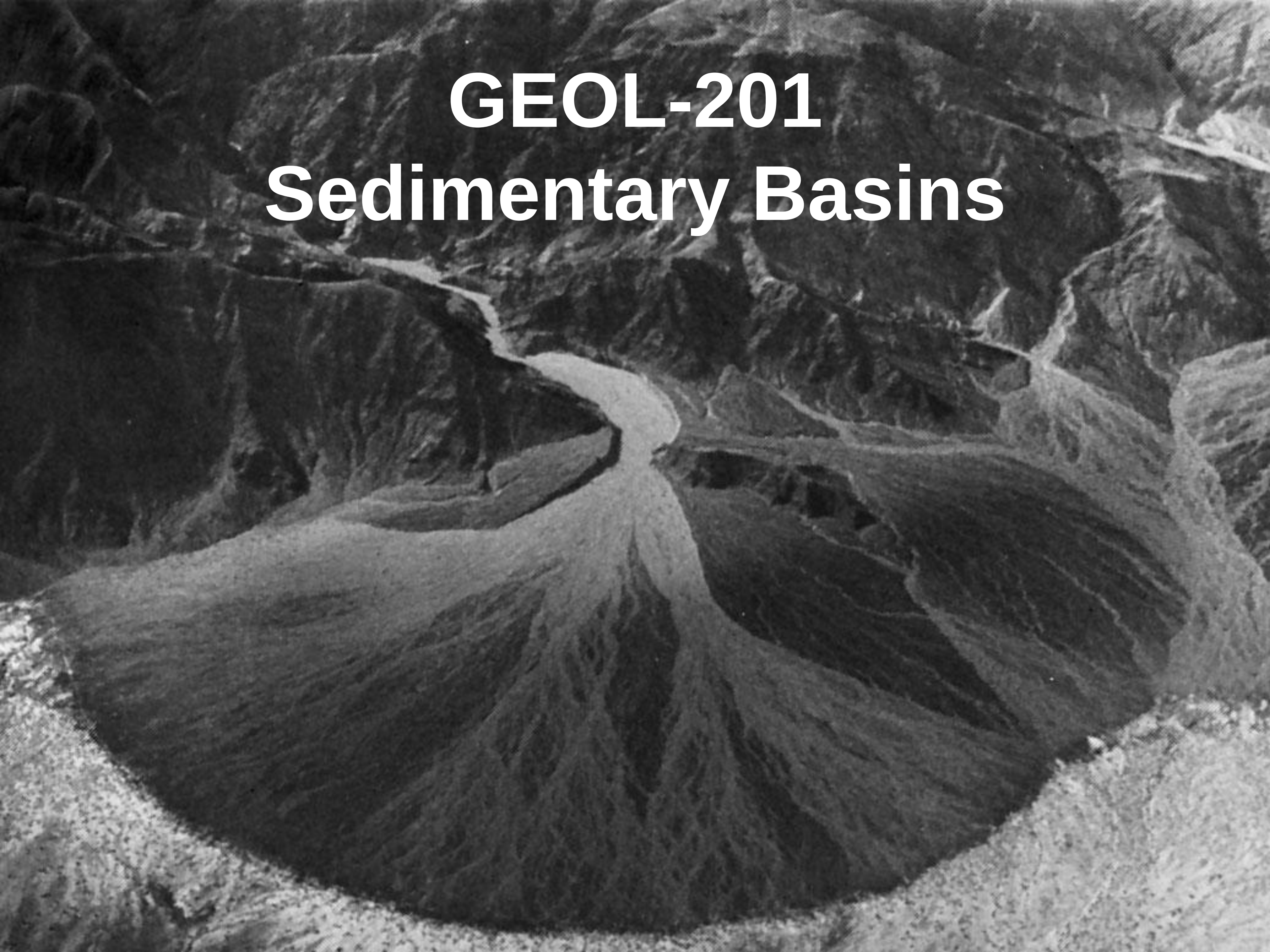
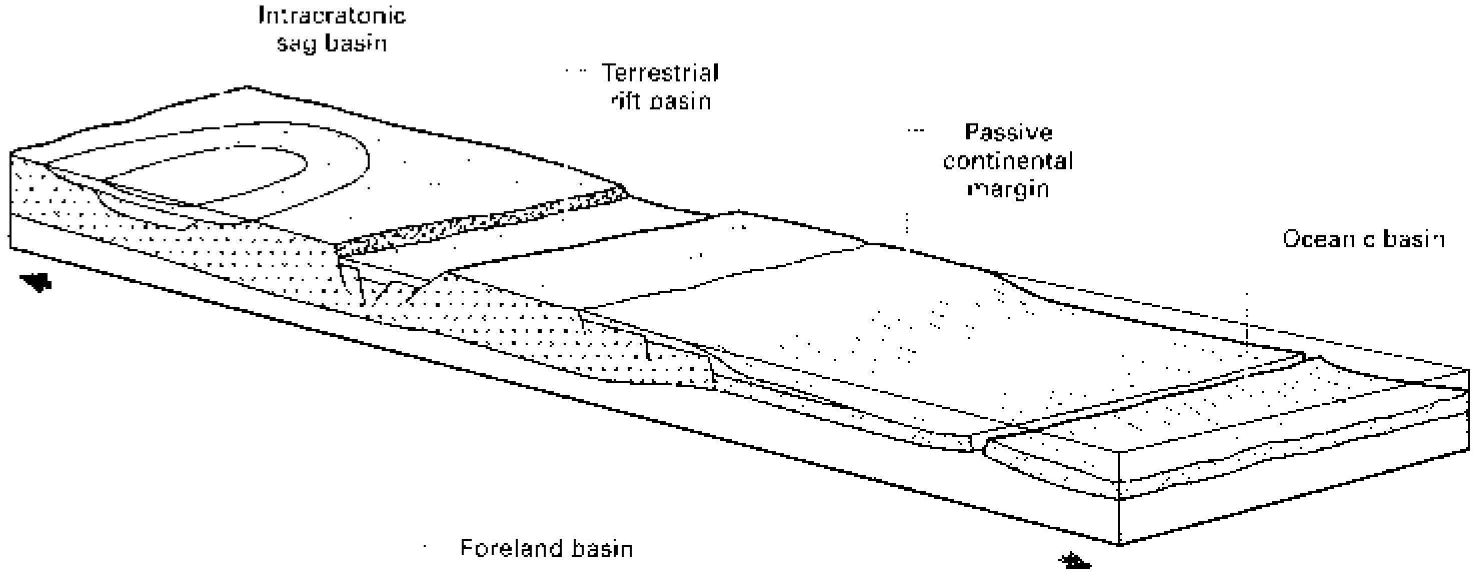
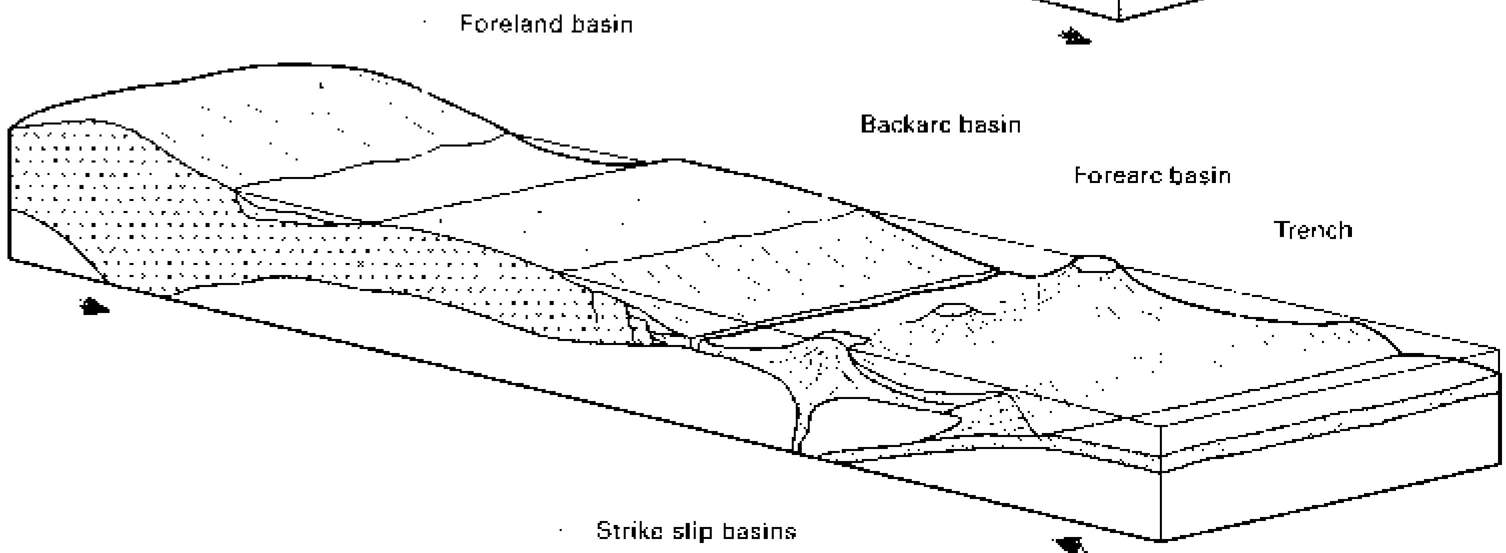
GEOL-201
Sedimentary Basins



