POSTGLACIAL ENVIRONMENTAL RECORD USING POLLEN ANALYSIS IN WILDCAT BOG, CENTRAL OHIO

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INTRODUCTION

At the height of the last Ice Age, more than 15,000 years ago, the Laurentide ice sheet covered Northern North America including much of Ohio. The objective of this research was to create an accurate climate and environmental record of the time up to the present since the ice sheet melted. To do so analysis focused on a small, representative slice of that area. As the ice sheet retreated it left behind many small basins that have since been filled up with sediment, preserving a continuous environmental record.

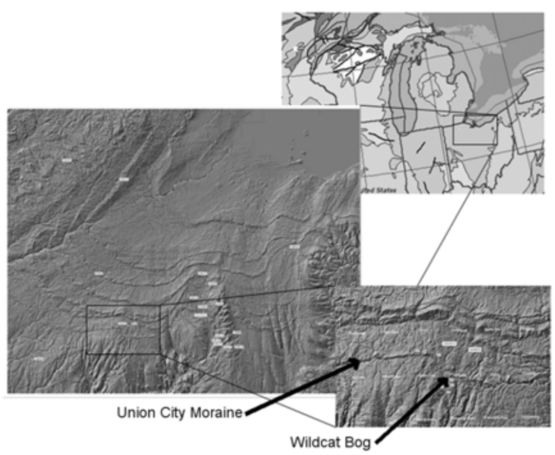

Figure 1: Site location just south of the dark line of the Union City moraine. Other terminal moraines are evident as dark "bathtub rings" around southern Lake Erie in larger image

grain size. Samples were taken and analyzed for dating and pollen content.

METHODS

Prior to coring, the bog was probed with a segmented tile probe to contour the underlying glacial basin. Probe locations were measured by GPS and the deepest part of the basin was selected for coring.

Cores were taken using a modified Livingston corer, in meter long sections until we could no longer push the coring device down. Two cores were taken a couple meters apart to fill gaps in the first core caused by sediment loss during retrieval. The ten-meter long core penetrated through peat and silt layers to the glacial diamict, which stopped the coring device. Field descriptions and photographs were taken. In the lab, we further described and photographed the core, and ran analyses of magnetic susceptibility (MS), percent composition by weight of total organic carbon (TOC) and inorganic carbon, and the grain size distribution on the core at 4 cm intervals. Silicate percentages were calculated by assuming all remaining sediment was silicate after organic carbon and carbonates were burned off. Grain size and MS can both indicate how energetic the sedimentary environment was. TOC and carbonate levels and trends can reveal climate and environmental changes. Analysis of the fossil pollen preserved in the sediment is ongoing. Samples of sediment were taken from 6 short intervals along the length of the core and sent to a lab for processing into slides. Microscope identification and counting of pollen can yield important information about vegetational

