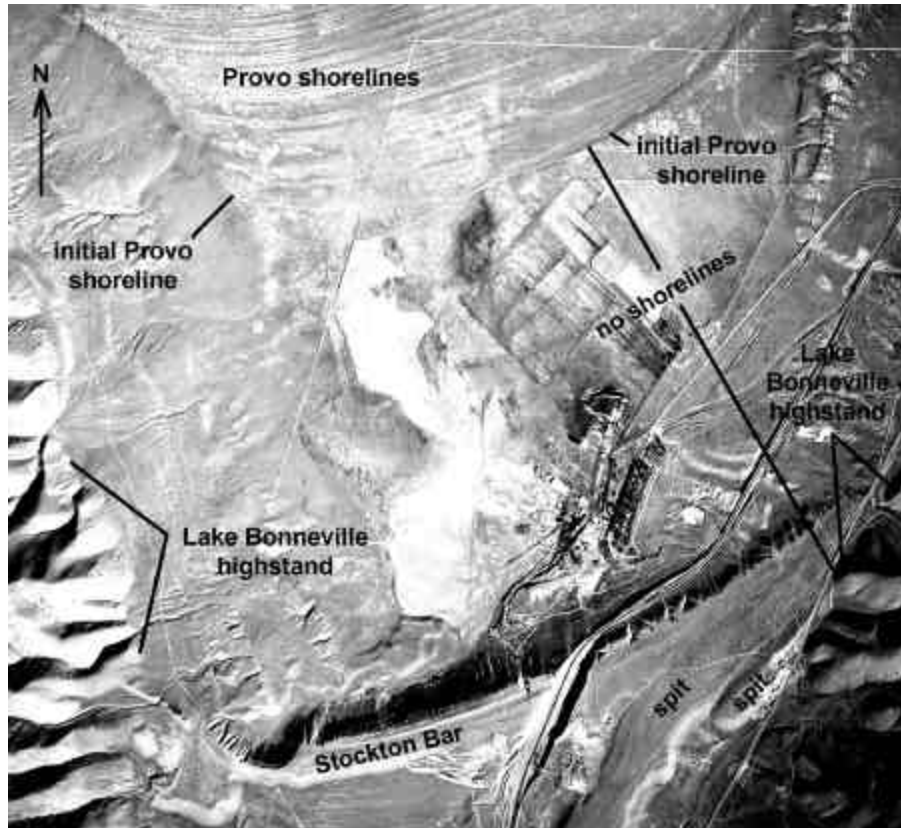


THE BONNEVILLE FLOOD



Evidence of the sudden drop in Lake Bonneville that resulted from a catastrophic discharge of the lake known as The Bonneville Flood. Bars, spits and shorelines near Stockton, UT, mark the highstand of Lake Bonneville. Provo shorelines are obvious to the north, but the absence of shorelines in between show that Lake Bonneville did not recede gradually; rather, the drop of 340 ft was sudden.

PRE-BONNEVILLE FLOOD

30 000 years before present [bp] Increased precipitation and decreased temperature during the most recent glacial-pluvial period [Pinedale; Marine Isotope Stage 2, about 32 000 –13 000 bp] led to the filling of that closed-basin portion of the Great Basin known as Lake Bonneville. This lake cycle lasted about 17 000 years, and during the later part of this cycle, before the lake reached an outlet to the Snake River at Zenda-Red Rock Pass, Idaho, the transgressing lake reached an elevation of about 5090 ft amsl.

