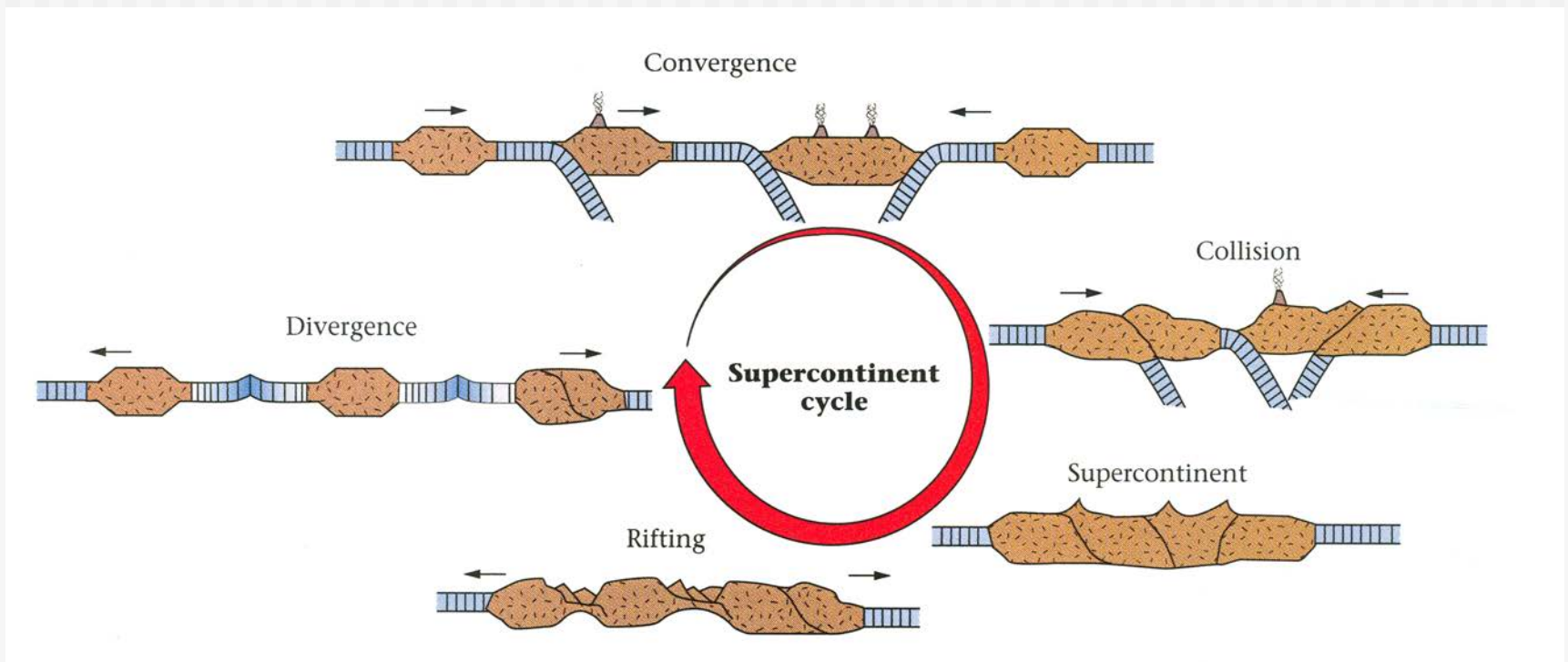


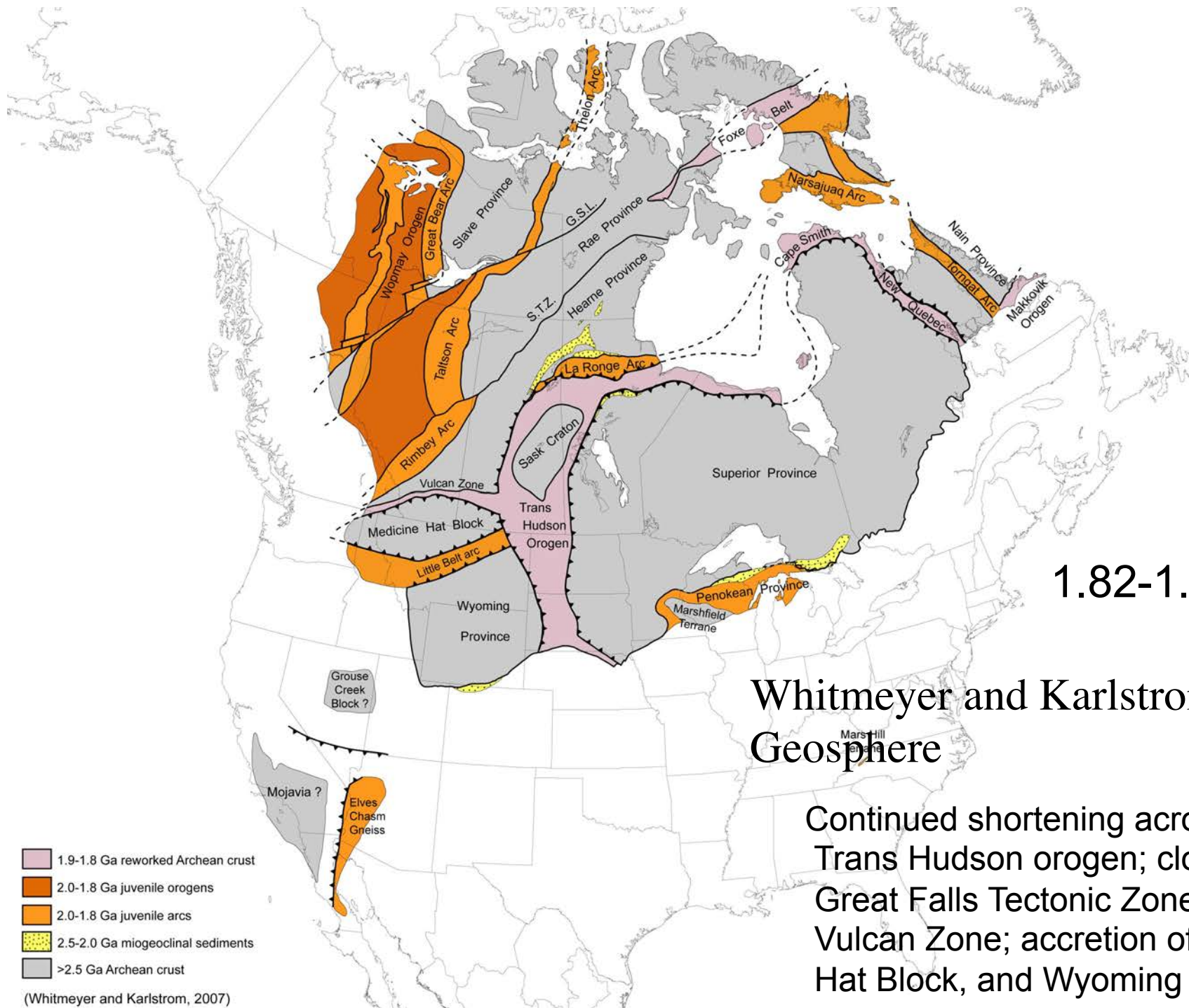
The Wilson Cycle



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

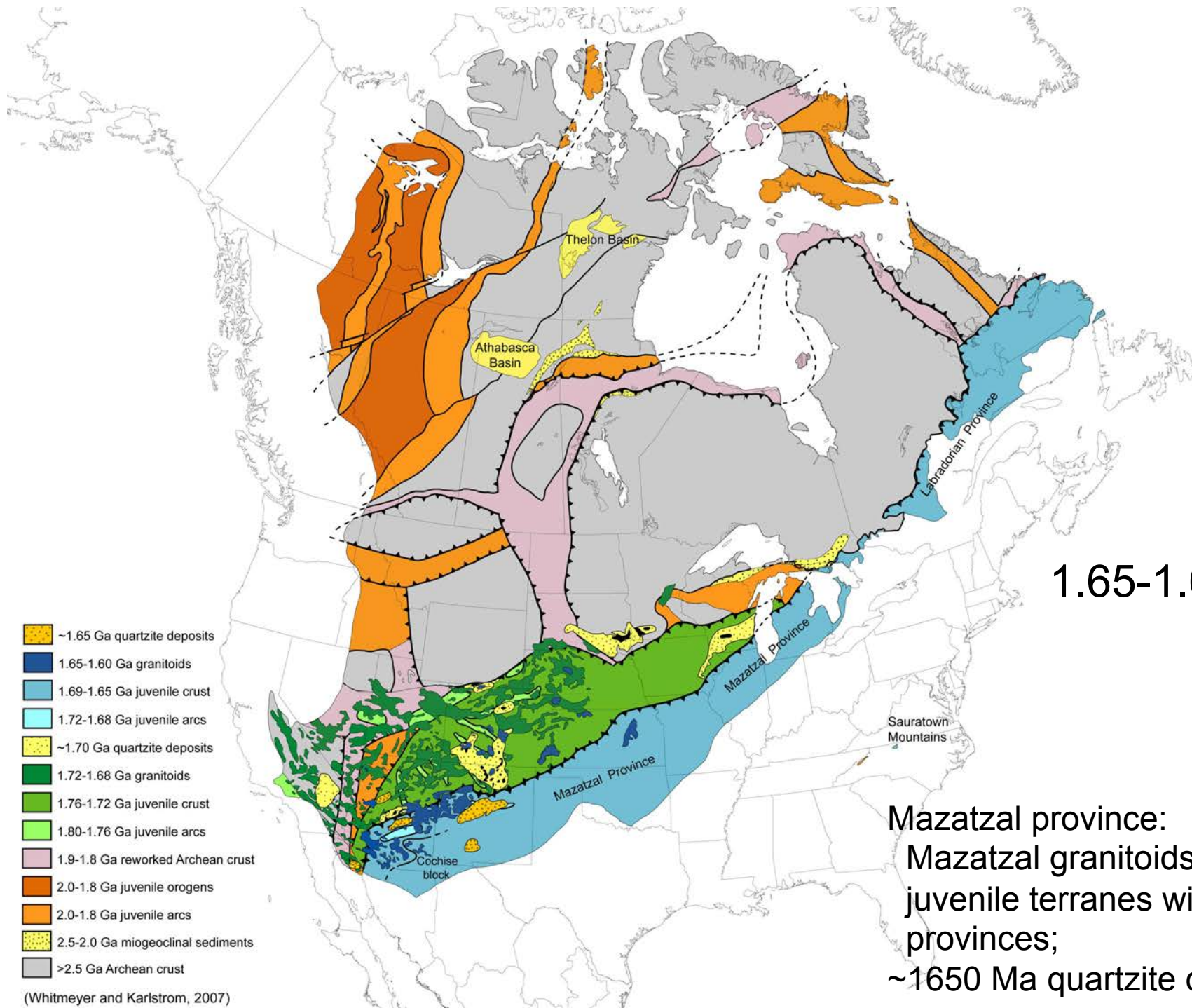


1.82-1.80 Ga

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

(Whitmeyer and Karlstrom, 2007)

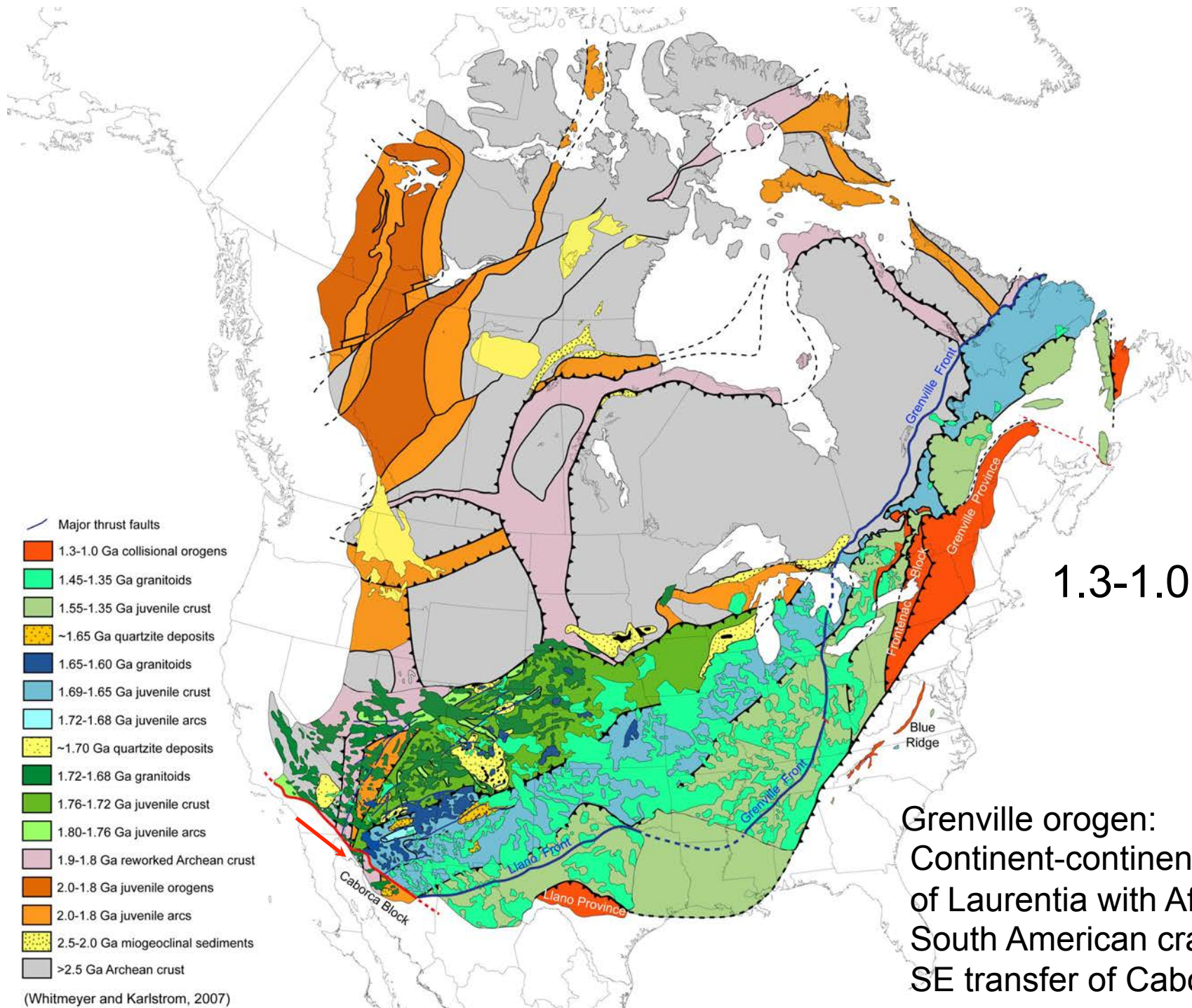


- ~1.65 Ga quartzite deposits
- 1.65-1.60 Ga granitoids
- 1.69-1.65 Ga juvenile crust
- 1.72-1.68 Ga juvenile arcs
- ~1.70 Ga quartzite deposits
- 1.72-1.68 Ga granitoids
- 1.76-1.72 Ga juvenile crust
- 1.80-1.76 Ga juvenile arcs
- 1.9-1.8 Ga reworked Archean crust
- 2.0-1.8 Ga juvenile orogens
- 2.0-1.8 Ga juvenile arcs
- 2.5-2.0 Ga miogeoclinal sediments
- >2.5 Ga Archean crust

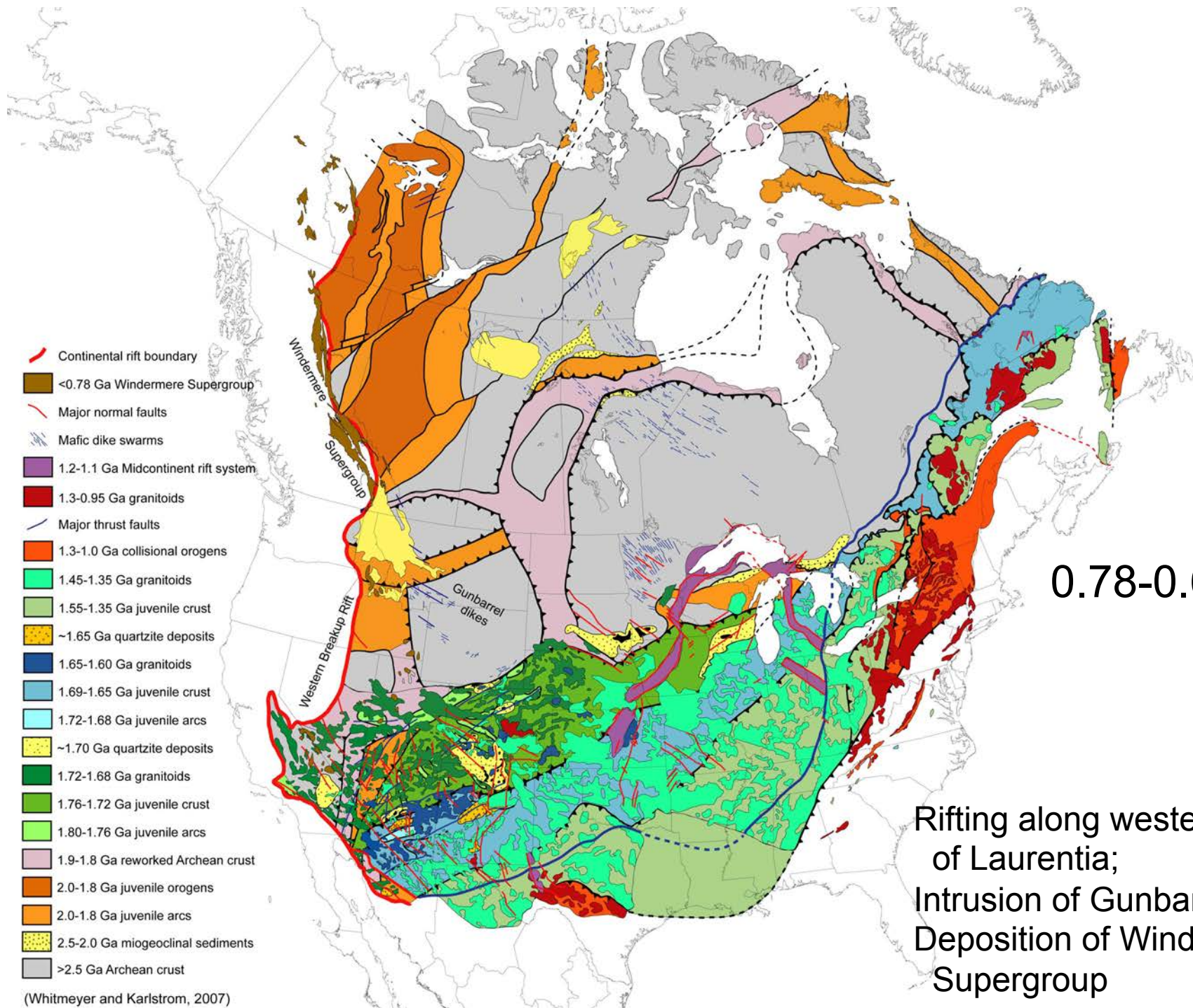
(Whitmeyer and Karlstrom, 2007)

