Why look at Canada’s Physical Geography?

• Physical environment shapes Canada
• People interact with physical environment
Reading

• Take a look at any traditional textbook in the geography of Canada
  • There is usually a chapter on physical geography
  • Chapter 2 from Bob Bone’s book is copied and on reserve in GRC S403 Ross
Figure 2.1 Physiographic regions and continental shelves in Canada.
The Arctic Lands consist of a dozen large islands and numerous small islands that together are known as the Arctic Archipelago. The Canadian Shield is the largest physiographic region and extends beneath the Interior Plains, the Hudson Bay Lowland, and the Great Lakes–St. Lawrence Lowlands. (Further resources: Atlas of Canada 1967, Physiographic Regions; at: <atlas.nrcan.gc.ca/site/english/maps/environment/land/arm_physio_reg>.)
Canada

• Is built on continental crust
• Therefore contains very ancient rocks
• Has a long and very complex geological history
• Is most geologically active around its edges
• We live here in one of its quieter middle bits
  • Life in the slow lane
Geologic Provinces

• Shield (continental crust)
• Sedimentary platforms
• Fold mountain belts
• Arctic coastal plain
Canadian Shield
Sedimentary Platforms
Arctic Coastal Plain
<table>
<thead>
<tr>
<th>Period</th>
<th>Millions of Years Ago</th>
<th>Regions formed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary</td>
<td>2-0</td>
<td>Great Lakes</td>
</tr>
<tr>
<td>Cenozoic</td>
<td>100-0</td>
<td>Cordillera, Inuitian</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>250-100</td>
<td>Interior plains</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>600-250</td>
<td>Appalachian uplands, Arctic lands</td>
</tr>
<tr>
<td>Precambrian</td>
<td>3500-600</td>
<td>Shield</td>
</tr>
</tbody>
</table>
Canadian Shield

- Ancient (3500 million years +)
- Crystalline base of continent
- Formed at great depth & pressure
  - faulted, folded, flowed
  - metamorphic rocks: gneiss
  - from 5+ phases of mountain building
- Poor agricultural soils
Shield Rocks

• Formed in an era of rather small continents
  • 1/10\textsuperscript{th} the size of present-day continents or less

• North American shield:
  • Formed out of 7 ‘provinces’
  • Each with separate belts/terranes
Shield Rocks

• The zones of mountain building (orogens) were smaller too
• Plate tectonics operated
  • But in many ways differently than today
Nain Province
Ungava, Quebec
Churchill province
Superior Province

- Abitibi belt is rich in metal ores
Northern Ontario
Malartic QC
Grenville Province

- Southern Ontario, S, Quebec, S Labrador
Canadian Shield

• Its ancient rocks preserve ancient astronomical impacts
• Impacts of a younger solar system
Manicouagan Crater QC

- Diameter 161 km (100 miles)
- Impact in Triassic era 214 million years ago
- Flooded for the Manic hydro development
Sudbury Basin

• A 10-15 km dia object (probably a comet) hit the Nuna supercontinent 1.85 billion years ago
• Impact debris went global, debris field extends over 1.6 million Km2
• Metal ores (esp. Ni, Cu)
Shatter-cones, impact breccias
Shatter cones, Ramsey Lk Rd Sudbury
Astronomical Impacts

• Probably involved in mass-extinctions
• Destructive impacts occur every 75 million years or so
  • Bringing geological eras to their ends
Mistastin Lake crater in Labrador

- A 5 km astronomical body airburst 38 million years ago, left a 30 km crater
- Impact generated 2,370 °C heat, the hottest known on the earth’s surface
Ultramafic intrusions

• Continental crust tends to be rich in silica, floats on denser, ultramafic material underneath
• As the ancient continental crust formed, blobs of ultramafic material penetrated/got trapped
• Find them in the shield, rich in minerals
• Darnley Bay anomaly, Paulatuk NT
Sedimentary Platforms

• Mainly Paleozoic onwards
• Sedimentary rocks
• on top of Shield
• Gently dipping domes, basins and escarpments
  • Niagara escarpment
  • Manitoba escarpment
• Good agricultural soils
Crustal History

• The clustering of the continents tends to cycle
• They join together, break apart, join together etc,. In a repeating cycle
  • The Wilson cycle
Pangea

• The last supercontinent: Pangea 250-150 million years ago
  • But it broke up
Crustal History