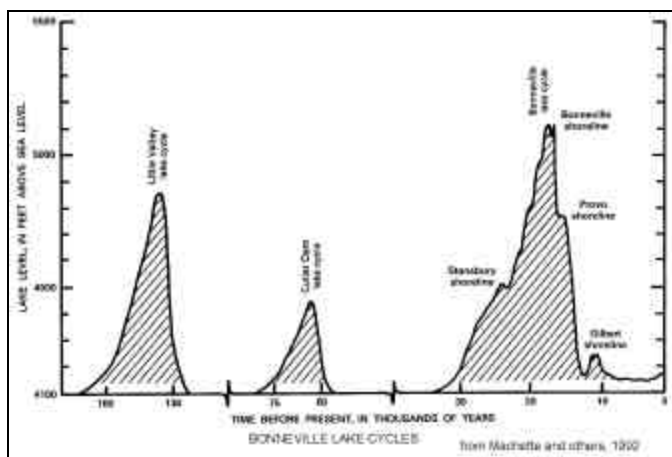


Figure 1--Late Pleistocene climate cycles

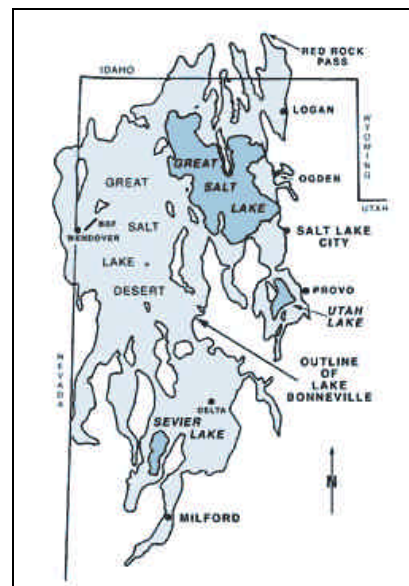


Figure 2--Lake Bonneville

15 500 bp Lake Bonneville rises to about 5090 ft, where it reaches a spillpoint at Zenda, Idaho, about 3 km north of the current Red Rock Pass. This Early Zenda Threshold is in “piedmont alluvium on Tertiary nonmarine beds” (Currey, 1982).

Lake Bonneville now has an area of about 51 530 km² [see map Fig. 2].

Surprisingly, the alluvial spillway remains constant for more than 400 years, allowing all of Lake Bonneville to discharge here at a constant threshold elevation of 5090 ft [Fig. 3, B₀-B₅]. There are two brief intervals during this period with no discharge because the lake level falls below the threshold in response to climate variations [Fig. 3, B_a and B_b].

Discharge during this time would average about 56 m³/s, or about 2000 cfs, if one assumes average discharge is approximately the same as average net storage gain just before the threshold was attained.

15 000 bp A rapid erosion of the alluvium, called the Early Zenda Incision, drops the threshold and the lake level about 40 ft, from 5090 ft to 5050 ft [Fig. 3, B₅-B₆].

15 000 -14 550 bp A climate cycle lasting 450 years begins – the Keg Mountain Oscillation – during which the lake drops below the Late Zenda threshold about 100 ft (to 4950 ft) over about 250 years, then rises to the Late Zenda threshold over about 200 years [Fig. 3, B₆-B₇].

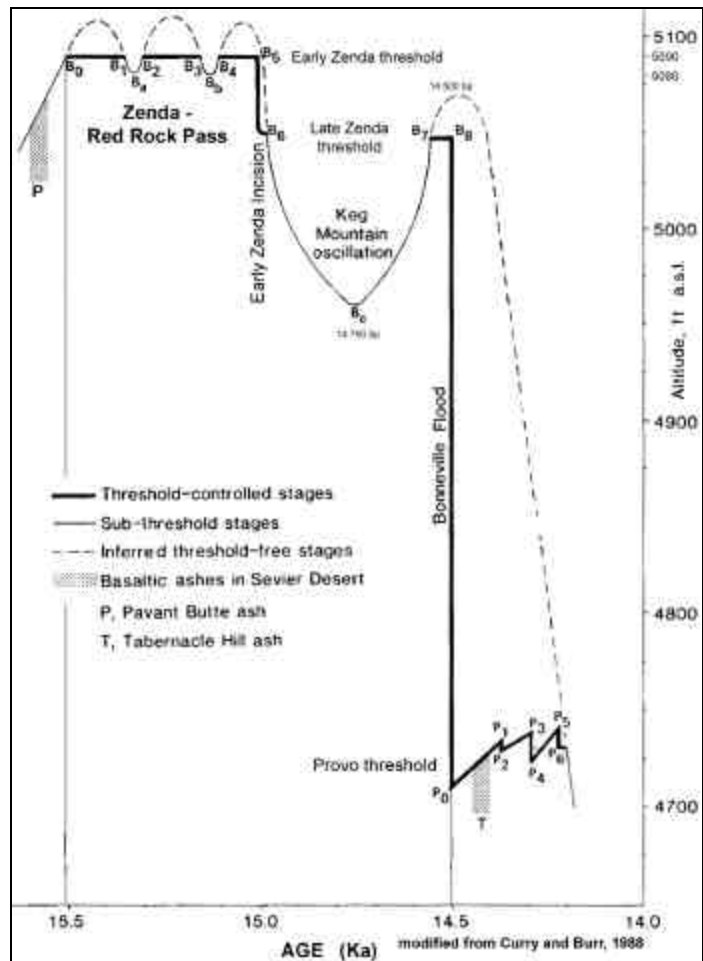


Figure 3—Bonneville lake cycles at Zenda, ID

14 550 – 14 500 bp Open-water conditions are attained at the Late Zenda threshold, and lake level is maintained at the 5050 ft level for about 50 years.

