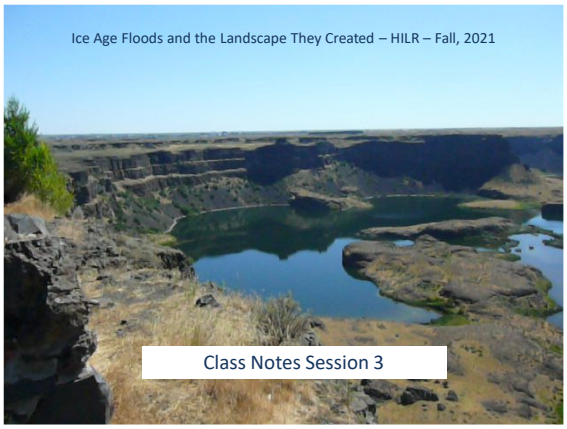


Class Topics

- The Channeled Scablands of Eastern Washington
  - A bottoms-up approach, following J Harlan Bretz, as he confronted the evidence on the ground
  - Dry coulees and cataracts
  - Erratics
  - Erosion of topsoil to a uniform elevation
  - Gravel bars well above river level
- The controversy over mechanism
  - Uniformitarianism vs. catastrophism
  - Problems with each "ism"

A Photo Tour of Key Features

- Erosional Features of the Scablands
  - The Grand Coulee
  - Dry Falls
  - The Drumhuller Channels
  - Palouse wheat fields next to scablands
  - Palouse Falls
- Depositional Features
  - Palouse topsoil (loess)
  - Air-borne deposits (Mt. St. Helens ash)
  - Boulder Fields
  - Graded gravel and sand bars far above present river levels

Scablands Overview

- The scablands cover much of central and eastern Washington State
- We will spend a few minutes examining the geography from Google maps

Coulees

- A Coulee is a (mostly) dry channel with steep walls
- Eastern Washington is covered with Coulees
  - The Grand Coulee
  - Moses Coulee
  - … many others
- We look at the map …

Photo: The Grand Coulee

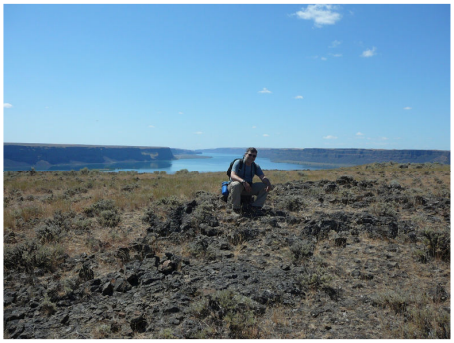
Steamboat Rock

- Steamboat Rock is an interesting erosional feature:
  - The water split around it, and a large eddy on its north side carved a semi-circular basin
- Map first, then photos

Photo: Steamboat Rock

Steamboat Rock, Up Close

Photo: Yes, We Climbed It



Dry Falls

- Dry Falls was perhaps the most puzzling feature for Bretz
  - A very wide apparent spillway (wider than Niagara)
  - Deep plunge pools
  - No river in the valley
- Map first, then photos and videos

Photo: Dry Falls

Video: Dry Falls Panorama

Video: Using the Plunge Pools

Drumhuller Channels

- This particular area of scabland is south of Moses Lake.
- It shows how complex the erosional scrubbing was.

Palouse River

- The Palouse River appeared to have changed course
  - The original course was West to East into the Columbia River
  - The present course, which goes over Palouse Falls, is North to South ending in the Snake River.
- We examine map

Palouse Falls

- The redirected Palouse River cut a channel through the basalt over a cataract, which has migrated upstream due to erosion
- We examine a series of photos and videos

Palouse Falls Panorama

Palouse Falls Closeup

Depositional Features

- Loess: the very fine topsoil present across the area before the erosion.
  - It is windblown dust left over from ancient volcanoes and glacial debris
  - It is very fertile when irrigated
- The scouring away of this topsoil is one of the most notable features of the scablands.
  - We saw similar scouring in the Snake River Plateau as a result of the Lake Bonneville Flood (but that scouring was not understood until long after the Missoula Flood was figured out).

Wheat Fields and Scablands

- Where the topsoil remained, the land is fertile, provided that water (from Banks Lake) is available for irrigation

Layers of Volcanic Ash

- This ash is from Mt. St. Helens 1980 eruption, but lower down in the strata (not visible here) there are layers from Mt. Mazama (Crater Lake), 7600 years ago, and Mt. St. Helens, 13,000 years ago.

Field of Boulders

- This particular boulder field, reminiscent of those on the Snake River Plain, is just south of Moses Lake, but there are many such fields dotting the landscape. These boulders are just a few miles from where the Mt. St. Helens ash photo was taken.

