Rocks,
Earth's Memory Sticks

Dept of Geological Sciences
San Diego State University

The 3 Major Rock Types

- **Igneous** –
  melted completely, then solidified

- **Sedimentary-**
  other rocks broken up/or other small stuff, dumped into a pile, cemented together, involves water

- **Metamorphic-**
  any rock, squeezed and/or heated but not to melting

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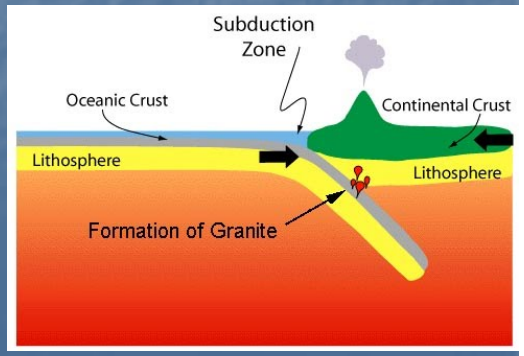
The Three Major Igneous Types :

melted completely then solidified

- **Basalt**
  bubbles out on Earth's surface, volcanoes
- **Andesite**
  bubbles out on Earth's surface, volcanoes
- **Granite**
  only forms/cools underground

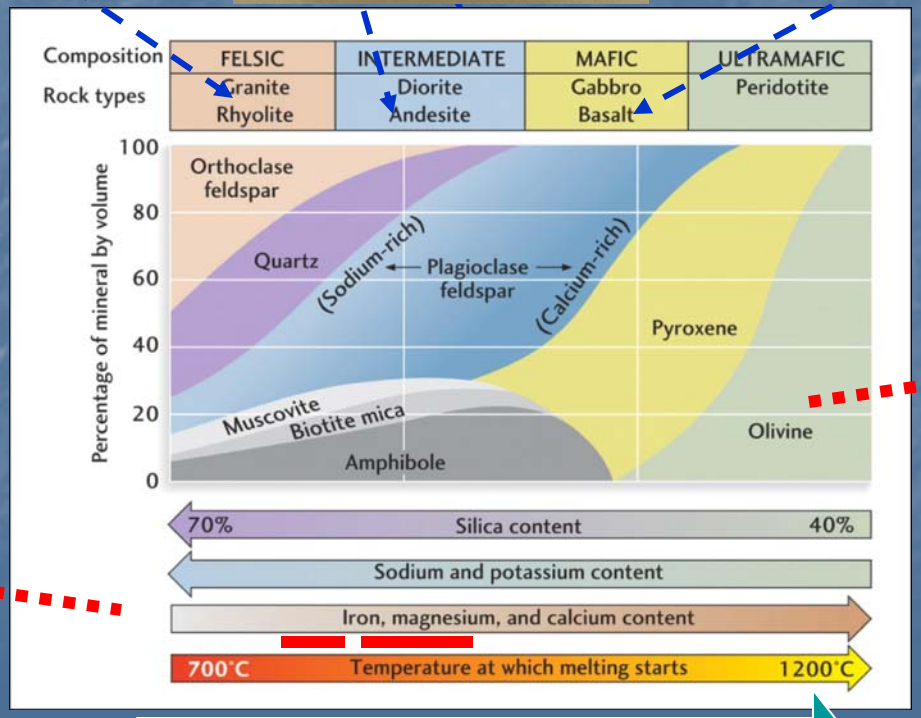


Igneous: Granite - Andesite - Basalt share many chemical elements, but differ in proportions

