Parry Sound

Canadian Shield and Glacier-sculpted Gneiss in Cottage Country

North of Barrie along Highway 400 the scenery changes suddenly from the rolling hills with farms and fields typical of much of southern Ontario, to a rugged and rocky landscape of rock and forests. This change marks the southern limits of the Canadian Shield, Canada's largest and oldest geological region. This southernmost part of the Canadian Shield is the famous cottage country of Georgian Bay and Muskoka, about a 2 hour's drive north of Toronto. The Parry Sound GeoTour tells the geological stories of this region through a description of the scenery and geology of one of its most popular sites, Killbear Provincial Park.

Highway 400/69 cuts through rocky Canadian Shield terrain near Parry Sound.

A typical Canadian Shield landscape in Killbear Provincial Park.

Canadian Shield rocks underlie a third of Canada.

Canadian Shield: the ancient core of the continent

The Canadian Shield is a vast and largely unsettled region of northern and eastern Canada, known for its rocky landscapes, thin soils, and abundant lakes and bogs. The Shield forms the ancient geological core of the North American continent and has some of the oldest rocks found on Earth. These ancient rocks are largely hard and resistant granite, gneiss and volcanic rocks that were formed more than a billion years ago.

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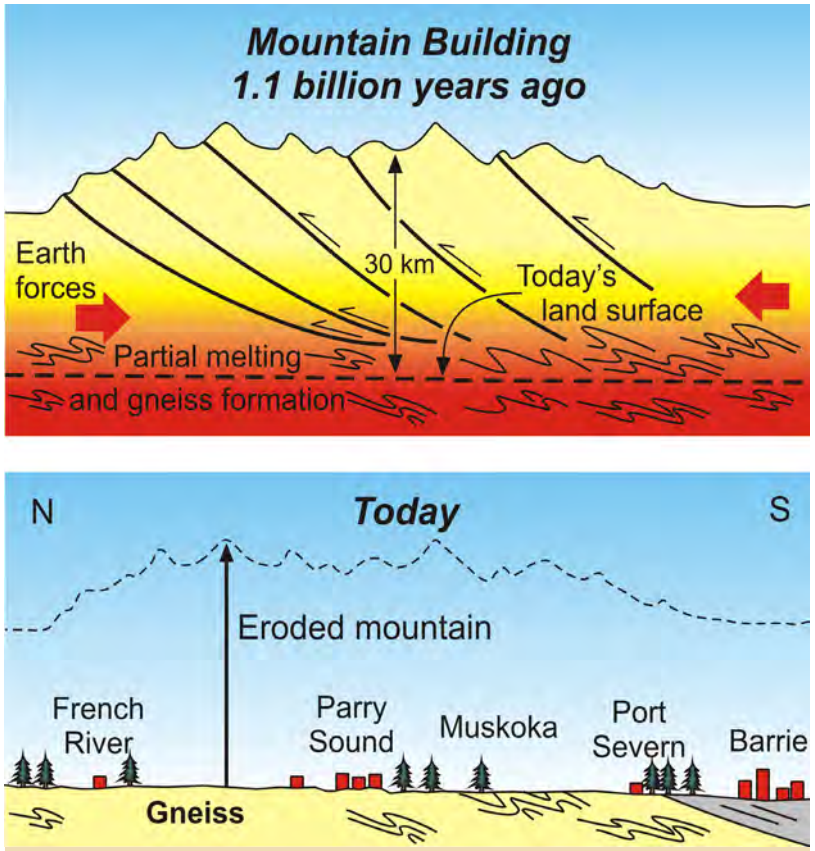
Gneiss: the iconic rock of Georgian Bay and Muskoka

Gneiss (pronounced "nice") is the iconic rock of the Canadian Shield in Ontario's cottage country. Gneiss is easy to distinguish from other rocks because of its alternating dark- and light-coloured layers, or bands. The lighter layers are granite-like and have a "salt-and-pepper" texture. This granitic texture tells geologists that the rock originated deep in the Earth at very high temperatures and pressures near the melting point of rock. The layers of gneiss are commonly contorted, suggesting conditions where forces within the Earth squeezed and deformed these rocks like modelling clay.

Gneiss with characteristic light and dark layers contorted into folds.

