North American Precambrian geology
- a proposed Young Earth biblical model

“Harry Dickens”
OUTLINE

Radiometric “age” clustering & heating Events

Archean to Mesoproterozoic basement & Neoproterozoic cover
- Regional geology
- Geological history

Conclusions
- Thermal-tectonic Events, geology and the Bible
CLUSTERING OF RADIOMETRIC "AGES"

- Dates have a non-random, clustering pattern.
- 4 global U-Pb Precambrian “age” peaks from zircons: 2.7, 1.9, 1.1 & 0.6 Ga.
- Associated major thermal, tectonic, magmatic, metamorphic & mineralization events.

Age frequency distribution of detrital zircon U-Pb “ages” from North America - after Voice et al. 2011.
Mega-episodes or “Events” in North American Precambrian.

- 3 Events in Canadian Shield: crystalline basement:
  Kenoran, Hudsonian & Grenvillian.

- 4th in Neoproterozoic sedimentary cover Pan-African

Histogram after Voice et al. 2011
North America’s Precambrian tectonic elements include:

1. Archean cratonic provinces
2. Northern Paleoproterozoic belts
3. SE Proterozoic belt & associated Mesoproterozoic rift basins
4. Neoproterozoic sedimentary cover (W & E margins, and cratonic sequences)
1. ARCHEAN PROVINCES

Geology

- Oldest rocks.
- Intense deformation over entire area.
- Granulite-gneiss & granite-greenstone.

- Rocks differ strikingly from modern. ie non-uniformitarian. eg
  - Algoma-type BIF in linear zones
  - Komatiites – hi temp. Mg basalt

$ gold, copper-zinc, iron etc.

Large late Archean zircon “age” peak in all continents
2. NORTHERN PALEOPROTEROZOIC PROVINCES Geology

- Linear belts.
- High-grade granulite-gneiss in N.
- Low-grade sedimentary-volcanic.
- Trans-Hudson Province has a conductivity anomaly
- Some similar features to Neoproterozoic: “glacials”, BIF, U
  - Superior-type BIF – most extensive type worldwide, relatively undeformed.
  - Gold, uranium, copper, nickel

Large late Paleoproterozoic zircon “age” peak in all continents
3. SE PROTEROZOIC PROVINCES Geology

Grenville Province
- Very high temperature metamorphism
- Granulite-gneiss mainly

Yavapai & Mazatzal Provinces
- Voluminous granitoids.

Associated Mesoproterozoic rift basins
- Mid-continent Rift Basin $\text{copper}$
  - Mainly basalt
- Belt-Purcell Basin (B) $\text{lead-zinc}$
  - Mainly sedimentary rocks

Large late Mesoproterozoic zircon “age” peak in all continents
3. ASSOCIATED MESOPROTEROZOIC RIFT BASINS Geology

Mid-continent Rift Basin

- Thick (15 to 20 km) succession of late Mesoproterozoic basaltic lavas & overlying Neoproterozoic sedimentary rocks.
- Large, arcuate and > 2000 km long.
- World-class copper deposits.

Belt-Purcell Basin

- Area ~200,000 km². Very thick ~6-20 km.
- Only slightly metamorphosed.
- Mainly fine-grained well-sorted detrital sediments.
- World-class SEDEX Pb-Zn deposit.
4. NEOPROTEROZOIC SEDIMENTARY COVER Geology

Significant $^{87}\text{Sr}/^{86}\text{Sr}$ ratio increase in successions of “age” between 0.9 Ga and 0.5 Ga.

Lower Neoproterozoic sequences
- contain braided-type well-sorted sheet sandstones.
- have Grenville-age detrital zircons (e.g. NW Canada, SE North America and overlying the basaltic rocks in Midcontinent Rift Basin).

In contrast, mid-Neoproterozoic sequences
- mainly poorly sorted immature clastic sediments, with lesser volcanic rocks.
- characterized by mixtites commonly interpreted to be “glacial”.
- Rapitan Group in Canada consists of mixtite, clastic rocks, volcanics and BIF ($\).

