

Chapter 12

The Proterozoic Eon of Precambrian Time

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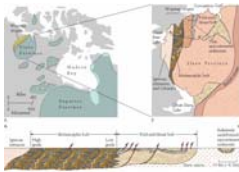
Proterozoic Eon



- Precambrian
 - Proterozoic
 - 2.5 Ga to ~ 0.6 Ga
 - Archean

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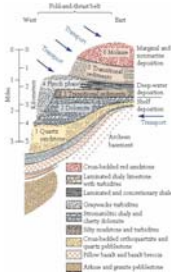
Proterozoic Orogeny



- Formation of large cratons
- By ~1 Ga, modern style orogeny
 - Wopmay
 - 2 Ga
 - Slave Province
 - Ancient fold and thrust belt

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Proterozoic Orogeny



- Thick deposit of quartz sandstone
- Carbonate platform
- Transitional mudstones
- Flysch deposits
- Turbidites then mudcracks and stromatolites
- Molasse deposition

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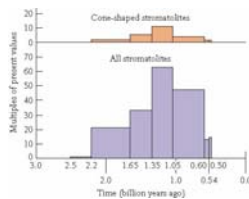
Proterozoic Orogeny



- Carbonate platform
 - Cyclic deposits indicated progradation of tidal flats across lagoon
 - Laminated dolomite forms base
 - Oolites or stromatolites are at top

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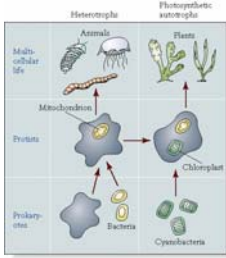
Proterozoic Events



- Widespread glaciation
 - Gowganda deposits
 - 2.3 Ga
- Stromatolites
 - Proliferate
 - Diverse shapes 1.2 Ga
- Early Eukaryotes

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Evolution of Eukaryotes



- Union of 2 prokaryotic cells
 - Mitochondrion
 - Allow cells to derive energy from their food by respiration
 - Evolved from 1 prokaryotic cell
 - Chloroplast
 - Site of photosynthesis
 - Protozoan consumed, retained cyanobacterial cell

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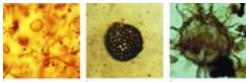
Algae



- Multicellular protists
- Algal ribbons wound into loose coils
 - 2.1 Ga

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Algae



- Prokaryotic forms
 - Gunflint flora 2 Ga
 - Lake Superior
- Acritarchs
 - Multicellular forms abundant after 2 Ga

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Proterozoic Life



- Complex organisms can be identified from trace fossils
 - None present until about 570 Ma
- Belt Supergroup, Montana
- 1.3 Ga

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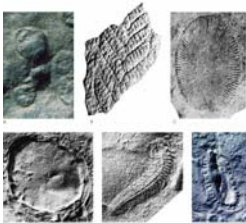
Proterozoic Life



- Trace fossils provide evidence for past life in Neoproterozoic
- Increasingly complex and varied

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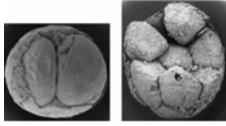
Proterozoic Life



- Non-skeletal fossils
 - Similar to Cnidaria
 - Imprints of soft-bodied organisms
 - <570 Ma
- Ediacarian fauna
 - Lived before predators
 - Some similar to modern forms

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Proterozoic Life



- Possible arthropod fossils

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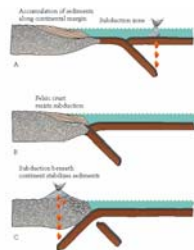
Proterozoic Life



- Skeletal fossils
 - Vase-shaped and tubular
 - Small size
- Timing may be related to glaciations

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Proterozoic Continents



- Continental accretion
 - Microplate accreted to continent
 - Orogenic stabilization
 - Welds sediment to crust
 - Thickens crust, hardens unconsolidated sediments
- Remobilization
 - Alter character of pre-existing rocks
 - Reset radiometric clocks

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Proterozoic Continents



- Canadian Shield
 - Includes northern U.S.
- Laurentia grew by accretion during Proterozoic

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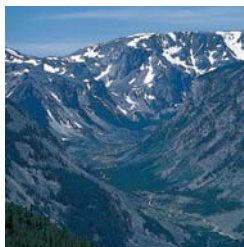
Proterozoic Continents



- 1.95- 1.85 Ga
 - Superior Province is largest
- 1.9 - 1.8 Ga rock unit
 - Separates Superior Province from Wyoming and Hearne provinces
- 1.8- 1.6 Ga
 - Exposed in southern Wyoming to northern Mexico

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Proterozoic Continents



- Wyoming Province
 - Archean terrane exposed in Wyoming and Black Hills
- Laurentia was probably attached to Australia and Antarctica and Siberia

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Proterozoic Continents



- Failed rift 1.2 - 1.0 Ga
 - Volcanic belt through midwest
 - Keweenawan basalts
- Grenville Orogeny 1.1 Ga
 - Accretionary event
 - added eastern belt
 - Exposed in Canada, Adirondacks, Blue Ridge, Llano (TX) uplift

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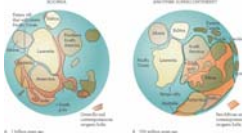
Proterozoic Continents



- Keweenawan basalts
 - Copper ore
 - Form mid-continent gravity high

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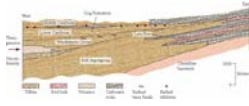
Proterozoic Continents



- Rodinia
 - Supercontinent
 - United Laurentia to other land masses
 - Full assembled 1 Ga
 - Broke up 0.8 - 0.7 Ga
 - Created Pacific Ocean
 - Created failed rifts in Western Laurentia

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Proterozoic Continents



- Belt Supergroup
 - 0.9 -1.5 Ga
 - Thick sequence of sediments formed in failed rift
 - Accumulated in shallow water during rapid subsidence

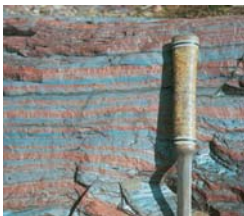
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Proterozoic



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Banded Iron Formations



- Stopped forming 1.9 Ga
 - Chert contaminated by iron
 - Red or brown color
 - Alternate with iron-rich layers (magnetite)
 - Oxygen- poor ocean waters
 - Iron was not oxidized

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Red Beds



- Never found in terranes older than 2 Ga

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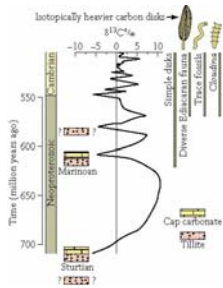
Snowball Earth



- Neoproterozoic glacial deposits

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Snowball Earth



- Light carbon isotopes

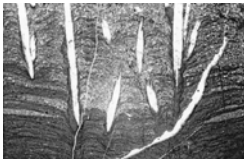
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Snowball Earth



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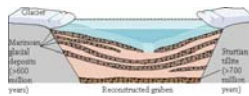
Snowball Earth



- Growth of stromatolites over columnar crystals of aragonite

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Snowball Earth



- Evidence for Marinoan ice age in Morocco

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