Parry Sound and Muskoka lie within a belt of gneiss that extends from Ontario to Labrador. Geologists have determined that this gneiss is the eroded remnants of an ancient mountain range that was similar in scale to the modern Himalayas. These mountains existed along the eastern edge of North America a billion years ago and have since been worn down by hundreds of millions of years of erosion. Today all that remains are the once deeply buried parts of these mountains, now exposed at the Earth's surface. These rocks give geologists a window into the rock-forming processes that take place deep within mountain belts.



Gneiss represents the eroded roots of ancient mountains. Mountains form because of compressive forces deep in the Earth's crust.

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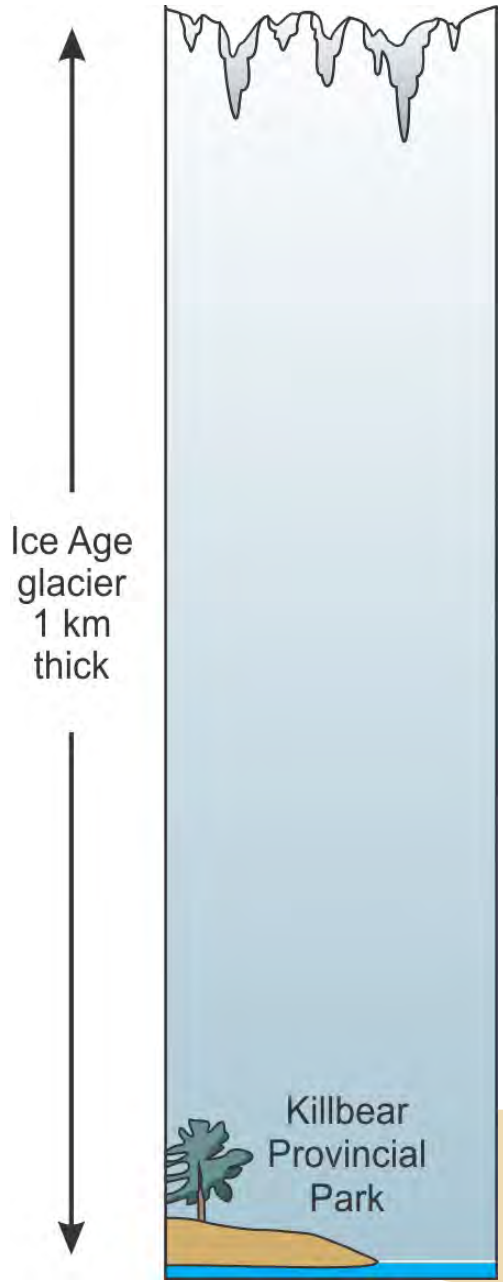
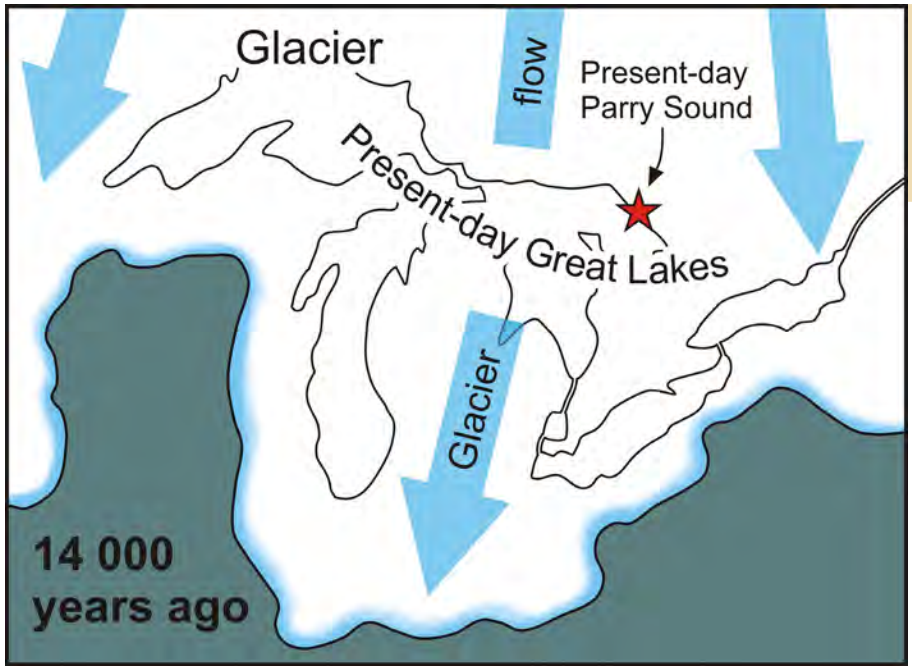


Imagine Killbear Provincial Park buried below a kilometre of glacial ice!

