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STUDY OF UTAH'S CLIMATIC HISTORY BY ANALYSIS OF LAKE CORE SEDIMENT COLECTED FROM LAKE BONNEVILLE SITE

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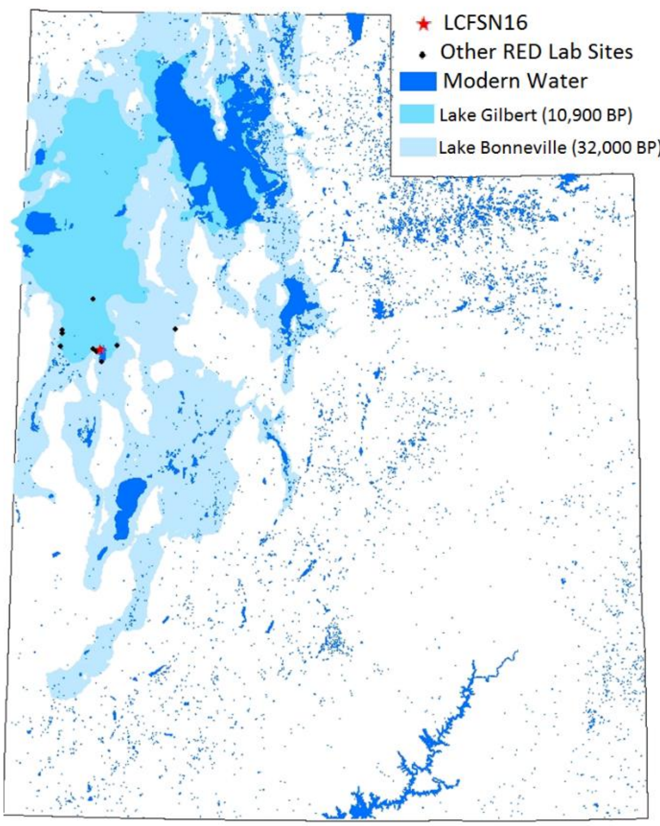
This research project focuses on paleoenvironmental reconstructions of ancient Lake Bonneville through lake core sediment analysis. Data is collected through the four following proxies: magnetic susceptibility, loss on ignition, and charcoal. Magnetic susceptibility shows the amount of iron-bearing sediments, and loss on ignition displays the organic carbon and carbonate components of the sediment. Changes in charcoal abundance within the sediment allows us to reconstruct fire disturbances. Data from these analyses help us to interpret past ecology, climate, disturbance events, and the lake chronology. The data for this research has been collected from core LCFSN16, which is located at the north most extent of the Fish Springs Wildlife Reserve, just south of Dugway Proving Ground. Its location, along with other sediment cores collected by the Records of Environment and Disturbance (RED) Lab are shown in figure 1.

Figure 1.



X-Ray Fluorescence is used for elemental analysis at very high resolutions. The elemental composition can indicate where sediment may have come from geographically, and if volcanic ash has been preserved. Every volcanic eruption has a unique elemental signature, and if identified, its presence can be used as a chronological constraint. Magnetic susceptibility is a beneficial test because sediments are oftentimes magnetized. Magnetism depends on the content of iron-bearing minerals, especially with magnetite and other members of the iron-titanium solid solution series. Magnetic susceptibility can be considered as a proxy for minerogenic makeup of the core and disturbance events (Last and Smol, 2001). Loss on Ignition (LOI) is a destructive test where sediment materials are burned off at specific temperatures. The difference in sediment weight is used to determine the percent water, organic material, and carbonate material in each sample.

Sedimentary layers with charcoal abundances are evidence of a fire event in the past. Charcoal particles deposit into the lacustrine bed during or shortly after a fire. A peak of charcoal in lake-sediment cores can be correlated with known fire events to define threshold abundance levels. This forms a basis for deriving older fire events from the charcoal stratigraphy. The characteristics of charcoal particles can reveal certain information about the fire such as the proximity of burning materials to the sample site. Larger particles are transported through the air at shorter distances, settling out closer to the original fire than do smaller particles (Whitlock, 8). Charcoal accumulation within sediment may continue about five years after the fire occurrence, which clarifies the broad peaks in charcoal count representing a single fire event in the stratigraphic record. In addition, charcoal is resistant to oxidation and microbial activity thus persists in a geological timescale (Mooney and Tinner, 1). This characteristic of charcoal makes it a reliable proxy in determining fire events dating back thousands of years and is able to accurately represent fires from the Holocene time period.

Results from LCFSN16 are displayed in the table below in correspondence to figure 2, which is an image of the entire sediment core (2.43 meters). Zones are determined by general trends in data.

ZONE	DEPTH	DESCRIPTION
1	1-20 cm	This section is the modern root mat. It is shown with an increase in organic materials, variation in carbonate, and stabilized magnetic susceptibility. Charcoal presence is the highest in this section indicating abundant fire events relative to the rest of the core.
2	20-165 cm	This zone is extremely clay-rich with a high carbonate content. Erosion is low shown by the stability of magnetic susceptibility. Organic material and charcoal are low, it is likely the surface was submerged at this time.
3	165-215 cm	High magnetic susceptibility indicates erosion, leaving behind various mineral fragments. This section includes a strontium peak of over 500,000 ppm, also indicating erosion. Organics and carbonates generally decrease at this time. This is likely the result of a change in lake level.
4	215-243 cm	Varves are shown in this section, indicating a deep water level is present. High carbonate and low magnetic susceptibility indicate the transgressive phase of Lake Bonneville. All four tests show little to no variance.

This research project is continuing with pollen analysis. Pollen is extracted from the sample through a series of chemical processes intended to remove all other elements of the sample such as organic, carbonate and clastic material leaving only pollen. Grains are identified using a microscope; grains have unique characteristics making them classifiable to the plant’s family level, sometimes down to genus or species. Plants live in certain environmental conditions, so changes in vegetation indicates change in landscape or climate. Knowing what types of vegetation are present in a sample increases understanding of what the environment was like at that time.

Figure 2.

References

Last, W.M., Smol, J.P., 2001. Tracking Environmental Change Using Lake Sediments. Kluwer Academic Publishers, v. 1

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