Cheney-Palouse-Snake Scablands Field Trip

Field Trip Leaders:
Karl Lillquist, Geography Department, CWU
Nick Zentner, Geology Department, CWU

Sunday 15 April 2012
Itinerary & Overview

8:00am  Depart
9:45  Stop 1--Restroom Stop, Hattan Coulee Rest Area, Jct WA 26 & US 395
10:00  Depart
10:30  Stop 2--Palouse Loess Exposure, WA 26 west of Washtucna
11:00  Depart
11:30  Stop 3--Loess “Prows”, WA 261 near Palouse Falls
12:00  Depart
12:15  Stop 4--Palouse Falls
1:15pm  Depart
1:30  Stop 5--Palouse River/Snake River Junction
2:00  Depart
2:30  Stop 6--Tucannon River Rythmites near Starbuck
3:00  Depart
4:00  Stop 7—Restroom Stop, Connell City Park, Jct. WA 260 & US 395
4:15  Depart
6:00  Arrive in Ellensburg
The Channelled Scablands
The Columbia Plateau and the areal extent of the Columbia River Basalt Group, the four major structural-tectonic subprovinces (the Yakima Fold Belt, Palouse, Blue Mountains, and Clearwater-Weiser embayments), the Pasco Basin, the Olympic-Wallowa lineament, and the CLEW, which is the central portion of the OWL that passes through the western part of the Columbia Plateau (Reidel & Campbell, 1989, p. 281).
Generalized map of major faults and folds along the western margin of the Columbia Plateau and Yakima Fold Belt (from Reidel & Campbell, 1989, p. 281).
Pacific Northwest and the "Missoula Floods"

- Cordilleran Ice Sheet
- Maximum extent of Glacial Lake Missoula (eastern) and Glacial Lake Columbia (western)
- Areas swept by Missoula and Columbia Floods

Topinka, USGS/CVO, 2002; Modified from: Waitt, 1985
Enroute to Stop 1

- **Kittitas Basin as a:**
  - Complex down-fold (i.e., syncline) of Columbia River Basalt Group & part of Yakima Fold & Thrust Belt
  - "depocenter" for alluvial fans

- **Whiskey Dick as a:**
  - Upfold (i.e., anticline) in CRB’s & YF&TB
  - Key spot for wind power in the "Kittitas Breezeway”
  - Impacted by Missoula Flood slackwater to 1263 ft

- **Columbia Gorge**
  - Operated pre-, syn-, & post-Missoula Floods
  - Dunes east of Columbia River

- **South Flanks of Frenchman Hills**
  - Columbia Basin Irrigation Project
  - Frenchman Hills as anticline
  - Crab Creek to south in syncline & served as outlet of Crab Creek-Telford Scabland Tract
  - Saddle Mountains to south as complex anticline
  - Impacts of floods on Saddle Mountains
Enroute to Stop 2

Sand Hills Coulee Dunes
Enroute to Stop 2

- Agriculture
  - Note transition from irrigated to dryland (rainfed) agriculture

- Sand Hills Coulee Dunefield
  - Sand Hills Coulee as Pleistocene coulee incised into loess-covered CRB’s
  - Sands derived from Miocene/Pliocene Ringold Fm
  - Dunes as parabolic dunes anchored by vegetation
  - Late Pleistocene to Holocene in age (similar to most dunes on Columbia Plateau)
  - Main phase of dune movement on Columbia Plateau in mid-Holocene
  - Like many other dune fields on plateau, these dunes have a SW to NE orientation but this is due here to the flood-created channel

- Agriculture
  - Conservation Reserve Program (CRP)
Stop 2
About Stop 2

- Palouse Formation as loess “layer cake”
  - Loess origins (see figure on page 15)

- Soil development
  - organics & darkening, B horizon reddening & carbonate translocation & cementation of B horizons
  - Accreting surfaces over time