Outflow discharge during this time may be primarily groundwater flow through the alluvium, which could lead to piping and eventual catastrophic failure of the alluvial-fan dam [Fig. 4].

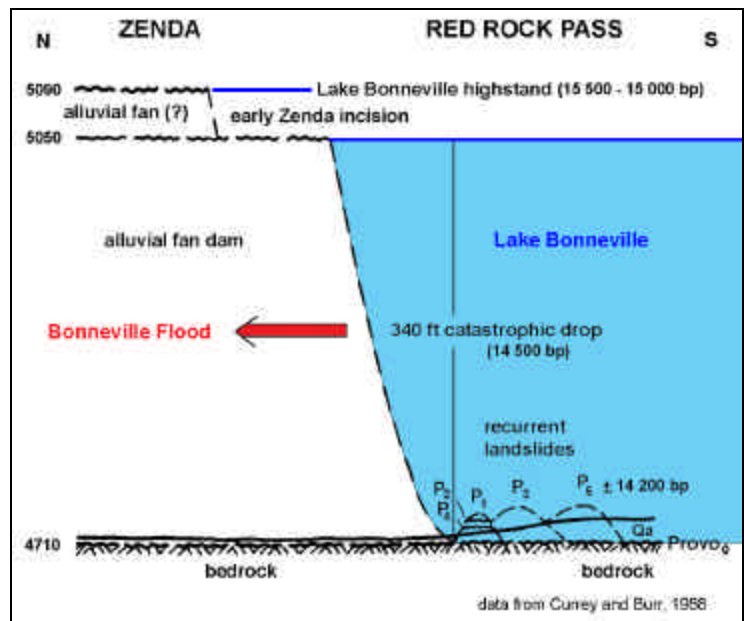


Figure 4—Lake stages at Zenda and Red Rock thresholds

THE BONNEVILLE FLOOD

14 500 bp The Bonneville Flood Catastrophic failure of the alluvial fan dam cuts spillway down 340 ft (to 4710 ft) and retreats southward 3 km to Red Rock Pass, where threshold control is established in Paleozoic limestones [*bedrock* in Fig. 4].

Route: Red Rock Pass --> Marsh Ck --> Portneuf River --> Snake River --> Columbia River --> Pacific Ocean [Fig. 5].

Flood Parameters [from O'Connor, 1993]:

Volume of flood: 4 700 km³

Discharge, maximum:

1 000 000 ± 150 000 m³/s at Red Rock Pass

935 000 m³/s in Snake River Canyon at Sinker Creek (Jarrett and Malde, 1987)

600 000 m³/s at the mouth of Hells Canyon near Lewiston, Idaho

Power: >100 000 W/m² at major constrictions

Unit stream power: 75 000 N/m/s

Shear stress: 2 500 N/m²



Figure 5—Bonneville Flood route to the Pacific Ocean

Depth of floodwaters through Portneuf Narrows [Fig. 6] was about 410 ft (O'Connor, 1993).

