

Ice Age Floods and the Landscape They Created

HILR Study Group for Fall 2021 (second half)

Stephen Senturia, Study Group Leader

Preliminary Syllabus (as of May, 2021)

Brief Description:

During the last Ice Age, melt waters created immense lakes, setting the stage for equally immense floods. Glacial Lake Bonneville in Utah overflowed north into the Snake River drainage, the released torrent carrying elephant-sized boulders and cutting the depth of Hell's Canyon, ultimately reaching the ocean via the Columbia River. The Great Salt Lake is its still-dwindling remnant. A vastly larger series of floods from Glacial Lake Missoula carved the coulees and scablands of central Washington and the present Columbia River Gorge, permanently changed the course of several rivers, and backed the Snake River up into southern Idaho and the Willamette River as far south as Salem. Because of the unprecedented geographical scale of these events, it took geologists half a century, and a lot of not-so-nice arguments, to figure them out. We will explore the history of the scientific discovery as well as this truly spectacular geologic story. (1.5 - 2 hrs/wk)

Readings:

John Eliot Allen, et. al., *Cataclysms on the Columbia*, Revised Second Edition (Ooligan Press, 2009) Pbk, \$19.

Internet access is also required, as we will assign reading from the web.

Class sessions will be a mix of lecture, discussion, and relevant video presentations.

About the Study Group Leader:

Stephen Senturia taught electrical engineering and applied physics at MIT for 36 years before joining HILR. He has led a wide variety of study groups, including two others in the area of geology: The Restless Earth (Volcanoes, Earthquakes and Tsunamis) and The Colorado Plateau. sds@mit.edu; 617-731-3905.

Extended Description

The history of geology, among other things, has been characterized by an intense debate over the speed with which geologic change can happen. The *catastrophists* argue for rapid dramatic change, some (on the fringe) even resorting to scripture to justify assumptions about the speed with which, for example, the Grand Canyon might have been created. The *uniformitarians* argue that all processes observed today are the same as those in previous eras and that, based on what we observe today, geologic change is always quite slow,

volcanic eruptions allowed as an exception. By the dawn of the twentieth century, uniformitarianism had won. Thus when J. Harlan Bretz proposed that the dramatic scablands of eastern Washington were caused by a huge catastrophic flood, he was flying into the teeth of the accepted uniformitarian view. It took more than half a century, an interval of invective-laden debate, but the correctness of Bretz's initial insight has now been rigorously demonstrated.

This Study Group looks at the science, but also at the scientific history, of the floods that occurred at the end of the last ice age, about 12,000 years ago. We will start with Fossil Falls, a simple case: the Glacial Owens River, swollen by the melting of upstream glaciers, coursed through a series of now dry lakes, ending up in Death Valley. Along the way, it carved a dramatic little waterfall, now a "fossil" of its former self.

We will next consider Glacial Lake Bonneville, the flooding of most of Utah by melting glaciers until the level got high enough to break through at its northern extremity into the Snake River drainage. Once that break happened, the rushing water carved its own channel that allowed the level of the lake to drop by hundreds of feet. The water flowed down the Snake River, enlarging what is now Hell's Canyon, eventually reaching the sea via the Columbia River. This was a one-time flood, and a dramatic one.

But the most interesting case is that of Glacial Lake Missoula, formed by melt water backing up behind glacial ice dams. Repeatedly over a period of two thousand years, the ice dam would fail and hundreds of cubic MILES of water would rush across eastern Washington, backing up rivers, carrying boulders, carving canyons. Then, as the glacier would move south, a new ice dam would form, and the process would repeat. We will spend four sessions on this sequence of events and the geologic evidence that support their interpretation.

By the end of the Study Group, you will discover that you are able to follow and understand a video-taped technical lecture by a senior geologist, talking about these floods.

Topic Outline

Session 1

- > Study Group overview
- > Ice ages
- > How glaciers work
- > Erosion by debris-laded streams
- > Fossil Falls, California

Session 2

- > The Columbia and Snake Rivers
- > The Colombia Plateau
- > Glacial Lake Bonneville
- > The Bonneville Flood
- > Hells Canyon impact

Session 3

- > J Harlen Bretz and his quest
- > Dry Falls
- > The Coulees
- > The Palouse
- > The Scablands
- > Erratics

Session 4

- > Ripples in streambeds
- > Pardee's role
- > Short video

Session 5

- > A tour of the scablands and coulees
- > The Palouse River and Palouse Falls
- > Another short video

Session 6

- > From the Wallula Gap to the coast
- > The Columbia River Gorge
- > Waterfalls and their future
- > The Willamette Valley
- > A longer video