Granite

Andesite

Basalt



Density

All Minerals Listed are mostly Silicon and Oxygen

Content, properties Shift

Big Picture: Igneous: Granite - Andesite - Basalt

share many chemical elements, but differ in proportions

especially,

more → **Magnesium** more →
← more **Aluminum** ← more

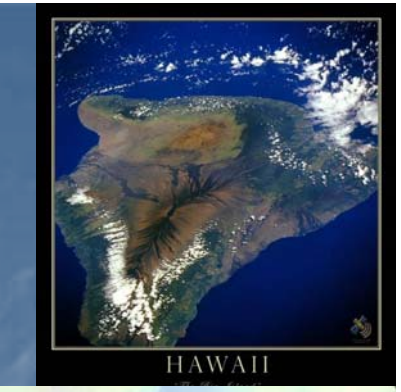
as a result…

more → Density more →

Granite

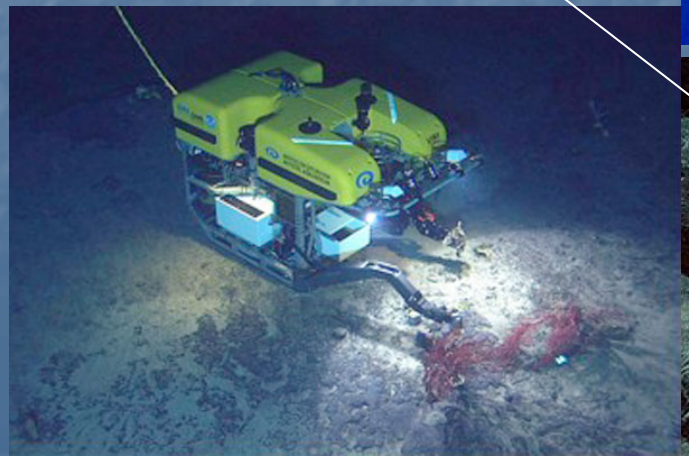
Andesite

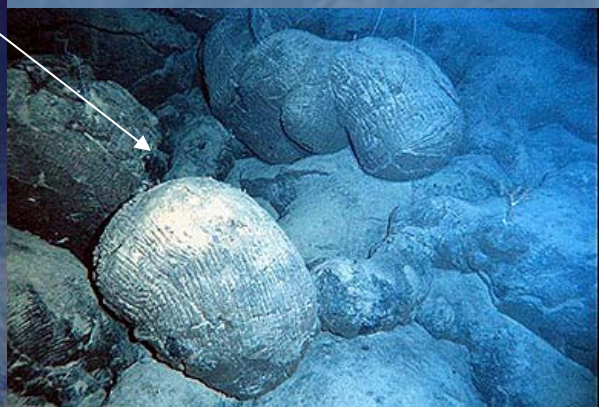
Basalt



Basalt

Spreading Center: Deep Ocean Floor - Basalt Conveyer Belt

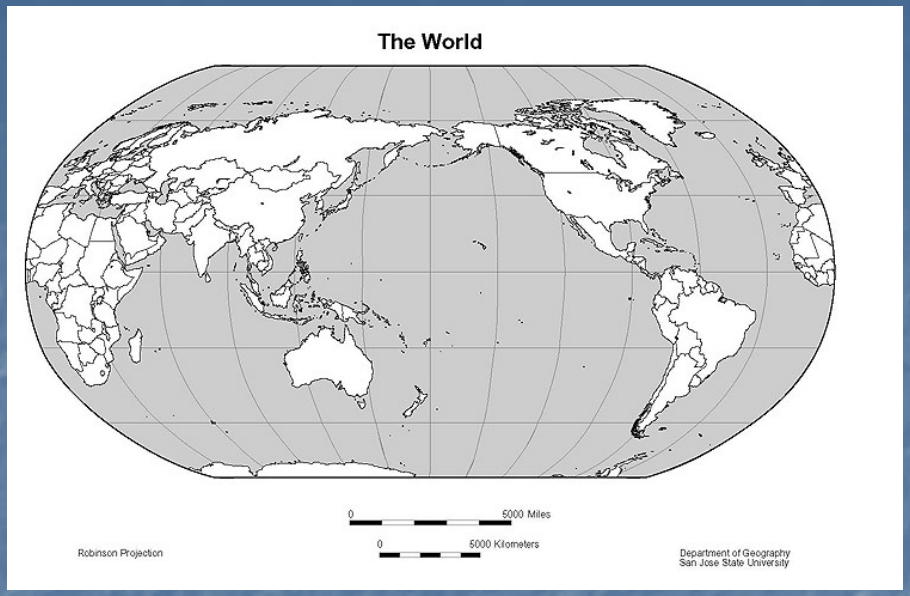




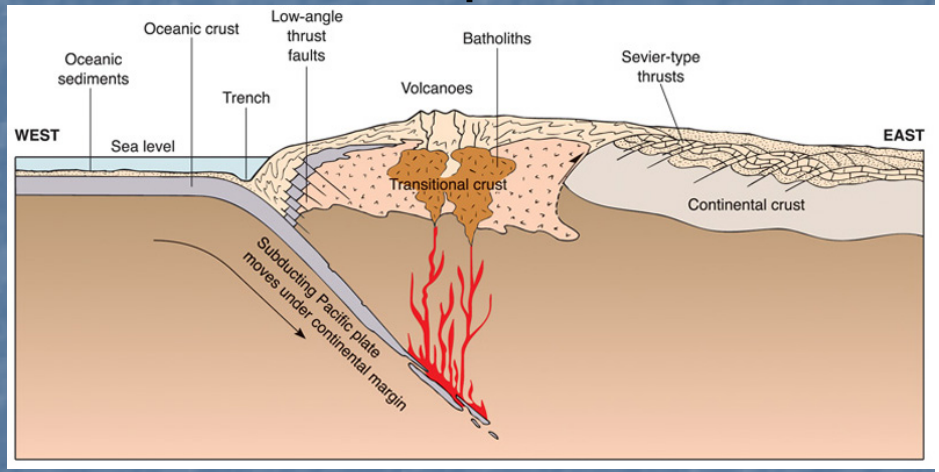
Basalt: all deep ocean basin floors, most ocean islands

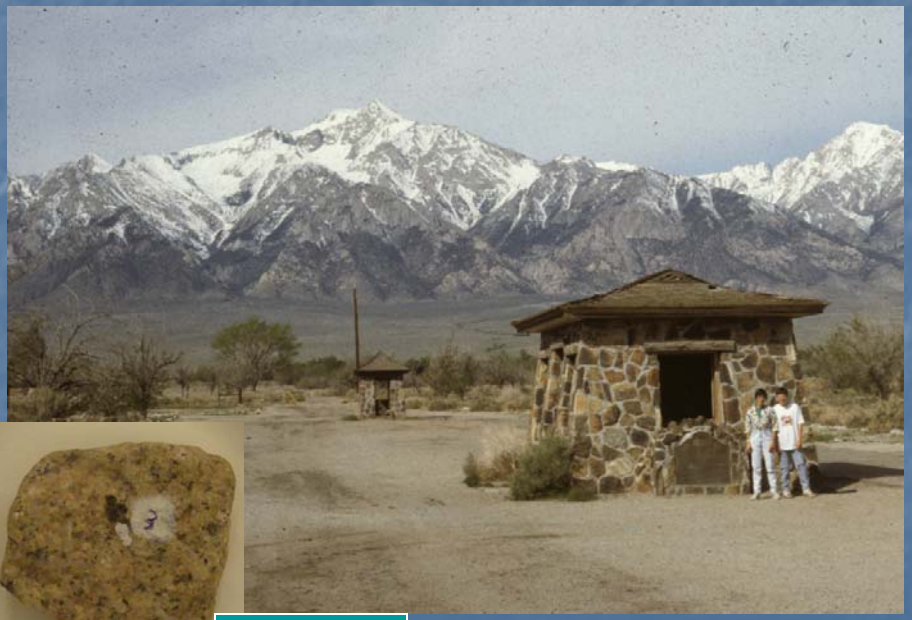
Basalt: on some continental areas

Basalt

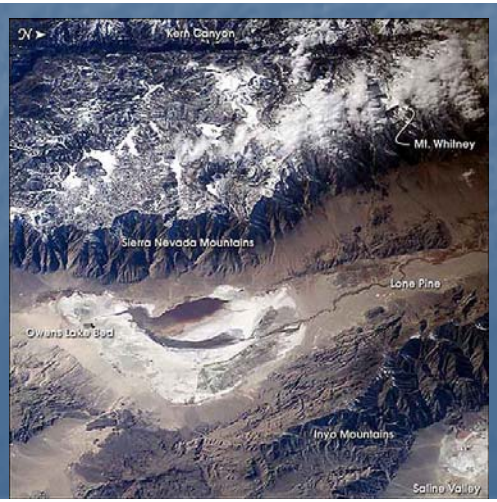


Granite: ONLY on continents, initially solidifies below surface, later pushed up, exposed



