

LANDSCAPES AND LANDFORMS

Canada 2: Unique landforms and geomorphic processes



Spirit Island in Maligne Lake, Jasper National Park, Alberta, Canada (Part of the Canada Parks World Heritage Area). Image: L. Chaffer

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GLOSSARY (<http://syllabus.bos.nsw.edu.au/hsie/geography-k10/glossary/>)

Glaciated landscape: shaped by the action of icesheets and glaciers

Fluvial landscape: shaped by the action of a stream or river

Volcanic landscape: shaped by tectonic forces in Earth's crust that cause volcanic eruptions



INTRODUCTION

The geomorphic processes of weathering, erosion and deposition by water and ice are responsible for the development iconic landscapes and their distinctive landforms in Canada, including the Columbia Icefields, the Great Lakes and Niagara Falls, Lake Louise and the Maligne and Fraser Canyons. These landscapes and landforms, along with the volcanic mountains, created by tectonic plate movements, hold important aesthetic, spiritual, cultural and economic value.

GLACIATED LANDSCAPES AND LANDFORMS

During the Pleistocene era the Laurentide Ice Sheet (Source A) covered most of Canada and northern USA. In parts of Central Canada the ice sheet was up to 3 km thick. Over time, the actions of the ice sheet and mountain glaciers left behind rugged mountain ranges, spectacular glaciated valleys and waterfalls, extensive plains and lake systems that making Canada **the most glaciated country in the world**. The last remains of the Laurentide Ice Sheet are the Barns Ice Cap and glaciers on Baffin Island in Canada's far north.

Source A: The extent of the ice sheet covering North America in the Pleistocene Era



Source: <http://serc.carleton.edu/eslabs/climatedetectives/3.html>

Can you name any unique landforms in the world created by glaciers, rivers and volcanic activity?



Icefields, glaciers, lakes and waterfalls

In western Canada, where the Rocky Mountains separate Canada's west coast from the interior plains thousands of glaciers and icefields are features of the mountain landscape. Melting snow and ice feed large river systems that cross the country and empty into oceans to the north, east and west. These rivers erode through mountains, plateaus and glacial sediments to create their own distinctive landform features.

The Columbian Icefield is one of Canada's most famous landscapes, covering an area of 325 square kilometres with ice to a depth of 100 to 365 metres. Up to 7 meters of snow falls here each year enhancing its aesthetic value. Millions of tourists visit the icefield and the spectacular landforms in Jasper National Park including:

- Glaciers e.g. Athabasca Glacier
- Mountain peaks, U shaped valleys, waterfalls, lakes and rivers fed by snow and glacial melt.
- Braided rivers – many channels as they erode through tonnes of glacial debris.



The Athabasca Glacier from the Icefields Parkway Visitors Centre. Image: L Chaffer



Tourists on the Athabasca Glacier. Image: L Chaffer

Values

Canada's spectacular glaciated landscapes and landforms attract millions of visitors each year for their aesthetic and spiritual value and are an economic asset because of the income they generate in states such as Alberta and British Columbia. Glaciers also have environmental value as indicators of environmental change and as water sources for many river systems. National Geographic ranks the Icefields Parkway and its landscapes among the top scenic drives in the world.

Lake Louise in Banff National Park was created when a natural dam of glacial debris trapped snow and glacial meltwater water to back up and form a lake. The lake feeds into the Bow River an important east flowing river and source of water on Canada's interior plains. Other glacial lakes are formed high in mountains where glaciers carved hollows, which later fill with water. These are known as **cirque lakes**.



Lake Louise is an iconic Canadian landform of glacial origin . Image: L Chaffer

Landslides also dammed rivers creating lakes such as Maligne Lake in Jasper National Park and Moraine Lake in Banff National Park.

The turquoise coloured water in Canada's mountain lakes and rivers is caused the presence of moraine flour deposited by snow and glacial melt. Over time glacial lakes will fill with debris currently being weathered and eroded by glaciers and water high in the mountains above.

Tourists flock to Lake Louise for the landscape and the adventure activities the landscape offers such as hiking, skiing, kayaking and photography.

