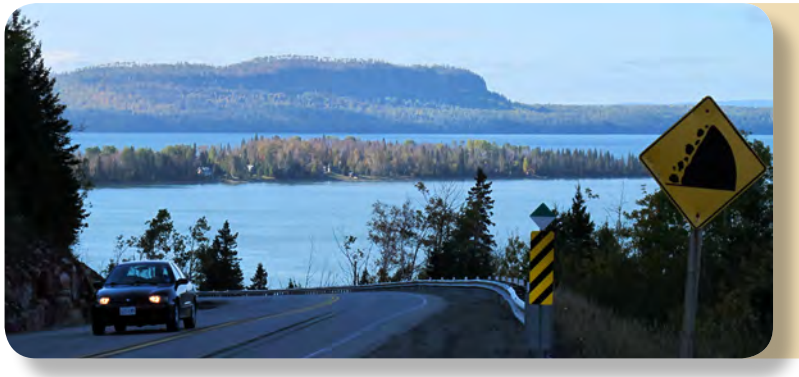
Palisades and Red Rocks on Lake Superior's Dramatic Northwest Shore

The Trans-Canada Highway skirts the north shore of Lake Superior from Thunder Bay to Marathon. The northwestern part of this route, centred on the town of Nipigon, is known for towering cliffs, distinctive red rocks, and a Lake Superior shoreline of elongate peninsulas, bays and islands. This GeoTour highlights 9 well-known geological sites that illustrate this unique geology and geography.

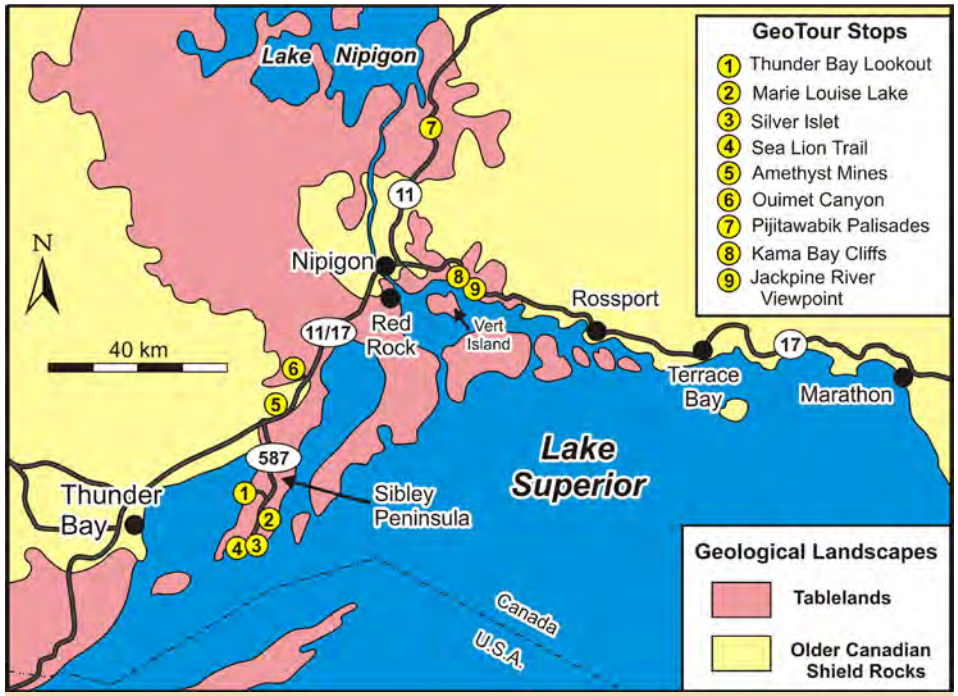


A view, from the Trans-Canada Highway near Kama Bay, of tablelands (flat-topped mountains) on Vert Island in Lake Superior.

Red and white sedimentary rocks are exposed along the Trans-Canada Highway near Red Rock.

Getting there

The GeoTour stops are easily accessible from the Trans-Canada Highway (11/17) between Thunder Bay and Rossport. Sites in Sleeping Giant Provincial Park, on Sibley Peninsula (Stops 1, 2, 3 and 4), can be reached via Highway 587. Short gravel roads from Highway 11/17 access amethyst mines (Stop 5) and Ouimet Canyon Provincial Park (Stop 6). Pijitawabik Palisades (Stop 7) is on Highway 11, about 40 km north of its junction with Highway 17. Kama Bay cliffs (Stop 8) can be viewed from 2 pullouts on Highway 17 between Nipigon and Rossport. Jackpine River viewpoint (Stop 9), just east of Stop 8, is accessible via a short road from Highway 17.