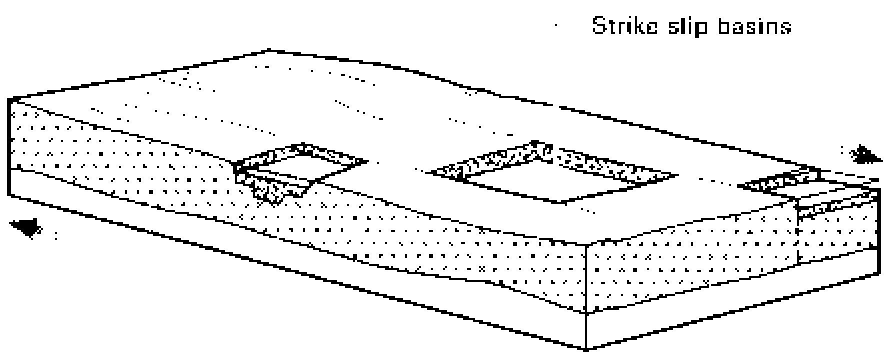
Cratonic basins

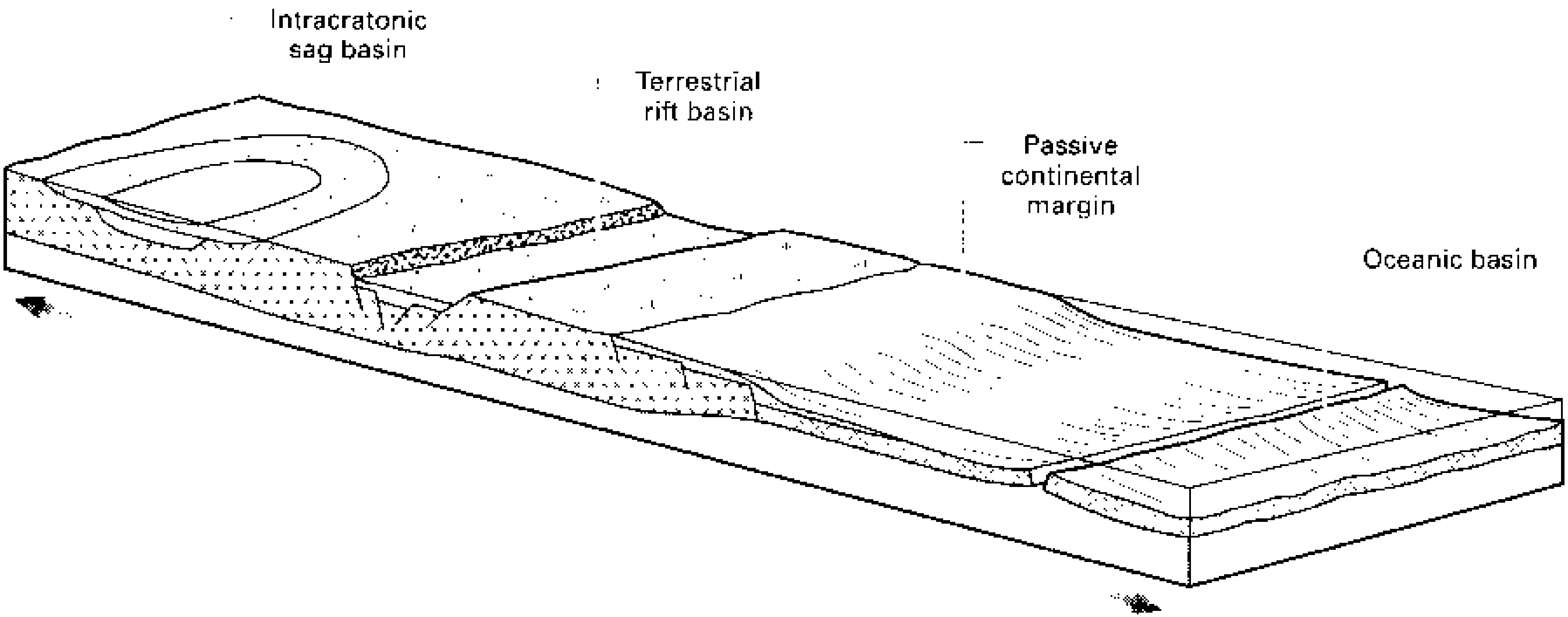


Convergence related basins



Strike-slip basins





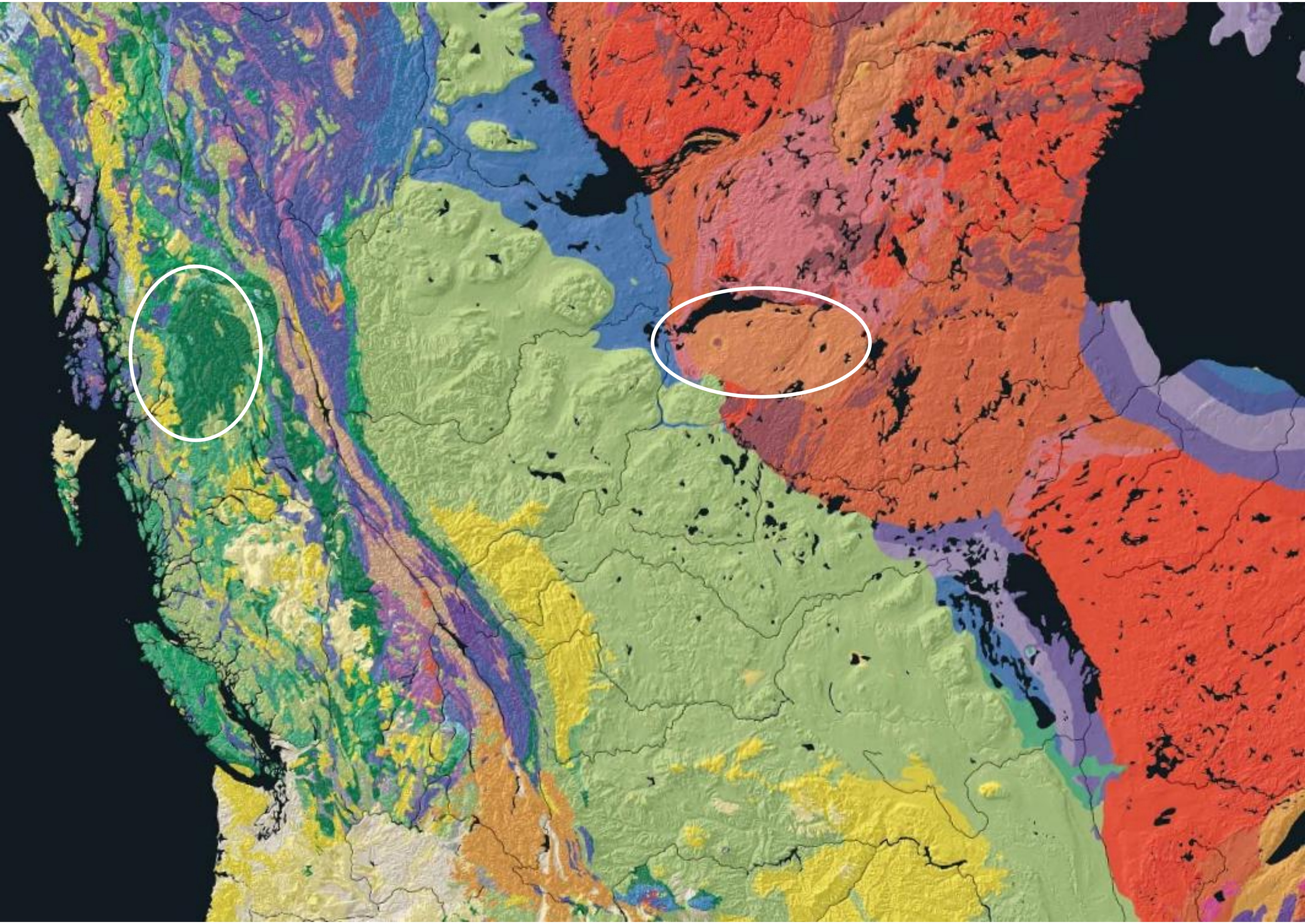
Intracratonic
sag basin
Terrestrial
rift basin
Passive
continental
margin
Oceanic basin

Intracratonic basins form within stable continental interiors. A good example is the Western Canada Sedimentary Basin extending from the eastern side of the Rocky Mountains to central Manitoba.

Examples of a smaller intracratonic basins are the Proterozoic Athabasca Basin in Saskatchewan and the Mesozoic Bowser Basin in northwestern BC.

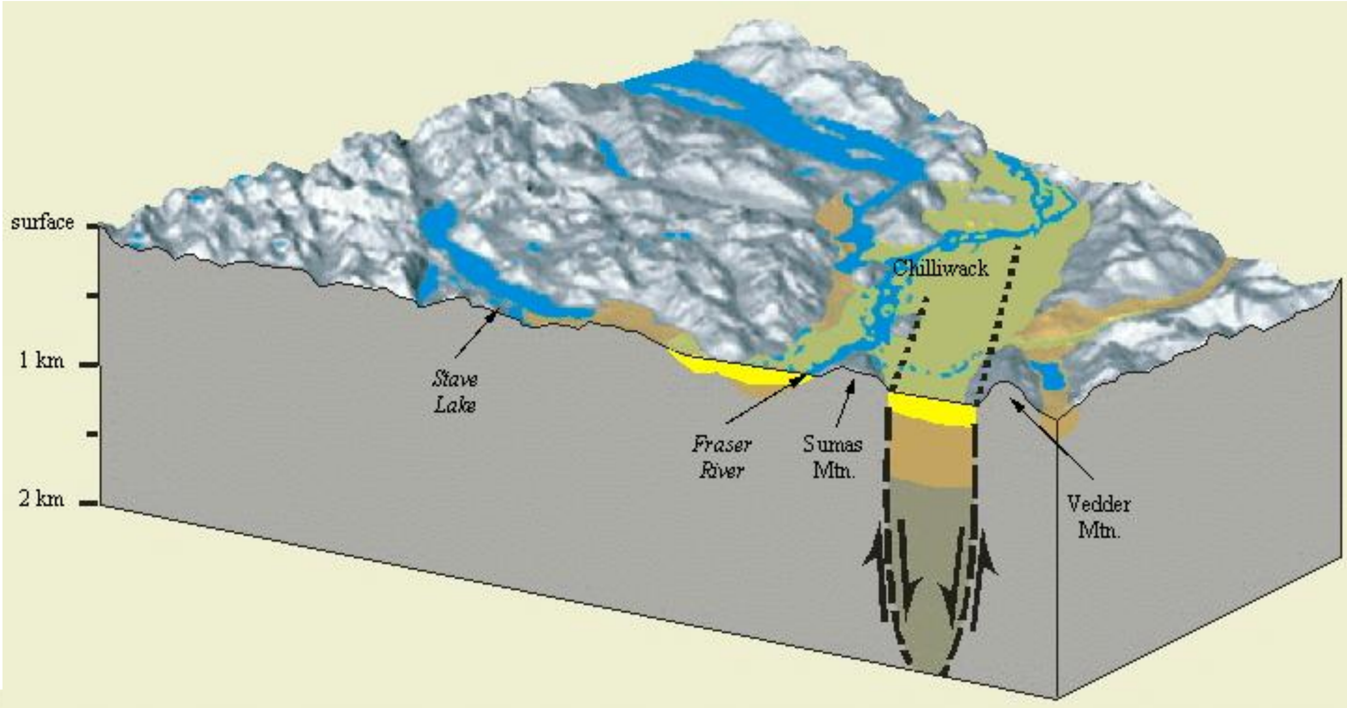
A modern example is Hudson Bay.

