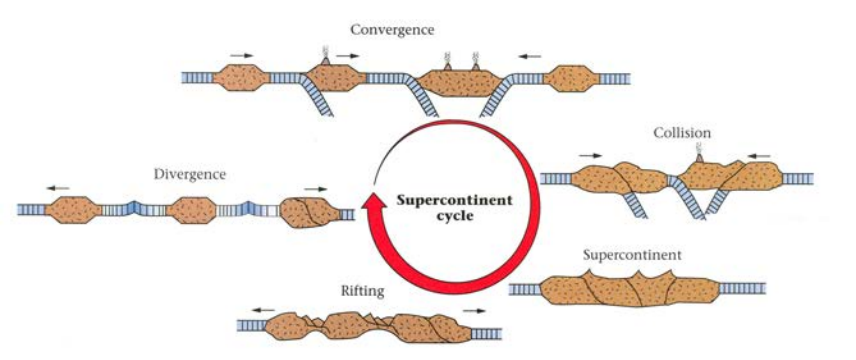
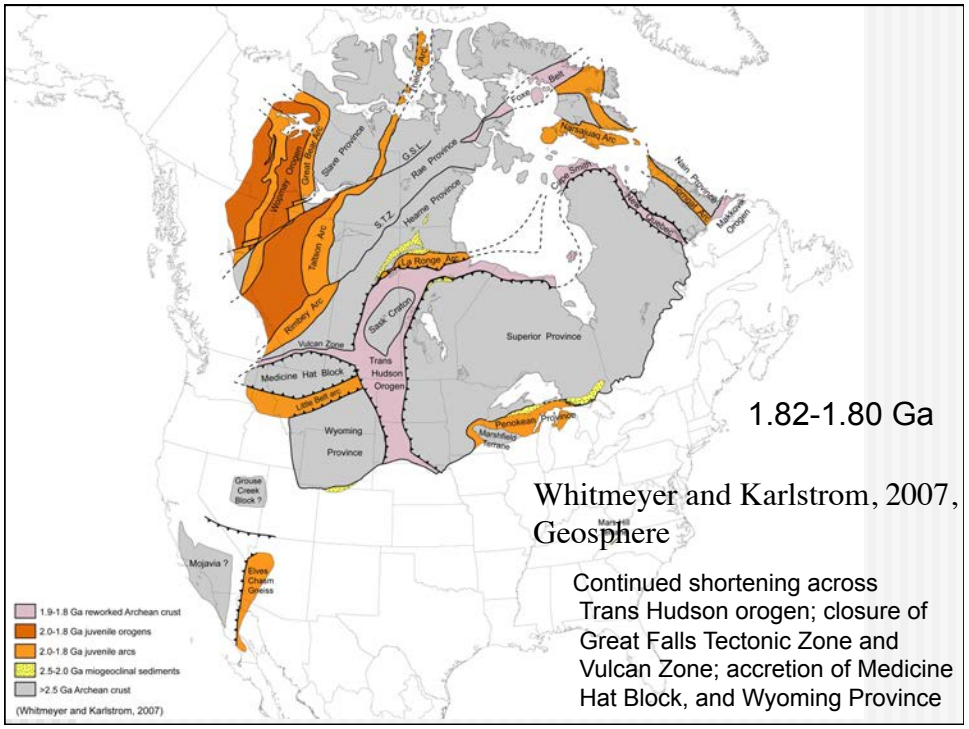
The Wilson Cycle



Marshak, 2005

Supercontinents

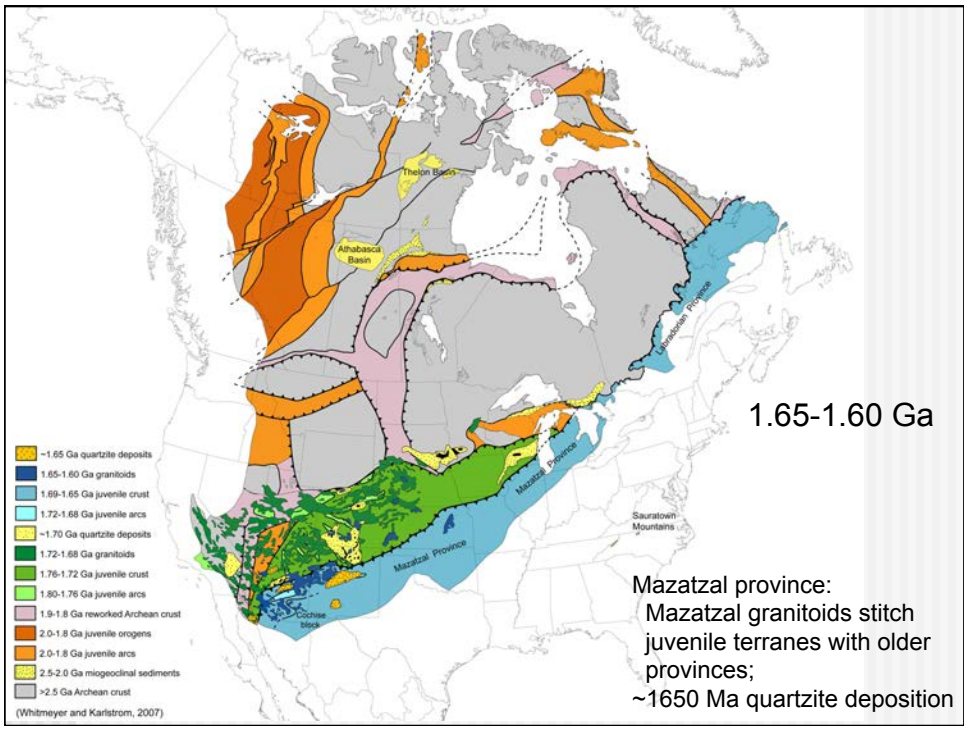
- Vaalbara-3.1 Ga
- Kenorland-2.7 Ga
- Nuna (or Columbia)-2.0-1.8 Ga
- Rodinia-1.1 Ga
- Pangea-270 Ma