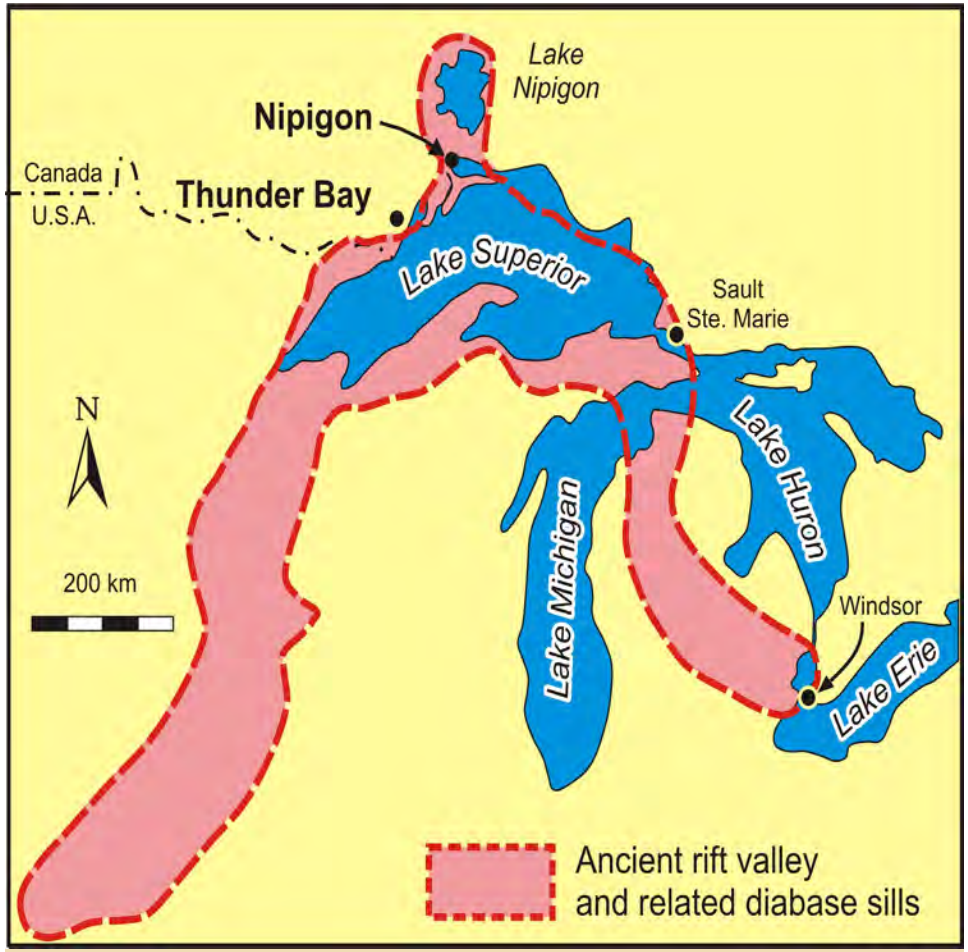
A map showing the extent of tablelands and the location of GeoTour stops.

Nipigon

An Ancient Rift Valley

Hidden beneath the waters of Lake Superior is the geological secret to its existence: a thick sequence of rocks that fills an ancient rift valley. These rocks underlie the entire lake, but only to the west and south are they well exposed on land. The history of these ancient rift rocks began 1.1 billion years ago when forces in the Earth's mantle stretched the North American continent, breaking it along geological faults. The land sagged between these faults, forming a rift valley similar to the modern Great Rift Valley in Africa. Melted rock, or *magma*, rose from the mantle and erupted as fiery lavas for tens of millions of years as the rift valley floor continued to sink. An impressive sequence of interlayered sedimentary rock (sandstone, conglomerate, shale) and volcanic rock, over 35 km thick, accumulated in the deepening valley, the sediments being transported into the rift valley by rivers. Some magma was injected into the sedimentary rocks and spread laterally along layers, cooling and crystallizing into great sheets of rock known as diabase *sills*. The Nipigon and Thunder Bay regions are underlain by extensive diabase sills.

During the Ice Ages, glaciers scoured deeply into the rift valley rocks because they were much less resistant to erosion than the older granite and metamorphic rocks of the adjacent portions of the Canadian Shield. When the glaciers retreated, water filled the great basin left behind, forming Lake Superior. Thus the unique combination of the formation of an ancient rift valley, filled with rocks softer than those surrounding it, followed by glacial scouring during the Ice Age, has created the giant basin that now holds the lake.



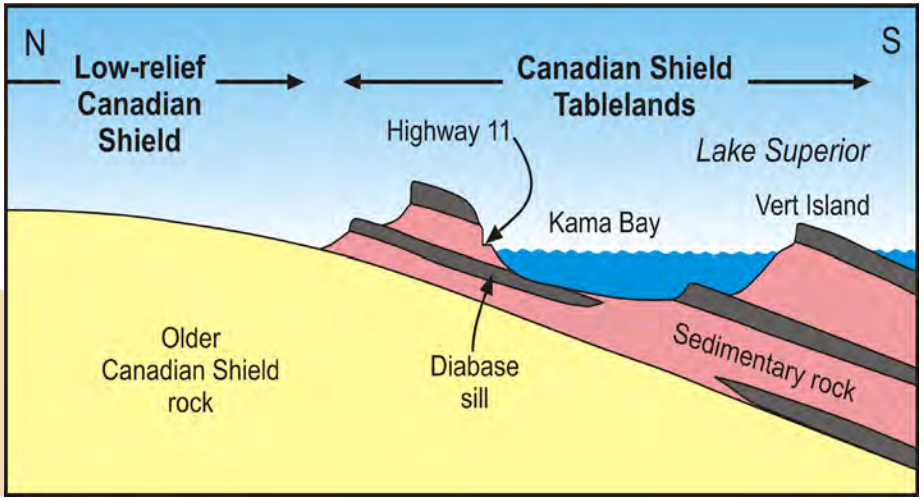
The Nipigon region sits along the margins of an ancient rift valley known as the Midcontinent Rift.