High-pressure metamorphic belts are restricted to rocks of “age” < 0.6 Ga.

*Large late Neoproterozoic zircon “age” peak in all continents*
PROPOSED HISTORY MODEL
I propose that the Lord instigated heating events to drive global geological processes such as:

- growth of continental crust in the early Creation Week.
- flooding of the whole Earth in Noah’s time.
- future intense heating of the Earth (2 Peter 3).
1. ARCHEAN PROVINCES History

Watery early world

*The earth was without form and void, and darkness was over the face of the deep. And the Spirit of God was hovering over the face of the waters* (Gen 1:2 ESV).

*…and the earth was formed out of water and through water by the word of God* (2 Pe 3:5b ESV).

Global ocean

- Archean pillow basalts, BIF, turbidites indicate presence of water.
- Granitoid continental crust formed by heating of basaltic oceanic crust.

Hydrothermal activity

*.. when he established the fountains of the deep.* (Proverbs 8:28b ESV)

- gold & base metals, BIF
- stromatolites
Archean tectonism

Kenoran thermal-tectonic Event
- Simultaneous tectonism, cooling & convective heat dissipation in Archean provinces.
- Late Archean “age” peak is thought to represent simultaneous cooling and beginning of stable cratons.

Precambrian continental crust intact from Archean to Neoproterozoic.

… the LORD, your Maker, who stretched out the heavens and laid the foundations of the earth (Isaiah 51:13a ESV)

Mantle roots of Archean cratons considered as foundations of Earth’s continental crust.

Day One processes correlated with development of Archean provinces and with Kenoran Event
2. NORTHERN PALEOPROTEROZOIC PROVINCES

History

And God said, "Let there be an expanse in the midst of the waters, and let it separate the waters from the waters." (Gen 1:6 ESV).
And God made the expanse and separated the waters that were under the expanse from the waters that were above the expanse. And it was so. (Gen 1:7 ESV).

Sense of vertical separation of waters

• Fluid transport upwards – mantle water delivered upwards during continent rifting.
• Trans-Hudson Province
  • Internal deformation & rifting. Not collision between two Archean provinces.
  • Conductivity anomaly may be related to hydrothermal fluid movement.
Similar features to Neoproterozoic geology:

- **Mixtites** formed by mass flows (not “glacials”) – Huronian Supergroup.
- **BIF** – pouring out of volcanics & hydrothermal fluids in a rifting environment.
- **Rift** settings eg Penokean and Trans-Hudson provinces.
- **Uranium** deposits related to metasomatism (alteration by high temperature fluid).

…”when he made firm the skies above … (Proverbs 8:28a ESV)
Atmosphere growth (oxygen, nitrogen)(GOE) due to volcanic degassing.

**Hudsonian** thermal-tectonic Event - further metamorphism of Archean provinces.

**Day Two** fluid flow processes correlated with development of northern Paleoproterozoic provinces and North America’s Hudsonian Event
“Great Proterozoic Orogen” - huge growth & thickening of continental crust (voluminous granitoid magmatism) and land appeared above the water (Day Three).

- **Grenvillian** thermal-tectonic Event
  “Perhaps the greatest orogenic event in Earth’s history… with assembly of the supercontinent … at end of Mesoproterozoic.”
- Grenvillian mountains may be example of pre-Flood high mountains (Genesis 7:19)

*Proterozoic provinces of the southeast of the North American craton, and North America’s Grenvillian Event correlated with processes in the earlier part of Day Three*
3. Associated MESOPROTEROZOIC RIFT BASINS History

Mid-continent Rift Basin
- NW-directed contraction at S margin of North America accompanied by intracratonic extension and voluminous mafic magmatism, during Grenville Event on Day Three.

Belt-Purcell Basin
- marine and fluviatile sediments
- Day Three: waters gathered to form seas (Genesis 1:10)
4. NEOPROTEROZOIC SEDIMENTARY COVER

**History**

In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on that day all the fountains of the great deep burst forth, and the windows of the heavens were opened. (Gen 7:11 ESV).

