TYPES OF EARTH MATERIALS

Ice

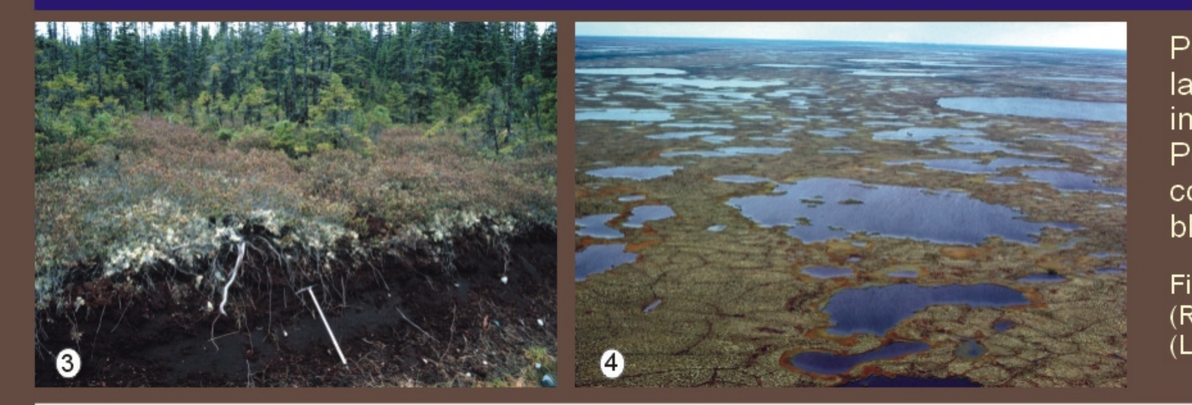
Ice occurs as glaciers in mountainous areas of British Columbia, Yukon Territory, Alberta, and the Arctic Islands. Glaciers form where the accumulation of snow, principally during winter, exceeds summer snowmelt. Most Canadian glaciers have retreated since the late 1800s. Meltwater from glaciers is important in maintaining the flow of many rivers in western Canada during the dry summer months.

Figure 1. Hikers dwarfed by glacier, Ellesmere Island (© P. vanPeenen). Figure 2. Glacier flowing into a small lake, Coast Mountains, British Columbia (I. McMartin).

Ice

Modern sediment

Modern, or postglacial, sediment has been deposited by rivers, wind, waves, landslides, plants, and glaciers since the end of the ice ages. Where present, it forms a blanket over more extensive Ice Age sediment or bedrock.



Peat is partly decomposed plant material. It occurs in wetlands and large tracts of poorly drained land known as 'muskeg'. Peatlands are important ecosystems and store vast quantities of carbon and water. Peat bogs are mined for sphagnum moss, which is used as a soil conditioner. Farms on peatlands provide important cranberry and blueberry production.

Figure 3. Peat exposed in a road cut, Terra Nova National Park, Newfoundland (R.J.W. Turner). Figure 4. Muskeg dotted with lakes, Hudson Bay lowland, Manitoba (L. Dredge).

Peat

Mud, sand, and gravel are mainly river, stream, and beach sediments. They occur on floodplains, deltas (bodies of sediment deposited where rivers enter a lake or the sea), and shorelines. Deltas and floodplains support important wetland ecosystems and, in southern Canada, are important agricultural areas. Sand and gravel are common along Canada's lake and ocean shores. Floodplains, deltas, and beaches are prone to flooding and to liquefaction during earthquakes.

Figure 5. Mud in tidal estuary, Vancouver, British Columbia (J.J. Clague).
Figure 6. Sand and gravel bars, South Saskatchewan River (P. Ashmore).

Mud, sand, and gravel

Sand underlies active and vegetated dunes. Wind-blown sand is extensive around Lake Athabasca, and in parts of southern Saskatchewan. Sand dunes also occur in coastal areas in association with sand beaches. Dunes retain little moisture, have limited nutrients, and thus support unique drought-tolerant plant communities.

Figure 7. Active sand dunes, Great Sand Hills, Saskatchewan (S.A. Wolfe).
Figure 8. Sand dune encroaches on playing field, Carcross, Yukon Territory (S.A. Wolfe).

Sand

Ice Age sediment

Ice Age sediment is common throughout most of Canada except in northern Yukon Territory and the western Arctic Islands. It forms a widespread, discontinuous blanket overlying rock. Most Ice Age sediment was deposited between about 20 000 and 10 000 years ago when ice sheets, similar to those in Greenland and Antarctica today, covered large areas of Canada.

Silt and clay were deposited in lakes dammed by decaying glaciers at the end of the ice ages. They were also deposited on coastal lowlands that were inundated by the sea due to depression of the land by the weight of ice sheets (e.g. lower Ottawa and St. Lawrence river valleys). Silt and clay form rich agricultural soils. Leda Clay in the St. Lawrence Valley is susceptible to landslides ('quick clay' failures).

Figure 9. Sandy silt, Niagara Peninsula, Ontario (R.J.W Turner). Figure 10. The Red River flows across a flat plain of ancient glacial lake silt (G.R. Brooks).