1.82-1.80 Ga

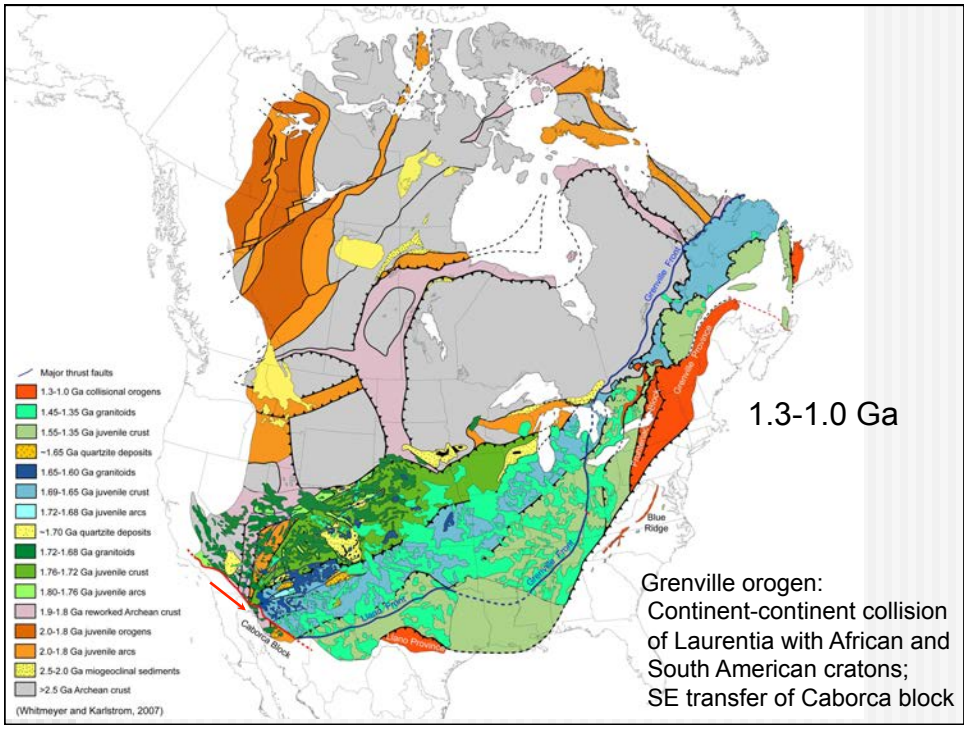
Whitmeyer and Karlstrom, 2007, Geosphere

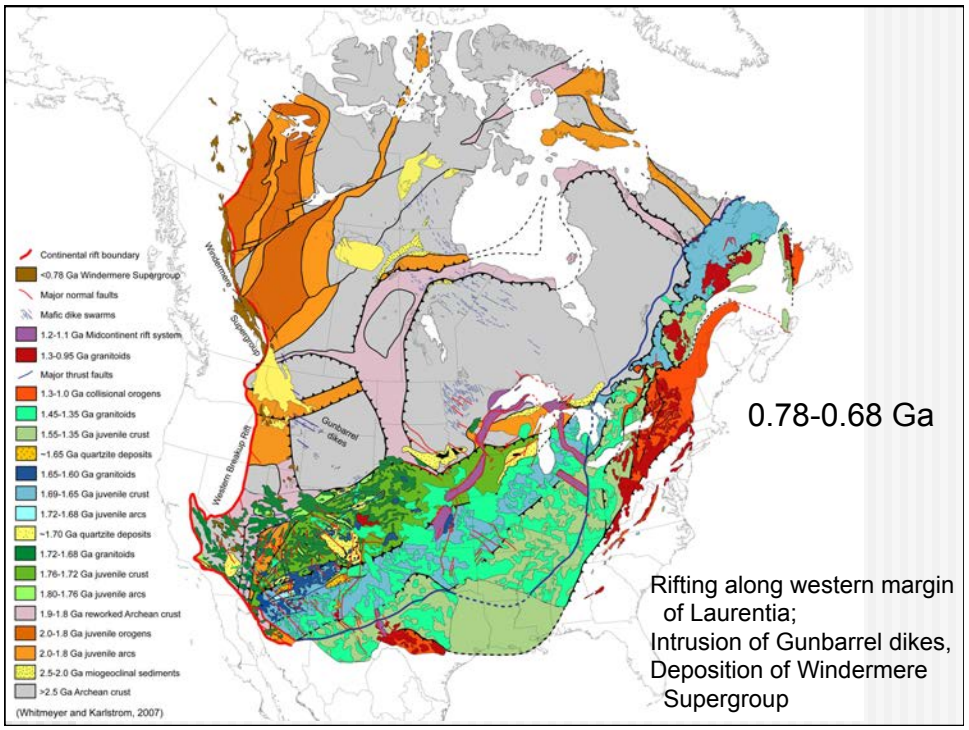
Continued shortening across Trans Hudson orogen; closure of Great Falls Tectonic Zone and Vulcan Zone; accretion of Medicine Hat Block, and Wyoming Province

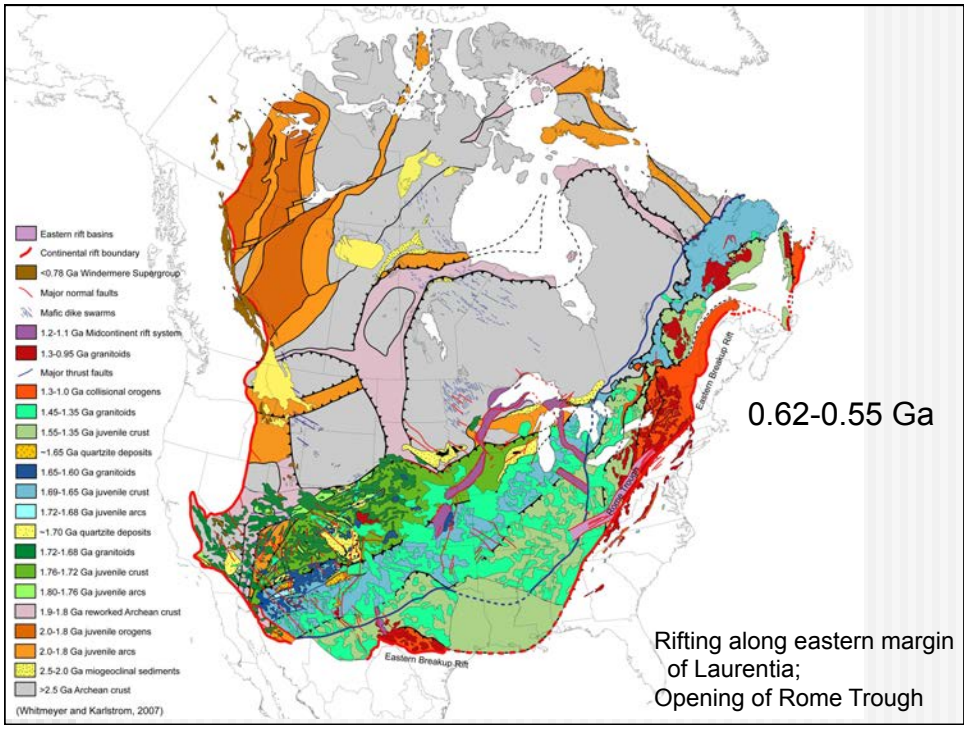


1.65-1.60 Ga

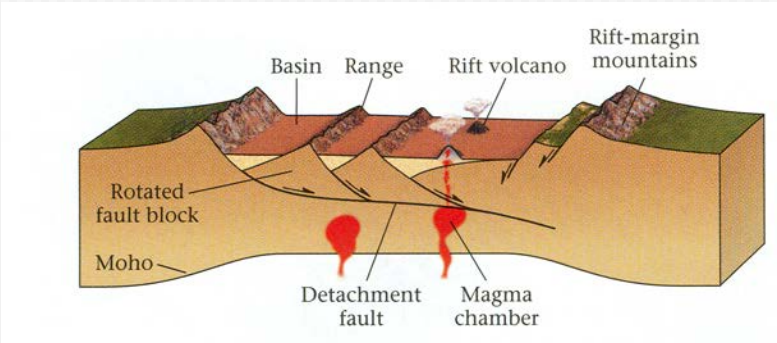
Mazatzal province:
Mazatzal granitoids stitch juvenile terranes with older provinces;
~1650 Ma quartzite deposition