- Supercontinent **fragmentation** & hydrothermal activity.
- Pan-African thermal-tectonic Event with massive rifting on Cordilleran & Appalachian margins.

And rain fell upon the earth forty days and forty nights. (Gen 7:12 ESV).

- Rain (prolonged & global) and tectonism of early Flood caused immense continental erosion.
Massive continental erosion

- Sr isotope evidence

Included erosion of Grenvillian mountain chain in SE:
- “… produced huge volumes of sedimentary detritus … dispersed by an enormous system of braided rivers”.

After Peters & Gaines 2012
Enormous water flows
Zircon grains transported thousands of km! and deposited in lower Neoproterozoic sheet sandstones.

Cross-bedded fluvial sediments consistent with SE to NW water flow.

Rainbird et al. 2012
Grand Canyon exposure - Cambrian sediments over tilted Neoproterozoic sediments

Tilted Chuar Gp sediments inferred to be detritus formed due to erosion caused by the Flood’s rain.

GREAT UNCONFORMITY

Photo source: Z Sylvester
Western margin North America

Mass flows, volcanics & BIF

Sheet sandstone - Grenvillian "age" detrital zircons.
Plate tectonics

Have you … walked in the recesses of the deep? (Job 38:16b ESV).
• Start of subduction indicated by hi P, lo T metamorphism, blueschists, ophiolites.
• Thus, modern-style plate tectonics may not have existed in the Archean to Mesoproterozoic.
• This is consistent with idea of
  o Growth of only one supercontinent by Day Three.
  o Supercontinent later fragmented in early Flood.

*Early Noah’s Flood* correlated with development of Neoproterozoic geology and the Pan-African Event.
CONCLUSIONS
4 Events. I infer:

- Growth of continental crust in Days 1 to 3 to form supercontinent.
- Supercontinent breakup in early Flood.
- 4 global radiometric “age” clusters and proposed God-instigated thermal-tectonic Events correlated with Bible in sequential order:

![Graph showing frequency of dated detrital zircon grains against time (Ga) and geological eras (Archean, Paleoproterozoic, Mesoproterozoic, Neoproterozoic)]
1. **Archean** – oldest rocks & granitoid continental crust forms underwater – **Day One**.

2. **Paleoproterozoic** rifting, hydrothermal metasomatism, oxygenation, and mass flows – consistent with **Day Two** water movement.

3. **Mesoproterozoic** evidence of huge thickening of continental crust, consistent with appearance of land to appear above water on **Day Three**.

4. Rifting, erosion of land by **Flood’s rain**, enormous water flows – evidence of **Neoproterozoic** sedimentary cover.
   - Corollary is that underlying **Archean to Mesoproterozoic** basement rocks can be correlated with **early Creation Week**.
The Flood drastically altered the world’s topography. Nevertheless, inferences have been made regarding some specific locations of the pre-Flood world’s geography in relation to today’s North American Precambrian rocks:

- **Pre-Flood land:** supercontinent, including North America
- **High mountains:** eroded mountain roots in the Grenville Province
- **A Pre-Flood sea:** in vicinity of the Belt-Purcell Basin
- **Fountain/s of the great deep:** margins of continent

The LORD’s glory above all the Earth!
Non-uniformitarianism abounds!
Numerous examples where uniformitarianism does not apply in the Precambrian eg:
• clusters of radiometric “ages”.
• lithologies with restricted “ages” (eg komatiite, BIF, anorthosites, ophiolites, blueschists).
• tectonic styles (permobile Archean vs linear Proterozoic belts), intracontinental deformation vs later plate tectonics, variation in magnitude of mountain building
• episodic fluid flow, massive water flow systems, mass flows, huge erosion.

Deep time not needed eg
Granite, banded iron formation, sedimentation, base metal sulfides and calcium carbonate precipitation.