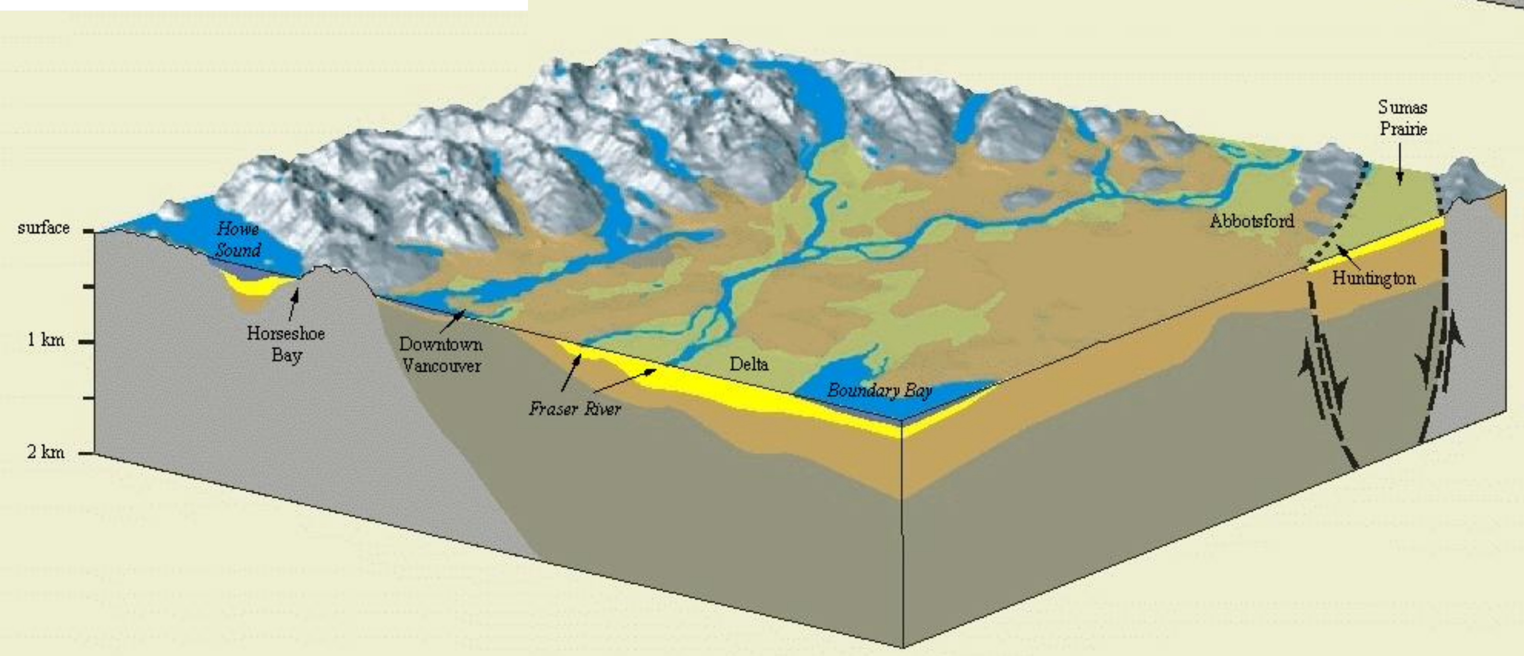
In all cases the underlying crustal rock is continental not oceanic.



Terrestrial rift basins form during rifting of a continent. The most obvious modern example is the East African rift. Rift basins don't necessarily result in continental rifting.

Other modern examples are Lake Baikal in Russia and the valley of the Rhine River in Europe (Rhine Graben) and the eastern part of the Fraser Valley



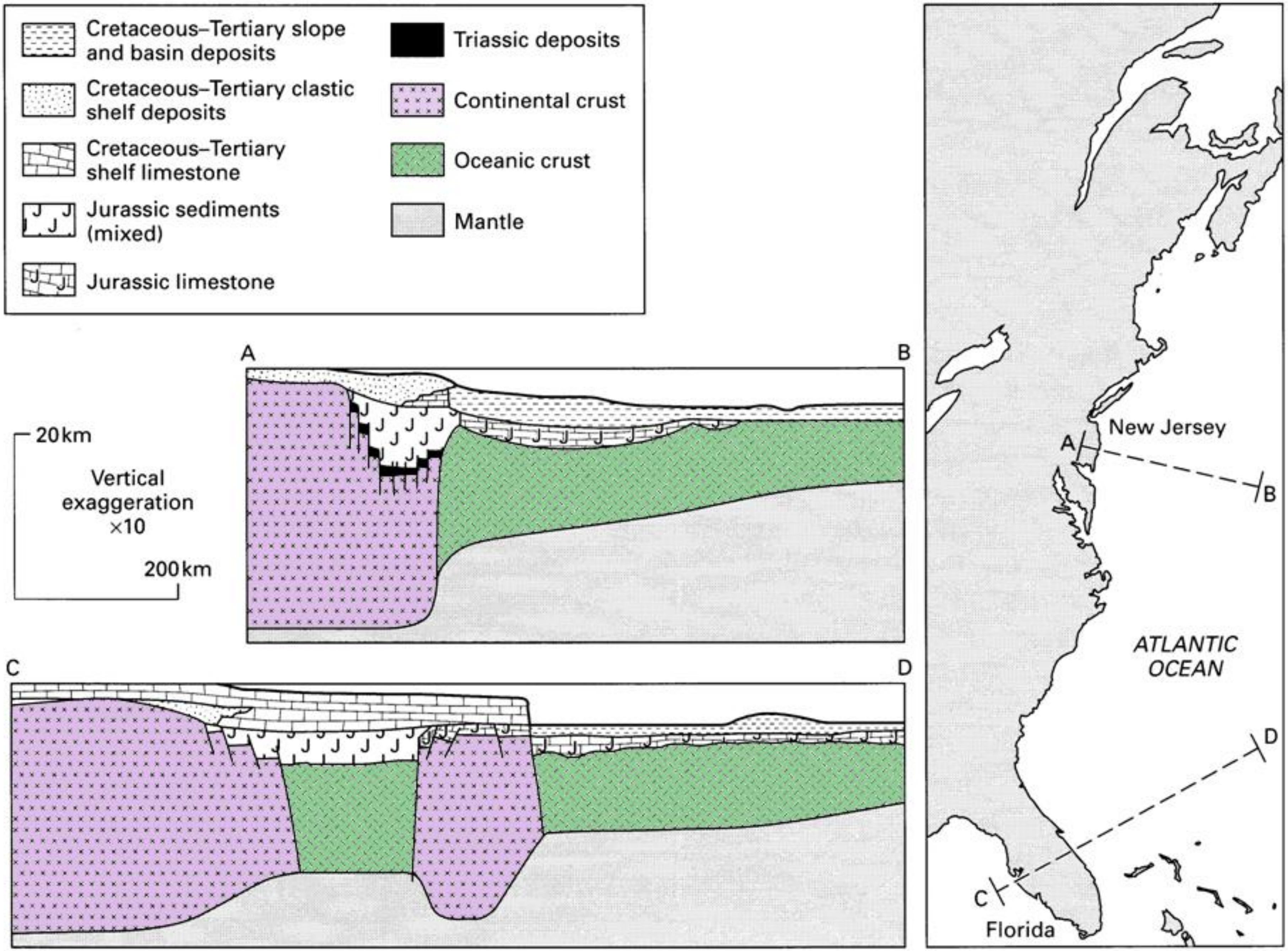


From GeoMap Vancouver

Passive margin basins form along continental-ocean margins where no subduction is taking place. Eamples include the eastern coasts of North and South America and the US Gulf Coast.

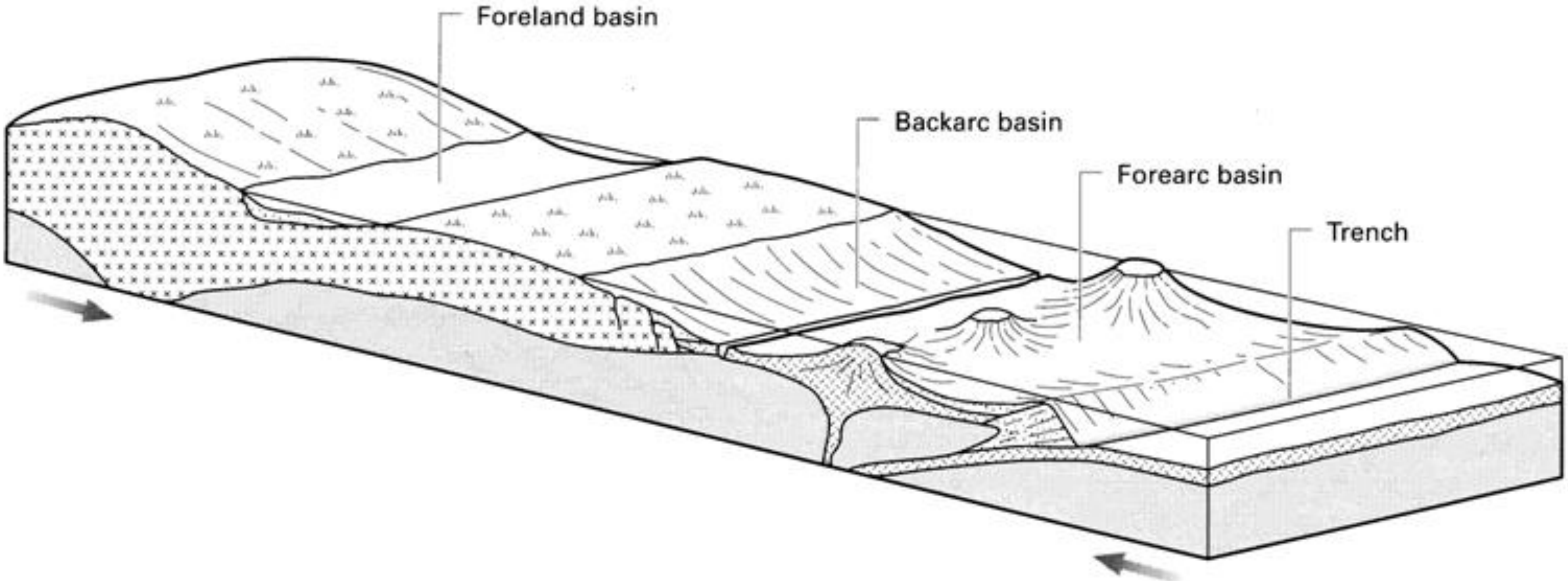
The west coast of North America was a passive margin basin from around 700 to 200 Ma and the sediments are now seen in the Rocky Mts.

