Mineral Commodities Driving Early Settlement and Development in Southeast Missouri

- **Lead – 1720 to Present**
  - Mine La Motte (1720-1959)
  - Valle Mines (1824-1917)
  - Old Lead Belt (1864-1972)
  - Annapolis (1920's-1940's)
  - Indian Creek (1953-1982)
  - Viburnum Trend (1965-Present)
- **Iron – 1815 to 2001**
  - Shepherd Mtn (1815-1864)
  - Pilot Knob Upper (1838-1890)
  - Iron Mountain (1845-1966)
  - Pilot Knob Lower (1965-1980)
  - Pea Ridge (1964-2001)
- **Granite – 1869 to Present**
  - Graniteville (1869-Present)
  - Knob Lick (1874-Present)

Background: 1855 drawing of Pilot Knob Mine

Genealogy of Iron, Granite and Lead Deposits in and around the St Francois Mountains of Missouri

Dr. Russell Myers

26 October 2021

Ozark Regional Library, Ironton, Missouri

Four Families to Remember

1. **Volcanic Family**, including rhyolites, iron deposits and associated granites

   This pioneering family built the land **1500 million years ago.**

2. **Graniteville Clan** of granites and basalts

   This clan invaded our area **1300 million years ago** while other forces tried to tear the land apart.

3. **Cambrian Group** of sedimentary rocks

   The members of this group have diverse origins but all had close links to the sea, which determined where and how they settled **500 million years ago**

4. **Scavenged Metal Migrants**, including lead, zinc, copper and cobalt

   Driven from their homes by tectonic forces **300 million years** ago they were caught in traps made by the Cambrian Group and forced to stay in the region.

Genealogical Thesis In a Nutshell:

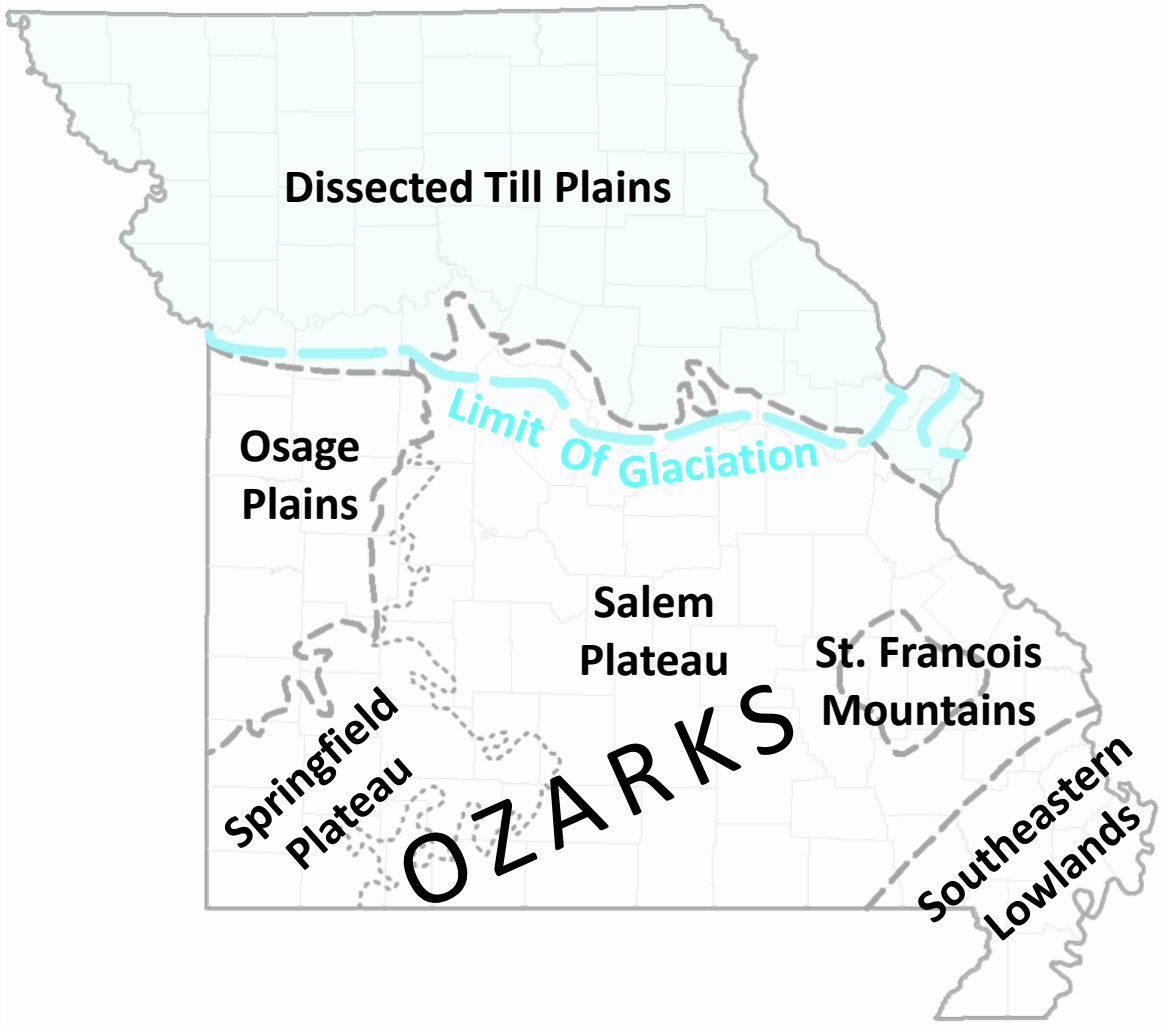
Even though the Scavenged Metal family were physically trapped by the Cambrian Sediment Group, their entrapment was ultimately due to the strong character of the Volcanic Family and their resistance to change.

Physiography Reflects Geology

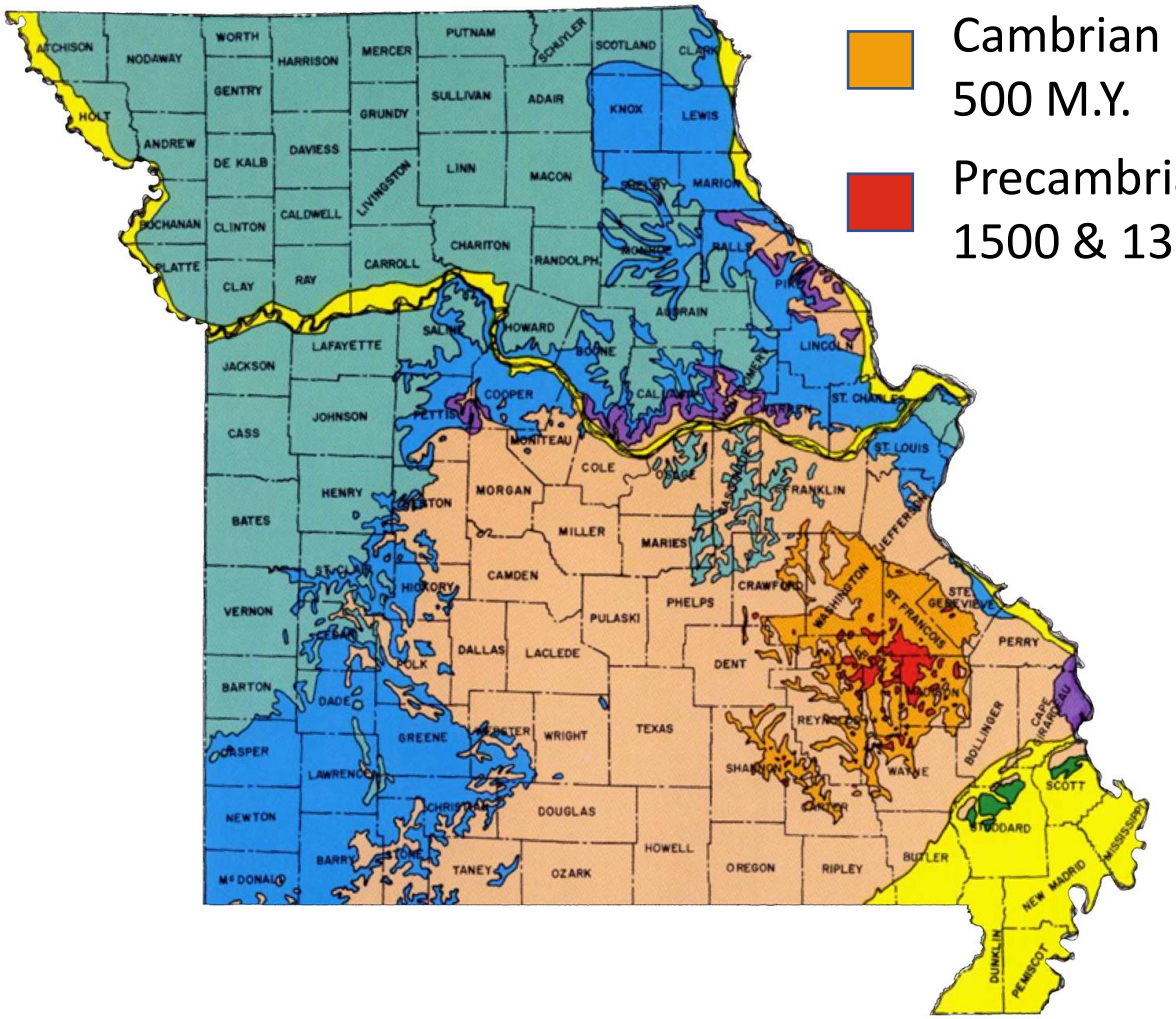
St. Francois Mountains

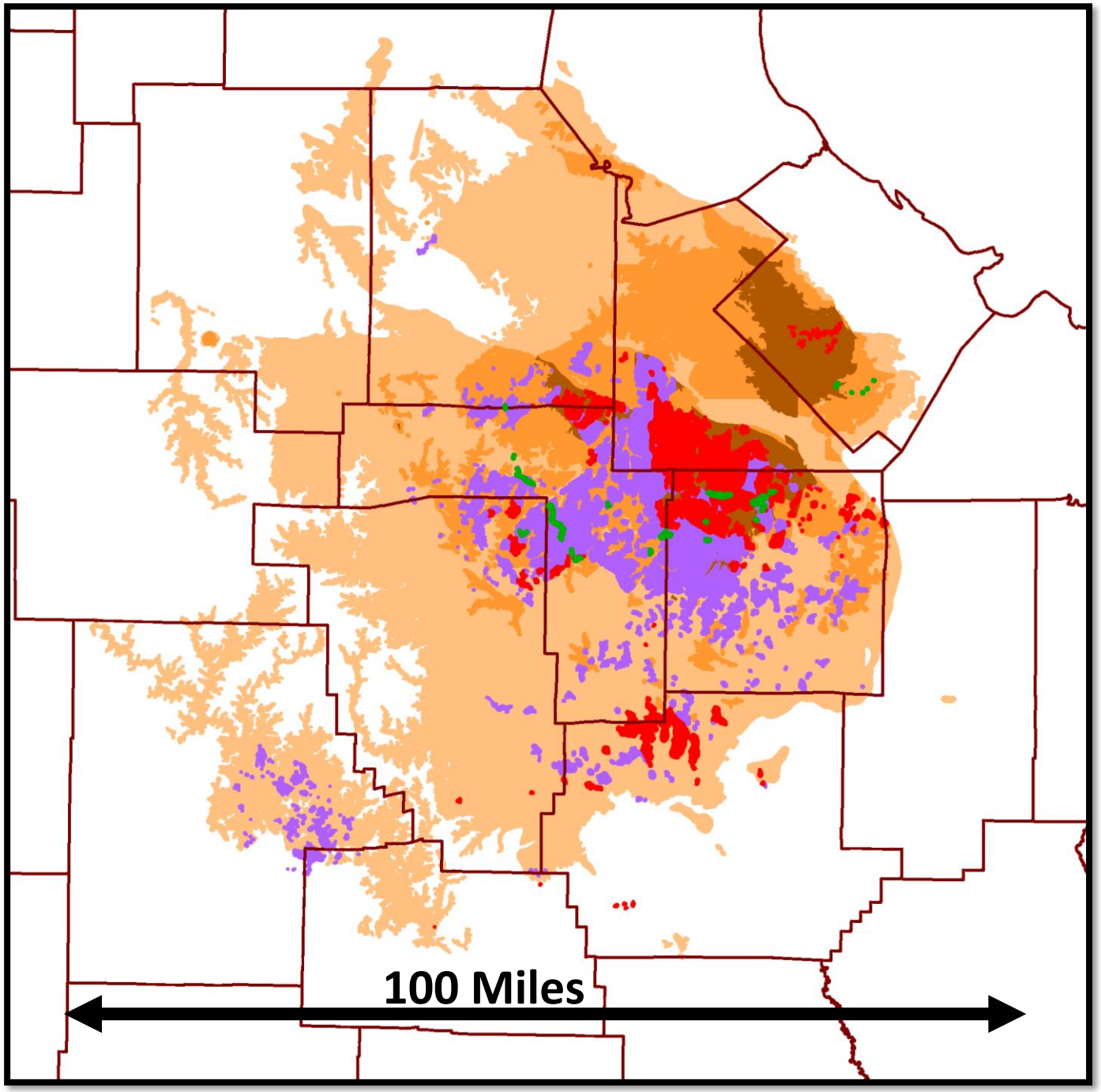
- **Highest Elevation**
- **Deepest Erosion**
- **Oldest Rocks**