- Some of Canada’s crustal rocks broke off other continents
  - Newfoundland contains bits of Africa
Fold Mountain Belts

• Rocks folded, faulted flowed at plate margins
• Accompanied by igneous activity, metamorphism, earthquakes
• High mountains tend to be geologically recent, active
Global Tectonics
Fold Mountain Belts

• Appalachian 300-500 mybp: eastern Canada
• Cordilleran 50-150 mybp: western Canada
• Inuitian 20-60 mybp: high arctic
Fold Mountain Belts

Appalachian

Inuitian

Cordilleran

Appalachian
Baffin Is:
Inuitian
Ellesmere Is: Inuitian
St Elias Range YK: Cordilleran
Rocky Mtns AB: Cordilleran
Appalachian: Cape Breton NS
Appalachian: Truro NS
Tablelands, NL
During Appalachian orogeny, some of the earth’s mantle became attached to western Newfoundland.
Arctic Coastal Plain

- Area of active sedimentation
- Gently-dipping sedimentary on top of Shield
Between Paulatuk and Inuvik NT
• McKenzie Delta
  NWT
Tuktoyukuk NT
Two kinds of Glaciation

• Mountain
  • Glaciers form around high mountains

• Continental
  • Glaciers merge together to form large ice-sheets
Continental Glaciation

• Last 1 million years
• Ice sheets kilometres deep
  • 2km over Toronto, 4km over Montreal
• Eroded & shaped most of Canada
• Dumped moraine, outwash
• Created temporary lakes
• Land depressed by weight of glacial ice, still rebounding
Mountain Glaciation: NU
Franklin Glacier BC
Bear Glacier BC
Powell Glacier YT
Axel Hieberg Island, NU
Melville Is: NU
Saguenay Fjord, near Jonquiere QC
90km inland: Saguenay Fjord, La Baie QC
Western Brook Pond, NL
Glaciation

• Changed sea-levels dramatically
Tadoussac QC

• The Champlain Sea was a late-glacial raised sea-level
• Created a series of beaches
• Sea level has fallen, the old beaches are left behind
Belcher Islands, Nunavut

• Belcher Islands are rising out of the sea by a few cm each year.
• The beaches of the old sea levels get abandoned (raised beaches).
Berengia

• Most of Canada has been glaciated
• But some regions escaped:
  • Berengia in the Yukon
    • Too low and dry to generate its own glacial ice
    • Too high to be glaciated by Laurentide ice sheet
Figure 2.2  Maximum extent of ice, 18,000 BP.
The last advance of the late Wisconsinan ice age (the combined Laurentide and Cordilleran Ice Sheets) covered almost all of Canada and extended into the northern part of the United States around 18,000 BP. Geologists believe that the present 'warm' climate is an interlude before the next ice advance. (Further resources: Atlas of Canada, 2003; 'Retreat of the last ice sheet', at: <atlas.nrcan.gc.ca/site/english/maps/archives/4thedition/environment/land/031_32>.)
Berengia

• Lack of glaciation means that pre-glacial sand and gravel deposits remain
  • Containing placer gold
  • Basis of the 1897 Klondike gold rush
Cypress Hills

- An un-glaciated area
  - The highest land between Labrador and the Rockies
- Ice sheets flowed around it
  - Cordilleran and Laurentide ice sheets met and flowed around it
Cypress Hills: SK/AB border
Ice-Margin Lakes

• Vast amounts of melt-water generated large systems of ice-margin lakes
• Lake Agassiz once covered most of Southern Manitoba, Western Ontario
Lake Agassiz, 13000 YBP
Lakes Agassiz & Ojibway 7500 YBP
Ice-Margin Lakes

• Glacial ice margin left behind remnant lakes
  • The Great Lakes
  • Lakes Manitoba/Winnipeg
  • Lake of the Woods
Glaciation in the GTA

• The GTA covered by glacial ice 2 km thick
• Covers the GTA with thick layers of clay-rich glacial till
  • Eventually good for farming, forests
• Retreating ice leaves outwash and moraines
  • Oak ridges moraine, Brampton Esker
  • and the Great Lakes
Conclusions

• Physical geography: Canada has a lot of it
• Ranges in age from the ancient to the very recent
• Canada is on top of a chunk of continental crust with an ancient and complex history
Physical Regions

• What regional structure does the geology suggest?
  • Provinces? Territories?
  • Canada is the glaciated part of North America

• Climate, vegetation and soils next time