Silt and clay (or mud)

Sand and gravel were deposited by streams flowing from retreating glaciers at the end of the ice ages. They are important sources of aggregate used in road construction and in the production of asphalt and concrete. Groundwater aquifers in shallowly buried sand and gravel bodies provide important water supplies to communities across Canada.

Figure 11. Coarse gravel, Coast Mountains, British Columbia (J.J. Clague).
Figure 12. Gravel pit, southern Ontario (A.V. Morgan).

Sand and gravel

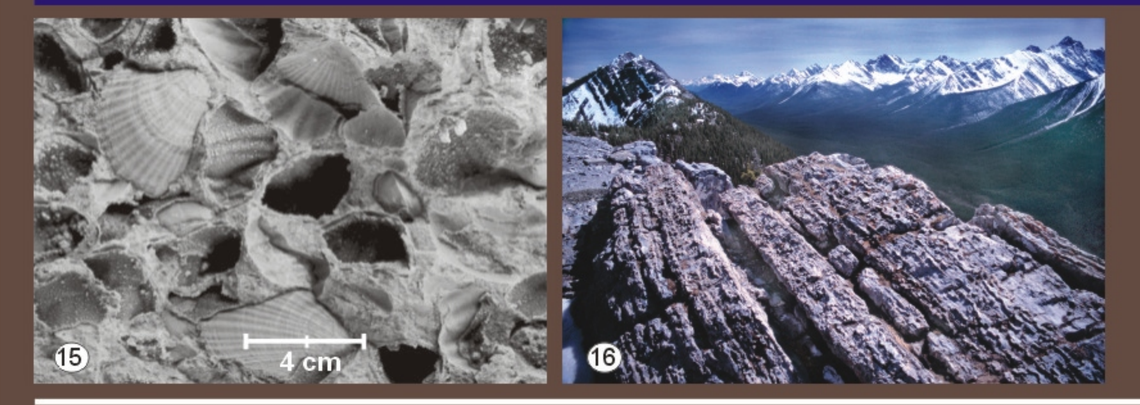
Till, the most common surface material in Canada, is debris deposited by glaciers. It consists of a mix of clay, silt, sand, and gravel. The composition of till is closely related to that of the rock from which it is derived. Typically, calcareous till overlies carbonate terrane, clay-rich till overlies shale and volcanic terranes, and sand-rich till overlies granitic terrane.

Figure 13. Till, southern Vancouver Island, British Columbia (J.J. Clague).
Figure 14. Hummocky till terrain, southern Alberta (J.J. Clague).

Till

Rock

Rock is the dominant surface material in mountains, on the Canadian Shield, along escarpments (e.g. the Niagara Escarpment), and along some shorelines. In many parts of Canada, rock is buried beneath thick modern or Ice Age sediments. Areas mapped as rock include sites where rock is covered by thin, locally derived modern sediment or thin, patchy Ice Age sediment.



Carbonate rock includes limestone, dolostone, marble, and calcareous shale. It can form rugged mountains and steep escarpments. Rain and groundwater slowly dissolve carbonate rock, forming caves and surface depressions. Waters in carbonate terranes are 'hard' due to high concentrations of dissolved bicarbonate. Carbonate rock contains important oil, gas, and metal (zinc, lead, silver) resources. Limestone is used in making cement.

Figure 15. Shell-rich limestone, Cape Breton Island, Nova Scotia (A. Sabina).
Figure 16. Layered limestone, Sulphur Mountain, Banff, Alberta (R.J.W. Turner).

Carbonate rock

Clastic sedimentary rock was deposited as loose sediment, similar to modern sediment (e.g. sand, mud, and gravel), and later transformed into solid rock. It includes sandstone, mudstone, shale, and conglomerate. Mudstone and shale are easily eroded and commonly underlie valleys. Sandstone is more resistant and can form ridges and cliffs. Clastic sedimentary rock is commonly porous and can contain abundant oil and gas in western Canada, the Mackenzie River delta, and offshore Atlantic Canada. It also hosts important tar sand, heavy oil, coal, uranium, and groundwater resources.

Figure 17. Microscopic view of sandstone, Ontario (R.J.W. Turner).
Figure 18. Layered clastic sedimentary rock, Blomidon, Nova Scotia (M. Gibling).

Clastic sedimentary rock

Clastic sedimentary rock transforms, or 'metamorphoses', into quartzite, slate, and schist when subjected to high temperature and pressure deep within the Earth. Metamorphism reduces rock pore space, thus these rocks are rarely important hydrocarbon reservoirs or groundwater aquifers; however, they do host important metal and uranium deposits. Metamorphosed clastic sedimentary rock is resistant to erosion; it is an important element of mountain ranges in western Canada and southern Quebec.

Figure 19. Folded metamorphosed clastic sedimentary rock cut by quartz, Bathurst Inlet, Nunavut (J. King). Figure 20. Folded slate at Blue Rocks, Nova Scotia (R. Fensome).

