LASTING IMPACTS

Crater explorer Charles O’Dale examines the legacy of space rocks that have smacked into Canadian soil

By Charles O’Dale

Pingualuit: 3.44 km diameter, 1.4 ± 0.1 Ma

Pingualuit is not easily accessible. However, it merits mention as many of the other craters I describe in this article were located and identified thanks to Pingualuit prompting a study at the Dominion Observatory in 1955 (Halliday et al. 1967).

The Pingualuit crater was evacuated in a nanosecond impact explosion. The people leading the hike are just visible on the rim in the far distance.

Imagine standing in the spot where a meteorite — hundreds of metres across and travelling from space at thousands of metres per second — slammed into Earth. Here in Canada, you certainly can. Numerous meteorite-impact craters in Canada are within reach by car or boat. I have physically examined many of these impact sites as an amateur impact-crater explorer. They are an experience to visit. Stand within these structures and you can see how much material is evacuated in microseconds to milliseconds during an impact. It gives you an appreciation of the energy expended in these explosions. All the impact craters in Canada have been exposed to millions of years of erosion, so they do not look anything like the "fresh" impacts that are visible on the Moon. This is an advantage, though, as the structures are cross-sectioned by the erosion, allowing direct observation of their impact geologies.

Craters you can drive or walk to

DRIVE OR WALK

Holleford: 2.35 km diameter, 550 ± 100 Ma

The Holleford impact structure is a two-hour drive south of Ottawa, Ontario. For many years, local residents drove down into a valley, travelled a couple of kilometres and then ascended the other side not realizing that the "valley" was the result of a large meteorite impact. To fully experience this site, stop on the top of one of the rims and walk into the crater. At the bottom, slowly turn 360 degrees to see the enclosed rim and crater floor to perceive the size of this structure.

↑ The 2017 Royal Astronomical Society of Canada Annual General Assembly attendees exploring the Holleford structure. This image was taken on the west rim looking northeast into the crater.

DRIVE OR WALK

Charlevoix: 54 km diameter, 342 ± 15 Ma

The Charlevoix impact crater is on the north shore of the St. Lawrence River, a four-hour drive from Québec City. It is an enigma as half of the crater is missing — a mystery still unsolved.

To first experience the size of the crater, stop at the lookout when arriving from the southwest. You will be on the west rim of the crater. The mountain visible to the northeast is the central peak of the crater; the peak is similar to the central peak of the Tycho Crater on the Moon. The missing part of the crater is to the south where the river is now.

Continuing the drive east through the crater along the river, you will cross over part of the central peak where many shatter cones were found. The structure was originally confirmed as an impact site when geologists identified shatter cones in a roadside rock cut within the crater.

The Charlevoix crater rim is defined by hills made of country rock — rock native to an area — to the north, at the outer modification zone. While travelling through the hills, you will realize the immensity of this structure.

↑ The view of the Charlevoix impact crater central peak from the southwest rim lookout.

← Shatter cones, the proof positive of an impact, can be seen on roadside rock cuts along a highway in the Charlevoix crater.

I have labelled each described crater with its diameter in kilometres and time since impact in million years (Ma). For detailed technical descriptions and the exact locations of each of these craters, please refer to my website: craterexplorer.ca

DRIVE OR WALK

Brent: 3.8 km diameter, 396 ± 20 Ma

The Brent impact crater is a four-hour drive north of Ottawa, Ontario, on the border of Algonquin Park. A lookout on the south rim of the crater will give you an appreciation of its size. From the lookout, a pleasant walking trail leads you into and out of the crater without getting lost. Along the trail, you will experience the size of the crater, the slope of the crater rim, some of the impact-shattered bedrock and a fossilized collection of rock fragments at the base of the crater rim (talus slope). If you feel more adventurous, visit my Brent crater web page for guidance about off-trail exploration.→

↓ Over millions of years, a small creek eroded this chasm through the shattered rock of the Brent crater rim.

Craters you need a boat to access

DRIVE OR WALK

Whitecourt: 36 m diameter, 1.13 thousand years ago

The Whitecourt crater — located about 10 kilometres southeast of the town of Whitecourt, Alberta — was once used as a "hole in the ground" meeting place by local hunters. When several metallic fragments were found nearby and identified as meteorites, the "hole in the ground" was confirmed as an impact crater. Visiting the crater requires a forest drive from Whitecourt and an hour-long hike from the parking lot to the crater.