Physiography



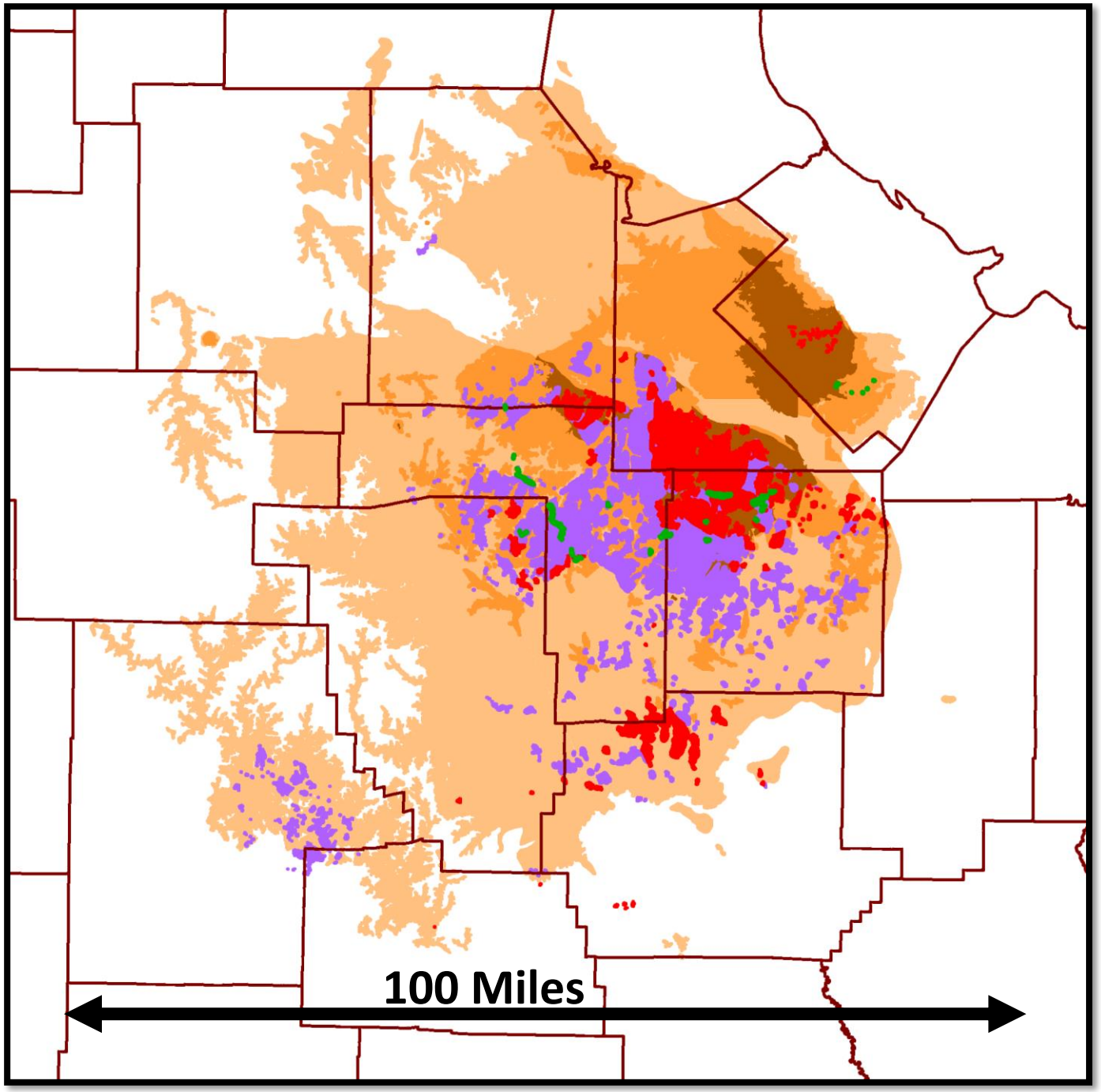
Bedrock Geology





Precambrian Rocks

- Volcanic Surface Deposits
  - ~1500 million years old
    - Rhyolite Ash Flow Tuffs
    - Pyroclastic Breccias
- Granite Intrusions
  - ~1500 million years old
    - Knob Lick
  - ~1300 million years old
    - Graniteville
- Basaltic Intrusions
  - ~1300 million years old



Precambrian Resources

Volcanic Surface Deposits

- Host Iron Deposits

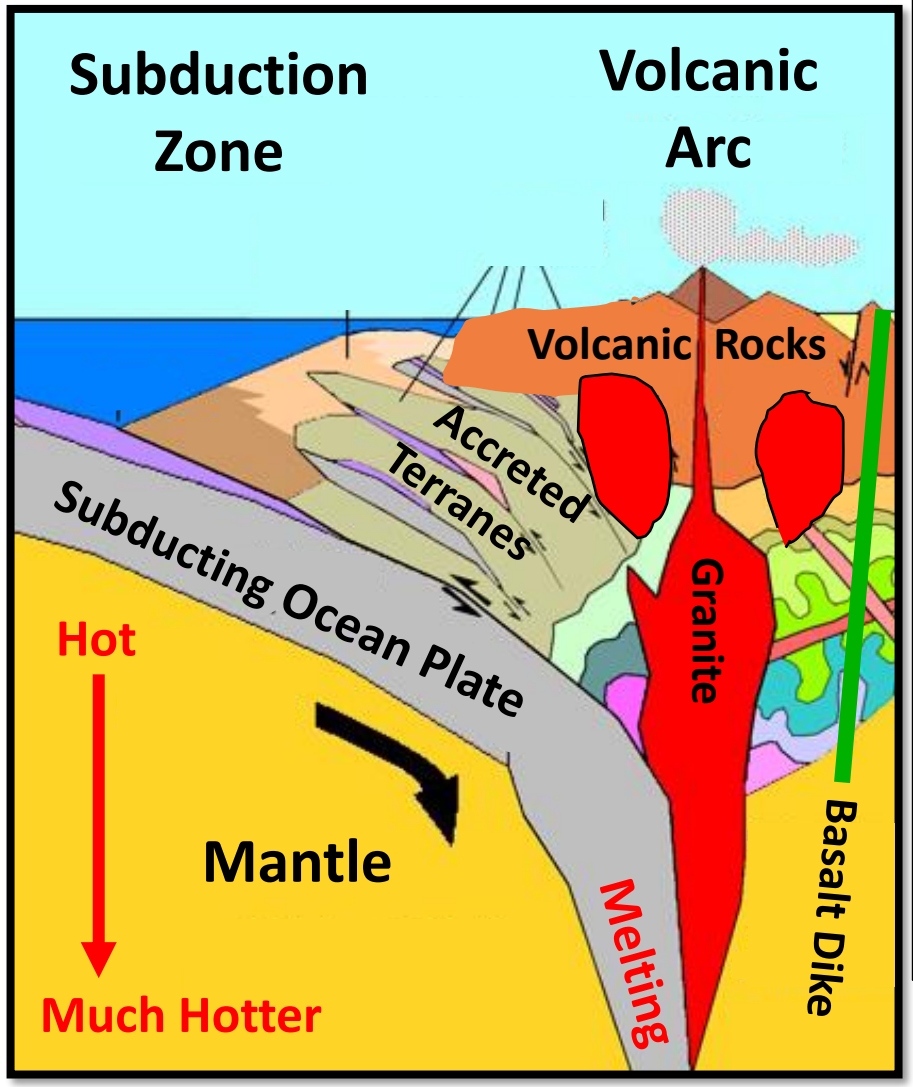
Granite Intrusions

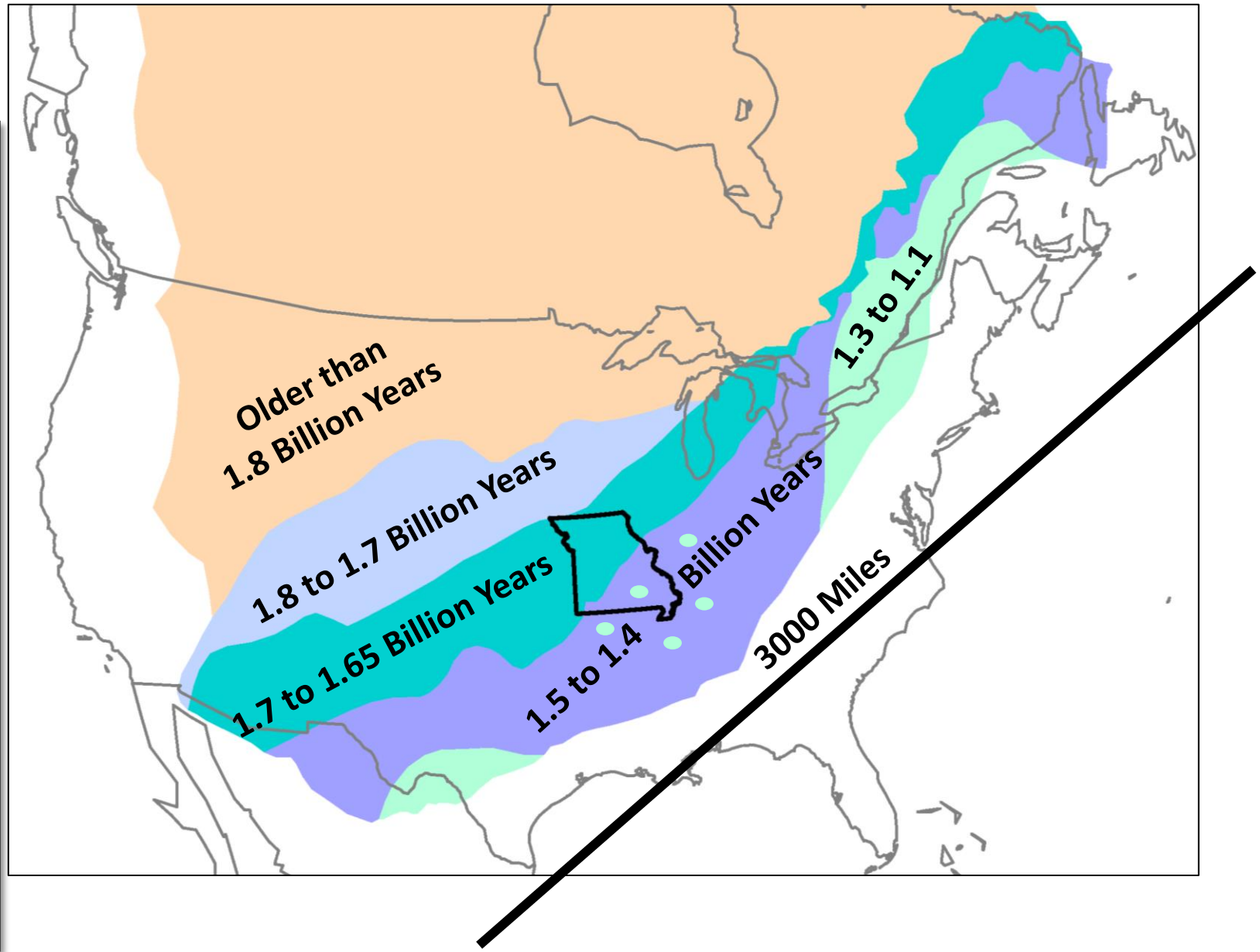
- Only granite building stone within 500 miles of St Louis
- Graniteville granite is world famous for color

Why are they here?

Growth of the North American Continent

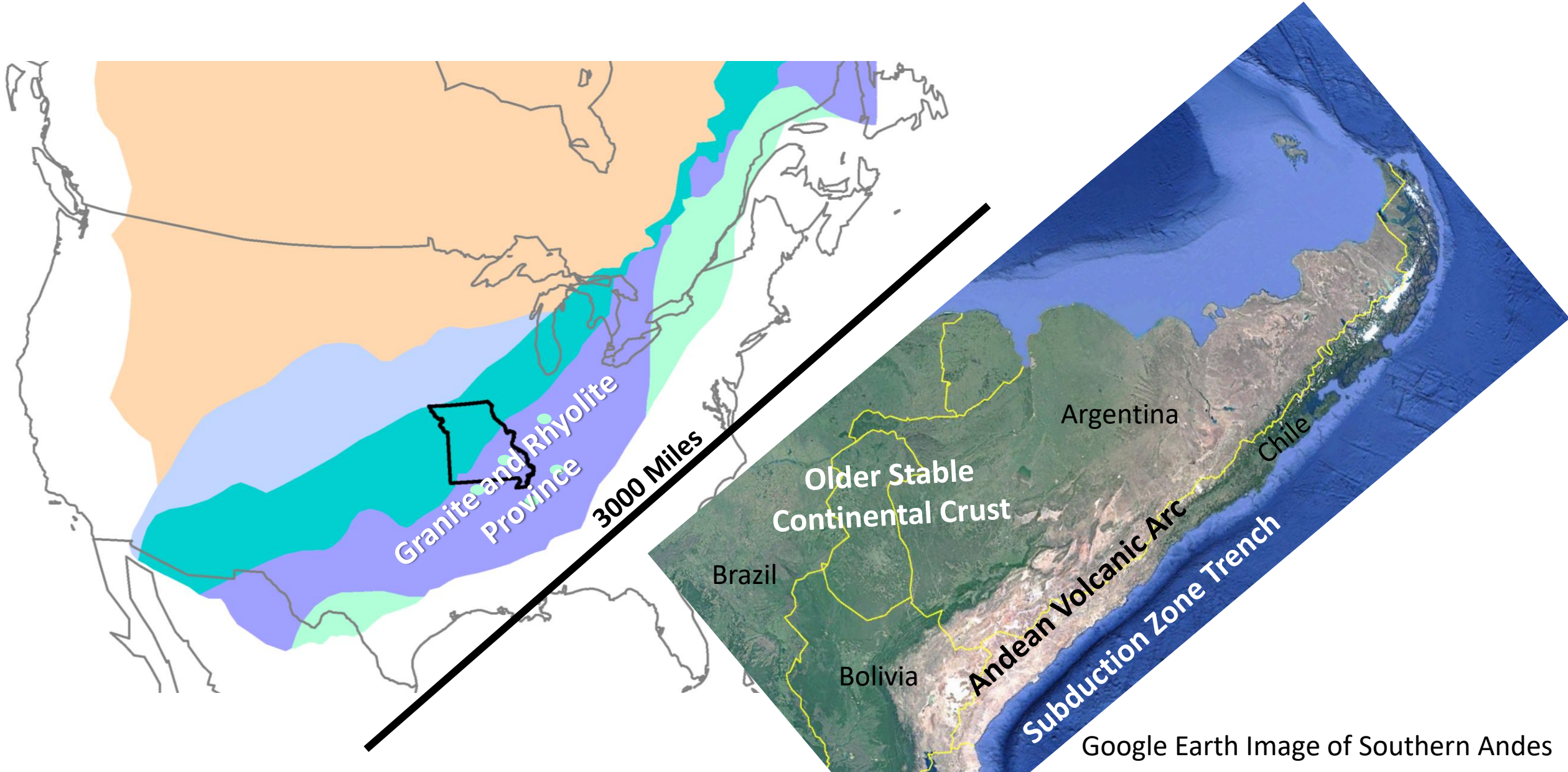
Growth by Accretion





What Did It Look Like?