Major thrust faults
1.3-1.0 Ga collisional orogens
1.45-1.35 Ga granitoids
1.55-1.35 Ga juvenile crust
~1.65 Ga quartzite deposits
1.65-1.60 Ga granitoids
1.69-1.65 Ga juvenile crust
1.72-1.68 Ga juvenile arcs
~1.70 Ga quartzite deposits
1.72-1.68 Ga granitoids
1.76-1.72 Ga juvenile crust
1.80-1.76 Ga juvenile arcs
1.9-1.8 Ga reworked Archean crust
2.0-1.8 Ga juvenile orogens
2.0-1.8 Ga juvenile arcs
2.5-2.0 Ga miogeoclinal sediments
>2.5 Ga Archean crust
(Whitmeyer and Karlstrom, 2007)
Grenville Front
Grenville Front
Blue Ridge
Caborca Block
Llano Province
1.3-1.0 Ga
Grenville orogen:
Continent-continent collision
of Laurentia with African and
South American cratons;
SE transfer of Caborca block


Continental rift boundary
<0.78 Ga Windermere Supergroup
Major normal faults
Mafic dike swarms
1.2-1.1 Ga Midcontinent rift system
1.3-0.95 Ga granitoids
Major thrust faults
1.3-1.0 Ga collisional orogens
1.45-1.35 Ga granitoids
1.55-1.35 Ga juvenile crust
~1.65 Ga quartzite deposits
1.65-1.60 Ga granitoids
1.69-1.65 Ga juvenile crust
1.72-1.68 Ga juvenile arcs
~1.70 Ga quartzite deposits
1.72-1.68 Ga granitoids
1.76-1.72 Ga juvenile crust
1.80-1.76 Ga juvenile arcs
1.9-1.8 Ga reworked Archean crust
2.0-1.8 Ga juvenile orogens
2.0-1.8 Ga juvenile arcs
2.5-2.0 Ga miogeoclinal sediments
>2.5 Ga Archean crust
(Whitmeyer and Karlstrom, 2007)
Windermere Supergroup
Gunbarrel dikes
Western Breakup rift
0.78-0.68 Ga
Rifting along western margin
of Laurentia;
Intrusion of Gunbarrel dikes,
Deposition of Windermere
Supergroup



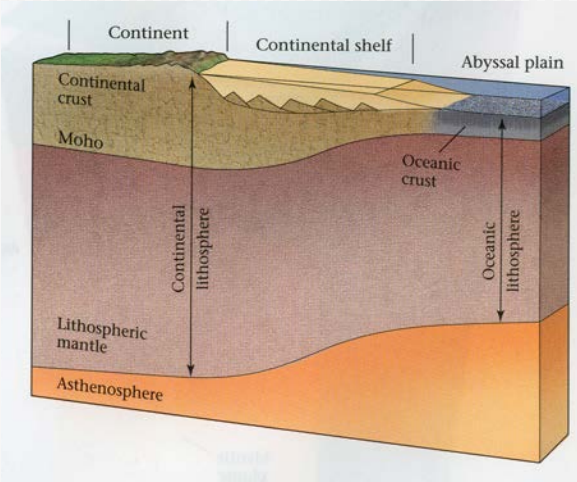
Rift



Marshak, 2005

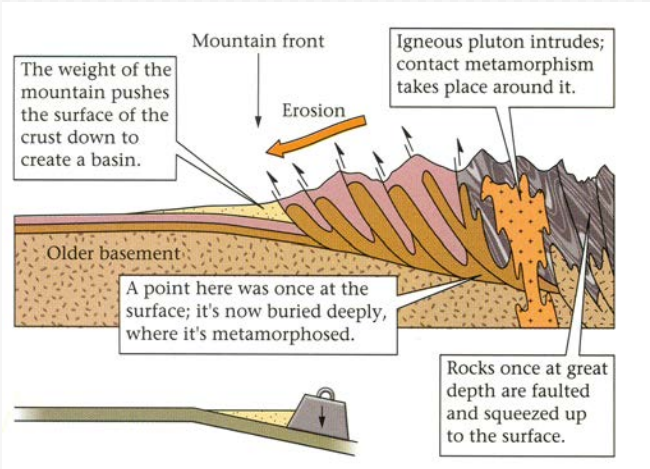
Drift

Marshak, 2005

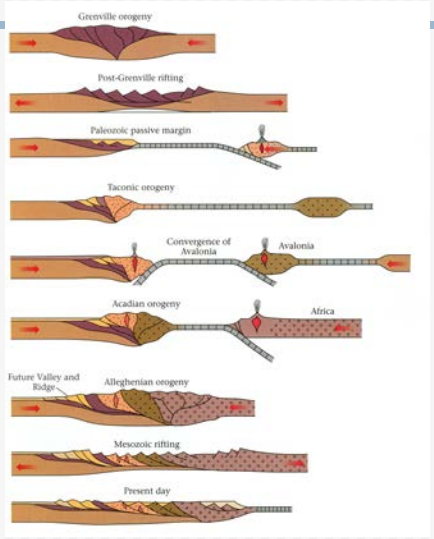


Flexure

Marshak, 2005

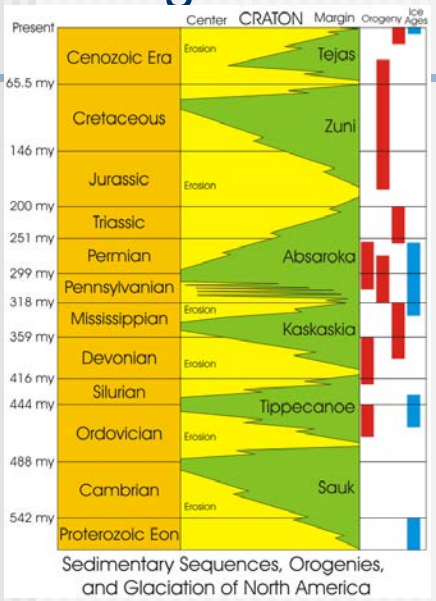


Tectonic History of the Appalachians



Marshak, 2005

Transgressions and Regressions

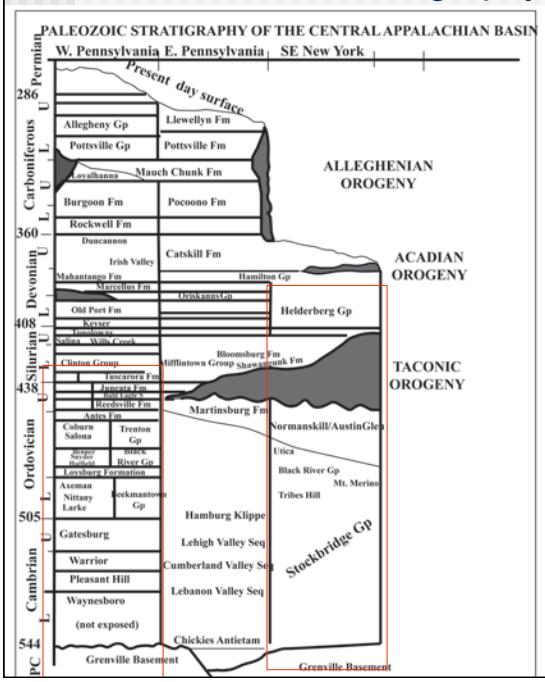


What are the causes of global (eustatic) sea level rise?

