Re-interpretating Events in the Bonneville Basin at the Beginning of the Holocene

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Introduction

Utah's Bonneville basin is a well-known physiographic feature in the geologic literature. The name evokes visions of old lakebeds, salt flats and sand dune deserts. Former Lake Bonneville, which apparently shaped the basin, is considered an integral element of the pre-Holocene Missoula (Spokane) Flood scenario that involves catastrophic torrents of water funneling through the middle part of the Columbia River watershed to form the now famous 'scablands'.

G.K. Gilbert (1890), one of America's famous geologists, mapped the Bonneville basin shorelines and discovered their outlet in the vicinity of Red Rock Pass in Idaho. He described Lake Bonneville as the highest level (5090 feet) to occupy the basin (Figure 1). This supposed ice-age freshwater lake, which is thought to have been in place roughly 16000 years ago, is credited with the evolvement of the Bonneville Cutthroat Trout, which is indigenous to the area. Also associated with the lake environ was a variety of mega-fauna that included Prehistoric Bison and Giant Beaver. About 15000 BP a natural dam at Red Rock Pass, or Zenda just to the north, gave way allowing Lake Bonneville to drop 350 feet to the Provo level (4470 feet). The sudden release of this water etched the numerous canyons that now characterize the Snake River system. Gilbert noted that the sequence of shorelines was level or horizontal around the basin's periphery (they have been likened to 'bathtub rings') but that these same shorelines were higher in the centre of the basin (Figure 1). He ascribed this domed effect in the central part to its having been depressed from the weight of Lake Bonneville itself and the subsequent crustal uplift that occurred after this water disappeared. This process, now called isostatic rebound, has been accepted as fact ever since. The somewhat generalized scenario portrayed here has also been accepted since the days of Gilbert albeit with minor modifications by later researchers.

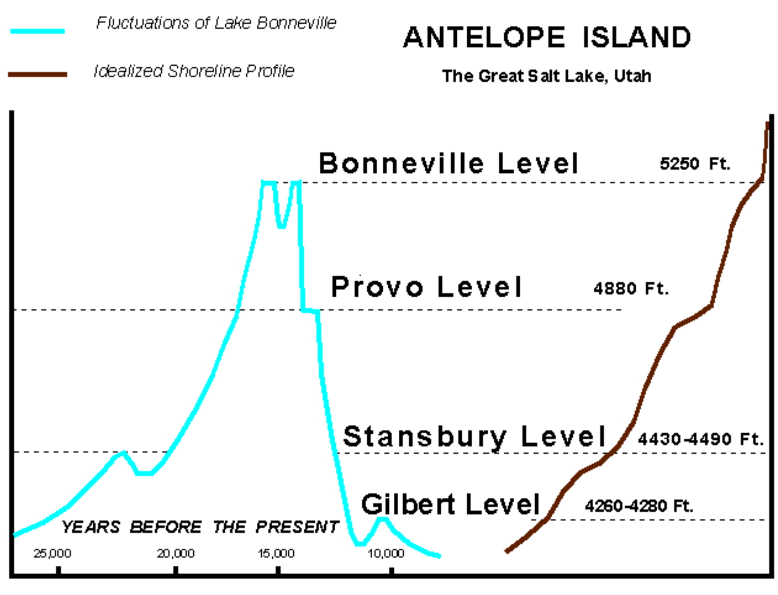

Figure 1. The diagram shows the up and down progression through time of Lake Bonneville as reflected by the various levels etched on the flanks of Antelope Island situated in present-day Great Salt Lake (figure from www.colorado.edu).

Anomalies

For a basin whose lake levels are supposed to be horizontal there is a wide range of elevations for each level, even given the so-called dome effect in the centre. The literature places Lake Bonneville at about 5090 feet at its Red Rock Pass outlet but various other elevations are cited around the basin including heights as high as 5250 feet. Provo elevations range from 4470 to 4890 feet. The amount that the water dropped from the Bonneville to the Provo level ranges between 300 to 400 feet. My observations of aerial photographs, however, indicate shorelines higher than 5090 feet at Red Rock Pass and these shorelines extend north beyond the so-called Bonneville outlet. The dates for the Bonneville water bodies are even more erratic. There is some agreement that the compendium of levels had terminated around 11000 BP but certainly prior to the initiation of the Holocene roughly 10000 years ago. Supposedly, today's lakebed has looked the same for, minimally, 10000 years. Surprisingly, there is little physical evidence of any animal life, human or otherwise, on the basin floor since that time.