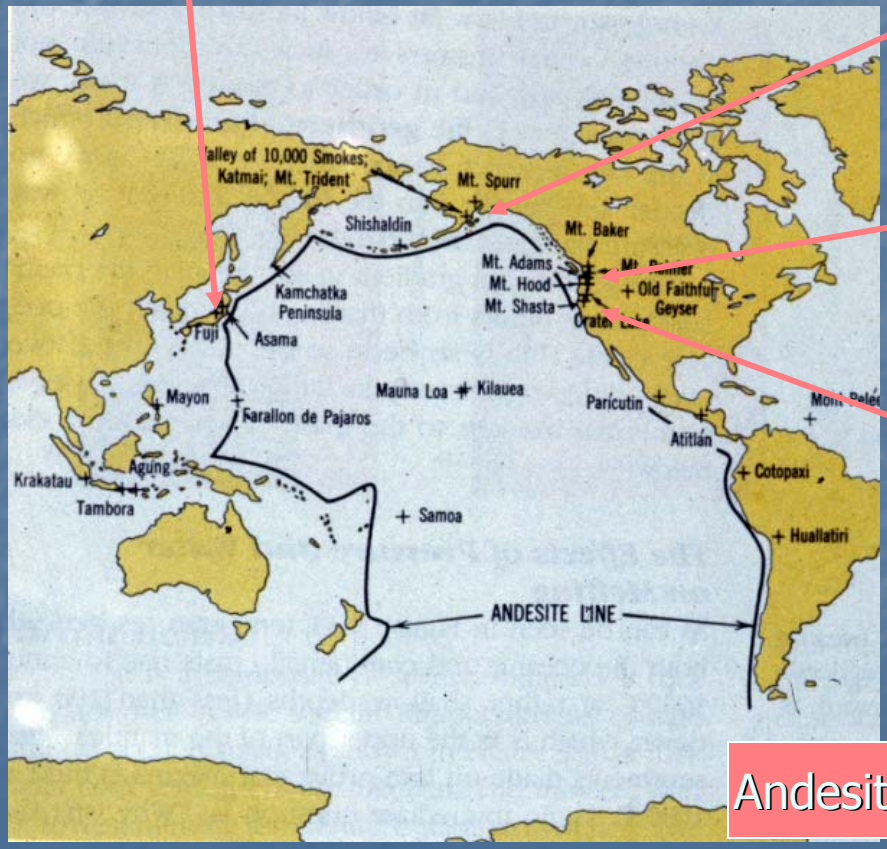


Granite



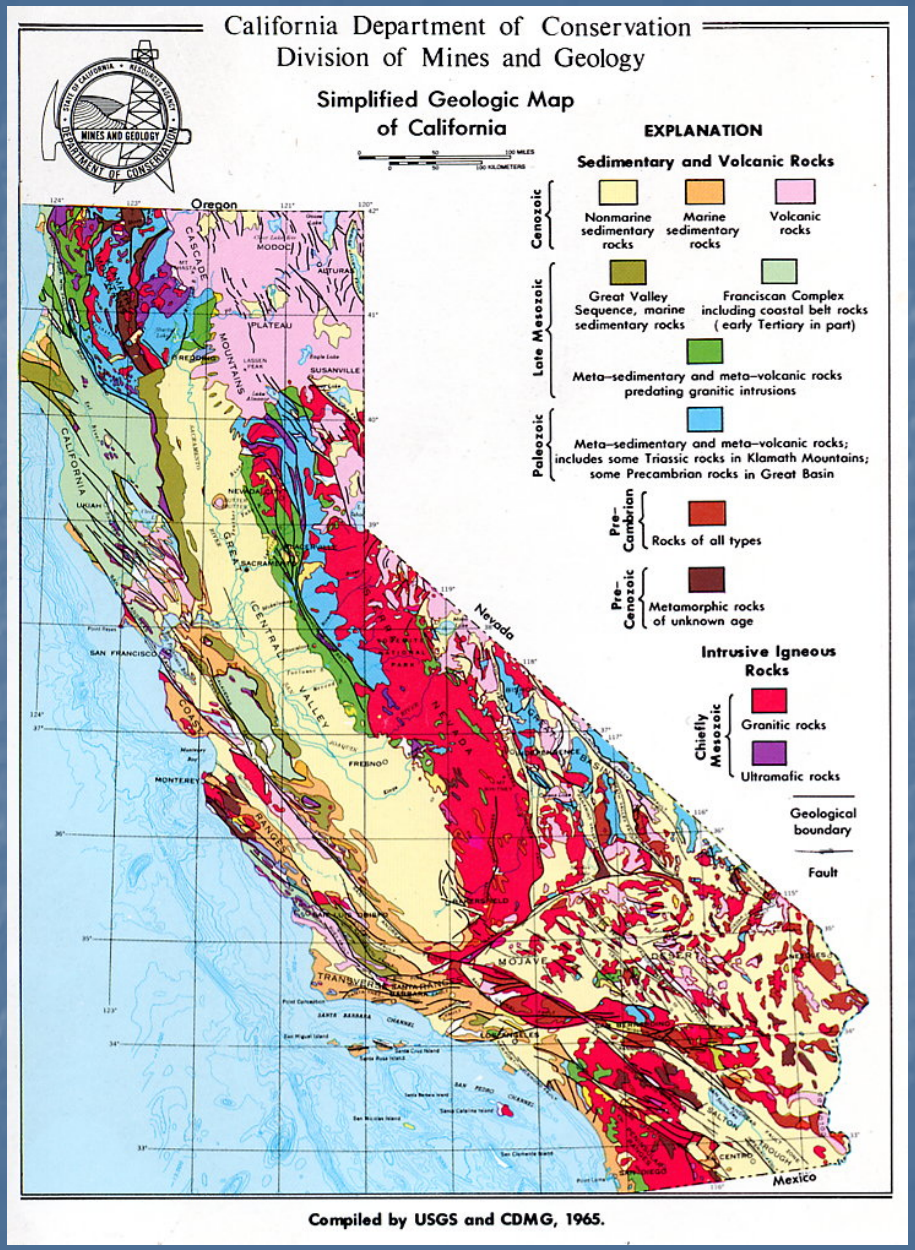
? Formation details

Andesite: found at edge of continent & ocean, many volcanoes with famous names



Andesite

Where is Nearest Example?



The 3 Major Rock Types

- **Igneous** –
  melted completely, then solidified
- **Sedimentary-**
  other rocks broken up/or other small stuff,
  dumped into a pile,
  cemented together,
  involves water
- **Metamorphic-**
  any rock, squeezed and/or heated
  but not to melting

Tourmaline Beach Cliff

Major Source Material For The Three Major Sedimentary Rock Types :

- **Weathered**
  other rocks broken up
- **Chemical**
  precipitate from water
- **Plant**
  plants (& trees)

Sedimentary Rock : Conglomerate:

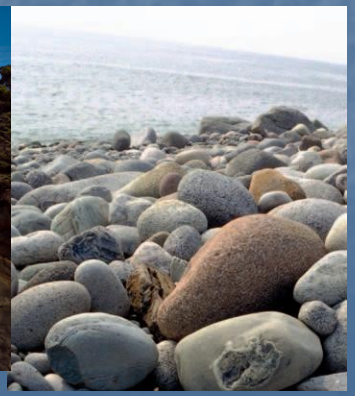
Weathering, Rivers: big rocks to smaller

Slow, dump, Pile up, cement

Conglomerate:
mix of larger & smaller rounded rocks, cemented together, formed in fast streams and beachs with big waves

Large beach waves break up big rocks, wear down sharp edges, pile them up

Conglomerate



Sedimentary Rock : Conglomerate:

Conglomerate

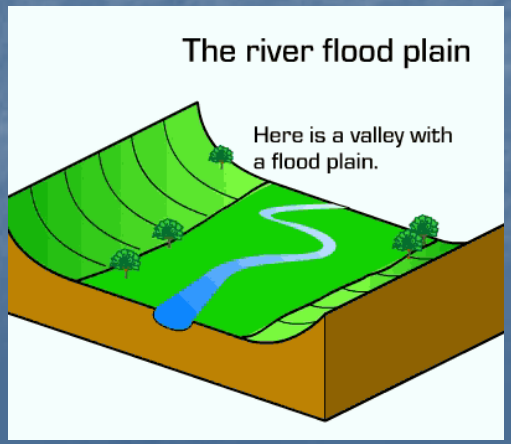
Conglomerate:
mix of larger & smaller rounded rocks, cemented together, formed in fast streams, beach with big waves