- Evidence of flooding in Cheney-Palouse Scablands:
  - Faint channels/coulees adjacent
  - Unconformities
  - Erratics atop some unconformities
  - Ripped up petrocalcic horizons
  - Sheet sand

- At least 7 episodes of flooding:
  - 5 episodes of floods since 780,000 yr BP (normally magnetized)
  - 1 or 2 episodes of floods before 780,000 yr BP (reversely magnetized)
Generalized map (modified from Patton and Baker, 1978) of Cheney-Palouse scabland tract. Stippled pattern shows areas of deep loess cover. Ignore numbers on map. Letters indicate towns: B = Benge, M = Moses Lake, R = Ritzville, Ro = Rosalia, W = Washtucna. Arrows show major pathways of floods through scabland. Cordilleran icesheet in inset map is shown at its Late Pleistocene maximum. From McDonald and Busacca (1989).
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Stratigraphy of Washtucna-9 exposure (SW ¼, S. 14, T. 15N, R. 35 E., WM). View to North. Line and stipple pattern marks approximate position of prominent calcium-rich B horizons of paleosols. Dashed lines are tephras. Those that are correlated are M, Mazama (6800 14C yr BP), MSH C = Mount St. Helens set C (36,000 14C yr BP). Heavy lines are flood-cut unconformities and are labeled alphabetically (A-F) interpreted to have been formed by pre-last glacial episodes of giant floods. Source: Busacca et al, 2002.
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Figure x (next page, left). Contour maps of thickness of (a) L1 loess and (b) L2 loess across Columbia Plateau. Contour intervals are 100 micrometers for the major contours and 50 micrometers for the thin contours. From Busacca et al. (2002).

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  - ancestral channel of Palouse River
  - Palouse River originates near Potlatch, Idaho
  - Initially occupied by earlier Missoula Floods until floodwaters overtopped a divide just east of us

- **Jct of WA 260 & 261:**
  - Loess-covered CRB’s little modified by flooding
  - The divide between ancestral Palouse & Snake River

- **H U Ranch in floor of Davin Coulee**
  - After divide was breached, Missoula Floods likely followed an ancestral channel to Snake forming Davin Coulee
  - Davin Coulee as recessional cataract
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- Washtucna Coulee
- Loess
- Scabland
- Dulin Coulee
- Palouse River
- Palouse Falls State Park
Stop 3
Stop 3

- A once continuous loess cover...
- **Loess Islands**
  - Streamlined, boat-shaped hills (Bretz, 1956)
  - “huge prows of loess islands pointing upcurrent, like a flotilla of great battleships” (Waitt, 1994, p. 1K-55)
  - hills as part of literally hundreds of isolated loess hills with steep, ungullied scabland-marginal slopes
- **Loess scarps**
  - especially prominent in Cheney-Palouse Scablands because of great depth of loess
  - Loess scarps, combined with adjacent scabland, as some of first evidence of giant floods (Bretz, 1923)
- **Origins**
  - Bretz (1956) attributed these to fluvial erosion
    - break in slope at basalt-loess interface was the high water mark
  - Baker (1973), in reconstructing high water marks in the area, attributed these islands to subfluvial erosion.
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  - Same general orientation as Davin Coulee and Washtucna Coulee--structural?
  - Rectangular drainage patterns
  - Flows at intersection of NE- and SE-trending joint systems (Fryxell and Cook, 1964)
  - differential erosion & zig-zag pattern of channel
  - Palouse River gorge excavated to max of 400 feet

- **Palouse Falls**
  - drops 185 feet
  - Current location shaped by tectonic joints and columnar joints (Trimble, 1950)
  - Double cataract
    - Cataract w/ base on our level receded ~9 miles N of here to intersect Washtucna Coulee & capture Palouse River
    - Palouse Falls formed from later headward erosion from Snake River

- **Processes of Waterfall genesis & modification**
  - Undercutting & headward recession
  - Downcutting
  - Freeze-thaw weathering
  - Gorge-edge mass wasting
Stop 5—Palouse-Snake River Jct.
Stop 5