Imagining an Ice Age

Fourteen thousand years ago, the Parry Sound region lay below at least a kilometre of slow-moving glacial ice. This was the final stage of the Ice Age, a time over the past 2 million years when vast ice sheets covered much of Canada and advanced and melted back many times. Sand, mud and stones lodged in the base of the ice scratched, ground and polished the rock surface below, sculpting today's familiar rocky landscapes of the Canadian Shield.



During the final stage of the Ice Age, glaciers flowed south across the Great Lakes region.

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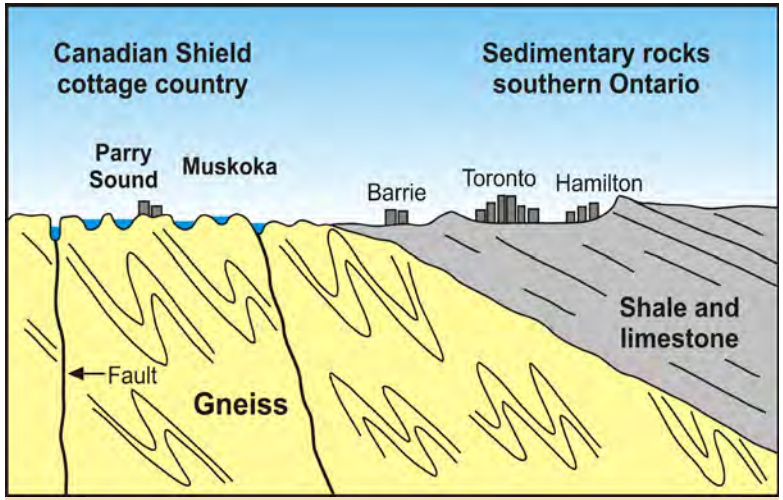
Why the Muskoka area doesn't look like southern Ontario

The scenery of Muskoka and Georgian Bay is very different from that of southern Ontario because of different geology. And why is there so little soil on these rocks?

Glaciers scoured the northern region over the past 2 million years, removing soil like a giant bulldozer and pushing, dragging and washing it to the south. Most of the rocks of the Canadian Shield are more resistant to erosion than the younger, sedimentary rocks that underlie the rest of southern Ontario, but the Canadian Shield also includes softer rock types, as well as broken rock in faults and fractures, the result of Earth forces over geologic time that formed these features. Because of this highly variable hardness, the glaciers sculpted a rugged topography of hills and basins. When the glaciers retreated, glacially carved depressions filled with water to become lakes. In contrast, southern Ontario is underlain by large areas of more uniform rock types that are less resistant to erosion. These southern rocks were more evenly and deeply scoured by the glaciers, and thicker layers of glacial soils were left behind by the melting glacier. These soils support the rich agriculture so characteristic of southern Ontario.



The gneiss of Canadian Shield cottage country differs from the sedimentary rocks that form the surface rocks of southern Ontario. These sedimentary rocks were deposited on older Canadian Shield rocks when shallow inland seas covered the region about 550 to 350 million years ago.

Why does Georgian Bay have 30 000 islands?

Georgian Bay is famous for the 30 000 Islands found along its eastern and northern shores. But why are there so many islands, and why only here and not along the shorelines of the other Great Lakes? The answer lies in a unique combination of gneiss, rocky shore and flat topography.

Scott Island, in Killbear Provincial Park, displays characteristic ice-sculpted rock and windswept pine.

