Spring 2-1-2004

GEOL 195.01: Roadside Geology

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Geology 195, Roadside Geology

Spring, 2004 A trip through time as illustrated by the rocks of the northwestern states and the events that produced.

M, W, F, 2:10-3, in SC 304 **Don Hyndman**, office, SC 357

Text: Northwest Exposures. Dave Alt and Don Hyndman, 1995, Mountain Press

Sequence of Topics:

mya = million years ago

Precambrian Era: Basement Rocks (pre-1600 mya) *[p. 1-12]*
- Location, age, the old continent – granites and gneisses formed deep in the crust, exposed by erosion; talc; Stillwater Complex, chromium, platinum and palladium.

Precambrian Era: Proterozoic (Belt) rocks (1500-1000 mya) *[p. 13-28]*
- The Precambrian world; carbon dioxide, water vapor, hot, greenhouse effect, Venus-like?, little oxygen, little wind, almost no limestone.
- Changing atmosphere, changing rocks with time.
- Circular continental basins; Belt basin deformed.
- Belt basin; Belt sediments deposited; rock types; thin layers, no animals, shallow water features.
- Stromatolites and formation of oxygen.
- Continental rifting and splitting off of Siberia or Australia from North America about **800 mya**.

Paleozoic Era (600-245 mya) *[p. 29-40]*
- First abundant animals, sea invades Idaho and Montana from west;
- Flathead sandstone, then shale, limestone; shallow seas.

Late Paleozoic *[p. 41-50]*
- Madison limestone, caves, Pennsylvanian sand dunes.
- Phosphoria Formation and fertilizer.
- Pangaea assembled; red Permian deserts at the equator.
- Horrible Permian extinction of 95% of all animal life.

Mesozoic Era (245-65 mya) *[p. 51-70]*
- Pangaea begins to split up; Atlantic Ocean begins to open; spreading and plate collision. Josephine ophiolite (slice of old ocean floor).

Kootenay Arc (200 mya) *[p. 71-76]*
- Folds and granite.
- Early Rocky Mountains of 200-150 mya.
- Dry plains of central to eastern Montana; shallow sea to east.
- Dinosaurs, birds; warm, dry, sandy beaches, red mudflats.

Jurassic time *[p. 77-84]*
- Landing Intermountain terranes microcontinent (170 mya) killing the oceanic trench so the trench jumps west.

Feb. 16 (Univ. Holiday)

Cretaceous time *[p. 85-108]*
- Collision of Blue Mountains/Seven Devils terranes 100 mya.
- Old continental margin. The Western Idaho mylonite zone.
- Arrival of the North Cascades terranes and the San Juan Islands. Then the Insular terrane, 90-100 mya.
- Old continental margin – the Western Idaho mylonite (110-90 mya)
- The Klamath Mountains move west: the Modoc basin forms.

The Idaho batholith granite: (90-60 mya) *[p. 115-134]*
Collapse of the early Rocky Mountains: deeply exposed rocks in the Rockies, shallow depth of exposure to the east; question of lubrication; rise of the unloaded Rockies; their original height.
Boulder batholith granite, Elkhorn Mountains Volcanics; big copper mines.
Overthrust belt: (70-55 mya) *[p. 135-149]*
Big slabs of rock move east over the plains; search for oil and gas.
The world of late Cretaceous time; the shallow inland sea retreats east; sandy beaches; coal swamps.
Dinosaurs roam the arid plains of Montana and Wyoming.

Mar. 1 [1st midterm – timing subject to change]

Catastrophe 65 mya: mass extinction of animal life. *[p. 151-160]*
Fort Union Formation: more coal swamps. *[p. 161-174]*
More terranes added on west: Olympic Peninsula and Oregon Coast Range.
Slicing up the North Cascades.
Metamorphic core complexes (40-50 mya) *[p. 175-182]*
Okanogan Range, Bitterroot Range. The crust stretches. The Blue Mountains begin to rotate northwest.
Eocene volcanic range in central Oregon and Washington (50 mya) *[p. 183-196]*
Challis volcano in central Idaho and a big dike swarm extending into southwestern Montana.
Peculiar igneous rocks in central Montana (50 mya) *[p. 197-213]*
Volcanoes, radial dikes, laccoliths. Diamonds and sapphires in central Montana.
New mountains in central Montana.
Blue Mountains continue rotating northwest about 50 mya *[p. 215-232]*
Old ocean floor is pushed up to form the coastal hills.
Western Cascades (13-17 mya)
First long dry spell: John Day, Renova, and White River beds. Valleys fill; mudflows, volcanic ash.
Horrible catastrophe in southeastern Oregon, 17 mya *[p. 233-254]*
Impact, a lava-lake volcano; immense floods of basalt lava; lava source, columnar joints, entablature, and counting flows.
Red soils, white lake beds, climatic side effects and their causes. *[p. 255-266]*
Basin and Range country: a cause, beginning, structure, faults, and earthquakes
Snake River Plain: a continental hotspot track (13-0 mya): *[p. 267-276]*
Rhyolite capped by basalt; Craters of the Moon – recent lava flows, their source.

Mar. 26 (video)
Mar. 29 - Apr. 2 [Spring Break]

Yellowstone Volcano (1.8 mya) *[p. 277-282]*
A brooding monster; consequences of a new eruption
Columbia Plateau folds *[p. 283-293]*
Brothers fault zone; Olympic-Wallowa lineament (15-0 mya)
Olympic Mountains: rising from the ocean floor.
Sheared western fringe of the continent. *[p. 294-298]*
Puget Sound, Willamette Valley, rotated “magnets;” northward drag of the Pacific Plate.

