

Copper Cliff Smelter Superstack, Greater Sudbury

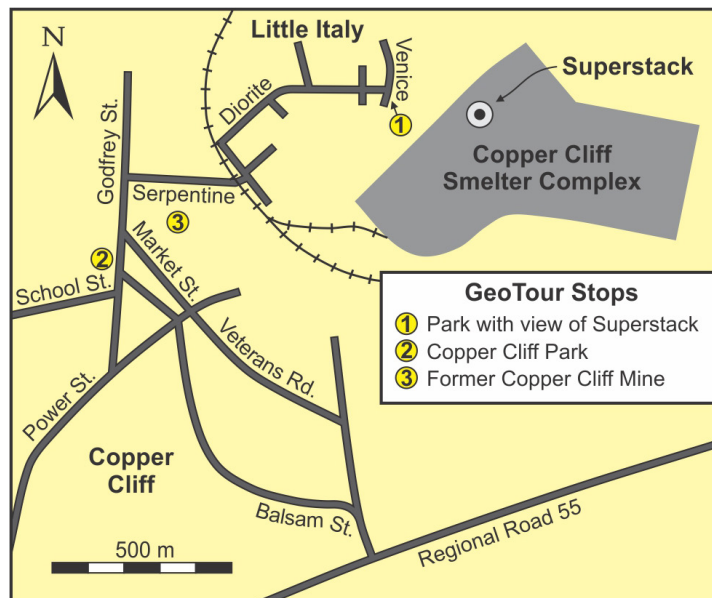
GPS co-ordinates: N46° 28.769', W81° 3.566'

Metals from Minerals, Managing Environmental Impacts, and Historic Mining

The towering Copper Cliff smelter “Superstack” is an iconic structure on Greater Sudbury’s skyline. The Superstack symbolizes both the primary role that mining plays in the Greater Sudbury region, as well as the evolving challenge of managing the environmental impacts of this industry. This GeoTour provides a close up view of this massive chimney from a park in a nearby historic neighbourhood of Copper Cliff, and a look at some nearby early mining history.

How to get there

Copper Cliff lies on Regional Road 55, just west of Greater Sudbury city centre. Turn north into Copper Cliff on Balsam Street. Turn right on Godfrey and Serpentine streets before passing through the underpass to the Little Italy neighbourhood. Proceed to the small park at the junction of Diorite and Venice streets. Retrace your route on Godfrey Street to Copper Cliff Park. The trail to the old Copper Cliff Mine leads from the parking lot at the corner of Godfrey and Market streets. A *History Hikes* walking tour of historic Copper Cliff is available at www.rainbowroutes.com.



Map of
Copper Cliff.



An aerial view of the Copper Cliff smelter complex.
Photo courtesy of Vale.

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➤ Stop 1: Little Italy, Copper Cliff

Wow! That chimney is tall. The Superstack rises dramatically above the small park in the Little Italy neighbourhood of Copper Cliff. This giant chimney sits atop the Copper Cliff nickel smelter, a vast industrial complex. The Superstack measures 381 m (or 1,250 feet) high, 35 m wide at the base, and 16 m wide at the top. It is the second tallest chimney in the world, exceeded only by a power station chimney in Kazakhstan. The Superstack also has the distinction of being the second tallest structure of any type in Canada, ranking behind Toronto's CN Tower. When it was completed in 1972, it held the record of being the tallest structure in the world.

Stop 1: View of the Superstack from Stop 1.



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Pouring molten metal in the smelter.
Photo courtesy of Vale.

Extracting metals from minerals

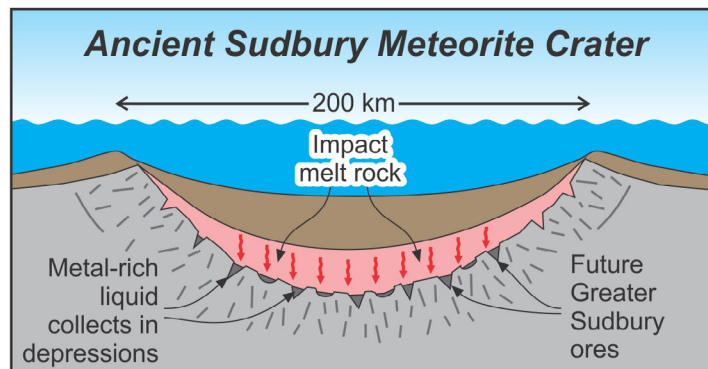
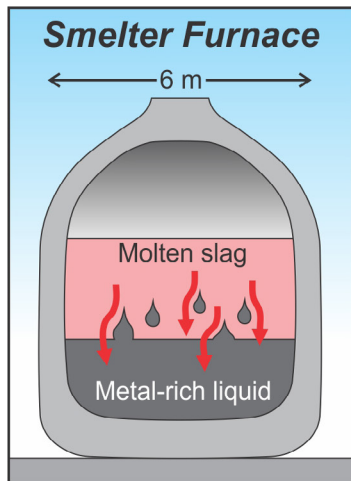
The Superstack is the most visible part of the Copper Cliff smelter complex, the largest integrated mining, milling, smelting and refining operation in the Americas.