PMBs can accommodate sediment accumulations as much as 20 km thick.

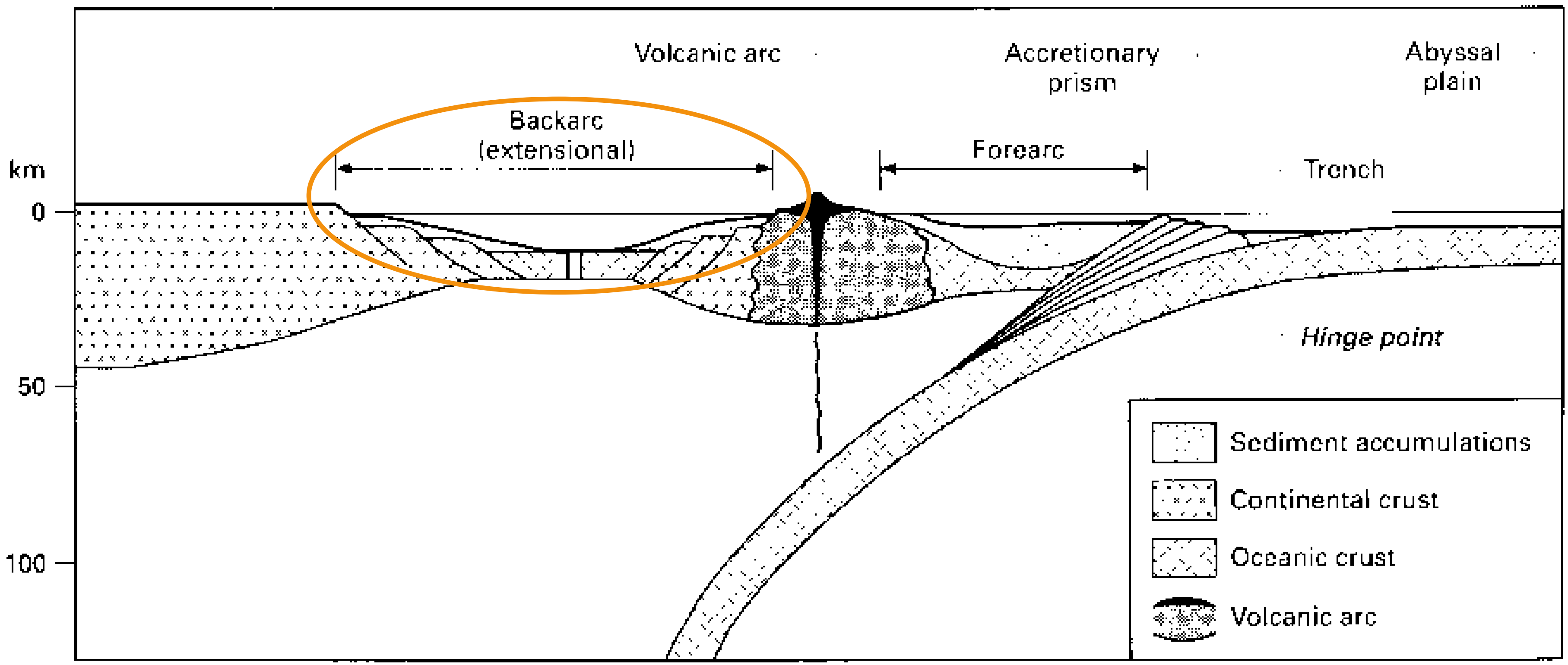


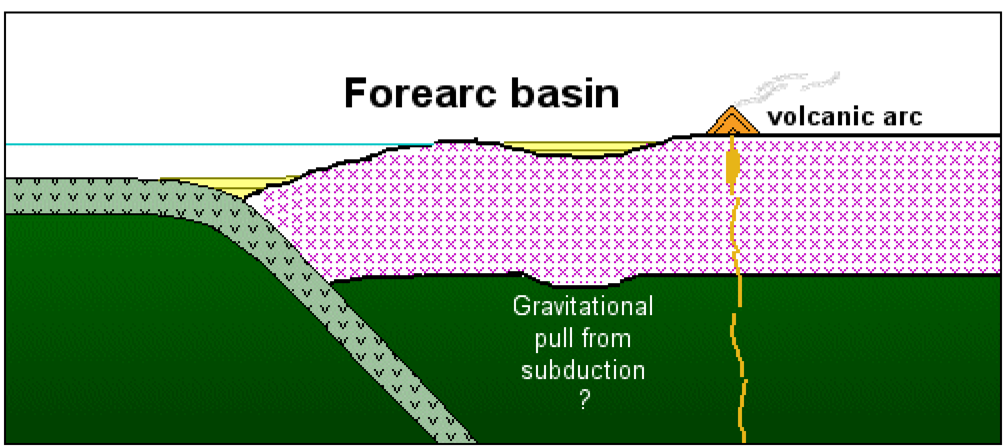
Cretaceous–Tertiary slope and basin deposits
Cretaceous–Tertiary clastic shelf deposits
Cretaceous–Tertiary shelf limestone
Jurassic sediments (mixed)
Jurassic limestone
Triassic deposits
Continental crust
Oceanic crust
Mantle
A
B
C
D
20 km
Vertical exaggeration ×10
200 km
New Jersey
ATLANTIC OCEAN
Florida