An Alternative Concept

I question the existence of this 10000-year void in the Bonneville basin's history. The basin we see today is not how the basin looked at the start of the Holocene. When I look at maps and aerial photographs of the basin I do not see what Gilbert saw. The rationale for the rapid drop in water to the Provo level is the lack of evidence of any intermediate shorelines between the Bonneville and Provo levels. I believe the intermediate horizontal scarps have been overlooked because researchers have accepted the rapid drop scenario. These intermediate shorelines are there but slightly tilted, difficult to discern and span a large time interval. In addition, the higher shorelines in the central part of the basin, particularly the islands in Great Salt Lake, are older, higher levels that were subsequently reoccupied.

My concern here is with the beginning of the Holocene, namely 10000 BP. I believe an important event occurred in the Bonneville basin at this time. I infer above that Red Rock Pass was not an outlet for the literature's Bonneville-Provo scenario. Water has, however, backed up behind a sill in the Red Rock Pass area, that I place about one quarter of a mile south of Red Rock Junction (Figure 2). The freshwater lake that it impounded was brackish because of saline evaporates remaining from an older period, possibly even due to the presence of an ocean embayment. This lake's shoreline now tilts up towards the south end of the basin. It also cuts other older shorelines with different tilt angles.

Figure 2. The top end of the dark swampy area in the bottom right of this USGS photo marks the sill south of Red Rock Junction that was the outlet for this paper's postulated 10000 BP water body. Older higher shorelines can be seen in the main valley and the incised lateral valleys.

For scale reasons, and the nature of the basin, I have not presented an outline of the lake. The literature levels are so closely aligned that they are hard to distinguish from one another on planimetric maps. Figure 3, however, depicts the elevation isolines for this lake. Along each respective line the elevation for this lake is the same. Figure 4 is a profile of this shoreline today starting at this paper's Red Rock sill. Although a rough guess from maps I place the outlet level at about 4790 feet (Figure 1). From here it extends to the south end of the basin where it intersects the present valley slope gradient.