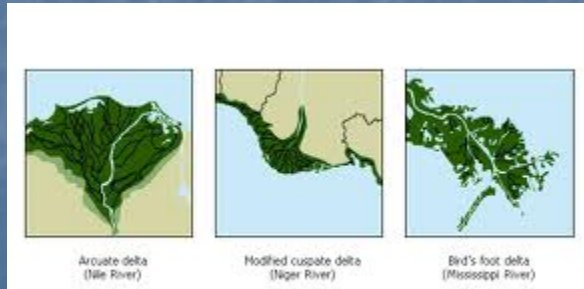
Sharp edge rocks
=
New and or no time in river or beach

Roundish rocks
=
Rolled with other rocks in a river or beach

Sedimentary Rocks: Sandstone

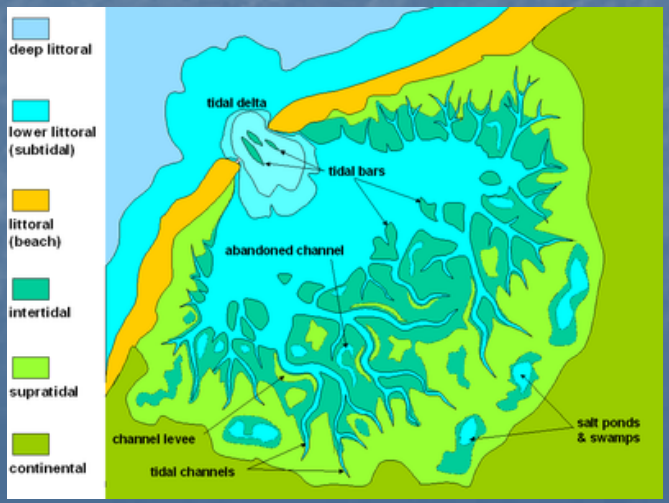
Sandstone:
Sand (sand sized), in beach, desert, flood plain, delta;
Piled up, cemented
-
Sand is tiny rock





Sedimentary Rocks: Shale

Shale:
Clay (<1/256 mm), settles in still water, as in quiet bay or lake
-
Clay is very, very, very tiny rock
-
Mud is wet clay



Sedimentary Rocks: Material Size from Weathered Rock

Formed From bigger weathered material

Conglomerate:
Mix of large & small rounded rocks, formed in fast streams, beach with big waves

Shale:
Clay (<1/256 mm), in quiet bay, lake
-
Clay is very, very, very tiny rock

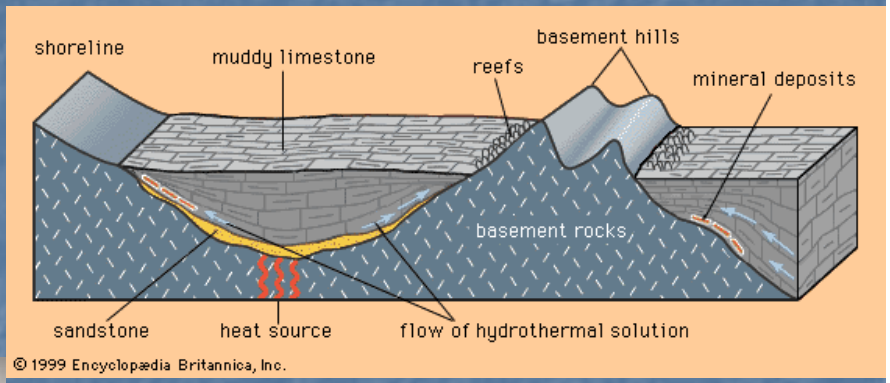
Sandstone:
Sand (sand sized), in beach, desert, flood plain, delta
-
Sand is tiny rock

Roundish rocks
=
Rolled with other rocks in a stream or river

Rocks from chemical or plant material

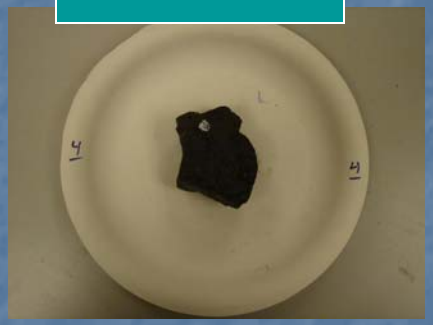
Limestone

Limestone:
mostly from marine shells, chemical deposition, especially in shallow seas

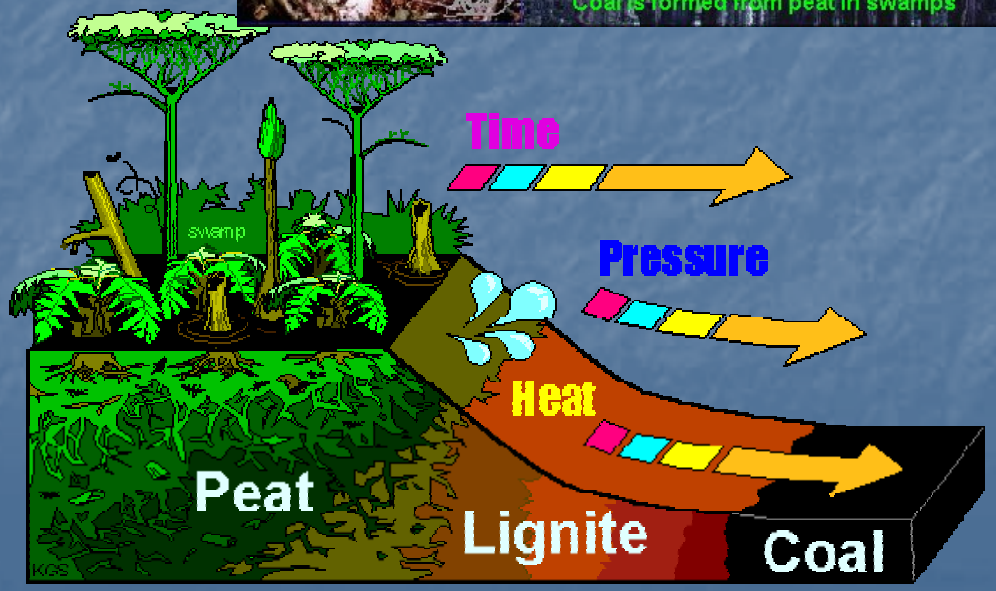


Sedimentary Rocks from chemical or plant material

Coal



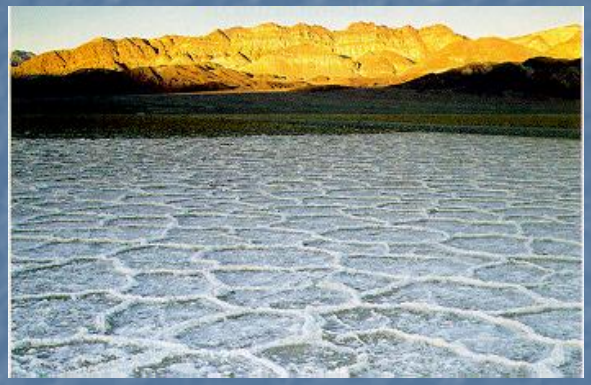
Coal:
forms from plants and trees
in warm, humid swamps