Please note that meteorite collecting is prohibited in the crater area.

↓ Image from the rim of Whitecourt impact crater illustrating its six-metre depth (using these two crater explorers for scale).

Shatter cones are a fracture phenomenon in rocks found only at asteroid impact or nuclear explosion sites. This example, from Sudbury, illustrates the unique striations and the cone shapes caused in bedrock by the high-energy impact shock. (Martin Schmieder)

DRIVE OR WALK

Sudbury: 250 km diameter, 1,852 +4/-3 Ma

The Sudbury impact basin — located just north of Sudbury, Ontario — is an enormous, eroded, multi-ring crater containing a melt sheet referred to as the Sudbury Igneous Complex (SIC). At the time of impact, a one-kilometre cross-section of country rock surrounding the crater was instantaneously melted. The SIC was then formed by the solidification of the impact melt pool as it cooled at the point of impact. After impact, thrust faulting of the Canadian Shield toward the northwest affected the entire Sudbury structure, resulting in the oval shape of the SIC.

To the north of the SIC is a row of hills, the remnants of the crater rim. Travelling through these hills, you may observe various types of impact rock caused by the differential cooling of the impact melt. Past the hills is an area of shattered rock and shatter cones.

↑ In the foreground of this aerial image is the remnant of the north crater wall of the Sudbury Impact Complex (SIC). The flat plain of the crater base is in the background.

Beals, C.S. & Halliday, I. 1967: Impact Craters of the Earth and Moon, Journal of the Royal Astronomical Society of Canada, Vol. 61, Page 295.

BOAT ACCESS

Manicouagan: 100 km diameter, 214 ± 1 Ma

A long drive into northern Québec will bring you to the large Manicouagan impact crater. On the trip, observe the roadside rock cuts as they change from solid to shattered. This is part of a large ring of shattered rocks surrounding the crater.

I recommend a boat longer than 20 feet to explore the crater. We had a close call with high wind and waves when we explored the crater via canoe! There is a limitless variation of impact geology to experience in the central peak area.

↑ The Manicouagan impact crater, with the central peak in the background, is an analogue of the Tycho Crater on the Moon. ← Impact melt cliffs and talus found in the central region area of the Manicouagan impact crater.

BOAT ACCESS

Presqu'île: 24 km diameter, <500 Ma

The Presqu'île impact crater is located south of the Québec town of Chapais. The surrounding topography of the crater is rolling hills without any indication of a crater rim. Access to the crater via canoe will be very rewarding. We discovered many shatter cones and impact geology at various parts of the crater. Getting there will require several hours of paddling and some portaging.

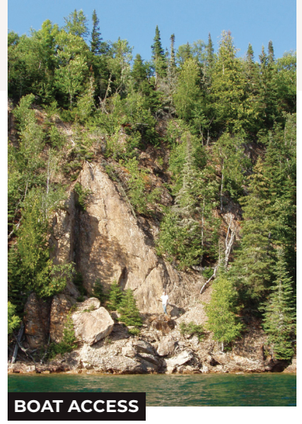
↓ We found many shatter cones in various places within the Presqu'île impact structure .

BOAT ACCESS

Île Rouleau: 4 km diameter, <300 Ma

The Île Rouleau impact crater in northern Québec is accessible via a day-long canoe paddle through Lake Mistassini from the town of Baie-du-Poste. It will take an hour or so to paddle around the central peak island. On the island's north shore is a 15-metre cliff that is covered with shatter cones.

↑ These shatter cones are found at the cliff on the northeast coast of Île Rouleau.



BOAT ACCESS

Slate Islands: 32 km diameter, 436 ± 3 Ma

A visit to the Slate Islands impact structure requires a 12-kilometre boat ride from the north shore of Lake Superior. The Slate Islands group represents the heavily eroded central peak of a complex meteorite crater. Exploring these islands will reveal a wide variety of breccias, many of which contain fragments exhibiting shock metamorphic features.

One of the largest known shatter cones on this planet is found on the Slate Islands.

The Slate Islands were designated as a provincial park in 1985 and are home to the largest known herd of woodland caribou. While exploring the islands, one of them casually sauntered by me as if I were invisible! They have adapted to a predator-free environment. ✷

↑ I am the white dot posing on the large shatter cone at the Slate Islands impact structure. ↓ In situ shatter cones at the Slate Islands impact structure.