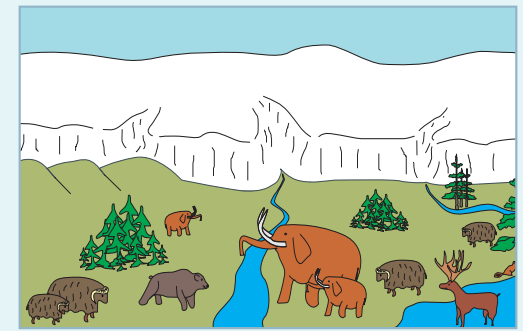


GEOLOGICAL HISTORY OF MANITOBA

Cold Manitoba – the Quaternary

What's the planet been up to in the past 2.6 million years?



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.

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*.

Glaciers retreat – the last to leave – 11 000 to 7 000 years ago

THE LAKE AGASSIZ STORY

As the glaciers, or *ice sheets*, that covered Manitoba continued melting, water typically accumulated along the southern margins, forming *glacial lakes*. The largest of these lakes was glacial Lake Agassiz. Its size, shape and depth were continually changing, due to fluctuations of the glacier's margin. Lake Agassiz covered much of Manitoba for several thousand years, particularly the area that is now the Red River Valley.

The water from the rapidly melting glaciers carried huge amounts of sediment to the lake. *Deltas* were formed from the coarser sand and gravel deposited at the lake shore, while the finer silt and clay flowed out to the deeper part of the lake.

The silt and clay that accumulated at the bottom of Lake Agassiz was up to tens-of-metres thick. The clay deposits, which form the current flood plain of the Red River Valley, have become some of the richest agricultural land in Manitoba. This flat landscape, however, is vulnerable to extensive flooding from even a small rise in the river's water level. Many Manitobans experienced the devastating effects of flooding in the Red River Valley during the province's 1997 flood.

SHORELINE TRACES 10 000-YEAR-OLD BEACHES

Whenever the water level remained at a constant depth for a decade or so, a *beach ridge* or *wave-cut cliff* would form along the shorelines or islands. Many old sand and gravel beaches can be found across the province, but are best seen today as the nearly parallel ridges along the Manitoba Escarpment. The large beach ridges near Arden, just north of Brandon, are part of a Lake Agassiz shoreline that can be traced from north of Swan River to south of Morden and into the United States.

DELTA TO DUNES

The Assiniboine delta – the best example of a glacial delta in Manitoba – extends from Brandon, where it's composed of gravel, to Portage la Prairie, where it's made up of sand. The sand dunes of south-central Manitoba (ex: Spirit Sands in Spruce Woods Provincial Park) started forming more than 10 000 years ago, as wind blew sands from the Assiniboine glacial delta into moving dunes – similar to modern deserts. The Spirit Sands dunes still shift today.