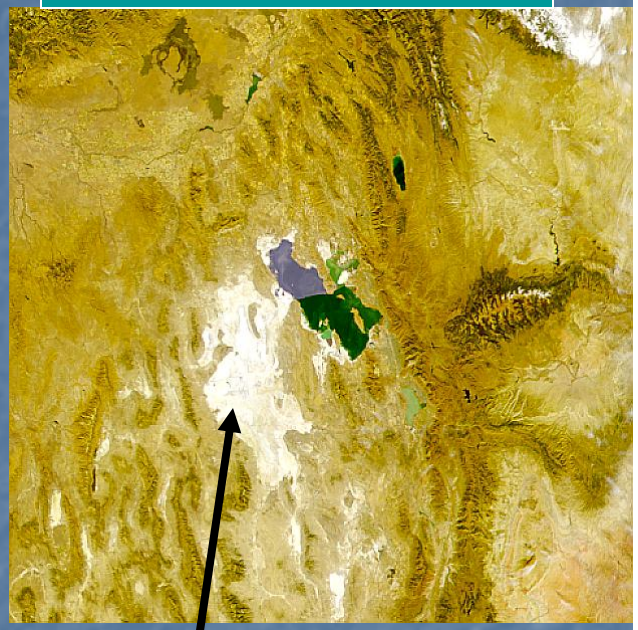
Sedimentary Rocks from chemical or plant material

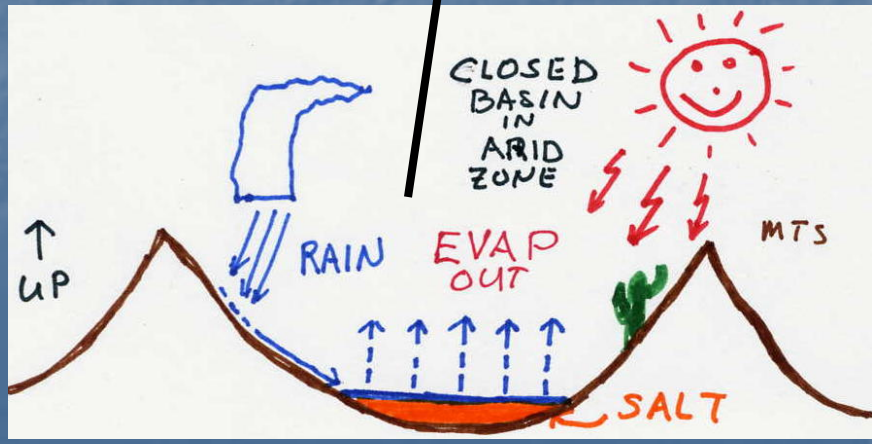
Salt

Salt:
Evaporite
in aired conditions
as a desert
or isolated,
shallow sea



Bonneville Salt Flats

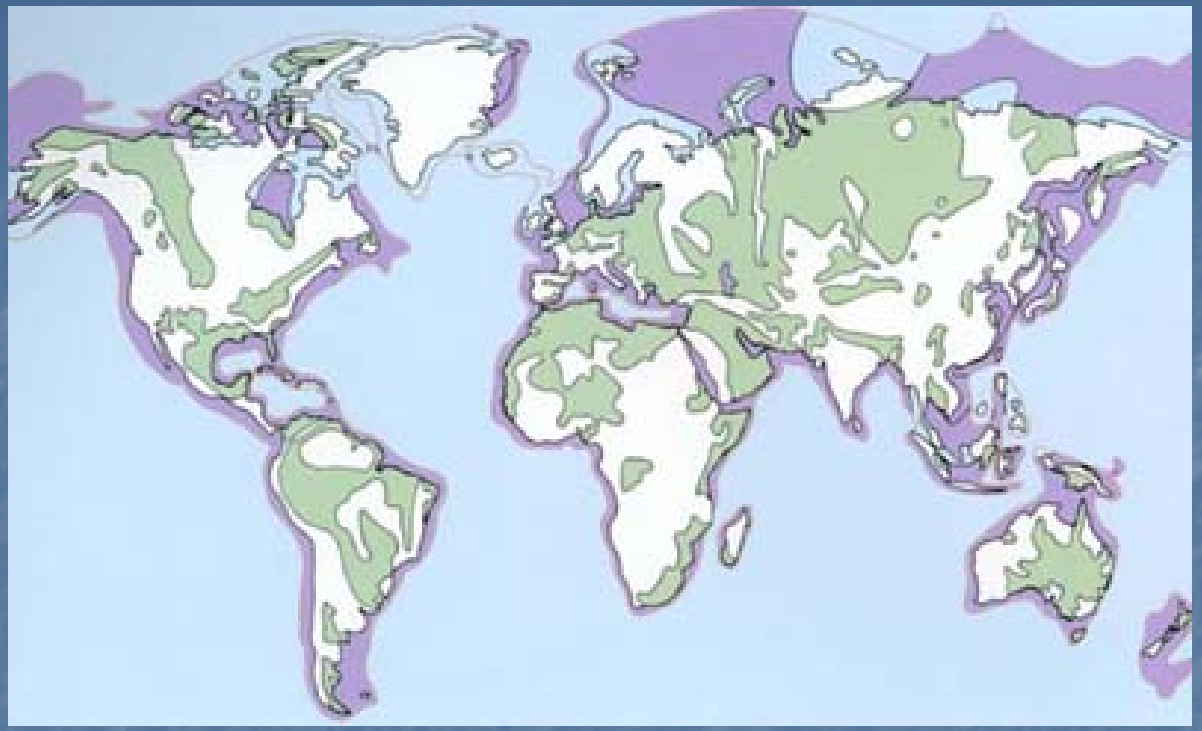




Land Sedimentary Rock: Usually erosion breaks up big rocks, rivers move them to some other place, dumps them, in a lake or shallow ocean, where they are cemented together

Grand Canyon

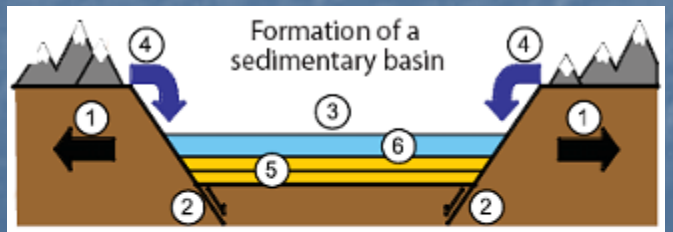
Layer "Cake" of Sedimentary Rock layers



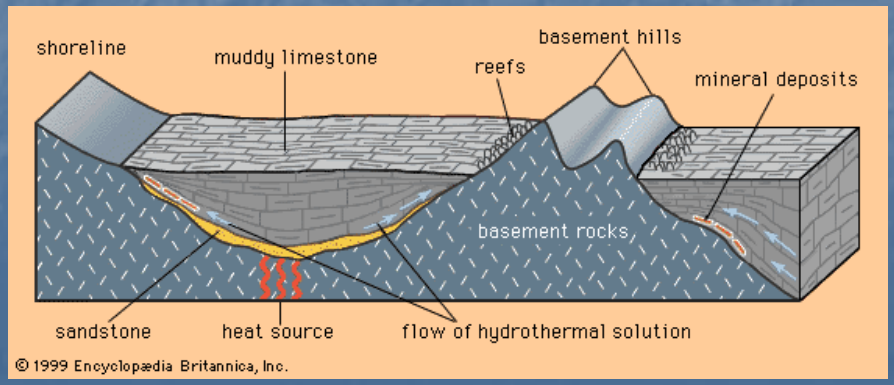
World Sedimentary Basins:
Thick layers of sedimentary rocks