Nipigon

Tablelands

In the Nipigon region, the erosion of diabase sills related to the ancient rift valley has created flat-topped or gently sloping mountains bounded by steep cliffs. In the American southwest, these mountains are referred to, respectively, as *mesas* or *cuestas*. Here we refer to them collectively as *tablelands*. The diabase sills are tough igneous rocks that occur as thick layers. In contrast, the sedimentary rocks interlayered with the diabase are riddled with fine fractures and soft minerals and erode easily. Over eons of time, erosion of the soft sedimentary rock undercuts the overlying diabase sill, causing the diabase to break off in blocks along vertical fractures, and create steep cliffs. Meanwhile, erosion of soft sedimentary rock overlying the diabase exposes the flat or gently sloping top of the sill.

A view, from the Trans-Canada Highway near Kama Bay, of sloping tablelands (cuestas) and cliffs along the shores of Lake Superior.

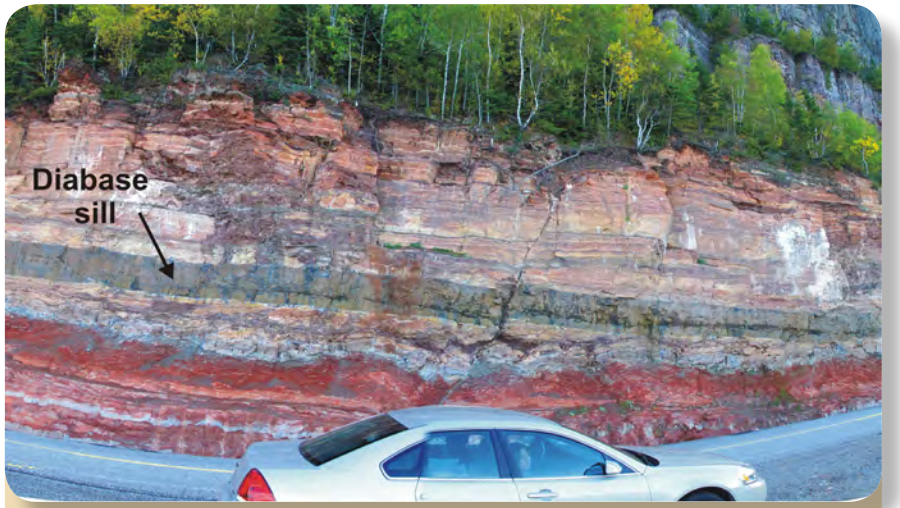


A cross-section across the Canadian Shield east of Nipigon illustrates that gently tilted layers of sedimentary rock and diabase lie above a basement of older Canadian Shield rock.

Nipigon

Red Rocks

The Nipigon region has one of the best displays of red-coloured rocks anywhere in Canada. Geologists believe that the red siltstones and sandstones were deposited on older Canadian Shield rocks between 1.3 and 1.5 billion years ago, during the Precambrian Eon, when an ancient desert environment existed in the Nipigon area. Most sedimentary rocks form from sand or mud deposited on ancient seafloors and range in colour from pale grey to brown or black. Sedimentary rocks that form in ancient desert environments are much less common and are often red in colour because of oxidation, or "rusting", of iron-bearing minerals by oxygen in the atmosphere.



A view of red sedimentary rocks intruded by a thin black diabase sill along the Trans-Canada Highway at Kama Bay.

A close up of red siltstone. Abundant fractures cause this rock to erode easily. The white spots are areas where the iron oxide has been removed by chemical reactions, essentially bleaching the rock. Finger for scale.

Nipigon

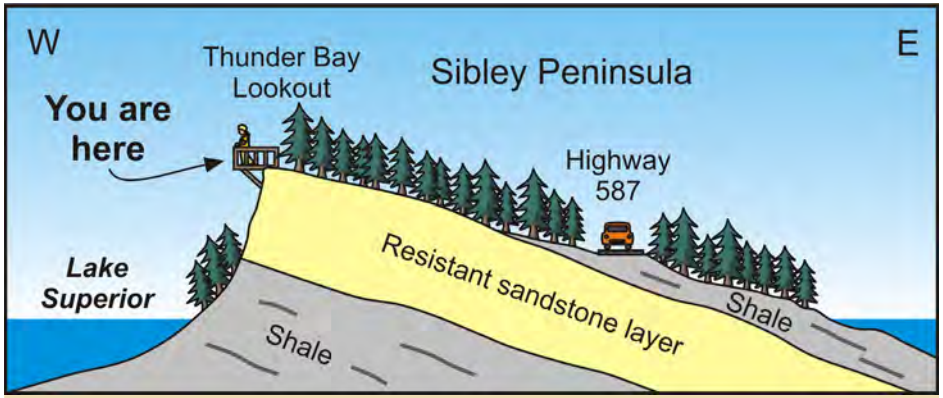
Stop 1: Thunder Bay Lookout, Sleeping Giant Provincial Park

GPS co-ordinates: N48° 28.514′, W88° 49.405′

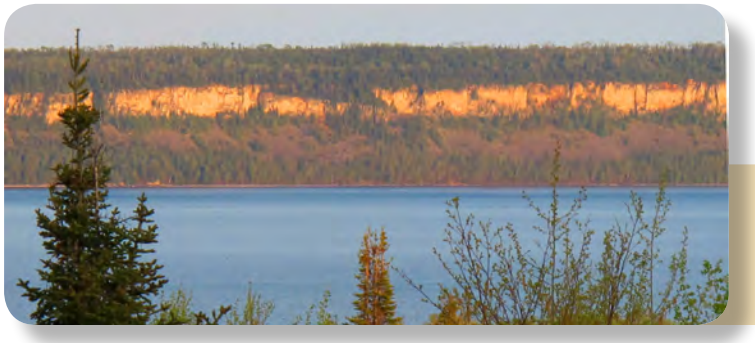
The Sibley Peninsula extends as a 50 km long finger into Lake Superior just east of Thunder Bay. Much of the peninsula lies within Sleeping Giant Provincial Park, which is named for the iconic mountain at its southern tip. Highway 587 runs the length of the peninsula and provides access to the park and the hamlet of Silver Islet.