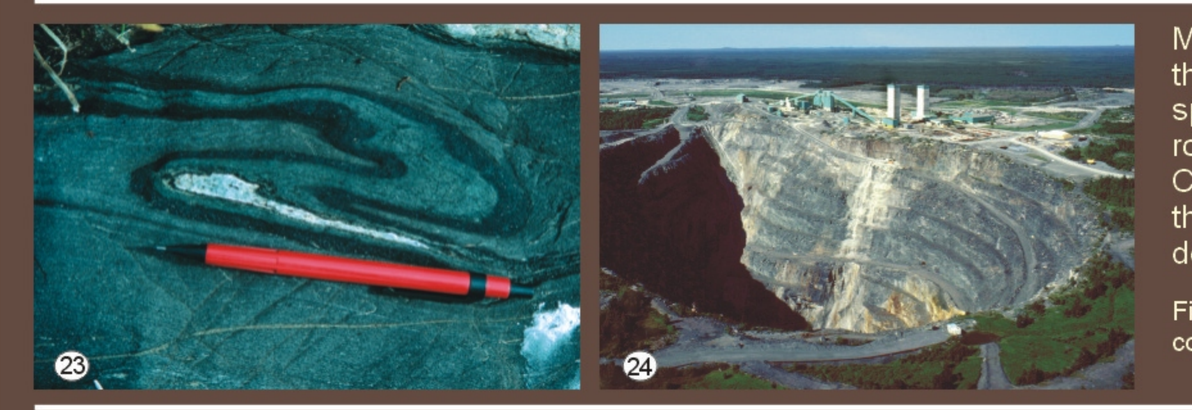
Metamorphosed clastic sedimentary rock

Volcanic rock is most common in the Cordillera and forms lava flows, intrusions (dykes, sills), volcanoes, and cinder cones. It ranges from fine-grained, dark coloured rock to paler, variably coloured, fragmental rock. Some volcanic rock contains abundant fractures and pores and can host important aquifers. Steep volcanic slopes are prone to landslides. Some volcanoes in British Columbia and southwestern Yukon Territory are dormant and will erupt in the future. Some volcanic intrusions (kimberlite pipes) in the Canadian Shield are important sources of diamonds.

Figure 21. Columnar-jointed lava flow, near Whistler, British Columbia (J.J. Clague).
Figure 22. Cinder cone, Mount Edziza, northern British Columbia (C.A. Evenchick).

Volcanic rock

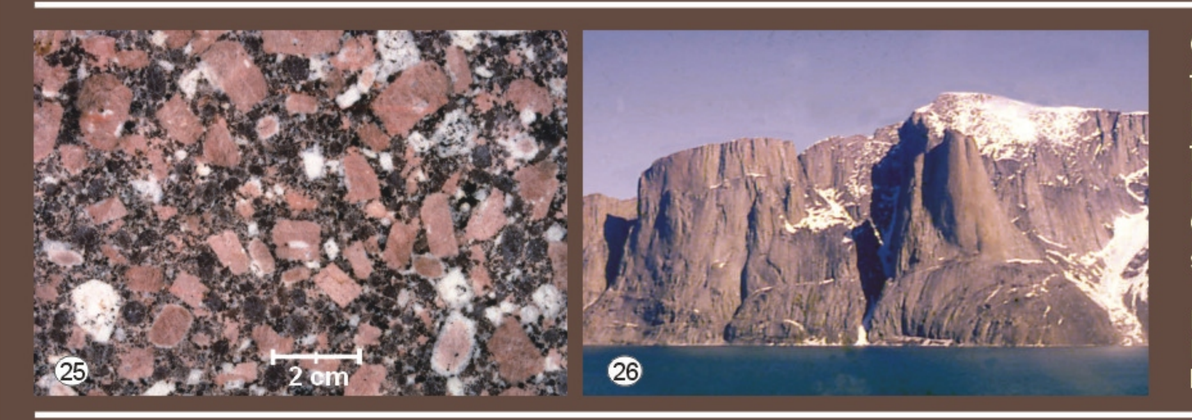
▲ Volcano



Metamorphosed volcanic rock has lost its original surface volcanic form through erosion, burial, deformation, and metamorphism. It has less pore space and is more resistant to erosion than unmetamorphosed volcanic rock. It typically is dark in colour, occurs widely in the Appalachians and Cordillera, and is a major component of extensive 'greenstone belts' on the Canadian Shield. Metamorphosed volcanic rock contains important deposits of copper, zinc, lead, nickel, silver, and gold.

Figure 23. Deformed basalt, Flin Flon area, Manitoba (J.J. Ryan). Figure 24. Kidd Creek copper mine in metamorphosed volcanic rock, Timmins, Ontario (© G. Oxby).

Metamorphosed volcanic rock



Granitic rock is coarse grained and varies from light to dark in colour. It forms deep within the Earth by crystallization of molten rock. Granitic rock is extensive on the Canadian Shield, eastern Baffin Island, and in the British Columbia Coast Mountains. It is commonly massive, resistant to erosion, and forms uplands with thin unproductive soils. Granitic rock hosts important copper, nickel, tin, gold, and building stone resources.