Sedimentary rocks –

- 75% of the surface rocks
- all fossil fuels – oil & coal



(1) Earth's surface is pulled apart due to movement of the plates
(2) Faults form and a sedimentary basin is created (3)
(4) Sediments are washed from the surrounding high ground into the basin where they are deposited in layers (5)
(6) Shallow sea invades the basin also depositing sediments



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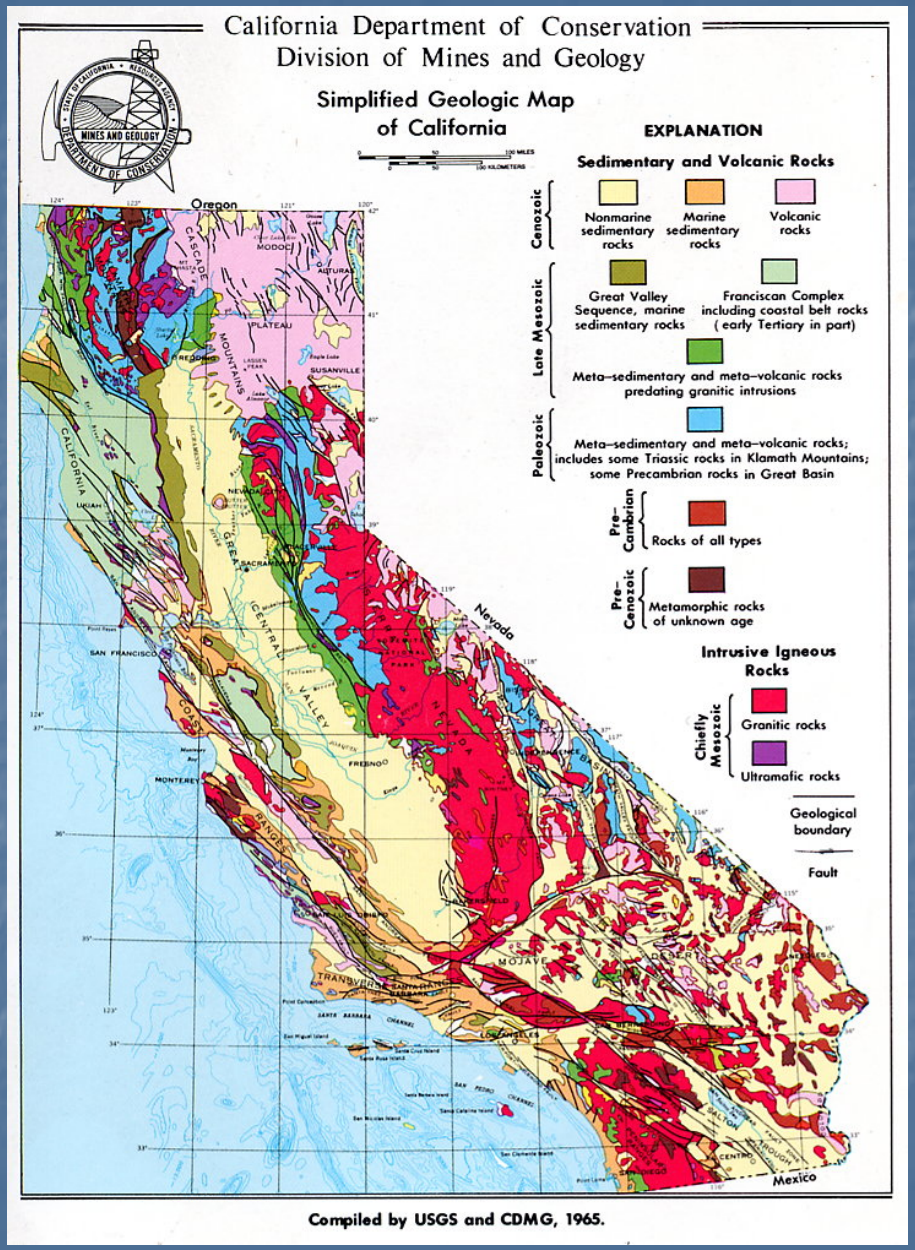

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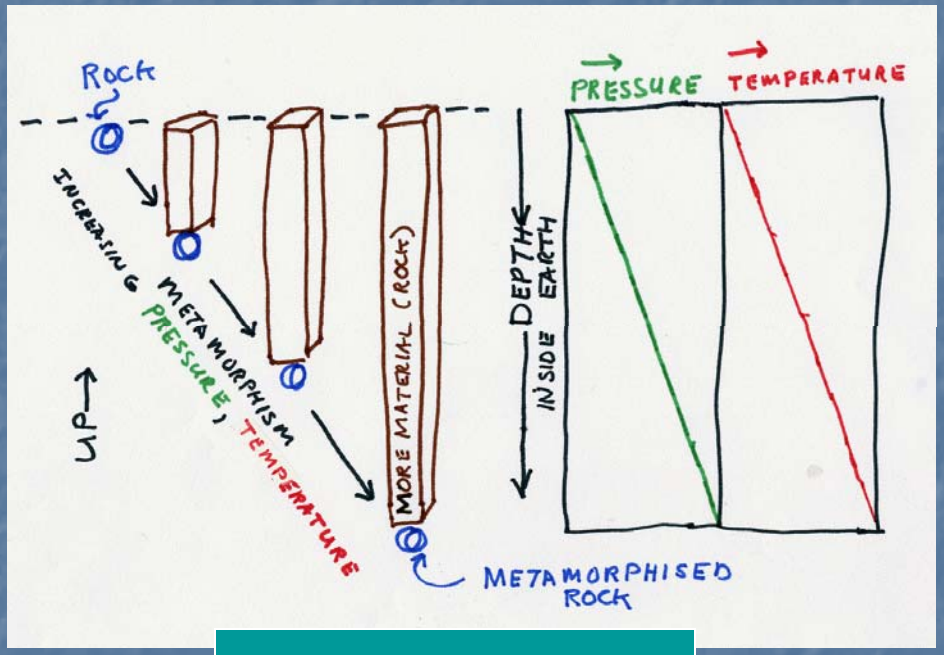
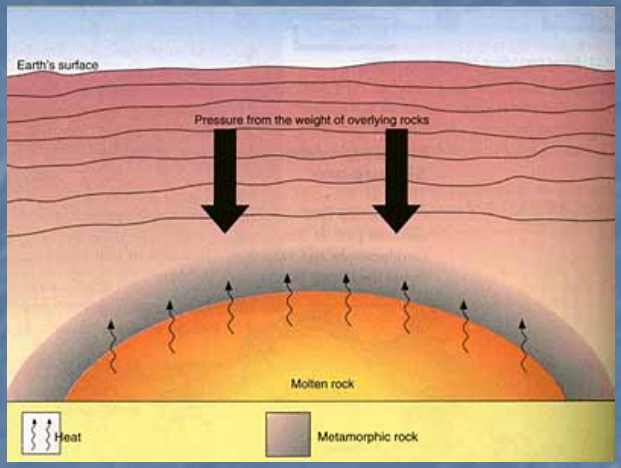
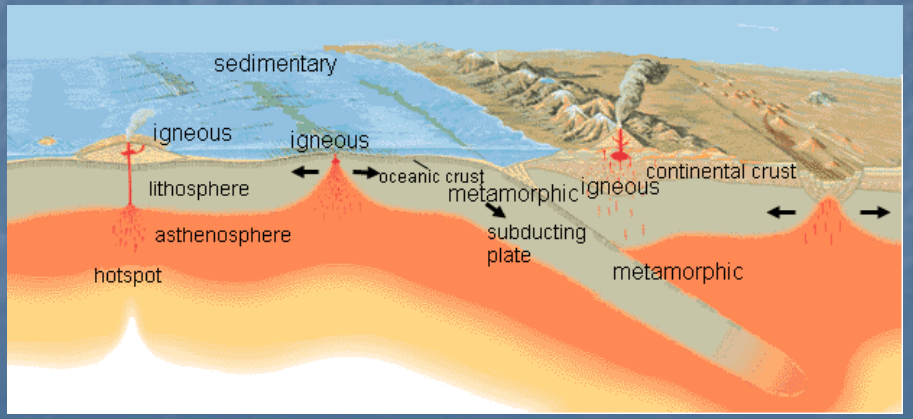
Metamorphic Rock: Any rock, usually buried, squeezed and/or heated, but not to melting

