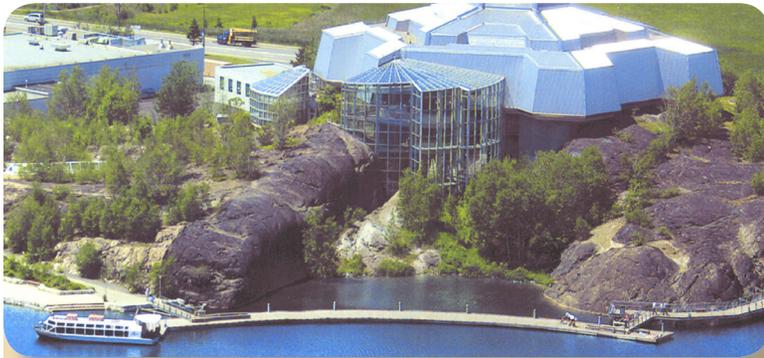


Science North, Greater Sudbury

Canadian Shield Rock with Stories of Ancient Meteorite Impact, Faulting and Glacial Sculpting

GPS co-ordinates: N46° 28.224', W80° 59.698'



Science North's snowflake-shaped buildings straddle a geological fault and sit on glacially sculpted rock outcrops along the shores of Ramsey Lake. *Photo courtesy of Science North.*

Science North is Canada's second largest science centre and northern Ontario's largest tourist attraction. It is internationally recognized for its innovative science communication programs and interactive exhibits. The science centre's rocky site is itself an exhibit. The main building is perched on top of Canadian Shield bedrock on the shores of Ramsey Lake. Inside, a rock tunnel shows evidence of an ancient meteorite impact, and a ramp spirals around glacially carved bedrock and a geological fault. The boardwalk along the lake provides great views of the shoreline geology. So let's start at the waterfront.

Fault! Geological faults are cracks in the Earth's crust where rocks on one side have slipped past the rocks on the other side. Each slip creates an earthquake and breaks and grinds rock along the fault.

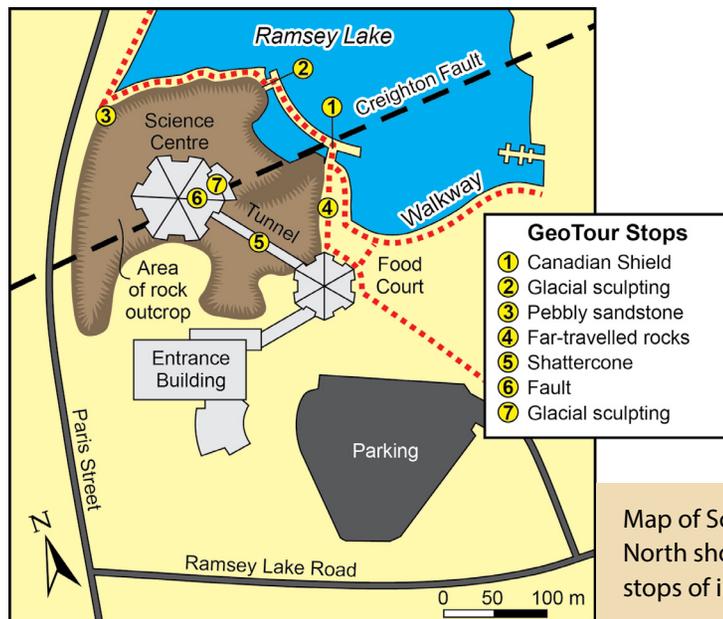
How to get to Science North

Science North is on Ramsey Lake Road just off Paris Street, about a 5 minute drive from the City of Greater Sudbury's downtown centre.



Stop 1: A Canadian Shield waterfront

From the parking lot, head for the waterfront past the Food Court building. The Jim Gordon boardwalk extends 2 km from Science North to Bell Park. Along the Science North waterfront, the boardwalk crosses a floating dock that skirts 2 rock headlands in Ramsey Lake. Stand at the east end of the floating dock. From here you have a great view of the rock that extends underneath Science North. These rocks are over 2 billion years old and have been shaped and smoothed by Ice Age glaciers. This rocky shore is classic Canadian Shield scenery.