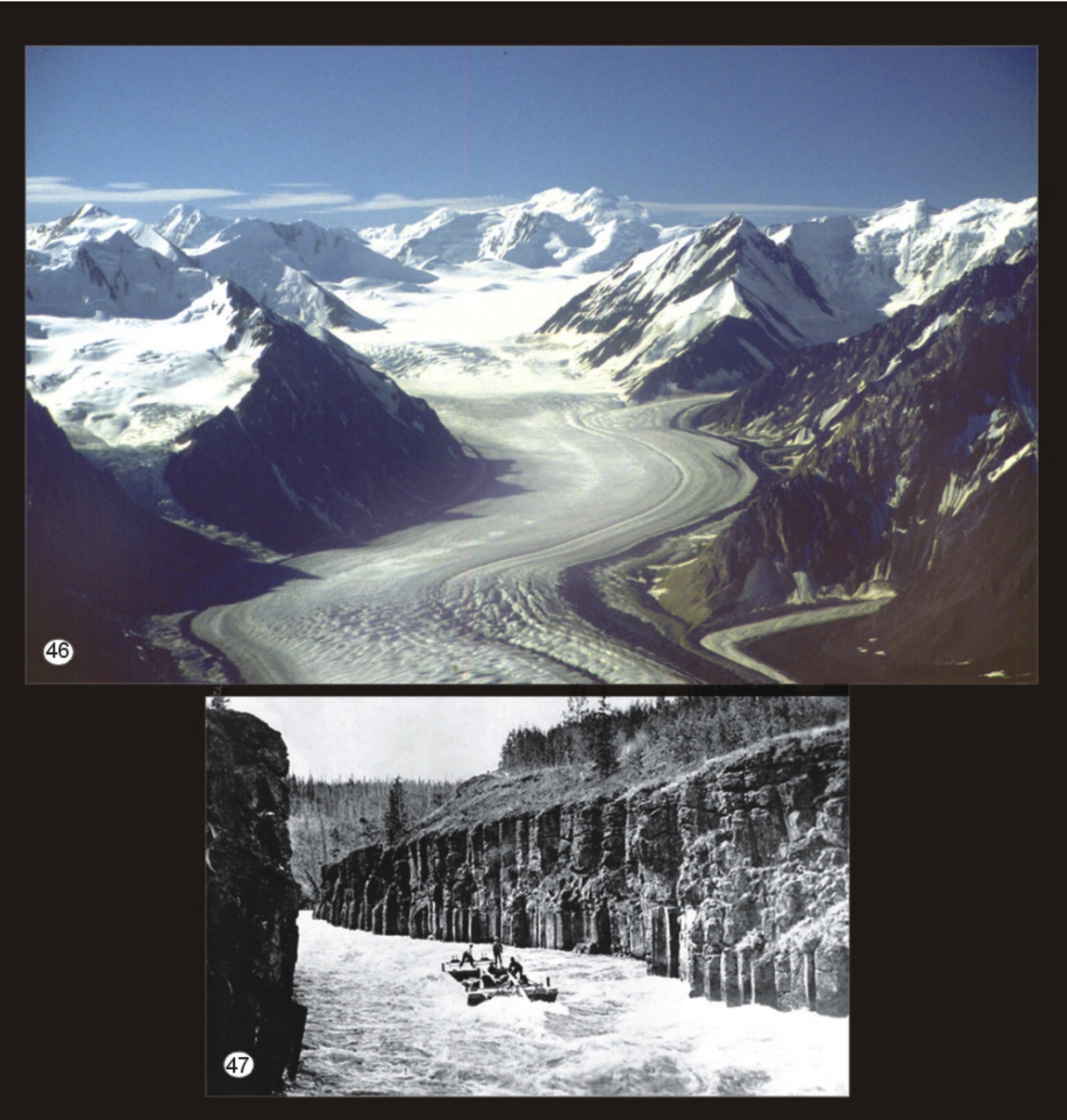
Figure 25. Close-up view of granitic rock, New Brunswick (J.B. Whalen).
Figure 26. Granite exposed in fiord wall, Cumberland Peninsula, Baffin Island, Nunavut (G.D. Jackson).