Thunder Bay Lookout sits above a dramatic sandstone cliff along the western shores of the Sibley Peninsula. A side road opposite the Rita Lake Picnic Site on Highway 587 (about 8 km south of the northern park boundary) heads 11 km west to Thunder Bay Lookout.

Stop 1: Thunder Bay Lookout viewing platform provides a stunning view of the sandstone cliffs and the waters of Thunder Bay more than 130 m below.



Stop 1: A cross-section of the northern part of the Sibley Peninsula shows the underlying gently sloping sedimentary rocks that create contrasting steep western and shallow eastern shorelines.



Stop 1: A view eastward from Highway 11/17 near Thunder Bay to the sandstone cliffs exposed along the western shores of the Sibley Peninsula.

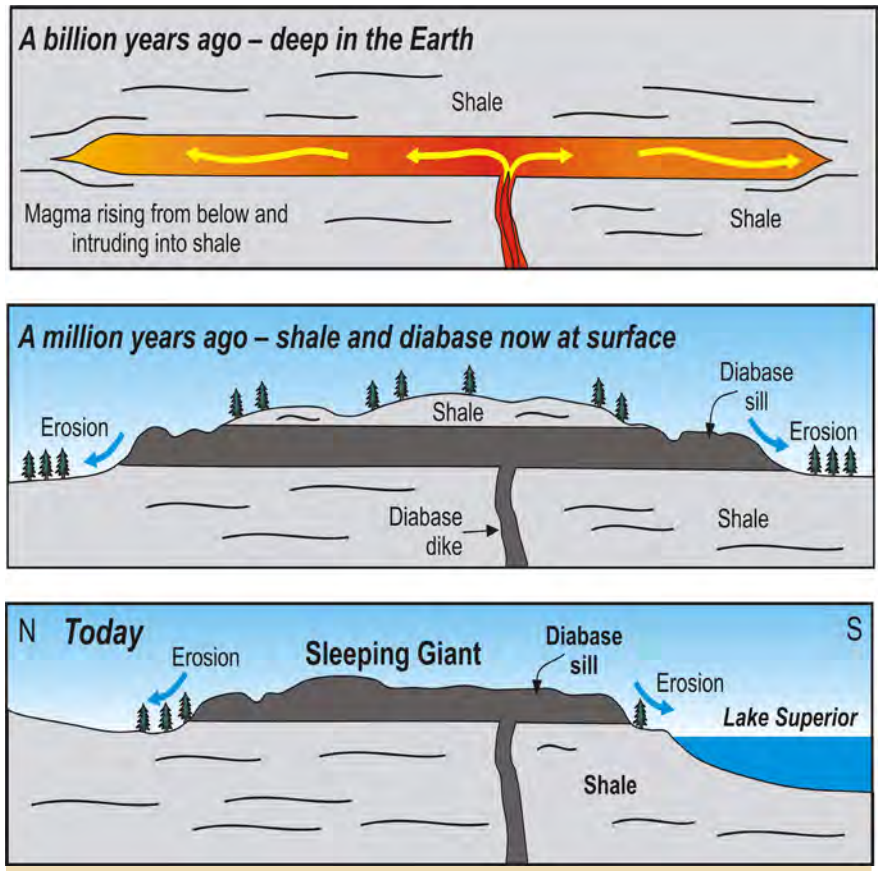
Stop 2: Marie Louise Lake Picnic Site, Sleeping Giant Provincial Park

GPS co-ordinates: N48° 23.672′, W88° 46.887′

About 10 km south of the turnoff to Thunder Bay Lookout along Highway 587 is a picnic site on the shores of Marie Louise Lake. There is a striking view across the lake to the Sleeping Giant. The Sleeping Giant is a flat-topped mountain bound by high cliffs that resembles a giant sleeping on his back. These mountains form the southernmost point of the Sibley Peninsula, Thunder Cape.

Stop 2: A view of the Sleeping Giant across the waters of Marie Louise Lake from Highway 587 near the picnic site.

Like other tablelands, the Sleeping Giant owes its distinctive flat top and steep sides to its geology. The rocks exposed at the Sleeping Giant are gently tilted layers of sedimentary shale and igneous diabase. The great cliffs of the Sleeping Giant are the retreating edges of a diabase sill layer that once covered a much larger area. More rapid erosion of soft shale underneath has undercut the diabase layer, causing it to break and topple, and erosion of overlying shale and sandstone—in fact, the same thick sandstone layer that can be seen at the Thunder Bay Lookout (Stop 1)—has exposed the flat top of the once-buried diabase sill.



Stop 2: Origin of the Sleeping Giant.

