

Geological time is divided into four eras (from youngest to oldest): Cenozoic, Mesozoic, Paleozoic, and Precambrian. The main events in the geological story of the Calgary region take place between 544 million years ago (the start of the Paleozoic Era) and the present. The story begins in the Precambrian, at the bottom of the time

Present As mountain-building ceased, the inland sea was filled by sediment and elevated. Most of the *Cenozoic* Era is dominated by river erosion of both the uring Mesozoic time. Paleozoic sedimentary rocks were pushed upward and form ancestral Rocky Mountains of Himalayan heights, which were n eroded; the sediment was transported by rivers into the inland sea to the

Paleozoic time, sediments were deposited upon the Precambrian 'basement' ver much of North America in an extension of an ancient Pacific Ocean. Many nose exposed now in the Rocky Mountains at Canmore.

of these sediments are the products of organic activity and were transformed by burial and compaction to limestone that is rich in fossils, including reefs, like Precambrian igneous and metamorphic rocks are the ancient foundation of North America, forming the Canadian Shield where they are exposed at the

surface in northern Alberta.

and now

Driving from Calgary to Canmore, it is hard to miss Mount Yamnuska, the most easterly peak north of the Trans-Canada Highway. It is a striking example of Paleozoic limestone, deposited about 520 million years ago, that was thrust on top of younger (Mesozoic) sandstone and shale deposited about 75 million years ago.

The paper-thin contact between the two rock formations is the McConnell Thrust Fault, one of the major faults of the eastern Rocky Mountains.

Thrust sheet made up of

Peaceful plains The Plains geological province, from Cochrane east to Manitoba, is made of sedimentary rocks not affected by mountain building and lies undeformed upon the original 'basement'.

The main hills in the Calgary and Cochraneareas are remnants of a much higher plain from 1 million years ago, that has been largely removed by river erosion. The eroded land surface was modified by glacial erosion during the Ice Age, and the river valleys were the site of sediment deposition as the glaciers melted. Most recently, rivers in the last 10 000 years have cut down through ice-age sediments to their present

Top of Nose Hill (ancient river level)

Precambrian rocks

Mountain building

During the building of the Rocky Mountains, from about 160 million to 60 million years ago, huge slabs of Paleozoic sedimentary rock ('thrust sheets') were shifted tens of kilometres northeastward and upward on top of much younger rock formations. Enormous tectonic forces over geological time allowed the rock to move and fold slowly, like a thick fluid.

Modern sediments Soil, with organic content — a rich Millions of years of erosion by water, wind, and ice have

defines the Rocky Mountains geological province. om the Rocky Mountains east to about Cochrane, the soft indstone and shale of the Mesozoic were also faulted and re not as hard as the limestone of the Rocky Mountains, however, and they have been eroded to form the gentler topography of the Foothills geological province.

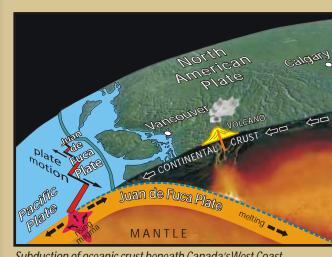
removed most of the original mountains, leaving only

remnants — high cliffs of far-travelled hard limestone that

now sit on top of much younger and softer sandstone and

shale. Paleozoic limestone forming a rugged topography

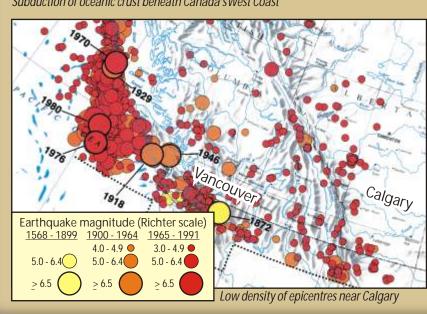
Location, location. Calgary is located in a geologically stable setting, 800 km inland from active faults and volcanoes. The faults are related to the subduction of the Juan de Fuca Plate under the continental crust of North America and are a major source of earthquakes on the West Coast. As the oceanic crust on the plate descends, it melts and gives rise to some of the



volcanoes in the west.

st a little bit shaky Despite Calgary's location far from active faults, some small earthquakes have occurred in the region. Some of these result from the minor jostling and adjustments related to movement of geological plates. Others are caused by stresses in the rocks sociated with removal of oil and gas from underground reservoirs, effect taken into account by the industry.