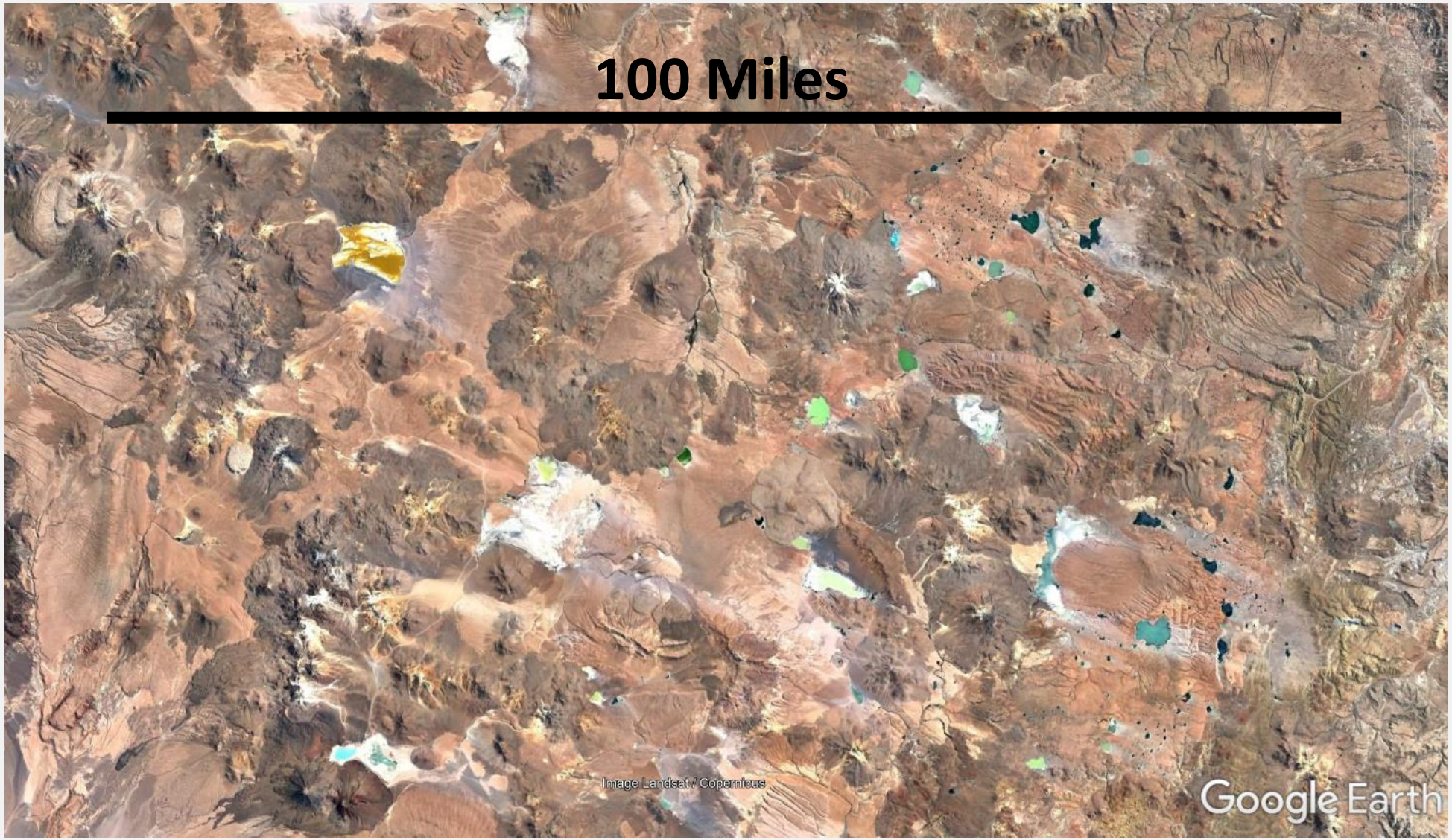
North and South America at the Same Scale



Google Earth Image of Southern Andes

What Did It Look Like?

Volcanic Family Building the Land 1500 million Years Ago

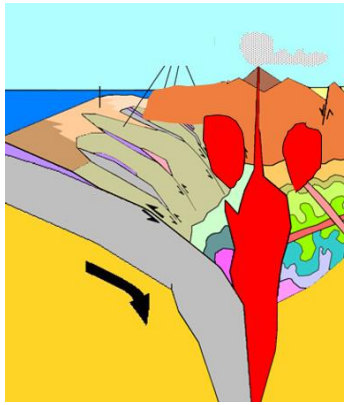


Volcanic Wasteland of Ash and Lava

Note Brilliant Colors of Chemical Lakes

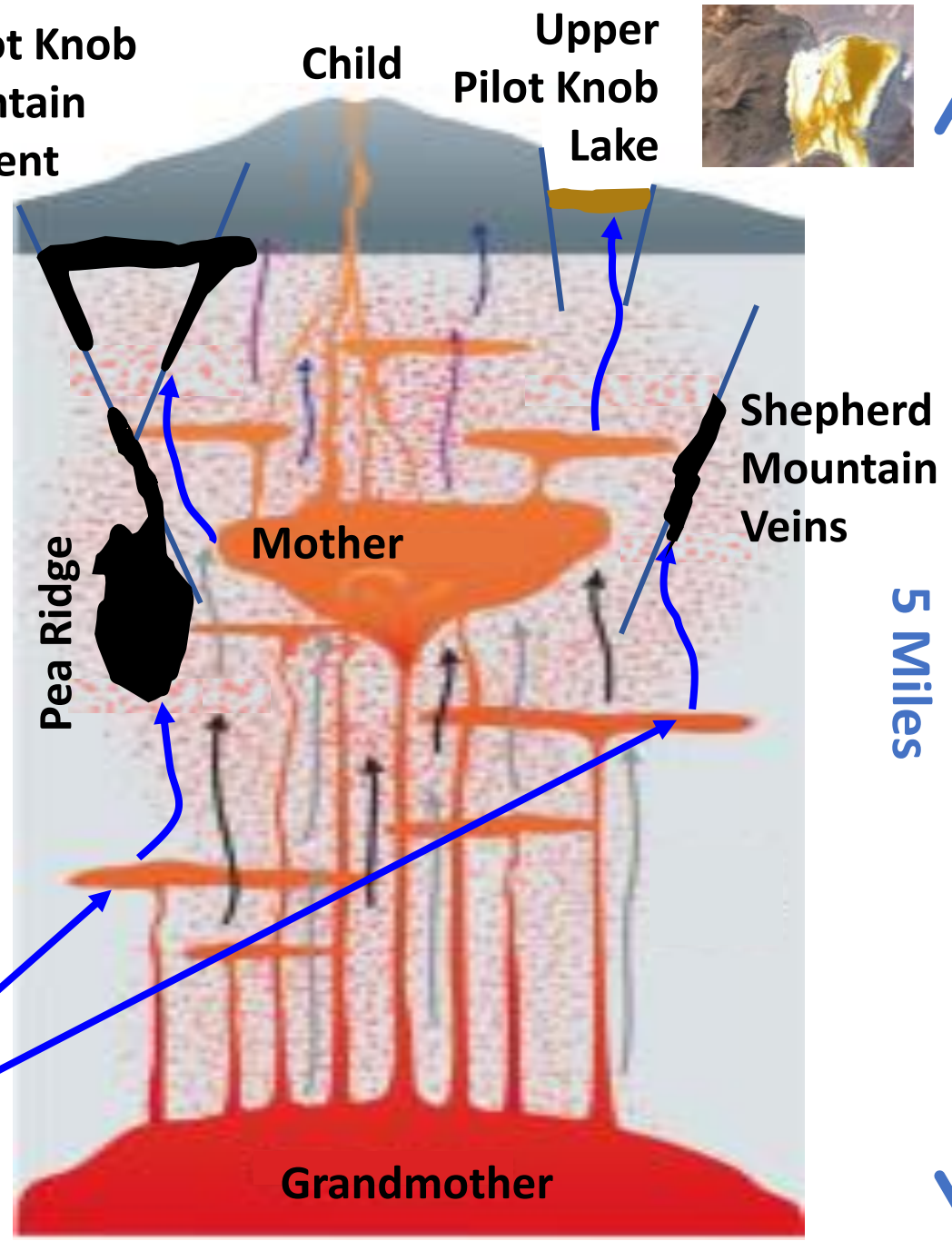
Analogous to high Andes landscape in Southern Bolivia and Northern Argentina

Volcanic Family Lines and Iron Deposits

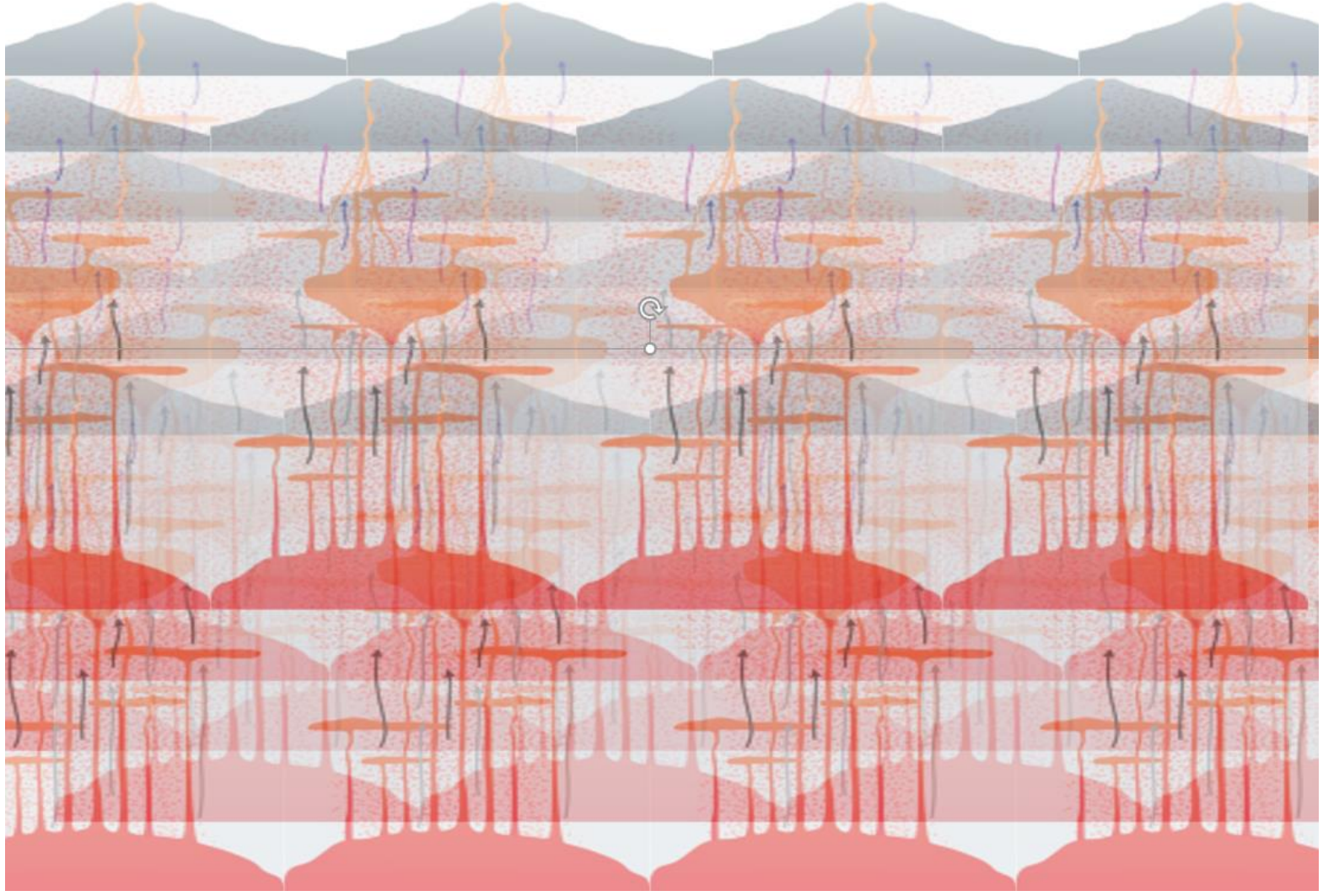


- Magmas intrude the crust rising and cooling producing descendants with different character
- Magma density controls depth of emplacement
- Most magma stays in the ground

- Deep crustal Great Great Grandmother magma
- Mid crustal Great Grandmother magma
- Upper crustal Grandmother magma
- Shallow crustal mother alternative lines
  a) Surface eruption with Volcanic children
  b) Crystallize in place releasing volatile children