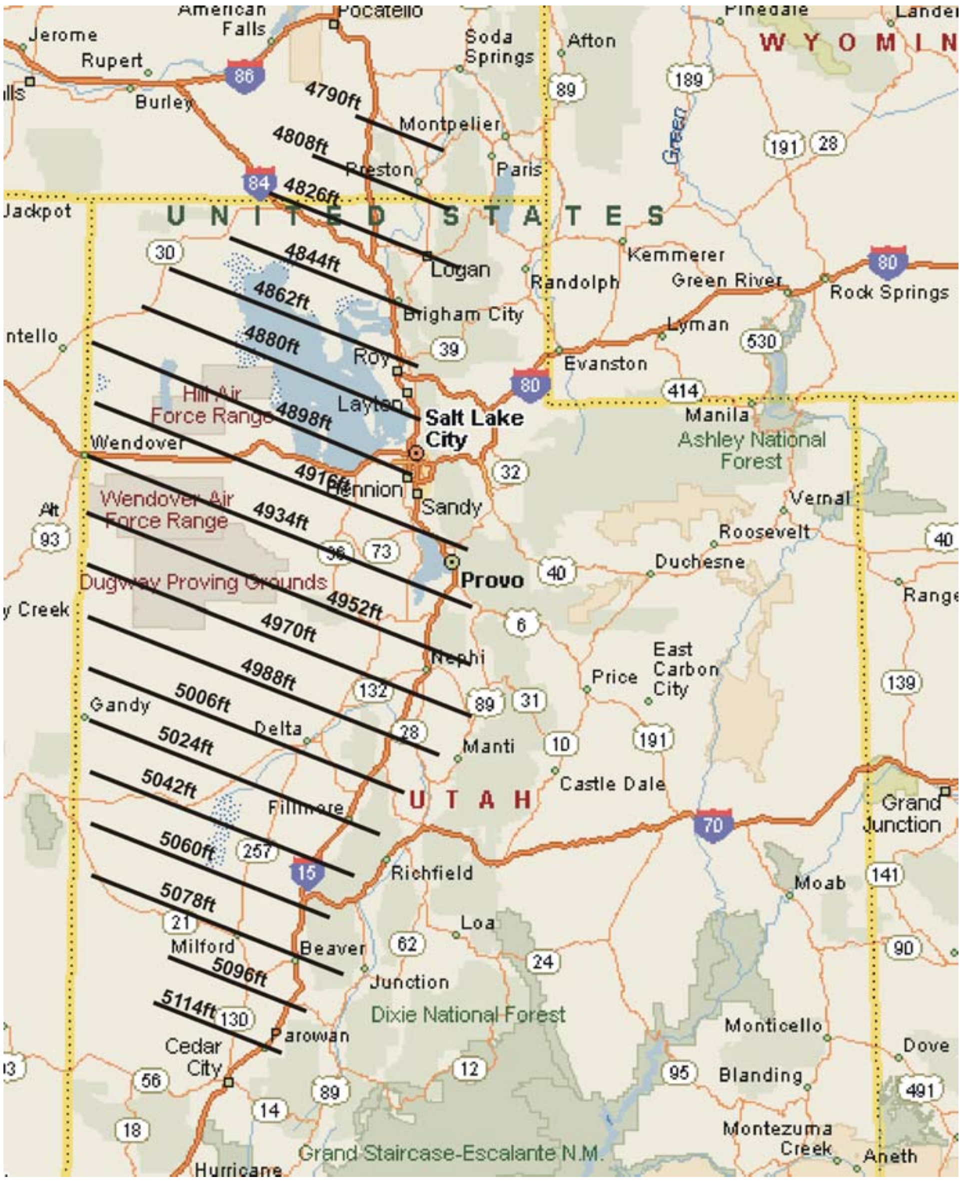

Figure 3. Isolines for the lake postulated to have occupied the Bonneville Basin (Great Salt Lake Basin) at the start of the Holocene (10000 BP). The lake stretched from near Red Rock Junction in the north to just beyond Lund in the south. The isolines portray a lake whose shoreline now tilts down to the north (background map from mappoint.msn.com).

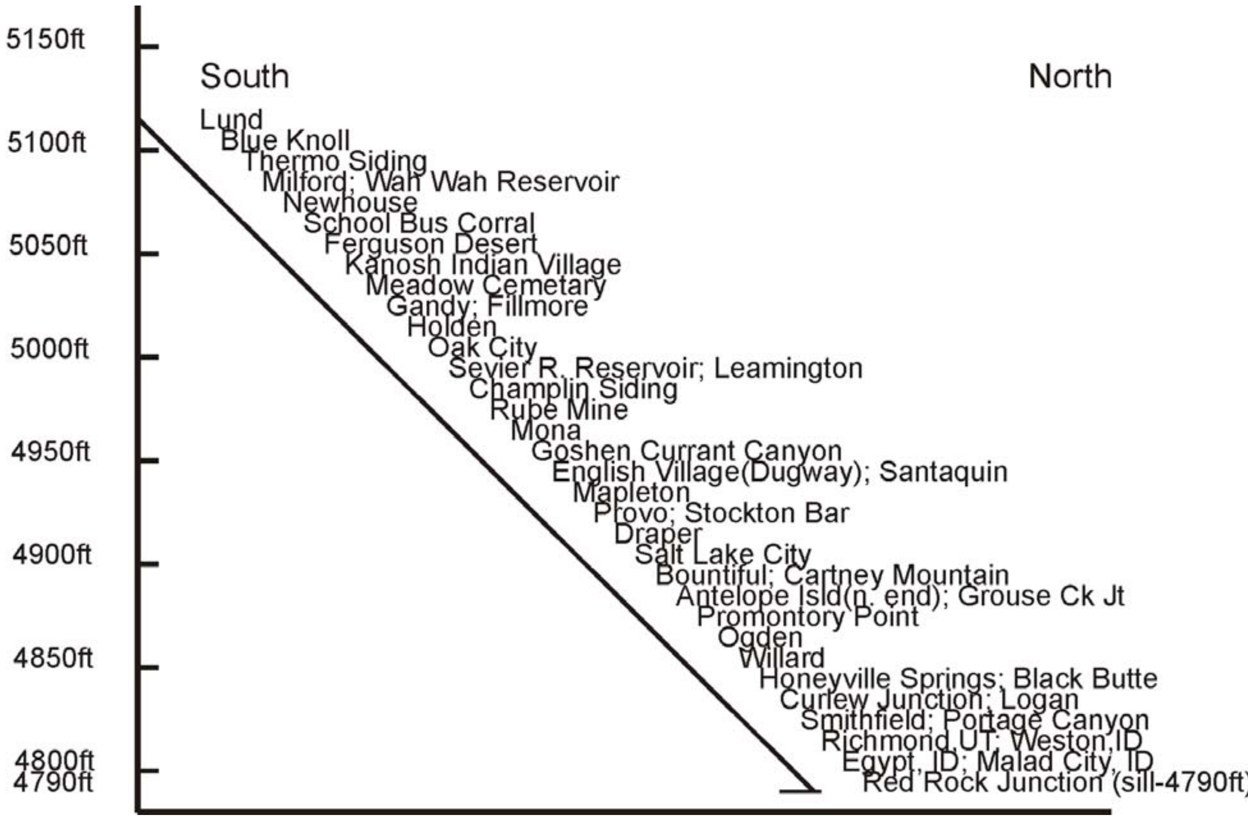

Figure 4. Shoreline profile (ratio 1:1) of the lake postulated to have occupied the Bonneville or Great Salt Lake Basin at the beginning of the Holocene 10000 years ago. The profile tilts down from the south to its outlet sill near Red Rock Junction in the north.

