# Paleoecology of Tibbetts Brook and Van Cortlandt Lake


Alex Byrne Van Cortlandt Park Alliance

Dr. DOROTHY PETEET LAHMONT - DOHERTY EARTH OBSERVATORY

CHRISTIAN LIRIANO AMNH NYBG VOL.

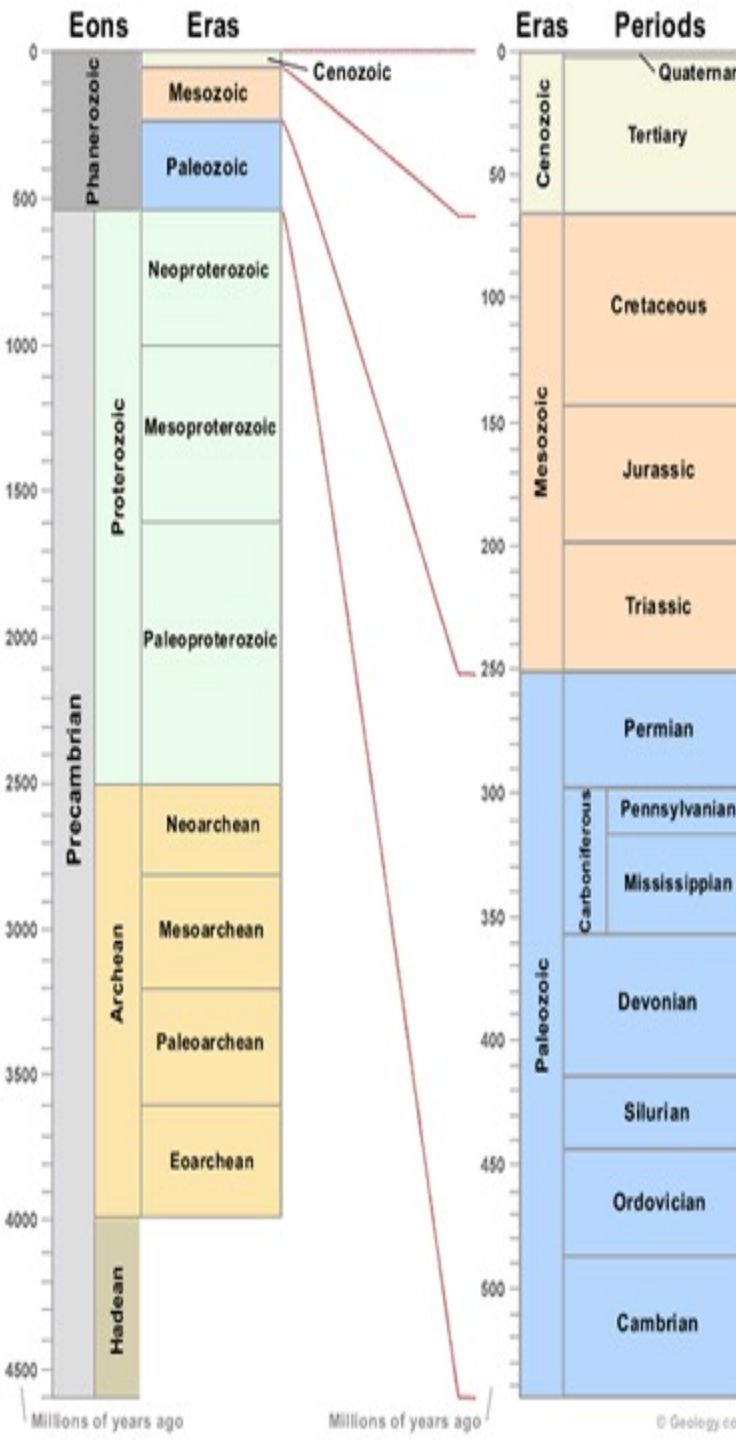
# CHRONOLOGY OF TALK

- PALEOECOLOGY
- PALEOECOLOGY AND WATER QUALITY UNDERSTANDING
- RESULTS: PERCENT ORGANIC MATTER
- RESULTS: DIATOM ASSEMBLAGE TEMPORAL DYNAMICS
- RESULTS: PERCENT ORGANIC MATTER ~ DIATOM COMMUNITY STRUCTURE
- FUTURE QUESTIONS AND STUDIES

# Paleoecology

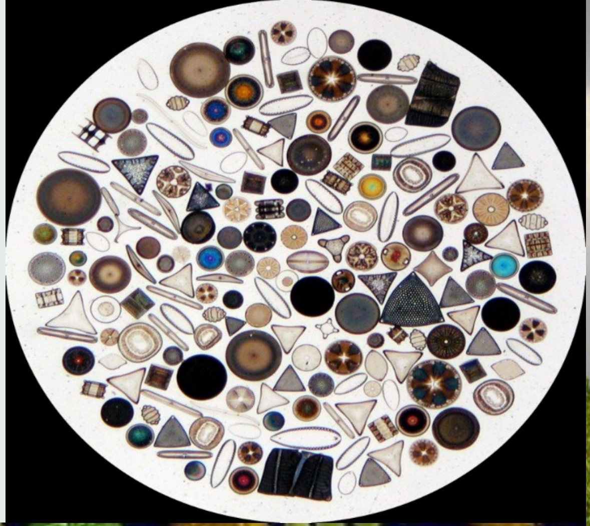
- Using deposited minerals, micro fossils, macro fossils and isotopes paleo ecologists reconstruct past environments and animal and plant communities in order to model the past and give context for future trajectories.
- Taking advantage of the chronological deposition of sediments.
- Use of biological and chemical proxies
- Reconstruct past environments and biological communities.