Generations of Volcanic Family Accumulation Create Crude Crustal Structure

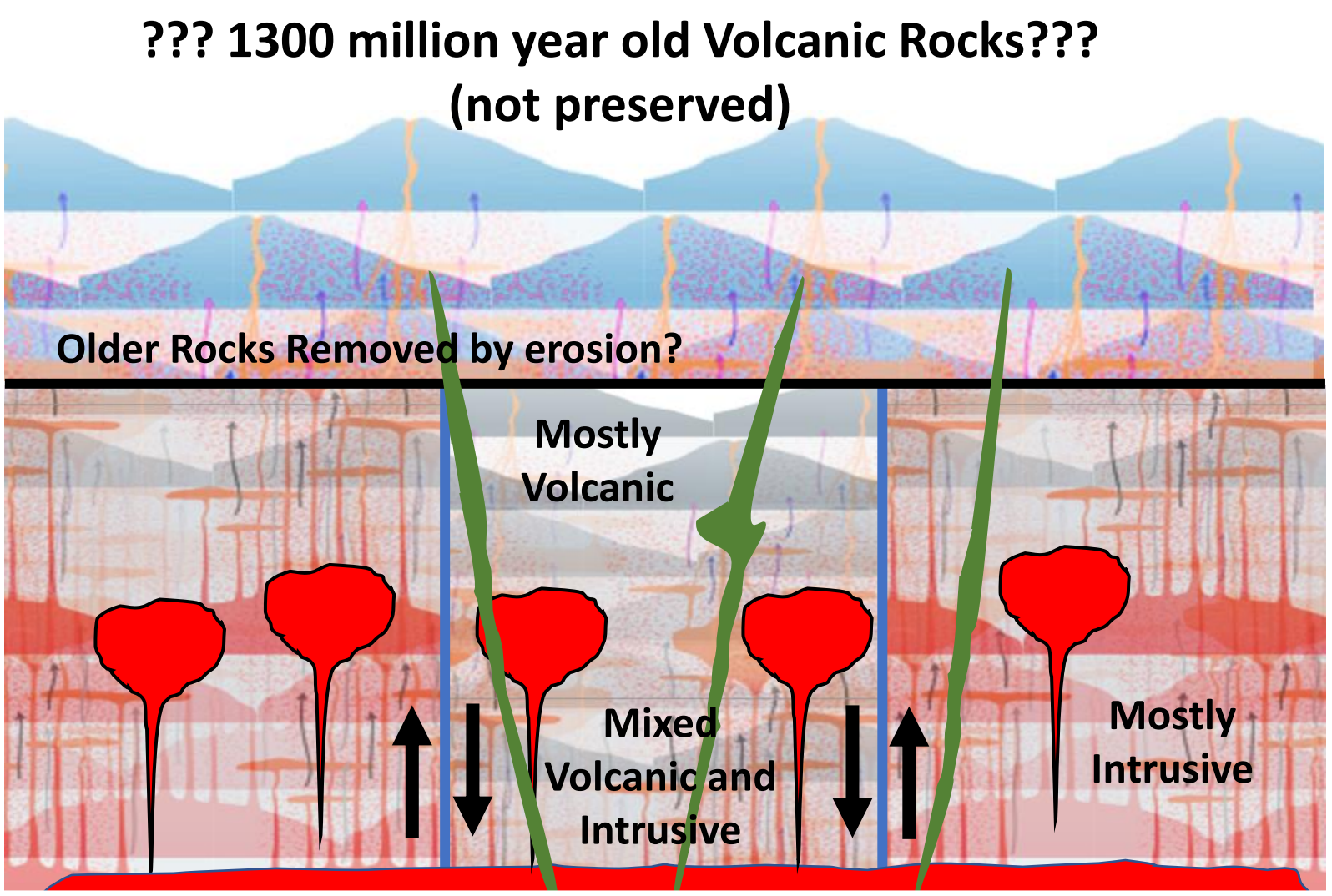


Dominantly Volcanic

Mixed Volcanic and Intrusive

Dominantly Intrusive

1300 Million Year Graniteville Clan Invasion



Known:

- **Graniteville granites intrude older rocks**
- **Granites cooled slowly more than a mile below the surface**
- **Deep cracks allowed basaltic mantle melt to get near the surface**

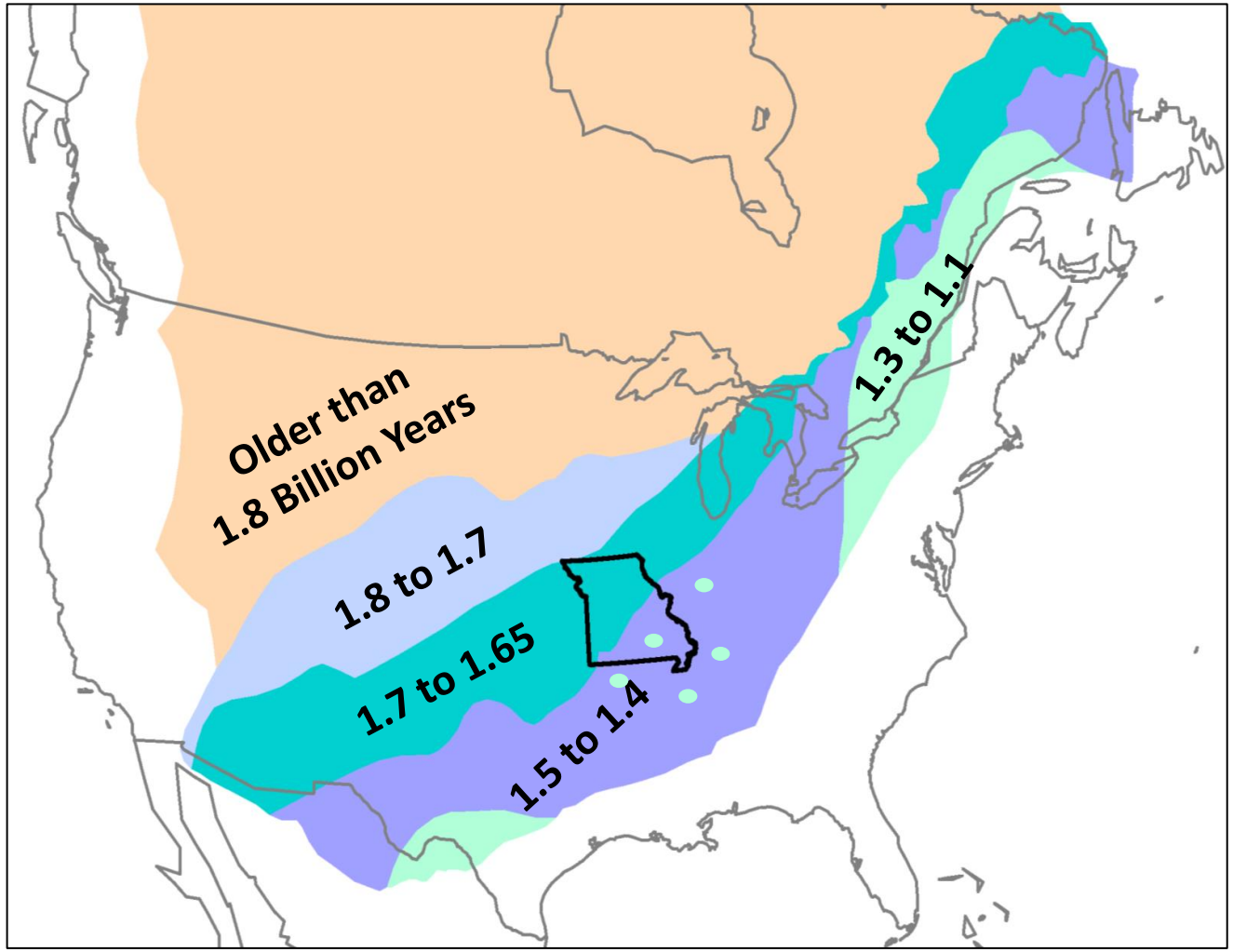
Inferred:

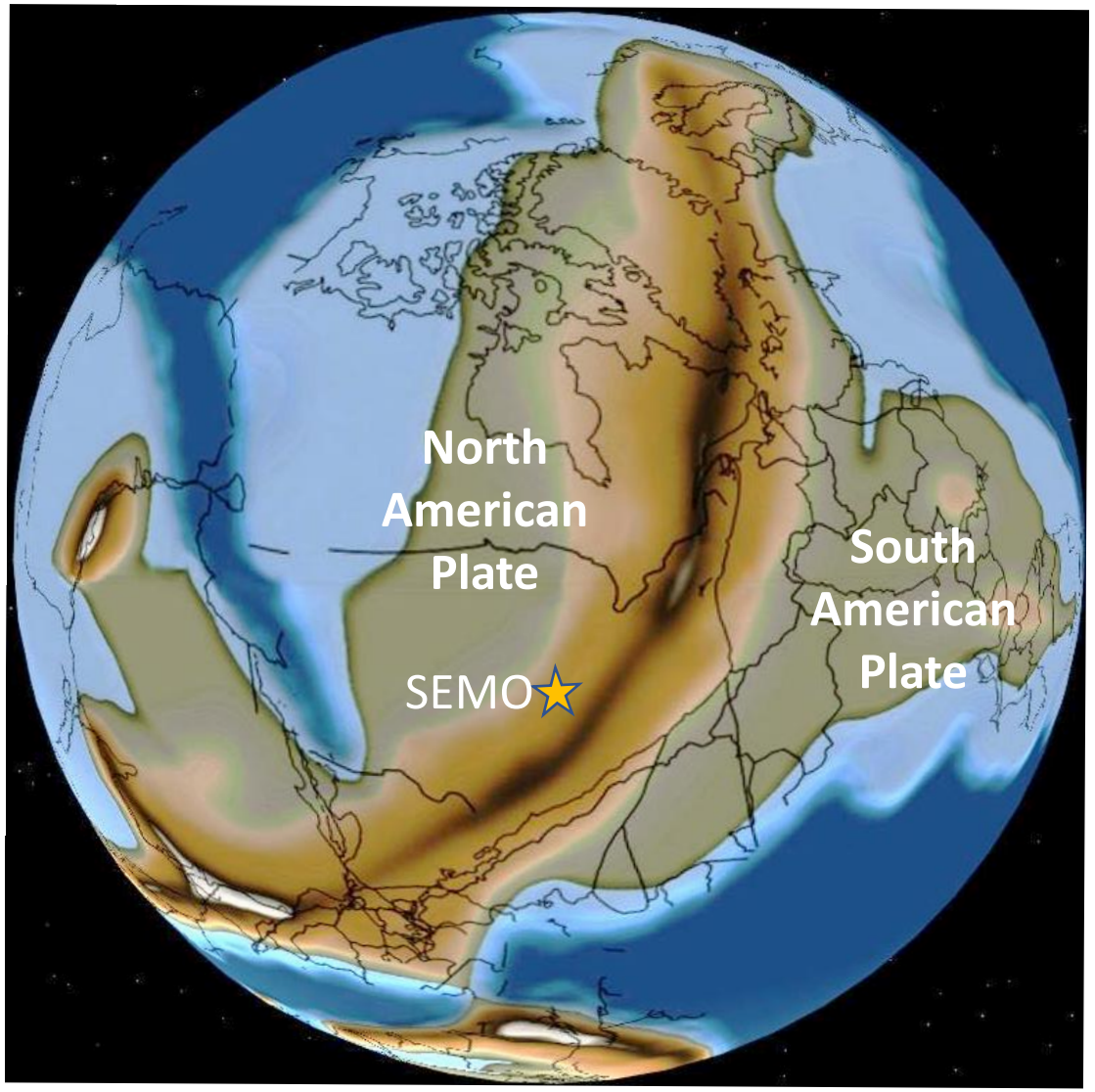
- **Large-scale faulting occurred before and/or during the Graniteville Clan invasion**

Faulted 1500 million year old volcanic and intrusive rocks

750 Million Year Continental Collision - Ouch!

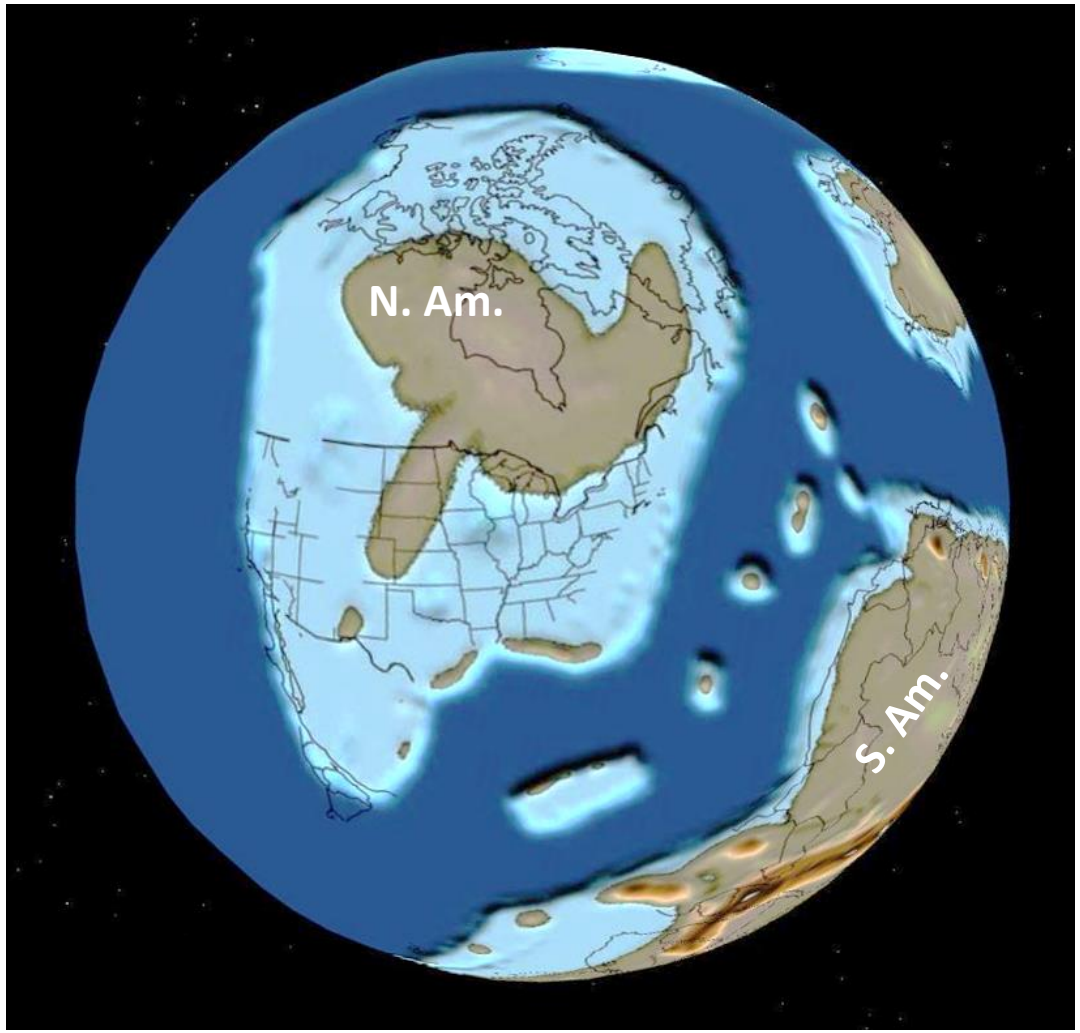
Change from accretionary growth to Himalayan collision with South America
SE Missouri sees massive uplift and erosion