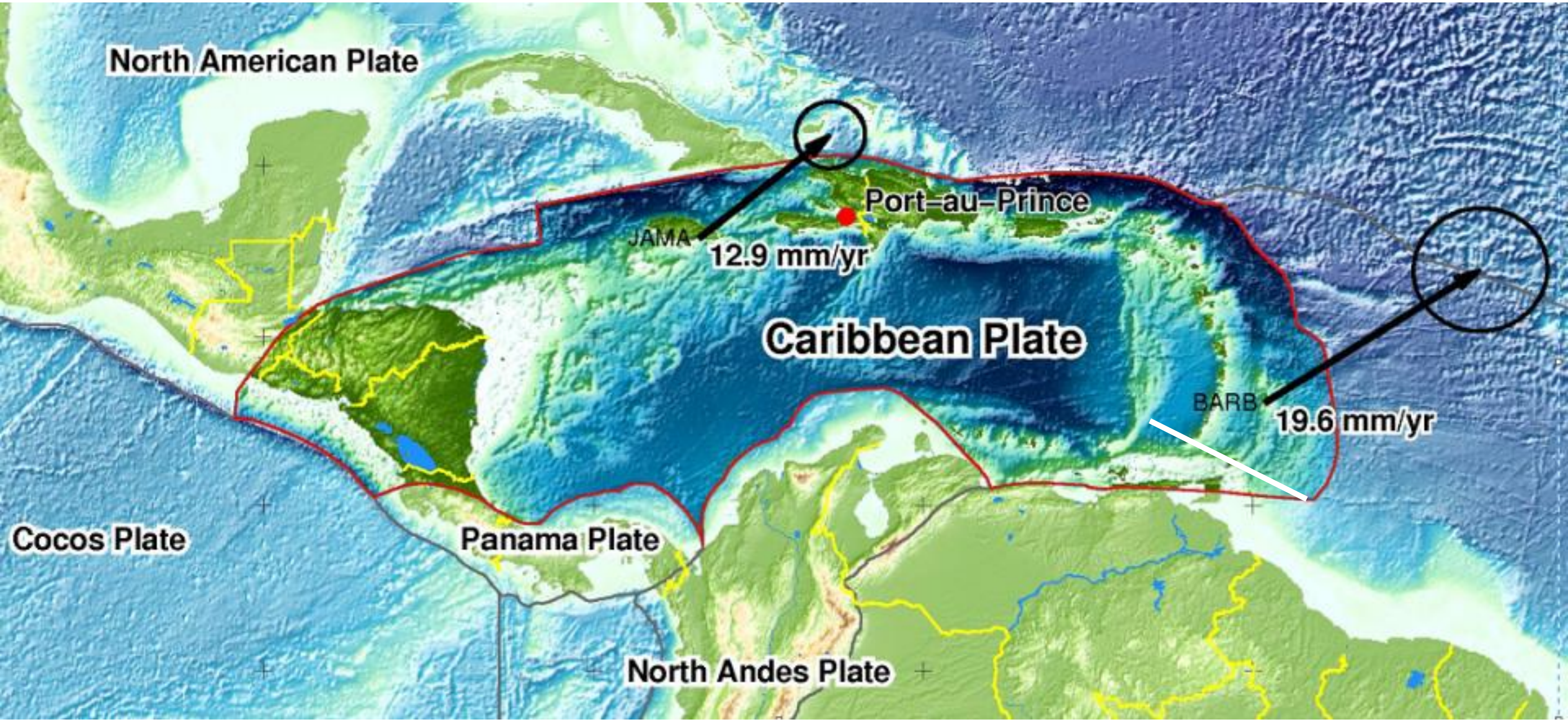
Convergence basins

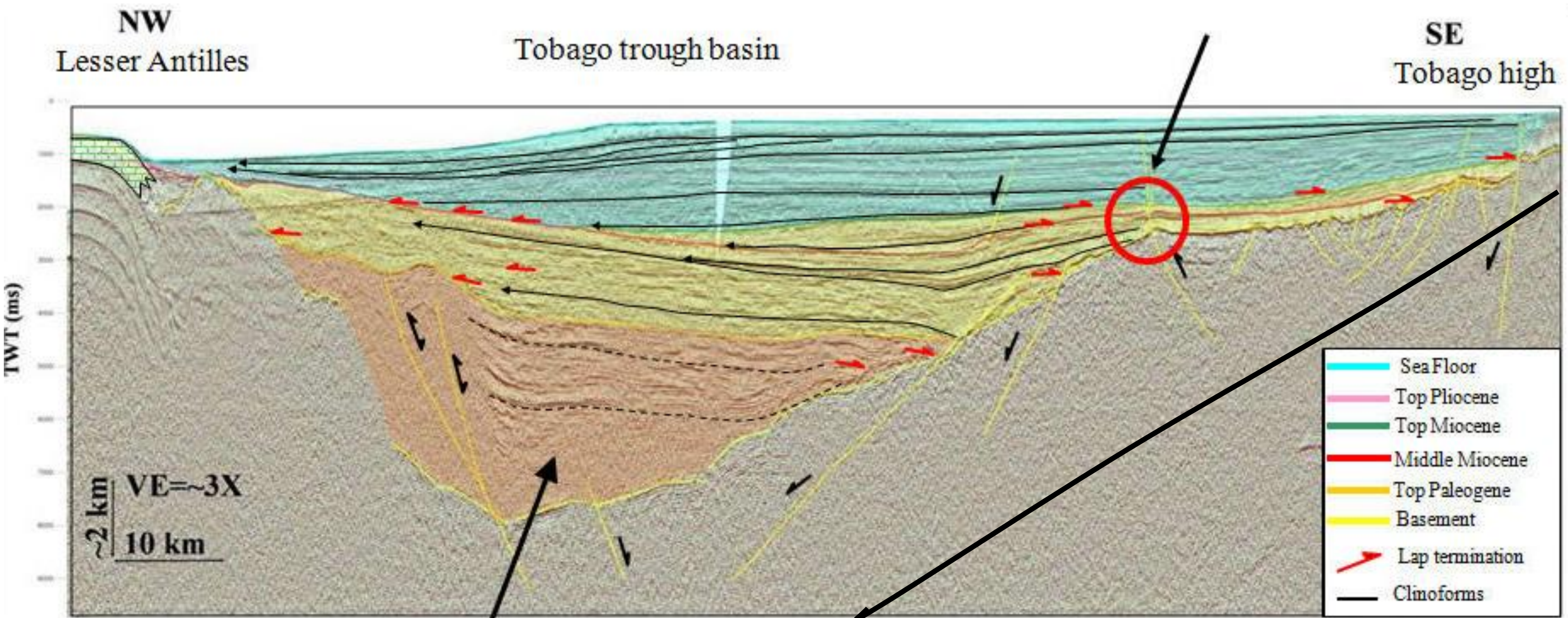


Trench, forearc, foreland and backarc basins form at active subduction boundaries.


Volcanic arc
Accretionary prism
Abyssal plain
Backarc (extensional)
Forearc
Trench
km
0
50
100
Hinge point
Sediment accumulations
Continental crust
Oceanic crust
Volcanic arc

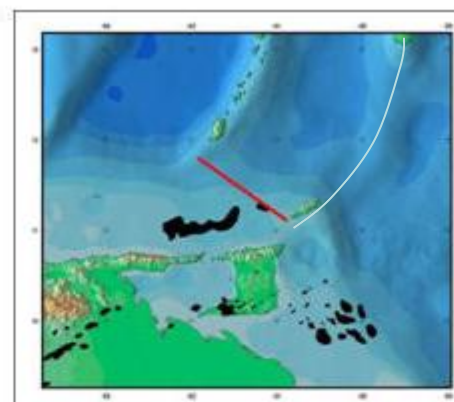

Forearc basin
volcanic arc
Gravitational pull from subduction ?


North American Plate
Port–au–Prince
JAMA
12.9 mm/yr
Caribbean Plate
BARB
19.6 mm/yr
Cocos Plate
Panama Plate
North Andes Plate

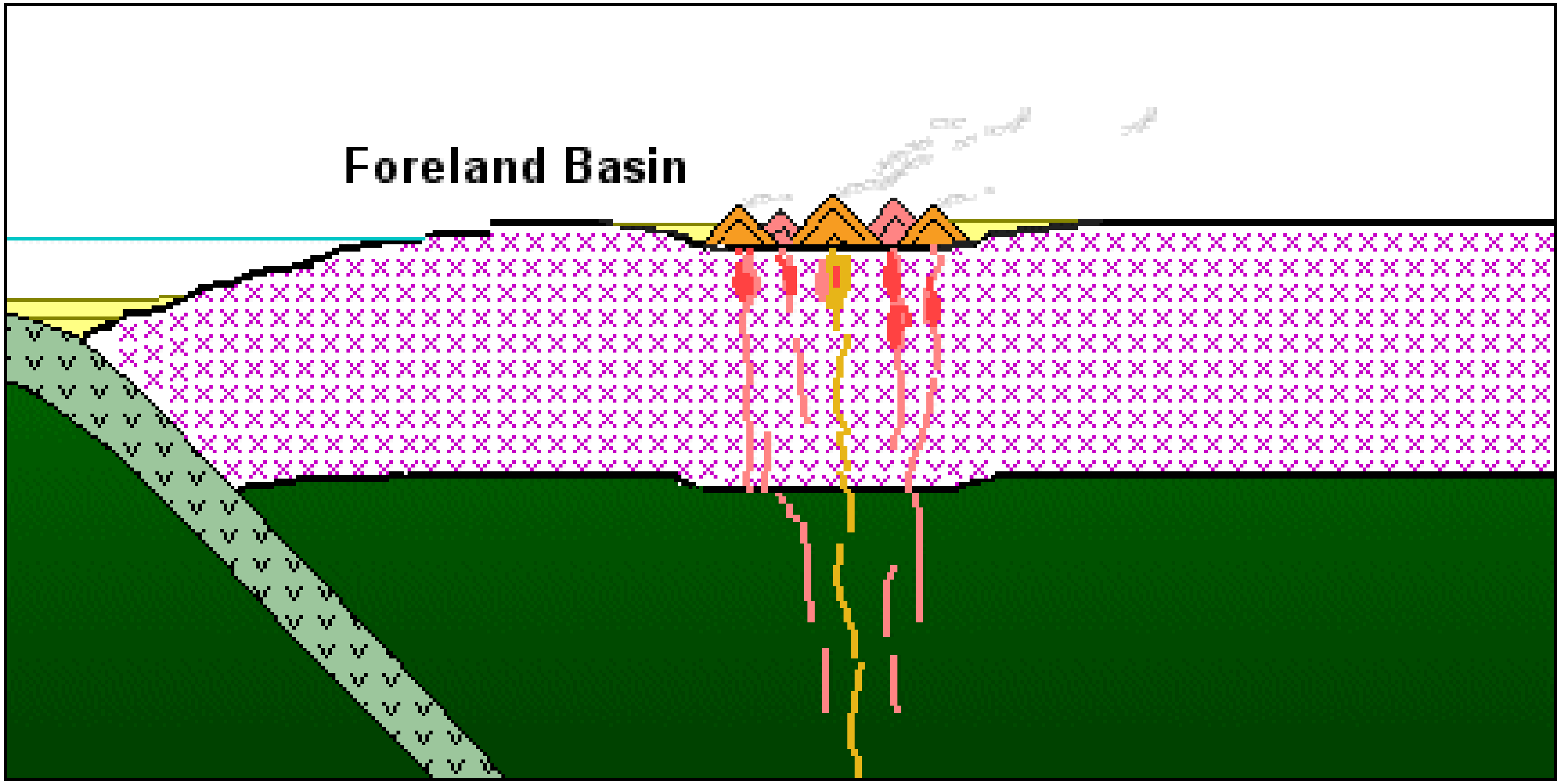


Paleogene: Potential source and reservoir rocks

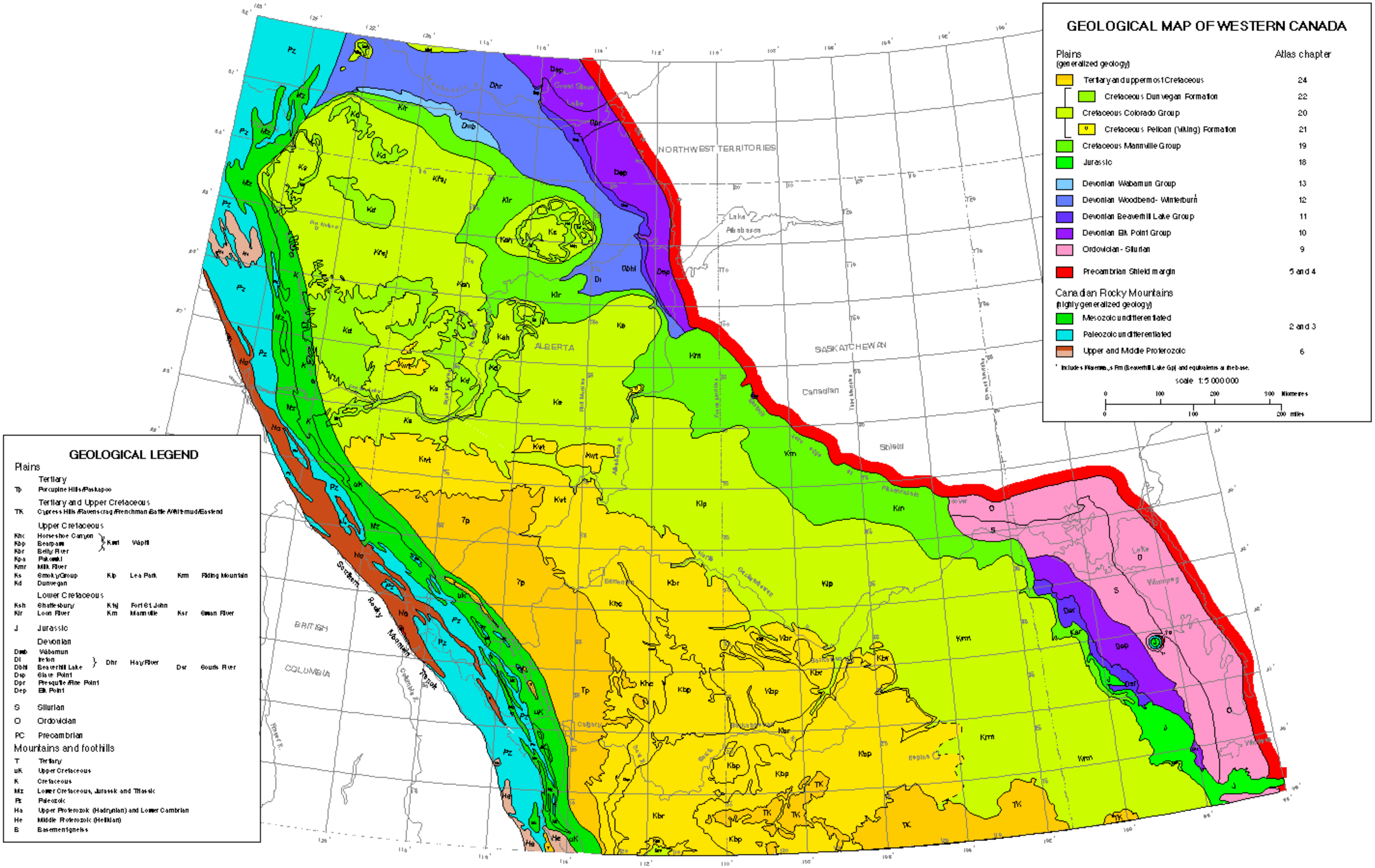
None or little indication of Cretaceous source rocks in this part of the Tobago basin



Foreland basins exist at convergent boundaries where large mountain belts have formed, such as the Coast Range, Andes, Rockies, Alps and Himalayas.