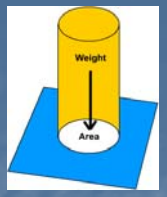






Burial: Chief tool for metamorphism

Metamorphic Rocks: with layers (Foliated), weak



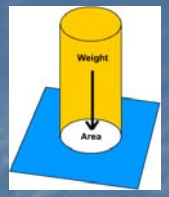
Shale

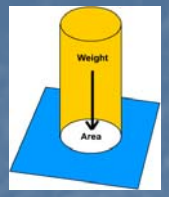
Weak Squeeze & heat

Layers (Foliated)

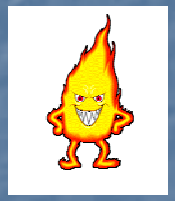
Slate

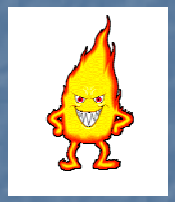
Metamorphic Rocks: with layers (Foliated), medium





Granite





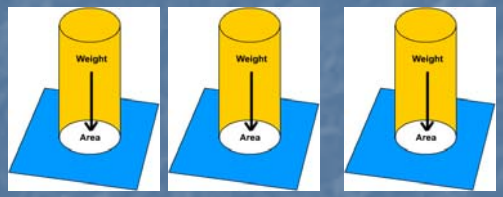
Medium
Squeeze
& heat
Igneous rock
as Granite

Layers
(Foliated)

Schist

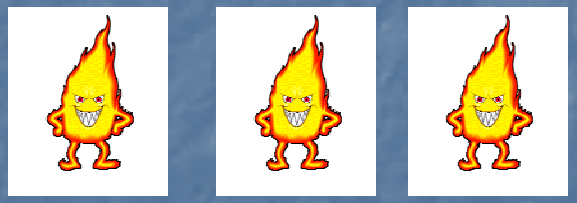
Metamorphic Rocks: with layers (Foliated), strong

Layers (Foliated)



Granite

Strong Squeeze & heat Igneous rock as Granite



Gneiss

Metamorphic Rocks: with layers (Foliated), summary

Weak Squeeze & heat Shale

Slate

Medium Squeeze & heat Igneous rock as Granite

Schist

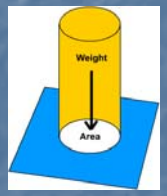
Strong Squeeze & heat Igneous rock as Granite

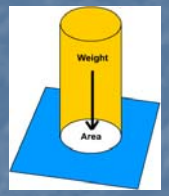
Gneiss

Layers (Foliated)

Metamorphic Rocks: no layers

No Layers



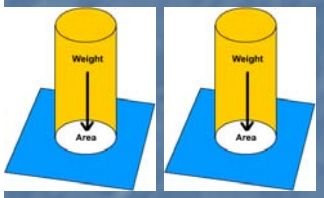


Medium Squeeze & heat as Limestone

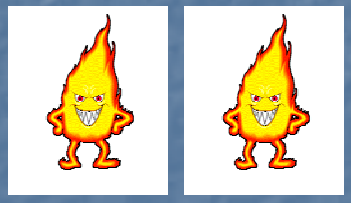
Marble

Metamorphic Rocks: no layers

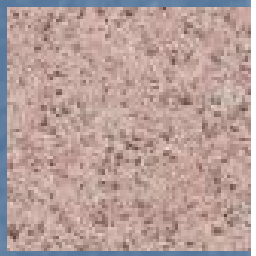
No Layers



Medium Squeeze & heat as Limestone



Quartzite



Metamorphic Rocks: Summary

Weak Squeeze & heat Slate

Slate

Layers (Foliated)

Medium Squeeze & heat Igneous rock as Granite

Schist

Strong Squeeze & heat Igneous rock as Granite

Medium Squeeze & heat as Limestone

Marble

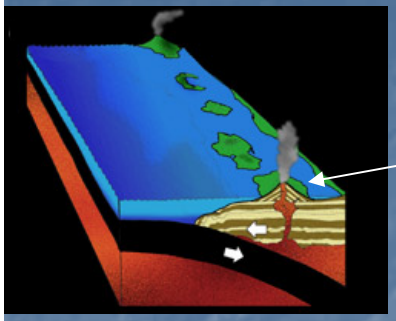
Gneiss

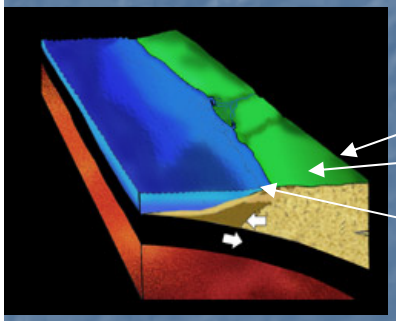
No Layers

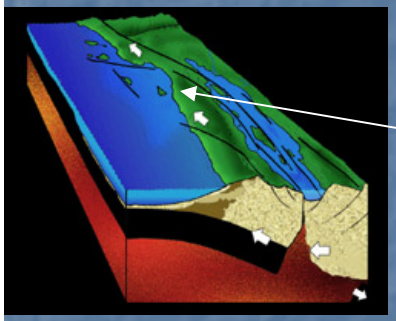
Medium Squeeze & heat Sandstone

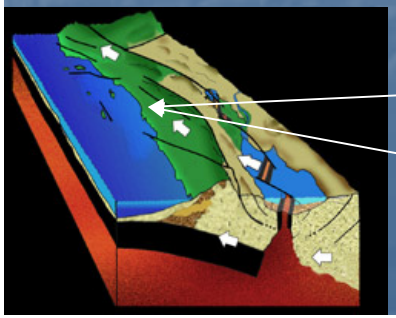
Quartzite

Local Favorite Metamorphic Rock: Rhyolite Cobble









Rhyolite cobble

About 150 MYA: Sonora, Mexico volcanoes erupt Rhyolitic lava and ash, form rhyolite bedrock