Ice volume-melting of ice

Rapid spreading- breakup of Pannotia

Stratigraphy of the C. Appalachians



Proterozoic-Early Paleozoic

Synorogenic clastic wedge- flysch and mollasse

Cambro-Ordovician "drift" carbonates

Late Proterozoic rift clastics

Grenville basement-1.0 ga gneisses

Stage I: Rifting Evidence

- Deep, fault-bounded troughs
- Arkosic and lithic wackes because:
  - Uplifted shoulders of rift provide local Grenvillian source terrain
  - Continental environments
  - Rapid sedimentation
- If lakes (like East Africa), then chemical sediments
- Acidic and basaltic volcanics; dike swarms

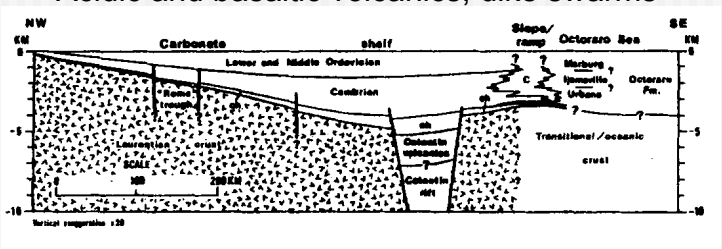
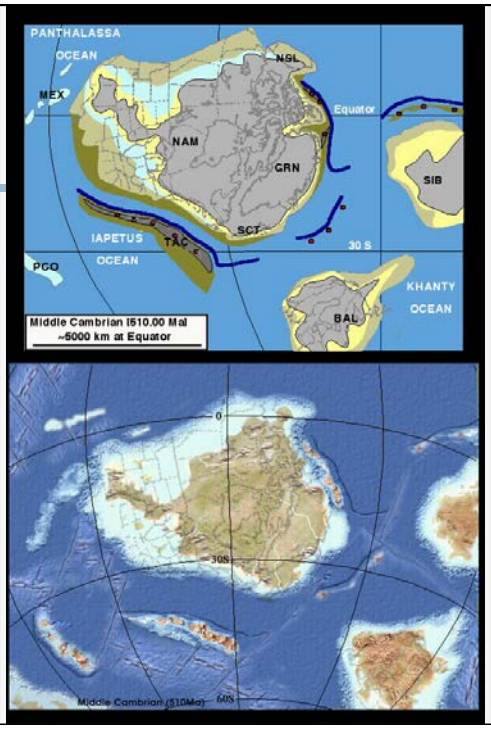


Fig. 8. Cross section of the carbonate shelf, shelf/slope/basin transition, and proximal basin (Ocoraro seaway) during the

Stage II: Drifting —550-460 Mya



Stage II: Drifting—550-460 Mya

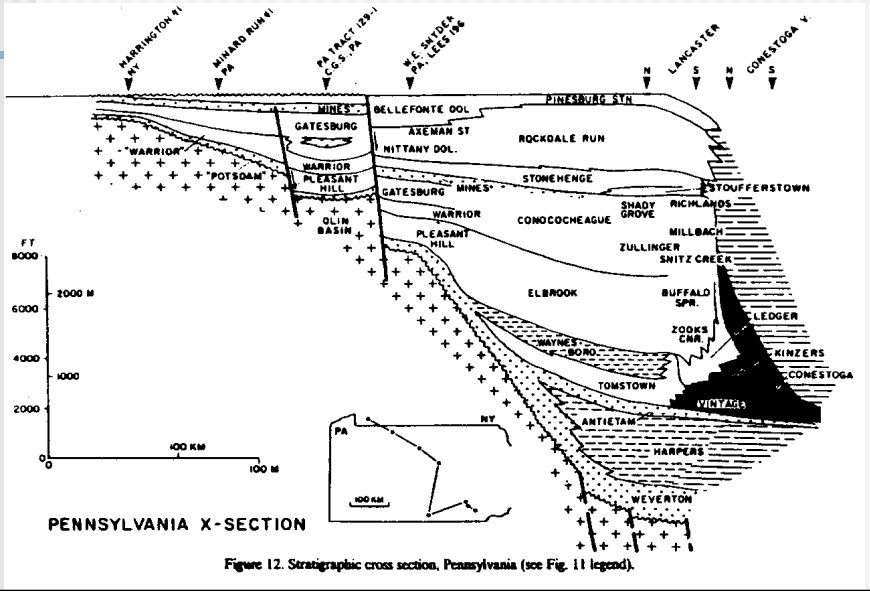
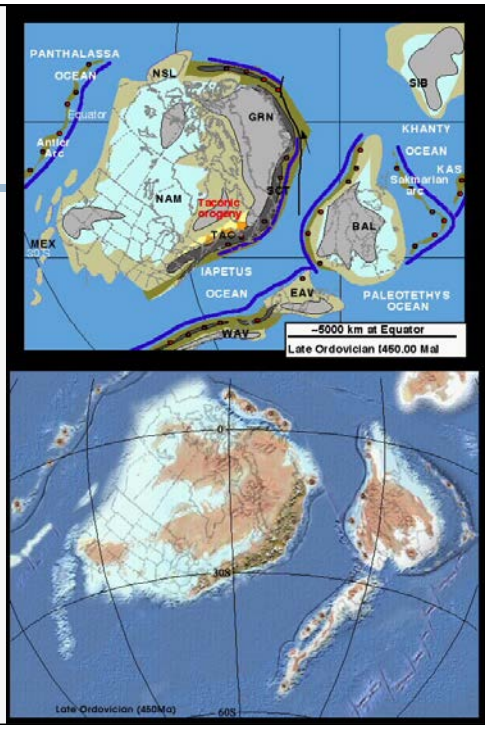
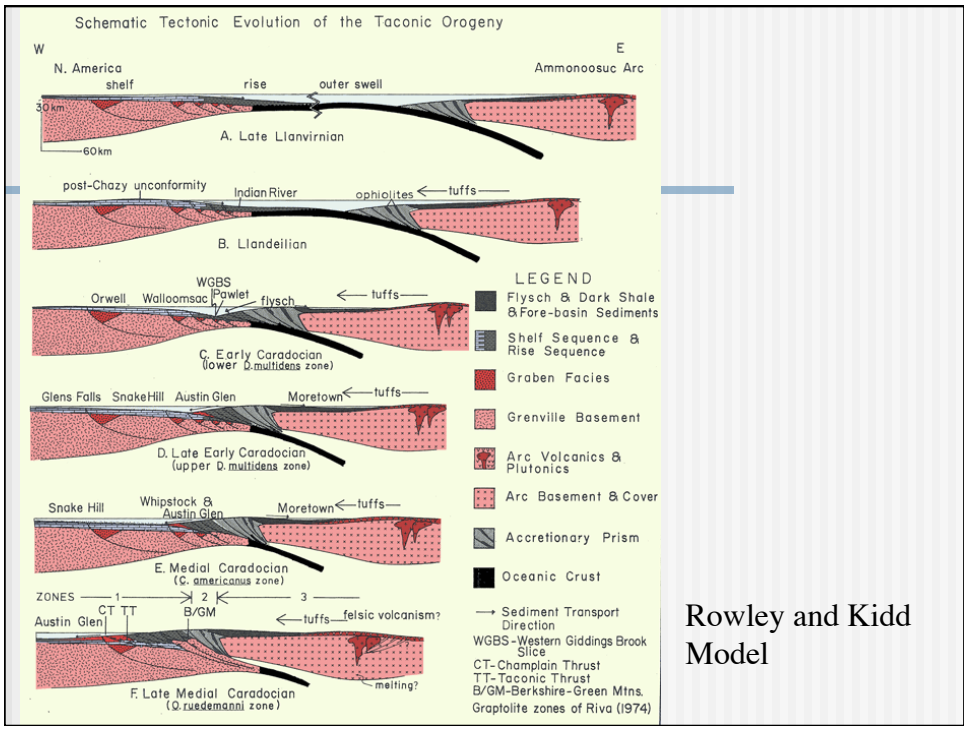