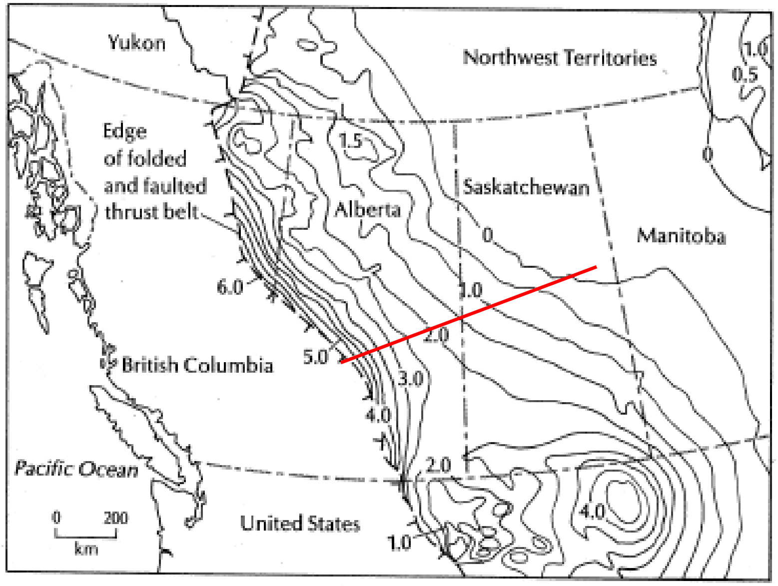

Foreland Basin

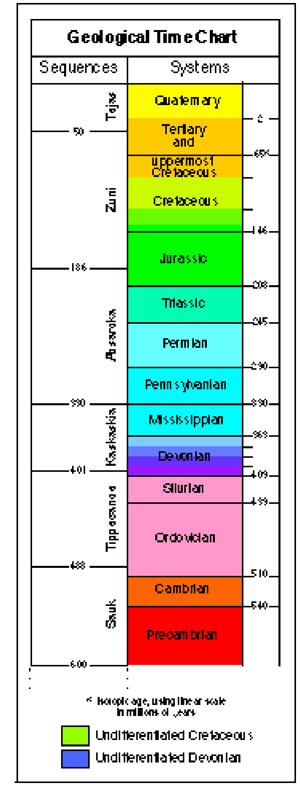
The WCSB is an intracratonic foreland basin

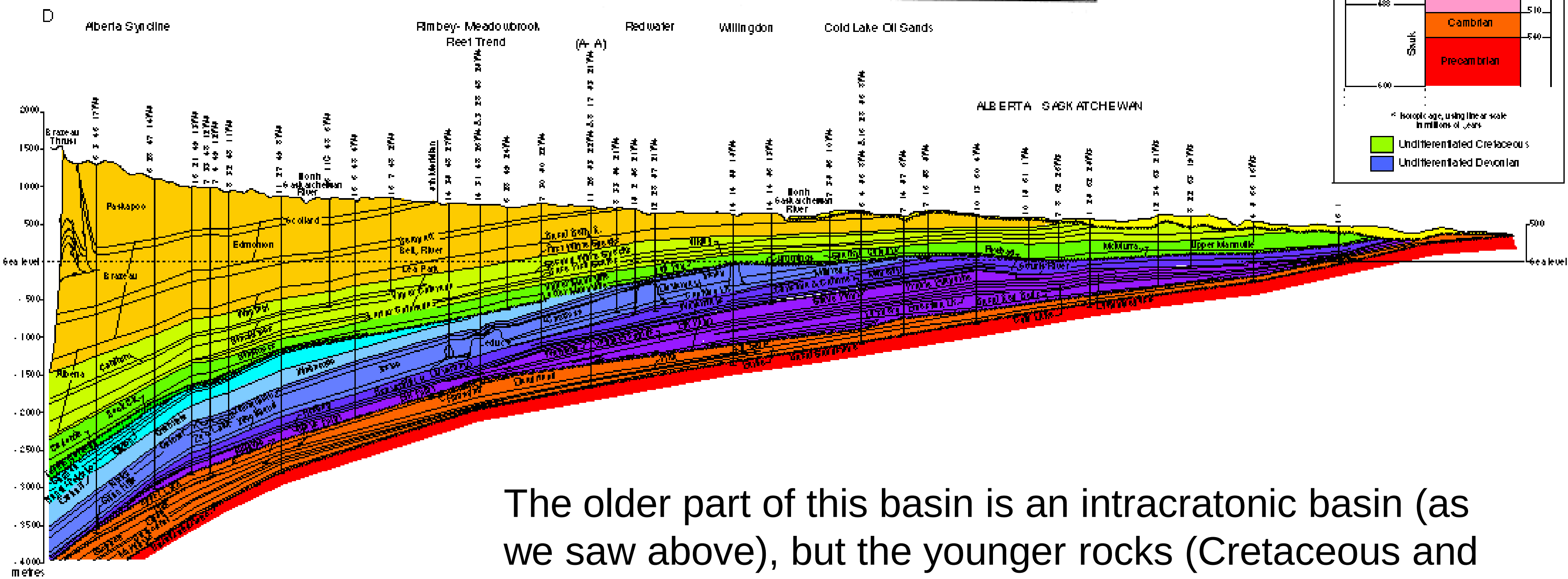


From Alberta Geological Survey

WCSB
(Foreland Basin)