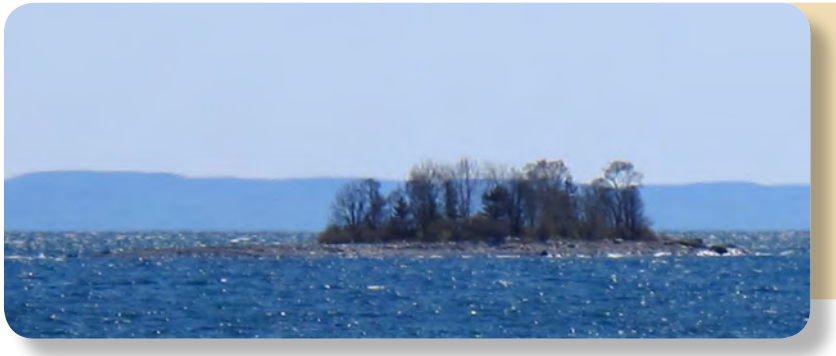
Stop 3: Hamlet of Silver Islet

GPS co-ordinates: N48° 19.861', W88° 49.221'

At the end of Highway 587 and on the shores of Lake Superior is the historic hamlet of Silver Islet. In the 1870s, Silver Islet was an active mining community that supported one of Canada's most improbable mines. In 1868, silver was discovered on the tiny island of Silver Islet, which lies just a kilometre offshore. The silver ore occurred in veins that cropped out on the islet and extended below the surrounding waters of Lake Superior. The owners struggled for years to operate the mine while protecting it from battering storm waves and seepage of water into the mine workings. Over the mine's 14-year history, the tiny island, which originally measured about 25 m in diameter, was fortified with rock and cribbing, expanding its original size 16 times. At its peak, the little island supported 11 mine buildings and the workings descended over 300 m below the lake. However, in 1884, the mine workings flooded when a coal shipment was delayed and the coal-fired pumps stopped working. Mining never resumed. Today, little remains on the island but the partly submerged foundations of cribbing and buildings.

Stop 3: The general store in Silver Islet was once the company store for the Silver Islet Mine.

Stop 3: A sample of rich silver ore from the Silver Islet mine contains silver-bearing minerals (grey) and calcite (cream). Quarter for scale. *Photo courtesy of the Ontario Geological Survey.*



Stop 3: The tiny island of Silver Islet is visible offshore from The Avenue, which follows the shoreline to the northeast of the general store.

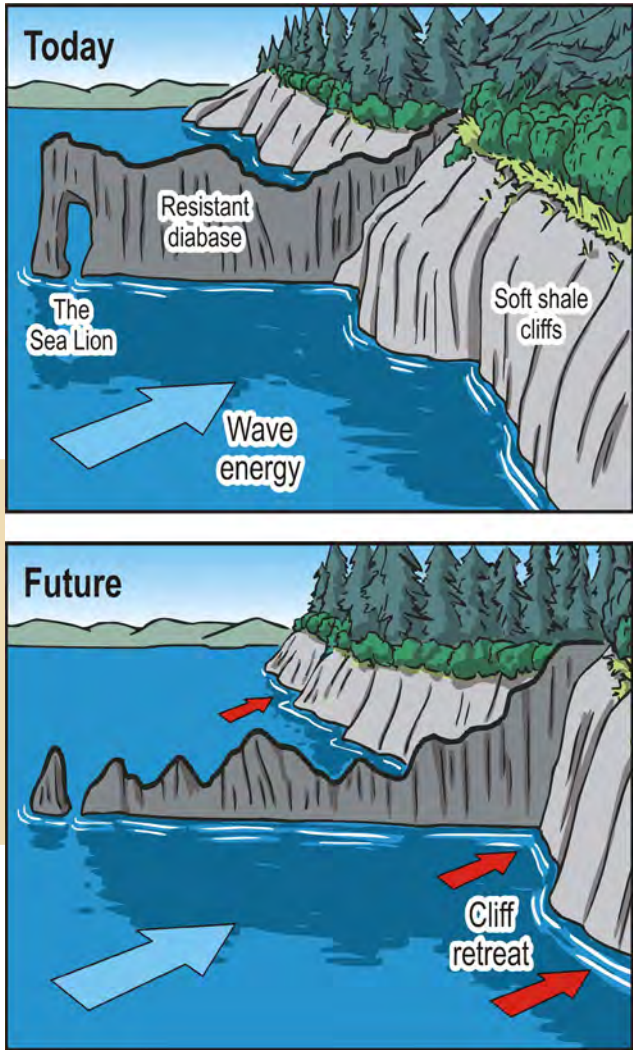
Stop 4: Sea Lion Trail, Sleeping Giant Provincial Park

GPS co-ordinates: N48° 20.416', W88° 49.342'

About 1 km north of the hamlet of Silver Islet is the head of the trail leading to the Sleeping Giant and the shores of the Sibley Peninsula. The Sea Lion, one of the most photographed landmarks in Ontario, is about a kilometre-long walk from the parking lot. The Sea Lion is a thin rib of diabase that forms a natural wave-cut arch along the Lake Superior shore. This feature resembled a lion sitting on its haunches prior to the early 1900s, when its head broke off. However, the name has persisted.

The Sea Lion has a similar geological origin as the Sleeping Giant. Both share the same 2 geological materials responsible for their form: diabase and shale. Both result from the more rapid erosion of soft shale relative to hard diabase. The diabase of the Sea Lion and Sleeping Giant are both crystallized from hot melted rock, or magma, that intruded into the shale while it was buried deep in the earth. Where they differ from each other is that the diabase of the Sea Lion is a thin *dike*, a vertical sheet that cuts across layers of shale, whereas the Sleeping Giant is much thicker and is a horizontal sheet, or *sill*, lying parallel to surrounding layers of shale.

Stop 4: The Sea Lion is about 8 m high, 1 m thick and projects 15 m into Lake Superior. Storm waves have eroded the surrounding shale, exposing the vertical walls of the diabase dike.