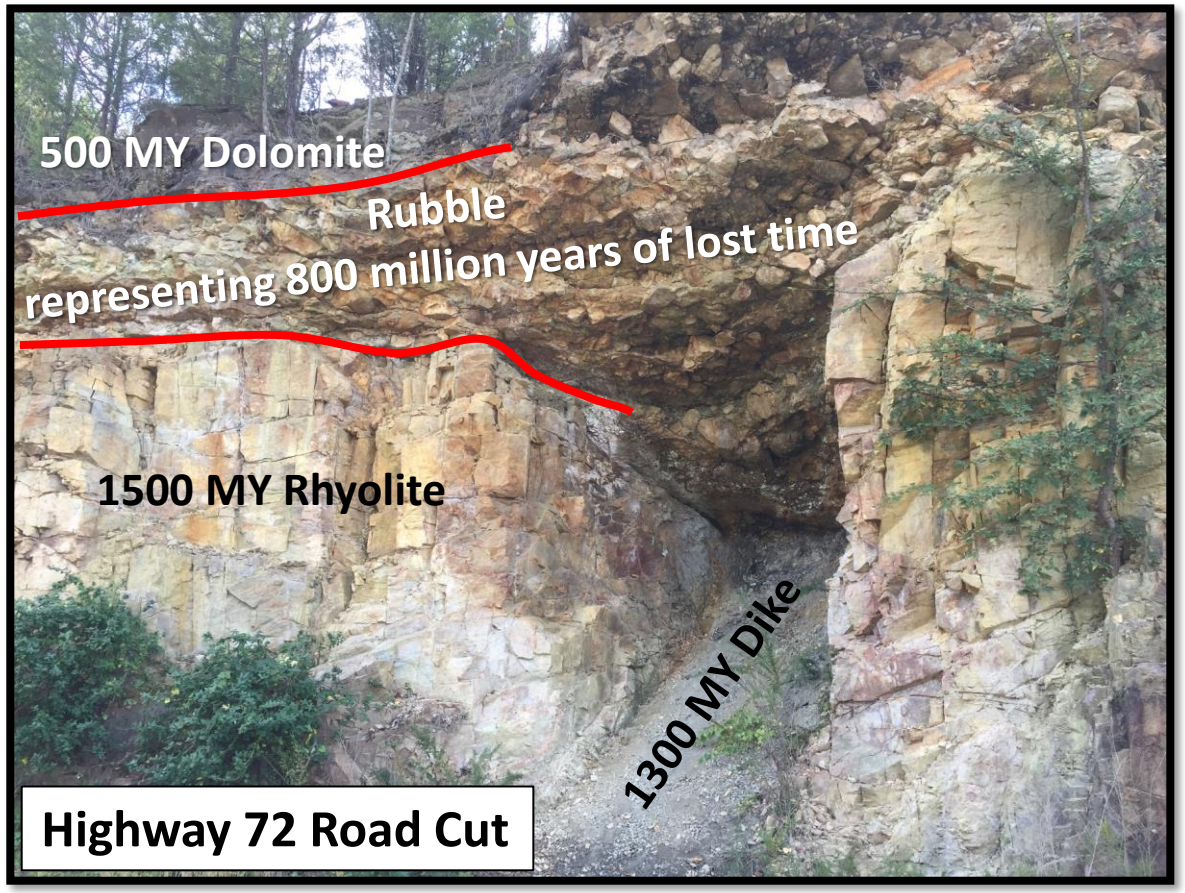


The Great Unconformity: The Missing Years

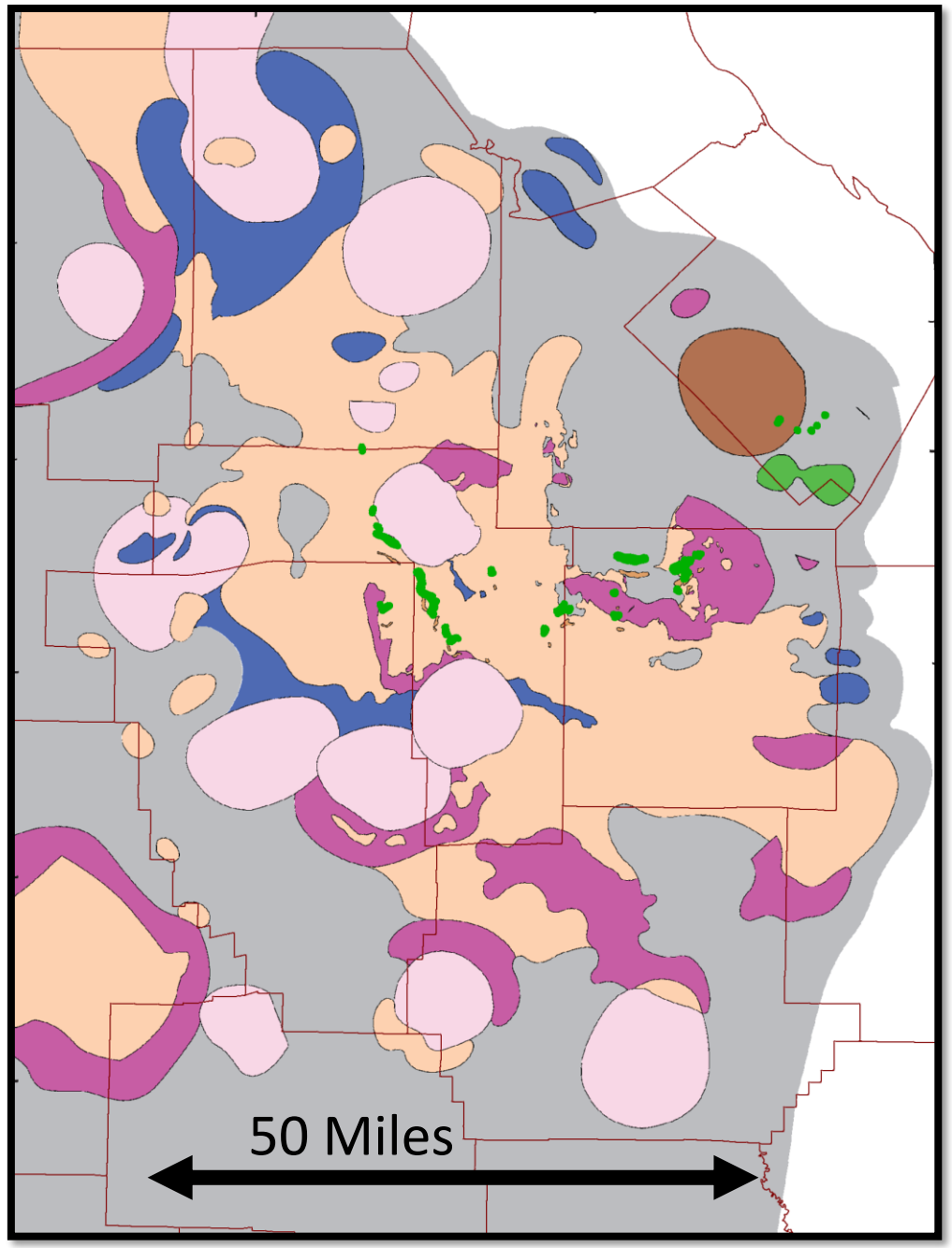
Missouri 500 Million Years Ago



South America separates from North America and between 750 and 500 million years the mountains are eroded almost completely away. Shallow seas begin to cover North America.



St Francois Mountains Surface Geology in Late Cambrian Time



Modified from Day et al. 2016

Graniteville Clan
1300 Million Years

- Graniteville-type Granite
- Basaltic Intrusions

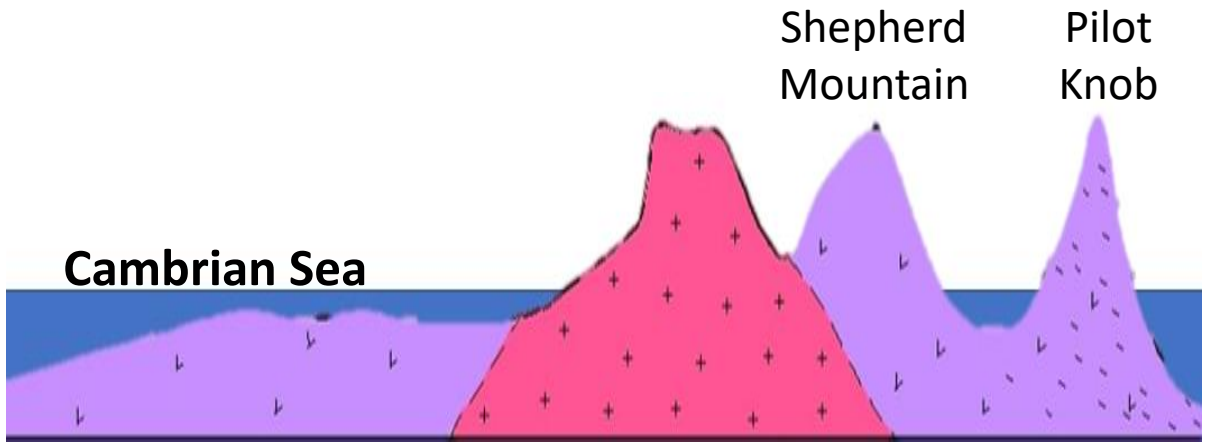
Volcanic Family
1500 Million Years

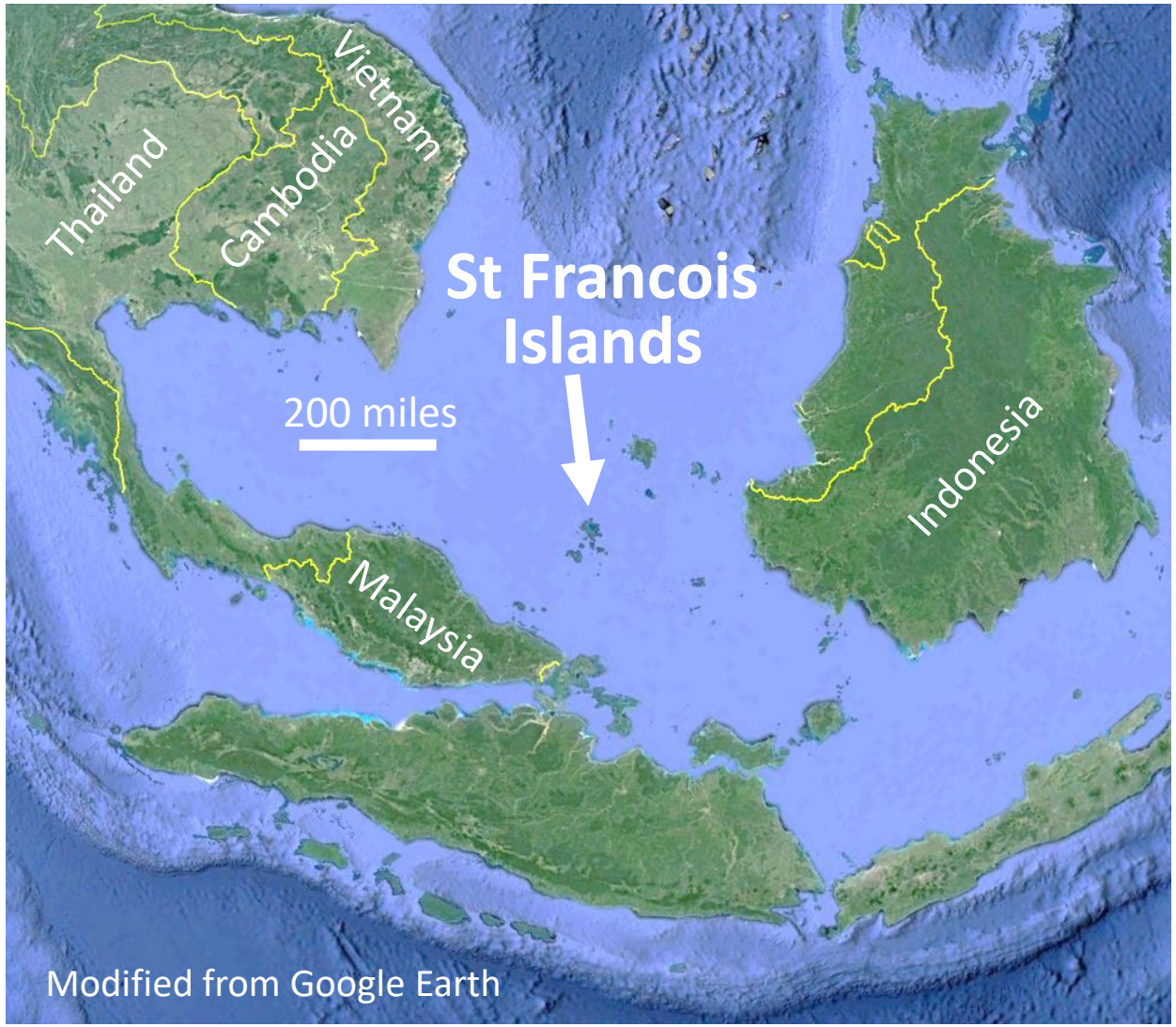
- Butler Hill-type Granite
- Iron- and magnesium-rich rocks
- Hawn State Park Gneiss
- Silvermine-type Granite
- Rhyolite Volcanics

This is a 2D view!