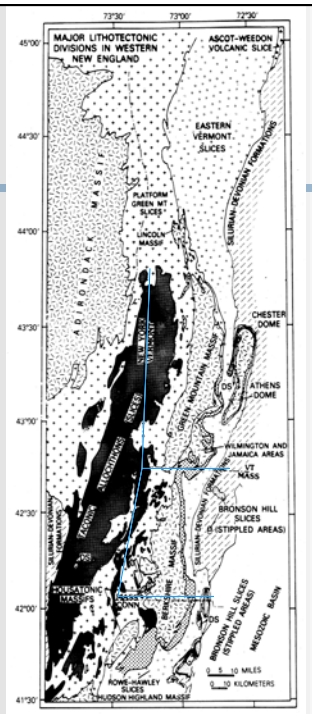
Figure 12. Stratigraphic cross section, Pennsylvania (see Fig. 11 legend).

Taconian Orogeny: 450 Ma





Rowley and Kidd Model



The Taconic Orogeny -late Ordovician

Autochthon- Adirondack Massif, Grenville basement

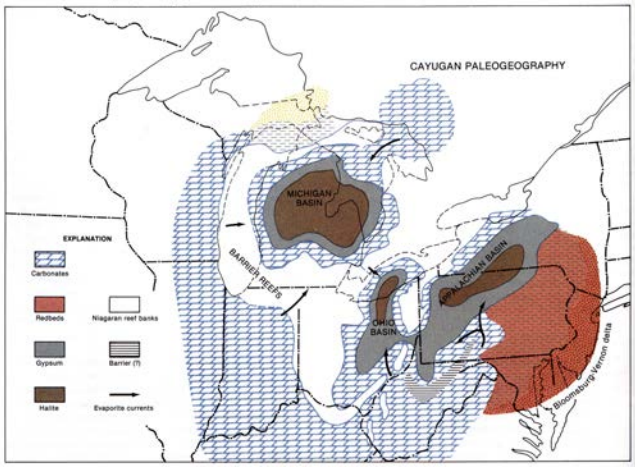
Allochthon- foreland, Taconic slices-in PA, the Hamburg klippe

Allochthon- hinterland, Berkshire Massif, Green Mountain Massif- Rowe-Hawley metamorphics- in PA, the Glenarm series

Note: The allochthon is the load. The load is not stationary relative to the authochthon (i. e. the plate that bends)

Late Silurian Paleogeography

FIGURE 12.32 Late Silurian paleogeography of the Michigan-New York-Ohio evaporite basin. Barrier reefs restricted marine circulation into the basins; evaporites occur in basin centers. (*After Alling and Briggs, 1961, Bulletin American Association of Petroleum Geologists, v. 45, pp. 515–547; by permission.*)



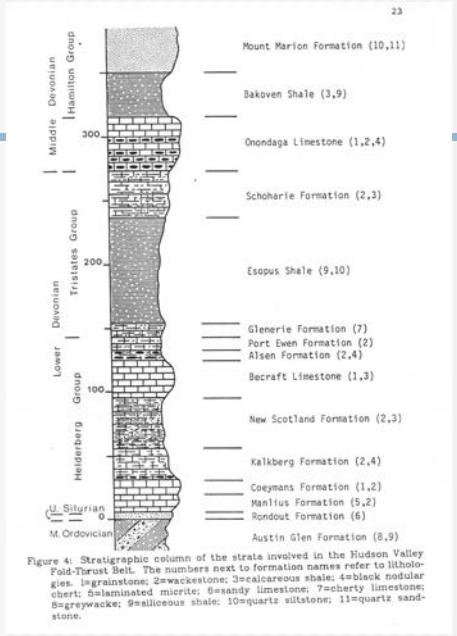
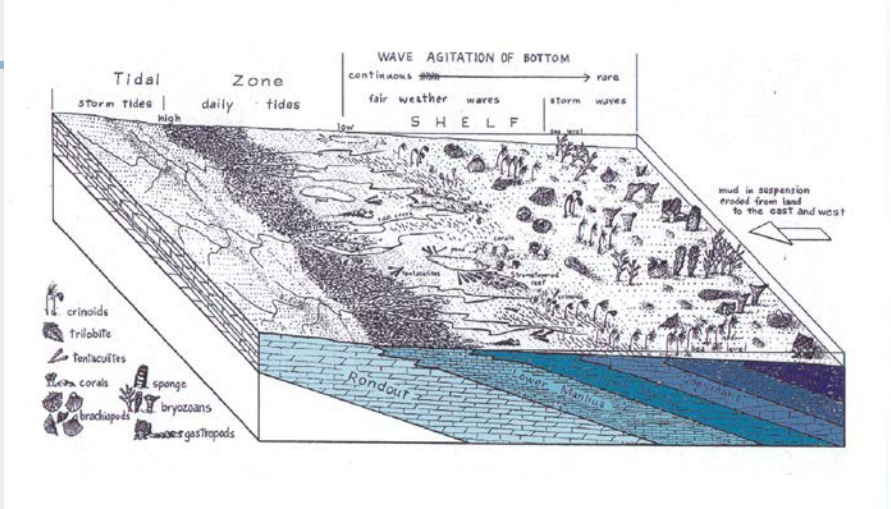
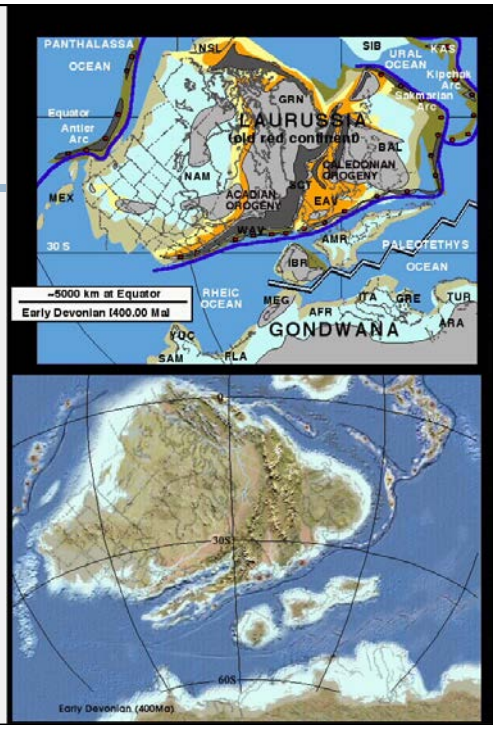


Figure 4: Stratigraphic column of the strata involved in the Hudson Valley Fold-Thrust Belt. The numbers next to formation names refer to lithologies. 1=grainstone; 2=wackestone; 3=calcareous shale; 4=black nodular chert; 5=laminated micrite; 6=sandy limestone; 7=cherty limestone; 8=greywacke; 9=siliceous shale; 10=quartz siltstone; 11=quartz sandstone.