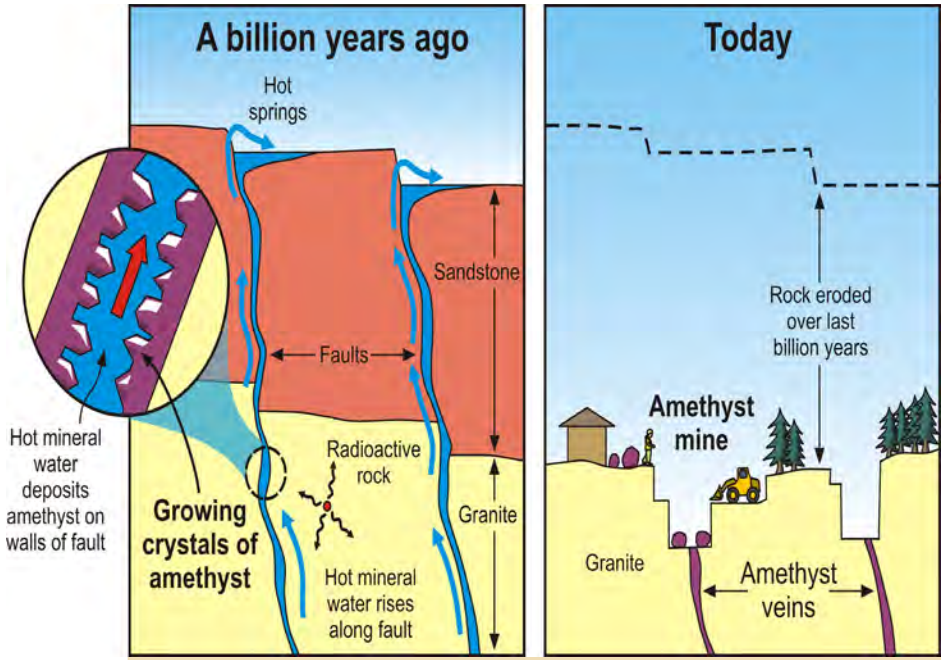
Stop 4: The shore near the Sea Lion is exposed to the energy of storm waves on Lake Superior. Resistant diabase is less susceptible to erosion and retreats more slowly relative to soft shales that form most of the shoreline.

Nipigon

Stop 5: Amethyst Mines

Just northeast of the Sibley Peninsula and near Highway 11/17 is a region famous for its amethyst mines. Amethyst, the strikingly beautiful purple-hued form of quartz, is Ontario's official mineral emblem. Several amethyst mines operate on a seasonal basis and thousands of visitors come each year to obtain specimens. The mines offer amethyst for sale, and some allow visitors to collect their own specimens for a fee. Check first with tourist information offices in Thunder Bay or Nipigon for directions to the mines and hours of operation.

Stop 5: A specimen from the Amethyst Mine Panorama displays an amethyst vein in granite. The vein formed in an ancient crack in the granite that was a pathway for hot, mineral-laden waters rising from deep in the earth. Amethyst crystals grew into the fracture, almost completely filling the fracture.



Stop 5: Amethyst formed along faults about 1.1 billion years ago when North America began to split apart along the Midcontinent Rift. The faults formed natural channel ways for hot, mineral-laden waters that deposited silica and iron to form amethyst. Natural low-level radiation from the granite bedrock is believed essential to the formation of amethyst by distorting the quartz's atomic structure and so allowing iron to enter the crystal structure.

Stop 5: Purple amethyst crystals almost completely fill the spaces between broken fragments of granite and siltstone at the Amethyst Mine Panorama. Movement along an ancient fault broke the rock and created pathways for hot waters that deposited the amethyst.

Stop 6: Ouimet Canyon Provincial Park

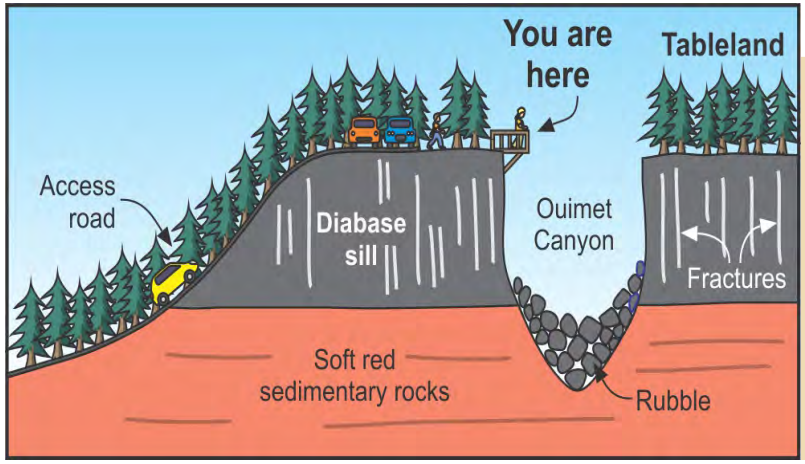
GPS co-ordinates: N48° 47.349', W88° 40.312'

A remarkable series of canyons cut the edge of the extensive tablelands in the Nipigon area. Ouimet Canyon (pronounced *wee-met*) in Ouimet Canyon Provincial Park is the most famous. The park is accessed from Highway 11/17 near the town of Dorion, along Ouimet Canyon Park Road. The access road climbs up to a tableland plateau and trailhead parking lot. A kilometre-long loop trail provides access to 2 spectacular viewpoints on the rim of this astonishingly steep-walled canyon.