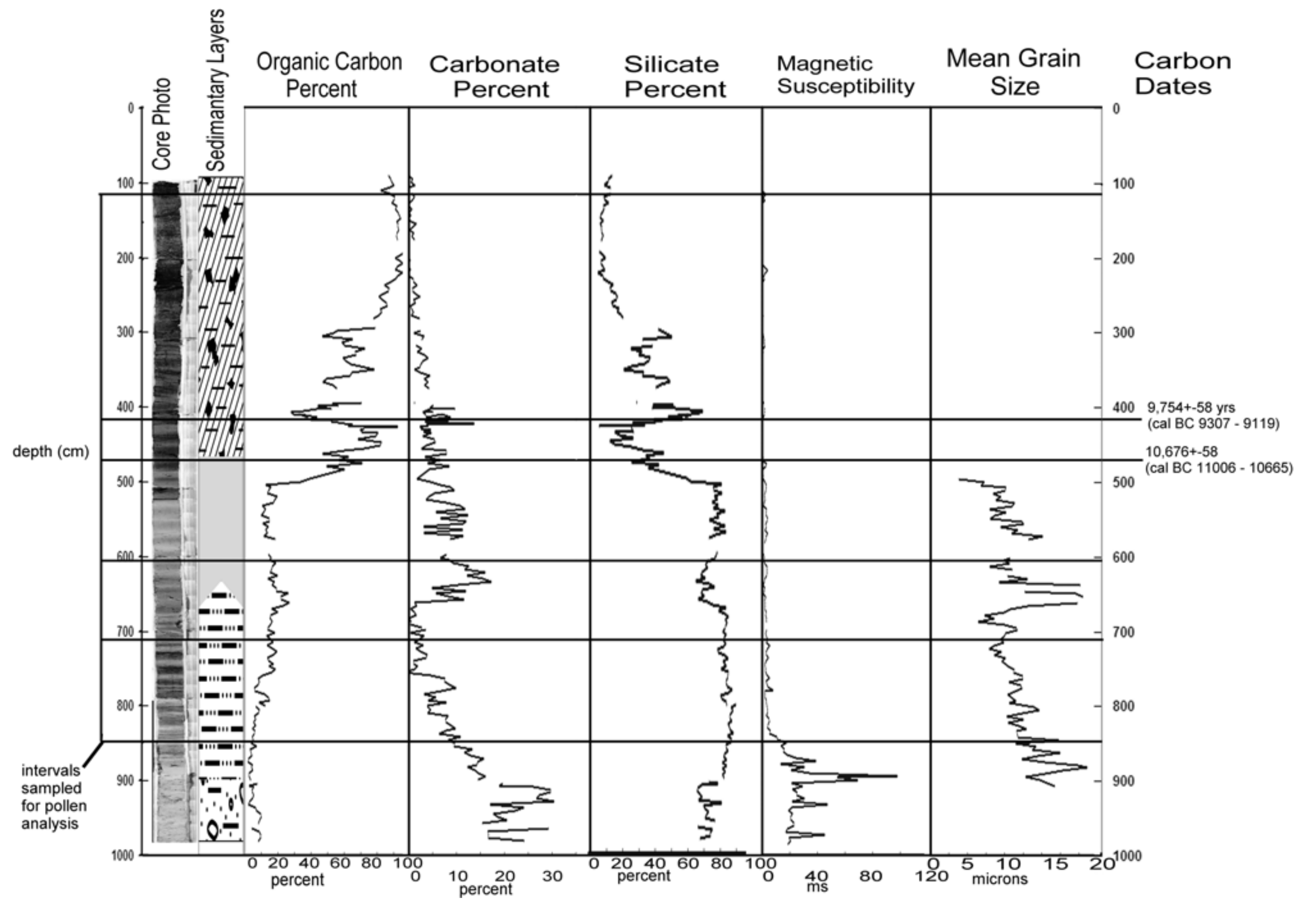

Figure 2: Analyses plotted against stratigraphic depth. Note the increasing trend in organic carbon content, with decreasing carbonate, silica, magnetic susceptibility and grainsize. Core photo and graphic log allow comparison with changes in sediment type and structure. The bottom of the core is glacial diamict, followed by silt, more organic rich

changes in the basin and surrounding area. Sections of the cores were processed to obtain samples of organic carbon, which were then sent to a lab for processing and Accelerator Mass Spectrometry (AMS) dating.

RESULTS

Initial results reveal several trends in the core. Moving up the core, organic content increased, while grain size, magnetic susceptibility, and carbonate content all decreased. Organic carbon content rapidly increased from around 20% to more than 80%, where the sediment transitioned to peat at stratigraphic depth 480 cm. This transition was sampled for AMS dating, and returned an age of 10,676+- 58 years (calibrated BCE 9307-9119.) Organic content dropped back to 50-60% between 420 and 320 cm before rising again to 80-90% above this (Figure 2.) Another AMS carbon sample was taken at depth 415 cm, just after this drop in organic productivity began, and yielded an age of 9,754+-58 years (calibrated BCE 11006-10665.)

Preliminary pollen analysis indicated a gradual transition upcore from spruce and other conifer dominated at the bottom, to oak and deciduous tree dominated by the time of peat formation. Notable quantities of the family Corylacea, which includes Alnus (alder), Betula (birch), Carpinus (beech), and Corylus (Hazel) were also present, as well as sphagnum (peatmoss), Compositae (aster), and Carya (hickory) (Figure 3.)

DISCUSSION

Magnetic susceptibility was high initially, but dropped off sharply around 850 cm depth, indicating that significant outside input into the basin stopped. Average grain size also decreased over this interval, confirming the decreasing influence of the retreating ice sheet. As the basin was small and closed, the most likely source of sediment was wind

