

GEOLOGICAL HISTORY OF MANITOBA

Cold Manitoba – the Quaternary

THE LATEST ICE AGES

The most recent ice ages took place in the Quaternary period. During this time, the Earth's climate alternated between cool and warm periods. When cooler (*glacial*) periods occurred, the glaciers advanced. During warmer (*interglacial*) periods, the glaciers retreated, receding up the mountains and towards the polar regions – as they are doing today.

The warmer periods often lasted several tens-of-thousands of years. During the coldest periods, massive glaciers (several kilometres thick and millions of square kilometres in area), covered much of Canada, northern Europe, Asia, and parts of the United States.

ANIMAL CROSSINGS

During the last major glacial period, as water evaporated, it fell as snow in the northern regions. This snow got trapped in the glaciers, preventing the water from flowing back to the sea. The result was a major drop in sea level, which made it possible for an ice-free land bridge to emerge across the Bering Sea, connecting North America and Asia. Now, animals like bison, moose, caribou, bear, wolf and lynx could migrate from one continent to another, using the land bridge – the same route taken by the first humans to reach North America, roughly 23 000 years ago.

MEANWHILE, AT HOME...

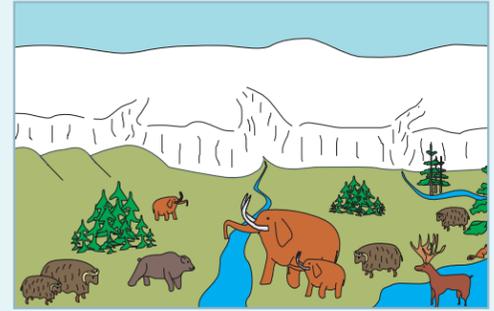
Manitoba went through many glacial/interglacial cycles in the Quaternary period and was often completely covered by ice. During the glacial periods, plants and animals were slowly forced southward into ice-free areas.

During the interglacial periods (when the ice retreated), most species gradually returned to the newly exposed landscape to find vast open areas, with vegetation consisting largely of woodlands and grasslands – similar to today. These areas provided ideal pastures for grazing animals and their predators. Large land animals, such as bison, camels, mammoths and woodland musk-ox, could be found grazing there.

ICE MOVES OUT – HUMANS MOVE IN

The end of the last ice age ushered in major environmental changes around the world. The expanding, shrinking and shifting landscapes had dramatic consequences for the animals, eventually leading to a widespread extinction of land animals like the mammoth, camel and giant beaver. As recently as 10 000 years ago, all had disappeared from the North American landscape.

As the ice receded northwards, Paleo-Indians moved into Manitoba in pursuit of the herds of big game animals. These people were the province's first known human inhabitants. Exactly when they came is not known, but the Ojibway have legends about people who ran over the glaciers. They called them *ice runners*.

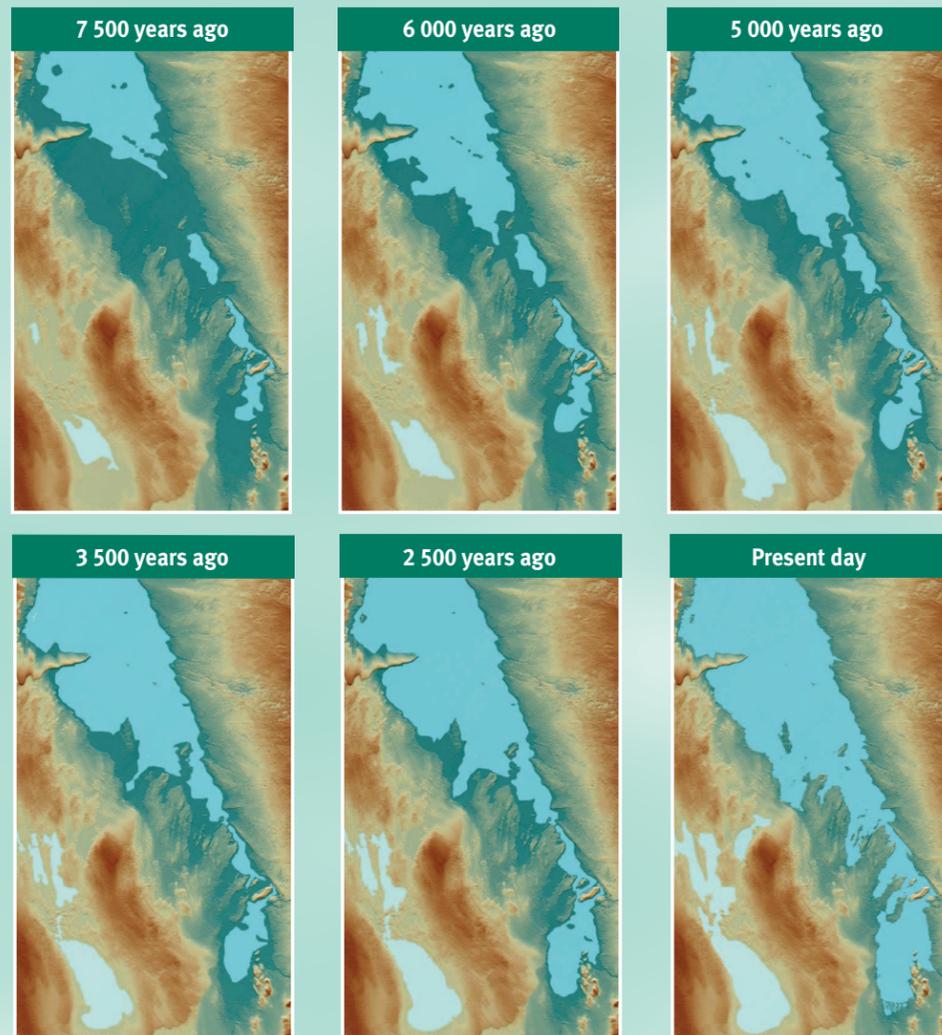


Animals such as mammoths, bison and caribou grazed in the grassland. This attracted the larger carnivores like sabre-tooth cats, bears and wolves. As the climate got warmer, camels, horses and lions also came on the scene.