Ouimet Canyon's history dates back over a billion years when magma rose from deep within the earth, flowed horizontally between layers of sedimentary rocks, and cooled to form a diabase sill. Further cooling and shrinkage of the rock resulted in extensive vertical cracking. Over a period of several million years, the rocks above the diabase eroded away, forming the flat top of the tableland. The origin of Ouimet Canyon is puzzling because no river currently flows through it. The canyon likely formed during the Ice Age by a river flowing across the tableland from glaciers to the northwest.

Stop 6: A view from a cliff rim viewpoint towards the mouth of Ouimet Canyon at the edge of the tablelands, and of the lowlands beyond. The walls of the canyon are cut by vertical fractures that cause sheets or columns of rock to collapse, maintaining the vertical sides of the canyon. The canyon bottom is filled with rock rubble from this ongoing collapse.

Stop 6: A cross-section of Ouimet Canyon. Red sedimentary rocks are exposed along the access road near the bottom of the hill, while rocks of the diabase sill form the walls of the canyon.



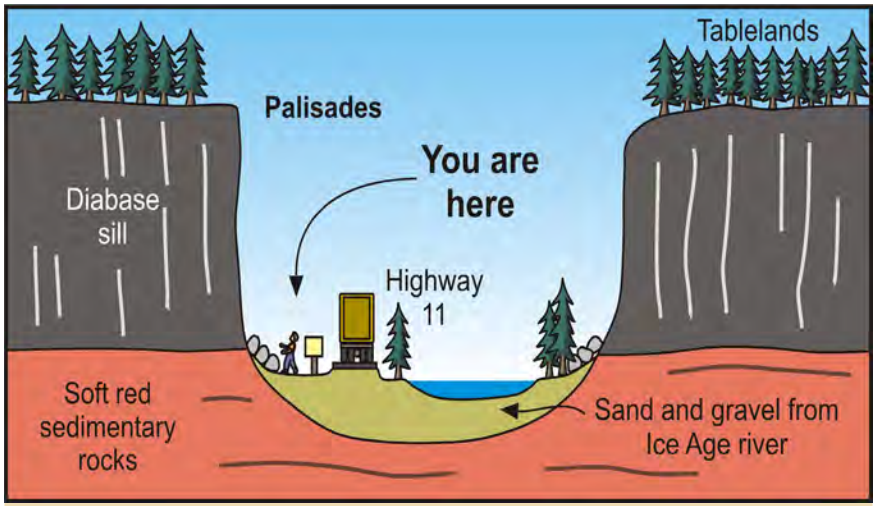
Stop 6: Ouimet Canyon is so narrow that sunlight rarely reaches the canyon floor. Arctic-type vegetation that remains from the Ice Age continues to grow on the cold canyon floor.

Stop 7: Pijitawabik Palisades

GPS co-ordinates: N49° 20.040', W88° 7.445'

Approximately 40 km north of its junction with Highway 17, Highway 11 follows a wide canyon cut through high tablelands. The most dramatic of the canyon cliffs are known as Pijitawabik Palisades (pronounced *pidg-i-ta-wa-bik*). Like Ouimet Canyon, high cliffs of diabase rise above a canyon floor. Though there are many lakes and small streams on the canyon floor, there is—like at Ouimet Canyon—no river present that might have carved it. However, the presence of sand and gravel deposits on the canyon floor suggests that the canyon likely funnelled meltwater flowing from glaciers during the end of the Ice Age.

Stop 7: A pullout on Highway 11, 40 km north of its junction with Highway 17, is the best place to stop and view the Pijitawabik Palisades.



Stop 7: A cross-section through the rocks and canyon at the Pijitawabik Palisades GeoTour stop illustrates a similar geology to Ouimet Canyon.

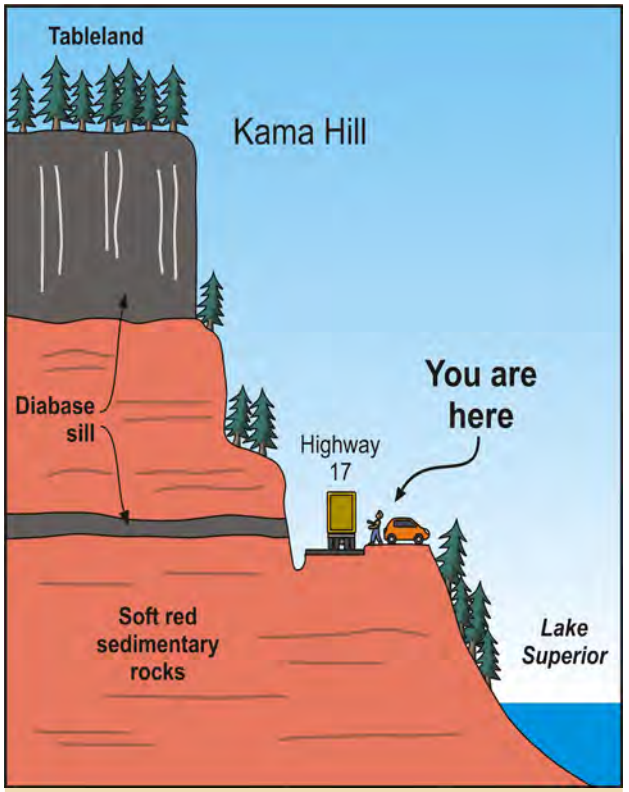
A historic marker on Highway 11 near Reflection Lake is our GeoTour stop and a good place to view these dramatic cliffs. Also, about 3 km south of the historic marker, along Highway 11, is the short access road to the trailhead for the Palisades hiking trail. The 7 km long hiking trail climbs to the summit of the Pijitawabik Palisades and a series of cliff-top lookouts. The Palisades are a major destination in winter for those who climb its many frozen waterfalls, some over 40 m high.