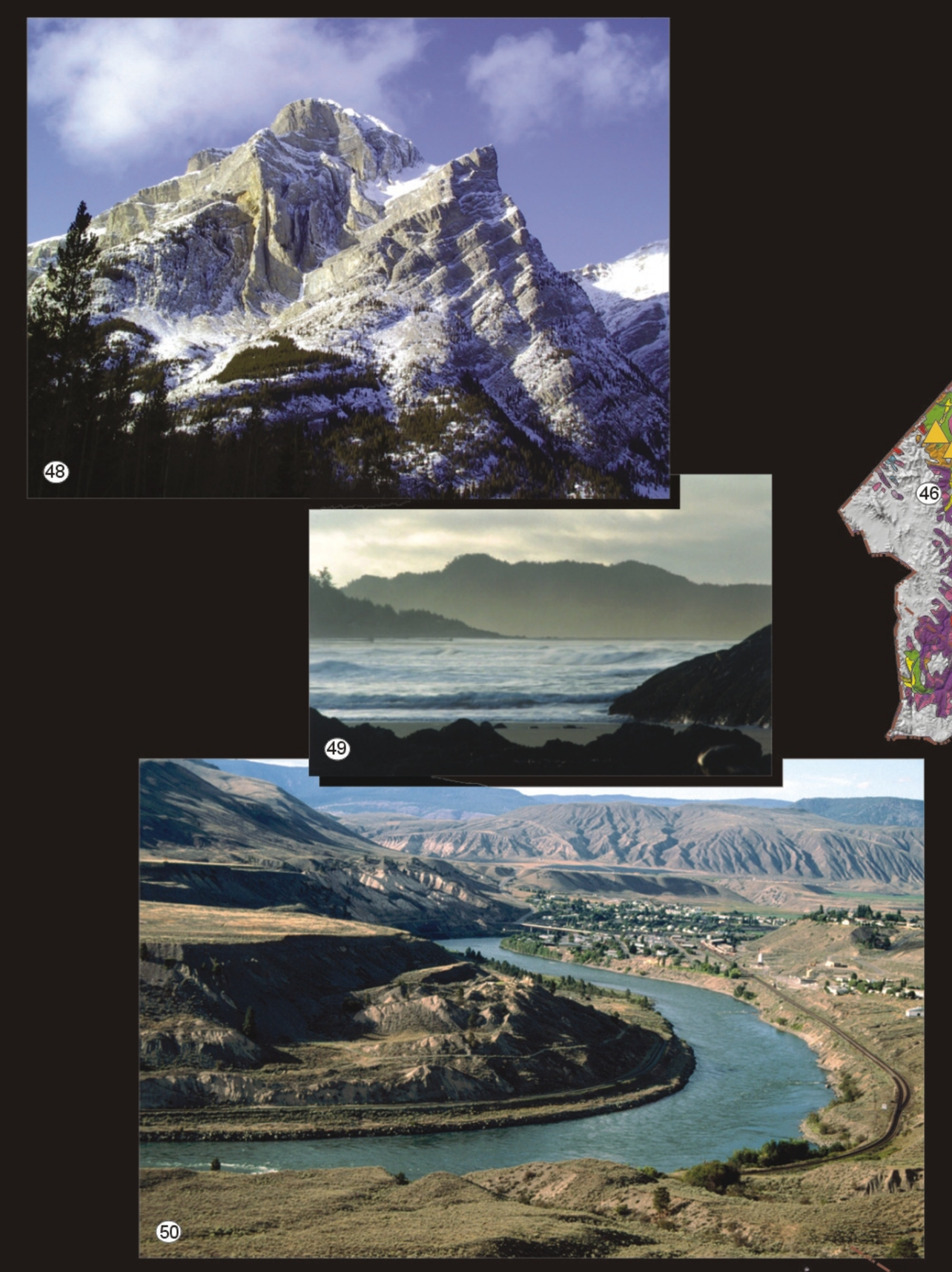
Granitic rock

Gneissic rock is a coarse-grained, banded metamorphic rock that has formed at high temperature and pressure deep in the Earth's crust. It has physical properties similar to those of granitic rock, forms extensive areas of the Canadian Shield, and commonly is associated with thin poor soils, 'soft' water, and lakes vulnerable to acidification from acid precipitation. Gneiss plateaus cut by steep-walled valleys and fiords occur in the eastern Arctic Islands and western Newfoundland.

Figure 27. Close-up view of folded gneiss, Nunavut (J.J. Ryan).
Figure 28. Thin-banded gneiss, Chesterfield Inlet, Nunavut (S. Tella).

Gneissic rock





Mountains of Western Canada

Figure 46. St. Elias Mountains with ice field and valley glaciers (J.J. Clague).
Figure 47. Miles Canyon, near Whitehorse, where Yukon River cuts through a lava flow (Emile Forrest Collection, Yukon Archives 80/60 PHO 131 #6).
Figure 48. Folded limestone and dolostone (carbonate rock), Kananaskis valley, Alberta (J.J. Clague).
Figure 49. Rocky shore (metamorphosed clastic sedimentary rock) and sandy beach, Pacific Rim National Park, British Columbia (R.G. Anderson).
Figure 50. Terraces of gravel and glacial-lake sand and silt (Ice Age sediment) incised by Thompson River, Ashcroft, British Columbia (J.J. Clague).

Arctic Canada

Figure 42. Tidewater terminus of Pallisade glacier, Ellesmere Island, Nunavut (© P. vanPeenen).
Figure 43. Channels and islands of the Mackenzie River delta, Northwest Territories (P. Hill).
Figure 44. Dark intrusions of diabase (volcanic rock) in layered carbonate rock, Wynniatt Bay, Victoria Island, Northwest Territories (R. Rainbird).
Figure 45. Glacially carved valley containing river gravel and sand in a mountainous granitic terrane, North Pangnirtung Fiord, Cumberland Peninsula, Baffin Island, Nunavut (W.J. Crawford).

Geoscape Canada

A map of Canada's earth materials

Figure 41. Coastal cliffs of dolostone (carbonate rock) and gravelly shoreline deposits, Percé Rock, Gaspé, Québec (A.V. Morgan).

