

A STRATIGRAPHIC ANALYSIS AND CORRESPONDING CORRELATION AMONG FOUR METHODS OF ANALYZING GLACIAL SEDIMENTS, HUNT'S BOG, OHIO

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INTRODUCTION

The sediment stratigraphy of mid-continental U.S. is important as a record of the glacial history of Pleistocene North America (Fig.1). Through the study of these sediments, it is possible to piece together the processes and events that have shaped this region of the continent and perhaps predict both the natural and human impact on climate fluctuations. This project is a contribution to the various studies and efforts that have focused on this overarching goal.

Through a detailed analysis of sedimentary characteristics in a depression known as Hunt's Bog, a sequence of depositional events was revealed that provides a small window into the environment that existed during sediment accumulation.

This project takes a step past the search for specific information related to the Laurentide Ice Sheet and uses the grain size, magnetic susceptibility and percent organic and carbonate data to compare their relative fluctuations and their connected or discrete relationships during deglaciation.

STUDY SITE

Hunt's Bog is located in southwestern Ohio just west of the Indiana-Ohio state border and Union City. It sits on the northern side of the Union City Moraine, proximal to the retreat of the Miami sublobe of the Laurentide Ice



Figure 1: The Erie Lobe of the Laurentide Ice Sheet in Ohio (modified from Chernicoff and Venkatakrishnan).

Sheet. The area has remained untouched by farming because it dips past the water table and remains too soggy for crops throughout the year (Fig. 2). The core from this site was extracted from the southwest portion of the northwest-trending elongate depression.

SEDIMENTOLOGICAL ANALYSIS

Methods

The 5.5m study core was extracted using a 6 cm, square-rod coring device. It was taken in

1-meter segments after auguring to an initial depth of 1.5 meters. Due to sediment loss on each thrust, two offset cores were extracted to



Figure 2: A photograph of Hunt's Bog. The cores were taken in the alder grove along side the pond.

provide overlap and complete stratigraphic recovery. Later in the lab, the correlation of physical sedimentologic features aligned the two cores.

To prepare the core for analysis, the sediment was sliced down the middle, exposing the interior of the cylinder. This material had not been contaminated by the coring tube or the extraction process. Immediately after the splitting and before oxidation could mask features that are prominent when fresh, a thorough description was recorded and it was photographed using a digital camera. Both the description and images have provided a record of the fresh sediment and a base-line to compare with changes that have occurred after a period of time has elapsed and oxidation has taken effect. After this process, the core was ready for analysis.

Four tests were conducted on the sediment in 4cm intervals. These included magnetic susceptibility, the grain size and the loss on ignition (LOI) of organics and carbonates completed by heating a plug of sediment to 550°C and 1000°C respectively. When comparing the results of these tests, changes in the sediment character can be detected that otherwise are not visible.

Core Stratigraphy

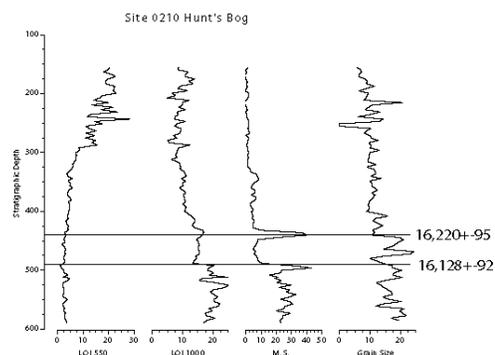
At the base of the core highly unsorted, coarse material with grains ranging from fine sand to

2cm pebbles was extracted. There is an abrupt transition between this material and medium-grained silt where a carbon 14 date of 16,128+/-92 years has been determined from several small wood branches (Fig. 3). Approximately 40cm from the base of the section is a distinct black horizon. Another date was taken at this level and revealed a date of 16,220+/-95 years ago. The carbon was extracted from several seed pods and small branches. Through the rest of the core the silt is fine to medium grained with increasing organics within the last 1.5 meters.

Significance

One variable, grain size, shows shifts in the energy of the transport medium thereby suggesting changes in the environment. For example, the coarse material at the base is till. This sediment was directly deposited by the glacier and was not reworked by any other processes. From the till is a shift to silty sediment that marks the point at which the ice retreated from the area and the depression became a pro-glacial lake. The rest of the section consists of fine to coarse silt with slight fluctuations throughout the core. The fluctuations represent shifts in energy of the water feeding the depression. It is likely that the depression was a lake due to its homogenous character. The silty sediment was deposited rapidly as shown by the overlapping dates taken in the section. Finally the bog turned into an organic-rich, peaty bog that continues to exist today.

Through the examination of the organic content throughout the core, the intrusion of plants into the environment is detected. Approximately 1m above the base of the silt, organic material began to accumulate, slowly



increasing in concentration. Nearly 1m from the top of the core the percent of organics drastically jumps, marking the base of peat. This contact is interpreted to be the time at which the basin was filled, no longer trapping sediment at the previous rate. Plants were allowed space to prosper without becoming buried and overridden by inorganic material.

Carbonates provide another check for changes in the depositional history. They are derived from the land at the base of the glacier and in the process of transportation, were ground into fine particles.