Devonian: Orogeny Returns

- Oblique collision with the Avalon microcontinent creates Acadian Orogeny
- 400 Mya in Maritimes; 380 Mya in PA



340 Ma

Early Mississippian

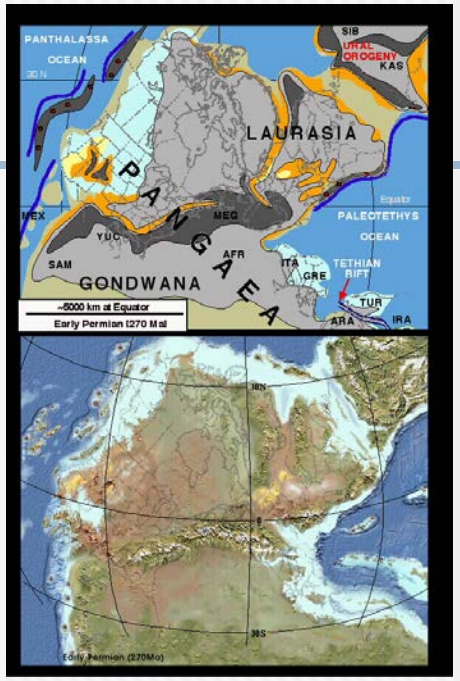
East Coast of Laurentia- Remnants of Acadian Orogeny- Approach of Gondwana