The earthquake epicentre map shows the location, magnitude, and timing of earthquakes in historical times. Note the greater density and higher magnitude of earthquakes on the coast.



Rock resources

Rundle Rock

seafloors about 245 million years ago.

A blast from the past Although Calgary is a long way from active volcanoes,

many residents will remember the dusting of volcanic ash from the eruption of Mount St. Helens in 1980. A much larger eruption occurred 7700 years ago, when Mount Mazama in southern Oregon erupted with such violence that much of the mountain was removed. creating the depression now occupied by Crater Lake. as Calgary and Edmonton. A layer of Mazama ash can be



agricultural resource

in the mountains

Ice-age sediments

landslides

Bedrock

Pre-ice-age landscape

a source of aggregate

stone and brick clay

River-valley floodplain deposit.

• Volcanic ash layer — from a huge

eruption in Oregon 7700 years ago

• *Till* — sediment deposited from

Glacial-meltwater gravel and san

— a source of aggregate

Glacial-lake silt — subject to

melting glaciers, blanketing much

the higher ground in and around

Bedrock topography — formed by

rivers cutting valleys into bedrock

Gravel beds of ancient rivers, now

preserved on the tops of the hills —

Paskapoo sandstone and shale

Sandstone and mudstone — a

significant source of oil and natura

Limestone, including fossil reefs—a source of oil around

'basement', extend to over 20 km below Calgary as the

Igneous and metamorphic rocks, commonly referred to as

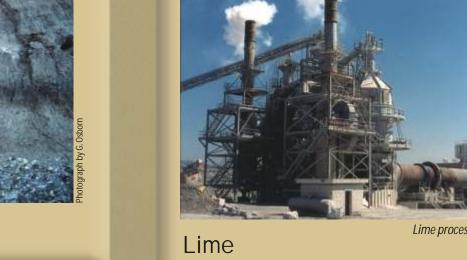
Calgary and rock resources from the mountains

form the main hills in Calgary and

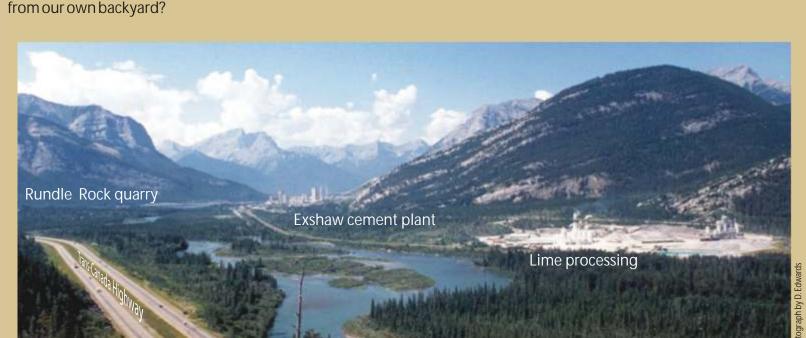
Cochrane — a source of building

(including pebbles and boulders)

derived in part from glacial deposits



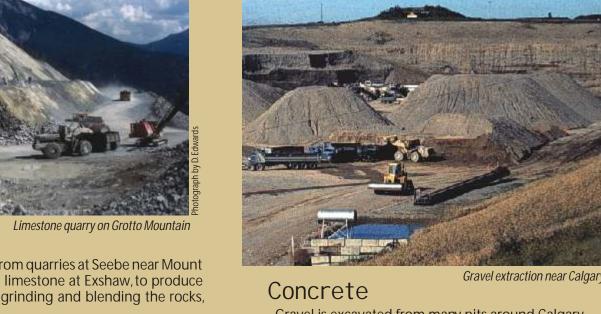
Limestone, trucked from the Grotto Mountain quarry, is crushed, screened, and burned in kilns at about 1450°C to produce lime (calcium oxide). Lime is used in agriculture, in water treatment, in sugar refining, and in the manufacture of steel and paper.