1.65-1.60 Ga

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

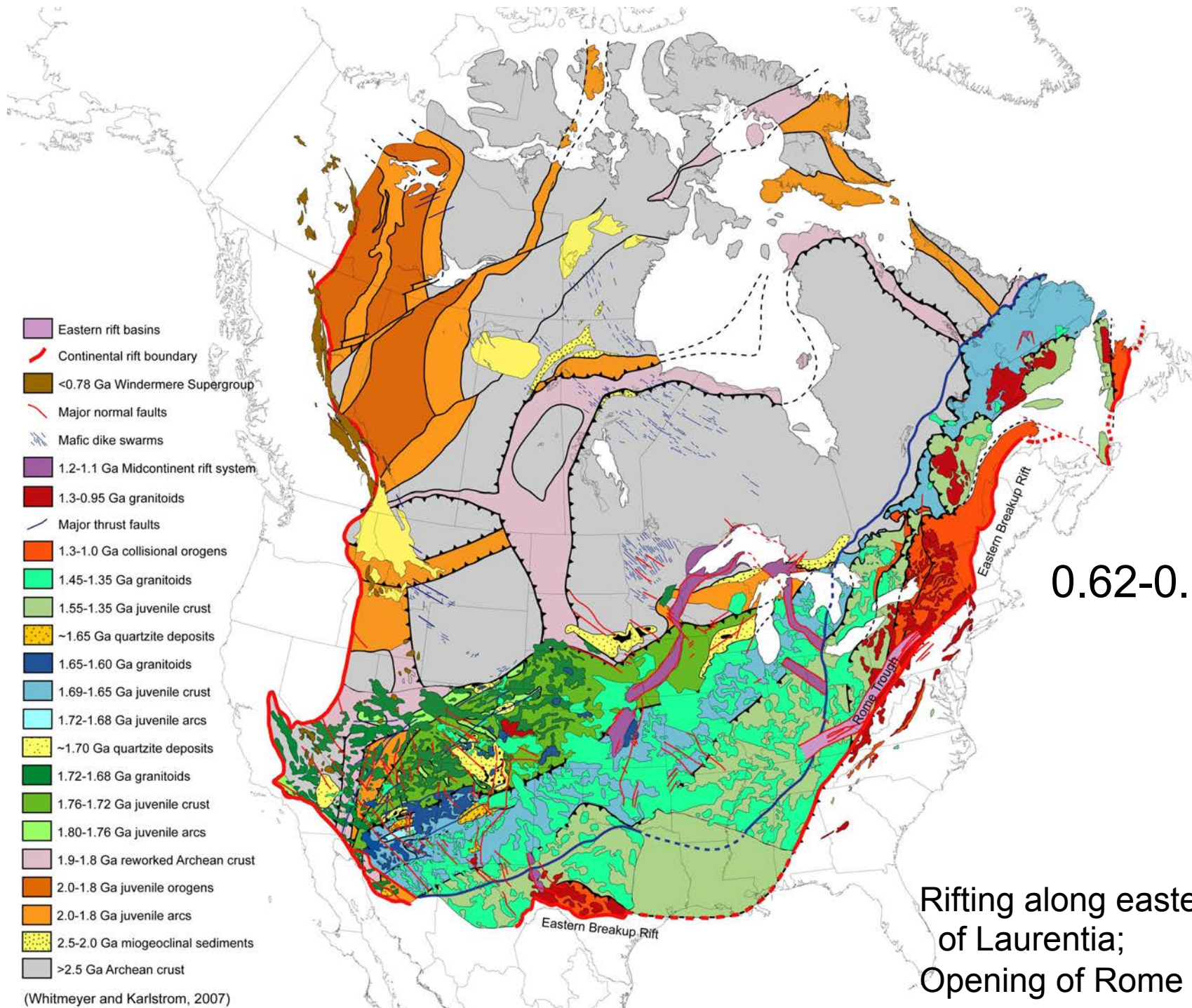


(Whitmeyer and Karlstrom, 2007)



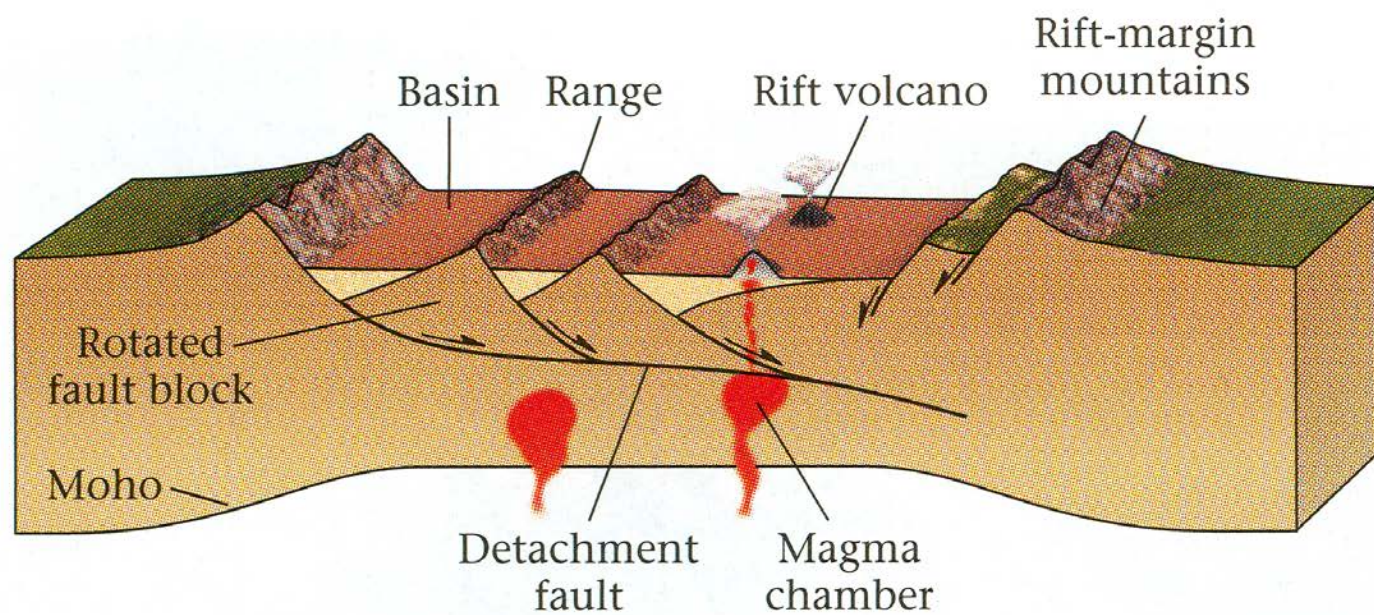
- Continental rift boundary
- <0.78 Ga Windermere Supergroup
- Major normal faults
- Mafic dike swarms
- 1.2-1.1 Ga Midcontinent rift system
- 1.3-0.95 Ga granitoids
- Major thrust faults
- 1.3-1.0 Ga collisional orogens
- 1.45-1.35 Ga granitoids
- 1.55-1.35 Ga juvenile crust
- ~1.65 Ga quartzite deposits
- 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)



(Whitmeyer and Karlstrom, 2007)

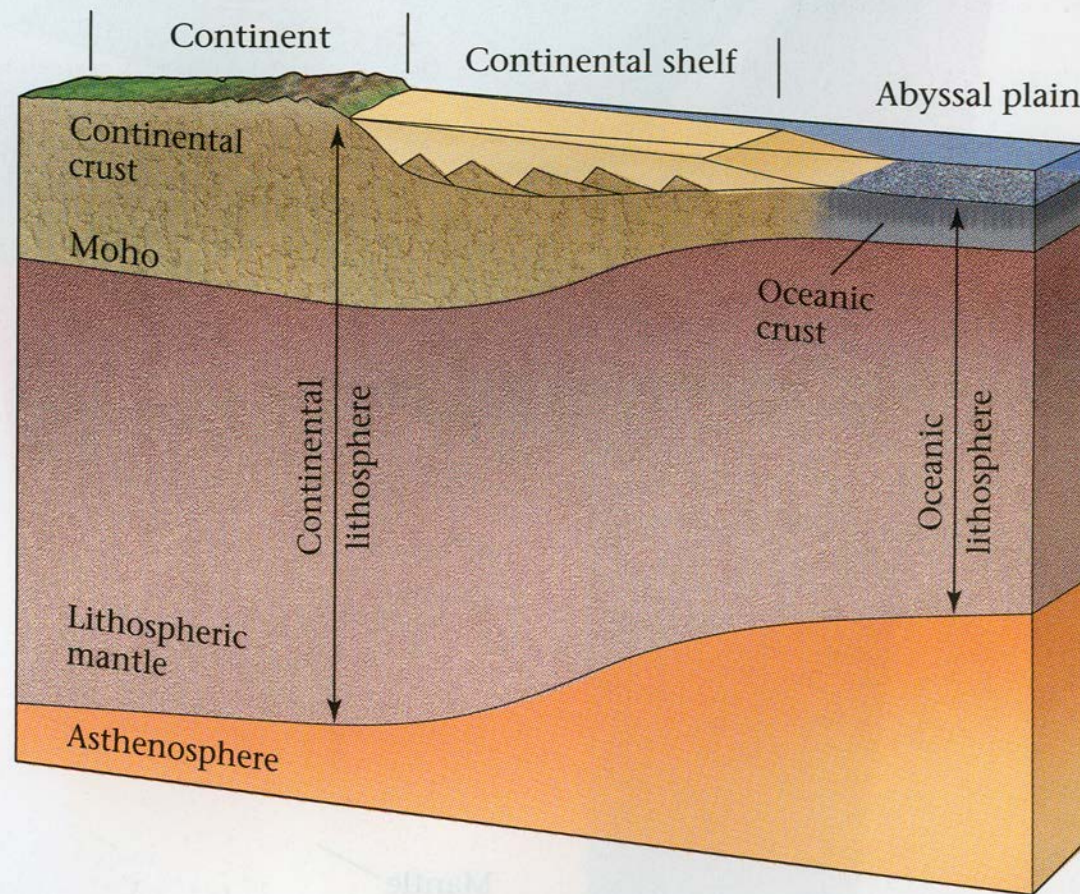
Rift



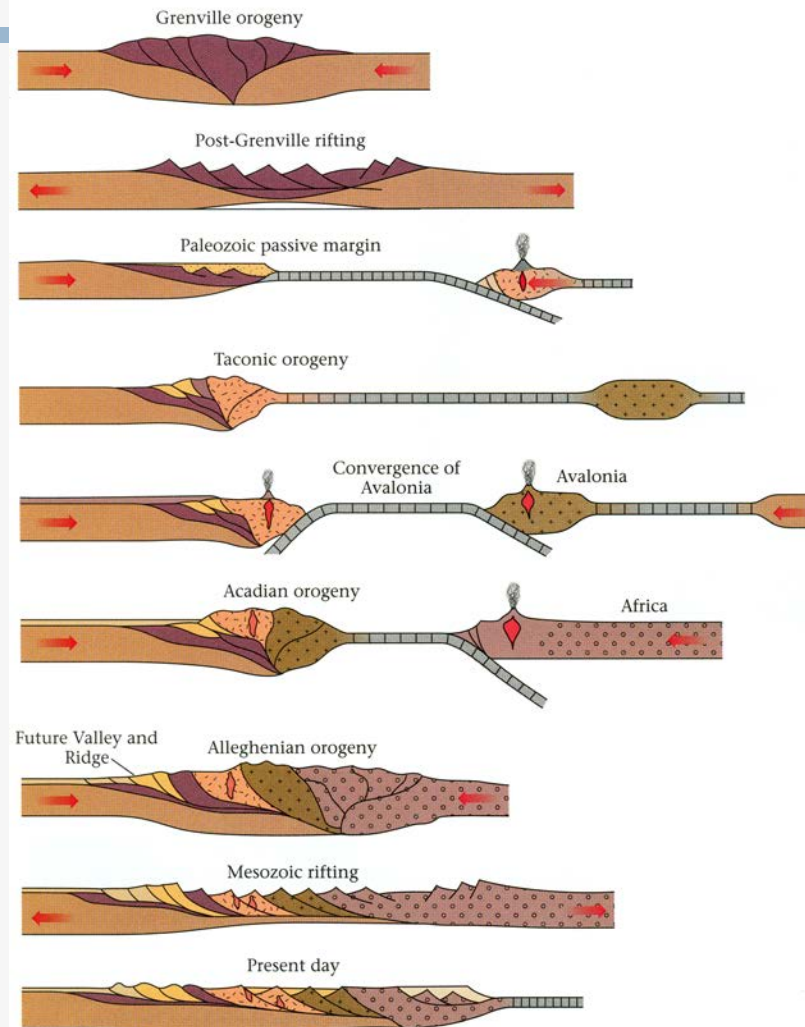
Marshak, 2005

Drift

Marshak, 2005

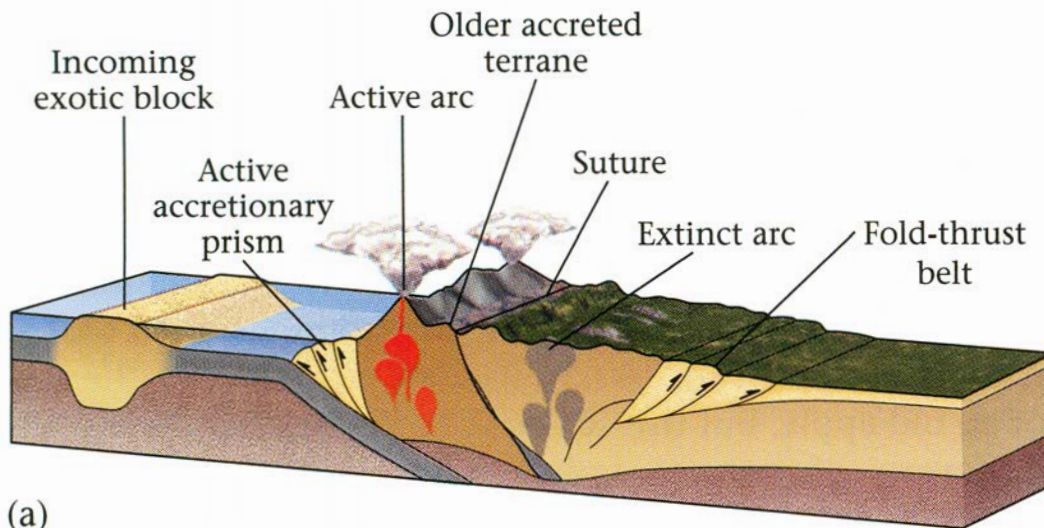


Tectonic History of the Appalachians

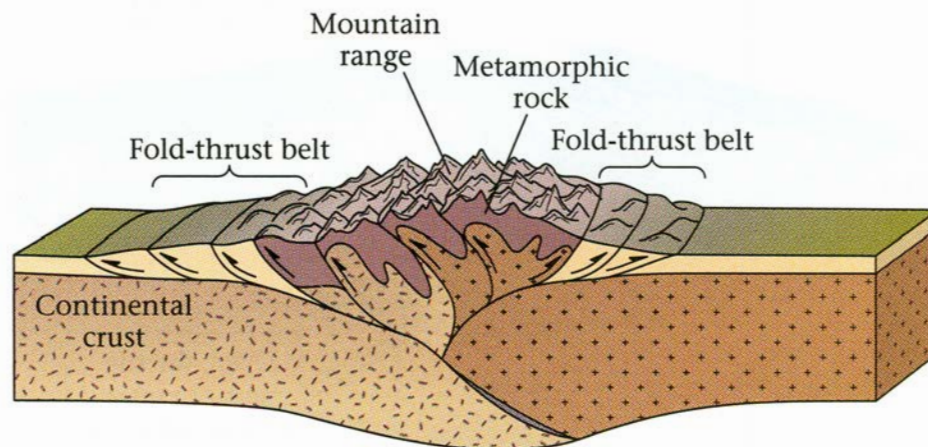


Marshak, 2005

Microcontinent vs. Continent Collisions



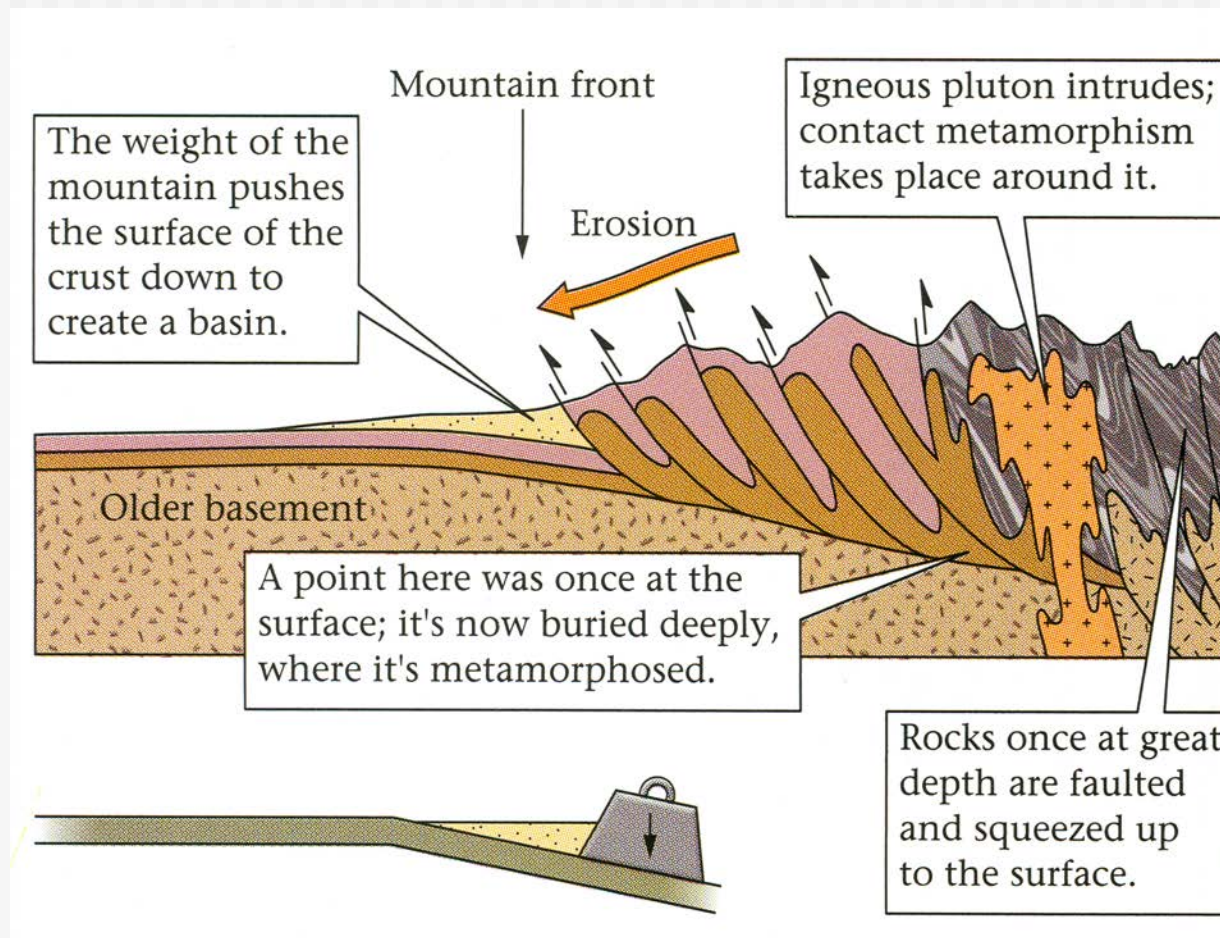
(a)