W. Coast- Collision of Klamath island arc with an active continental margin

300 Ma

Eastern margin of Laurentia collides with the northern margin of Gondwana

Western margin-continued subduction-growth of the Ancestral Rocky Mountains



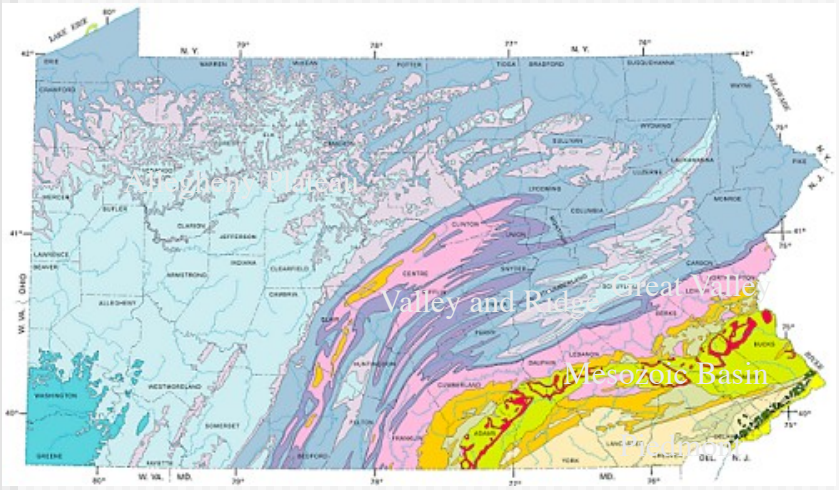
270 Ma

Collision of Siberian craton with Laurasia to form the Ural Mountain Range

Appalachian Mountains lie at mid-continent near the Equator

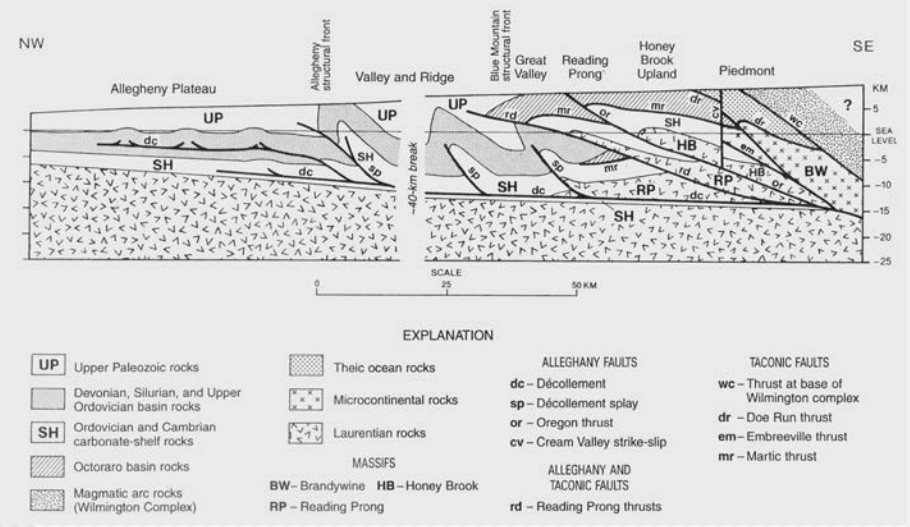
Subduction on the West coast

Geology and Physiographic Provinces of Pennsylvania



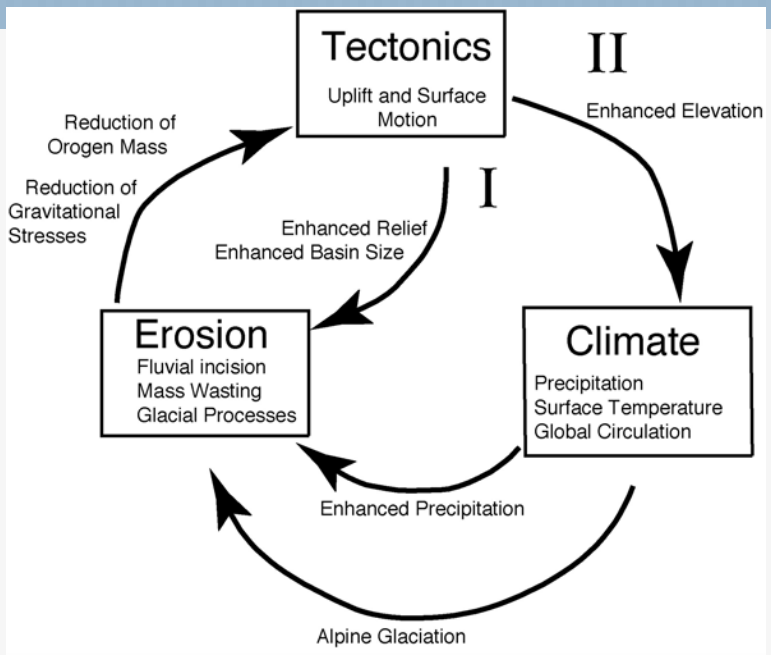
Cross Section across Pennsylvania

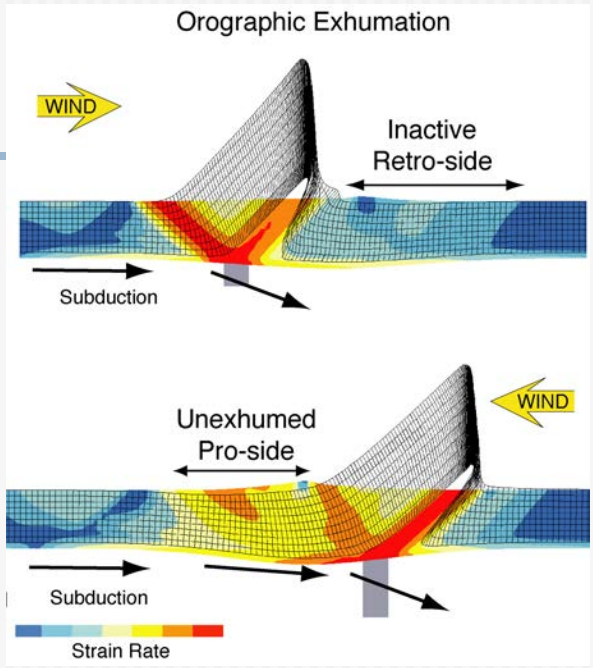
Faill, 1999

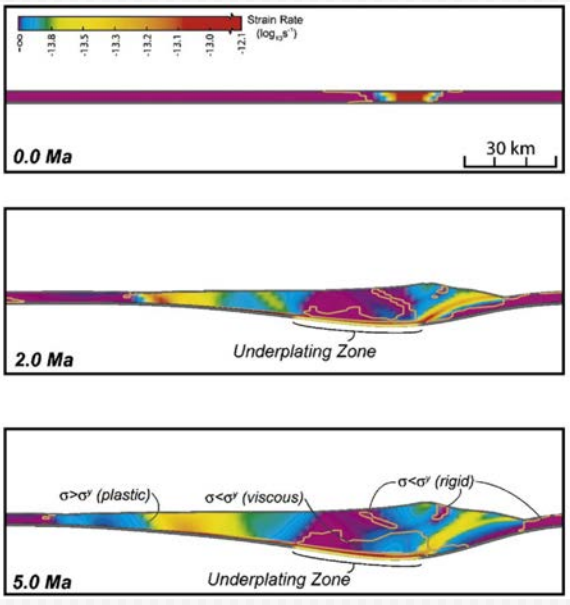


Main points related to structure

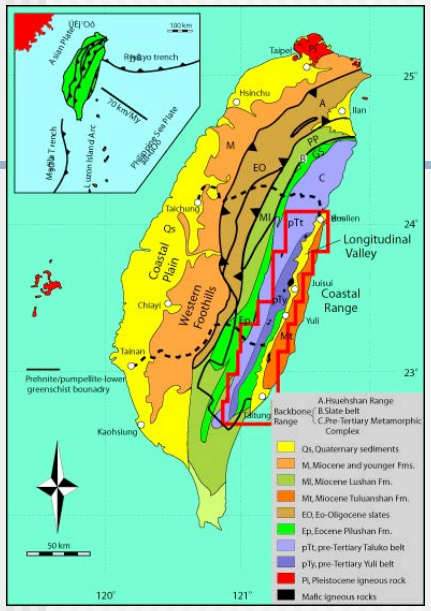
- Decollement- In Silurian salt beneath the plateau, steps down into basement in the Great Valley-Piedmont (e.g. Reading prong)
- Telescoping of the continental margin- positions restore to positions to the southeast
- Progressive advance of the tectonic load-Mollasse is consumed by the thrust belt
- Deformation extends to greater distances from the collisional suture than any of the earlier Paleozoic orogenies