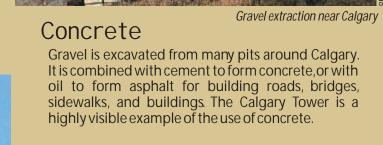


Valuable building stone and aggregate materials are abundant in the mountains and along the Bow River valley, reducing

the need for lengthy transport. Did you know that the Calgary Tower and the Banff Springs Hotel were built with materials

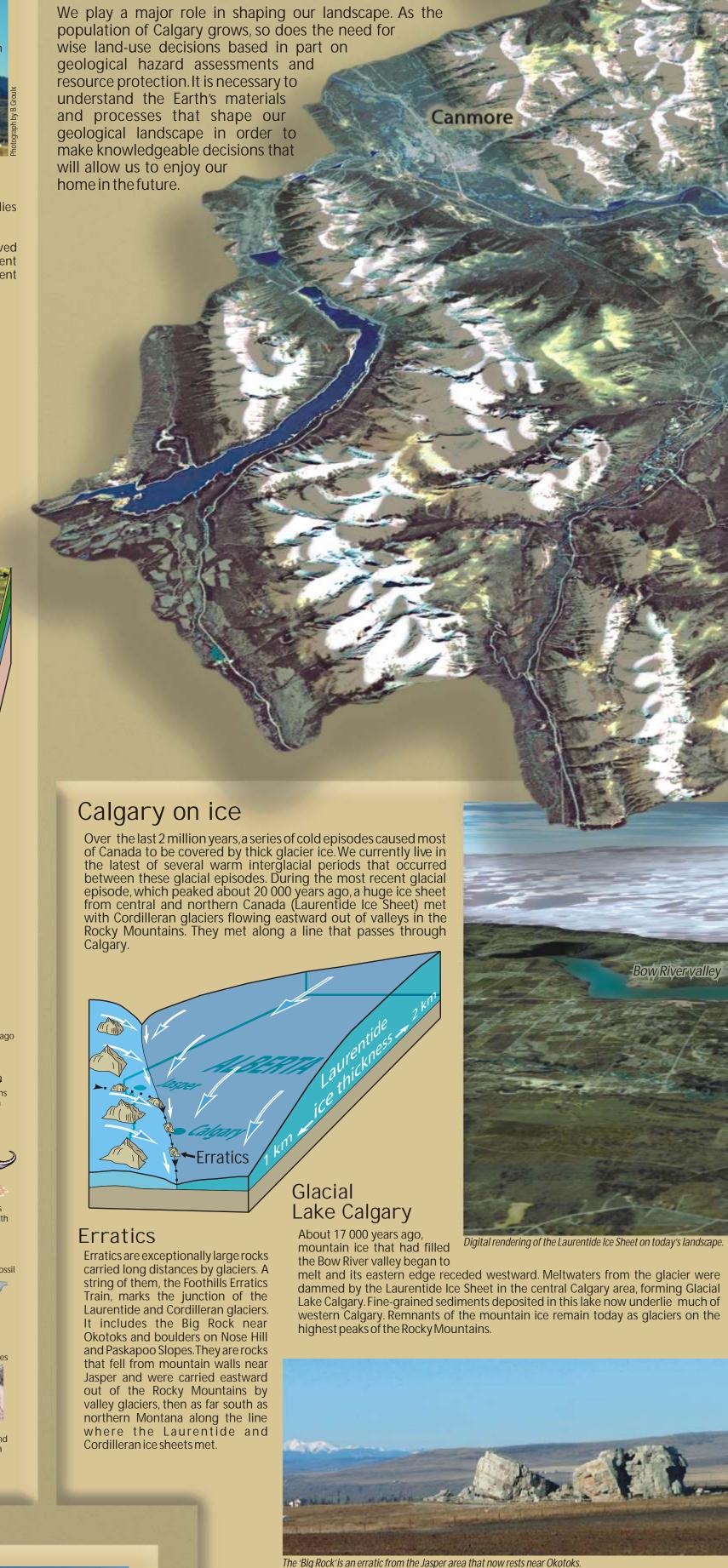
Sandstone and shale, trucked from quarries at Seebe near Mount Yamnuska, are combined with limestone at Exshaw, to produce cement. The process involves grinding and blending the rocks, and burning the mix in kilns.











