GY 112: Earth History

The Proterozoic
Lecture 19: Tectonics Part 2

Instructor: Dr. Douglas W. Haywick
Today’s Agenda

Last Time

1) The Proterozoic time frame
2) Paleogeography
3) Tectonics (Wopmay Orogeny)

(Web Lecture 18)
The Proterozoic Eon

<table>
<thead>
<tr>
<th>Eon</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phanerozoic</td>
<td>550 MA to 0 MA</td>
</tr>
<tr>
<td>Proterozoic</td>
<td>2.5 GA to 550 MA</td>
</tr>
<tr>
<td>Archean</td>
<td>4.1 GA to 2.5 GA</td>
</tr>
<tr>
<td>Hadean</td>
<td>4.6 GA to 4.1 GA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division (ERA)</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoproterozoic</td>
<td>900 MA to 550 MA</td>
</tr>
<tr>
<td>Mesoproterozoic</td>
<td>1.6 GA to 900 MA</td>
</tr>
<tr>
<td>Paleoproterozoic</td>
<td>2.5 GA to 1.6 GA</td>
</tr>
</tbody>
</table>

- Paleo- old
- Meso-middle
- Neo-new
• But we can “guestimate” back to about 1 GA
Proterozoic Tectonics
Proterozoic Tectonics

**Coronation Geosyncline**
Proterozoic Tectonics

- Coronation Geosyncline
- Wopmay Orogen
Proterozoic Tectonics

• Coronation Geosyncline
• Wopmay Orogen
• Bathurst Aulocogen
• Athapuscow Aulocogen
Proterozoic Tectonics

- A paleogeographic reconstruction of the Coronation Geosyncline 2.1 GA would look like this:
• The Coronation Geosyncline therefore represents the opening of an ocean basin (i.e., a new ocean formed). But…
Proterozoic Tectonics

- Linear trenches also opened up.
- They were mostly filled with coarse gravel and breccia (phase 1 fill in the Coronation Geosyncline)
- Ternary rifting patterns
Proterozoic Tectonics

- Triple junctions are common

http://www.learner.org/interactives/dynamicearth/plate.html
Proterozoic Tectonics

- But the Coronation Geosyncline ocean did not last a long time.
- Granite was emplaced along the western side around 1.8 GA…
Proterozoic Tectonics

• This mountain-building event is called the Wopmay Orogeny
Proterozoic Tectonics

- But the Coronation Geosyncline ocean did not last a long time.

- Granite was emplaced along the western side around 1.8 GA...

...indicating a plate collision with another continent.
• The culprit was Australia seen here fleeing the scene of the accident about 500 MA after the incident
Today’s Agenda

The Proterozoic Part 2

1) The Wilson Cycle
2) The Trans-Hudson Orogenic Belt
3) The Grenville Orogeny

(Web notes 19)
• Oceans are created when plate tectonics results in rifting
The Wilson Cycle

- But the Wopmay Orogeny demonstrates that not only do ocean open up, they can also close back up again (Subduction)
The Wilson Cycle

- And sometimes they repeat this cycle more than once (e.g., the Atlantic Ocean)
• This is now called the Wilson Cycle in honor of J. Tuzo Wilson who first suggested it for the Atlantic Ocean
Other Proterozoic Orogenies

**Orogeny**: A mountain building event (mostly collision and subduction, occasionally transform motion, but doesn’t require continent-continent collisions)

Note: Most mountain building episodes (regardless of the actual process are given specific names)

e.g.: the Wopmay Orogen
Other Proterozoic Orogenies

And starting in the Paleoproterozoic, orogenies became very common around the world.
Trans-Hudson Orogeny

2.0-1.8 GA
Trans-Hudson Orogeny

Modern Island Arcs
Grenville Orogeny

Karlstrom, K.E. et al., 1999
Grenville Orogeny

Karlstrom, K.E. et al., 1999
Grenville Orogeny

1.0 GA

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Grenville Front

35 km.

Superior Province (2.5 Ga)

Grenville Province (1.0 Ga)

Zone of intense metamorphism.
Grenville Orogeny

1.0 GA
Grenville Orogeny

1.2 Ga:
- Superior Province
- Rae Province
- Nain Province
- Grenville Province
- Urants ocean
- Urants ocean destroyed ca. 1.0 Ga

500 Ma:
- L. Arctus Ocean
- L. Arctus ocean destroyed ca. 500-935 Ma
- Europe
- Africa

Atlantic Ocean = 800 Ma → Present
Today’s Homework

1. Study for Lecture test 2  March 22, Tuesday after spring break
   
2. Study for Lab Test 2 (Next Wednesday)

Next Time

1. Proterozoic climate (a “cool” lecture)
GY 112: Earth History

Lecture 19: Proterozoic Tectonics Part 2

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