Re-Examining Pluvial Lake Chewaucan Shorelines

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Abstract

The Chewaucan Basin in Eastern Oregon has been the subject of numerous studies and notable archaeological finds, including the oldest known human remains in North America. While currently a high desert, 20,000ya it held Lake Chewaucan, a vast lake covering 1,244km² and up to 114 meters deep. As people entered the basin, about 15,000ya, Lake Chewaucan was receding from its most recent high stand and provided inhabitants with freshwater resources. 14,000ya, ZX Lake overflowed into receding Winter Lake. This event could have occurred multiple times, but was most likely brief. Thus, the archeological significance of the region, it remains imperative to build on the previous lake-level research and develop the most accurate shore-line map possible in the hopes of supporting further archaeological and paleo-environmental research in the Great Basin. This project re-examines previous lake-levels cited in literature through the use of an RTK GPS system to obtain more accurate elevations from previously identified lake-shore sites, and then maps these elevations using current satellite imagery and DEM data. Shoreline profile elevations obtained from different data sources are then compared to discuss the best method.

Published Research

Methods and Potential Error

- Topographic maps and aerial imagery
- Allison (1982)
- Frisvold (2001)
- Jacob Staff and Clinometer
- Liccardi (2001)
- Total Station
- Petixyane (1995)
- Digital Elevation Model (DEM)

Published Chewaucan Shoreline Data

The topographic maps used for this project all have contour intervals of 20 feet, so 90 percent of the points must be within 10 feet (3.3m) of the actual elevation. The DEM has an absolute vertical accuracy expressed as the root mean square error (RMSE) 2.44 meters.

Published Chewaucan Shoreline Data

14,000ya, ZX Lake rose to 1337m and spilled into the Winter Lake sub-basin, cutting an overflow channel across the fan delta. Winter Lake rose to 1321m. The ZX spillover event, probably brief, took place around 13,786 cal BP. Morphology of the channel suggests a broad gentle flow at first, then faster as it cut into the soft sediments.

Our measurements of the top of the overflow are 1338m. The chart above shows the comparison of the channel cross section using the TopCon, topographic map, and DEM.

Tucker Hill

The chart above shows the elevation data from the three different sources down the NNE slope of Tucker Hill. The TopCon profile shows greater topographic detail than the other two methods and is, on average, 5.6 meters lower than the Topographic Map and 5.5 meters lower than the DEM. Topographic Map elevations are relatively close for the first 100 meters, but the difference increases as the slope increases.

Lake Abert

On the south east shore of Lake Abert, Liccardi described a road cut with multiple stratigraphic units indicating multiple shorelines and lake oscillations. Liccardi used a Jacob's Staff and Clinometer to obtain lake elevations. We visited this cut and recorded the elevations of the upper and lower boundaries of Qg1. This unit is described as “well-rounded, clast-supported boulders, cobbles and pebbles” interpreted as being beach gravels. Liccardi measured the boundaries at 1335.75m and 1306.45m. These measurements are 0.659m and 0.497m above elevations recorded with the TopCon.

Conclusions

Understanding the fluctuations of pluvial lake basins is essential to estimating the surrounding environments and where those who took advantage of those beaches and marshes lived and collected resources. While estimating the elevations of shorelines with topographic maps was adequate and worked for researchers in the past, the advanced technology we have today can be used to refine data and obtain much higher accurate elevation measurements. This project has shown that elevations of shoreline features on topographic maps can be off by 5 meters. This difference is significant and demonstrates that we must use modern tech to re-evaluate elevation data. This can be in the form of an advanced GPS, such as the TopCon, drone imagery, or fine satellite elevation data, such as high resolution DEMs or LiDAR. In order to properly track the shorelines in the Chewaucan Basin, shoreline features all around the basin need to be studied and a better DEM is needed for mapping the data.

References

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