Mountains and winding through the Foothills. A dynamic landscape surrounds us,

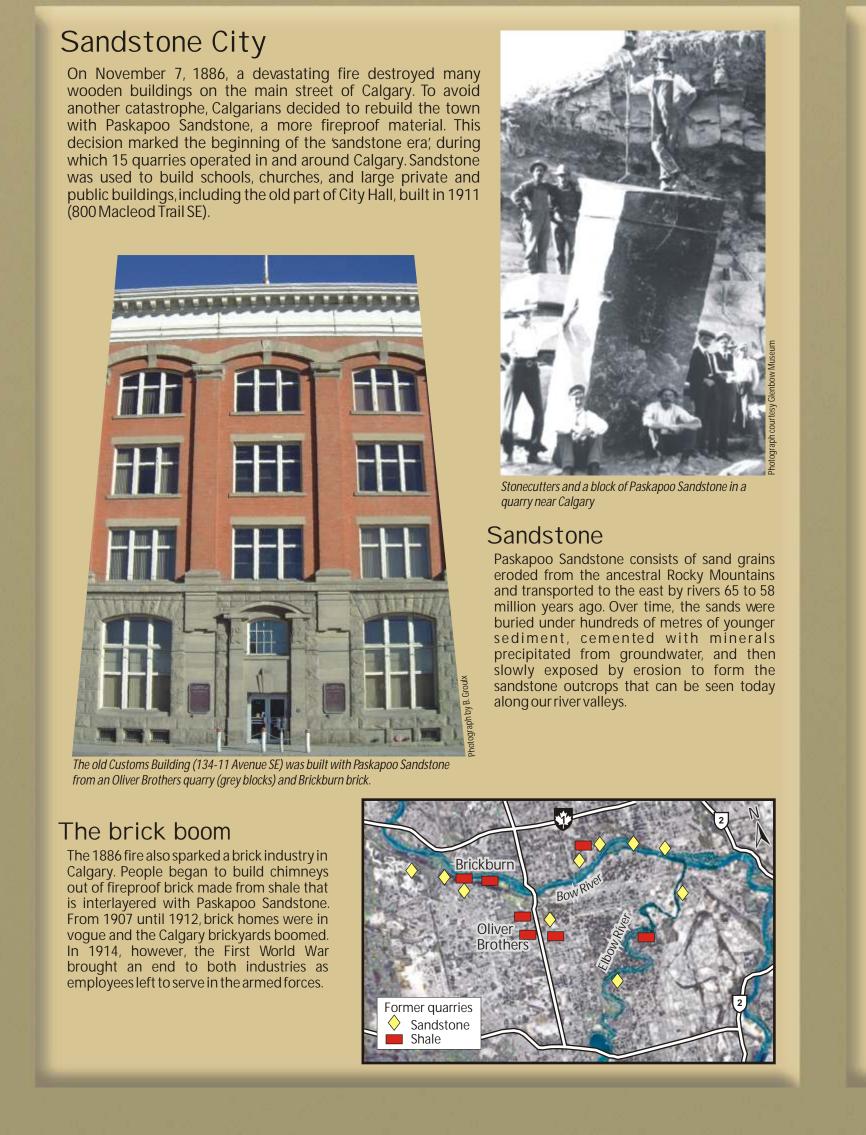
the product of ancient mountain building, succeeding ice ages, and river erosion. To our west, the Rocky Mountains bring us warm