The Great Lakes and Niagara Falls

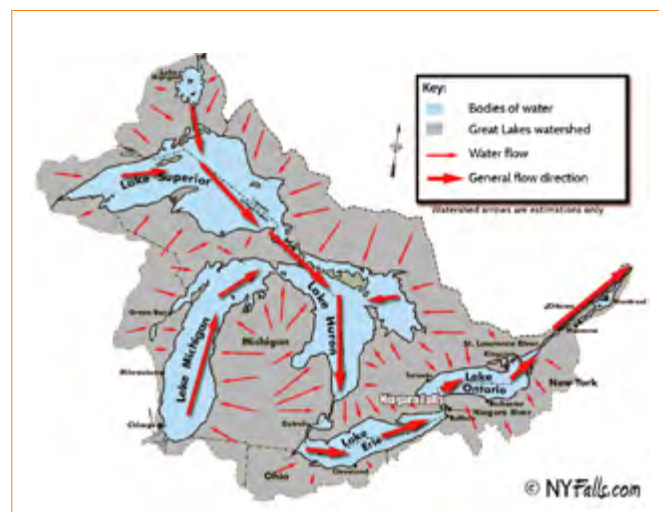
The Great Lakes, a series of five interconnected lakes (Superior, Michigan, Huron, Erie and Ontario) on the border of Canada and the USA, were formed by **retreating ice sheets** that carved large basins into the land that filled with glacial meltwater. Water from the lakes then eroded a passage through the Niagara escarpment where a resistant layer of rock created the three waterfalls (Horseshoe, American and Bridal Veil Falls) that combine to form **Niagara Falls**.

The lakes are the largest freshwater basin in the world with a fifth of Earth's freshwater, and two thirds of this water flows over Niagara Falls each year. From the falls, water travels to the Atlantic Ocean via Lake Ontario and the St Lawrence River. Water erosion continues to sculpt the falls causing them to change shape and move upstream. In 12,000 years the falls migrated approximately 11 km upstream leaving a deep gorge below. Snow and ice remain an important influence on Great Lakes landscapes and landforms. (Source B)

Niagara Falls

Niagara Falls provides inspiration for travelers, creatives (artists, authors and filmmakers) and residents. The aesthetic and social values of the falls led to efforts to reduce threats from industrial and commercial exploitation like withdrawal of water for hydroelectricity. Laws have been used in the past to restrict the amount of water diverted from the falls and erosion control strategies such as strengthening the rocks at the top of the falls have been implemented to reduce erosion and ensure the safety of visitors.

Source B: The Great Lakes and Niagara Falls



Source: <http://nyfalls.com/niagara-falls/faq/>

Source C: NASA satellite image of The Great Lakes



Source: <http://visibleearth.nasa.gov/view.php?id=54379>

Source D: Niagara Falls



Source: <http://www.niagarafallslive.com/images/pano2.jpg>



Does Australia have any large waterfalls? If yes, where are they? Suggest possible reasons for differences between Australia and Canada.

FLUVIAL AND KARST LANDSCAPES AND LANDFORMS

Water is the main agent of erosion and deposition responsible for the formation of landforms across much of modern day Canada including valleys, canyons, caves, waterfalls, lakes, floodplains and deltas. In places the erosion is influenced by past glaciation and tectonic activity as well as the type of rock present. Most of Canada's canyons are recent additions to the landscape formed since the departure of glaciers. As ice melted, large amounts of water with high erosive power was released creating deep narrow canyons. Karst landscapes and landforms resulted where carbonate rock such as limestone dissolved in water to leave caves, underground rivers and deep canyons (Source E).

The Fraser Canyon is an 84 km canyon formed by the **Fraser River** as it cut through the interior plateau and Coast Mountains on its journey from the Rocky Mountains to the sea. The past volcanic history of the landscape can be seen in lava flows present in cliffs along the canyon. The Fraser River emerges from the canyon slightly above sea level but over 100 km inland then winds its way to the Pacific coast near Vancouver depositing sediment on a large floodplain and delta.

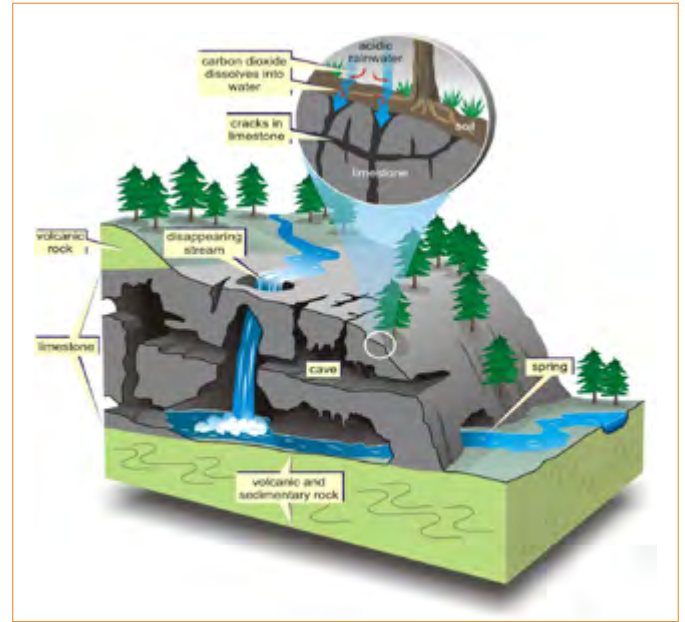


Fraser Canyon in British Columbia



Does Australia have Karst landforms?