Volcanic Family still has more to say!

Rhyolite Volcanic Rocks Resist Weathering!





St Francois Islands/ Great Bahama Bank Comparison

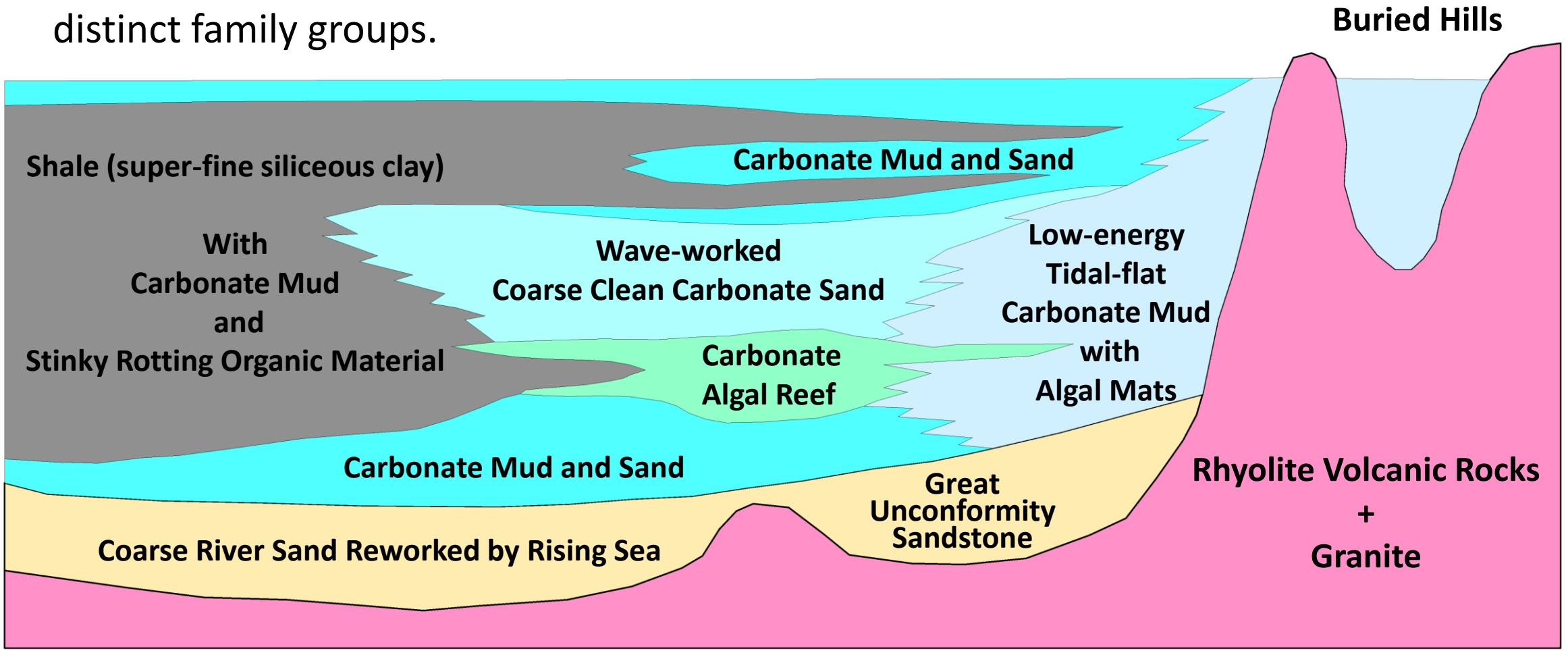
Clean shallow water – calcium carbonate precipitates from seawater to make limestone mud and sand
Shoaling waves rework carbonate sediment creating sand waves and banks extending miles from the shore.

Imagery from Google Earth

St Francois Islands – Shoaling Cambrian Seas (500 M.Y.)

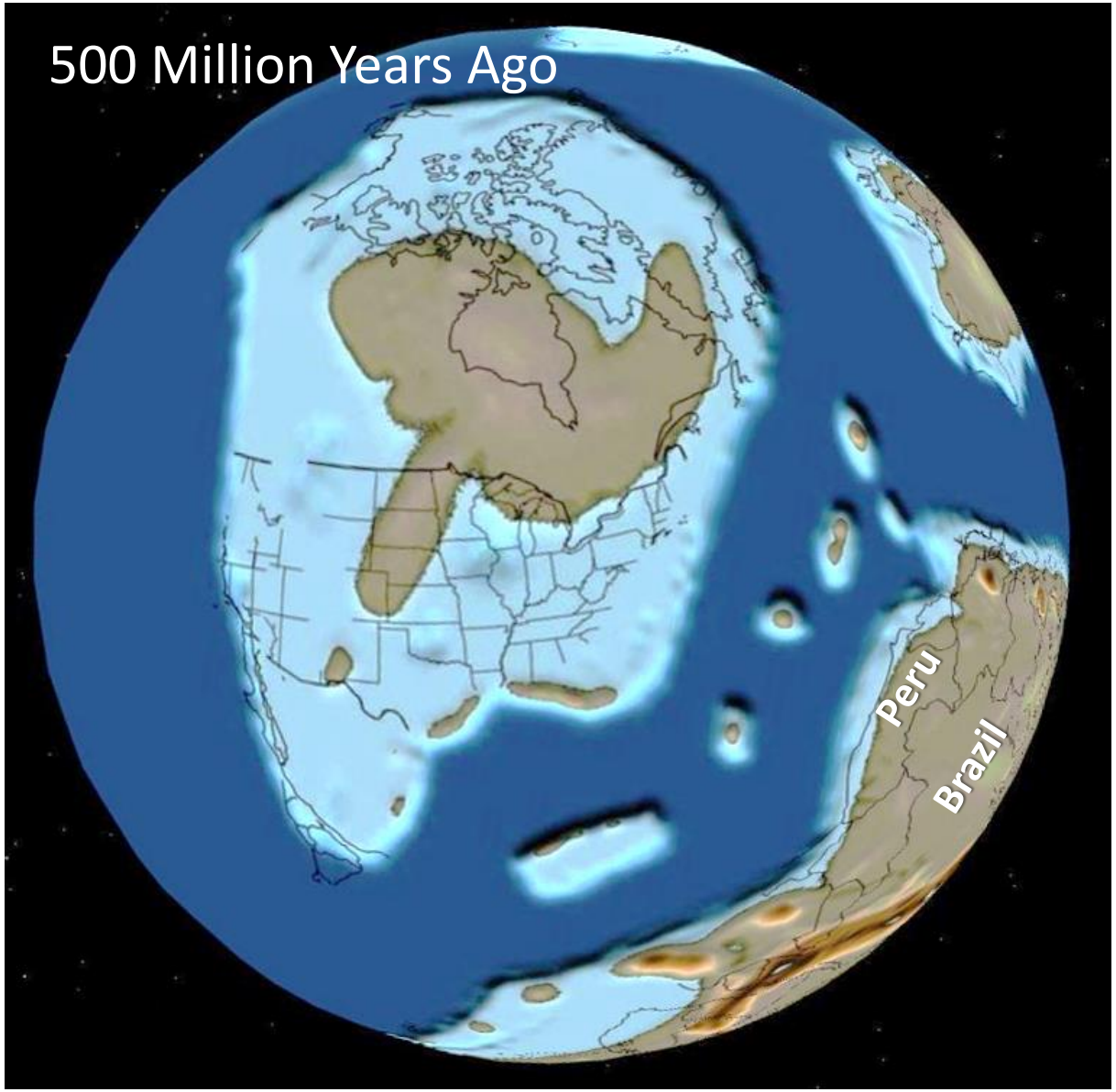
Cambrian Group families settle in the region (pun intended)

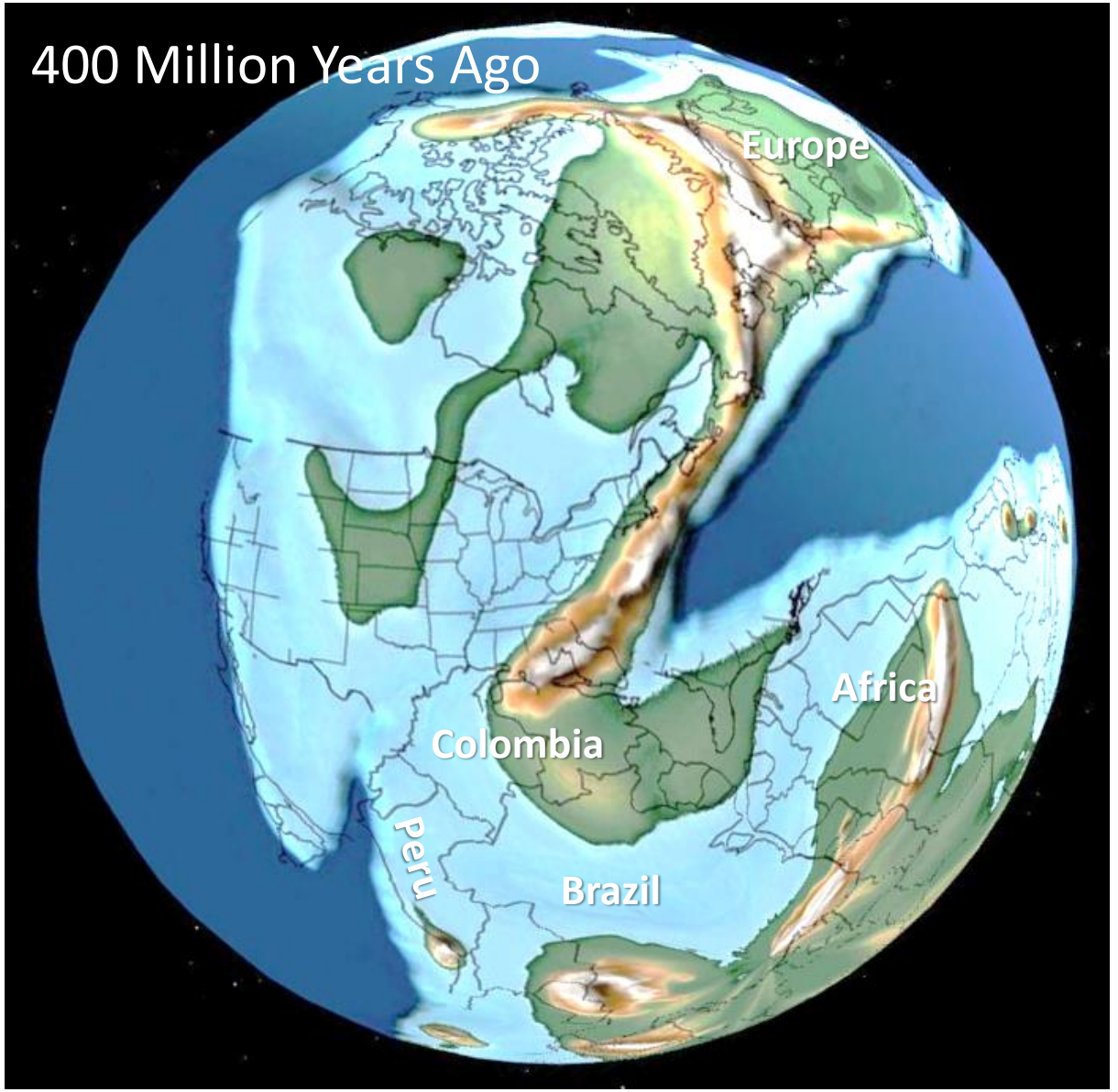
- Transition from deeper water to shoaling waves separate sediments into distinct family groups.



