GLG310--Structural Geology, Fall 2013

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Tuesdays and Thursdays, 10:30-11:45 AM LSE-B04 (Lecture)
Mondays OR Thursdays 1:30-4:30 pm, PSH 460 or in the field (Lab)

Announcements Syllabus Schedule Weekly lecture notes GLG310 Labs Links

Rotating porphyroblast in amphibolite (Alps)  Folding at Barnhardt Canyon

Left-lateral offsets along the Altyn Tagh Fault

Mohr Circle and equations for stress

\[ \sigma = \frac{1}{2}(\sigma_1 + \sigma_3) + \frac{1}{2}(\sigma_1 - \sigma_3) \cos 2\theta, \]

\[ \tau = \frac{1}{2}(\sigma_1 - \sigma_3) \sin 2\theta. \]
Cordilleran (W. North America) Tectonic overview

cordillera (n.) --1704, from Spanish, "mountain chain," from cordilla, in Old Spanish "string, rope," dim. of cuerda, from L. chorda "cord, rope"
Cordilleran (W. North America) Tectonic overview

Well studied; Dominantly a convergent margin (starts at 800 Ma)

- 1 continental plate interacting with numerous oceanic plates (Pacific and Farallon) + continental and oceanic (mostly island arc) fragments
- Terrane accretion is important (terranes are tectonic fragments with their own history distinct from surrounding rocks (island arcs, aseismic ridges, oceanic plateaus, small fragments of probable oceanic crust). Accretion means to add to margin during subduction
- Mostly from Moores and Twiss, Tectonics
Figure 12.1 Worldwide pattern of orogenic belts differentiated according to the time period during which the deformation occurred. Belts are grouped according to their ages in ocean basin time (1–200 Ma), plate tectonic time (200–1000 Ma), Meso-Paleoproterozoic (1000–2500 Ma), and Archean (2500–3800 Ma). (After B. C. Burchfiel, 1983)
• Noteworthy as an orogen for
  • Suspect terranes (far travelled allochthons; more as you go oceanward)
  • Strike-slip faulting (San Andreas System)
  • Voluminous magmatism
  • Plateau uplift
  • Normal faulting (Basin and Range)

Figure 12.3 Map of U.S. Cordillera showing major tectonic features discussed in the text. Section lines A–A’ through C–C’, indicate locations of the cross sections shown in Figure 12.4. (After King, 1977)
Serial cross sections through the modern system

Figure 12.4  Cross sections of the North American Cordillera. Locations indicated in Figure 12.3.  A. Cross section A–A’ across Alaska.  B. Cross section B–B’ approximately along the 49th parallel.  C. Cross section C–C’ of the Cordillera through the Basin and Range province.  (A. after Csejtey et al., 1982; Roeder and Mull, 1978; B. after Potter et al., 1986; C. after Maxwell, 1974; Allmendinger et al., 1986)
Global Paleogeography
(see Plate Tectonics lecture)

http://www.youtube.com/watch?v=Cm5giPd5Uro
Future Cordillera

560 Ma Late Precambrian

http://cpgeosystems.com
Cordilleran convergent margin

Appalachian collisional orogen
150 Ma Late Jurassic

Oblique West-hemi view

Equatorial Tethys view
Oblique West-hemi view

105 Ma "Middle" Cretaceous
Equatorial Tethys view
Plate Tectonic history
(cross sections of margin and geological examples)

Figure 12.10  Possible plate tectonic cross-sectional model for development of the U.S. portion of the North American Cordillera, along cross section C–C' of Figures 12.3 and 12.4. See text for discussion. (After Moores, 1970; Schweickert and Snyder, 1980)

A. Early Paleozoic
Sea level
Passive margin
Miogeoclone

Approach of exotic island arc

B. Middle Devonian

Antler orogeny
Minor fold-thrust belt
Miogeoclone
Arc collision

C. Late Devonian–early Mississippian

Continental crust
Oceanic crust
Arc complexes
Figure 12.10 Possible plate tectonic cross-sectional model for development of the U.S. portion of the North American Cordillera, along cross section C-C' of Figures 12.3 and 12.4. See text for discussion. (After Moores, 1970; Schweickert and Snyder, 1980)

A. Early Paleozoic

East Antarctica

800 Ma

A Continent undergoes extension. The crust is thinned and a rift valley forms (East African Rift Valleys).

B Continent tears in two. Continent edges are faulted and uplifted. Basalt eruptions form oceanic crust (Red Sea).

C Continental sediments blanket the subsiding margins to form continental shelves and rises. The ocean widens and a mid-oceanic ridge develops (Atlantic Ocean).
700-1000 Ma
Rodinia
super continent

Figure 12.33 Possible late Precambrian continental configurations. A. Possible prebreakup configurations of Precambrian cratonic region in supercontinent Rodinia; areas of Grenvillian (800–1500 Ma) orogenic belts. B. Possible configuration of Gondwanaland formed by breakup and rearrangement of fragments shown in (A). (After Hoffman, 1991)

500 Ma—fully rifted away
Figure 12.10 Possible plate tectonic cross-sectional model for development of the U.S. portion of the North American Cordillera, along cross section C-C' of Figures 12.3 and 12.4. See text for discussion. (After Moors, 1970; Schweickert and Snyder, 1980)

- Continental crust
- Oceanic crust
- Arc complexes

http://jan.ucc.nau.edu/~rcb7/paleogeogwus.html
Arc-arc collision (Nevadan orogeny)

Dextral strike-slip faulting

Miogeoclone
Fold-thrust belt

Formation of mountain root

G. Mid-Jurassic

Detached slab

Detached slab

Polarity reversal
Franciscan

Active transform fault

Great Valley

Sierra Nevada

Rectilinear faulting

Fold-thrust belt
Miogeoclone

H. Late Jurassic–Cretaceous
H. Late Jurassic–Cretaceous
Collision of Wrangellia with continent, dextral faulting

I. Late Cretaceous

http://jan.ucc.nau.edu/~rcb7/paleogeogywus.html
Major elements of orogens

Figure 10.3 Cross section across a model composite orogenic belt. (After Hatcher and Williams, 1986)

-from Moores and Twiss, Tectonics