Map of Science North showing stops of interest.

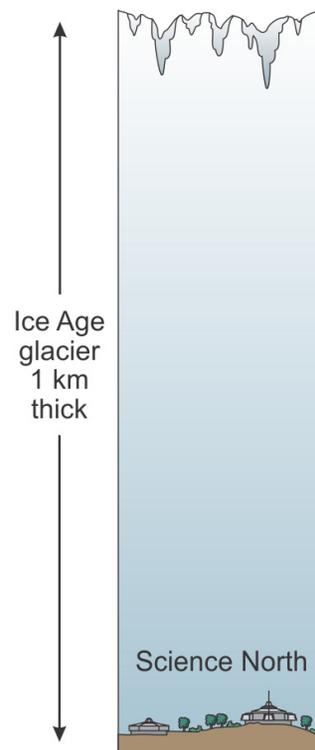
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Stop 1: You are on the trace of a geological fault as you stand at the east end of the floating dock. The fault cuts through dark-coloured igneous rock on the headland beside you, on your left. The igneous rock formed from magma that cut through the older, paler coloured sedimentary rock exposed across the bay. The fault is on display inside Science North.



Stop 2: The northern headland displays a glacially smoothed and streamlined surface that slopes into the lake. Ramsey Lake fills a glacially scoured depression in the bedrock.



Stop 2: Glacial sculpting

Walk to the west end of the floating dock. The rock headland in front of you displays a smooth, streamlined “whale back” shape that is the hallmark of glacier scouring. Try to imagine yourself below a kilometre of cold, grinding glacier ice. Fifteen thousand years ago, Science North lay below a great slow-moving glacier. Ice flowed across the Greater Sudbury region from northeast to southwest. Sand, mud and stone that were lodged at the base of the glacier ice scoured, scratched and polished the underlying rock surface. The smooth and rounded shape of the rock that you see is a legacy of this glacial sculpting. Look for scratches on the rock surface – these are parallel to the direction of ice movement.

Stop 2: The Science North site lay below a kilometre of glacier ice 15 000 years ago.

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Why does Greater Sudbury have so many lakes?

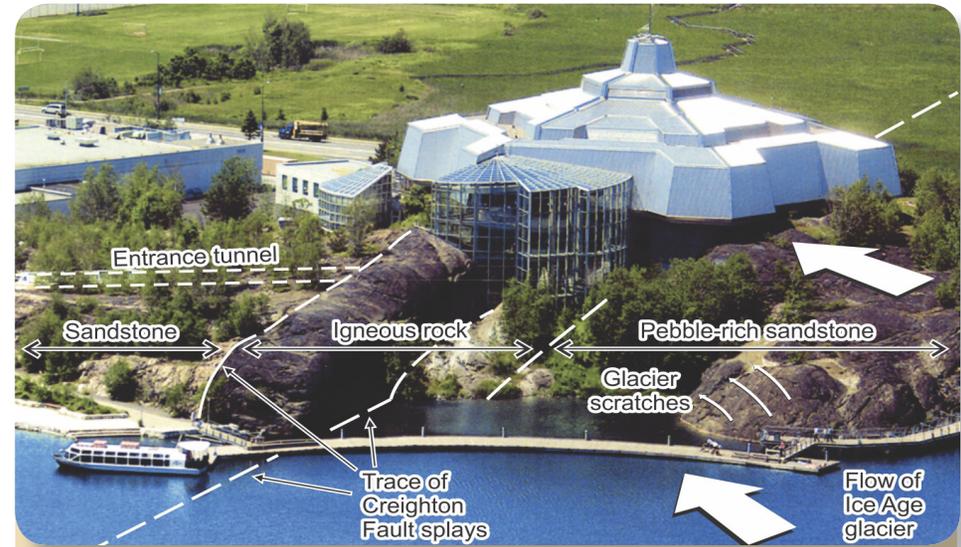
Greater Sudbury has 330 lakes within its city limits – more than any city in Canada. Why?