Most of the nickel-copper ore mined in the Greater Sudbury region is processed at the smelter complex. The ore is ground to a powder, and the metal-bearing minerals are separated from the rest of the minerals. The concentrated metal-bearing minerals are roasted at 650°C, driving off the sulphur content. The roasted concentrate is then mixed with quartz sand and melted in furnaces in the smelter at 1300°C, allowing the metals to separate from a waste “slag” rich in silica and iron. Sulphur in the metal-bearing minerals reacts with oxygen in the roasting and smelting processes to form the gas sulphur dioxide, which is captured and converted to sulphur products for sale. From mine to metal, it all happens in Greater Sudbury.

Separating metal from molten rock: smelting and meteorite impacts

The separation of molten metal from slag in a modern smelter furnace is intriguingly similar to the ancient origin of Greater Sudbury ores. In the furnace, molten metals sink to the bottom, allowing metal to be separated from the molten rock slag. This process mimics nature. When the giant meteorite hit the Greater Sudbury area 1.85 billion years ago, it instantaneously melted a vast volume of Earth’s crust, filling the bottom of the impact crater with a molten rock. The crater acted like

a giant smelter furnace. Metal-rich liquids in the molten rock sank to the crater floor and collected in depressions, creating the ores that would be mined 1.85 billion years later.



(Left) Greater Sudbury’s modern smelter furnaces produce a metal-rich liquid by melting rock, a process similar to the (right) ancient origins of Greater Sudbury ores by melting of rock by meteorite impact.

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From fiery slag to regreened hills

The spectacle of fiery molten slag dumped at night was once a “must see” experience for visitors and residents of Greater Sudbury. Trains from the smelter carrying molten slag dumped glowing streams down the slopes of the slag pile. Slag solidifies into a material similar to volcanic rock. The flat-topped piles of slag are a prominent feature of Greater Sudbury’s landscape. These slag piles are now being planted with grass, shrubs and trees. To start this process, soil is spread over the slag and seeded with nutrient-rich liquid mulch that promotes quick growth of grasses and other plants.

Pouring slag.
Photo courtesy of Vale.



Reducing smelter emissions

There have been great improvements to smelting practices over the past century. In the early 1900s ore was heated on open roast beds using the technology of the day. The process released sulphur dioxide, which combined with the impacts of extensive logging and forest fires to denude the local landscape of vegetation and cause the soil to erode. Smelters eventually replaced open roasting, but their emissions included both sulphur dioxide and metal particulates. By the 1960s, extensive areas of barren rock and treeless soil covered the Greater Sudbury region. In the early 1970s, a major pollution reduction strategy was launched which improved smelting processes and captured sulphur dioxide. 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, Greater Sudbury’s Regreening Program has planted over 12 million trees. Because of this work, Greater Sudbury is recognized as a world-leader in the environmental restoration of mining landscapes.



Partly revegetated slope of slag pile shows before (right) and after (left) effects of regreening. *Photo courtesy of Vale.*



Stop 1: Air quality monitoring station in the Little Italy park beside the Copper Cliff smelter.

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Stop 2: A moving overhead trestle dumps ore from rail cars on a blanket of logs in preparation for open roasting during the early 1900s.

Photo courtesy of City of Greater Sudbury Historical Database.

➤ **Stop 2: Copper Cliff Park: a former roast yard**

This park, near the corner of Godfrey Road and Market Street in Copper Cliff, and nearby areas were once the site of the Copper Cliff Roast Yard. Roasting the nickel-copper ore was the first step in the smelting process. Imagine an area the size of several football fields, covered with a layer of logs 2 m high. On top of the logs were piles of broken ore. The whole yard would be set on fire and the ore would “roast” for 3 to 4 months! This roasting burned off the sulphur in the ore so that the metals could be more easily extracted. After 2 months of cooling, the ore would be sent to the smelter for further processing. The Copper Cliff Roast Yard operated from 1901 to 1915. Other roast yards operated in the Greater Sudbury area until 1930, when the process was replaced by roasting in smelters.

➤ **Stop 3: Historic Copper Cliff Mine**

Across the street from Copper Cliff Park is the former office of the Canadian Copper Company. Behind the office is the site of the former Copper Cliff Mine, the first major mine in the Greater Sudbury area. A short trail leads to the old “glory hole” as it was known, where men worked 10 to 14 hour shifts, prying ore from the walls with picks, bars, hammers and shovels.



Stop 3: Former office of the Canadian Copper Company, on the corner of Godfrey and Market streets, features a squared-rubble wall on the first floor.

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Stop 3: (Left) The Copper Cliff #1 Mine in 1890. *Photo courtesy of City of Greater Sudbury Historical Database.* (Right) Remains of the Copper Cliff #1 Mine "glory hole". A glory hole is formed when underground mining comes to surface, creating a surface opening. Today, the glory hole serves as a ventilation shaft to the workings of the modern Copper Cliff South Mine deep below Copper Cliff.

Authors: Bob Turner and Marianne Quat (Natural Resources Canada), Mia Boiridy (Science North), Ruth Debicki (Ontario Geological Survey), Phil Thurston (Laurentian University)

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