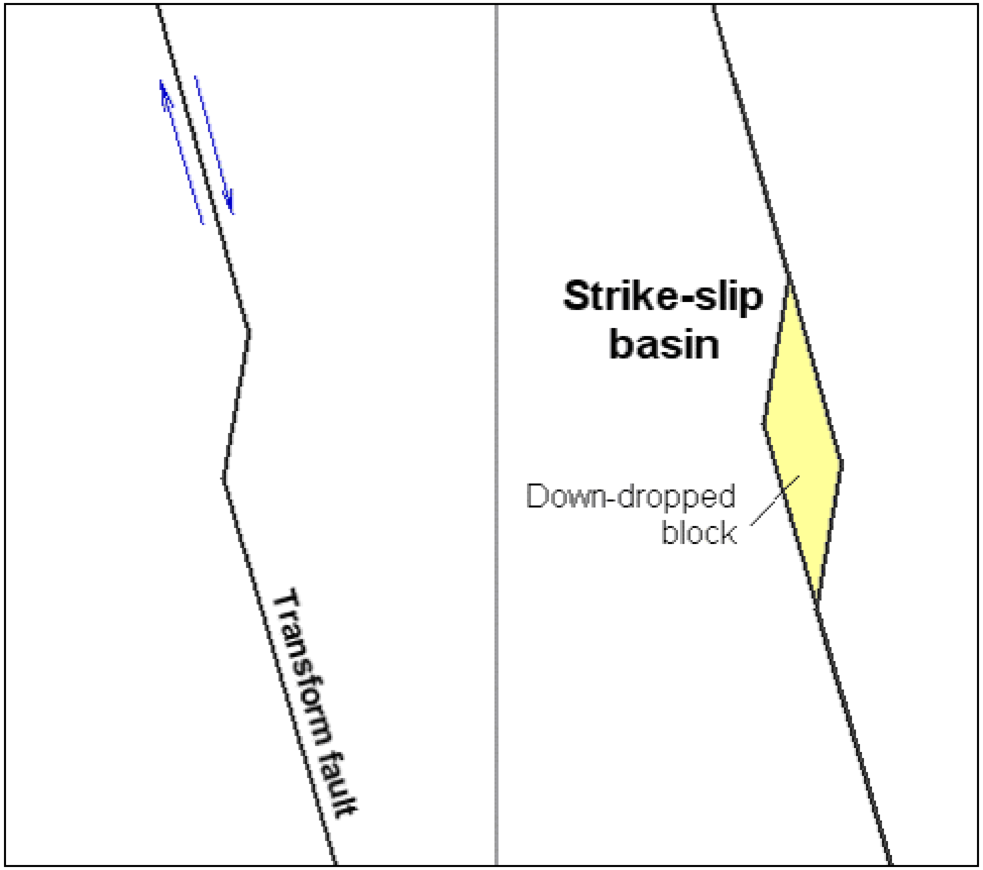


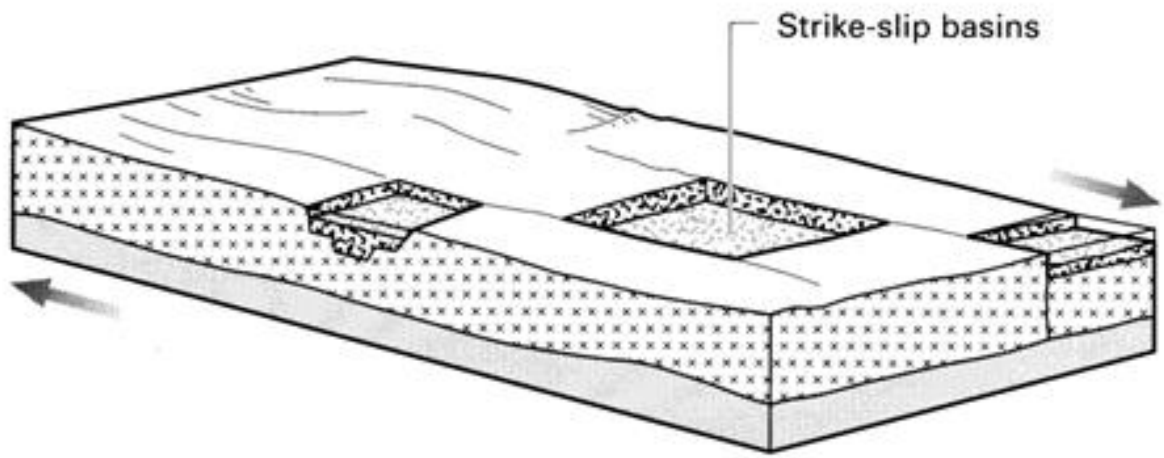


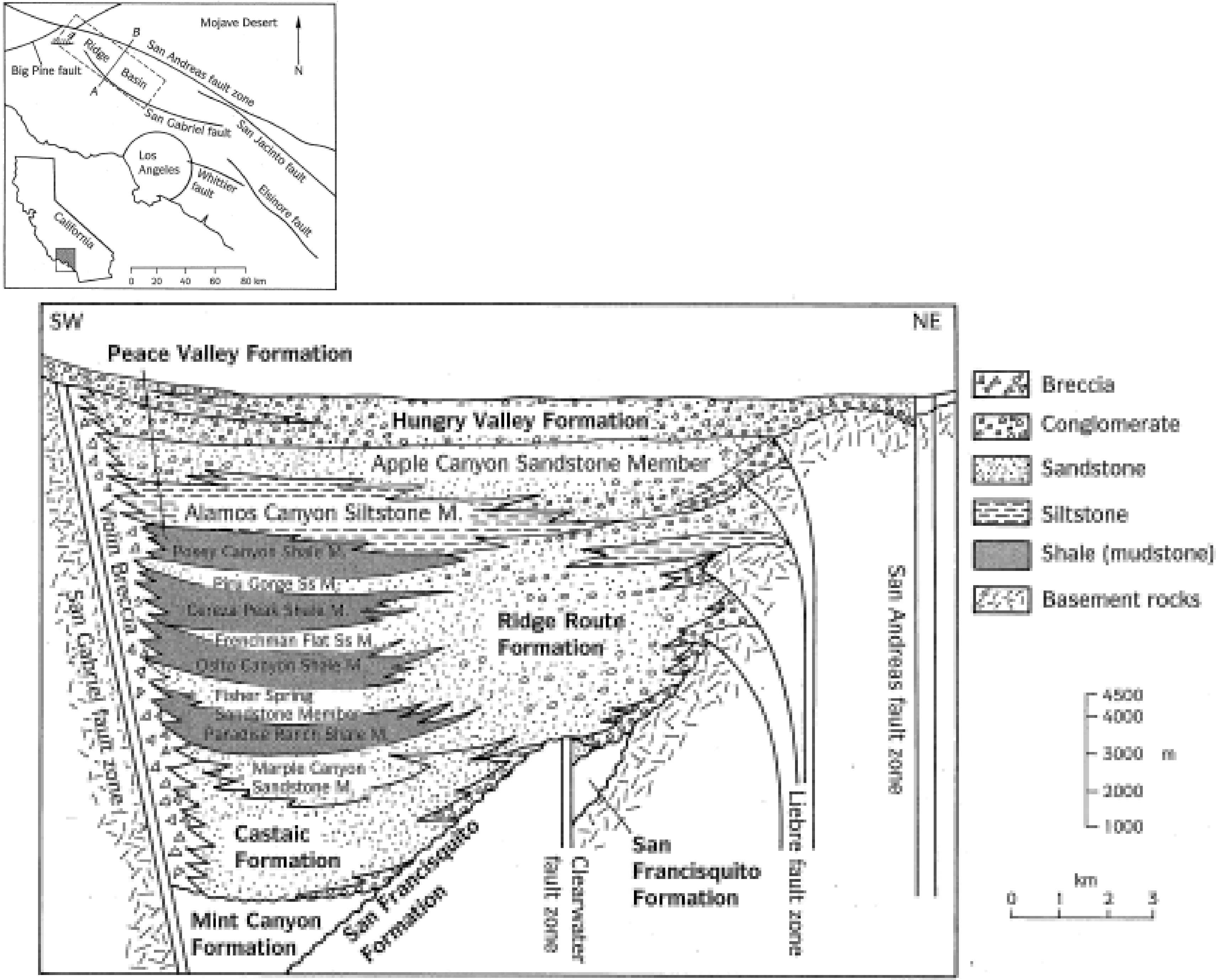


The older part of this basin is an intracratonic basin (as we saw above), but the younger rocks (Cretaceous and younger) accumulated in a foreland basin.

Pull-apart or strike-slip basins form along major transform faults where they bend, or between fault splays. They tend to be deep and narrow, and are characterized by very fast subsidence. There are some good examples along the San Andreas fault-zone.


Strike-slip
basin
Down-dropped
block
Transform fault


Strike-slip basins


Mojave Desert
N
B
Ridge
Basin
A
Big Pine fault
San Andreas fault zone
San Gabriel fault
San Jacinto fault
Los Angeles
Whittier fault
Elsinore fault
California
0 20 40 60 80 km
SW
NE
Peace Valley Formation
Hungry Valley Formation
Apple Canyon Sandstone Member
Alamos Canyon Siltstone M.
Posey Canyon Shale M.
Piru Gorge Ss M.
Cereza Peak Shale M.
Frenchman Flat Ss M.
Osito Canyon Shale M.
Fisher Spring Sandstone Member
Paradise Ranch Shale M.
Marple Canyon Sandstone M.
Violin Breccia
San Gabriel fault zone
Ridge Route Formation
Castaic Formation
Mint Canyon Formation
San Francisquito Formation
Clearwater fault zone
San Francisquito Formation
Liebre fault zone
San Andreas fault zone
Breccia
Conglomerate
Sandstone
Siltstone
Shale (mudstone)
Basement rocks
4500
4000
3000 m
2000
1000
km
0 1 2 3

B

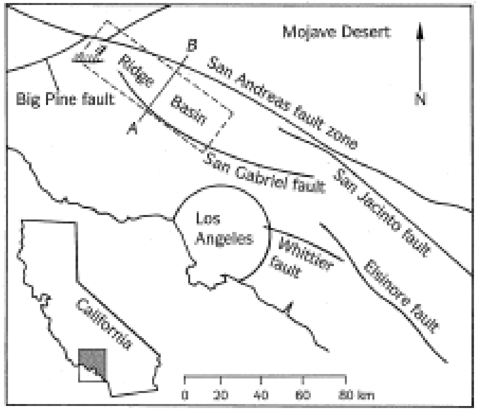
Accommodation

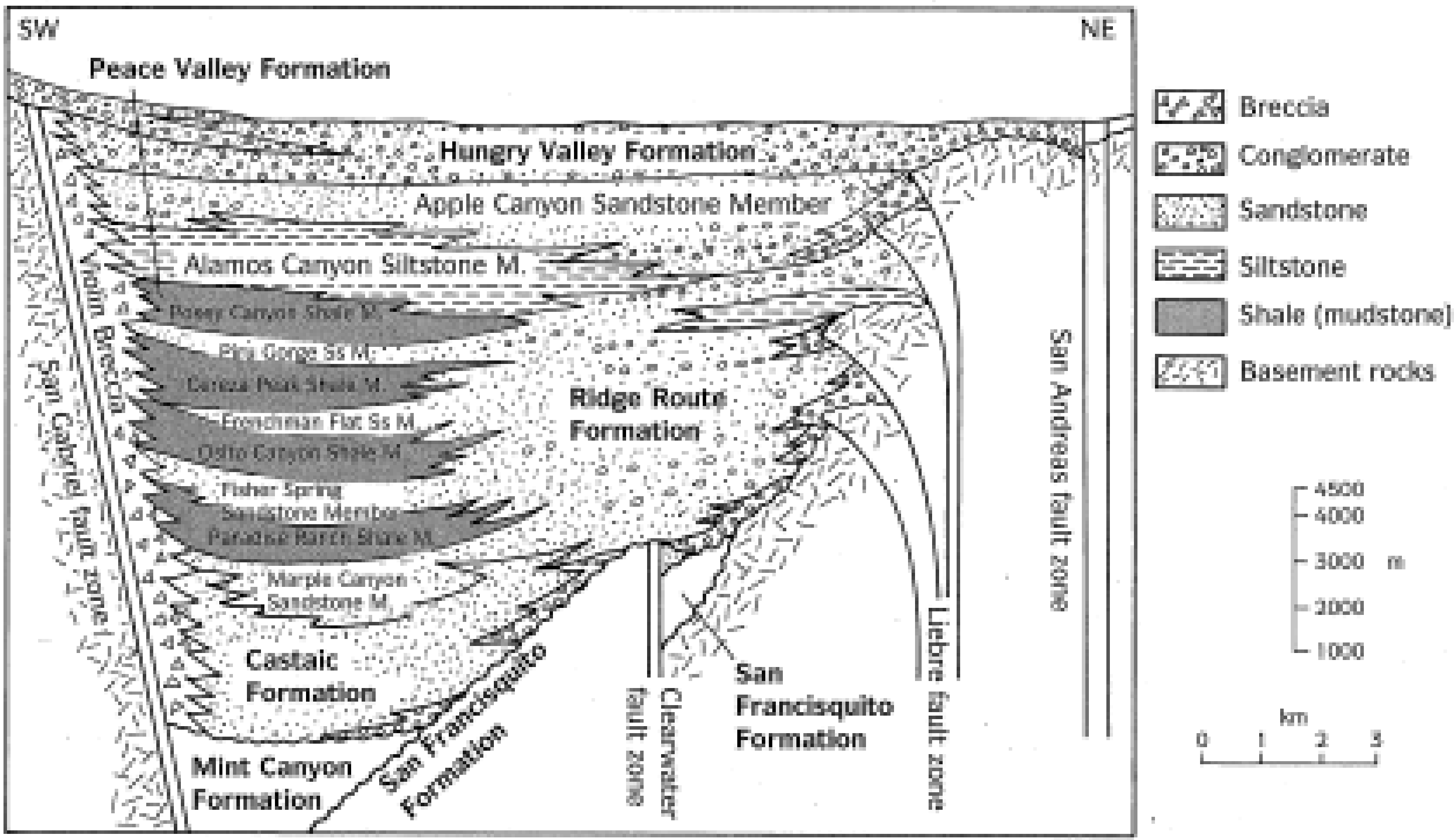
In the context of sedimentary basins "accommodation" refers to the amount of vertical space available for sediments to accumulate.