About 45 MYA , bedrock eroded, swept into rivers

Rivers beat rocks together, rounding & move downstream

Rivers dump cobble in coastal deltas, Forms a conglomerate stratum in a sandstone matrix with other rocks

About 13-10 MYA: Plate Tectonics forms incipient Baja CA, Splits off from Mexico, moves north

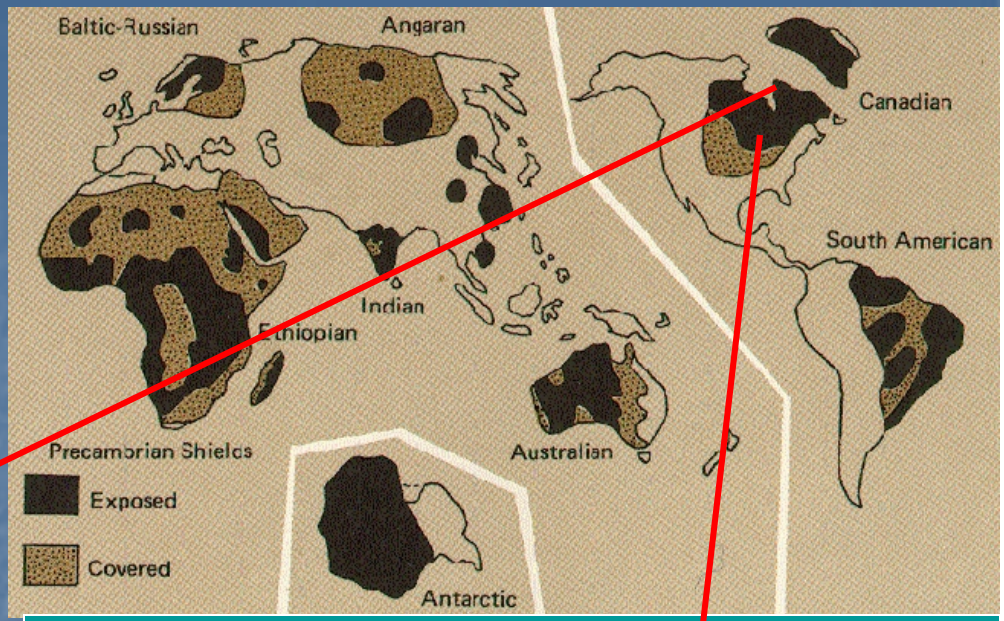
Plate Tectonics moves N. Baja to north with cobble – is now coastal southern CA

Today: Top of conglomerated stratum exposed, weathered, cobble seperated

Metamorphic rocks:

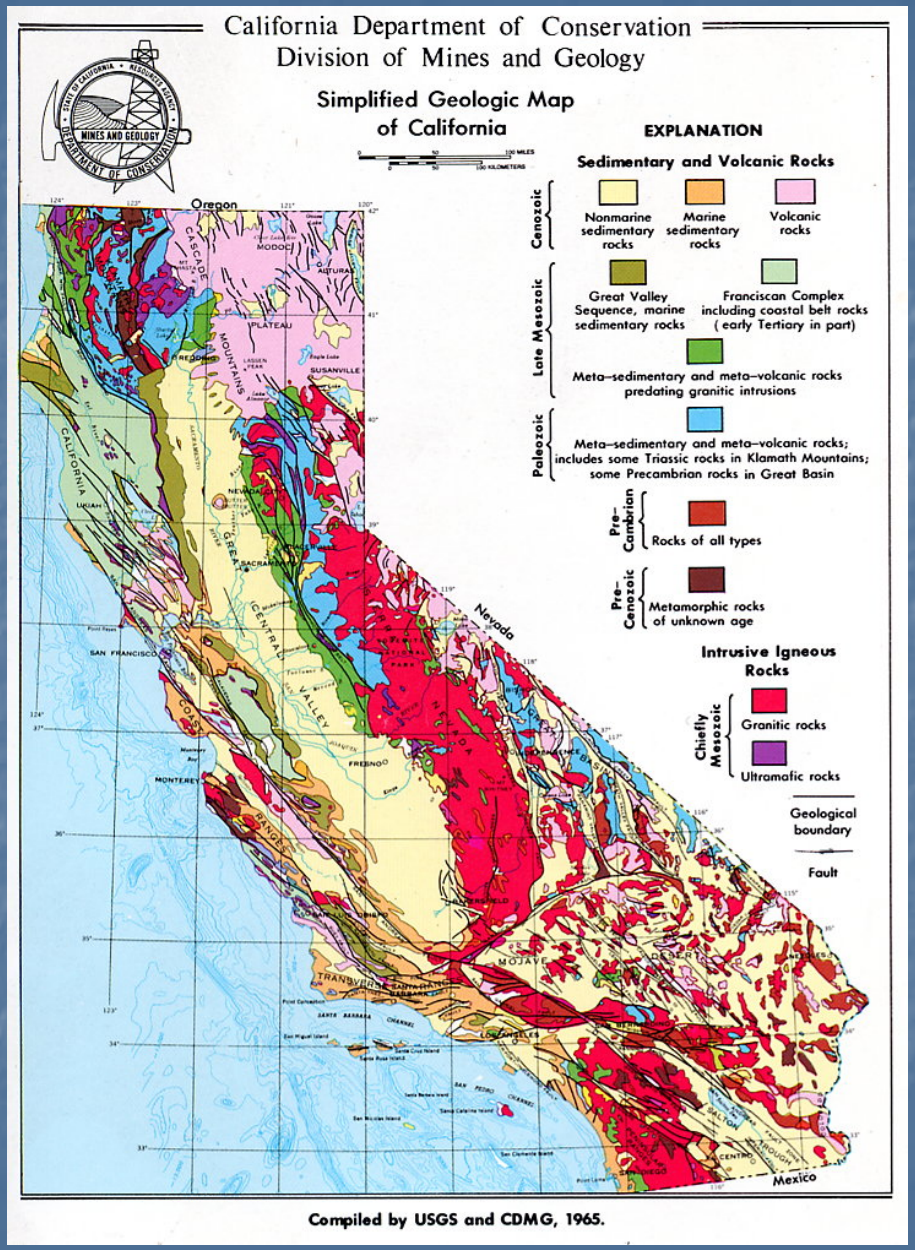
- mostly continental
- make up big, old blocks of continents (shields)
- Earth's oldest rocks

Earth's Oldest Rock Contest:
4.28 Billion years old,
eastern shore of Hudson bay, Quebec,
Nuvvuagittuq greenstone belt,
Sept. 2008.



Shields: old rock zones (> 600 million years) found only on continents

Where is Nearest Example?



The End