Chinook winds, abundant water, and recreational opportunities

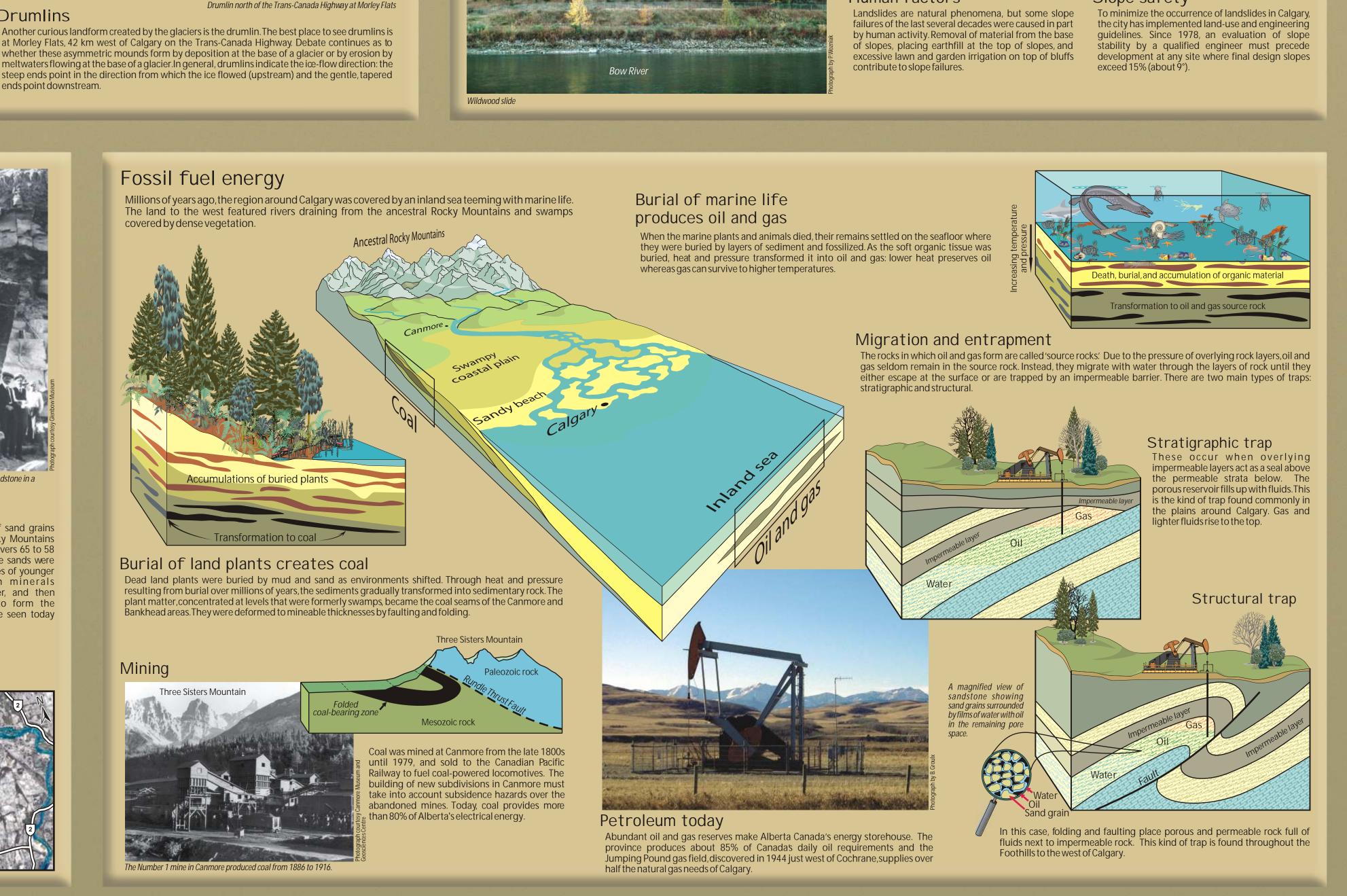
sedimentary basin rich in natural resources, including oil, natural

gas, and coal.

unparalleled on Earth. Beneath the prairie landscape lies a



ends point downstream.