Gravel Bars in Odd Places

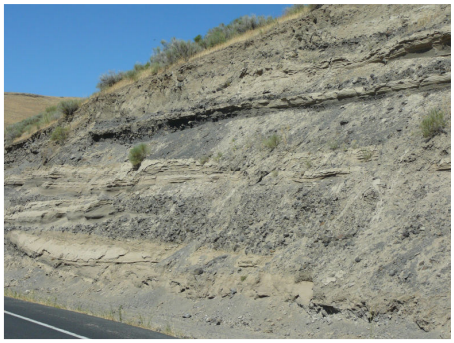
- One of the most puzzling features were the gravel bars, clearly of a type deposited by streams, located at elevations where no rivers would reach:
  - High above the Columbia River gorge
  - Far upstream in various tributaries of the Snake (the Touchet Beds, for example)

Gravel Bar at the Hell's Canyon Exit

At Tammany Bar south of Lewiston, Idaho - Bonneville Flood gravels (B) are capped with Lake Missoula Floods rhythmites (M) 2-20 feet thick. The Missoula sand and silt deposits were backflooded to this location when Ice Age floodwaters temporarily reversed the Snake River's course.

Bedded Deposits (Touchet Formation)

Photos: Gravel, Sand, and Silt Deposits



Details of Bedded Deposits

- This is a mix of stream deposited gravels and deposited layers of sand and silt
- This photo is well upstream on one of the tributaries of the Snake, which backflooded for more than a hundred miles

Bretz's Flood

- Bretz proposed in 1923 that all of these features could be explained by a catastrophic flood which he called the Spokane Flood.
- No one believed him:
  - It violated the concept of Uniformitarianism.
  - Bretz couldn't explain where the water came from.

Uniformitarianism vs. Catastrophism

- The puzzles:
  - The fossil record can be used to identify rock strata of similar ages across continents, even oceans
  - Under the assumption that geological process are slow and that younger rocks sit on top of older rocks, changes in the fossil record indicate mass extinctions
  - There are gaps (unconformities) in some locations where rock is simply missing
- Two extreme schools of thought did battle …

Uniformitarianism

- The premise is that the forces and mechanisms that produced geological changes in the past are the same as those operating today (Hutton)
- With the exception of earthquakes, volcanoes, tsunamis, and river floods, the processes are slow.
- River erosion, in particular, is a slow process.
- The scablands were formed by slow erosional processes.

The Problem With "Extreme" Uniformitarianism

- Kinetic energy of water goes as the square of the velocity
- Normal flow rates can't move big rocks!!!

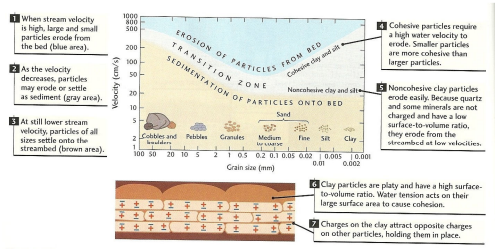


Figure 14.3 The relationship between particle size and current velocity. [After F. Hjulstrom, as modified by A. Sundborg, "The River Klarälven," *Geografisk Annaler,* 1956.]

Catastrophism

- The premise is that the features in our present geology are the result of short, violent episodes (even including mountain-building).
- We know from the fossil record that mass extinctions happen, which supports catastrophism.
- But … creationists love catastrophism and use it as a club against scientific geologists.
- By the time Bretz showed up, the uniformitarians had won.

Bretz's Problem

- By suggesting a truly catastrophic flood event as the source of the channeled scablands, Bretz was re-igniting catastrophism.
- Uniformitarians were not buying, even refusing to look at the evidence.
- It was painful.

Where Things Sit Now

- As we will see next week, the debate over Bretz is over. He was right
- The reconciliation of uniformitarianism with catastrophism is that both are correct:
  - Geological phenomena of the past are the same as those today
  - … but
  - Some of those processes, are catastrophic in their nature

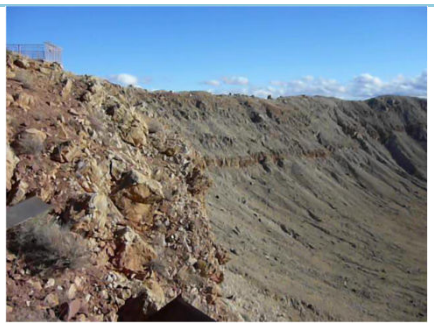
Examples of Catastrophic Events

- Flood basalts (like the Columbia River Plateau, 16 mya)
  - They produce lots of gases which, initially, result in cooling followed by heating
  - There is a strong correlation between the dating of the mass extinctions with the creation of flood basalts:
    - The Permian extinction (248 mya) – Siberian Traps
    - The Cretaceous extinction (65 mya) – Deccan Traps in India
- Major floods
  - Jökulhlaups (Floods from glacial lakes are common events)
  - Tsunamis
  - The opening of the Bosporus into the Black Sea (Noah?)
  - Massive floods from Glacial Lakes (Bonneville; Missoula)
  - Tsunamis that remake coastlines
- Meteor Impact
  - Meteor Crater in Arizona, east of Flagstaff
  - Huge meteor impact in the Yucatan (65 mya)
    - Blamed for the Cretaceous extinction

Videos of "Normal" Catastrophic Floods

- Pine Island Massive Glacier Burst
- https://www.youtube.com/watch?app=desktop&v=g75-kFMnCXg&ab_channel=YesEpicYes2.0
- Glacial lake floods (Hunza, Iceland)
- https://www.youtube.com/watch?v=3Iri1Evfies&ab_channel=UNDPNEPAL
- Fukushima Tsunami footage from Japan
- https://www.flixxy.com/japanese-tsunami-viewed-from-a-car.htm

Meteor Crater Panorama



Next Week

- Closing the loop: Pardee explains where Bretz's water came from.