Glacial leftovers – post-glacial period – the last 7 000 years

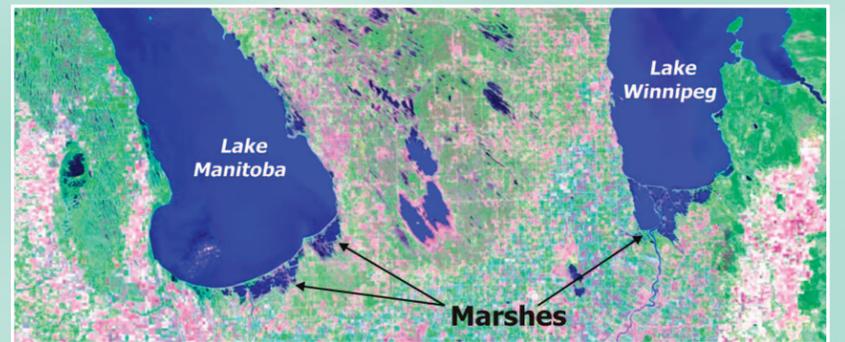
BIG LAKES GOING SOUTH

There's a good reason why large marshes are found at the southern margins of Manitoba's big lakes (Lake Winnipeg and Lake Manitoba). They are the result of the slow but steady southward migration of the lakes, where the moving waters drown the southern shores.¹



EARTH OVERLOADED

Why are the lakes migrating south? The answer lies in the frozen depths of the last glacial period, or *ice age*. During an ice age, the Earth's crust is pressed down under the incredible weight of the ice. Though it's hard to imagine, these glacial ice sheets could be more than two kilometres thick! This is particularly significant in northern regions, where the ice was thickest and lasted the longest. In Manitoba, the Earth's crust was pressed down more than 200 metres.



EARTH BOUNCES BACK

As the glaciers melted, the Earth's crust slowly began to return to its original position. This process is called *isostasy* and it is still happening today. The further the crust is pressed down the faster it comes back up, or rebounds. We know the ice was thickest in northern Manitoba, which means the Earth's crust is more depressed there than in the province's southern regions. As a result, Lake Winnipeg and Lake Manitoba are rising more quickly at their northern ends. The water drains north and pools behind the rising outlets, drowning the southern shorelines, to form the large marshes we see today.²

STILL COLD

During a glaciation, the ground under the glacier is frozen very deep in the earth. After the glacier melts, the ground will stay frozen for thousands of years. This is called *permafrost*.



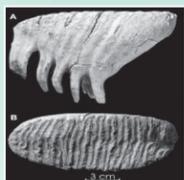
Outline of present-day permafrost.

Glacial deposits – a valuable resource

SAND AND GRAVEL – A GRITTY TEAM

Although we rarely think of it, sand and gravel is central to our daily lives. Look down. Every road you drive on, every sidewalk you stroll down, every playground you play in – the street you live on, the school you attend, the building where you work – it's a sure bet sand and gravel was used in their construction.

Our province is fortunate that large amounts of sand and gravel remain in the deposits left behind by the glacier. An added advantage is that these deposits are scattered throughout the province – this reduces the distance, and therefore the cost, of transportation to construction sites.



A. Side view.
B. Top view.

Extinct bison molar from Manitoba. Bones, teeth and shells of animals, as well as fragments of trees and other things that lived in Manitoba during the interglacial periods, have been found in gravel pits and eroding river banks across the province.



Gravel pit showing stockpiles of different sizes of gravel. Sand and gravel from the pit is put through a machine called a screener, which sorts the material into the different sizes.



Petrified wood (top), agate and jasper (bottom), from the Souris gravel pits. These rock types were carried into Manitoba by pre-glacial rivers.



FEATS OF CLAY

In addition to providing Manitoba with rich farmland, the clay from glacial Lake Agassiz is a major component in the manufacture of Portland cement. The large ponds near Fort Whyte were dug to provide clay for cement production. The clay is also used in producing lightweight aggregate.



Selenite crystal. This perfectly formed selenite crystal was found in glacial-Lake-Agassiz clay deposits located around Winnipeg. Selenite is the crystal form of gypsum.

ICE MOVEMENT – AN EXPLORATION TOOL

It's important for geologists to know the direction of glacial ice movement. To understand how the ice behaved in an area, they observe ice-flow indicators such as *striations* and *drumlins*. They also examine the types of rock fragments and minerals in the *till*. Some of these minerals are characteristic of specific ore deposits (ex: diamonds, copper). They're called *indicator minerals*. Mining companies use till-sampling as an exploration tool. When indicator minerals are found in the till, geologists know the source must be somewhere along the glacier's path.

¹ Evolution of lakes images created by the Manitoba Geological Survey from NASA Shuttle Radar Topography Mission data and Canadian Hydrographic Services charts.
² Satellite image from NASA Landsat Program.