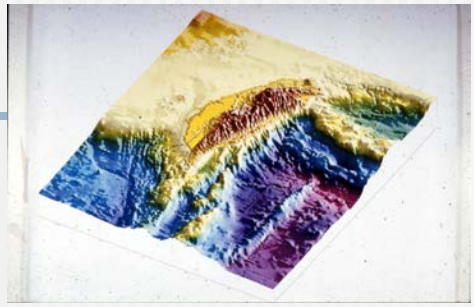






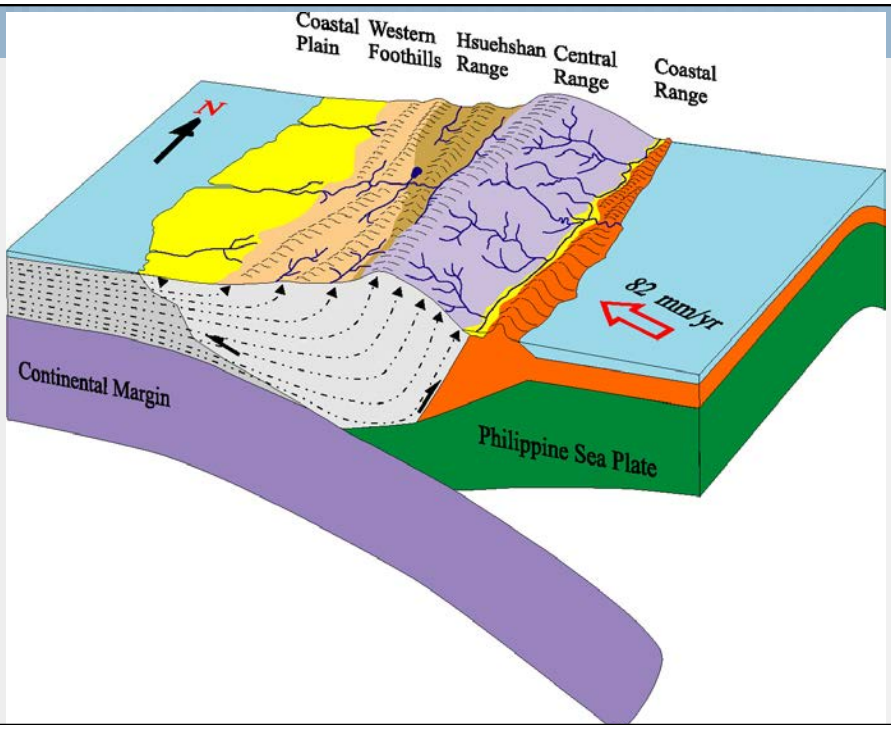
Fuller et al., 2006



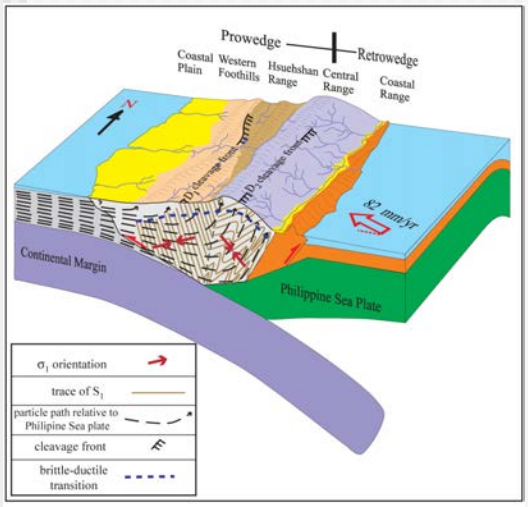


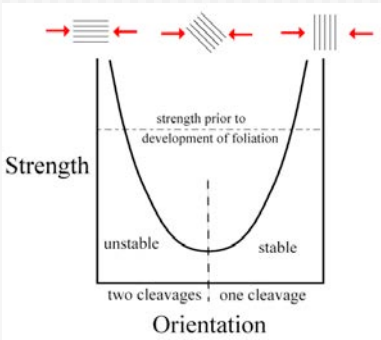
Tectonics

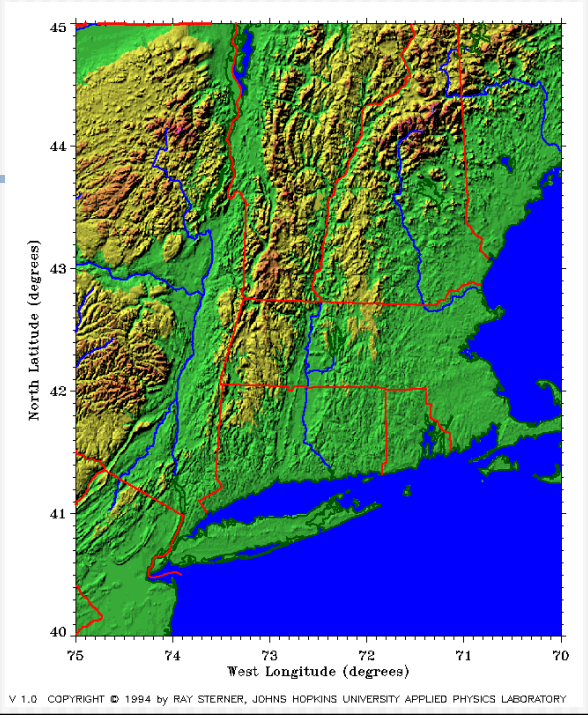
Geology

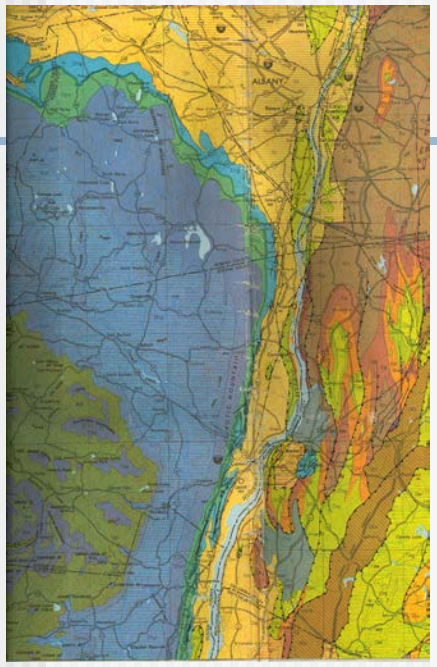


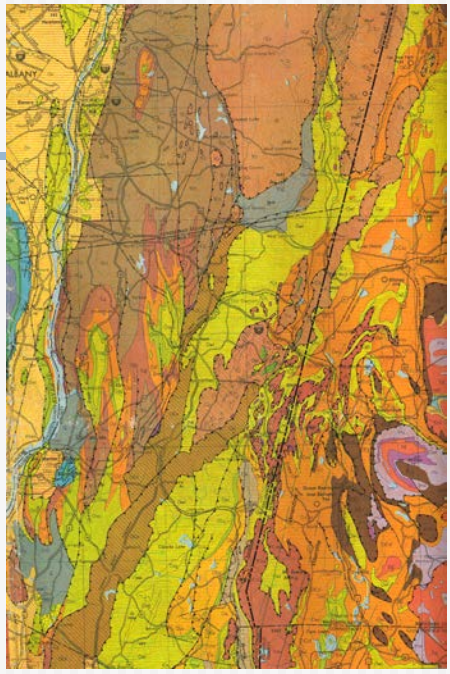
Cleavage fronts and fans

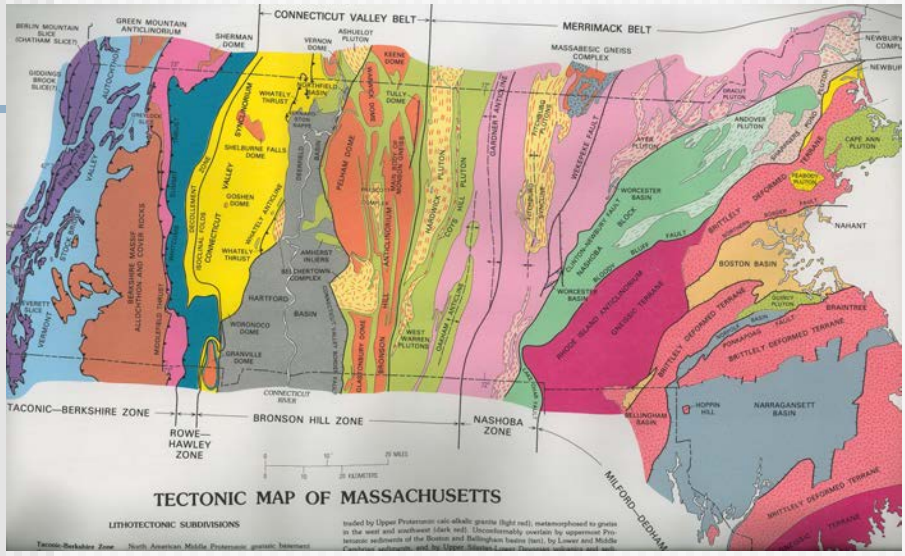




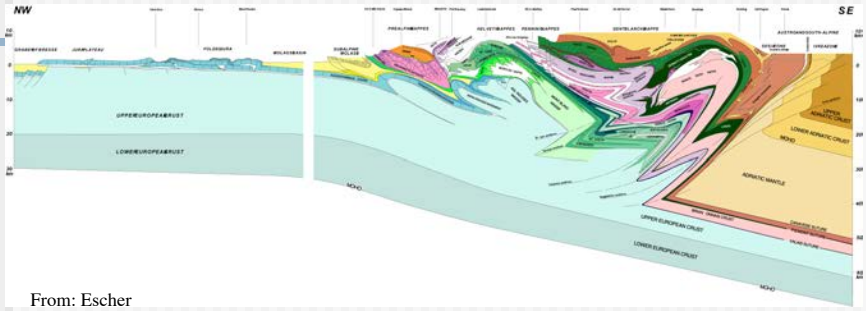







CONNECTICUT VALLEY BELT
MERRIMACK BELT
TACONIC—BERKSHIRE ZONE
ROWE—HAWLEY ZONE
BRONSON HILL ZONE
NASHOBA ZONE
TECTONIC MAP OF MASSACHUSETTS
LITHOTECTONIC SUBDIVISIONS

Western Alps



From: Escher