Both halves of the core were then realigned to perform the magnetic susceptibility test that shows the magnetic strength of the material at certain stratigraphic intervals. This test provided interesting results. At the base of the core within the section of till there were strong fluctuations reflecting the unsorted nature of these types of deposits. At the top to the till there was one last peak, much higher than all previous values. The readings suddenly decrease drastically, indicating a new depositional environment. Only 40cm further up the stratigraphic column marked another dramatic peak in the measurement. These two prominent peaks correlate to zones in the core, that when first extruded, showed accumulations of black material that has now oxidized into a bright orange color. We had suspected these regions were paleosols due to the evidence given by the color. This agrees with Maher and Thomson (1991) who believe that increases in the magnetic susceptibility can reflect soil development.

After all tests were completed the results were aligned on a graph with the same stratigraphic scale. Macrofossils for carbon 14 dates were extracted from sections of the core that showed evidence for soil horizons. These included the top of the till and the section with the concentration of dark material and anomalous high values for magnetic susceptibility. An additional section was picked further up the core to provide a time constraint on the bulk of the silty sediment. These macrofossils have been sent to the

University of Minnesota's limnology lab for analysis.

DATA COMPARISON

For every 4cm interval there is a value given for each measurement of grain size, magnetic susceptibility and LOI of organics and carbonates. Throughout the core there are fluctuations in the size of grain particles, changes in the magnetic susceptibility and varying concentrations of organics and carbonates. The change between intervals was calculated throughout the core for all sets of data. Comparing the changes, I attempted to find ways in which the measured factors fluctuated either harmoniously, disharmoniously or if they merely represented random and unrelated sedimentological features.

The values for the changes were graphed against those of each additional measurement taken. For example, the changes between values of grain size were graphed with magnetic susceptibility, LOI of carbonates and

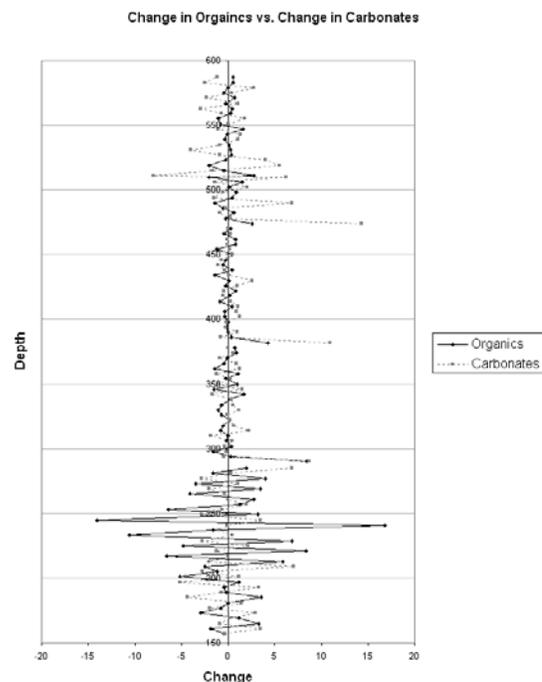


Figure 4: This is a graph showing the change in the percent organics and percent carbonates. The negative numbers represent a decrease in value and the positive numbers represent an increase.

LOI of organics. This produced six graphs with both positive and negative peaks of varying amplitude (Fig. 4). The positive peaks represent points where the values increase from one measurement to the other and, vice versa, negative peaks show a decrease in value. I also counted the number of times each variable fluctuated in relation to another (Fig. 5).

	1000 increase	1000 decrease
GS increase	18	33
GS decrease	31	16

Figure 5: The count of the number of times grain size and percent carbonates positively or negatively fluctuate in relation to each other.

The results from this examination reveals that some of the parameters show trends of fluctuation that suggest relation between the values that they measure while others vary in random and unrelated ways.

Those that show trends suggesting a relationship include grain size vs. percent organics, grain size vs. percent carbonates and percent organics vs. percent carbonates. The relationship between the magnetic susceptibility and all three other parameters show no patterns and apparently fluctuated independently.

The inverse relationship between the organic content and the carbonate content is somewhat intuitive. When the flow of sediment into the basin is high, inorganic material is going to dominate the core in that section. When the basin filled in, organics are given space to accumulate.

The relationship between grain size and the percent carbonates can also be justified. Carbonates are a relatively soft material. In contrast, other silica based minerals are much harder and resistant to wear. Sections with a higher proportion of fine grains correlate with a higher concentration of carbonates.

It is more difficult to justify the direct connection between grain size and organics. When the grain size increases, the percent of organics also increases. It's possible that organic-rich sediment was not completely

deflocculated before running it through the process to calculate grain size. However, it's more likely that the trend is a result of the connection between grain size and carbonates and, organics and carbonates. We know, for example, that when the grain size increases, there is a trend that shows the percent of carbonates will decrease. We also know that there is a trend showing that when the carbonates decrease, the percent of organics increases. Therefore, due to the relationship of both grain size and organics to carbonates, we know that when grain size increases, organics will also increase.

CONCLUSION

Examination of the cores extracted from Hunt's Bog shows a history of glacial deposition followed by a period of stability and the formation of a soil. Eventually the soil was overridden and silt accumulated until there was another period of stability. This is marked by a concentration of oxidized soil and an increase in value of magnetic susceptibility. Again the soil was buried by an influx of silt which gradually became more organic-rich until suddenly organics began to dominate the sediment.

REFERENCES CITED

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