontario's landscape. Its thick, white walls of Amabel Dolostone loom over forests, cities, and shorelines, while lower layers of dolostone, sandstone, and shale form natural terraces and valleys that provide texture to the landscape.

These rock layers aren't just scenic, they're storied. They've built Toronto's historic buildings, fuelled lime kilns, and formed the very bricks that built and still build communities.

But what lies within the rocks tells an even deeper story. A micro-sized world of minerals and fossils makes up the Niagara Escarpment. From sparkling crystals of calcite and sphalerite, to ancient sea creatures fossilized in stone, the Escarpment is a geological world in miniature waiting to be uncovered.

Dolomite ($CaMg(CO_3)_2$ - calcium magnesium carbonate) Dolomite crystals form when calcite in limestone is altered by magnesium-rich seawater.

Escarpment Rocks

Rocks are made up of assemblages of minerals, which form in different ways depending on their rock type. Most of the time the minerals are too small to see individually, but occasionally large, showy crystals can be found in cavities in the rock, normally in quarries, road cuts or rock falls, where the minerals have only been exposed to the elements for a relatively short period of time.

The rocks of the Niagara Escarpment are sedimentary, and so the minerals form primarily through such processes as the accumulation and compaction of mineral-rich sediments, the evaporation of water containing dissolved elements, and the precipitation of minerals from solution. These processes often occur in bodies of water like seas, lakes, or riverbeds, where minerals crystallize as solid layers over time. The resulting minerals typically have a specific chemical composition and structure, formed through low-temperature, surface-level geological activity.

The types of minerals found in the Niagara Escarpment depend on the specific rock layer. In the dolostone, you'll primarily see crystals of calcite and dolomite, but you might also come across less common minerals like celestite, sphalerite, and fluorite—colourful minerals that often form in cavities within the rock. Celestite, sometimes referred to as celestine, is a particularly beautiful mineral that is normally sky blue in colour, and is found at many of the dolostone quarries along the Niagara Escarpment. A somewhat rare orange variant of celestite is found in the area of Georgetown and Forks of the Credit, the orange color being due to iron impurities or inclusions that tint the mineral. Hilltop Quarry northwest of Glen Williams has produced many fine samples of orange celestite, and I have also found it in the former York Quarry waste piles below Devil's Pulpit at Forks of the Credit.

Often the minerals in Niagara Escarpment rock formed from elements present in the pore water, which is the microscopic amount of water that exists within the sedimentary rock. These elements assemble into minerals; if there is a cavity within which they can expand unimpeded, the minerals can become quite large. In the shale layers, gypsum nodules formed when shallow pools of mineral-rich water evaporated in the

▲▶ CALCITE WITH DOLOMITE CRYSTALS
Calcite ($CaCO_3$ - calcium carbonate) Calcite (the larger yellowish crystals) forms in dolostone mainly through original precipitation from seawater, from the calcium-carbonate in shells and corals, and from precipitation of the minerals from calcium-rich pore waters within the rock.

The rock of the Niagara Escarpment formed between 450 and 420 million years ago from tropical seas that once covered the region. These warm, shallow waters teemed with coral and other marine life. When these organisms died, their calcium-rich shells and skeletons accumulated on the sea floor, eventually compacting into limestone. Over time, magnesium in the seawater gradually replaced some of the calcium in the limestone, transforming it into dolostone. Although limestone and dolostone look similar, dolostone contains magnesium, which makes it more resistant to weathering.

In addition to forming from biological remains, this limestone and dolostone rock can also form when calcium and magnesium carbonate precipitate directly from seawater, a process similar to the scale that builds up in a kettle. These two methods of formation, biological and chemical, help explain why some rock layers contain abundant fossils, while others have few or none.

◀ Sphalerite (ZnS - zinc sulphide) Sphalerite, the brown crystal within the cavity, forms when zinc and sulphide ions in the seawater during rock formation or from the decay of organic matter, combine. The sphalerite precipitates within pore spaces in the dolostone or along its bedding planes.

▼ Gypsum ($CaSO_4 \cdot 2H_2O$ - hydrated calcium sulphate) Gypsum formed when calcium- and sulfate-rich water evaporated in pools in the muddy deltas, leading to the precipitation of gypsum as nodules.