Greater Sudbury lies on the lake-rich Canadian Shield, and there are very few Canadian cities on the Shield – Thunder Bay, Ontario, and Saguenay, Quebec, being two of the exceptions. Why is the Canadian Shield so riddled with lakes relative to other parts of Canada?

Glaciers have scoured almost all parts of Canada over the past 2 million years, removing soil like a giant bulldozer and pushing, dragging and washing it to the south. In general, the rocks of the Canadian Shield are more resistant to erosion than much of the rock that underlies the rest of Canada. But the Canadian Shield also includes softer rock units, as well as broken rock in faults and fractures. Because of this highly variable hardness, glaciers were able to sculpt a rugged topography of hills and basins. When the glaciers retreated, glacially carved depressions filled with the glacier meltwater runoff to become lakes. Deposits of glacial debris of stones, sand and clay were strewn across the landscape and further blocked flow, creating more lakes. In contrast, southern Ontario and much of the rest of Canada are underlain by large areas of more uniform rock types that are less resistant to erosion. These rocks were more evenly and deeply scoured by the glaciers and thicker layers of glacial soils were left behind in those areas by the melting glacier. After the glacier retreated, meltwater runoff was able to cut channels through the soils, draining depressions through a network of streams and leaving fewer lakes.

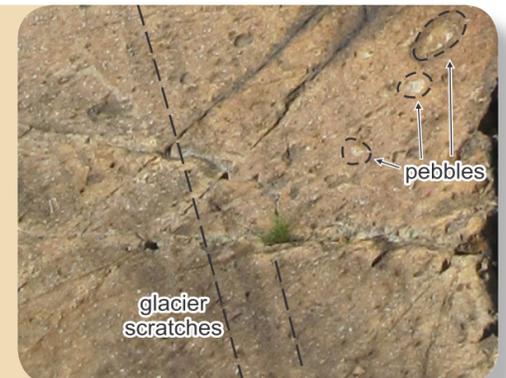
Stop 3: Pebbly sandstone: record of an ancient Ice Age

Continue along the walkway to Paris Street. You will note in the rock the outlines of fragments. This rock is a sedimentary rock composed of pebbles and sand. Geologists interpret this rock to be debris that was left behind by glaciers 2.3 billion years ago. This record of glaciation, one of the oldest known on Earth, is **in** the rock. The smoothed and scratched surface **on** the rock records a much younger glaciation that ended 10 000 years ago. So, you are looking at the records of 2 glaciations separated by 2 billion years of Earth history. How wild is that!



The rocky shores at Science North are composed of 3 different rock types, each recording a unique ancient environment. Tan-weathering rock near the Food Court is hard sandstone whose tilted layers were laid down as sand beds in ancient rivers 2.3 billion years ago. The dark ridge extending out from Science North's snowflake building is igneous rock that crystallized from magma as it rose up along the Creighton Fault. The pebble-rich sandstone to the right (north) of this formed as glacial debris.

Stop 3: Pebble-rich sandstone formed as glacial debris 2.3 billion years ago. The scratches on the surface of the rock were caused by glaciers during a more recent glaciation that ended 10 000 years ago.



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➤ Stop 4: Far-travelled rocks

Head back towards the entrance to Science North. The walkway near the Food Court building is lined with rectangular slabs of limestone, but there is a large pink boulder in a small plaza that is very different than the slabs of limestone. Take a look at both rocks. The boulder is pink granite, a common type of Canadian Shield rock. This rounded boulder is an example of a glacially transported rock that was eroded from the Canadian Shield, moved south by the glacier, and left behind when the glacier melted. Rocks like this, called erratics, are found hundreds of kilometres south of the Canadian Shield in the Prairies, southern Ontario, and northern United States.

