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PALEOECOLOGICAL RECONSTRUCTION OF ANCIENT LAKE BONNEVILLE THROUGH SEDIMENT ANALYSIS

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The Bonneville Basin is a large drainage basin located in North America's Great Basin region and extends across western Utah, eastern Nevada, and southern Idaho. Lake Bonneville was an ancient pluvial lake that formed within the basin approximately 30,000 years ago during the last ice age (Oviatt et al., 1992). It covered an area of more than 19,691 square miles and formed as a result of a combination of factors such as lower temperatures, decreased evaporation, and higher precipitation (Oviatt et al. 2003). The lakes history can be placed into 3 categories, which are referred to as the transgressive, overflow, and regressive phases (Currey, 1990). The transgressive phase refers to a period when the lake was a closed system, and apart from evaporation the lake had no surface outputs. Lake Bonneville existed until approximately 15,000 years ago, when a large portion of the lake was released by sudden erosion of a natural dam at a low point on the lake in southern Idaho (Oviatt, 2015). The Bonneville Flood designates the start of the overflow phase, where water drained into the Sevier Basin and led to the formation of Lake Gunnison (Oviatt et al., 1992). The end of this flood event indicates the start of the regression phase, which has resulted in lake levels comparable to those of the modern Great Salt Lake (Oviatt, 2015). As the climate warmed, Lake Bonneville began drying up and left behind remnants such as the Great Salt Lake, Utah Lake, Sevier Lake, Rush Lake, and Little Salt Lake.

The goal of this undergraduate research project is to analyze sediment from a modern spring site collected within the Bonneville Basin for paleoecological reconstruction. Proxy record research techniques such as Magnetic Susceptibility (MS), Loss on Ignition (LOI), charcoal and pollen analysis provide data that will contribute to a better understanding of the geomorphic and biological changes in this area during the Late Pleistocene and Holocene time periods. The research for this project is part of a larger study that is funded by the Department of Defense. Data collected for this project will contribute to this long-term study that aims to provide comprehension to the paleoenvironmental conditions and the effects of climate change in this region for approximately the last 30,000 years. As a whole this study, can serve as a useful benchmark to current and future studies examining ecosystem responses to climate change.

MS measurements are non-destructive and detect the presence of iron-bearing minerals within sediments (Naseh et al., 2012). Individual sediment samples are exposed to an external magnetic field. Sediments become more susceptible to magnetization as the present amount of iron-bearing minerals increases (Naseh et al., 2012). This proxy record can be used to identify metal pollutants, erosion and flood events, and large-scale disturbance events such as fire and volcanic eruptions (Zolitschka et al., 2001).

The LOI technique uses a series of low, medium, and high temperature combustion chamber experiments to reveal the percentages of water, organics, carbonates, and clastics of a sediment sample (Dean, 1974). This proxy record can be used to determine time periods of high moisture (high organics) and drought (low organics), which is directly related to the amount of biomass on the landscape. Performing LOI allows us to establish a long-term record that can be used to identify geomorphic and biological changes during the Lake Bonneville sequence and the Holocene. LOI will be used to indicate carbonate levels of the sample, which can be indicators of climate.

The charcoal method shows the burn history in the area (Clark, 1988). Using sodium hexane to disaggregate the sediment sample, we are able to count how many pieces of charcoal are in each sample. From there, we count fragments that are greater than 250 um, as well as fragments that are between 125 and 250 um using a light microscope.

Pollen analysis shows what species of vegetation inhabited the area in the past, as well as how much was present. By studying the pollen grains found in each core, we should be able to see a change in organics over time.

About 15 cores have been collected from an army facility located in western Utah, Dugway Proving Ground (DPG), as part of the on-going, long-term study funded by grants from the Department of Defense. This research project focuses on past time periods when humans inhabited the area, therefore, our data will provide further insight to archaeological and paleoecological changes in the Bonneville Basin. The sediment analysis should demonstrate variations in the environment throughout time, which could have had an effect on humans residing in the area. Currently, the complex relationship between anthropology, geomorphology, and climate are not well understood. The data gathered from this project could aid in explaining how these factors are interconnected and contribute to the structure of the ecosystem.

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