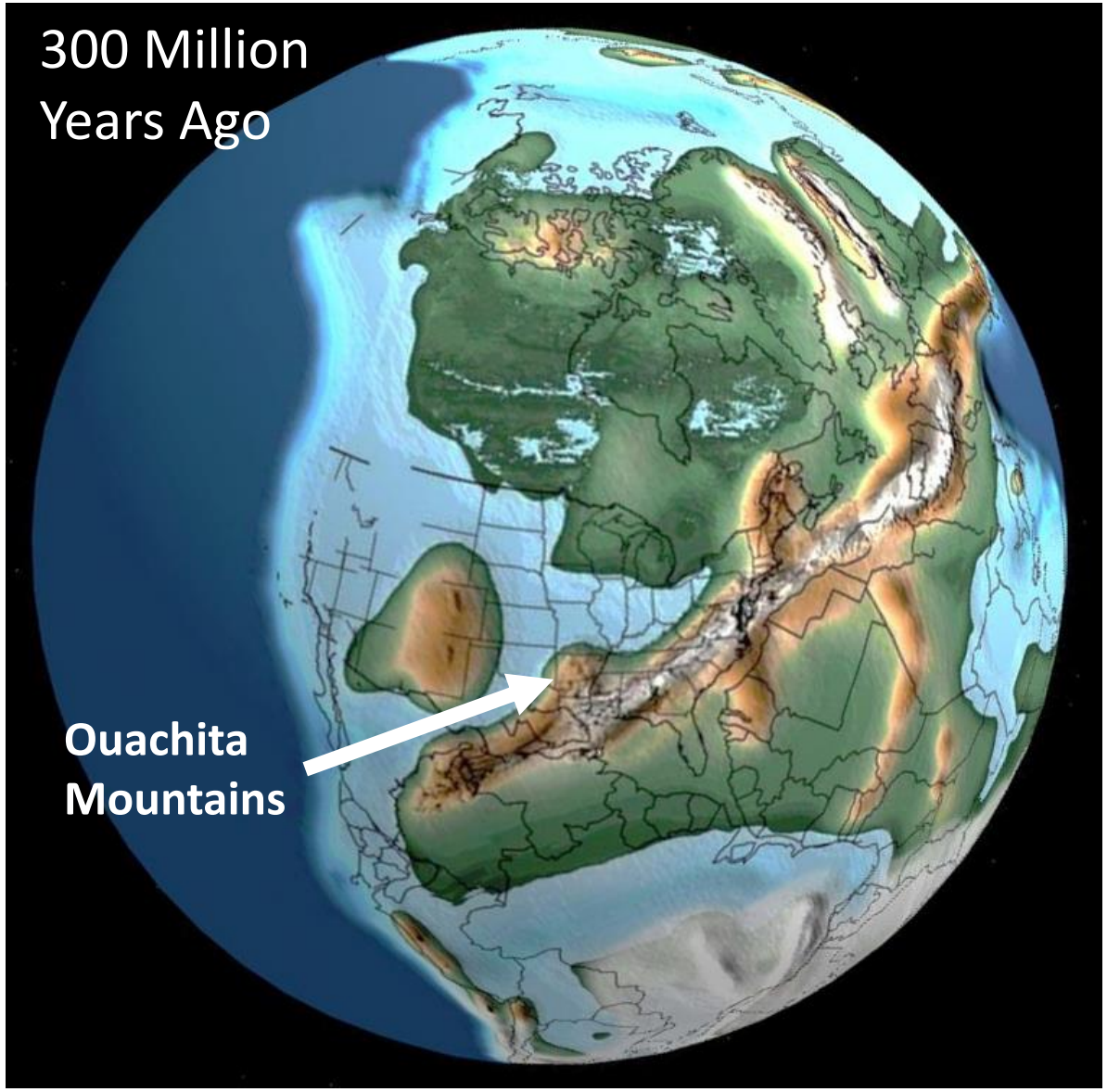
Modified from Shelton et al. 1992

South America Comes Back For Another Round!

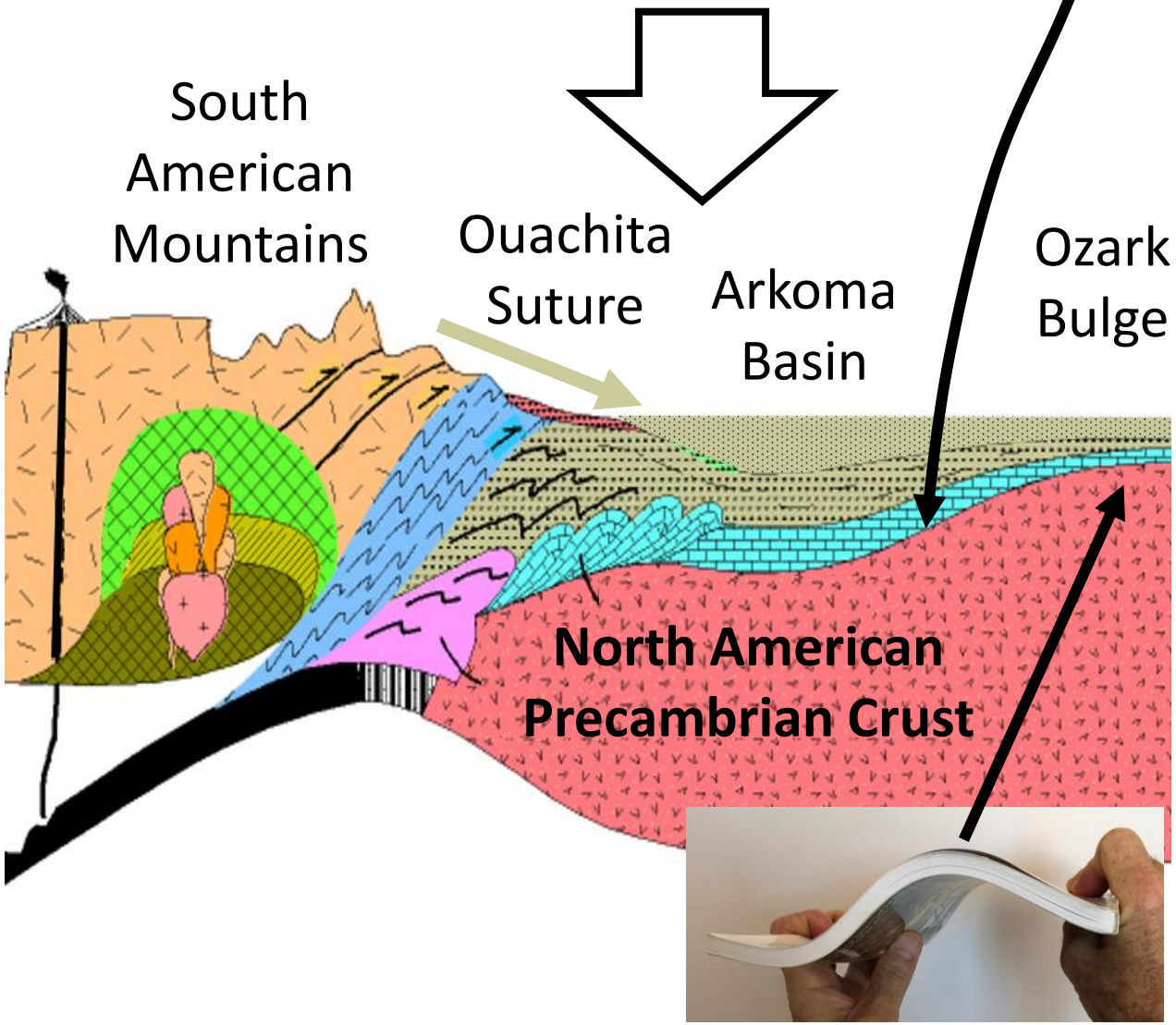




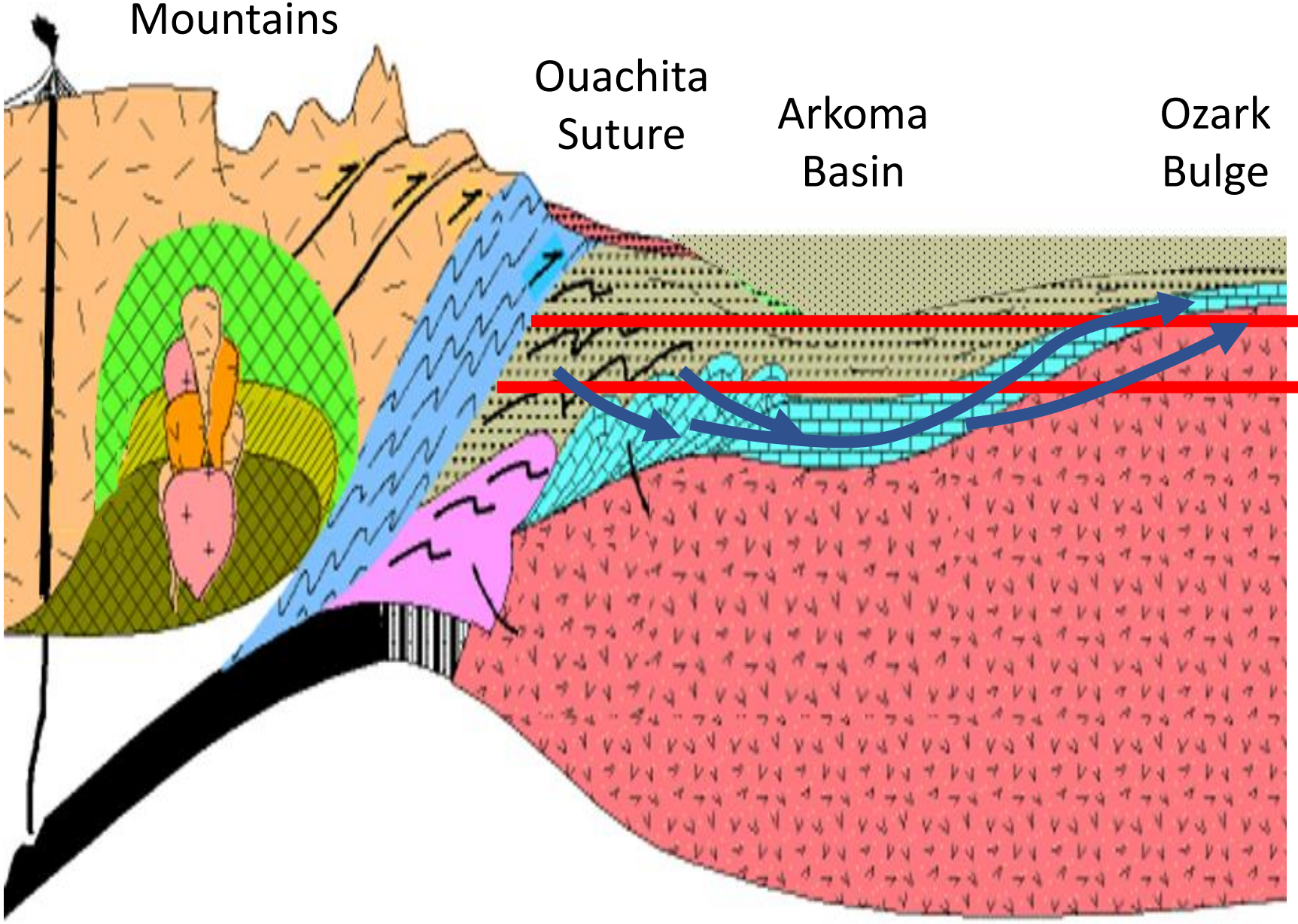
Collisional Consequences



Crust and old carbonate sediments are pushed down and buried by sediments eroding from the collision mountains.



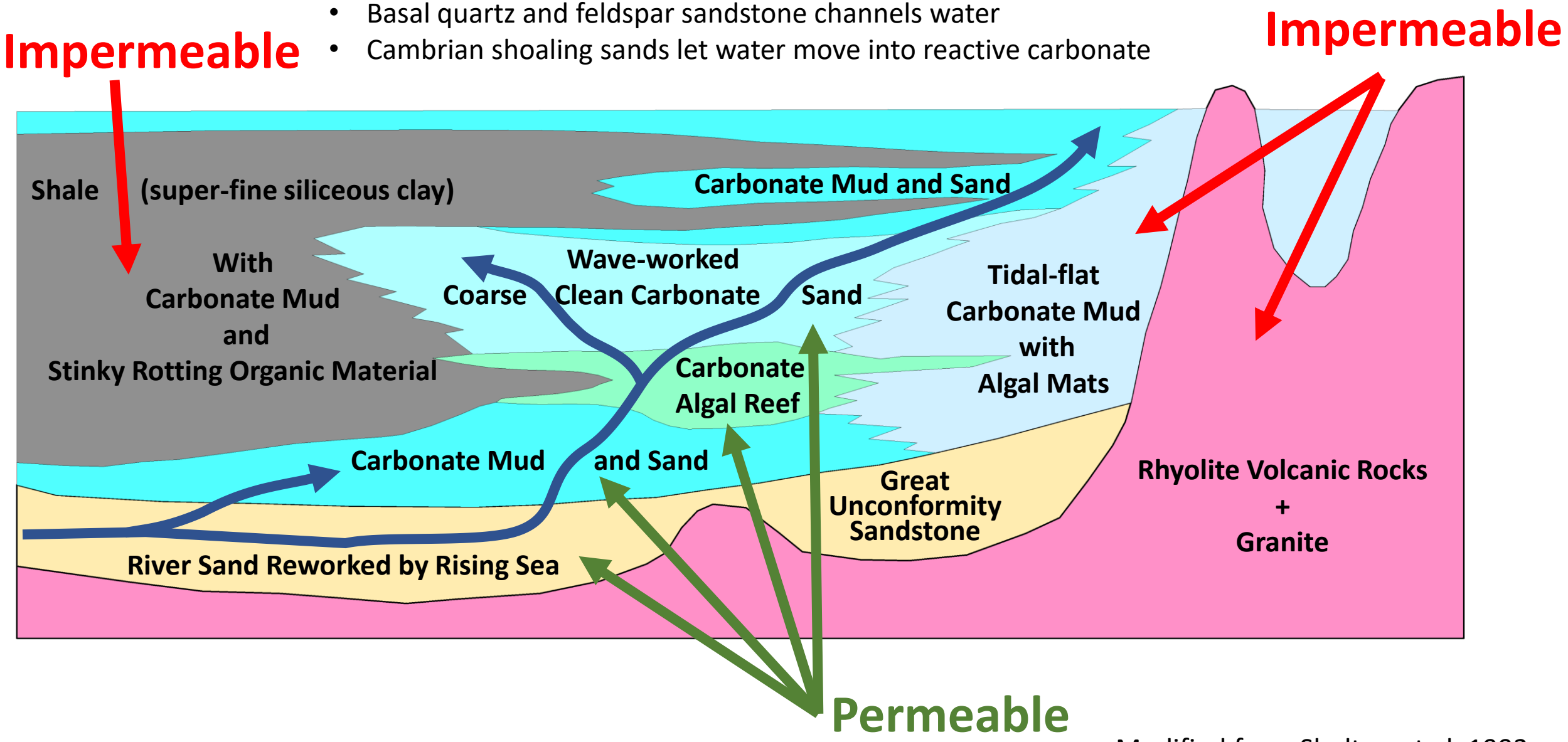
Scavenged Metal Migrants Move



- Heat makes seawater trapped in ocean sediments corrosive
- Pressure of burial forces water out along the path of least resistance
- Hot corrosive water dissolves lead and zinc from rocks along the way