Stop 8: Kama Bay Cliffs

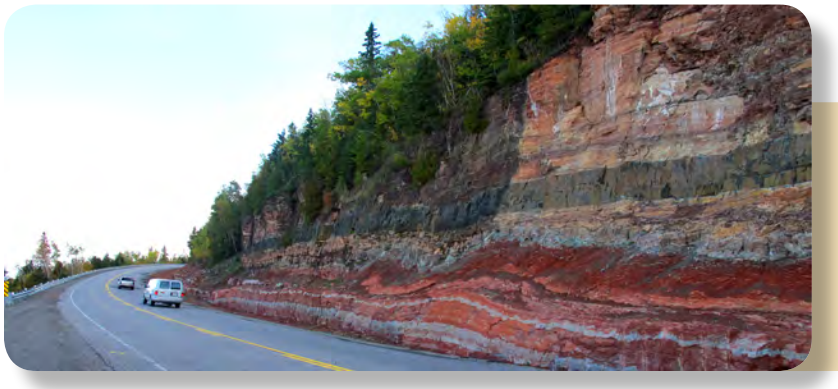
Northern pullout, GPS co-ordinates: N49° 0.086′, W88° 1.297′
Southern pullout, GPS co-ordinates: N48° 59.551′, W88° 1.368′

A remarkable exposure of red rocks and towering cliffs occurs along Highway 17 above Kama Bay on Lake Superior, about 20 km east of its junction with Highway 11. Two pullouts, a kilometre apart along the highway, provide superb views of photogenic rocks and cliffs.

Stop 8: A view from the northern pullout, of Kama Hill, the high cliffs of diabase below a tableland plateau. Layers of red siltstone and pale sandstone and thin sills of black diabase are exposed along the roadside.



Stop 8: A cross-section of the rocks at the Kama Bay GeoTour stop.



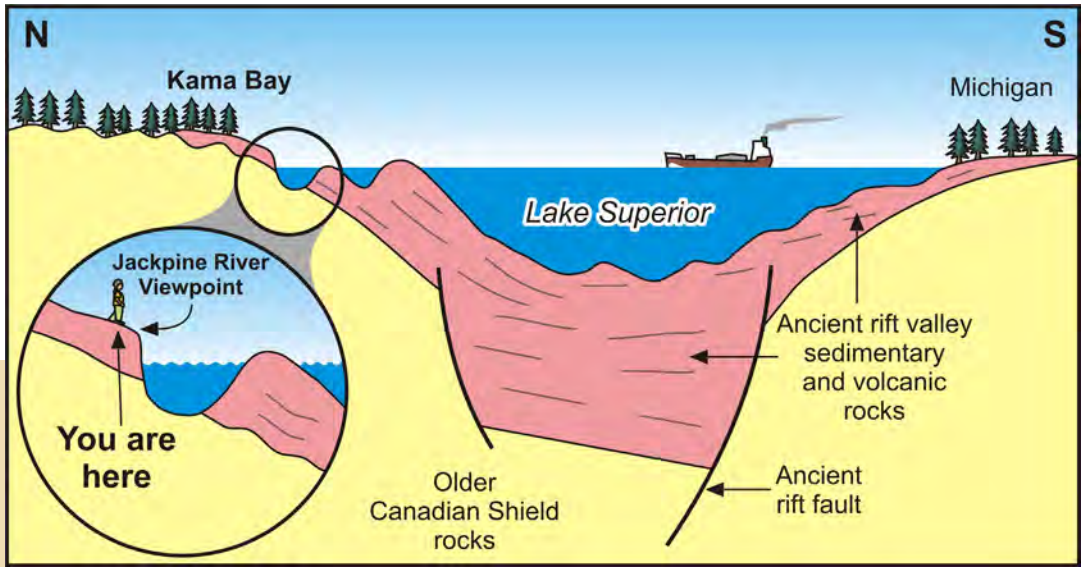
Stop 8: A view from the southern pullout. Colourful layers of red siltstone, pink and grey sandstone, and grey limestone and chert provide a record of an ancient desert and desert-lake environment. Stromatolites, dome-shaped structures produced by now-fossilized bacterial colonies, occur within the layer of limestone and chert. The black diabase sill was intruded into these rocks during formation of the Midcontinent Rift, when magma rose from the Earth's mantle.

Stop 9: Jackpine River Viewpoint and Picnic Site

GPS co-ordinates: N48° 58.013', W87° 59.114'

East of the Kama Bay cliffs (GeoTour stop 8), Highway 17 crosses the Jackpine River and climbs to the top of a tableland. A short road heads south from Highway 17 to a picnic site and viewpoint above the tableland cliffs.

Stop 9: The view from the picnic site viewpoint across the waters of Nipigon Bay, Lake Superior, to tableland cliffs on Vert Island. The viewpoint is on the top surface of the thick diabase sill that underlies the tableland at this site.



Stop 9: The islands and peninsulas near Kama Bay are the tilted edges of sedimentary and igneous rock layers that fill the northern part of the Midcontinent Rift.

Nipigon

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