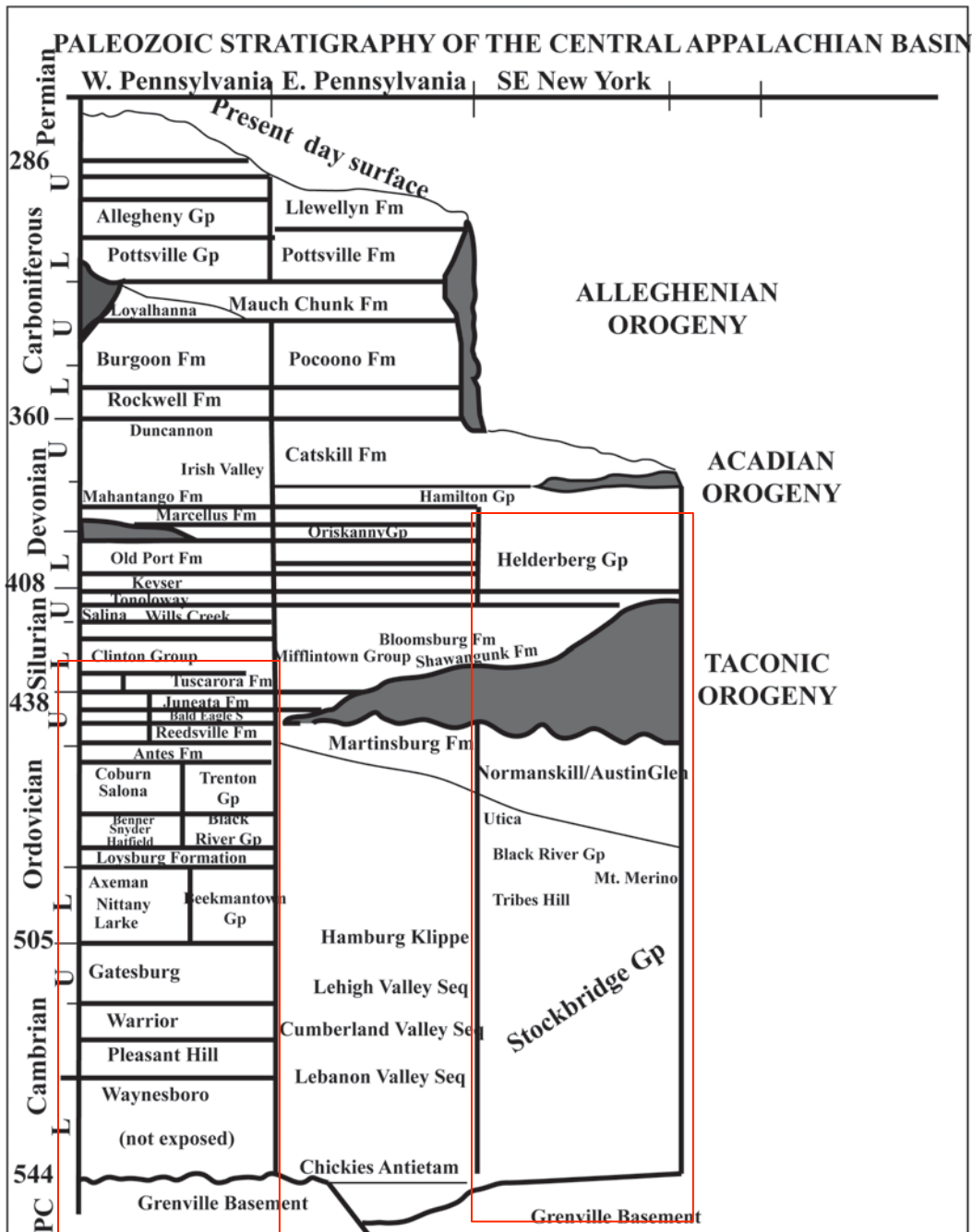
Marshak, 2005

Flexure

Marshak, 2005



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

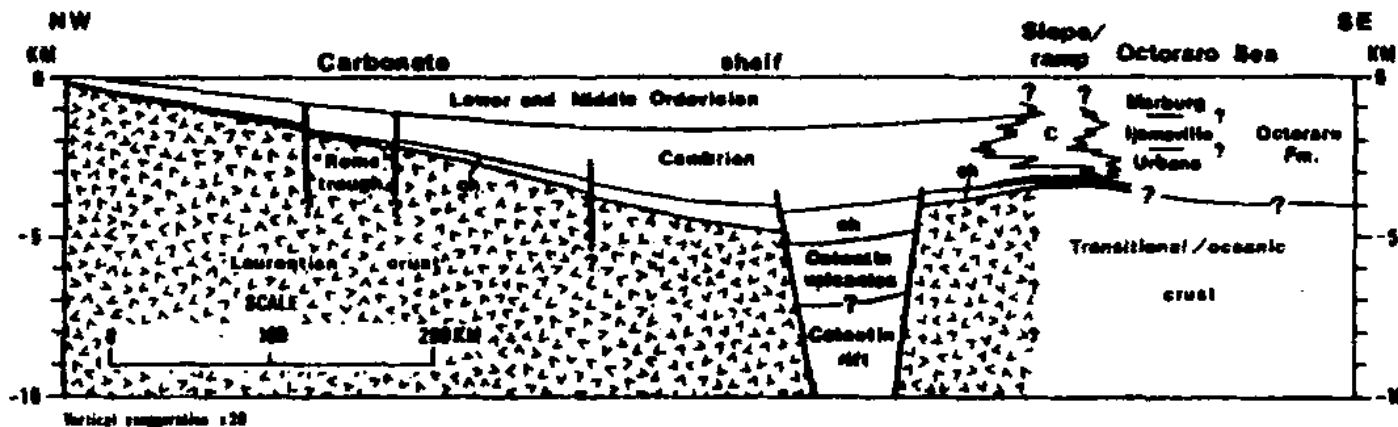
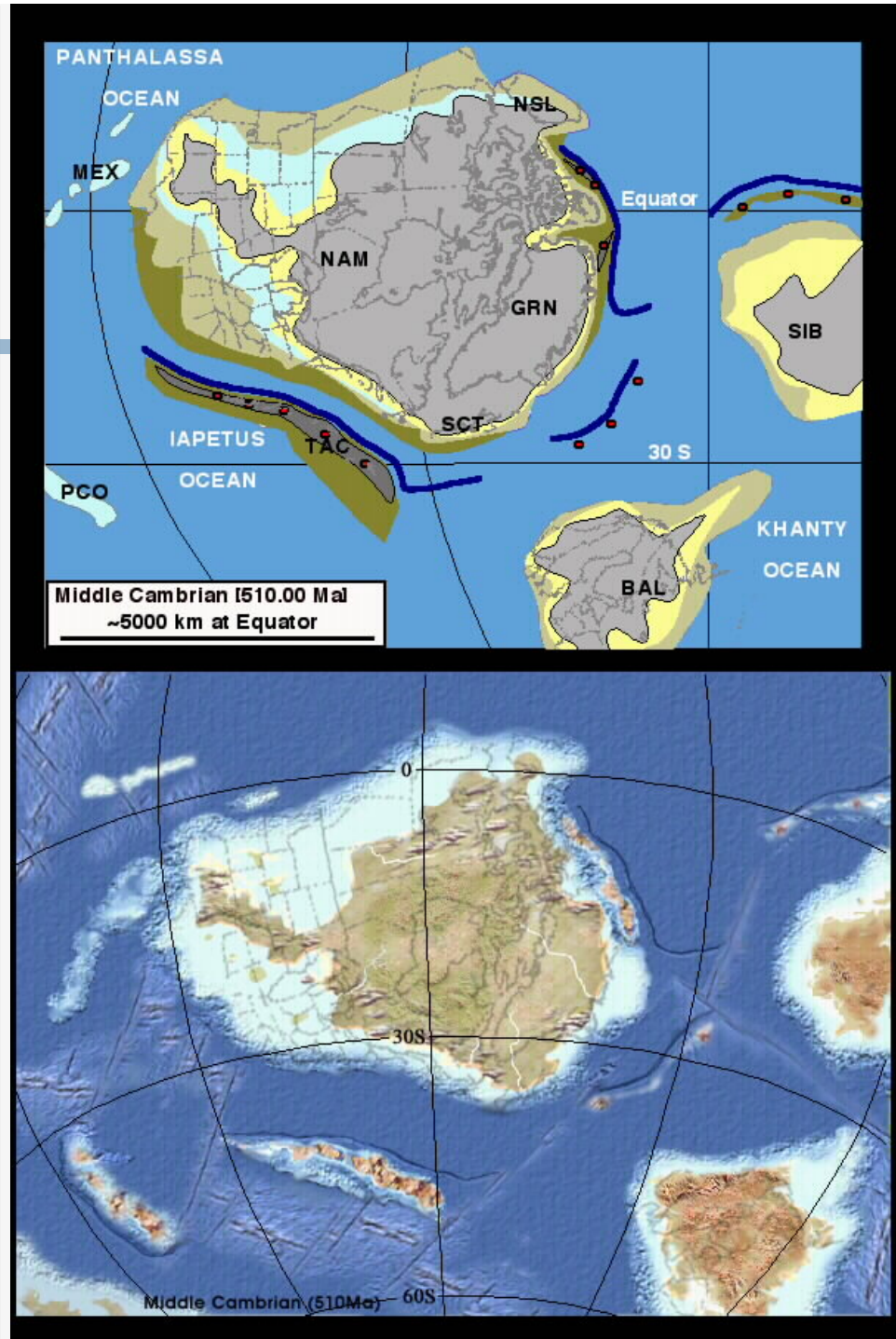


Fig. 8. Cross section of the carbonate shelf, shelf/slope/basin transition, and proximal basin (Octoraro seaway) during the Middle Ordovician, from Erie (NW) to the present Atlantic coastline (SE; see Fig. 7 for location of section). Derived from Ryder

Stage II: Drifting —550-460 Mya



Stage II: Drifting—550-460 Mya

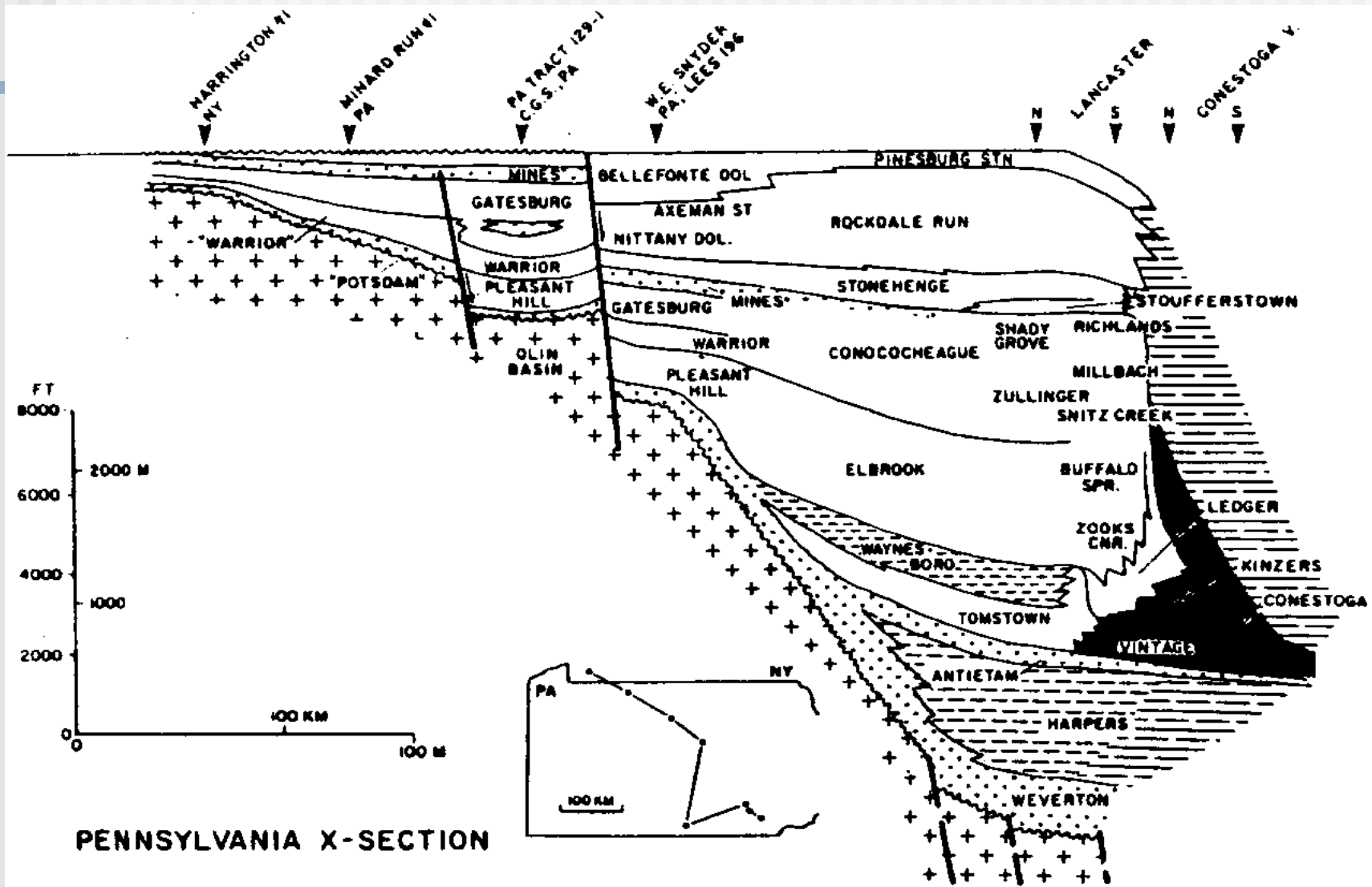
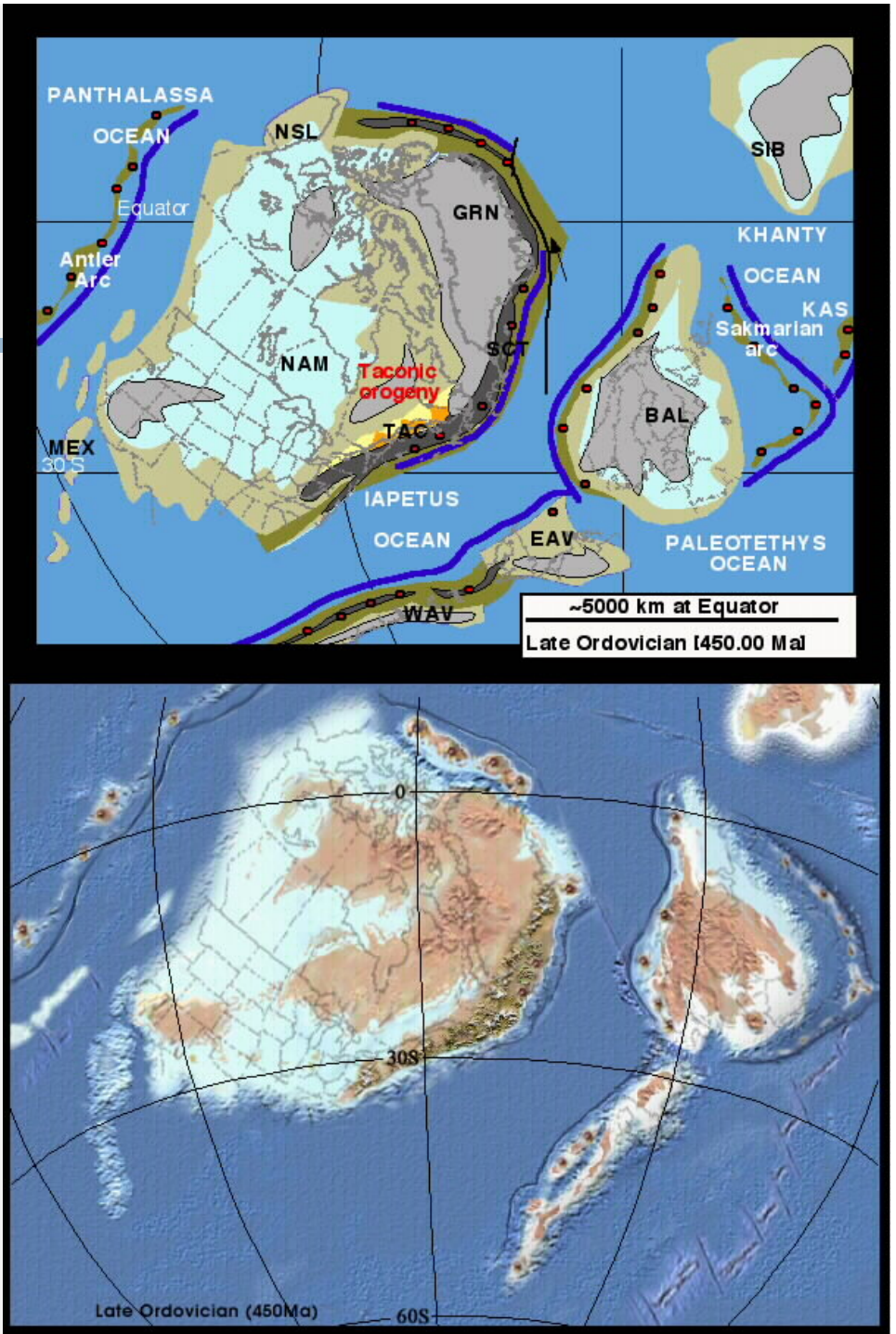
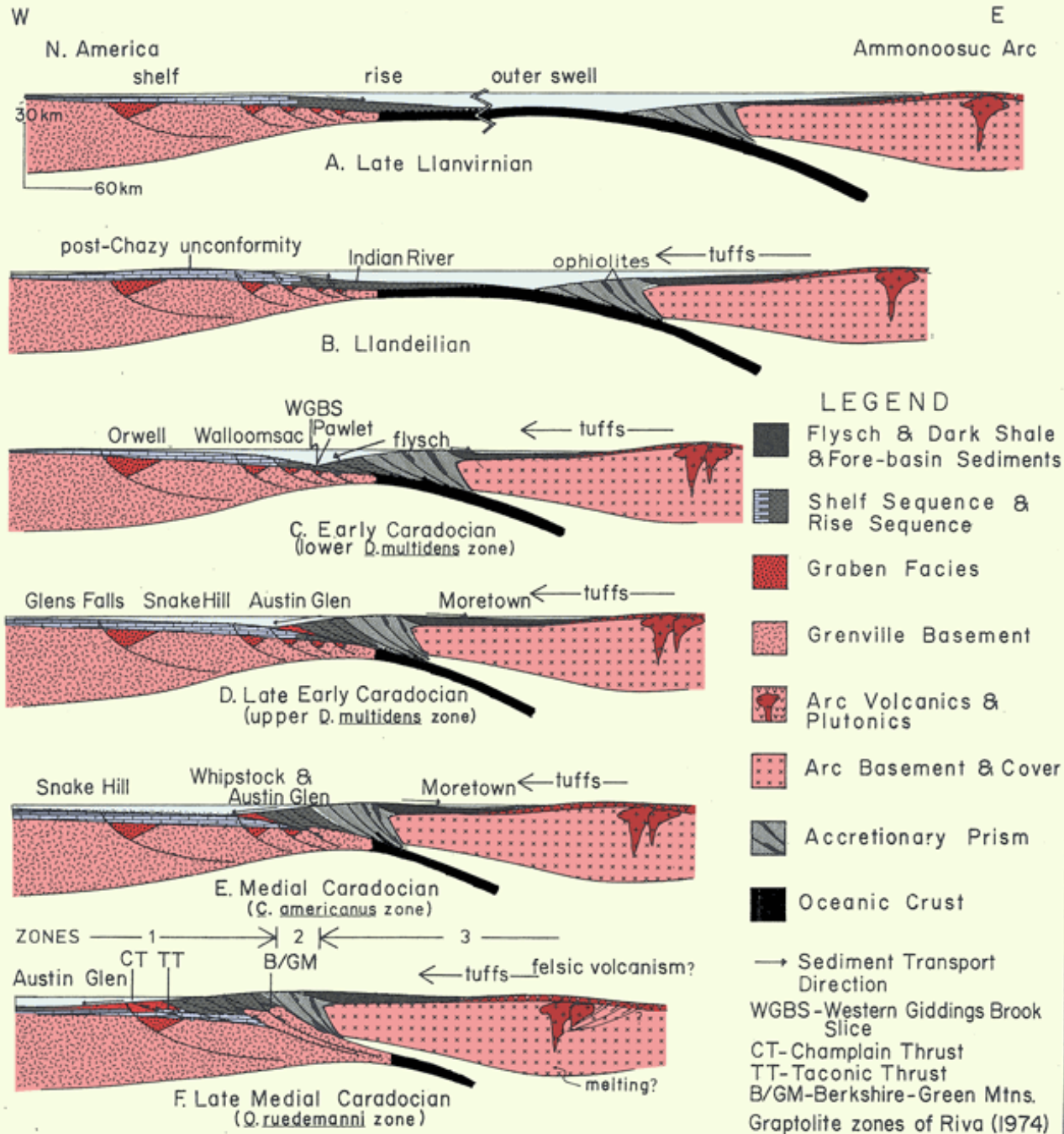


Figure 12. Stratigraphic cross section, Pennsylvania (see Fig. 11 legend).

