Dynamic Earth, Greater Sudbury

Ancient Seafloor, Meteorite-Blasted Rock, Ice Age Sculpture and Greater Sudbury's Smelter

GPS co-ordinates: N46° 28.439′, W81° 01.954′

Dynamic Earth and the Big Nickel sit atop a hill on the west edge of Sudbury.

Dynamic Earth in Greater Sudbury is one of Canada's finest geoscience centres. Interactive exhibits, multimedia shows and an underground mine tour highlight the unique geology and rich mining heritage of the Sudbury area. It is also the site of the Big Nickel, one of Greater Sudbury's most famous landmarks and a tribute to Sudbury as the nickel mining and processing capital of Canada. But there is more. Dynamic Earth sits on a bedrock hill that provides a great view of Sudbury's mining and mineral processing industry. Exposures of bedrock display superb geological features that tell intriguing geological stories. Dynamic Earth, inside and out, will keep you engaged and learning!

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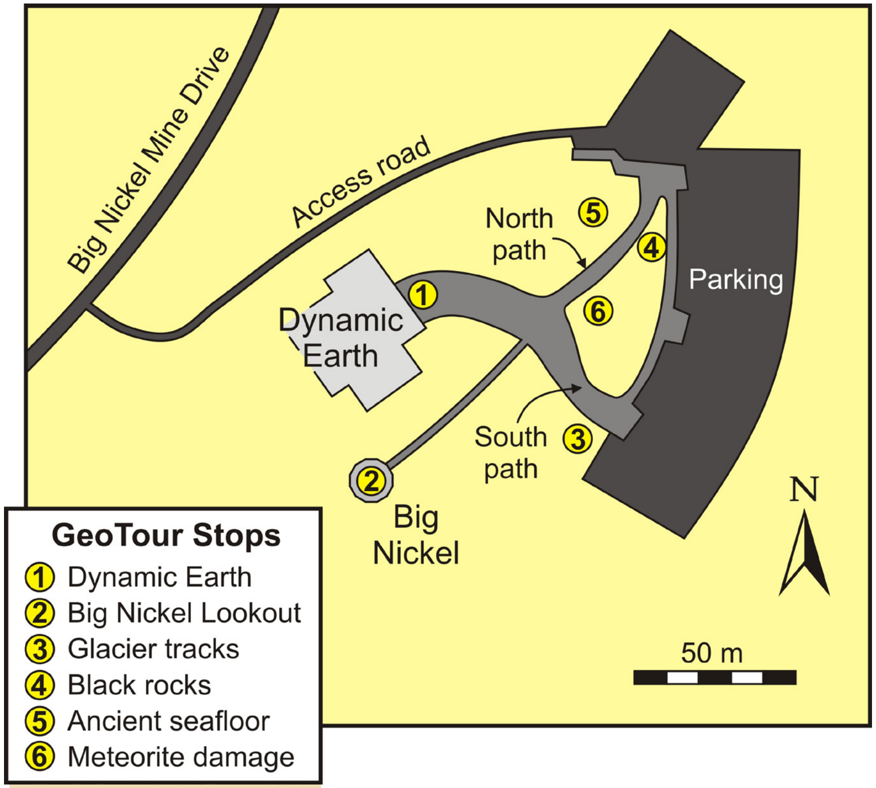
How to get to Dynamic Earth

Dynamic Earth is accessed off Big Nickel Mine Drive several kilometres west of Greater Sudbury's city centre. Exposed bedrock flanks the 2 paths from the parking lot to Dynamic Earth. Geological stories displayed in this bedrock are located on the map below.



Map of Dynamic Earth with the location of stops of interest.

Stop 1: Inside Dynamic Earth: engaging earth science and underground mine tour

Dynamic Earth is filled with interactive exhibits where you can explore rocks and minerals, the ancient meteorite impact that created Greater Sudbury's mines, and mining technology. Multimedia shows tell the story of how nickel and copper metal are extracted from Greater Sudbury ore, and illustrate Greater Sudbury's history of discovery and development over the past 125 years. A highlight is the underground mine tour. A guide leads visitors through a labyrinth of rock-carved tunnels, demonstrating the technology and working conditions of different eras of mining in the Greater Sudbury area, from the late 1800s to modern-day robotic mining.

