

Using Biogenic Silica, Pb-210 dating and Loss on Ignition analysis to see how land management affects shallow lakes

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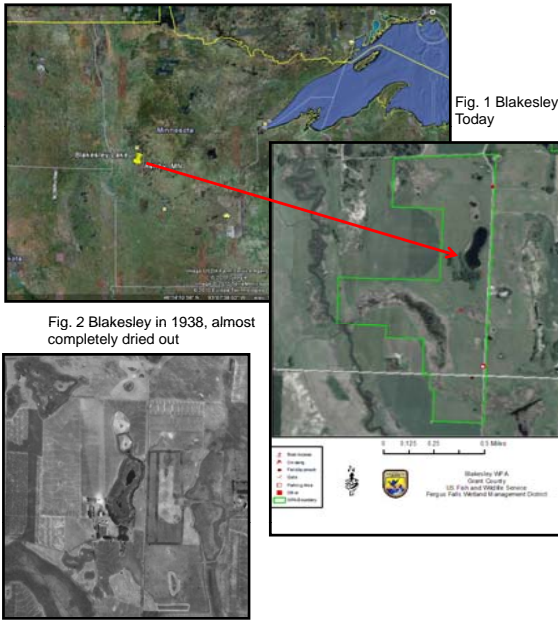


Fig. 1 Blakesley Today

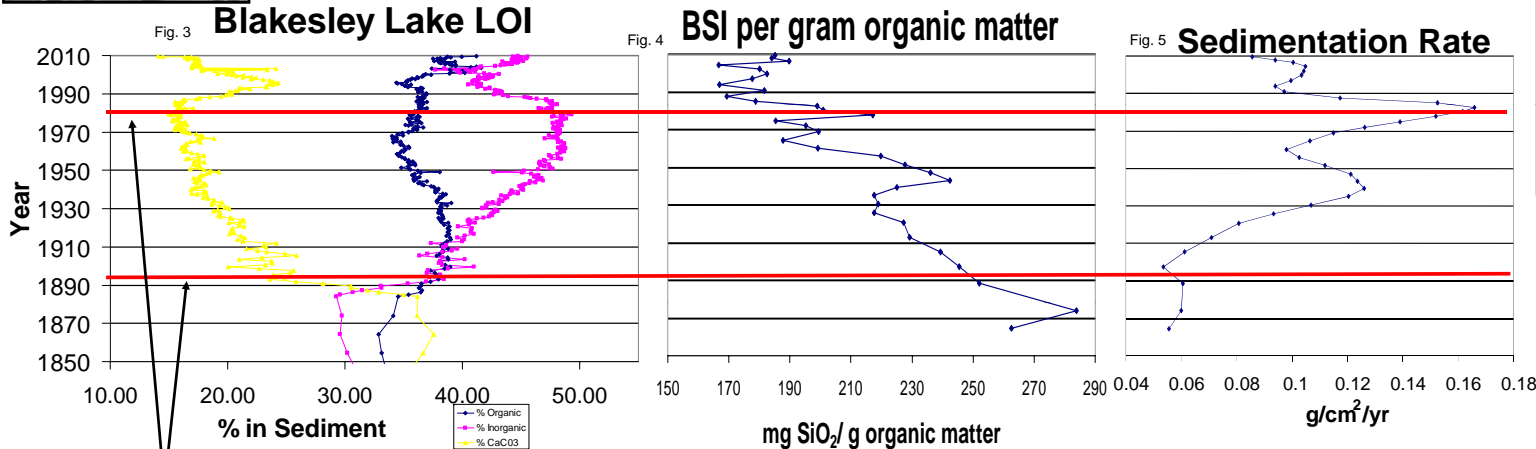
Fig. 2 Blakesley in 1938, almost completely dried out