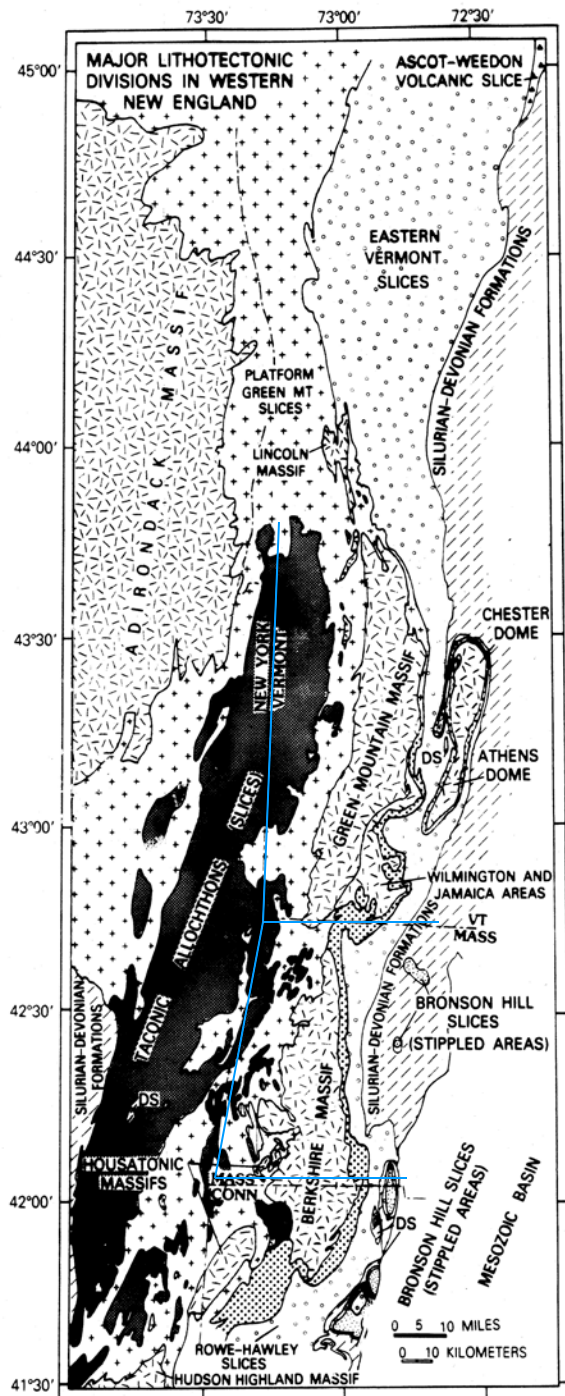
Taconian Orogeny: 450 Ma



Schematic Tectonic Evolution of the Taconic Orogeny



Rowley and Kidd Model



The Taconic Orogeny -late Ordovician

Autochthon- Adirondack Massif,
Grenville basement

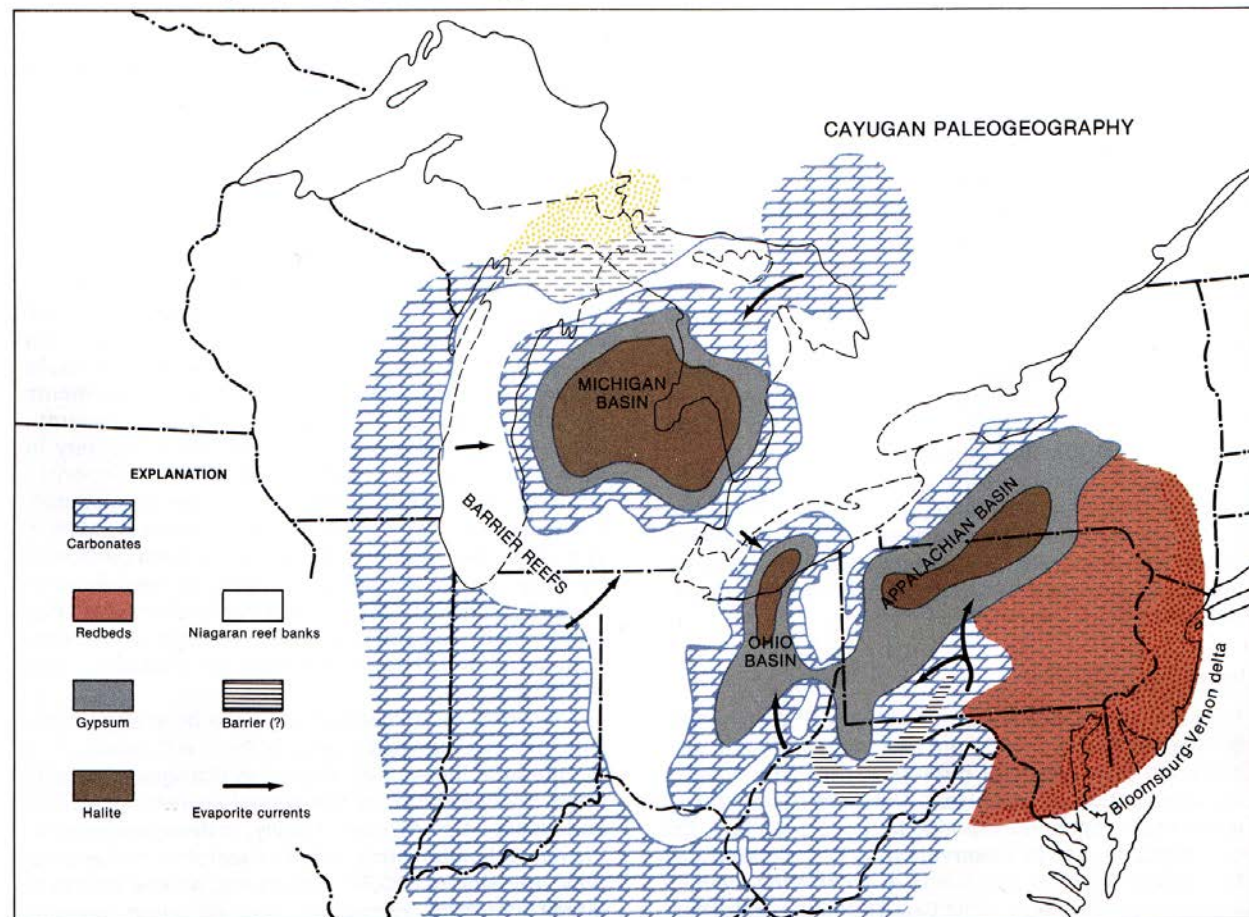
Allochthon- foreland, Taconic slices-in
PA, the Hamburg klippe

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
autochthon (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.)



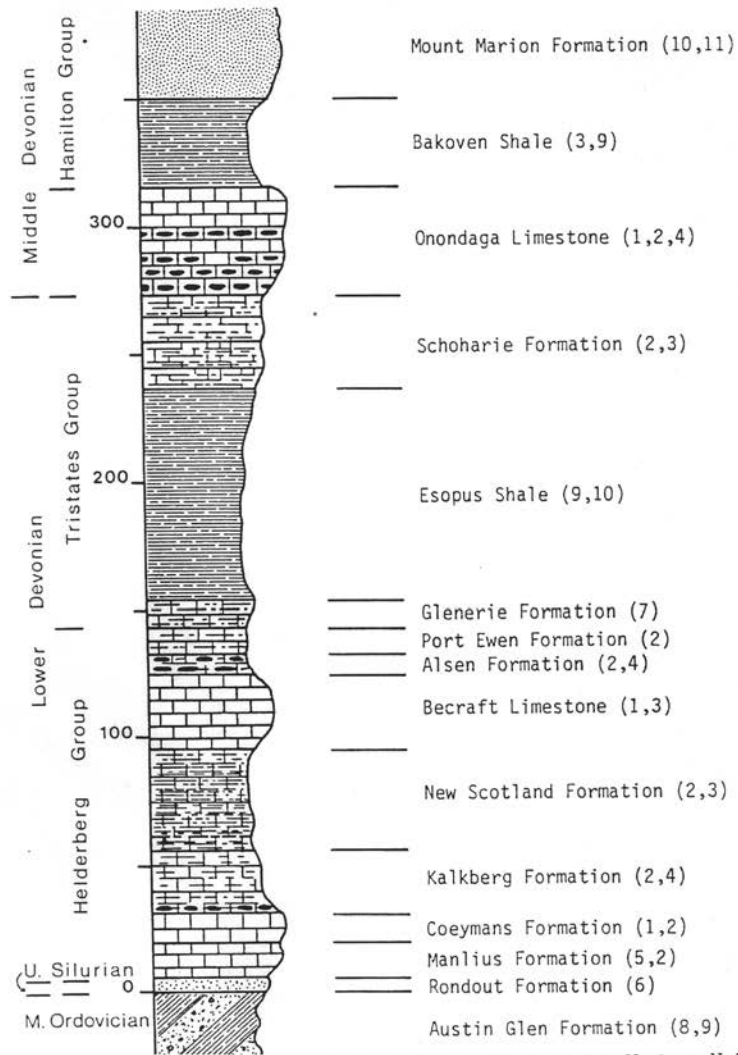
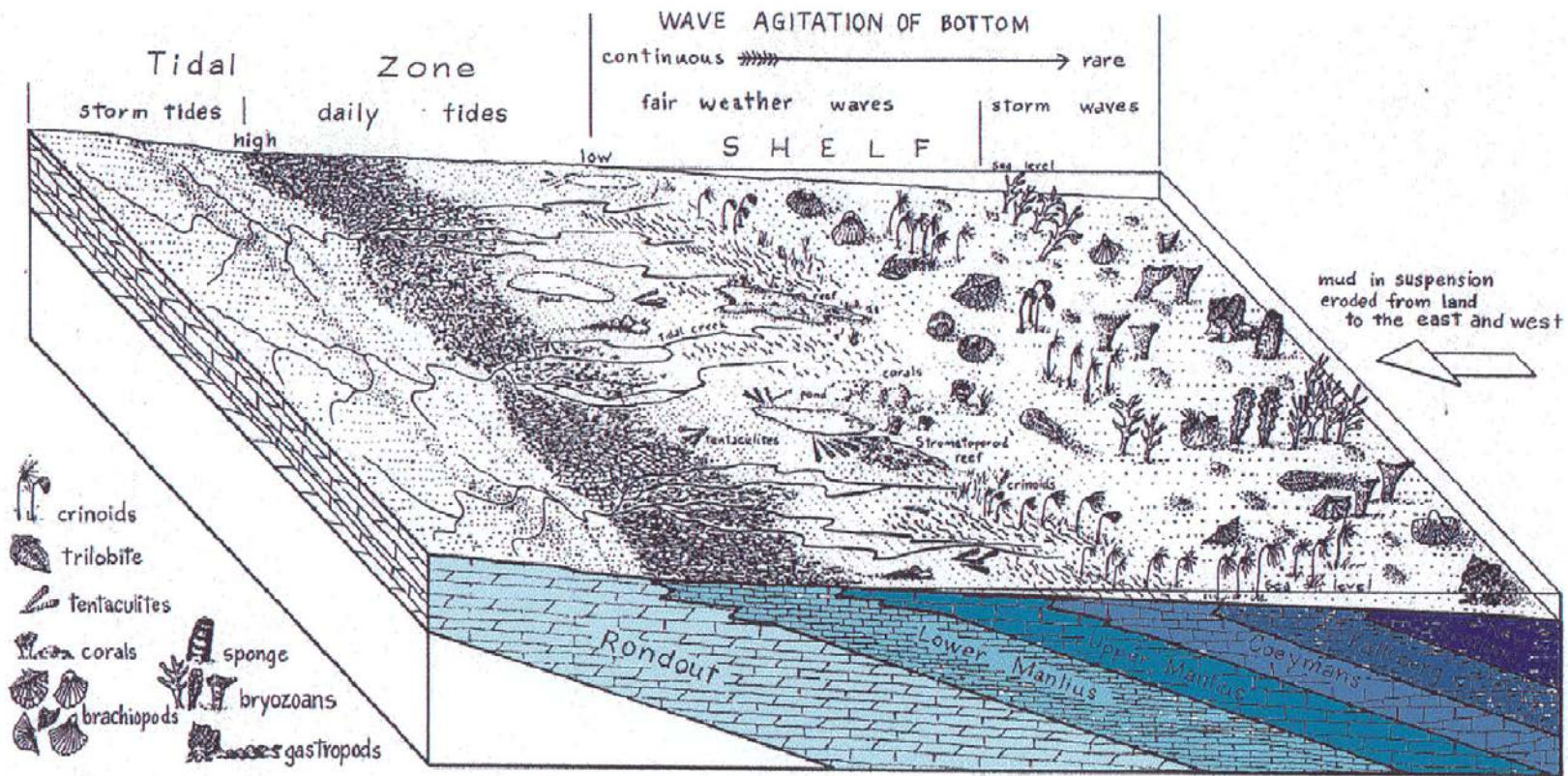
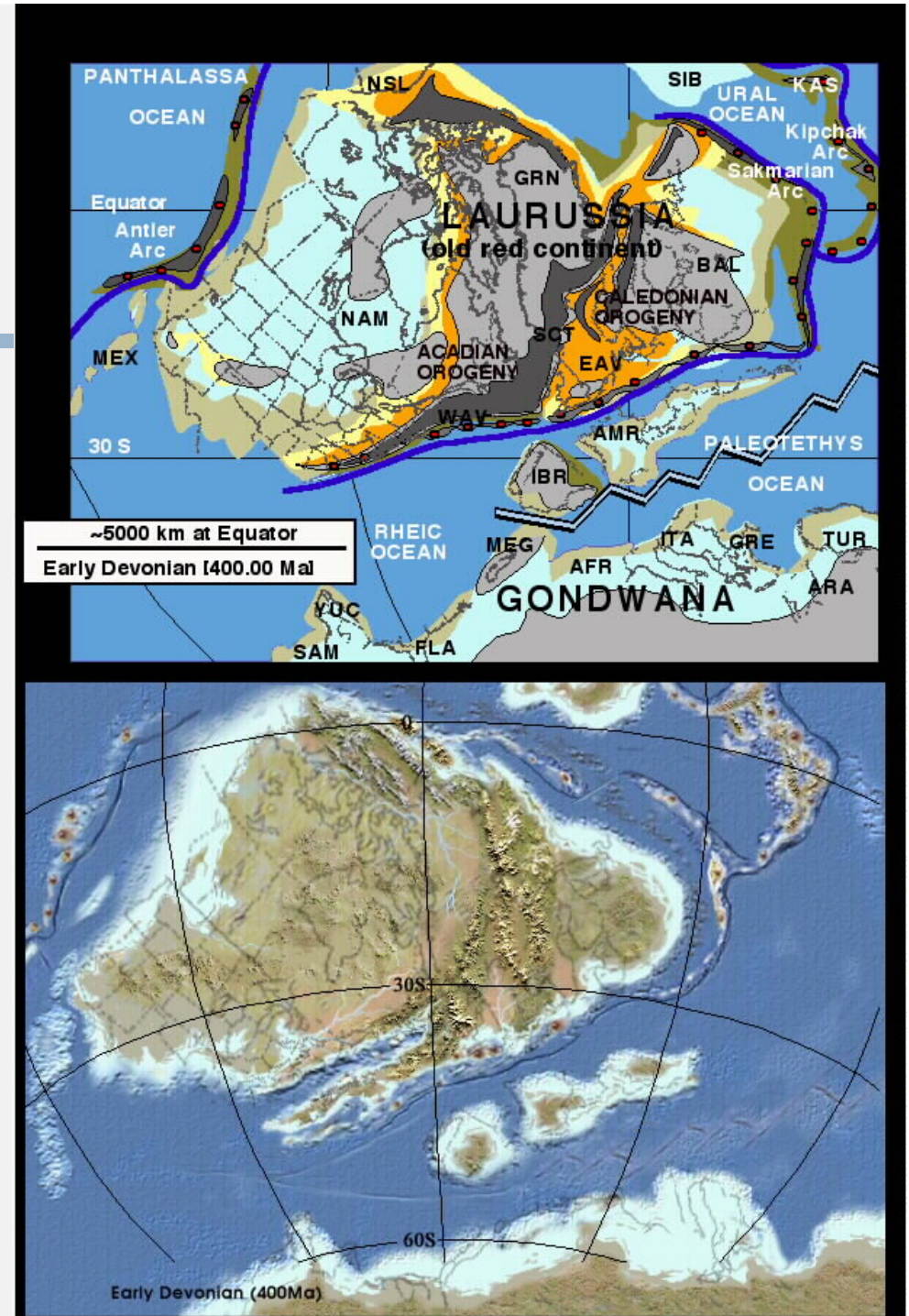


Figure 4: Stratigraphic column of the strata involved in the Hudson Valley Fold-Thrust Belt. The numbers next to formation names refer to lithologies. 1=grainstone; 2=wackestone; 3=calcareous shale; 4=black nodular chert; 5=laminated micrite; 6=sandy limestone; 7=cherty limestone; 8=greywacke; 9=siliceous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

