

To learn more about the Ice Age Floods

The National Parks Service has completed a special study that proposes designating an Ice Age Floods National Geologic Trail - a four-state system of marked highway routes featuring significant landforms created by the floods.

This Study Report has been submitted to the U.S. Congress, and is online, along with an extensive list of references, at <http://www.nps.gov/iceagefloods>.

The Ice Age Floods Institute website at the address below lists a wide range of information sources including displays, exhibits, guidebooks, videos, and maps, as well as links to other related websites.

The Institute is a non-profit organization dedicated to promoting public awareness and understanding of the full story of the Ice Age Floods, and of their effect on the region's natural and cultural history.

Local chapters are operating in Montana, Idaho, Washington, and Oregon communities.

We invite you to explore the fascinating floods landscape, and learn more about how it was formed.

For information about Institute activities and membership, please contact

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The story of immensely powerful

ICE AGE FLOODS

**Thundering torrents
of water, ice, and earth
roared across the
Northwest, carving new
canyons, creating
monstrous waterfalls,
instantly transforming
the face of the land**

*Then, almost as suddenly
as they had come,
the floods were gone
It is a magnificent
story, still unfolding...*



It is a clear, cold morning in the interior Northwest about 15,000 years ago.

While mammoths graze peacefully in the distance, you view with joy the magnificent landscape that is home to you and your people. You welcome the warmth of the rising sun.

But there is something strange in the distant wind. Your heart pounds as you realize the sound is not of the wind alone. The animals are suddenly restless as the sound becomes a roar and the earth begins to tremble. Remembering stories told by the elders, you scramble up the slope, gasping for breath with the sudden exertion.

Instantly, the view northward across the landscape changes. The roar becomes deafening as a great mass of water and ice hundreds of feet deep bears down on you. As blocks of ice the size of whole villages tumble in seething, muddy water, you realize that your people will be swept away. You struggle for footing as you race further up the steep slope. Maybe you can outrun the torrent...

It is probable that humans were indeed witnesses, and victims, of the immense power of the Ice Age Floods. Archeological records date human presence back to nearly the end of the Ice Age. But the raging torrents erased the land of clear evidence, leaving us to question who, if anyone, may have survived.

"I could conceive of no geological process of erosion to make this topography except huge, violent rivers of glacial meltwater... It was a debacle which swept the Columbia Plateau."

J Harlen Bretz

The unfolding of a magnificent story

When geologists first saw the vast Columbia Basin, they recognized that a large volume of water and ice had sculpted the dramatic landscape of canyons (coulees), buttes, dry cataracts, boulder fields, and gravel bars. They assumed the likely cause to be normal flooding and erosion during the Ice Age.

However, in subsequent years two geologists were instrumental in revealing that it had been extraordinarily huge and powerful deluges that had shaped this region.

It was J Harlen Bretz who in the 1920's looked more deeply into this fascinating landscape. As he explored the region, he was astounded by the colossal size and distinctive characteristics of the landforms. He felt that they had to have been formed not merely by normal floodwaters, but by massive flows of very fast-moving glacial water.

Where could such a massive deluge have originated?

The source of such catastrophic glacial flooding eluded Bretz. His theories were consequently rejected by his professional colleagues as unrealistic; decades of arguments ensued within the scientific community.

Earlier, in 1910, another research geologist, Joseph T. Pardee, had described evidence of a great Ice Age lake, "Glacial Lake Missoula", in northwestern Montana. In 1940 Pardee reported on his discovery that giant ripple marks 50 feet high and 200-500 feet apart had formed on the floor of the lake. These huge current features, along with other newly found landforms, demonstrated that Glacial Lake Missoula had suddenly emptied to the west, producing the tremendous erosive forces that Bretz's theories required.

Through the work of many other geologists, evidence of more than one flood was discovered, and it is now established that there were scores of Ice Age Floods that swept across the Northwest. Some of these were among the largest and most powerful freshwater floods that have ever occurred on earth.

Mountains of gravel as tall as 40-story buildings were left behind; boulders the size of small houses and weighing many tons were strewn about as though they were pebbles.

The Ice Age Floods story

Setting the stage

Over the last two million years, large parts of northern North America, Europe, and Asia were repeatedly covered with glacial ice sheets, at times reaching over 10,000 feet in thickness. Periodic climate changes resulted in corresponding advances and retreats of the ice.

About 18,000 years ago a large finger of ice advanced into Idaho, forming an ice dam at what is now Lake Pend Oreille. It blocked the Clark Fork River drainage, thus creating an enormous lake reaching far back into mountain valleys of western Montana.

Glacial Lake Missoula grew to massive proportions, at times containing over 500 cubic miles of water - more than Lake Erie and Lake Ontario combined.