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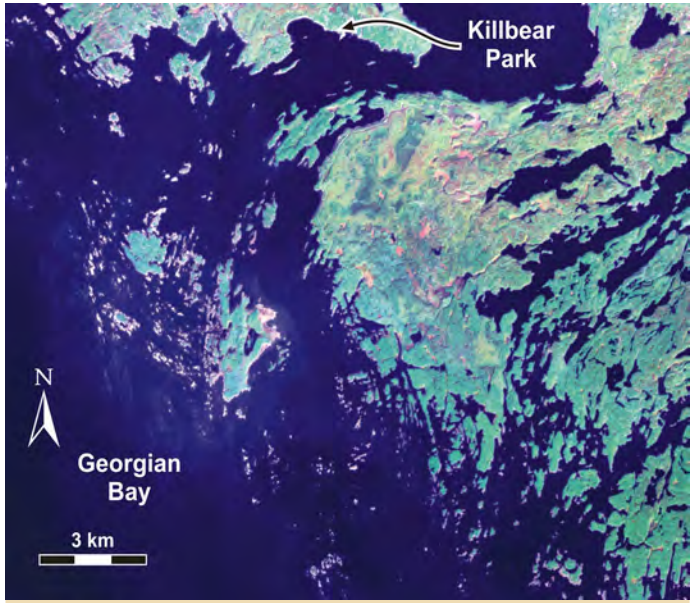
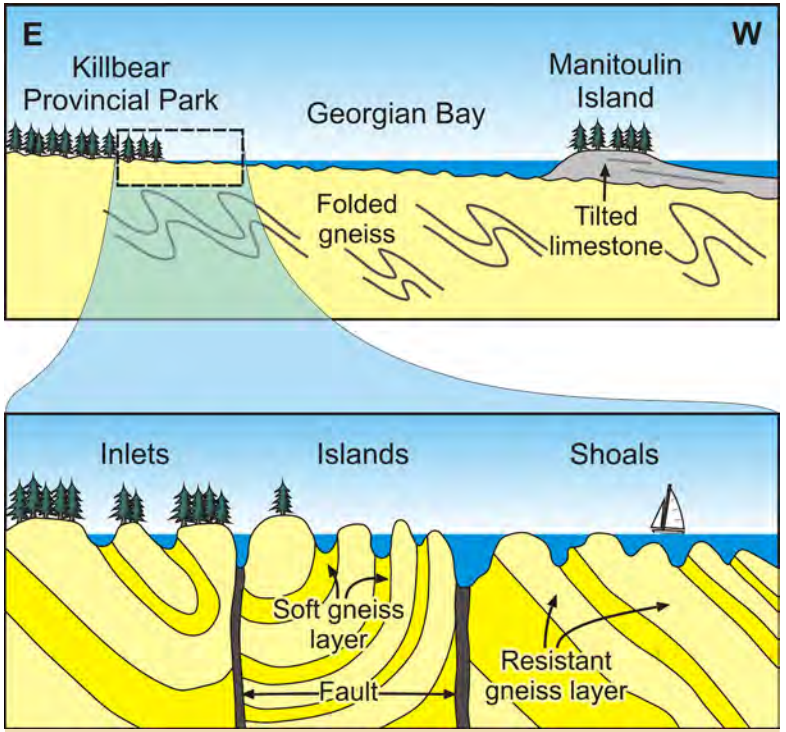
Of all the shorelines of the Great Lakes, only those of eastern and northern Georgian Bay are carved from gneiss bedrock. Other Great Lakes shorelines are carved from other kinds of rock such as granite, volcanic rock or limestone, or by Ice Age deposits of sand or glacial debris. Another example of island-rich shorelines carved into gneiss bedrock is the Thousand Islands region of the St. Lawrence River near Kingston.

Why do shorelines underlain by gneiss favour the formation of islands? The answer lies in the differing resistance to erosion of lighter coloured layers rich in the durable minerals quartz and feldspar, versus the darker layers rich in minerals more susceptible to weathering. Such layers can be tens to hundreds of metres thick. Where the layers have been tilted by Earth forces during ancient mountain-building events, the resistant layers erode to form ridges while the less resistant layers are eroded to form parallel valleys. Where these ridges and valleys form the shorelines of Georgian Bay, they create narrow peninsulas and elongate bays. The second factor that favours the formation of islands is that the land surrounding eastern and northern Georgian Bay is relatively flat. Because the land slopes very gently under the waters of Georgian Bay and forms extensive areas of shallow-water, undulations in the ridges can rise above or fall below the level of the lake, and thus form islands and shoals.



