# 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.

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

### MEANWHILE, AT HOME...

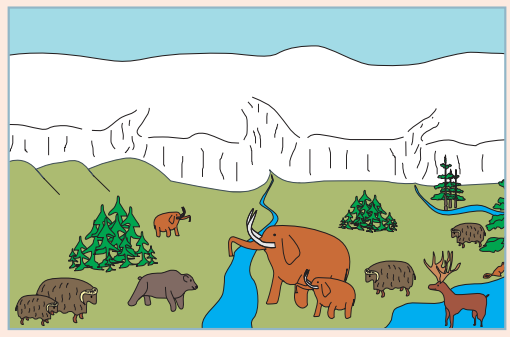
Manitoba went through many glacial/interglacial cycles in the Quaternary period and was often completely covered by ice. During the glacial periods, plants and animals were slowly forced southward into ice-free areas.

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.*

## Glaciers – Manitoba's landscape artists – 25 000 to 11 000 years ago

### WHERE DID THE ICE COME FROM?

Glaciers develop when the snow that accumulates in winter is greater than the summer's melt. Over time, the accumulated snow is compressed into ice, which eventually starts to flow under its own weight. In areas where lots of snow accumulates, *ice domes* form and become the centres of the ice flow. The glaciers, or *ice sheets*, that covered Manitoba flowed from ice domes in Nunavut and Labrador.

### HARD ROCK GROOVES

As the glacial ice moves, it picks up loose sediment that is then frozen into its base. The debris acts like sandpaper, grinding down the land beneath. This *glacial abrasion* carves ***striations*** (nearly straight scratches) and ***grooves*** into hard rock surfaces. The direction of these striations helps scientists determine the direction of past ice flow. When the ice melts, the debris that remains – a mixture of fine particles and rocks – is called ***till***.

### MORAINE – A GLACIER'S SIGNATURE

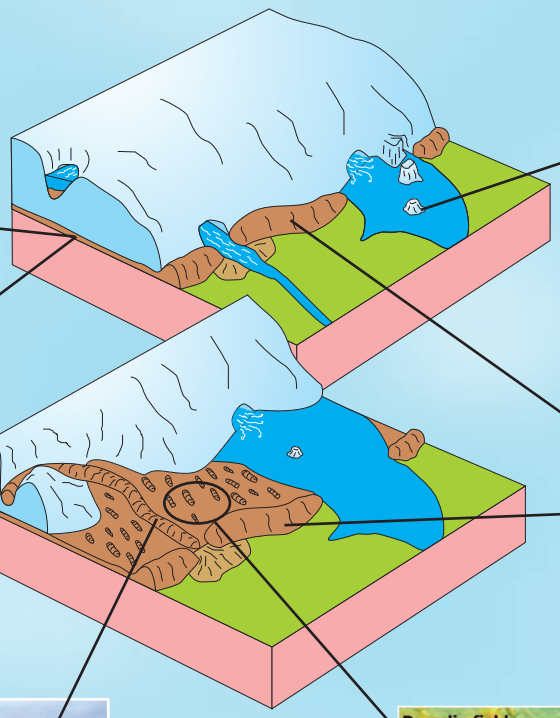
Some melting is always taking place around the margins of a glacier. As the ice melts, debris that was frozen into the glacier tens-of-kilometres up-ice, eventually gets dumped at the glacier's edge. Gradually, the debris builds up into a ridge, or *moraine*. Moraine ridges found today are proof that the glacier was there, dumping debris at its margin, for many years. The bigger the ridge, the longer the glacier was there.

The Pas moraine, one of the largest in Manitoba, extends from the town of The Pas, along the north shore of Lake Winnipegosis and into Lake Winnipeg to form Long Point. This moraine reaches a height of 30 metres in places. Closer to Winnipeg, a string of high hills beginning at Bird's Hill – extending northeast to Mars Hill and north to Elk Island in Lake Winnipeg – is really a moraine composed of sand, gravel and till.

### NEED TO KNOW ICE FLOW? HEAD FOR THE HILLS.

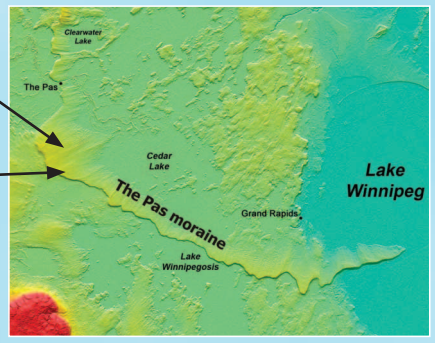
*Drumlin fields*, which typically cover hundreds of square kilometres, are a common glacial feature, particularly in northern Manitoba. These fields of small, elongated hills – one to two kilometres long and five to 50 metres high – were formed parallel to the ice flow. As a result, drumlin fields are excellent indicators of past ice flow direction.