The limestone blocks have also been transported, but by humans rather than glaciers. The limestone was quarried on Manitoulin Island, a little over an hour's drive to the southwest of Greater Sudbury, and brought to Science North as a feature rock. The island is an area underlain by limestone south of the Canadian Shield. Limestone underlies much of Southern Ontario but is rare in the Canadian Shield. From here, let's head into Science North.



Stop 4: (Left) Pink granite. (Right) Limestone contains cavities etched by rainwater. Look for fossils – this limestone formed in a warm shallow tropical sea 430 million years ago.

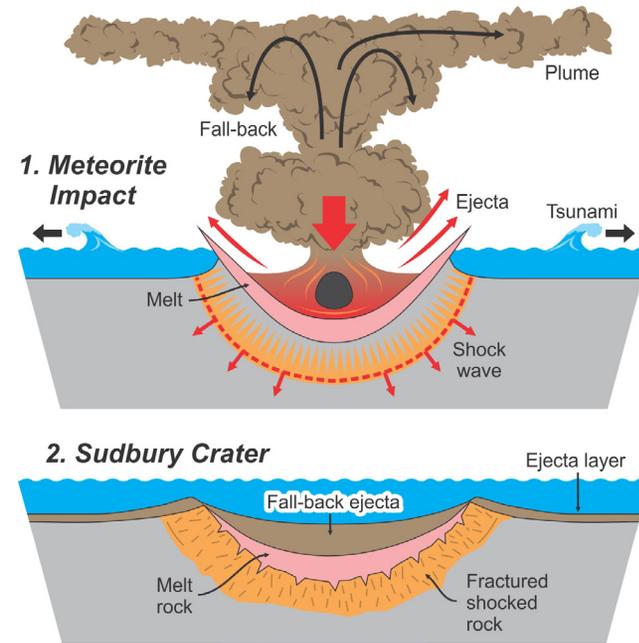
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Stop 5: A tunnel through shocked rock

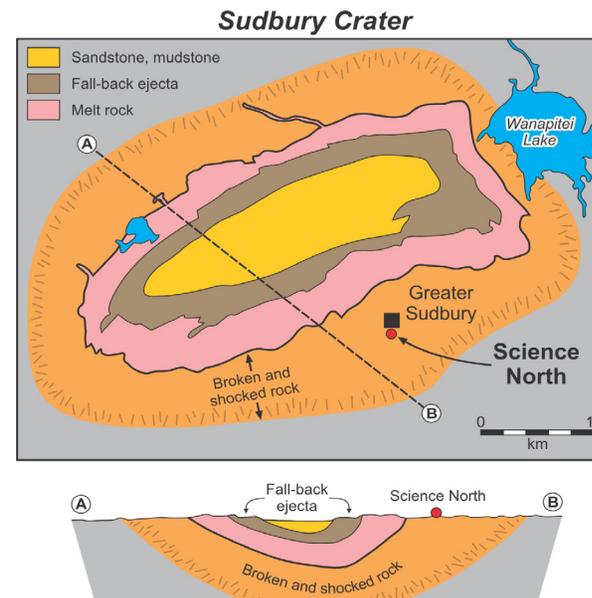
Inside Science North, head for the tunnel leading to the science centre (paid admission is required). The tunnel is cut through the same tilted layers of sandstone that are exposed outside along the walkway. About 1.85 billion years ago, the Greater Sudbury area was struck by a meteorite 10 km across that created a giant crater 200 km in diameter. The eroded edge of that ancient crater lies only 3 km northwest of Science North. Intense shock waves from the impact travelled through the surrounding rock, including the sandstone exposed in the tunnel. These shock waves shattered the rock, creating features called shattercones. A spotlight highlights a small shattercone exposed on the tunnel wall.



Stop 5: (Left) Walls of the tunnel display tilted layers of sandstone, many fractures and shattercones. (Right) A shattercone, about 15 cm long, formed by the shock wave from the meteorite impact.



Stop 5: The shock wave from the meteorite impact 1.85 billion years ago created a halo of broken and shocked rock.