Stop 1: The mine tour.

Stop 2: Big Nickel Lookout: superstack, smelter and slag

A path leads to the Big Nickel and lookout. From the lookout there are panoramic views of Sudbury, including the towering "Superstack" chimney of the Copper Cliff smelter. The "Superstack" is an iconic structure on Greater Sudbury's skyline and symbolizes the role that mining plays in the Greater Sudbury region and the evolving challenge of managing its environmental impact.

Greater Sudbury is one of the largest mining and mineral processing complexes in the Americas. Ore is milled, or ground to a powder, and the metal-bearing minerals separated from the rest. The metal-bearing minerals are roasted in furnaces to a high temperature, allowing the metals to separate from the other components of the mix, which form Greater Sudbury's famous "slag". Waste gases are "scrubbed" of most of their sulphur dioxide and metal particulates before release from the Superstack. Molten slag cools and solidifies to a black glassy material similar to volcanic rock. When hot slag is poured, it produces a spectacle of glowing rock that resembles a lava flow. Vast piles of slag have been created over the decades and their vegetated slopes stretch to the east of the smelter. A layer of soil is spread over the slag and seeded with grasses. Later, trees and shrubs are planted to anchor the soil and enhance the landscape.

Stop 2: The Copper Cliff smelter complex as viewed from the Big Nickel Lookout.

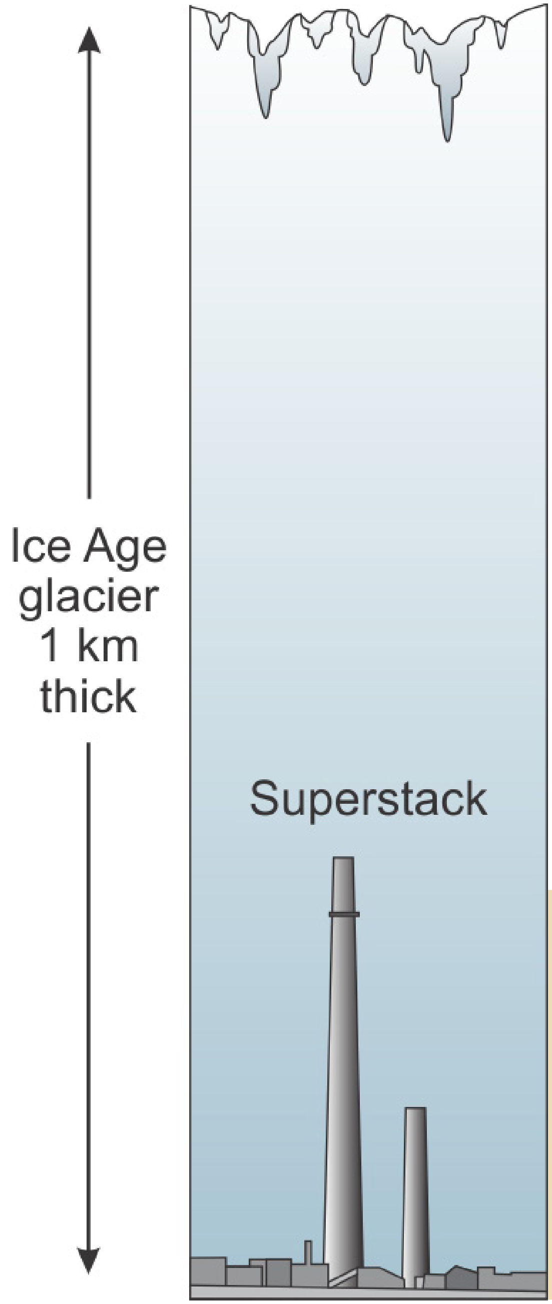
Tree growth will soon block the view of the smelter from the Big Nickel Lookout. Fifty years ago, the view from Dynamic Earth was a scene of barren rock and treeless soil because of a history of early logging and later smelter emissions. In the early 1970s, a major pollution reduction strategy was launched that improved smelting processes, captured sulphur dioxide and converted it to sulphuric acid (a useful product), and constructed the Superstack. These changes dramatically improved local air quality. At the same time, the community and mining industry initiated an ambitious project to revegetate damaged lands. Today, much of the Dynamic Earth site and the surrounding hills have been planted with over 12 million trees as part of Greater Sudbury's Regreening Program. Because of this work, Greater Sudbury is recognized as a world-leader in the environmental restoration of mining landscapes.