Canada's surface is a mosaic of diverse earth materials, forming a **geo**logical land**scape** or **geoscape**. We depend on these earth materials as the foundation for our rich ecosystems, for the agricultural soils that produce our food, for critical groundwater resources, for the metals and building materials on which our civilization is based, and for oil and gas that fuel our economy and provide essential plastics. We also live on a dynamic Earth, which is vulnerable to floods, landslides, earthquakes, and volcanic eruptions. We must carefully consider our geoscape in land use decisions to achieve wise stewardship of our great landmass.

Populated places
0–999
1000–4999
5000–24 999
25 000–99 999
100 000–299 999
300 000 or greater
Provincial and territorial capitals
Canada's capital
International boundary
Provincial and territorial boundary
Major roads

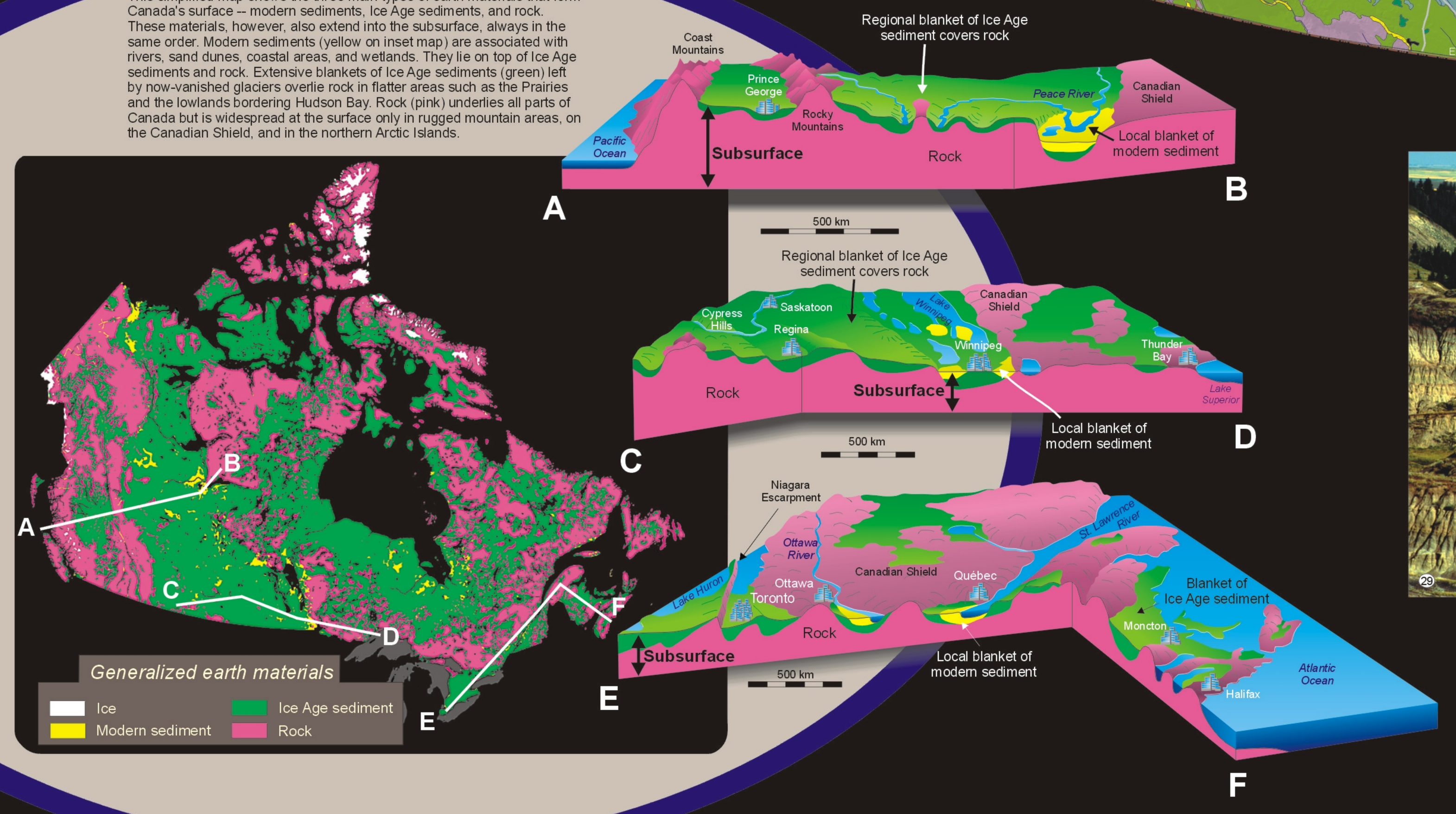
Scale 1:6 000 000
100 0 100 200 300 400 500
kilometres

This map is dedicated to the many geoscientists, working for the Geological Survey of Canada, provincial geological surveys, universities, and resource companies that mapped the Canadian landmass over the last century and a half, and continue this work today.

What do the map patterns mean?