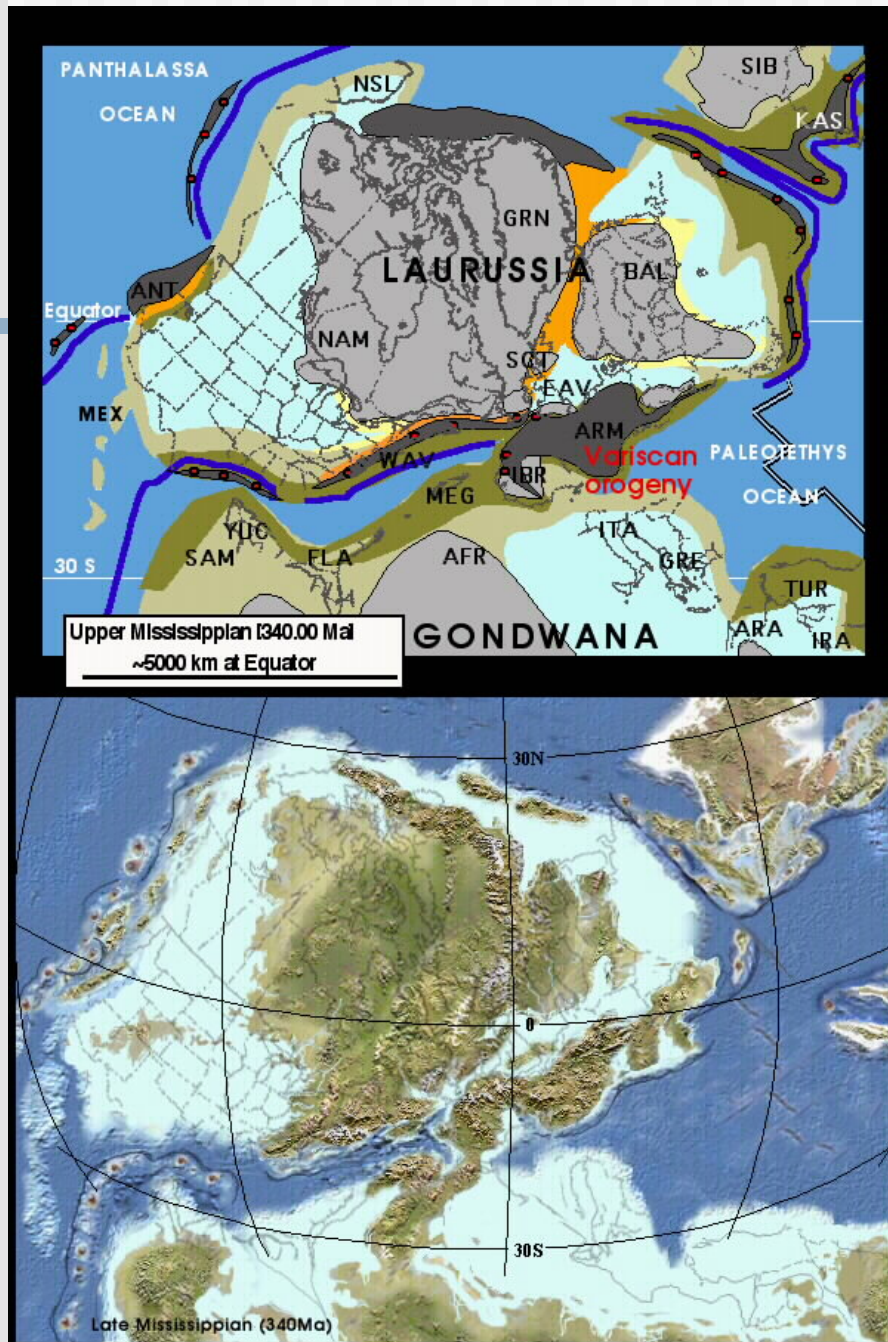


340 Ma

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

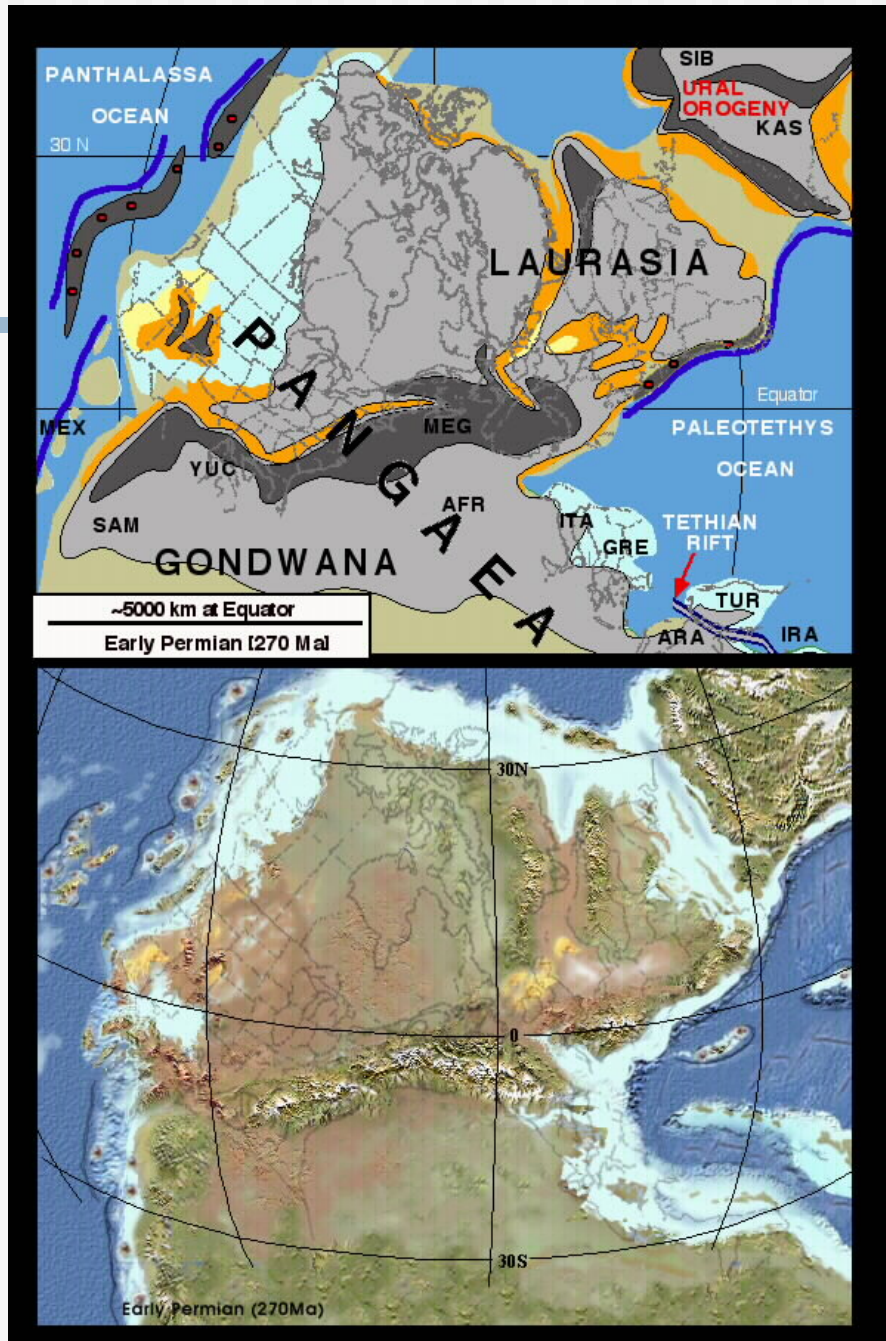


300 Ma

Eastern margin of Laurentia collides with the northern margin of Gondwana

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





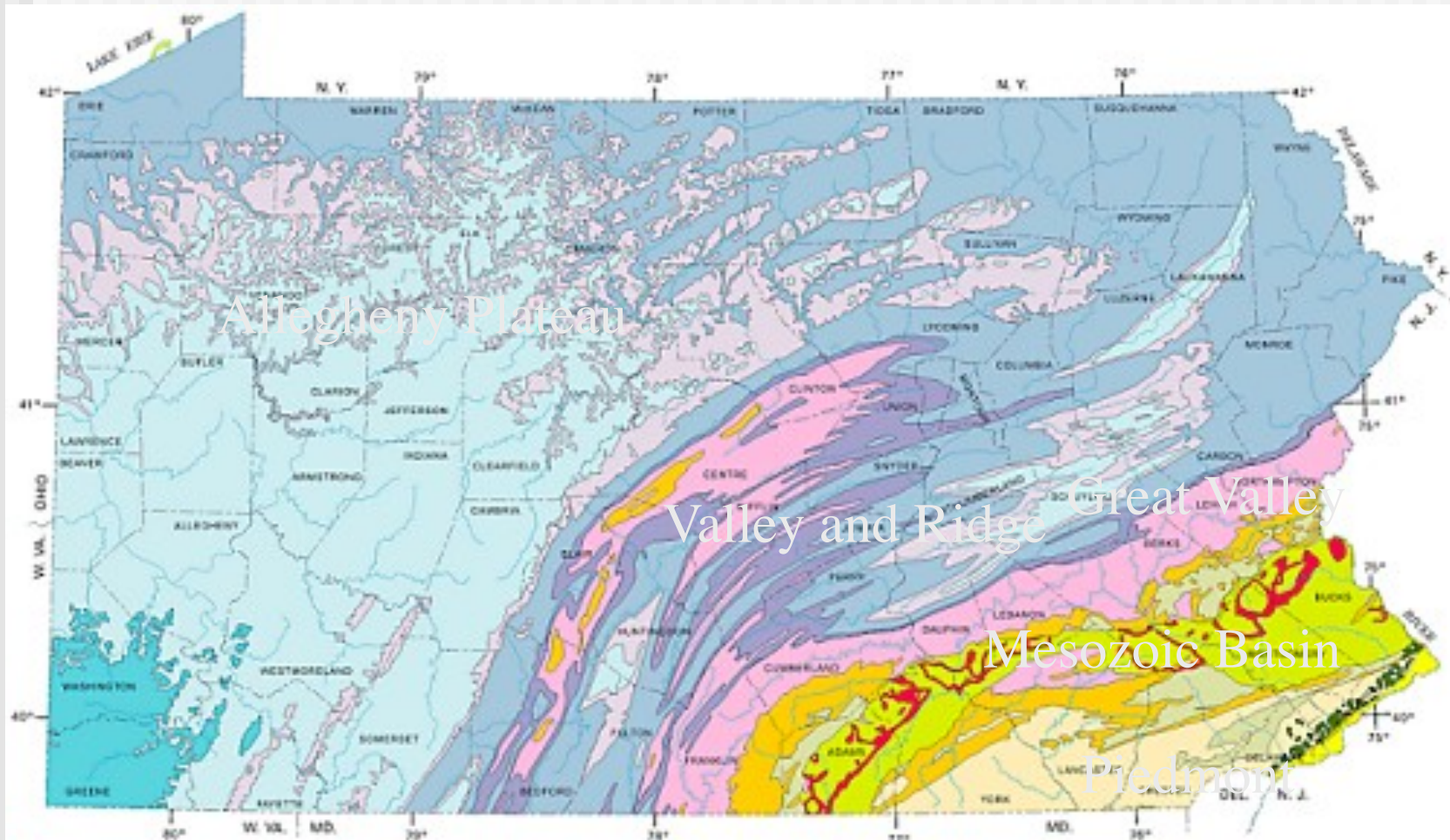
270 Ma

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

Appalachian Mountains lie at mid-continent near the Equator

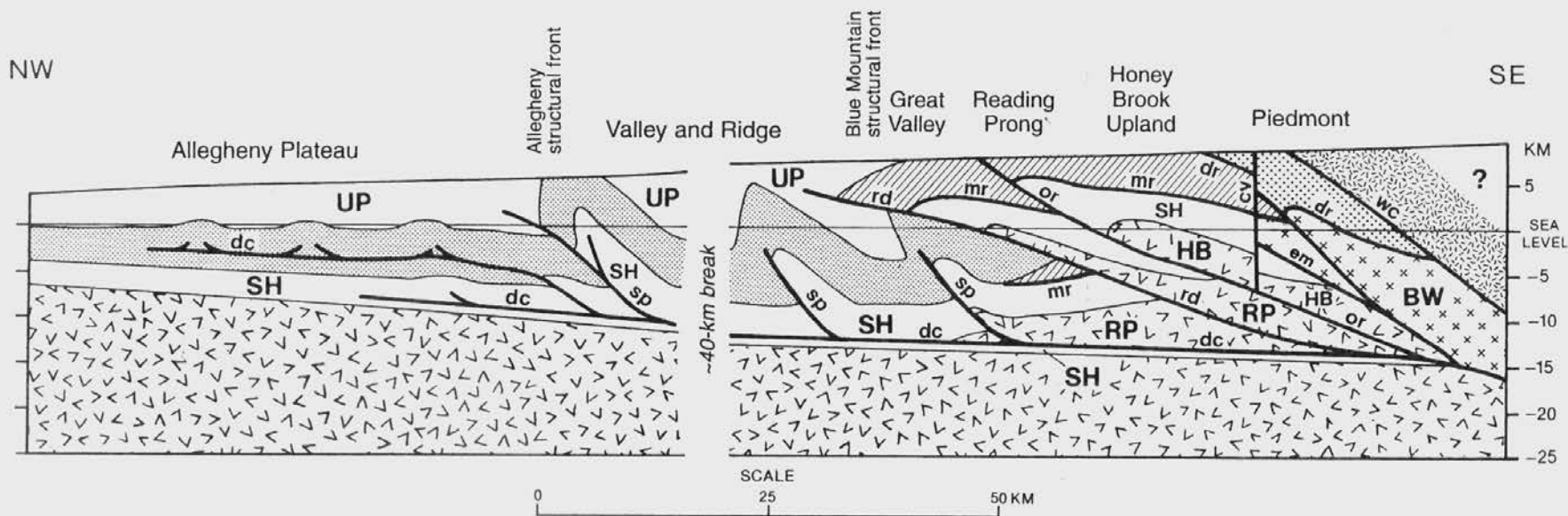
Subduction on the West coast

Geology and Physiographic Provinces of Pennsylvania



Cross Section across Pennsylvania

Fail, 1999



EXPLANATION

UP Upper Paleozoic rocks

Devonian, Silurian, and Upper Ordovician basin rocks

SH Ordovician and Cambrian carbonate-shelf rocks

Octoraro basin rocks

Magmatic arc rocks (Wilmington Complex)