Path of Least Resistance Leads to Cambrian Group Trap

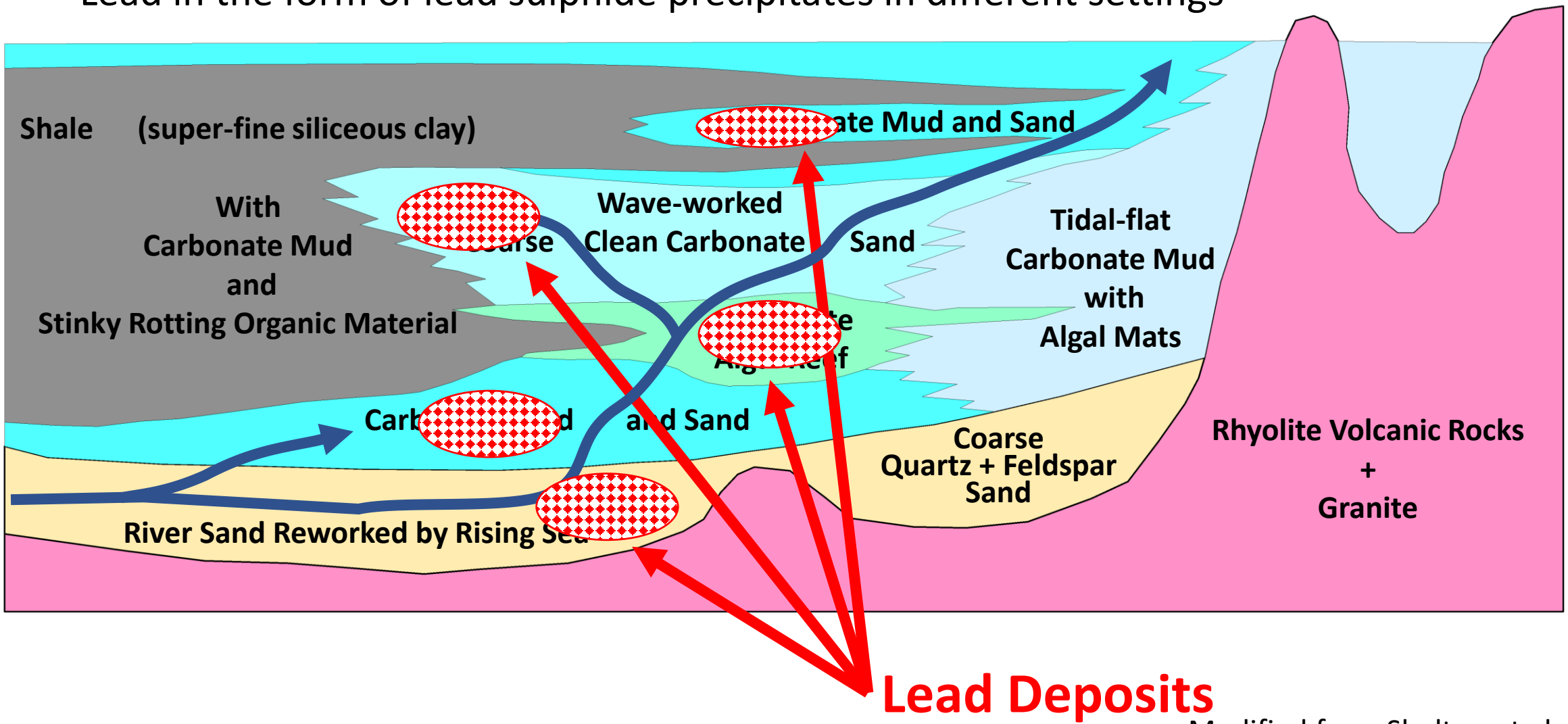
- Basal quartz and feldspar sandstone channels water
- Cambrian shoaling sands let water move into reactive carbonate



Modified from Shelton et al. 1992

Lead Does Not Like Change

- Fluid moving vertically encounters different chemical environments
- Lead in the form of lead sulphide precipitates in different settings



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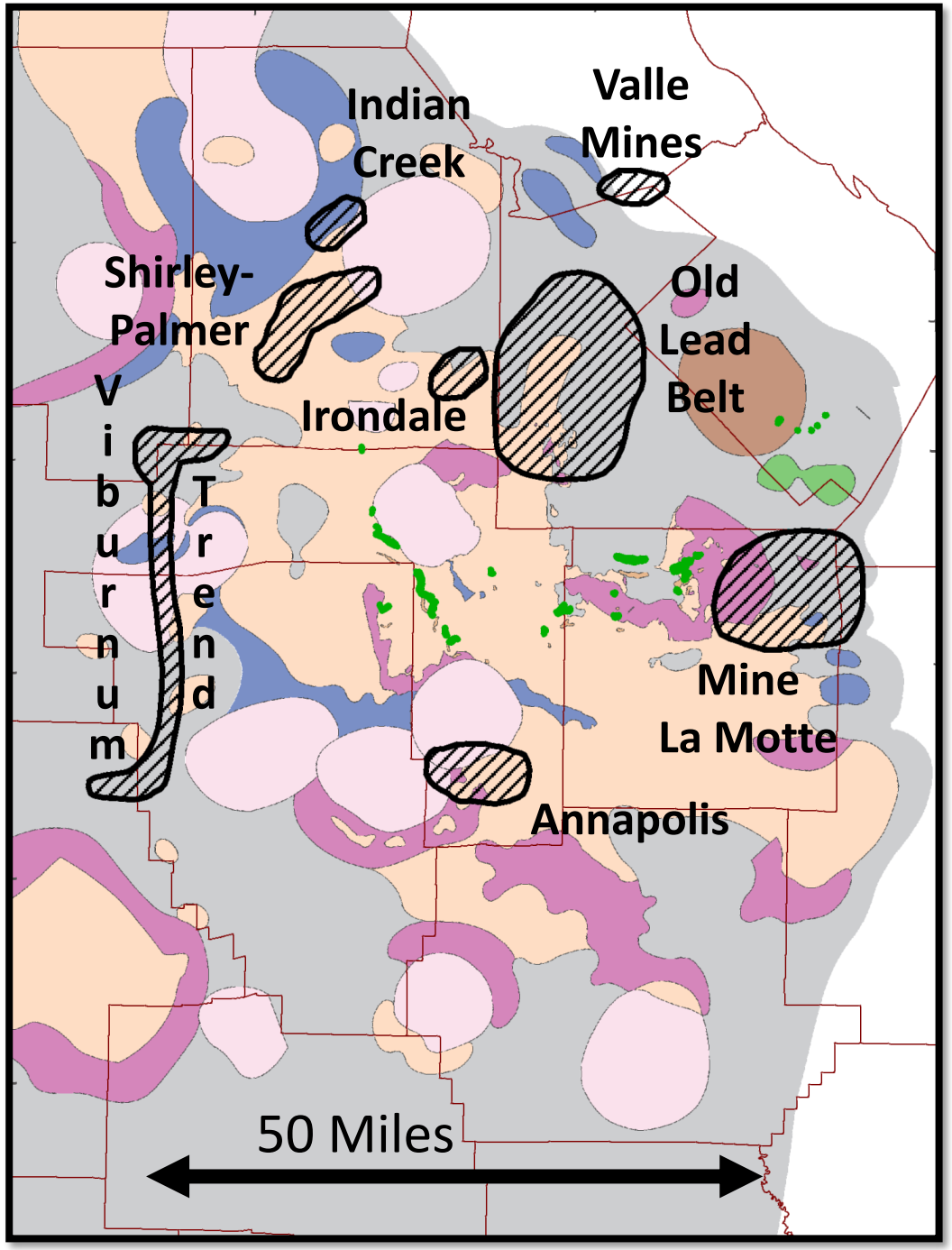
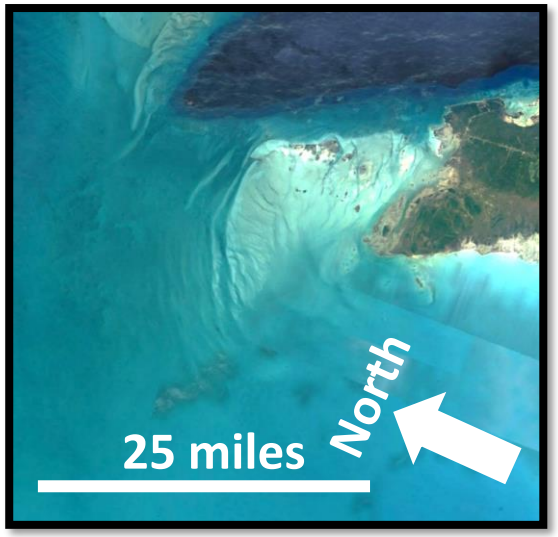


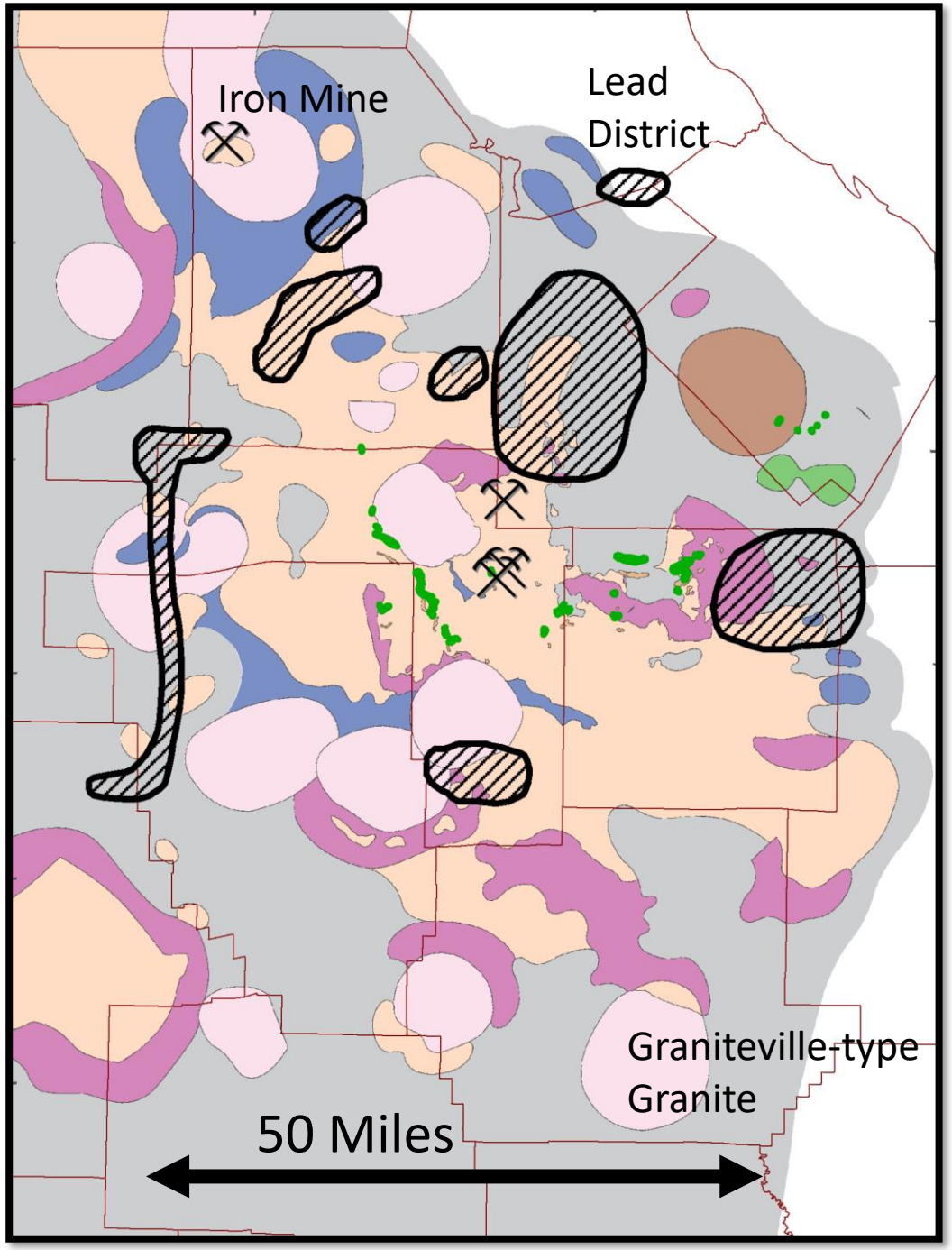
SEMO Lead Districts
St Francois Islands
Andros Island Comparison

Andros Island



Andros Island and St Francois Islands at same scale

- Districts peripheral to volcanic rocks (islands)
- Scale of districts similar to Andros sand shoals
- Linear nature of sand ridges like Viburnum Trend



Ode to the St Francois Islands

Volcanic Families long ago
built land that could withstand the
Graniteville Clan invasion

Land so strong that 800 million
years later it still left hills
That become islands

Where families of carbonate sand
settled in shoaling Cambrian seas
Leaving pathways

Which 200 million years later
would trap migrating metals
from the continent's edge

Creating deposits of lead
that would initiate
the settlement of our region