The answer lies underground

This simplified map shows the three main types of earth materials that form Canada's surface -- modern sediments, Ice Age sediments, and rock. These materials, however, also extend into the subsurface, always in the same order. Modern sediments (yellow on inset map) are associated with rivers, sand dunes, coastal areas, and wetlands. They lie on top of Ice Age sediments and rock. Extensive blankets of Ice Age sediments (green) left by now-vanished glaciers overlie rock in flatter areas such as the Prairies and the lowlands bordering Hudson Bay. Rock (pink) underlies all parts of Canada but is widespread at the surface only in rugged mountain areas, on the Canadian Shield, and in the northern Arctic Islands.

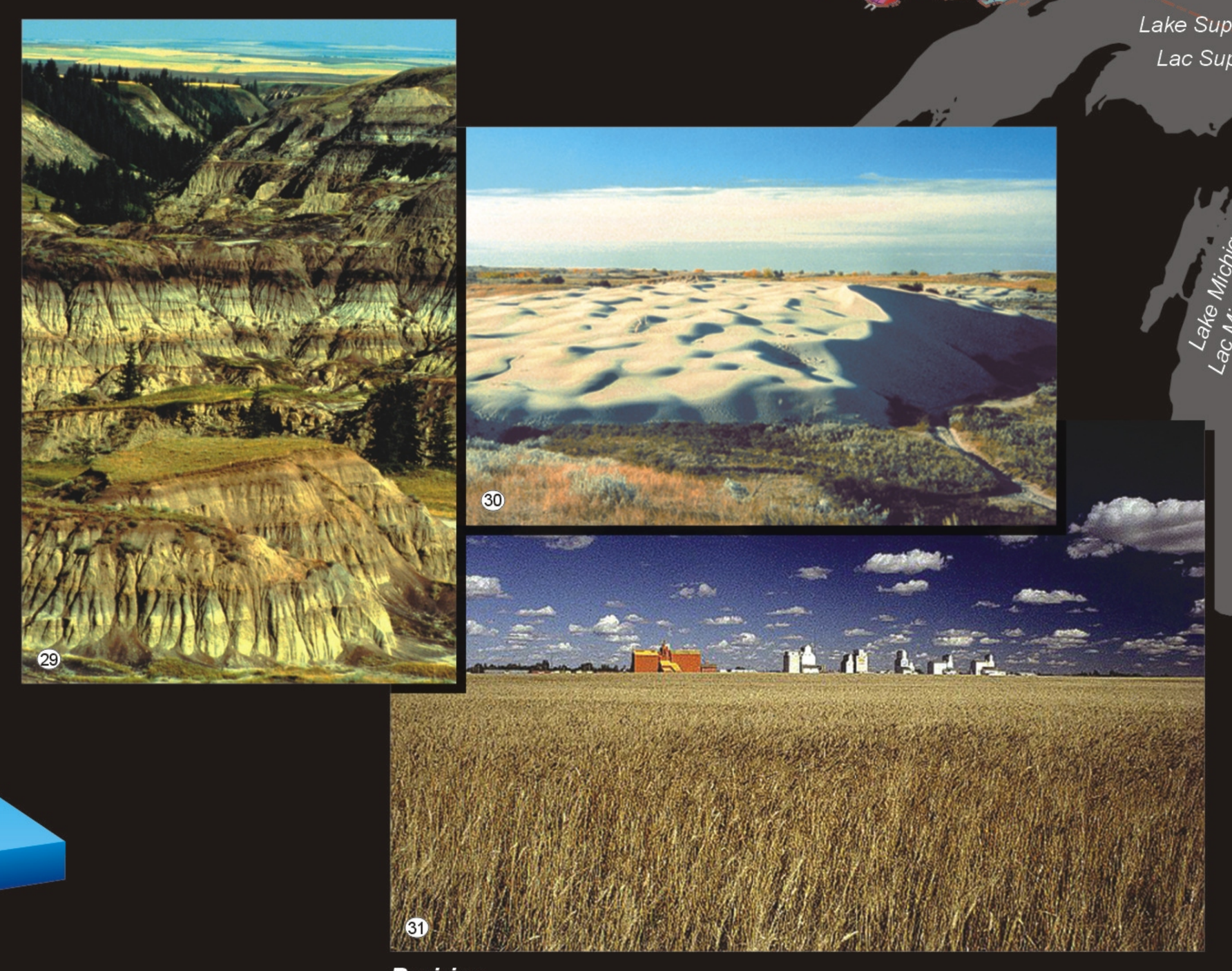


Atlantic Canada

Figure 37. Partly vegetated sand dunes and sand beach, north shore, Prince Edward Island (A.V. Morgan).
Figure 38. Red iron-stained conglomerate carved by ocean waves into cliffs and 'flower pots', Hopewell Rocks, New Brunswick (B. Atkinson, © Images of New Brunswick).
Figure 39. Shoreline formed in metamorphosed sandstone and conglomerate at the entrance to St. John's Harbour, Newfoundland (A.V. Morgan).
Figure 40. Bog on coastal plain backed by gneissic rock of the Long Range Mountains, Gros Morne National Park, Newfoundland (D. Grant).