This satellite image of Georgian Bay near Killbear Provincial Park shows the elongated peninsulas, bays and islands left by the erosion of layers of hard and soft gneiss. *Image generated from Natural Resources Canada GeoBase Orthoimage 2005–2010 under the Open Government Licence—Canada.*



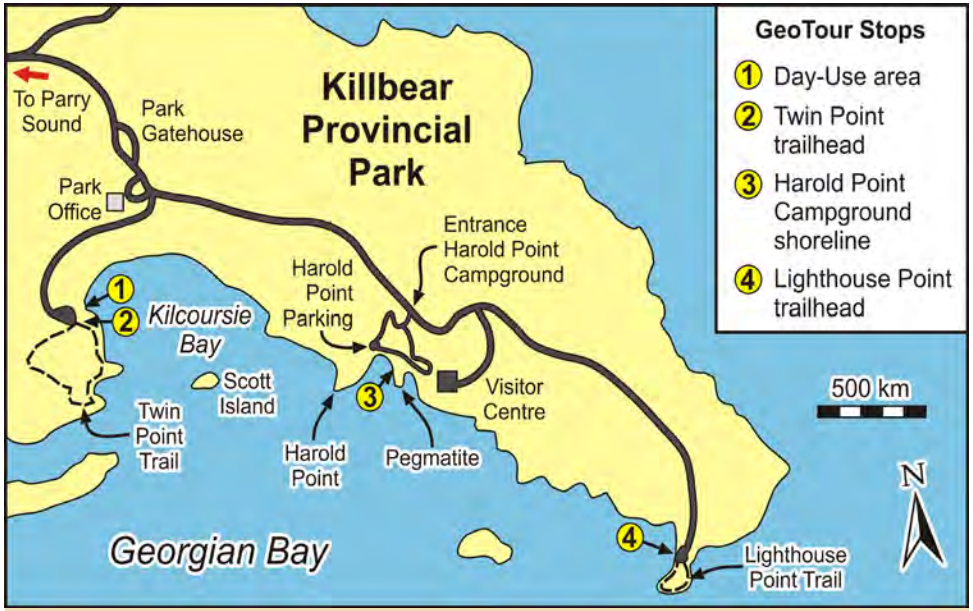
A geological cross section illustrates how alternating resistant and soft layers of gneiss create inlets, islands and shoals.

Killbear Provincial Park

Killbear Provincial Park is popular with visitors because of its rugged rocky shores, sand beaches and beautiful sunsets over Georgian Bay. This guide highlights 4 stops along the park's trails and shorelines that display examples of the unique geology and landscape of the Georgian Bay region.

How to get there

Killbear Provincial Park is about a 30 minute drive north of Parry Sound, first north on Highway 400/69 and then west on Highway 559. There is an entrance fee for day use of the park and for overnight camping. The GPS co-ordinates of the park office are N45° 21.361', W80° 12.755'.



Map of GeoTour stops in Killbear Provincial Park.

Stop 1: Day-Use area, Kilcoursie Bay

GPS co-ordinates: N45° 20.970', W80° 13.063'

Killbear Provincial Park is famous for its long sand beaches and for Kilcoursie Bay beach, the largest beach in the park, which rings Kilcoursie Bay. The Day-Use area is a short drive from the park office and provides access to the western end of the beach. Kilcoursie Bay beach is part of an extensive deposit of sand that extends below the waters of the bay and forms small shoreline sand dunes along the shore to the north. Where does all this sand come from?

Stop 1: Day-Use area beach on Kilcoursie Bay.

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Making a beach

Killbear Provincial Park is famous for its beaches, in part because sand beaches are rare along the rocky shores of eastern and northern Georgian Bay. Geologists have examined the area and have identified a thick and extensive deposit of sand underlying the forests in the western part of the park. Geologists interpret this sand body to have been deposited by an ancient Ice Age river. Over the thousands of years since the Ice Age, streams have eroded this sand and carried it to the shore. Waves then spread the sand along the shore, creating the extensive beaches we see today, and winds have blown the loose sand into dunes above the shoreline.