Accommodation

When sediments accumulate, the basin in which they are being deposited will tend to subside because of isostasy.

If a basin is filling up faster than the rate of subsidence then the deposition will move elsewhere – either to a new basin – or farther out into the ocean.


Mojave Desert
N
B
A
Ridge
Basin
Big Pine fault
San Andreas fault zone
San Gabriel fault
San Jacinto fault
Los Angeles
Whittier fault
Elsinore fault
California
0 20 40 60 80 km

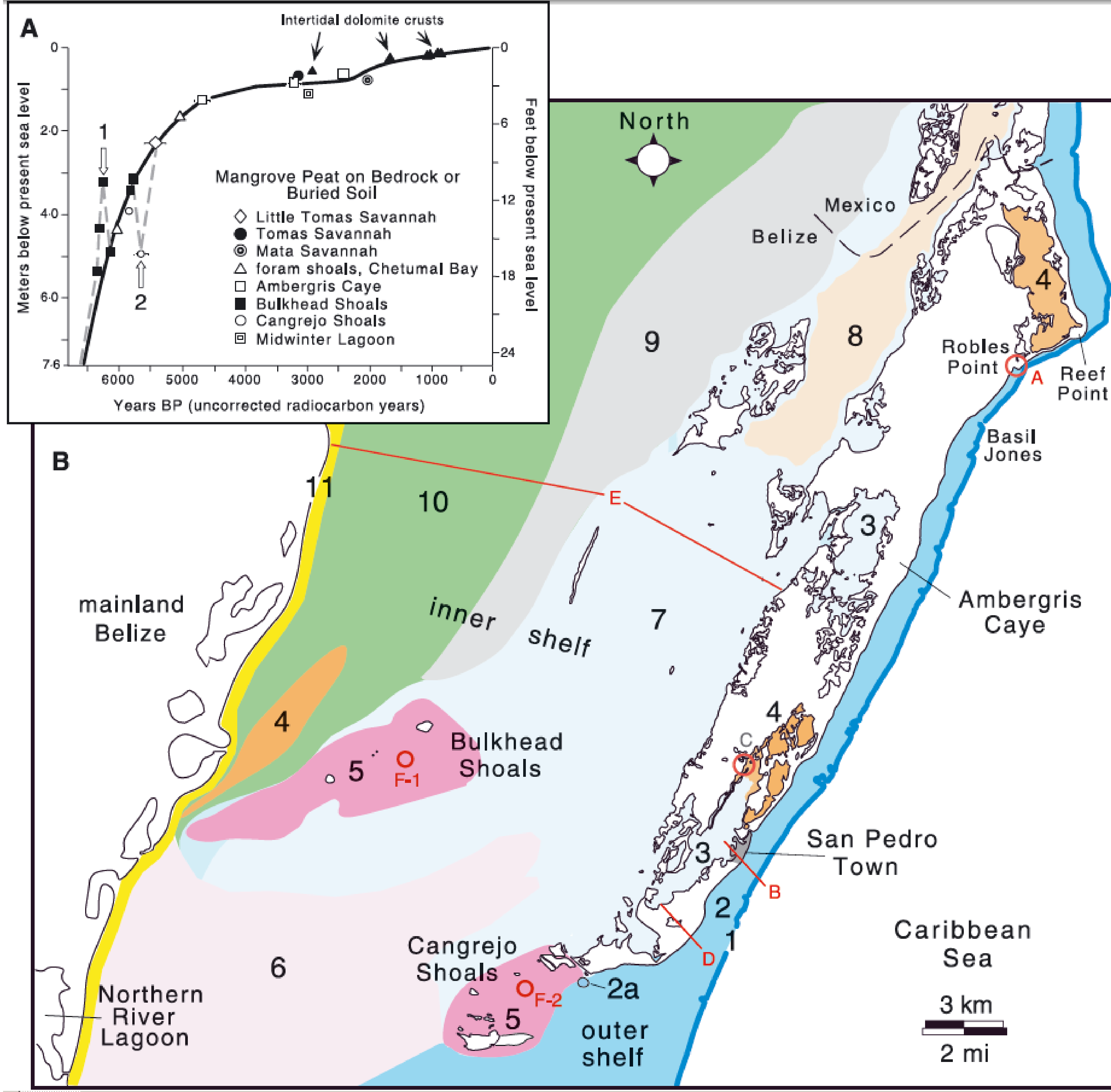

SW
NE
Peace Valley Formation
Hungry Valley Formation
Apple Canyon Sandstone Member
Alamos Canyon Siltstone M.
Posey Canyon Shale M.
Piru Gorge Ss M.
Cereza Peak Shale M.
Frenchman Flat Ss M.
Osito Canyon Shale M.
Fisher Spring Sandstone Member
Paradise Ranch Shale M.
Marple Canyon Sandstone M.
Ridge Route Formation
Violin Breccia
San Gabriel fault zone
Castaic Formation
Mint Canyon Formation
San Francisquito Formation
Clearwater fault zone
San Francisquito Formation
Liebre fault zone
San Andreas fault zone
Breccia
Conglomerate
Sandstone
Siltstone
Shale (mudstone)
Basement rocks
4500
4000
3000
2000
1000
m
km
0 1 2 3

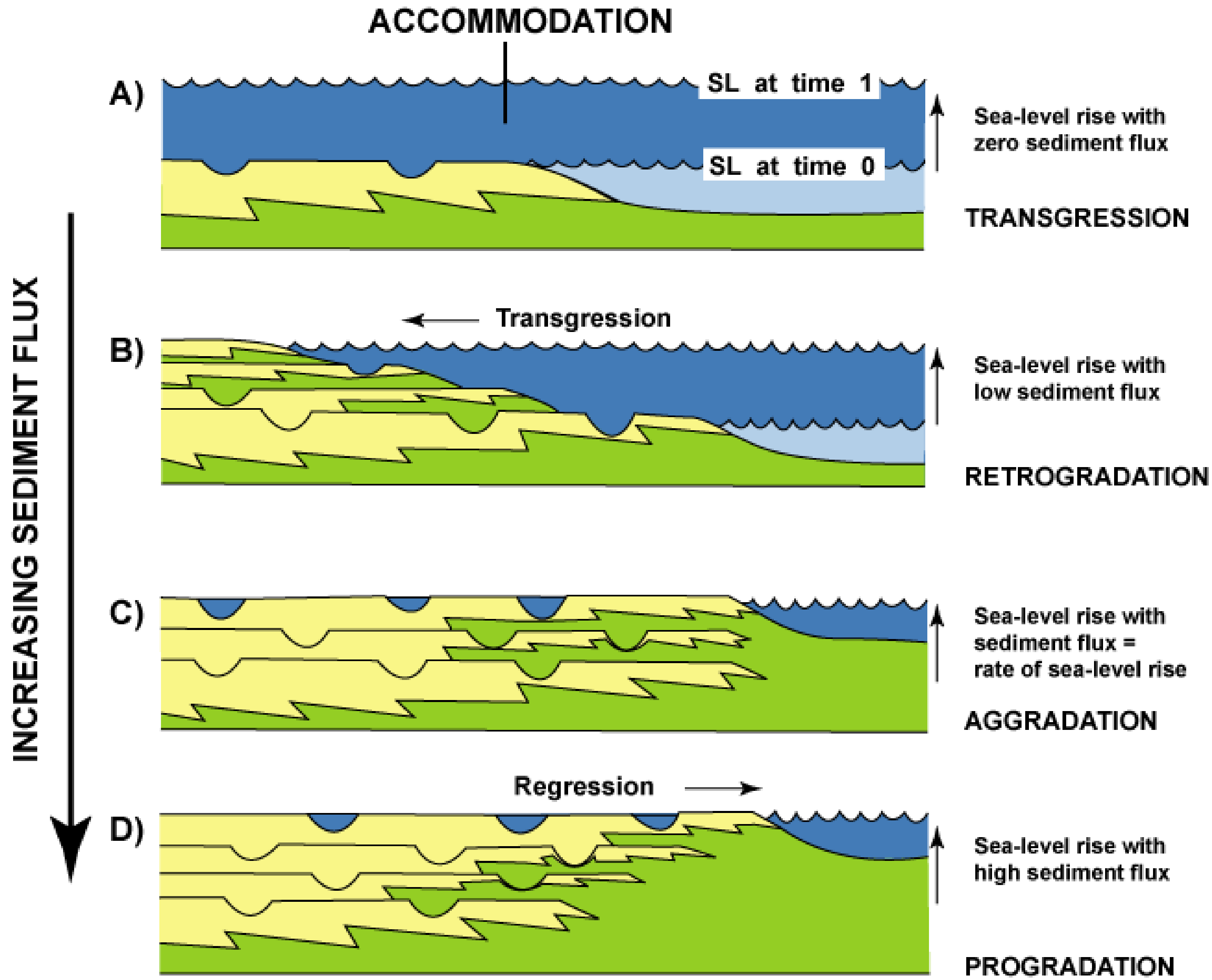
B

Accommodation

Accommodation is affected by other tectonic processes and by sea-level rise.

Sea level rose dramatically after the end of the last glaciation and the impact is observed on shallow marine shelves like the one in Belize.


A
Intertidal dolomite crusts
Meters below present sea level
Feet below present sea level
0
2.0
4.0
6.0
7.6
0
6
12
18
24
1
2
Mangrove Peat on Bedrock or Buried Soil
Little Tomas Savannah
Tomas Savannah
Mata Savannah
foram shoals, Chetumal Bay
Ambergris Caye
Bulkhead Shoals
Cangrejo Shoals
Midwinter Lagoon
6000
5000
4000
3000
2000
1000
0
Years BP (uncorrected radiocarbon years)
B
North
Mexico
Belize
9
8
4
Robles Point
A
Reef Point
Basil Jones
11
10
E
3
mainland Belize
inner shelf
7
Ambergris Caye
4
Bulkhead Shoals
5
F-1
4
C
San Pedro Town
3
B
2
D
1
Caribbean Sea
6
Cangrejo Shoals
F-2
2a
5
Northern River Lagoon
outer shelf
3 km
2 mi



After Posametier & Allen, 1999