Theic ocean rocks

Microcontinental rocks

Laurentian rocks

MASSIFS

BW - Brandywine **HB** - Honey Brook

RP - Reading Prong

ALLEGHANY FAULTS

dc - Décollement

sp - Décollement splay

or - Oregon thrust

cv - Cream Valley strike-slip

ALLEGHANY AND TACONIC FAULTS

rd - Reading Prong thrusts

TACONIC FAULTS

wc - Thrust at base of Wilmington complex

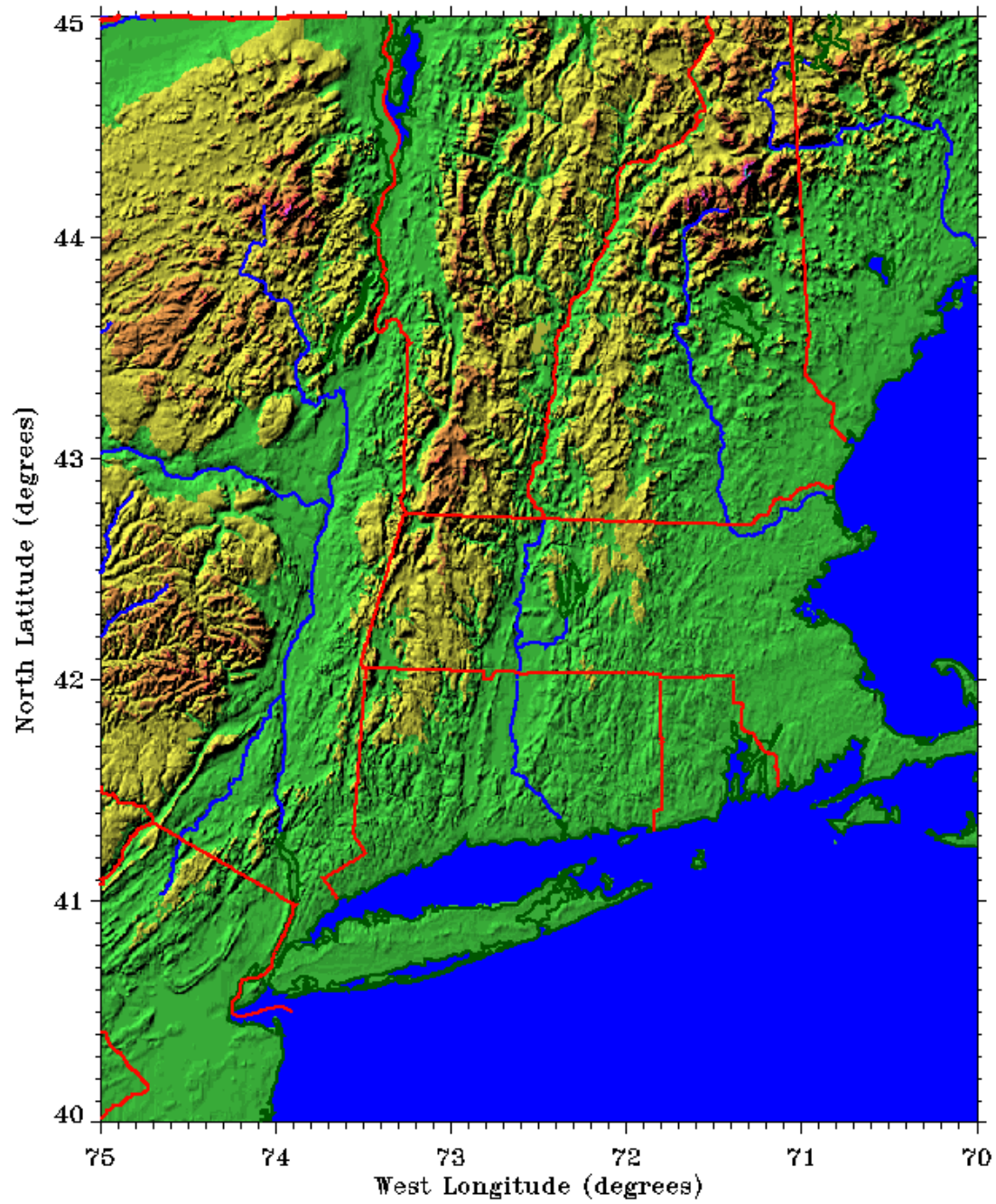
dr - Doe Run thrust

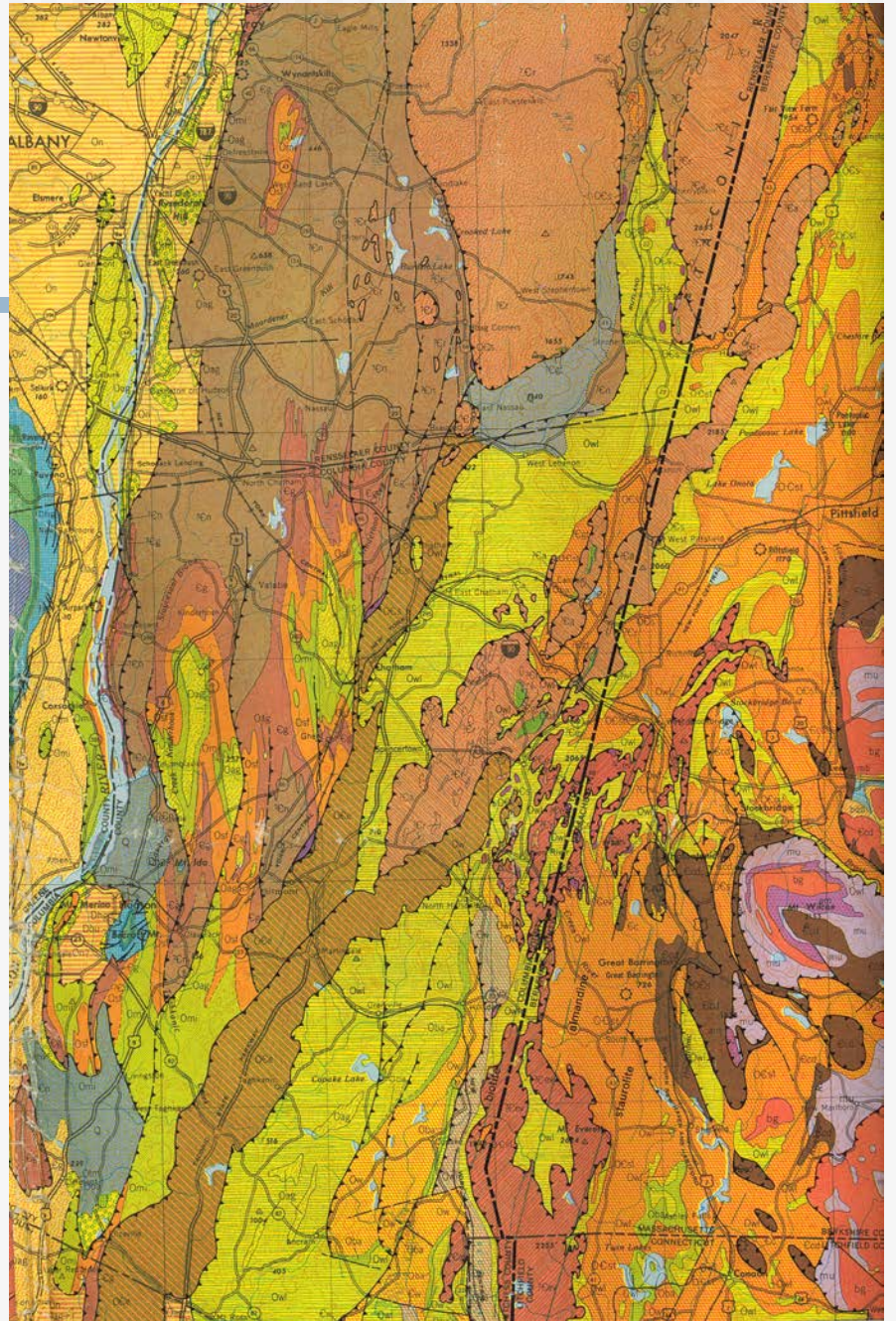
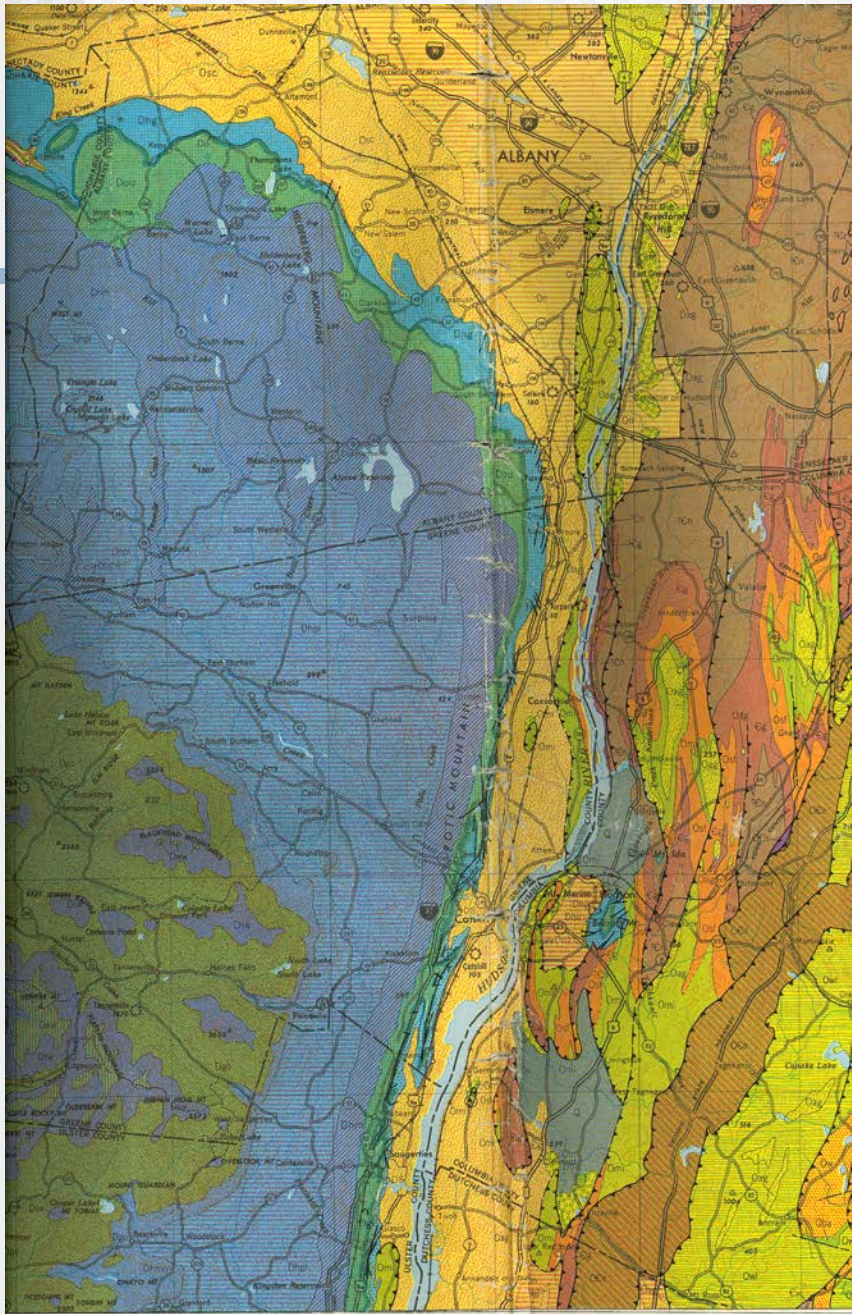
em - Embreeville thrust

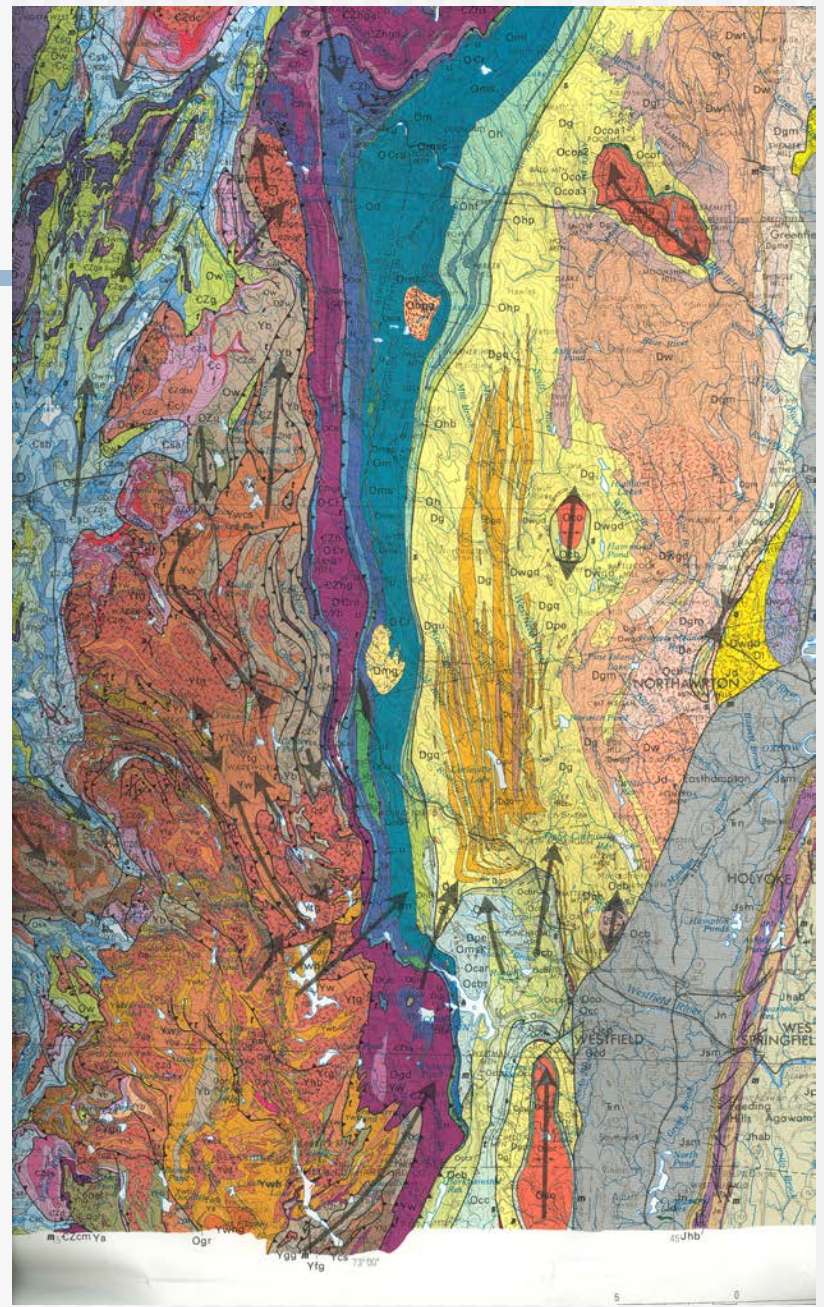
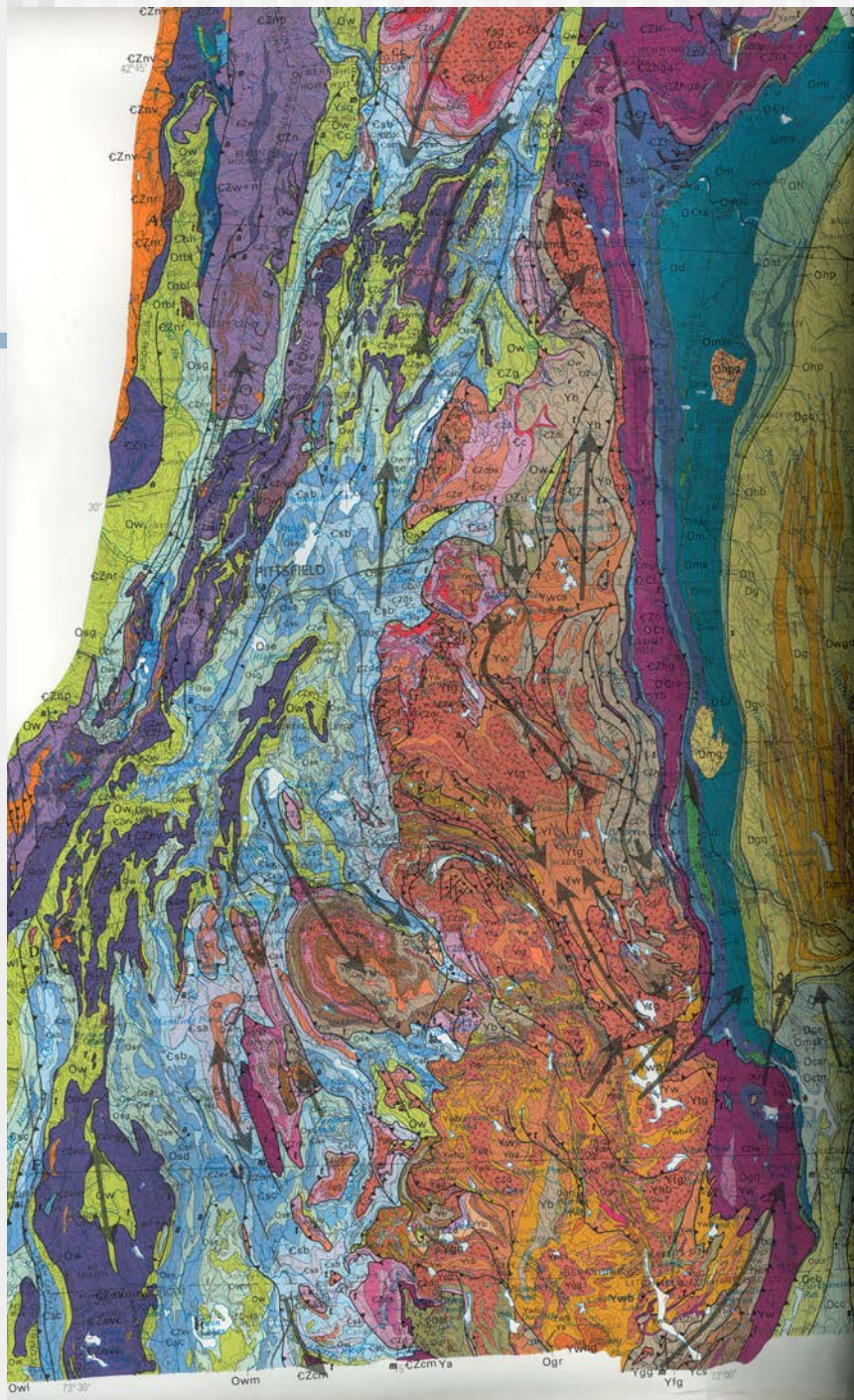
mr - Martic thrust

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







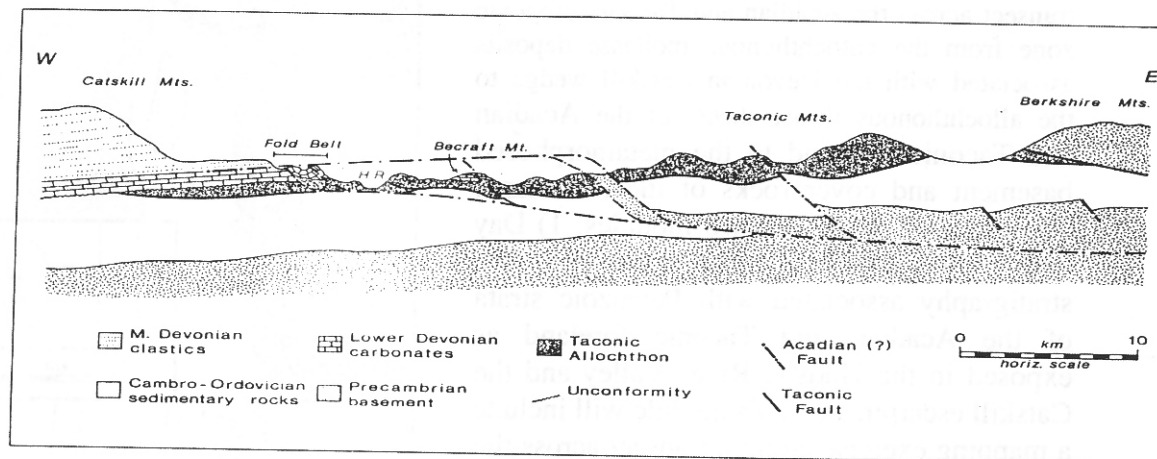
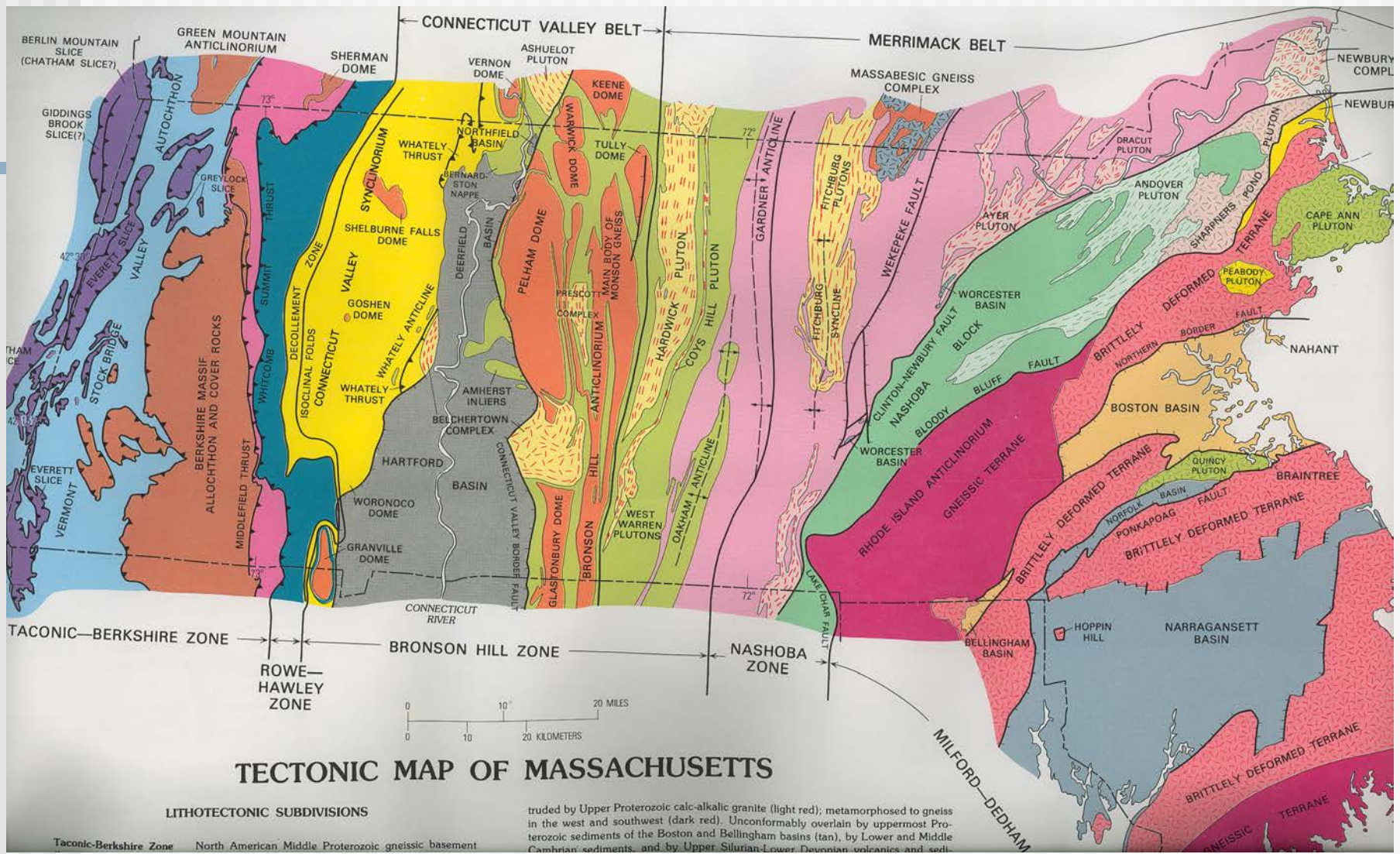
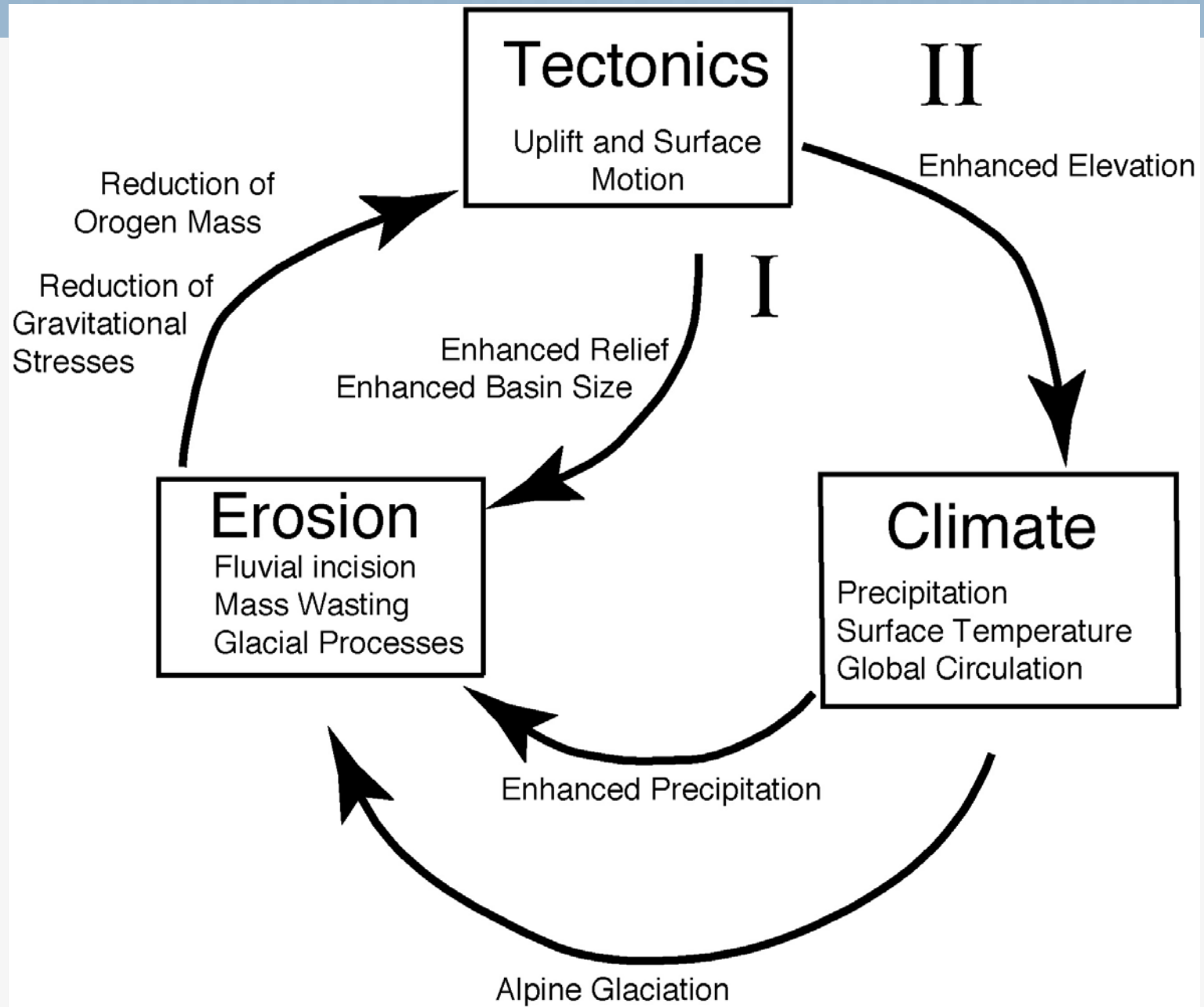
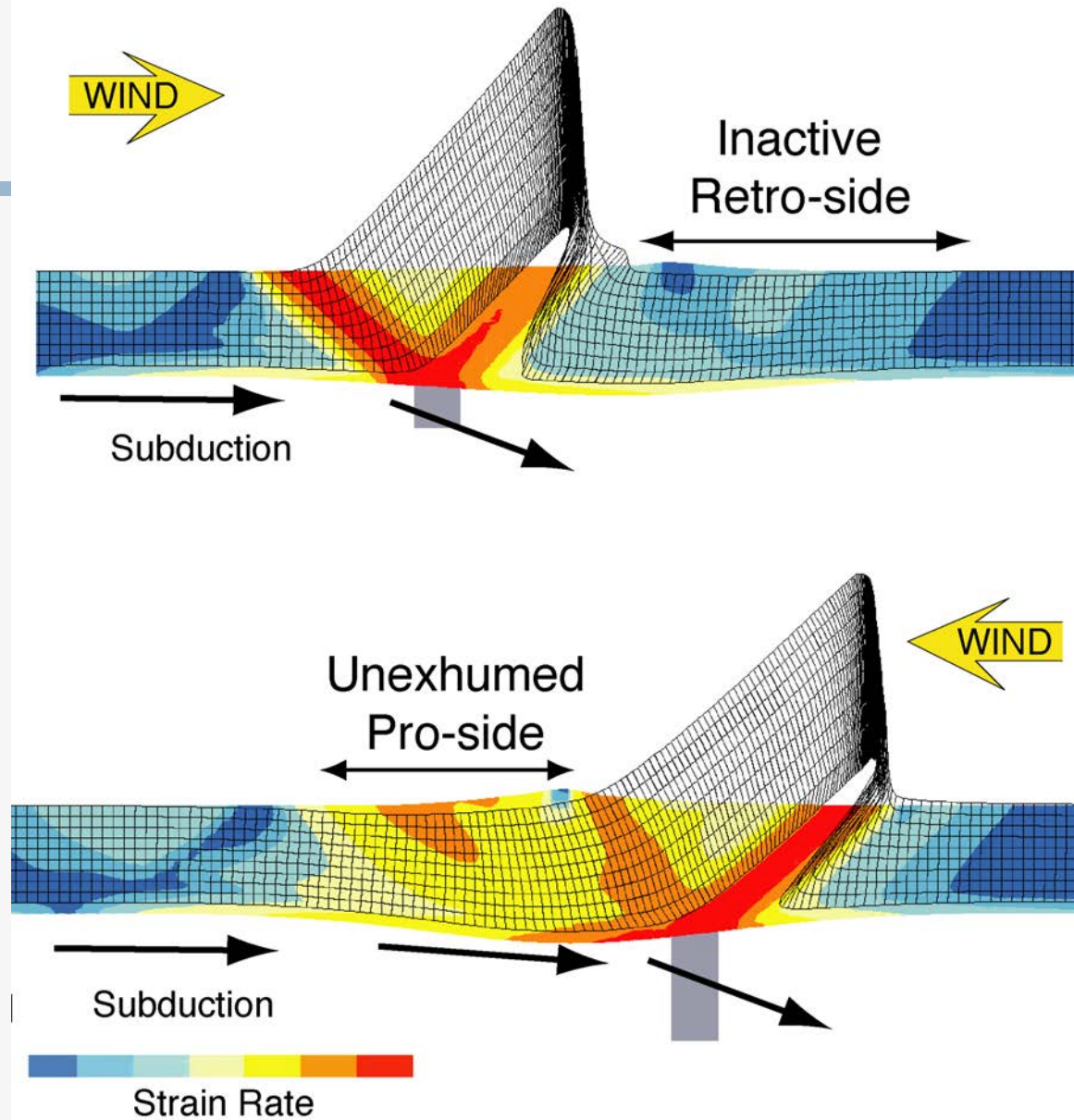