Introduction

Shallow lakes are very numerous in Minnesota, especially in the prairie pothole region in the Alexandria lakes area. Historically, this portion of western Minnesota was a broad, sweeping grassland. Within this landscape was an abundance of wetlands. Agricultural changes to the landscape along with droughts in the 1930's (See Fig. 2,6) resulted in drainage of many small lakes and destruction of the prairie. In 1929 The government passed the federal duck stamp as part of a program to protect wetlands after realizing the need to properly manage these shallow lake systems. Waterfowl Production Areas (WPA) and Wildlife Management Areas (WMA) were established by various agencies which, along with preserving wetlands, allowed research to be done on systems that have been largely influenced by human input. Research at the University of St. Thomas and the Science Museum of Minnesota aims to see how shallow lakes bury carbon and to see if such systems can be managed in a way to aid in the fight against global climate change. My project looks to use biogenic silica (BSi) analysis, loss on ignition (LOI) analysis and Pb-210 dating together to: (1) Provide a historical record of a shallow lake. (2) See if turning Blakesley lake into a WPA had a positive or negative affect on the lake.



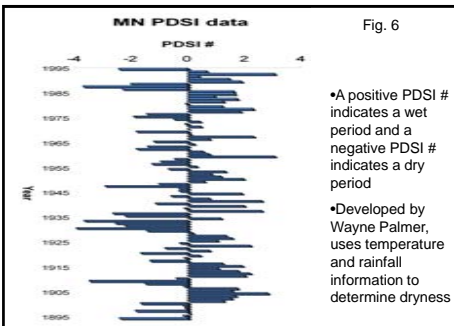
Above: Making labels while sectioning a core
Below: Prepping samples for Freeze dryer



Red Lines indicate two major shifts in land usage. First, the lower represents the approximate time of human settlement and land clearance for this area. A large farm was established until the second major land usage change. The upper red line indicates the completion of the purchase of lands from Federal duck stamp revenue for a WPA in 1978. The land has since been restored to the prairie that it was before agriculture.

Methods

A piston core was collected from Blakesley lake in October 2009. The core was then sectioned into quarter centimeter segments and labeled all the way down the core. The relative composition of the sediment was analyzed by % organic matter, % CaCO₃ and % Inorganic matter. The core was then freeze dried using an Edwards-Modulyo freeze drier. Core A was then Pb-210 dated (Appleby, 2001) at the St. Croix Watershed Research Station. Biogenic silica analysis was performed on the core using the wet chemical digestion method (Conley&Schelske, 2001). Information about land acquisition and the WPA was acquired from U.S. Fish and Wildlife Service. PDSI data was taken from the National Climatic Data Center



•A positive PDSI # indicates a wet period and a negative PDSI # indicates a dry period
•Developed by Wayne Palmer, uses temperature and rainfall information to determine dryness

Conclusions

- Blakesley lake has experienced two major impacts that affected its productivity and sediment composition.
- First, human settlement and land clearance around 1900 instigated a large increase in inorganic material coming into the lake and thus the sedimentation rate went up. Sedimentation rate peaked in 1982, four years after Blakesley was completely turned into a WPA.
- Second, after WPA establishment the sedimentation rate and inorganic material coming into the lake sharply decreased. This suggests establishing a WPA has impacts on sedimentation rates and the composition of the sediment coming into the lake.
- BSi shows that diatom production has gone down over the past century perhaps suggesting the lake is producing less algae and more macrophytes than it had in the past. Because it is standardized to grams of organic matter, we can infer that the relative percentages of diatoms and macrophytes have decreased and increased respectively
- BSi may also be influenced by changes in lake area, which is driven by changes in climate. (see Fig. 4, 6)

Works Cited

Daniel J. Conley, Schelske, Claire L. Biogenic Silica. In Tracking Environmental Change Using Lake Sediments. J.P. Smol, H.J. B. Birks & W.M. Last. 2001.

P.G. Appleby. Chronostratigraphic Techniques In Recent Sediments. In Tracking Environmental Change Using Lake Sediments. J.P. Smol, H.J. B. Birks & W.M. Last. 2001.

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