Stop 2: Long flat hills of slag are covered with soil and grasses.

Stop 3: Glacier tracks

Walk back from the lookout to where the main (south) path meets the parking lot. The bedrock surface to your right (southwest) is a series of low ridges and troughs. Many are aligned in a southwest direction. Striking grooves and scratches mark this polished bedrock surface. The grooves, scratches and polish hint at the erosive power of the glaciers that once flowed across Ontario and most of the rest of Canada. Fifteen thousand years ago, the Dynamic Earth site lay below a kilometre of slow-moving glacial ice. Sand, mud and stones lodged in the base of the moving ice scratched, ground and polished the rock surface below.

Stop 3: A view, looking to the northeast, of glacier-carved grooves and scratches in the bedrock surface at Dynamic Earth. Glaciers flowed across the area towards the southwest.



Stop 3: Fifteen thousand years ago, Dynamic Earth and the Greater Sudbury area were covered by a slow-moving glacier over 1 km thick.

Stop 4: Why are the rocks black?

Many of the rocks at Dynamic Earth, as elsewhere in the Greater Sudbury area, are a distinctive black colour. Is this natural?

Greater Sudbury's rocks are not naturally black – rather, rock surfaces were stained black by early mining practices. Early smelter emissions contained sulphur dioxide and metal particulate. Sulphur dioxide mixed with atmospheric moisture to form acid rain that corroded the rock and produced a coating of silica gel, which in turn trapped metal particulate fallout to form a black coating. However, not all the rocks at Dynamic Earth are black. Many low-lying rock surfaces between ridges are a grey colour with smooth surfaces. These areas were covered by soil until recently and therefore protected from the effects of early smelter emissions.

Stop 4: Undulating glacier-sculpted bedrock beside the north walkway exposes two-tone rock. Rock is stained black except where soil that protected its natural pale grey colour has been stripped away.

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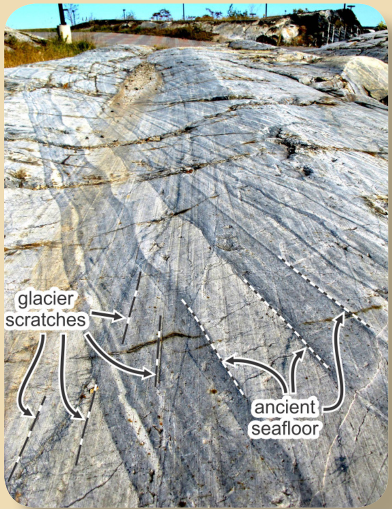
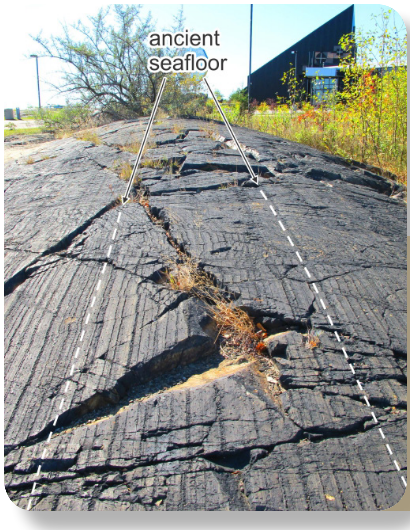