Source E: Karst landscapes and landform

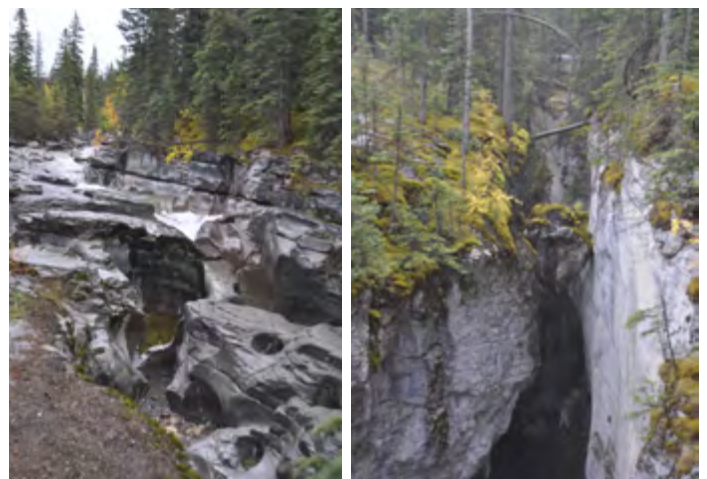


Maligne River, Maligne Canyon and Medicine Lake

Maligne Canyon formed from a hanging glacial valley, when a smaller glacier melted to leave a valley high above the main floor of the retreating Athabasca Glacier. The Maligne River carved quickly downwards to reach the lower level of the main valley leaving a deep narrow canyon.

The Maligne River formed from meltwater from the surrounding mountains, flows into and out of Maligne Lake (a large glacial lake created by a natural moraine dam), enters **Medicine Lake** and then disappears underground for 14 km before reappearing in a 55 metre deep canyon.

The underlying limestone rock is easily dissolved in the rapidly flowing and swirling water creating caves, underground channels and large potholes. Marine fossils in the limestone provide evidence that these rocks formed when covered by ocean water before being lifted by tectonic activity.



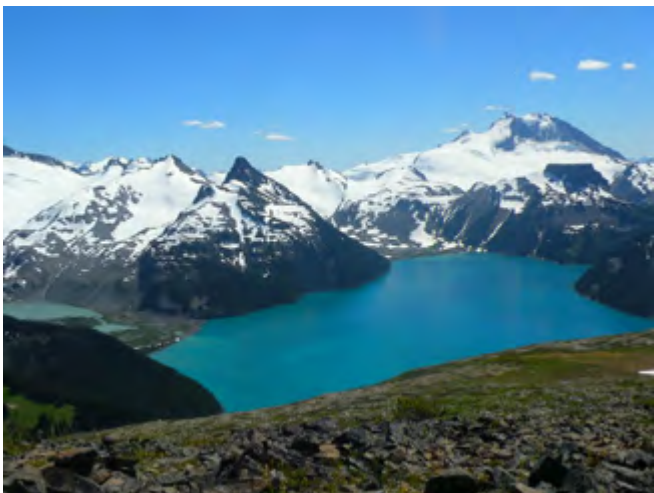
Maligne Canyon is an example of a Karst landscape

LANDSCAPES AND LANDFORMS: CANADA 2

Karst and cave experiences, such as caving, attract an increasing number of visitors to Canada each year. Vancouver Island attracts more than 55 000 visitors annually to its Horne Lakes Caves Provincial Park.

The Badlands, on the interior plains to the east of Calgary in Alberta, is one of the most interesting depositional and erosional landscapes in Canada. Unusual rock formations, known as Hoodoos, were created by river erosion and wind over 70,000 years ago. The layers of sedimentary rock formed millions of years before the hoodoos were created contain dinosaur fossils that still being uncovered by archeologists today. Specimens of every group of cretaceous dinosaurs have been found here including those of 35 species dating more than 75 Million years ago. The site is now a part of Dinosaur Provincial Park World Heritage Area.

Source F: Hoodoo Mountain (1,850 m) in British Columbia is a volcano that formed beneath a glacier but since exposed by retreating ice.



Source: http://www.bcmag.ca/British_Columbias_18_Sleeping_Volcanoes

VOLCANIC MOUNTAINS

Mountain landscapes in Canada been shaped by **volcanism**. Western Canada is on the **Ring of Fire zone** of earthquake and volcanic activity circling the Pacific Ocean. Over 100 volcanoes are located in western and northern Canada, mostly in remote locations, and are less active than those in other Pacific countries. Some volcanic mountains formed beneath glaciers and were exposed when ice retreated. Mount Garibaldi (2,678 m), just 66km north of Vancouver, is the youngest volcano in Canada and most likely to become active in the future. (Source G).



Hoodoos in Canada's Badlands landscape

Source: <http://interiorplains.weebly.com/location-and-landscape.html>

Source G: Volcanic mountains in British Columbia



Source: <http://plate-tectonic.narod.ru/volcanoam10bphotoalbum.html>



Are there volcanic landscapes in Australia? If yes, where are they and what do they look like?