*Glacial striations visible on smooth, hard, rock exposures. The arrow indicates the direction ice moved, parallel to the striations.*

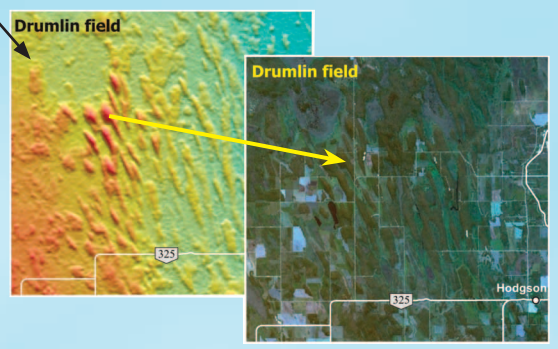

*Ice blocks that detached from glaciers and floated away on glacial lakes are called icebergs. Their huge keels sometimes scraped the muddy bottom of the lakes, leaving significant grooves that can still be seen today. Here, iceberg scours can be seen on the bottom of Lake Manitoba.*

*Till being sampled by a geologist in a road cut near West Hawk Lake in Whiteshell Provincial Park. Till is a mixture of fine particles and rocks that was deposited by a glacier.*


*The Pas moraine is one of the largest moraines in Manitoba. This digital elevation model clearly depicts the moraine running southward through the town of The Pas and then southeastward ending in Lake Winnipeg.*[1]

*Esker running through Nejanilini Lake in extreme north-central Manitoba. Eskers are a valuable source for sand and gravel and are common throughout Manitoba.*


*Drumlin fields northwest of Hodgson in the Interlake (left: digital elevation model of the area, orange is higher [1]; right: aerial photo of the area [2]). Drumlins are commonly composed of till. They are excellent indicators of ice flow. Around Hodgson, the orientation of the drumlins indicates the ice flow was from the northwest.*

### ICE AGE HAS MAJOR MELTDOWN

The glaciers began to melt when the climate started warming up, about 16 000 years ago. As it got progressively warmer, more and more of the glacial ice melted each summer, going from a trickle to a stream to raging rivers of *meltwater.*

Some of this meltwater formed tunnels inside the glaciers. The water in the tunnels carried a variety of sediment that had eroded from the frozen debris. While the fine silt and clay were carried far along the tunnel, the coarser sand and gravel accumulated at the bottom. When the surrounding ice melted, the coarse debris was left as long, sinuous, gravel-rich ridges called *eskers*.

When the meltwater reached the ice margins, all the sediment was deposited in large, fan-like sheets of sand and gravel. The deposits that formed on land are now called *outwash plains*, while those that formed in lakes are referred to as *deltas*. The Assiniboine delta near Brandon is an excellent example of a *glacial delta*.

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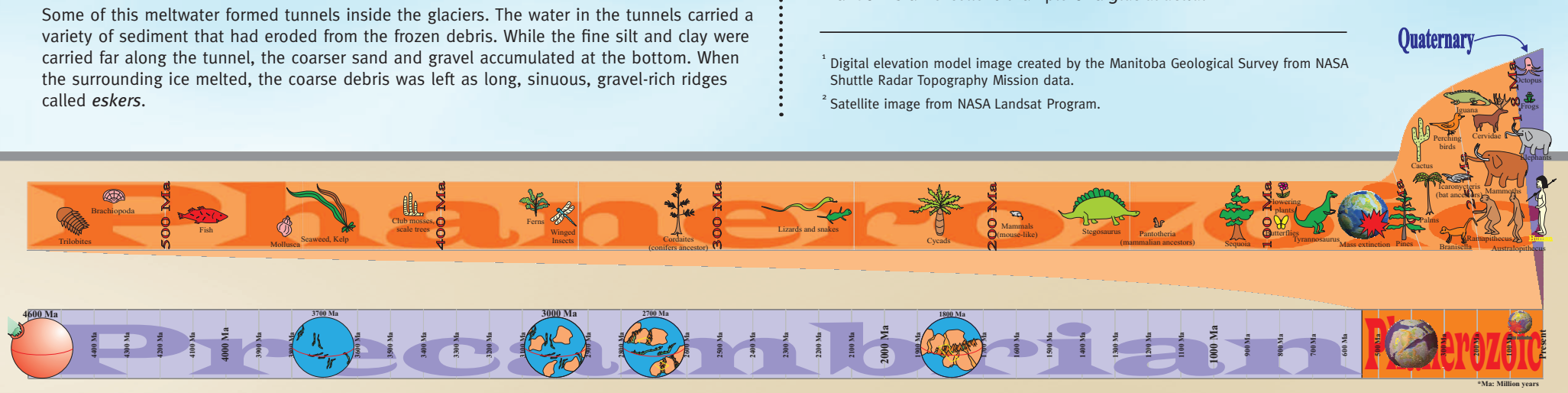
[1] Digital elevation model image created by the Manitoba Geological Survey from NASA Shuttle Radar Topography Mission data.

[2] Satellite image from NASA Landsat Program.

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