Given the shortcomings of a map displaying this lake I recommend readers use Figures 3 and 4 in conjunction with a web site that provides contour map and aerial photo coverage of the Utah-Idaho area (e.g., Terraserver.com or Topozone.com). One can circumnavigate the basin in this manner. The shoreline is easy to follow moving south out of the Cache Valley but as the basin widens the task is more arduous. For example, it can be difficult along bluffs where it reoccupies and/or cuts older shorelines. In many places it is defined by older gully systems that appear to have been filled and shaped by transgressive flooding. It also is covered in some areas by younger dune sands, alluvial fans and landslides, particularly along the eastern margin. In many places it marks the down-slope limit of what appears to be treed savanna (Juniper?) on aerial photos. Springs are also a characteristic feature of this shoreline. An interesting aspect of this lake level is that it passes through the northern end of Antelope Island in Great Salt Lake at the 4880-foot elevation, which corresponds to the literature's representation of the domed Provo level.

Discussion

The lake portrayed here contradicts the literature's portrayal of events in the Bonneville basin. The mechanism that caused this lake to form behind the Red Rock Pass sill is thought to be the earth shifting in relation to its orbital axis around the sun. This process has been described in my previous internet papers (see www.axialshift.com). It is suffice to say here that the water buildup relates to the spatial movement of the sill (i.e., the sill was not at its present geographic location when the event happened). As the Earth was shifting southwards through the orbital axis on this side of the hemisphere the impounded water maintained its horizontality. In doing so it inundated the smaller basins until ultimately the south slope of the larger basin was submerging. Had there been a southern outlet low enough to serve as a ‘back-door’ exit for this water, as in many other basins, the Red Rock Pass outlet would have been abandoned at some point during the shift. The water, still remaining horizontal, continued creeping up the south slope until the shift stopped. When this happened it marked the furthest south that this side of the Northern Hemisphere had been in the last 10000 years. One might think that the water exited through the lateral Sevier River valley, however, it only got a short distance beyond what is now the Yuma Dam that now impounds the Sevier River Reservoir.

The furthest south that the lake reached was just past the Escalante Desert community of Lund where it filled a shallow embayment that terminated adjacent to what appear on aerial photographs to be older incipient bedrock drumlins. The water-worked landscape that characterizes the desert beyond this point relates to older water levels. In the shift back the Lund embayment became a small shallow lake that drained over a low sill north of this community. It quickly dried up but was the first stage in a process that culminated in today’s remnant Great Salt Lake.

The water flowing out of the basin via Red Rock Pass drained to the Snake River where it ultimately reached the ocean. The Pacific Ocean shoreline, however, was not where it is today. In the shift, seawater encroached up the Columbia River valley into the Pasco Basin to a point just upstream from where the Palouse River joins the Snake River valley. This ocean margin and the contemporary lake within the Bonneville Basin were short-lived as the Earth embarked on a subsequent shift north. There were subsequent lake cycles over the next few thousand years but they were smaller ones that were integral parts of this larger ongoing shift back to the north. Each lake was increasingly smaller until such time as the terminal or pluvial lake stages were reached (i.e., evaporation overtook inflow).

The thesis put forward here is that the Bonneville basin was not an arid void during the past 10000-11000 years but changed drastically both in the amounts of water it contained and the climate that it experienced. Brown (1971, 1978) put forth the interesting idea that the basin’s mountain systems and the hot, dry lakebed were analogous to MacArthur and Wilson’s (1963, 1967) use of oceanic islands to study equilibrium-extinction models (i.e., the dry deserts were comparable to oceanic barriers). I believe an actual water barrier existed at this time and many of the mountain systems were islands not unlike the four islands in today’s remnant Great Salt Lake. The cyclic lake events described here were responsible for the evolution, distribution, disappearance, and, in some cases, the possible reappearance of certain faunal species, including man. Much of this evidence will be derived from caves, which are, in fact, sea caves, or minimally related to older seawater events. Those caves located below the shoreline were submerged. Caves above it served as refuges. If there is one species whose evolution spans, and is directly related to, both the older seawater (i.e., pre-Holocene) and younger Holocene events, it is the Bonneville Cutthroat Trout. Salmonids such as this epitomize axial shift activity and the change from seawater to freshwater conditions throughout the Northern Hemisphere. Taking the analogy even further, the distribution of all plant and animal species, including humans, reflects events and processes that are directly related to these shifts.

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