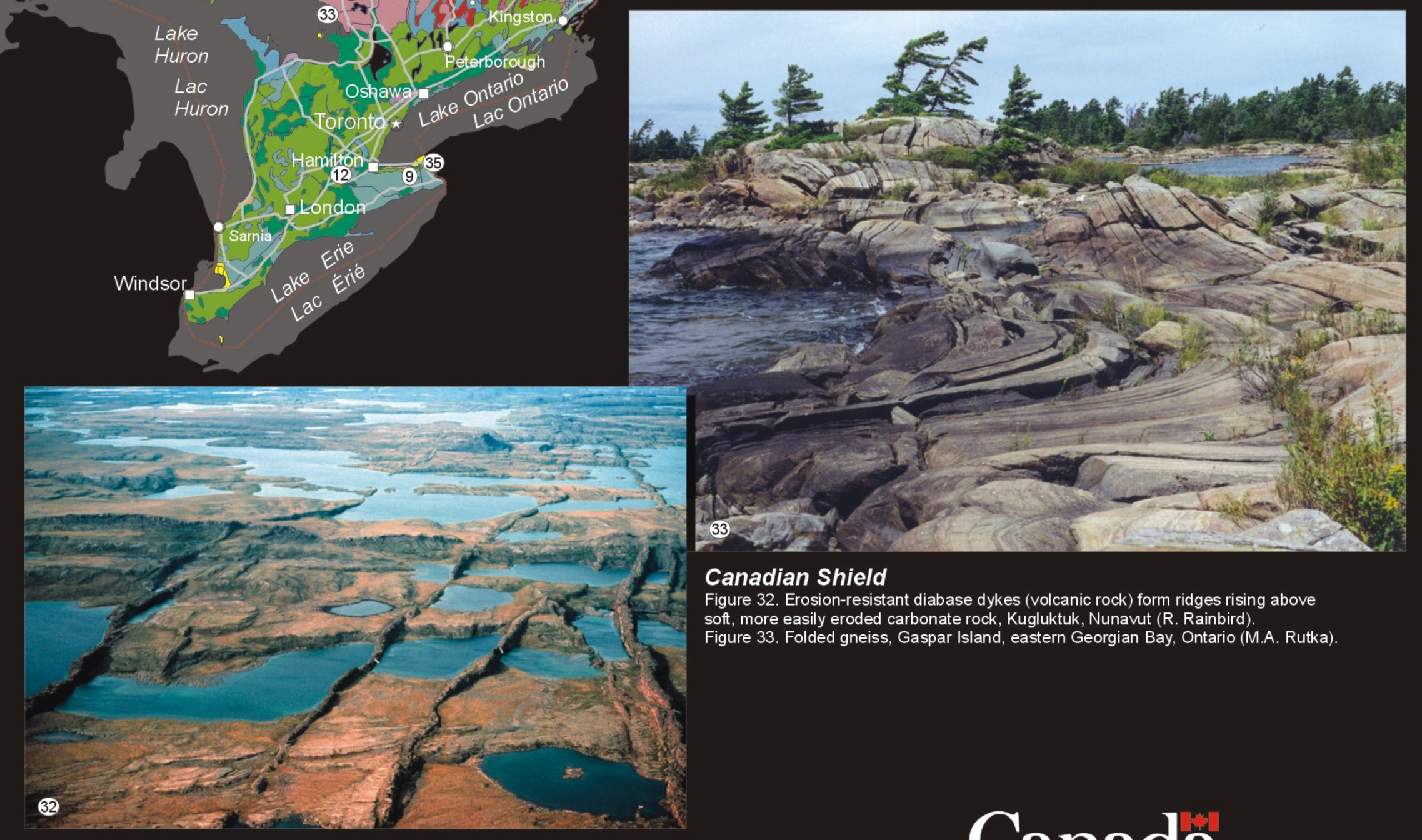
Great Lakes/St. Lawrence Lowlands

Figure 34. Limestone cliffs along the Ottawa River at Parliament Hill, Ottawa, Ontario (R.J.W. Turner).
Figure 35. Niagara Falls cascades over a resistant layer of dolostone (carbonate rock) that caps the cliffs of the Niagara River gorge in Ontario (A.V. Morgan).
Figure 36. Vegetated cliffs of shale, sandstone, and carbonate rock separate the upper and lower parts of Québec, Quebec (A.V. Morgan).



Prairies

Figure 29. Eroded sandstone and shale (clastic sedimentary rock), Horseshoe Canyon, Alberta (S.E.B. Irwin).
Figure 30. Active sand dune (modern sediment), Great Sand Hills, southwestern Saskatchewan (S.A. Wolfe).
Figure 31. Grain growing on rich soil formed on silt-clay glacial lake sediments, Davidson, Saskatchewan (Agriculture and Agri-Food Canada).



Canadian Shield

Figure 32. Erosion-resistant diabase dykes (volcanic rock) form ridges rising above soft, more easily eroded carbonate rock, Kugluktuk, Nunavut (R. Rainbird).
Figure 33. Folded gneiss, Gaspar Island, eastern Georgian Bay, Ontario (M.A. Rutka).

Geoscape Canada
A map of Canada's earth materials

Geological Survey of Canada Miscellaneous Report 81, 2003

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