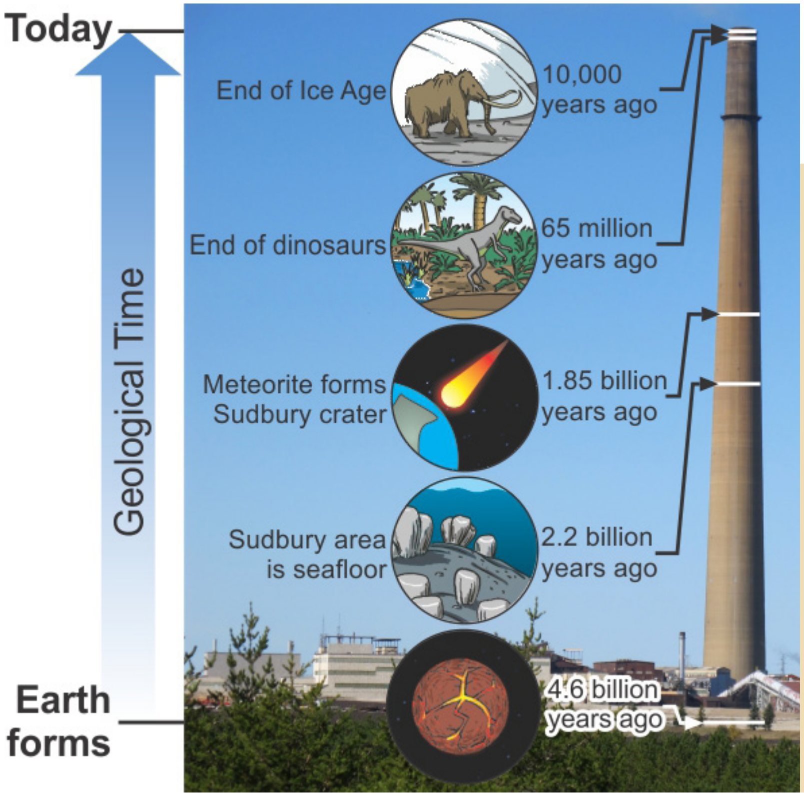
Stop 5: A comparison of the same type of rock blackened and pitted by smelter emissions (left) and protected, until recently, by a cover of soil (right). Glacial scratches are preserved on the protected rock.



Stop 5: Bands on the surface of glacially smoothed and black-coated "whale-back" bedrock surface reflect rock composed of tilted layers of alternating siltstone and mudstone.

Stop 5: Greater Sudbury was once seafloor!

Across the north walkway from Stop 4 is a low "whaleback" of bedrock, smoothed and sculpted by glacial ice. When you look at this rock, you'll notice bands within it that are 1 to 15 cm thick. These bands are a characteristic feature of sedimentary rock. Some layers are smooth while others are corroded and appear recessed. These rocks are alternating layers of siltstone (smooth surfaces) and mudstone (corroded). Geologists interpret that these layers formed as mud and silt deposited on an ancient seafloor that once covered the Greater Sudbury area 2.3 billion years ago. These layers have been tilted from their original horizontal position by geological forces.



Stop 5: Rocks exposed at Dynamic Earth represent events that occurred at different times during Earth history. This figure uses the 381 m height of the Superstack to represent the 4.6 billion years of geologic time and illustrates where the events recorded in the rock at Dynamic Earth fit into this history.

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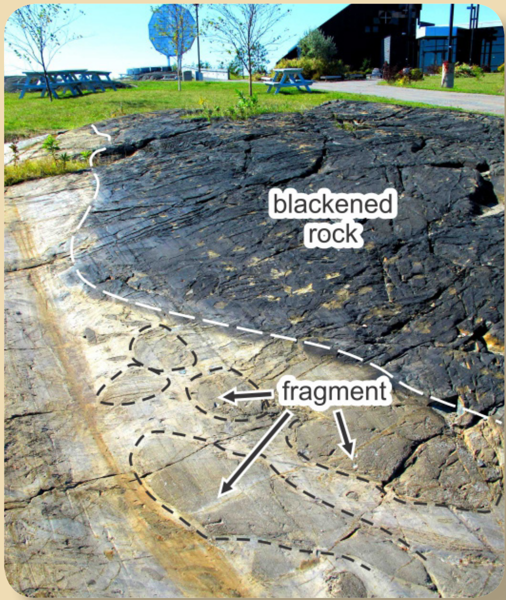

Stop 6: Fragments in the rock near the junction of the north and south paths.