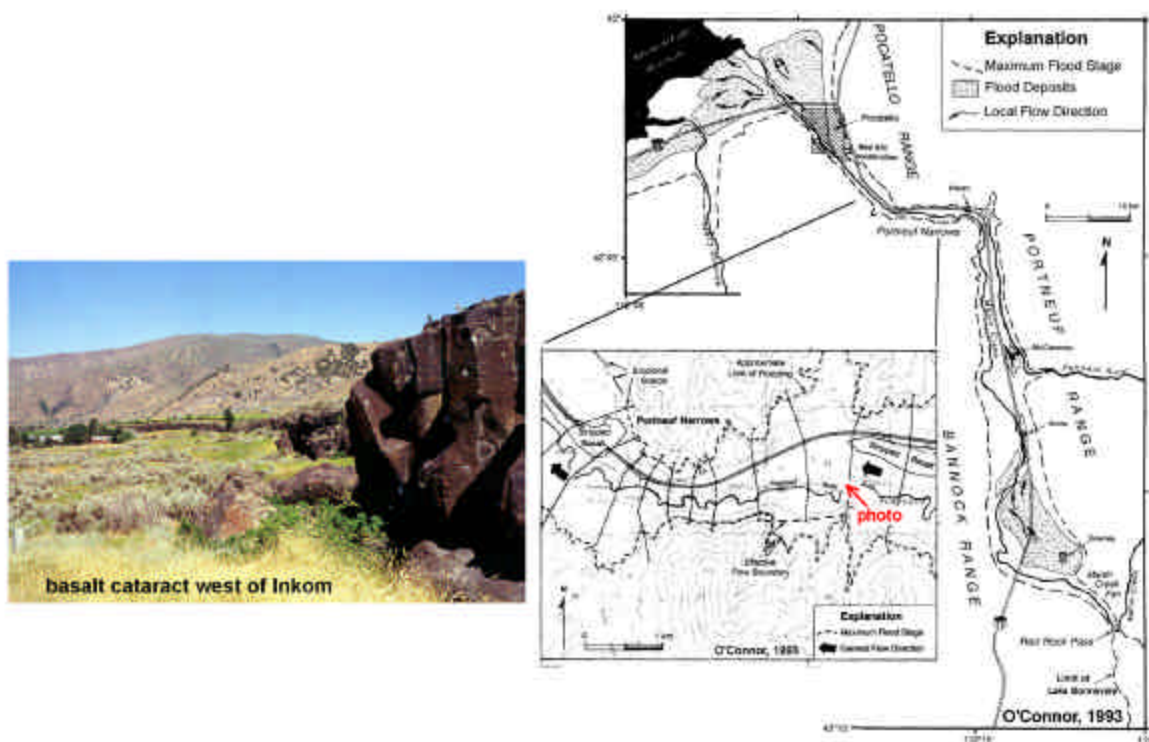


Figure 6—Bonneville Flood through the constriction of Portneuf Narrows

Flood duration - minimum 8 weeks, probably lasted better part of a year

The Bonneville Flood ends when a new bedrock threshold is established at Red Rock Pass [Fig. 4].

POST-BONNEVILLE FLOOD

14 500 – 14 200 bp The newly stabilized, lower Lake Bonneville is renamed Lake Provo, which has an area similar to, but smaller than, that of Lake Bonneville [Fig. 7].

The Provo Shoreline Complex varies from 4710-4740 ft in response to at least three landslides at Red Rock Pass that raised the spillway temporarily [Fig. 4].

14 200 bp Flow from Lake Bonneville/Lake Provo ceases entirely when lake level drops below the spillway in response to climate change to warmer and drier conditions.

14 200 – 12 000 bp The Bonneville Lake Cycle ends as shorelines regress to about 4200 ft [Fig. 1], about the same elevation as the modern Great Salt Lake [Fig.7].

12 000 bp – Present The Bonneville lake basin rises in isostatic adjustment to the loss of lake water. Great Salt Lake varies in size slightly in response to climate variations, but these are minor compared with those of the Pleistocene.

Futurescene The entire cycle may repeat at the onset of the next glacial-pluvial period.

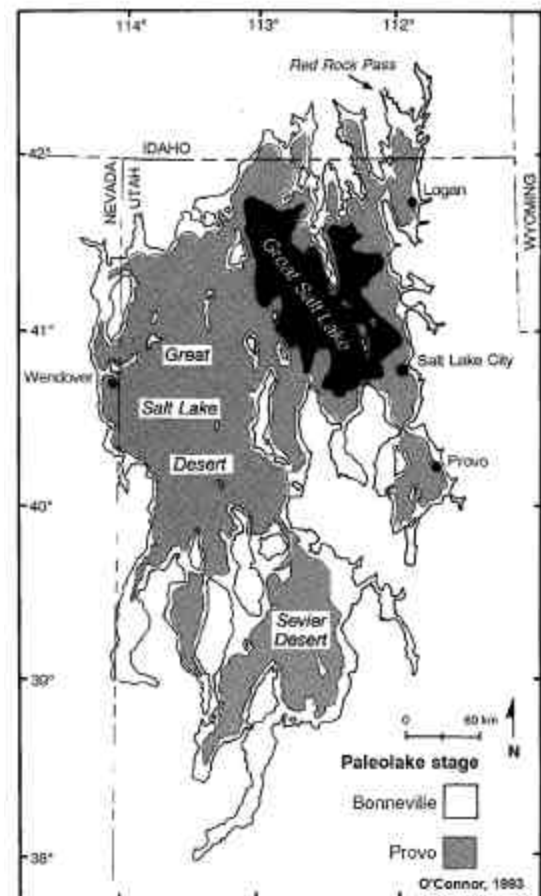


Figure 7—Extent of Lake Provo and Lake Bonneville

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