11 000 years ago

10 400 years ago

9 900 years ago

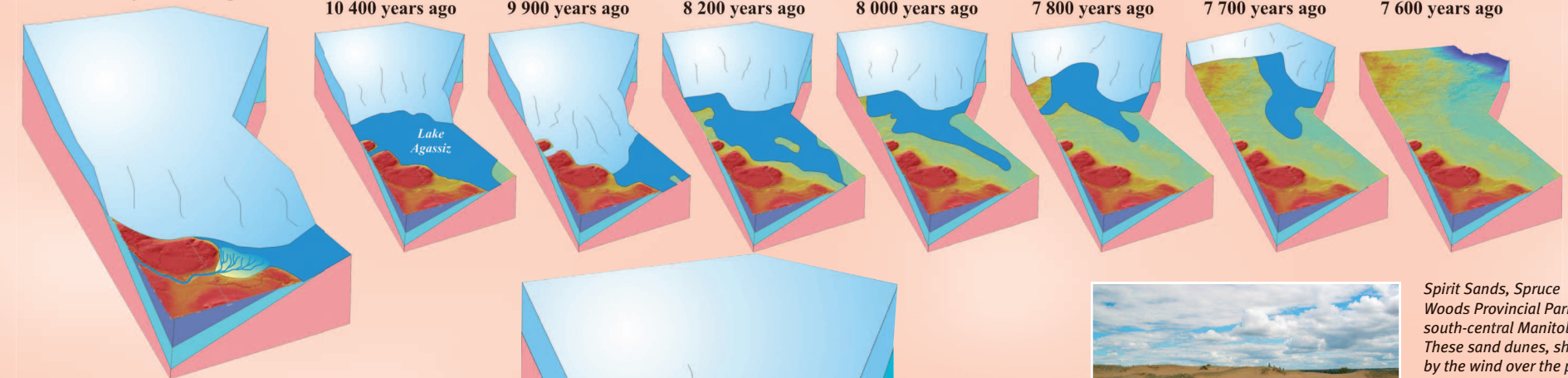
8 200 years ago

8 000 years ago

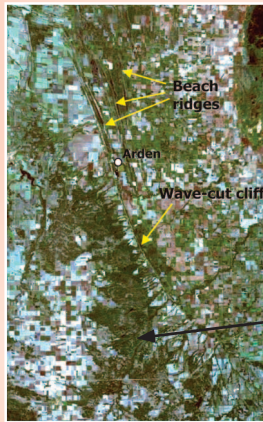
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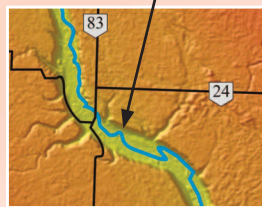


Beach ridges near Arden, just north of Brandon, were formed 10 000 years ago along the shores of glacial Lake Agassiz.¹

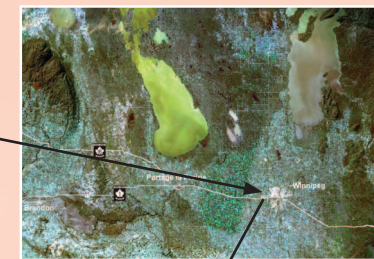


Spirit Sands, Spruce Woods Provincial Park, south-central Manitoba. These sand dunes, shaped by the wind over the past 10 000 years, are made of sand from the Assiniboine glacial delta.

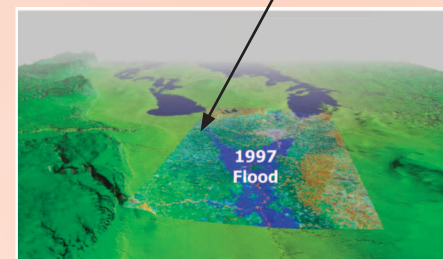
Assiniboine River Valley, north of Brandon. The width of the valley reflects the extent of the old glacial spillway, which was much larger than the present-day Assiniboine River.



Digital elevation model depicting the Assiniboine spillway north of Brandon.²



The very flat clay deposits that form the current flood plain of the Red River Valley are now some of the richest agricultural land in Manitoba.¹



A consequence of the flat landscape is that a small rise in the water level of the Red River will flood a very large area, as happened during the 1997 flood.

FROM SPILLWAYS TO VALLEYS

When glaciers prevented meltwater from following its natural course towards Hudson Bay, this water pooled against the ice margins to form *glacial lakes*. Over time, the meltwater eroded channels called *spillways*, which drained water from one lake to another. These spillways accommodated large flows of water, often contributing to catastrophic flooding.

Occasionally, an ice dam would break, causing a massive surge of water to flow downstream, greatly eroding and enlarging these downstream channels. Most of the large valleys in western

Manitoba, such as the Assiniboine, Souris and Pembina River valleys, are actually glacial spillways. The present-day Assiniboine River west of Brandon is called an *underfit stream*, because it's too small to have eroded the valley it now flows through.

¹ Satellite image from NASA Landsat Program.

² Digital elevation model image created by the Manitoba Geological Survey from NASA Shuttle Radar Topography Mission data.

Quaternary