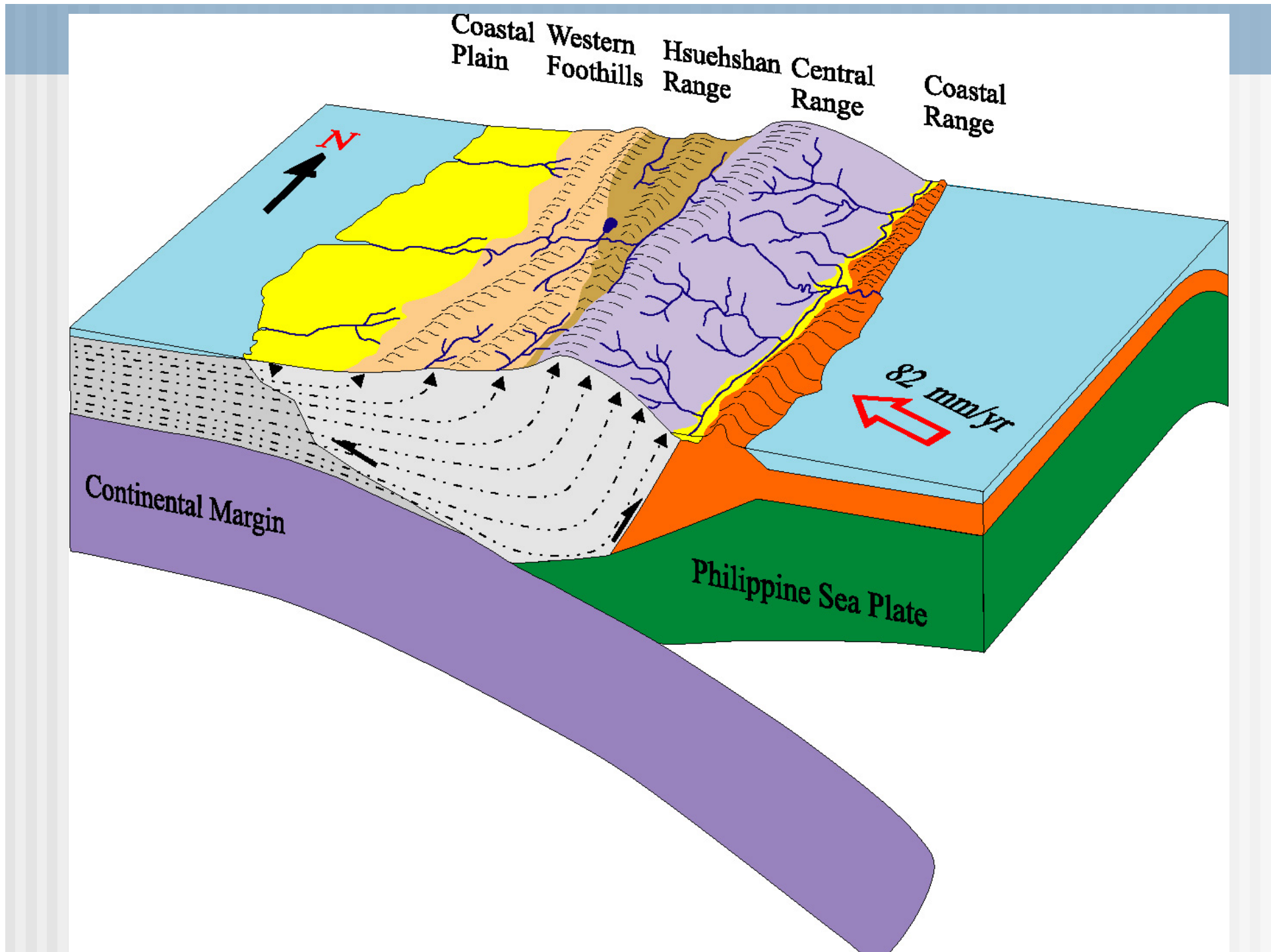
Figure 2. Schematic cross section between the Berkshire and Catskill Mountains (from Marshak, 1983)

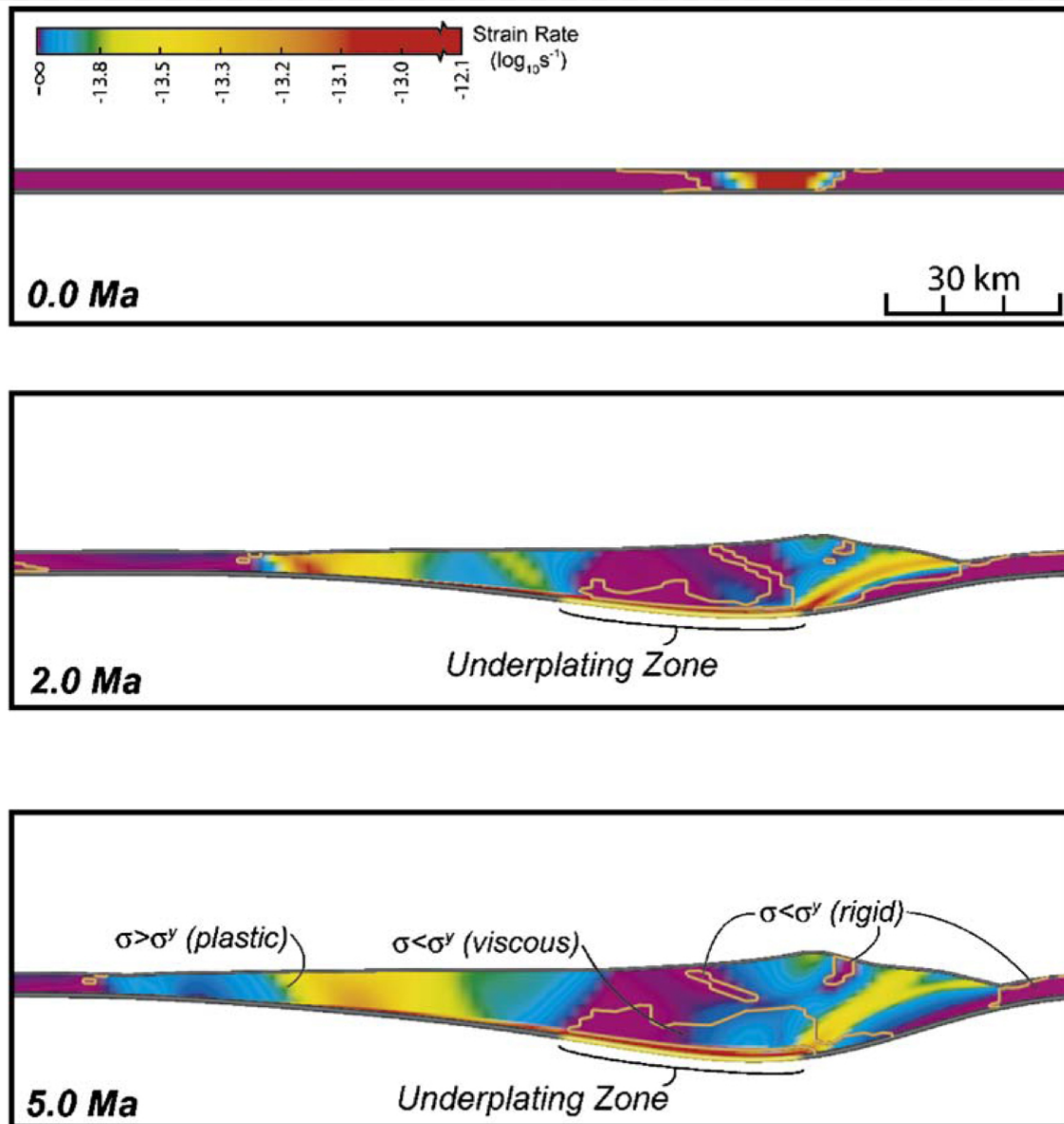




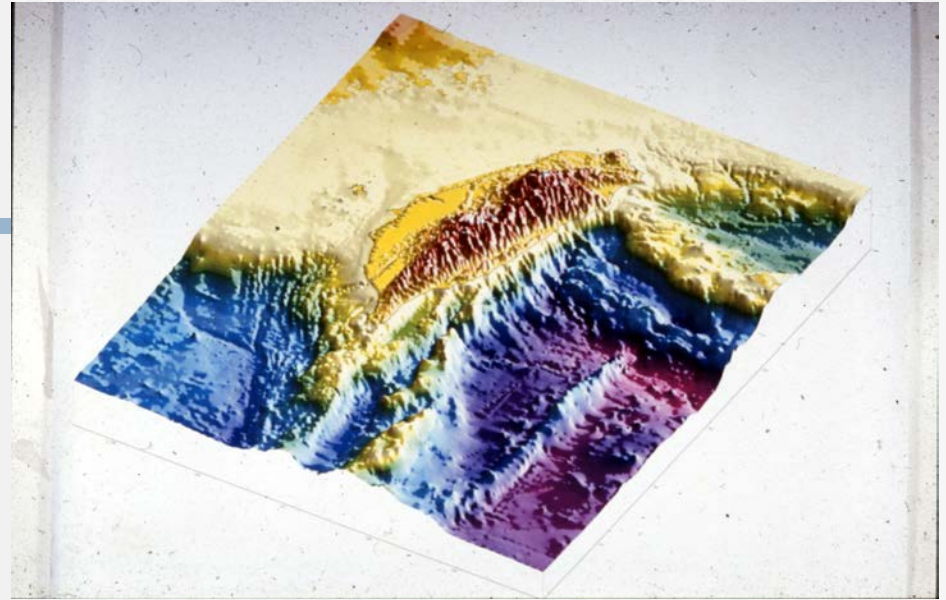
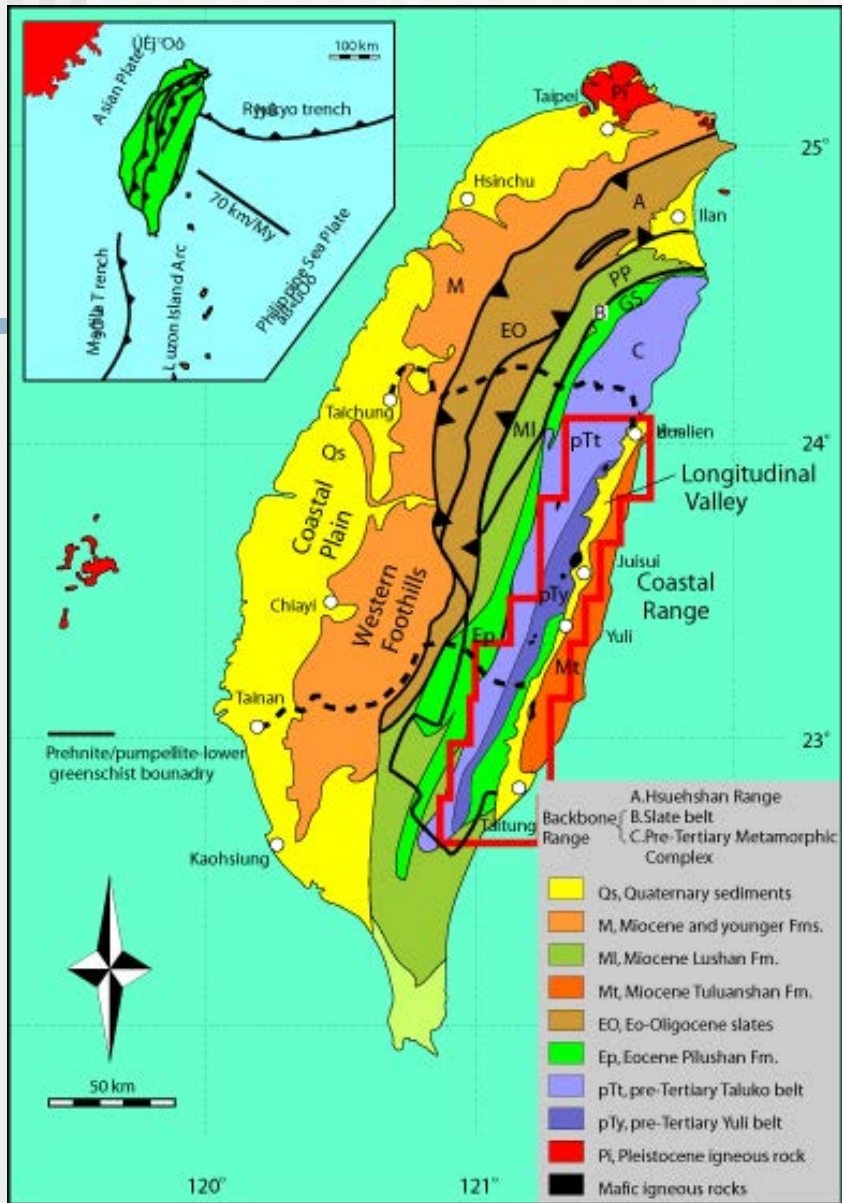
Orographic Exhumation