Sliding slopes

valleys of the Bow and Elbow rivers.

causing the upper surface to tilt back.

rainstorms and flow downslope.

site in north Calgary.

Rotational slumps are landslides that occur when a

slumping block slides on a curved failure surface,

Mudflows occur when unconsolidated materials

become saturated with water during snowmelt or

At times, combinations of both types of landslide

occur together, for example at the Wildwood slide

Slowly moving rotational slumps and mudflows are fairly common on the steep slopes along the

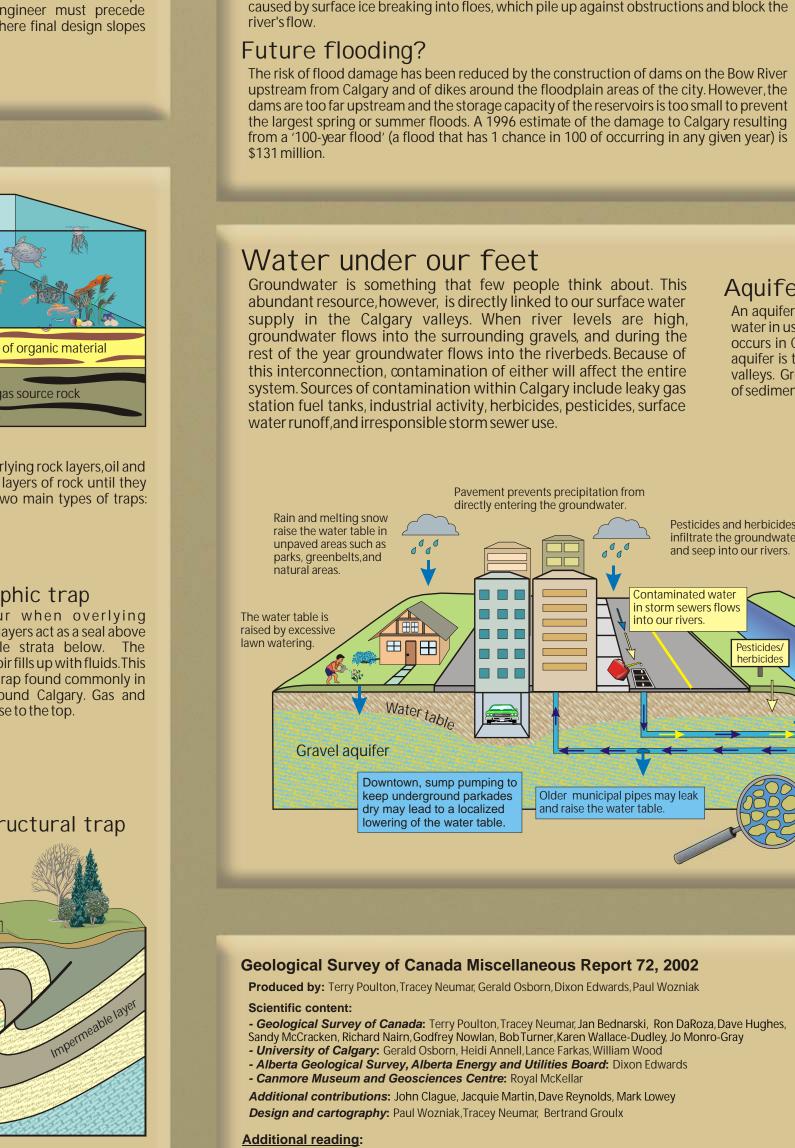
Why slopes fail in Calgary

The stage was set for failing slopes when large quantities of glacial and lake sediments were deposited during the Ice Age in the broad pre-glacial Bow and Elbow river valleys. The rivers

cut down through these sediments to create the steep slopes that we see along the rivers

today. These steep slopes are unstable and may fail when the ground becomes saturated

Bow River in unstable glacial sediments. Lake sediments were deposited in Glacial Lake Calgary.



Association of Canada, Special Paper 42.

Provincial Museum of Alberta.