- Palouse River Channel:
  - Original channel here perhaps for small N-S flowing stream
  - Palouse River as easternmost entry of scabland discharge into Snake River
  - ~25 Missoula Floods overtopped ridge to north of us cutting a wide N-S channel that is now partially occupied by the Palouse River
  - Headward recession of Palouse Falls began here

- These floods hit the opposite side of Snake River canyon where some:
  - bent downstream where they deposited No-Name Bar
  - bent upstream where they deposited Midcanyon Bar
    - At least 20 Missoula Floods extended up the Snake River at least to Lewiston (80 miles upstream)

- Types of flood bars (see Figure):
- Sand dunes
  - Fryxell & Cook say at least 3 major periods of post-flood dune activity
  - Earlier dunes completely blocked Palouse River for “short periods of time”
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Current Ripples

No Name Bar
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  - Giant current ripples spaced about 225 feet, crest to crest. This is much less than the spacing of current ripples on Shoulder Bar which is also much higher. Waitt (1994) suggests that this indicates that Midcanyon Bar was last shaped by relatively shallow (and lower velocity) floods.
  - Asymmetry of ripples suggests they were created by upvalley flows.

- **Great Bar**
  - Foreset bedding in bar on north side of Snake River dips steeply upvalley suggesting that high velocity flows moving upstream constructed the feature.

- **Bar at mouth of Tucannon River Valley**
  - Foreset bedding here also suggests high velocity flows moving upstream.
Stop 6
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- Proximal Rhythmites (Coarse Touchet Beds)
  - 50-100 cm thick
  - Basalt pebble gravel with upvalley-oriented foreset bedding (bottom)
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  - Possible origins: seismic, periglacial, groundwater erosion, landslides, desiccation cracks, groundwater injection, rapid deposition of soft sediments & associated sliding
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(From Carson and Pogue, 1996, p. 15)
Enroute to Stop 7

Devils Canyon
Enroute to Stop 7

- **Washtucna Coulee**
  - ancestral channel of Palouse River in its path to Pasco Basin
  - Early Missoula Flood path to Pasco Basin prior to topping divide
  - Huge gravel bars present throughout its length
  - Lake Kahlotus (also known as Washtucna Lake) occupies a scour depression in bottom of Washtucna Coulee just N of Kahlotus
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- Proximal Rhythmites (Coarse Touchet Beds)
  - 50-100 cm thick
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Sunday 15 April 2012
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4:15   Depart
6:00   Arrive in Ellensburg
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The Columbia Plateau and the areal extent of the Columbia River Basalt Group, the four major structural-tectonic subprovinces (the Yakima Fold Belt, Palouse, Blue Mountains, and Clearwater-Weiser embayments), the Pasco Basin, the Olympic-Wallowa lineament, and the CLEW, which is the central portion of the OWL that passes through the western part of the Columbia Plateau (Reidel & Campbell, 1989, p. 281).
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Pacific Northwest and the "Missoula Floods"

- Cordilleran Ice Sheet
- Maximum extent of Glacial Lake Missoula (eastern) and Glacial Lake Columbia (western)
- Areas swept by Missoula and Columbia Floods

Legend:
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Map credit:
Topinka, USGS/CVO, 2002; Modified from: Wall, 1985
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Sand Hills Coulee Dunes
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  - Note transition from irrigated to dryland (rainfed) agriculture

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About Stop 2

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Stratigraphy of Washtucna-9 exposure (SW ¼, S. 14, T. 15N, R. 35 E., WM). View to North. Line and stipple pattern marks approximate position of prominent calcium-rich B horizons of paleosols. Dashed lines are tephras. Those that are correlated are M, Mazama (6800 14C yr BP), MSH C = Mount St. Helens set C (36,000 14C yr BP). Heavy lines are flood-cut unconformities and are labeled alphabetically (A-F) interpreted to have been formed by pre-last glacial episodes of giant floods. Source: Busacca et al, 2002.

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