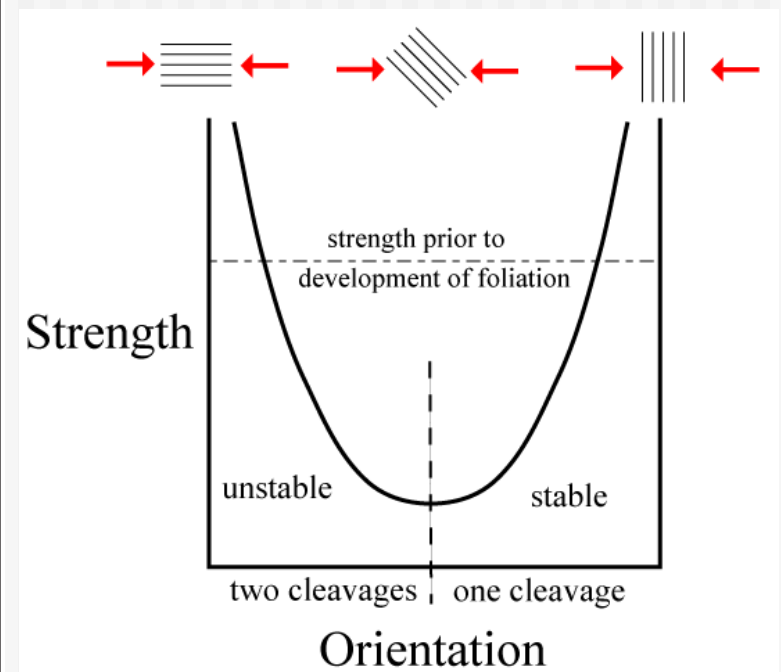
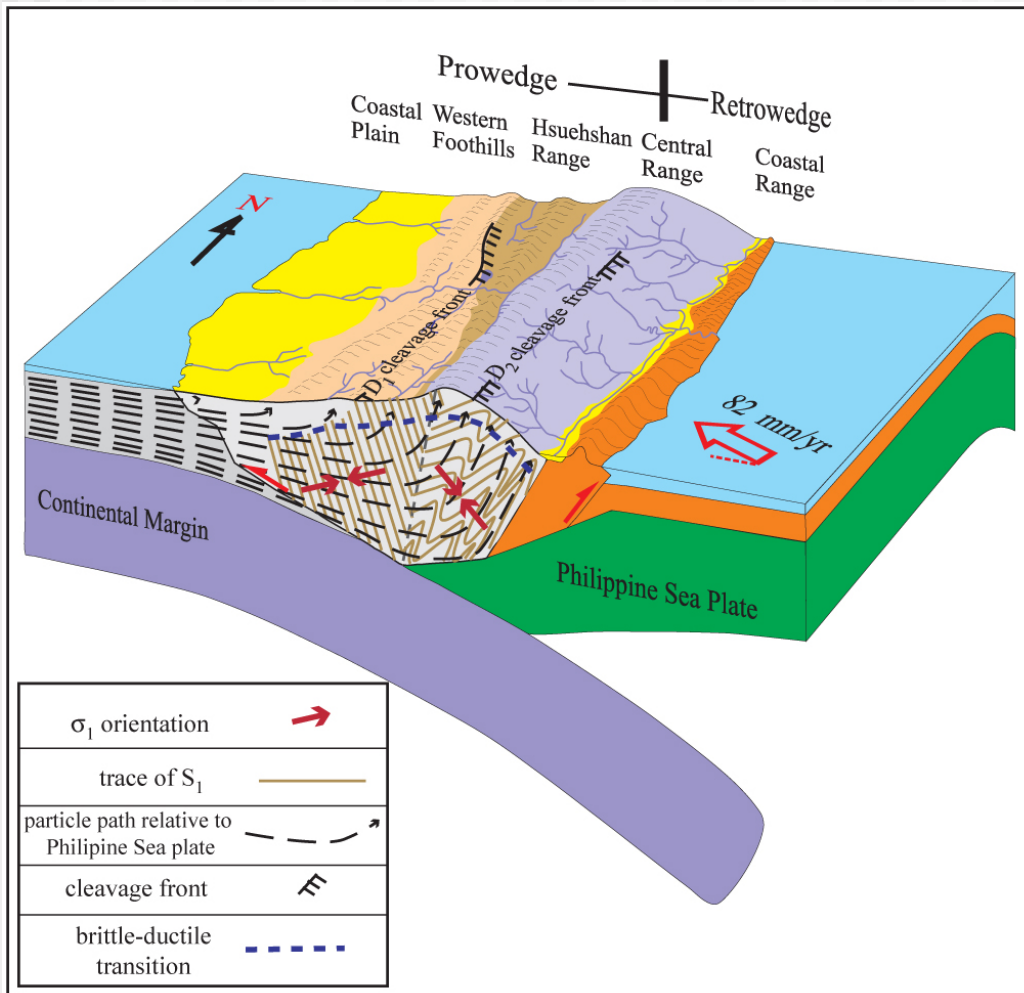


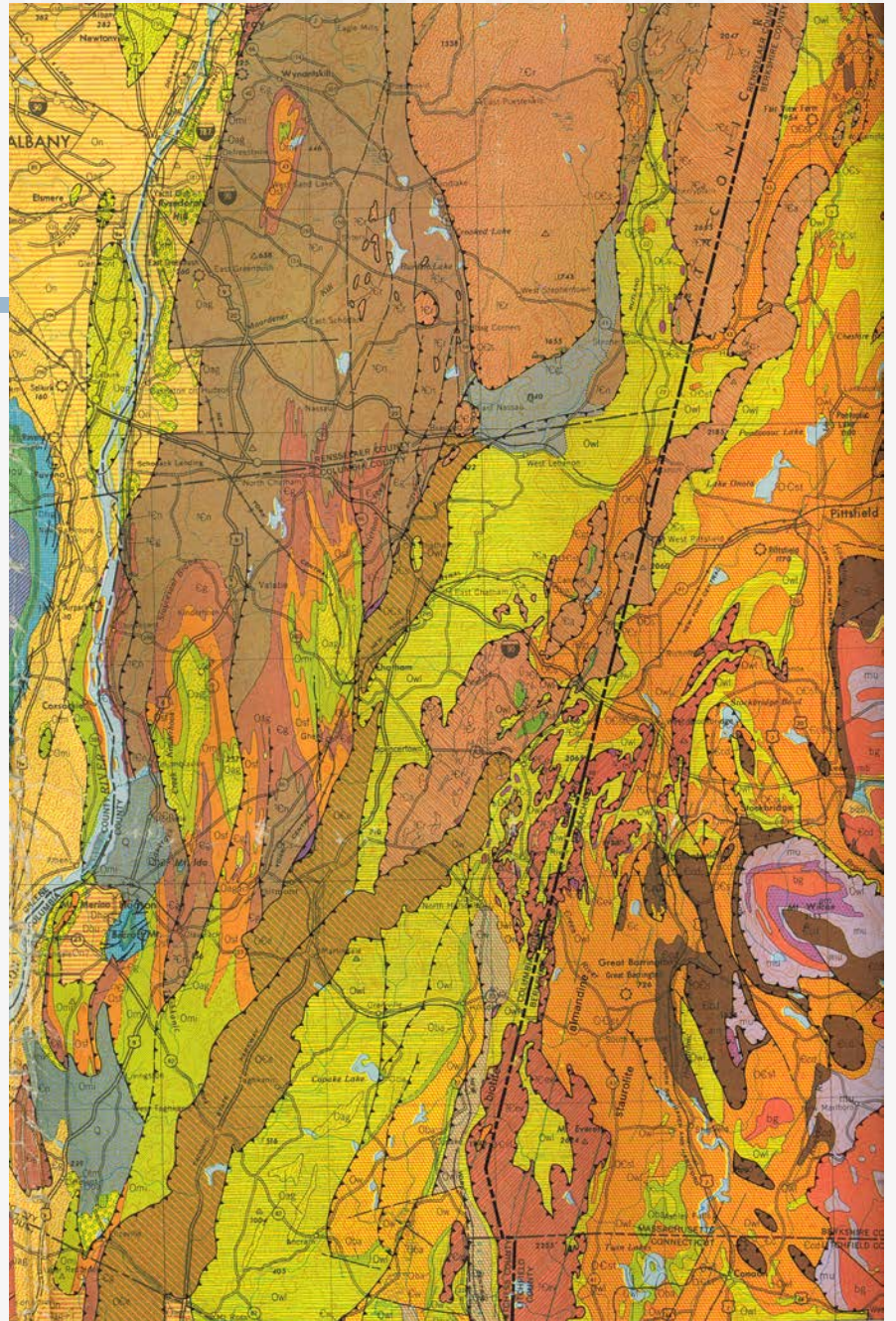
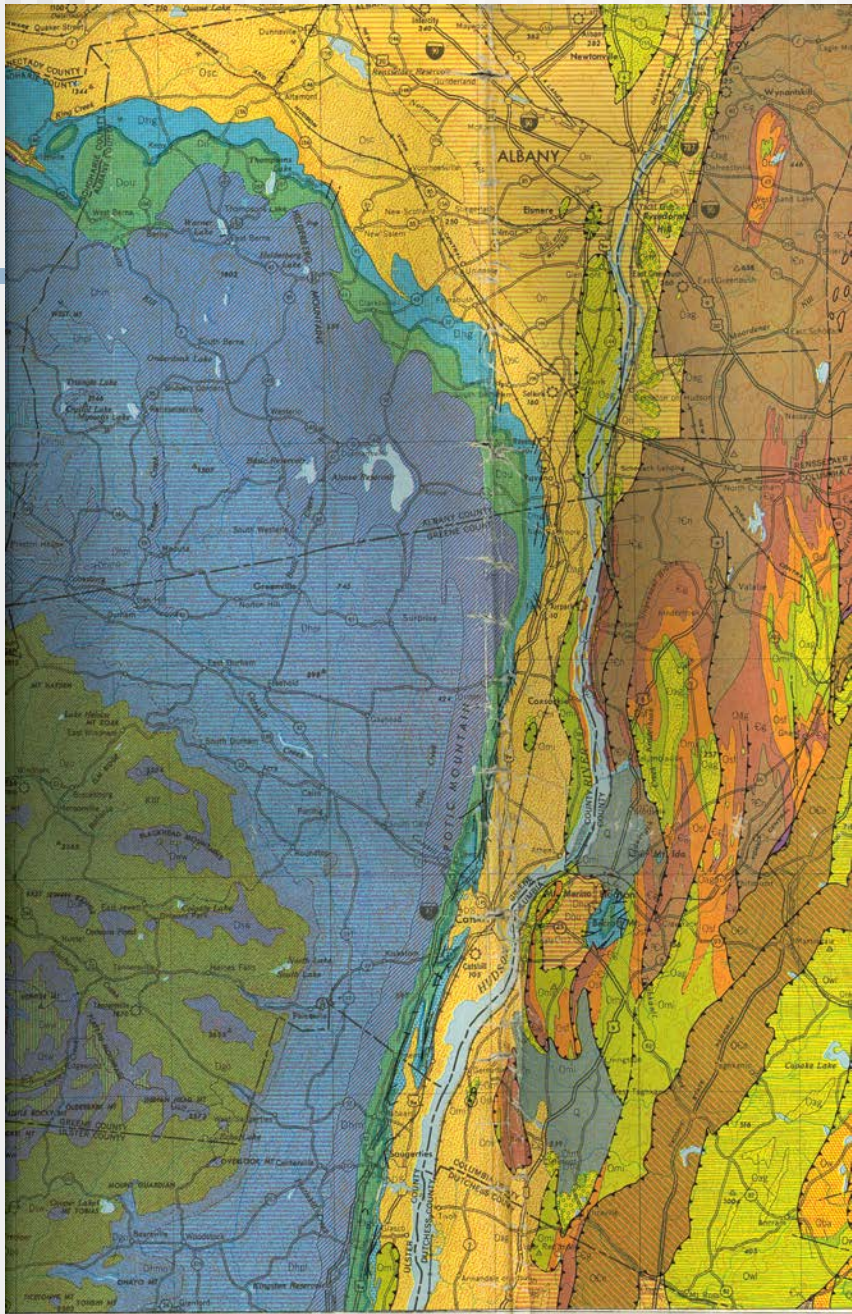
Fuller et al., 2006

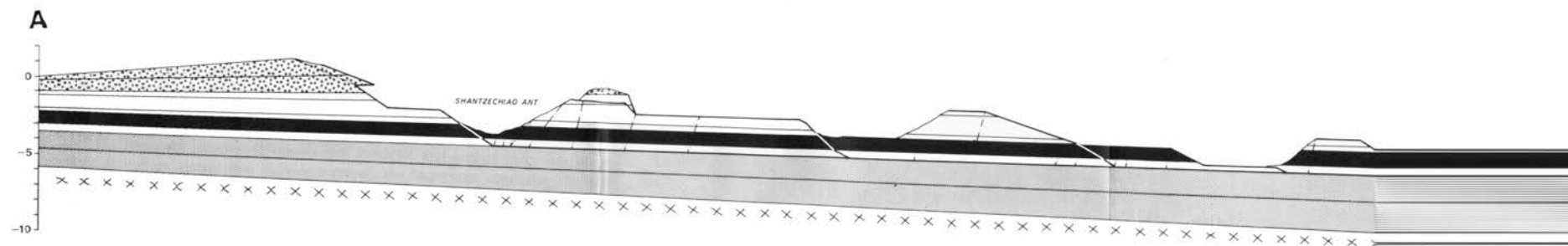
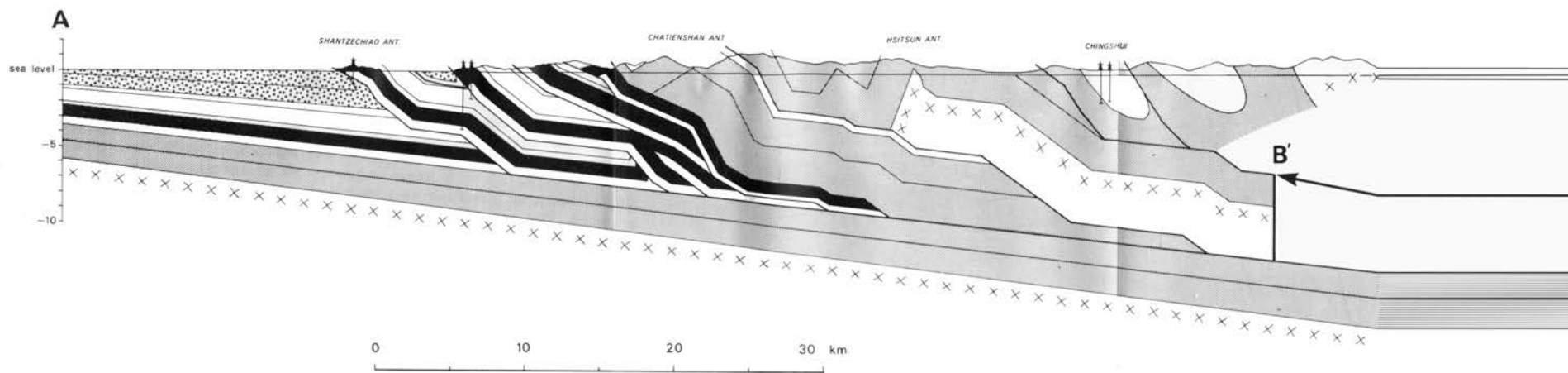


Tectonics Geology

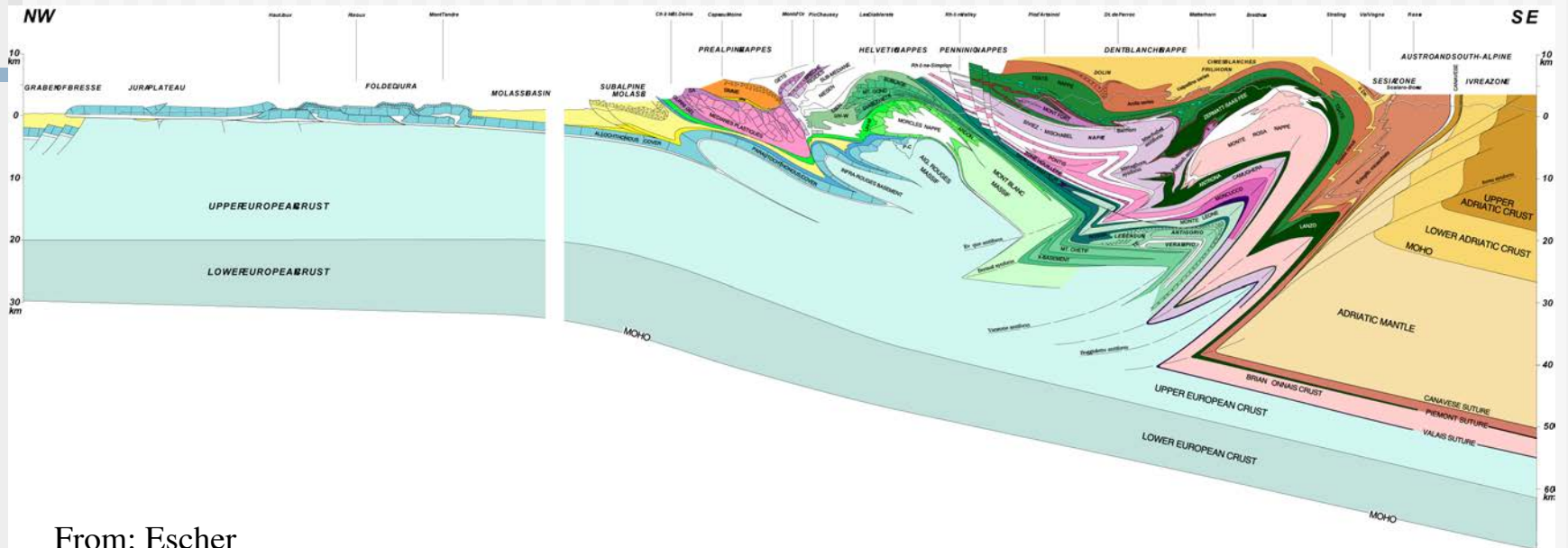
Cleavage fronts and fans





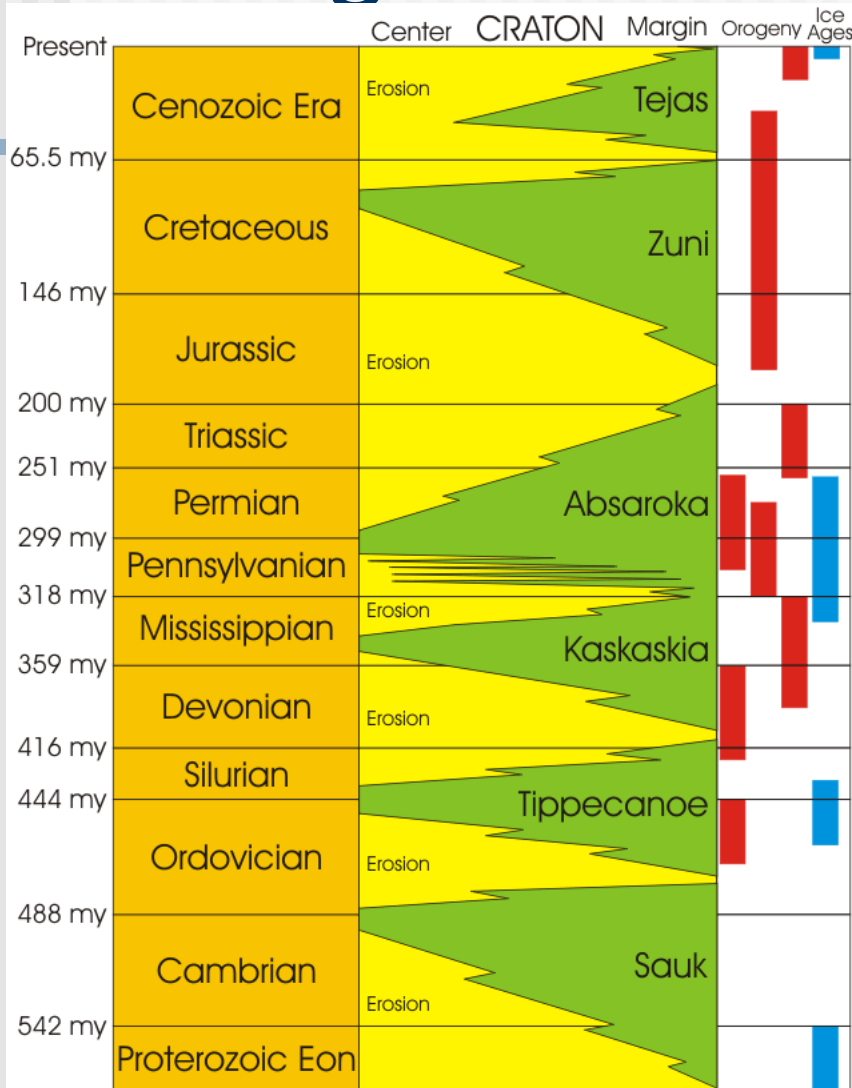


Western Alps



From: Escher

Transgressions and Regressions



Sedimentary Sequences, Orogenies, and Glaciation of North America

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

Ice volume-melting of ice

Rapid spreading- breakup of Pannotia