Definition! Sedimentary rocks form at the Earth's surface. They are made up of eroded pieces of pre-existing rocks that were deposited by wind, water or glacier. When these sediments were buried by more layers of sand, mud or gravel, the fragments cemented together and hardened to produce sedimentary rock.

Stop 6: Ancient meteorite damage

Although layered rocks are common at the Dynamic Earth entrance area, there are many areas where the layered rock has been broken into large and small fragments. What event broke these rocks apart?

Dynamic Earth and the city centre of Greater Sudbury are located a few kilometres south of the edge of the eroded remnants of a crater formed by meteorite impact 1.85 billion years ago. The force of the impact sent shock waves through the surrounding rocks. In places the rock shattered, forming distinctive shattercones such as those featured in the tunnel at Science North. Elsewhere, the rocks ruptured because of violent vibrations. The rocks at Dynamic Earth provide a superb exposure of this damage. Geologists have mapped a belt of similar broken and shocked rocks around the entire Sudbury crater.

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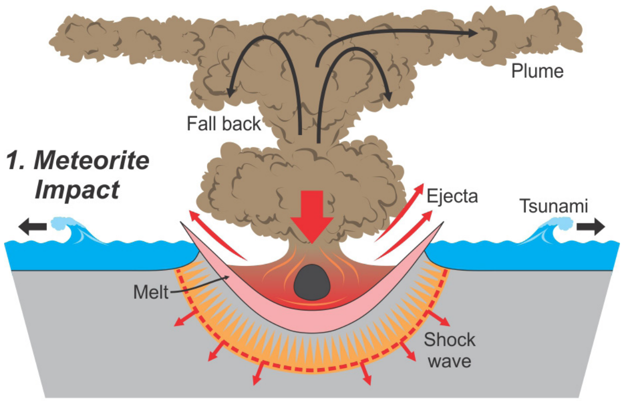
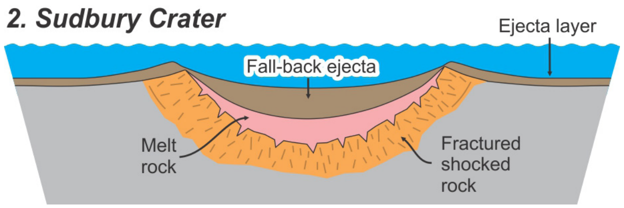
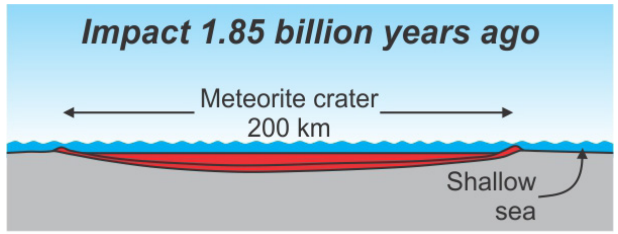
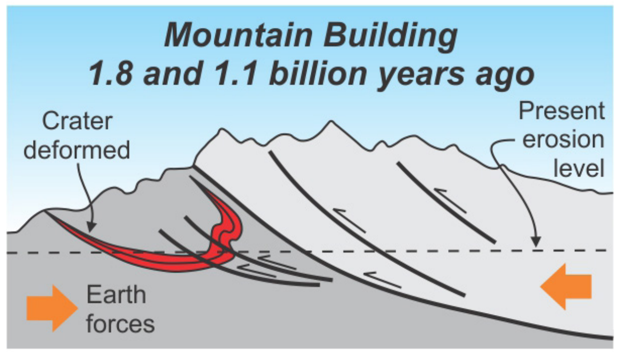
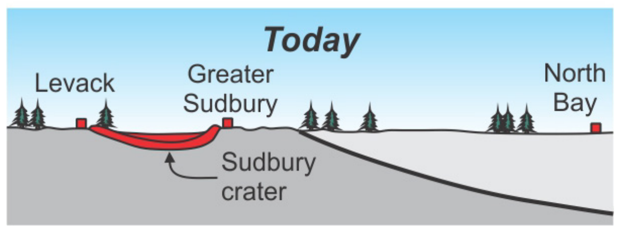