Stop 1: The mouth of a small stream on Kilcoursie Bay near the Day-Use area. The stream carries sand eroded from forest soils to the bay.

Shoreline stripes

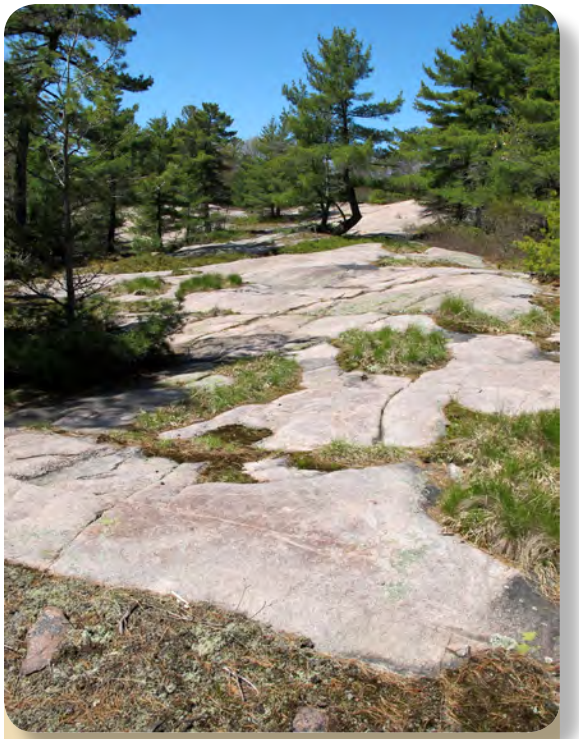
The sands of Kilcoursie Bay beach often have stripes of cream, black and red along the shoreline. A close look reveals that mineral grains of different colour make up these bands. Geologists explain these stripes as the result of waves sorting minerals of different density (and colour). As a wave washes ashore and its energy wanes, the denser grains of red garnet settle first, then less-dense grains of black amphibole, and finally the least dense grains of pale-coloured quartz and feldspar.

Stop 1: (Left) Distinct stripes, or bands, mark the shoreline. (Centre) Close-up of bands made up of cream-, black- and red-coloured sand grains. Penny for scale is 1.9 cm in diameter. (Right) Close up of sand showing that it is a mixture of different coloured grains. Two dollar coin for scale.

Stop 2: Twin Points Trail

GPS co-ordinates: N45° 20.969', W80° 13.063'

The trailhead for the Twin Points Trail is at the Day-Use area parking lot. This trail is an excellent introduction to the rocky landscapes and shorelines typical of the Parry Sound region. The trail crosses several rock barrens, extensive upland areas of smooth and rolling exposures of rock that support only scattered patches of grasses, herbs and pine. Between the upland barrens are low valleys with thicker soils that support a mixed forest of deciduous and coniferous trees. Where these upland barrens extend into Kilcoursie Bay, they form rocky points. The trail is named for 2 such rocky points, which it crosses on its way back to the Day-Use area.



Stop 2: The Twin Points Trail crosses 2 low ridges of smooth bedrock with sparse vegetation, referred to as rock barrens.

Stop 2: The rock ridges form 2 rocky points along the shores of Kilcoursie Bay.

Stop 2: Close up showing the texture of granite-like gneiss. Pink feldspar grains are intergrown with clear quartz grains and scattered finer black grains of amphibole. Penny for scale.

Everywhere along the Twin Points Trail, the rock exposed in the rock barrens and along the shore is a light-coloured rock that lacks layering and looks like a fine-grained granite. However, these are very thick layers of granite-like gneiss.