Rivers... friend and foe

Bow River summer flood of 1932

Floods can occur during the summer when exceptionally heavy rainfalls combine with

rapid snowmelt in the mountains. In June 1929, flooding on the Elbow River washed out the

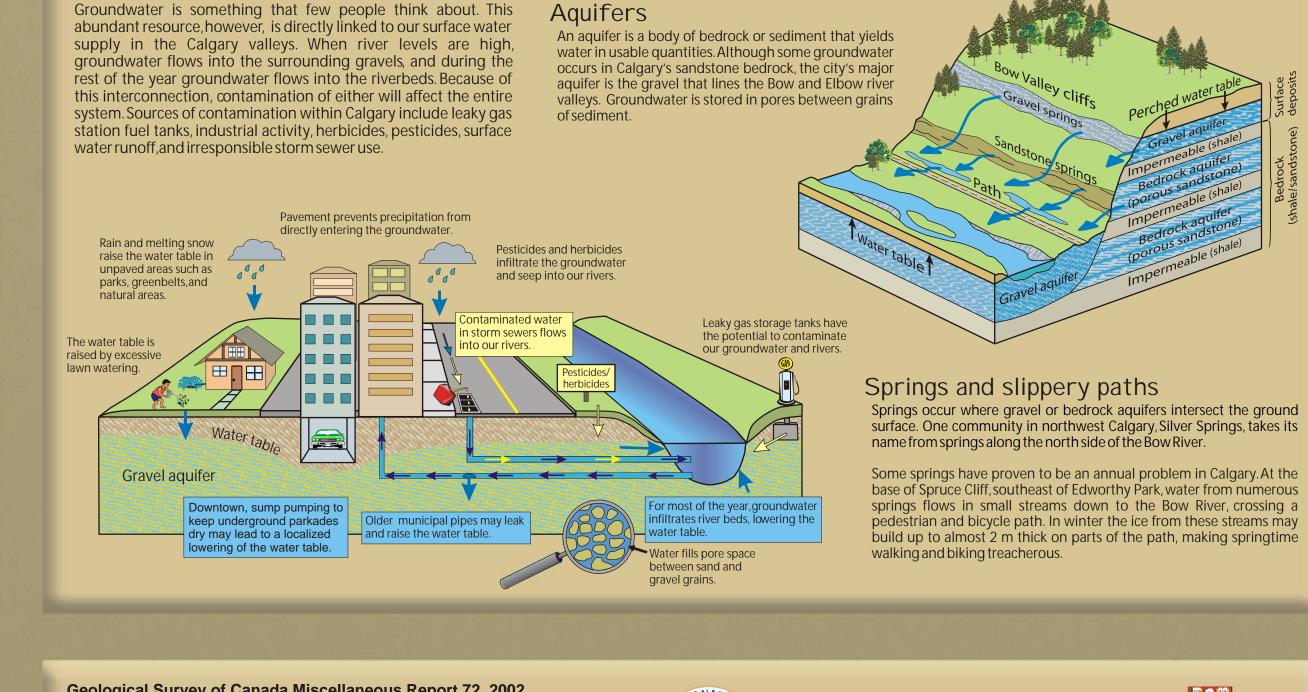
25th Avenue SE bridge and created a lake where Victoria Park had been. The last major

summer flood to hit Calgary was in 1932, when the Bow River inundated Sunnyside and

Ice jams form during spring breakup or during Chinook winds in midwinter. They are

Floods

other communities.



Water from the Bow and Elbow rivers meets the urban and agricultural needs of much of southern Alberta. Reservoirs along both rivers provide Calgarians with fresh water, and irrigation

canals carry water to farms east of Calgary. The rivers also provide a natural retreat within Calgary and attract trout fishermen from around the world.

Geological Survey of Canada: Terry Poulton, Tracey Neumar, Jan Bednarski, Ron DaRoza, Dave Hughes, Sandy McCracken, Richard Nairn, Godfrey Nowlan, Bob Turner, Karen Wallace-Dudley, Jo Monro-Gray

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