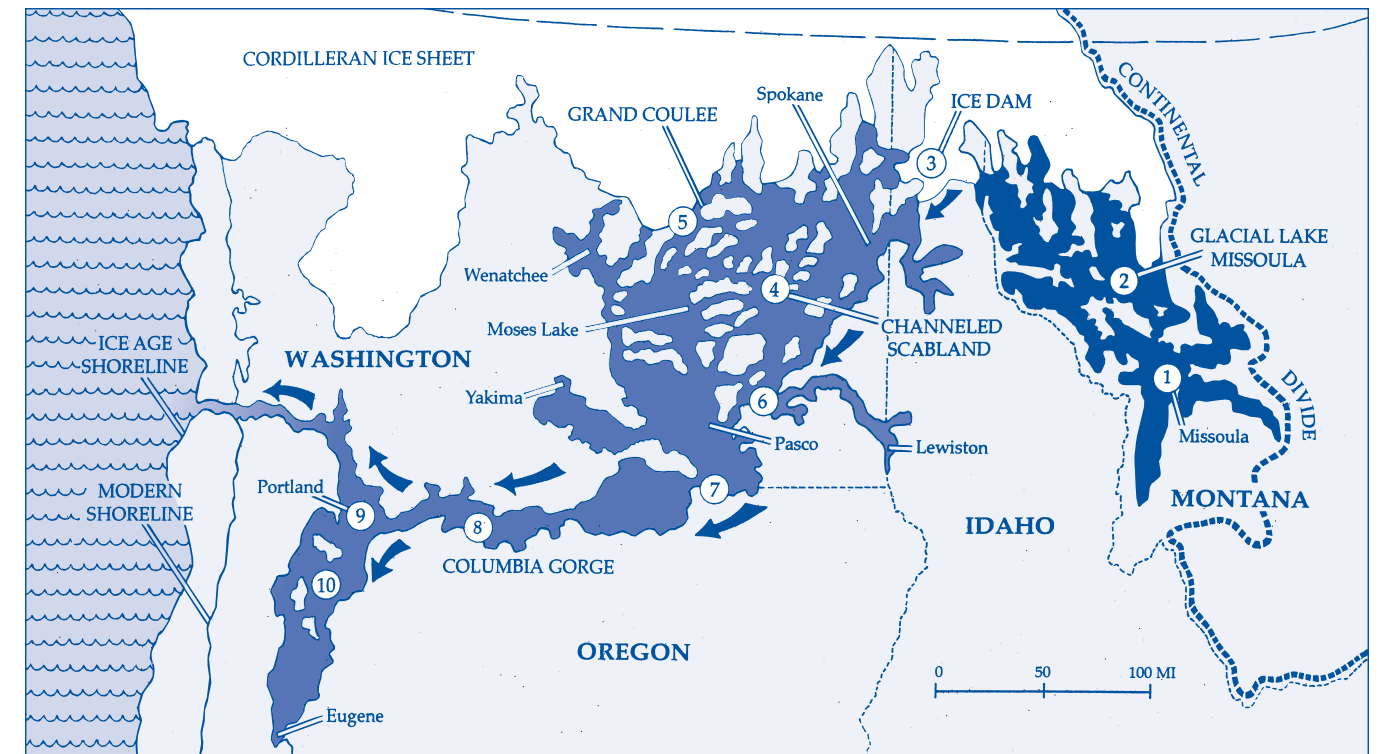
As the lake deepened, the ice began to float. Leaks likely developed and enlarged, causing the dam to fail suddenly and release the full volume of the lake.

Massive power unleashed

Resembling science fiction more than reality, this towering mass of water and ice, over 2,000 feet deep near the ice dam, suddenly burst forth. It literally shook the earth as it thundered across the Columbia Basin, moving at speeds of up to 65 miles per hour.

Great Glacial Lake Missoula may have emptied in a mere two or three days. The rate of flow was 10 times the combined flow of all of the rivers in the world. The deluge stripped away soil, cut deep canyons, and carved areas of stark "scabland". Altogether, flood waters carved out more than 50 cubic miles of earth, depositing some of it to create new landforms, while carrying most of it far out into the Pacific Ocean.

Over a period of about 2,500 years, the cycle was repeated many times: the glacial ice would block the valley, the lake would form, and the ice dam would fail, releasing another cataclysmic flood. Then, almost as suddenly as they had arrived, the colossal floodwaters were gone, leaving lasting marks across Montana, Idaho, Washington, and Oregon. The face of the Northwest was forever changed.



Seeing the landscape in a new light

Much of the Ice Age Floods story is revealed in spectacular and unusual landforms that are readily visible by highway - and especially impressive by air. You can discover how the lake and the floods shaped the land, when you visit locations such as these:

- ① **Glacial Lake Missoula** - Shorelines on slopes above the city show that the lake was 950 feet deep at Missoula.
- ② **Camas Prairie** - Giant ripple marks formed on the floor of Lake Missoula as it rapidly drained.
- ③ **Lake Pend Oreille area** - Ice dams up to 2,000 feet high released tremendous outbursts when they failed.
- ④ **Channeled Scabland** - Patterns of braided channels were eroded into the Columbia Basin volcanic bedrock.
- ⑤ **Dry Falls** - One of the largest waterfalls ever known formed as deep water moved through Grand Coulee.
- ⑥ **Palouse Falls** - The eroded uplands, huge plunge pool, and deep gorge testify to the power of the floods.
- ⑦ **Wallula Gap** - The narrow gap held back the full volume of the floods, creating temporary Lake Lewis.
- ⑧ **Columbia Gorge** - Water was 1,000 feet deep entering the Gorge, and shot out at velocities as high as 90 mph.
- ⑨ **Portland Basin** - Water rose to a depth of 400 feet; huge gravel bars formed on both sides of the Columbia.
- ⑩ **Willamette Valley** - Slackwater deposited fertile soil; icebergs left numerous boulders from distant sources.

Marked travel routes and new interpretive facilities are now being proposed as elements of an Ice Age Floods National Geologic Trail tracing the pathways of the floods. Further information can be found at the websites noted on the back panel of this brochure.