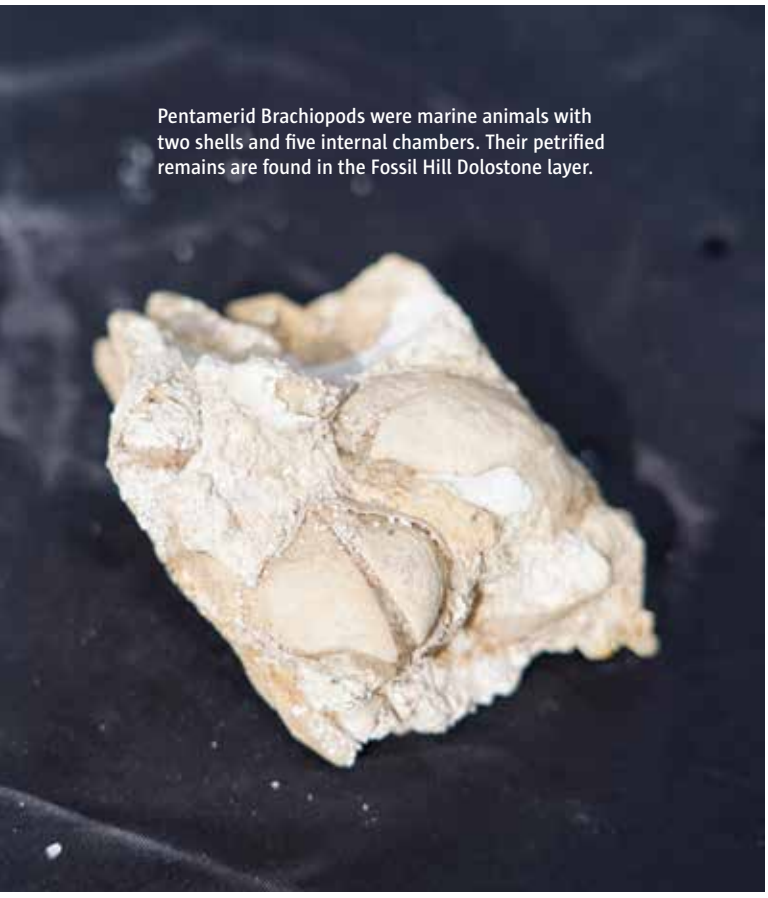
muddy environment that later became shale, leaving behind concentrated deposits.

Most quarrying of the Niagara Escarpment rock is for creation of cement and building stone material. But the presence of sphalerite (zinc-based) and galena (lead-based) minerals in the dolostone resulted in several small lead-zinc mines to spring up on the Saugeen (Bruce) Peninsula. Dow Chemical once owned several thousands of acres at Hope Bay, where they intended to extract the magnesium in the dolostone. Thankfully they abandoned their plans when Niagara Escarpment development control came into force, and today the area is the Hope Bay Forest Nature Preserve.

Layers of Fossils

The fossils in Escarpment rock hint at the tropical seas and ancient coral reefs that inhabited the area over 420 million years ago. All of the dolostone layers have fossils, but they differ depending on the layer, and in fact that's often how the different layers are distinguished. Extending from Hamilton north to Manitoulin Island is the Manitoulin Dolostone. Its fossils are primarily small shells, but occasionally one can find beautiful crinoid stem pieces and even more rarely, trilobites and cephalopods. Despite their plant-like appearance, with long stems and waving, petal-like fronds, crinoids were animals that used feathery arms to capture plankton in the tropical seas.

The Amabel Dolostone caprock also has crinoid fossils, though they are



Pentamerid Brachiopods were marine animals with two shells and five internal chambers. Their petrified remains are found in the Fossil Hill Dolostone layer.

hard to find unless you are in just the right location.

The most fossil-rich layer on the Niagara Escarpment is the Fossil Hill Dolostone. Named for Fossil Hill on Manitoulin Island, it contains a rich assortment of corals (favosites, halysites, Syringopora and others), stromatoporoid sponges, and other fossils.

It's not just the dolostone layers that have fossils. The Rochester Shale, which is found in the southern reaches of the Escarpment on the Niagara Peninsula, contains several different fossil types, including the beautiful trilobite *Trimerus delphinocephalus*.

Next time you look at the towering Niagara Escarpment rock, remember that there is a world of hidden stories beneath your feet – a microscopic realm of minerals and the preserved remains of life from hundreds of millions of years ago. **NEV**

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▲▶ Celestite (SrSO4 - strontium sulphate) Celestite forms when strontium- and sulfate-rich fluids precipitate celestite in cavities or fractures within the dolostone rock. Celestite is most often a sky-blue or celestial colour, which inspired its name.

Stromatoporoids are fossils of sponges, and are found in the Fossil Hill and other dolostone layers.