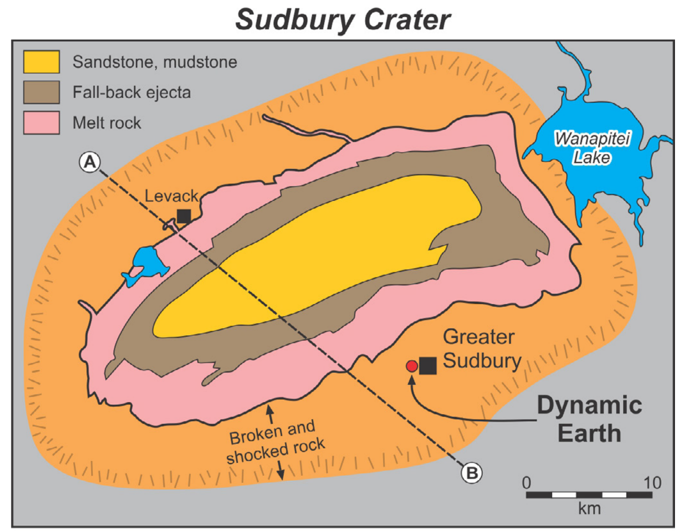
Stop 6: The impact of a 10 km diameter meteorite 1.85 billion years ago melted, evaporated or fragmented ejected rock, forming a crater 200 km across and sending intense shock waves through the Earth. Melted rock collected at the base of the crater and was covered with ejecta that fell back into the crater. A zone of broken and shocked rock, which includes the broken rock at Dynamic Earth, surrounded the crater.

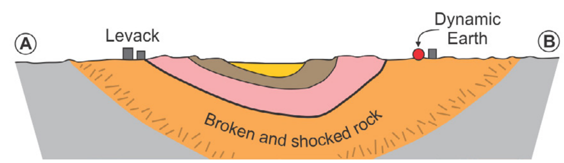






Stop 6: For millions of years after it formed, the crater was slowly buried below accumulating sediments of a shallow sea. Colliding continents resulted in mountain building and deformation of the ancient crater rocks. Over the millions of years that followed, the mountains, as well as the crater rocks, were eroded into the Canadian Shield landscape we know today. Only a small remnant of the original crater rocks remains.





Stop 6: Today, the remnants of the impact crater underlie a vast area north of Greater Sudbury city centre. Dynamic Earth, as well as Science North, lies just outside the crater, in a belt of broken and shocked rock that surrounds the impact structure. Lower figure shows what the rocks look like below surface along line A–B.

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Stop 6: Artist's depiction of a large meteorite striking the Earth.
Image courtesy of NASA and artist Don Davis.

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Acknowledgments:
Technical editing: Marg Rutka (Ontario Geological Survey)
Review: Christine Hutton (Natural Resources Canada)
Graphic layout: Roxanne Corcoran (Ontario Geological Survey), Natural Resources Canada
Graphic illustration: Richard Franklin
Assistance with research: Tobias Roth (Science North), Robert Alemany and Dan Farrow (Ontario Geological Survey)

Please refer to this publication as:
Natural Resources Canada and Ontario Geological Survey 2015. Dynamic Earth, Greater Sudbury: Ancient seafloor, meteorite-blasted rock, ice age sculpture and Greater Sudbury's smelter; GeoTours Northern Ontario series.

All GeoTours Northern Ontario brochures area available for free download from http://www.sciencenorth.ca/dynamic-earth/geotours/ or http://www.mndm.gov.on.ca/en/mines-and-minerals/geology.

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