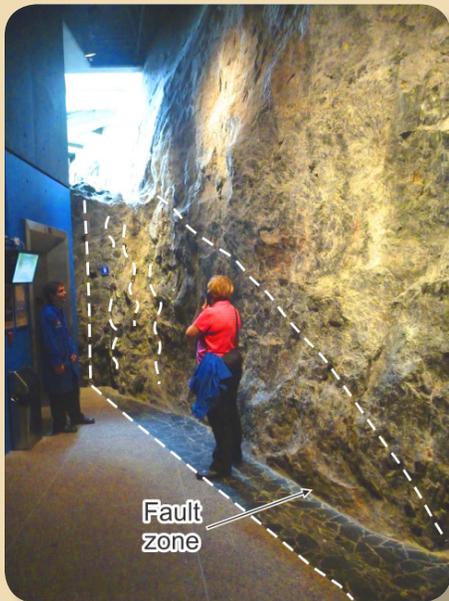
Stop 5: Map of the Sudbury crater. Greater Sudbury encompasses the eroded and deformed remnants of an ancient meteorite crater, the second largest known on Earth. A halo of broken and shocked rock, like the shattercones in the tunnel, surrounds the crater. (Bottom) View of rocks in the subsurface (a cross section) along line A-B.

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Step 6: A close look at a geological fault

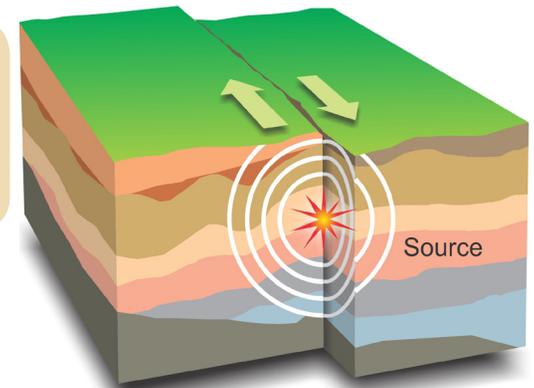
As you exit the tunnel, look for 2 dark bands that cross the floor. These bands mark the location of 2 splays of the Creighton Fault. Splays of this geological fault are exposed on the rock walls near the entrance to the tunnel and beside the elevator.

The fault splay by the elevator continues east to form the straight cliff along the shores of Ramsey Lake. Above the fault is a deep groove in the bedrock surface where glaciers have scoured the broken rock. As you climb the spiral ramp to the upper floors, you will view the fault groove in the glacier-sculpted bedrock.



Step 6: (Left) The rock wall by the elevator exposes broken rock and clay along a splay of the Creighton Fault. The black band on the floor marks the trace of the fault below the floor. A deep groove in the bedrock surface above the fault was carved by glaciers that scoured the weak rock along the fault. (Right) Rock grinding against rock during fault movement has created a seam of finely crushed rock.

Step 6: An example of fault movement triggering an earthquake on a fault with lateral movement like the Creighton Fault.



The Creighton Fault can be traced across the Greater Sudbury area and connects with the Murray Fault, which continues several hundred kilometres west to Sault Ste Marie. Geologists believe that the fault was once similar to the San Andreas Fault in California but that it has been inactive for more than a billion years. Rocks on the south side of the fault (the tunnel side) have moved upwards 140 to 180 m and westwards 600 to 900 m relative to rocks on the north side of the fault (the Vale Cavern side).

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Step 7: More glacial sculpting

There is likely no better place in Canada to get a close-up view of glacially sculpted and scratched rock than along the ramp at Science North. Continental ice sheets once covered the site of Science North with over a kilometre of slow-moving ice. Pebbles, sand and clay embedded in the base of the moving glacier ground, scratched and polished the underlying rock into rounded streamlined shapes covered with fine scratches.

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Step 7: The ramp provides a view of the deep groove above the Creighton Fault eroded by glaciers scouring the broken rock.

Step 7: (Top) Glacially sculpted rock along the ramp. (Bottom) Close up of glacial scratches. Glacial movement was from left to right.