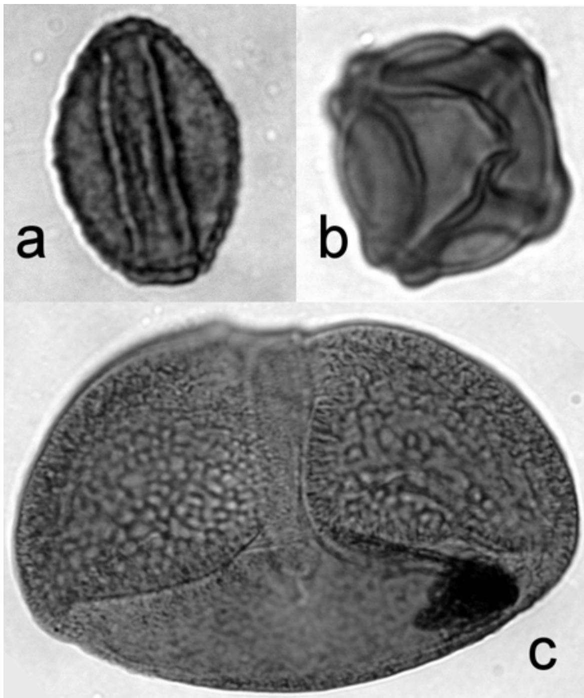

Figure 3: Light micrographs under 630x magnification of a) Quercus (oak) b) Alnus (alder) and c) Picea (spruce.) Quercus and Picea in particular are important indicator species of climate change. All pictures of pollen taken from the Wildcat Bog cores.

transport. Silt sized particles are abundantly produced by glaciers, and commonly transported by wind (Donghuai et al., 2002.) Rivers may transport this silt far downstream before depositing it on sandbars, where the wind picks it up, allowing deposition near glacial drainages long after the glacier retreated from the area. This perhaps explains the continuing dominance of siliciclastic deposition in the core up until the onset of peat formation at 480 cm depth.

When climate cools organic production should decrease as well. The AMS dates indicate that the large drop in organic content within the peat layer occurred too late to be caused by the Younger Dryas, a cold period lasting from approximately 11,000-10,000 ^{14}C years BP (Yu & Wright, 2001). It is unlikely that the dates were erroneously young, as the hard water effect is the most likely influence on carbon isotope ratios in this core, and that would cause the ages to appear incorrectly old. The cold, arid climate during the Younger Dryas may have had a role in keeping organic production low in the bog for several thousand years after the ice sheet retreated. The marked increase in organic content at 480 cm depth was coincident with the end of the Younger Dryas. The rapid transition from high silicate deposition may have been driven not by an increase in productivity, but by better organic preservation. Deep, stagnant water protects organic matter from oxidation and breakdown. A warmer, wetter climate after the end of the Younger Dryas would have produced higher water levels in the bog.

The peat between the two dating depths was deposited at a rate of about 1 meter every 3000 years. The average depositional rate of the peat above it was 1 meter every 2700 years. Peat deposition rates are consistent with rates found in other modern bogs (Ikonen, 1995.) These rates cannot be compared to depositional rates of the underlying silts because not enough carbon was found in the silt layers to date.

The drop in organic content at 420 cm depth may have been triggered in part by a milder Preboreal cooling period whose record has been noted in the Greenland ice cores and elsewhere in the Great lakes region (Yu & Wright, 2001) This cool period was relatively minor and short, and the extended decrease in organic content indicates that this drop was probably produced at least in part by factors local to the basin, not just regional climatic forcing.

Pollen analyses of similar till plains sites in published literature differentiated the record from this period into four sections (Shane & Anderson, 1993.) The first was a cooler period lasting until about 13,000 ^{14}C years ago. The area was dominated by cold resistant species, particularly pine and spruce. As temperatures warmed, more deciduous trees, particularly oak species, moved into the area, until the Younger Dryas, when colder temperatures caused a marked spruce recurrence. After then end of the Younger Dryas the deciduous trees dominated the forest until modern times. The increase in deciduous species and decrease in conifers seen upward in this core was consistent with previous pollen studies in the area, although pending precise pollen counts, the spruce recurrence was not noted in this core.

CONCLUSIONS

Together these records show that after the Laurentide ice sheet retreated organic production began slowly, with cold hardy conifers dominating the plant assemblage. Siliciclastic deposition, probably from wind transport, dominated the bottom five meters of the core, spanning several thousand years. The long period before organic carbon began to be preserved in large amounts may have been due to the influence of the cool, dry Younger Dryas. As the climate warmed, deciduous trees moved in, and organic productivity and preservation increased, to the point where organic carbon constituted nearly 100% of the sediments deposited. A temporary decrease in organic levels may have been caused by a period of cooling, with lowered productivity. It most likely also reflected some depositional change specific to the basin. This was followed by further expansion of deciduous trees and increasing organic content, indicating warming.

The climate and environmental record from this bog was similar to others nearby, with the difference that significant organic preservation did not begin until after the Younger Dryas ended. The core record showed some changes isolated to this bog and others which reflect forcing by regional climate.

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