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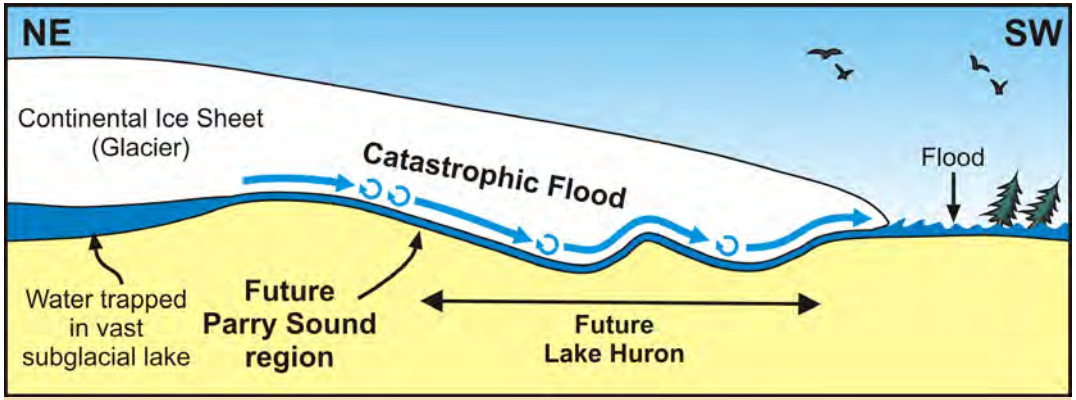
A great Ice Age flood

What made the surfaces of these hard granitic rocks so smooth? And why is there so little soil on these rocks? If you carefully observe the rock surfaces along the shorelines you can see faint parallel scratches in the rock. These scratches were made by rock debris trapped at the base of glaciers that covered this land between 2 million and 10 000 years ago. However, geologists have been puzzled by peculiar features carved in the bedrock surface throughout the Georgian Bay area—large grooves, potholes and various streamlined landforms—features suggesting that an ancient flood, as well as glaciers, may have scoured the bedrock surface. A current theory is that a flood occurred during the final stages of the Ice Age when the water of a vast glacial lake, trapped below the continental ice sheet, was suddenly released and surged southwards along the base of the glacier. This catastrophic flood carried a turbulent load of sand, mud and stone that scoured the bedrock and stripped away the soil throughout the Georgian Bay region.



A schematic cross-section through the continental ice sheet covering the Great Lakes region during the catastrophic flood event. The height of the glacier ice and trees is greatly exaggerated.

Stop 2: A pencil is oriented parallel to glacial scratches in rock on the shores of Kilcoursie Bay along the Twin Points Trail. Ice Age glaciers flowed toward the viewer from the north.

Stop 3: Harold Point Campground shoreline

GPS co-ordinates: N45° 20.844′, W80° 11.580′

Harold Point Campground lies across Kilcoursie Bay from the Day-Use area. There is day-use parking in the campground between campsites 526 and 528 that provides access to a swimming beach in a cove east of Harold Point. If this parking area is full, park at the amphitheatre and walk to the cove. A small rocky point divides the cove and has a fascinating geology of pink gneiss, black gneiss and very coarse-grained igneous rock that geologists refer to as *pegmatite*. It is well worth a look!

Stop 3: Harold Point is made of ice-sculpted, light-coloured, granite-like gneiss similar to the rocks along the Twin Points Trail.

Stop 3: A view along the small rocky point and its shallowly tilted layers of pink gneiss.

Stop 3: Near the tip of the small rocky point is a large patch of pegmatite (pale colour) surrounded by dark gneiss. The gneiss is largely made up of amphibole, a black mineral.

Stop 3: The pegmatite displays large crystals of pink feldspar, shiny flakes of black mica (biotite) and grey quartz. Smaller grains of these same minerals, along with the mineral amphibole, make up most of the rock in the Parry Sound region. This pegmatite formed from molten rock that penetrated the surrounding gneiss after the gneiss had already formed. As the molten rock cooled, abundant water in the magma inhibited the formation of crystals, resulting in the growth of fewer but much larger crystals.

Stop 4: Lighthouse Point Trail

GPS co-ordinates: N45° 20.117′, W80° 10.085′

The Lighthouse Point Trail is located at the east end of Killbear Provincial Park. The short loop trail provides access to this picturesque point. Strongly layered shoreline rocks contain abundant mica, a platy mineral that breaks easily. As a result, the rock weathers into sloping ledges and broken slabs.

Stop 4: Thin layers of gneiss at Lighthouse Point have eroded into sloping ledges separated by thin recesses. Ledges are composed of resistant layers of quartz and feldspar while recesses reflect more rapid erosion of weak layers rich in amphibole and mica.

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