Apr. 12 [2nd midterm – timing subject to change]

Second long dry spell (15.2 mya) (15-2 mya) *[p. 299-306]*
High Plains gravel on an enormous desert plain – wheatfields; Pliocene gravel in western Montana.
The High Cascades (12-0 mya) *[p. 307-324]*
Ash and lava, mudflows; which volcanoes are active?
Pleistocene time (2-0 mya) *[p. 325-350]*
Ice cover; two ice ages.
The modern streams begin to flow, excavating the valleys. The High Plains, Rocky Mountain streams, Lake Idaho and Hells Canyon.
Columbia River and its tributaries (16-0 mya)
Clinker hills on the High Plains
Mountain Glaciers (2-0 mya) *[p. 351-360]*
Glaciated peaks and valleys; Regional ice on the northern High Plains (15,000 years ago), lakes, displaced streams.
Western regional ice (15,000 years ago) *[p. 361-374]*
Puget Sound, Okanogan Valley, Purcell Trench, Flathead Valley
Lake Bonneville, Lake Missoula, and their floods (15,000,12,000 years ago) *[p. 375-390]*
Lake Missoula floods: shorelines, dam, channeled scablands of Washington.
The coast (10,000-0 years ago) *[p. 391-401]*
Rise of sea level; formation of estuaries, rocky cliffs, sandy beaches, dunes.
Rising land, wave-cut benches, terraces.
Missing earthquakes; future giant coastal earthquakes.
The future *[p. 403-407]*
The San Andreas Fault, end of the High Cascades, a new Coast Range.
Yellowstone hotspot, Snake River Plain, and Basin and Range.

Finals WEEK, May 10-14 – Final Exam on Thursday May 13 at 3:20-5:20

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Course Grade based on: 2 midterms worth 25% each
Final exam worth 50%
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Lecture times for each topic **Lectures**

Week 1, Sept. 2, 4,
Introduction (1)
Streams & Floods (1) = 2

Week 2, Sept. 9, 11,
Streams & Floods (2) = 2

Week 3, Sept. 16, 18,
Flood Case Hist. (1)
Climate & Weather (1) = 2

Week 4, Sept. 23, 25
Thunderstorms & Tornadoes (¾)
Waves & Beaches (1¼) = 2

Week 5, Sept. 30, Oct. 2,
Midterm 1
Hurricanes (1) = 1+ MT 8 ½ preMT

Week 6, Oct. 7, 9
Hurricanes (1/2, finish)
Hurricane case Hist (½)
Landslides (1) = 2

Week 7, Oct. 14, 16
Landslides (1 ¼)
Landslide Case Hist (¾) = 2

Week 8, Oct. 21, 23,
Swelling soils, subsidence, sink holes (1)
Plate Tectonics; Rocks (1) = 2

Week 9, Oct. 28, 30, Earthquake waves, faults, determining location and size, damages, stresses on a building, building oscillations, prediction, surviving earthquakes
Earthquakes (2) = 2?

Week 10, Nov. 4, 6 (GSA)
Midterm 2; Video =Video+MT **9½preMT**

Week 11, Nov. 11 (UM holiday), 13

Earthquakes (½)
Earthquake Case Hist. (½) = 1
Holiday + holiday

Week 12, Nov. 18, 20
Earthquake Case Hist. (½+)
Tsunamis (<1) = 2

Week 13, Nov. 25, 27 (Thanksgiving), magmas, magma chambers, eruptions, types and settings of volcanoes, collapsing volcanoes, volcanic hazard and risk
Volcanoes (1) = 1 + Thanksgiving

Week 14, Dec. 2, 4
Volcanoes (1)
Volcano Case Hist (1) = 2

Week 15, Dec. 9, 11
Wildfires (1/3) ; Society & Hazards/Disasters (½) = 1
Dec. 15-19: FINALS

(1) – 1-2 hr, 14 p (1 lect) - Avoiding disasters, land use, who is to blame, predictions,
and risk, population pressures, societal attitudes
(11) – 5 hr, 50 p (3 lect) – Streams & Floods
(1 lect) *Flood case hist*
(10) – 2 hr, 20 p (1 ¼ lect) - Climate and weather related to hazards
(10a) - 1 hr, 8 p (3/4 lect) - Thunderstorms and tornadoes
(13) – 2-3 hr, 26 p (1 2/3 lect) - Waves and Beaches
(14) – 2-3 hr, 23 p (1.5 lect) – Hurricanes
(I lect) *Hurricane case hist*
(6) – 3-4 hr, 34 p (2 ¼ lect) – Landslides
(1 lect) *Landslide case hist*
(8) – 1-2 hr, 13 p (I lect) - Swelling soils, subsidence, sink holes
(1A) – 1-2 hr, 14 p (1 lect) - Plate tectonics; rocks
(2) – 4 hr, 36 p (2 ½ lect) – Earthquakes
(I lect) *Earthquake case hist*
(9) – 1 hr, 10 p (2/3 lect) - Tsunamis
(4) – 3-4 hr, 34 p (2 ¼ lect) – Volcanoes
(1 lect) *Volcano case hist*
Wildfires (1/3 lect) – 15 ms p
Asteroid Impact (1/2 lect) – 23 ms p

Need 20 lect.
Needed = 29.5 "hr" @ 50 min = 1475 min.
Avail. = 26 lect – 2 midt. = 24 lect @ 80 min = 1760 min
[diff = 1760-1475=275/23=11 more min/lect.]
so 8 lect + midt, 8 lect + midt, 8 lect

7 lect .. midt .. 8 lect .. midt .. 8 lect