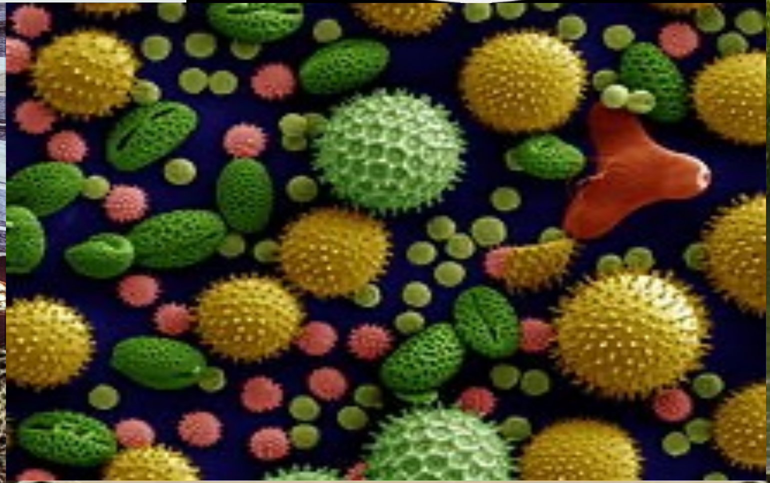
- Lakes as paleo laboratories



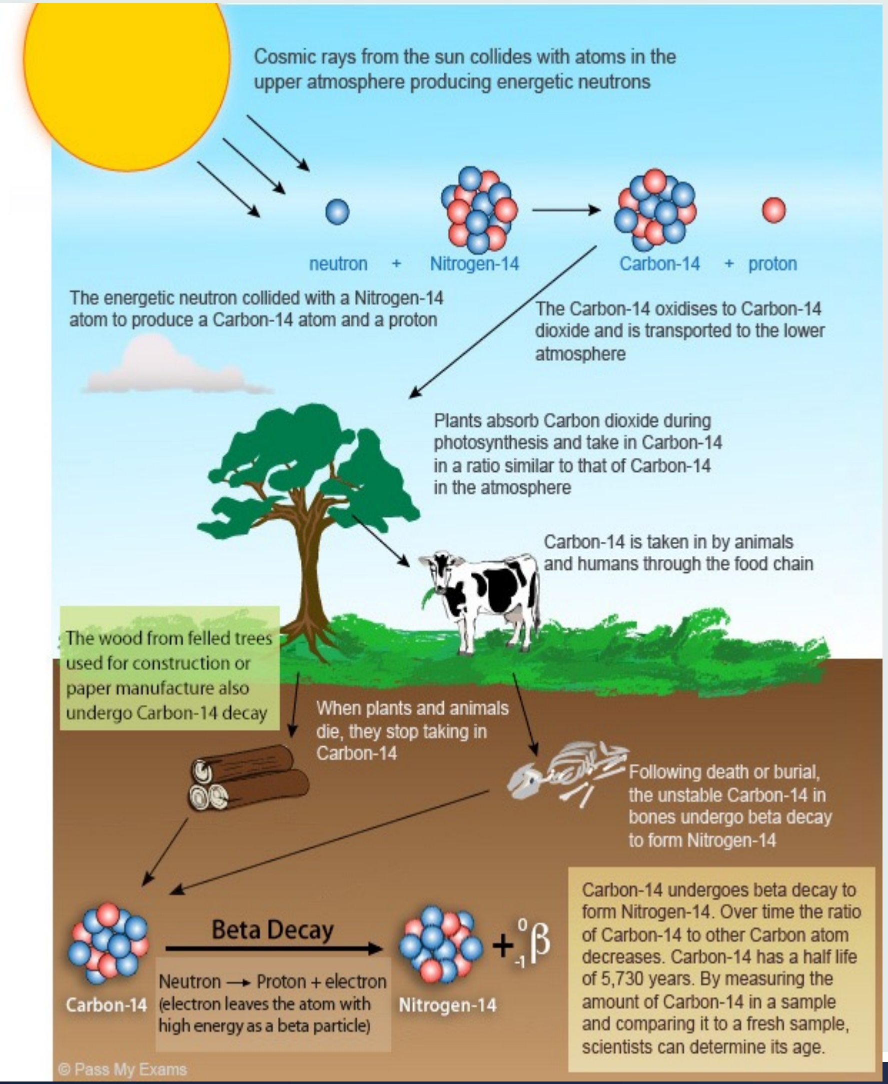
# METHODS IN PALEOECOLOGY

MINERAL ANALYSIS
RADIOACTIVE DECAY ANALYSIS
MICROFOSSIL ANALYSIS





# Radioactive dating  and sedimentation rates




0.039 0.028 0.12 0.016 0.01 cm/yr

Pb

Ce

800mm

200-400 years of data?

# METHOD

- SEDIMENT PROBES (FIND DEEP SEDIMENT)

- RUSSIAN PEAT BORER (TAKES ONE METER SAMPLES)
- TWO CORE SAMPLES

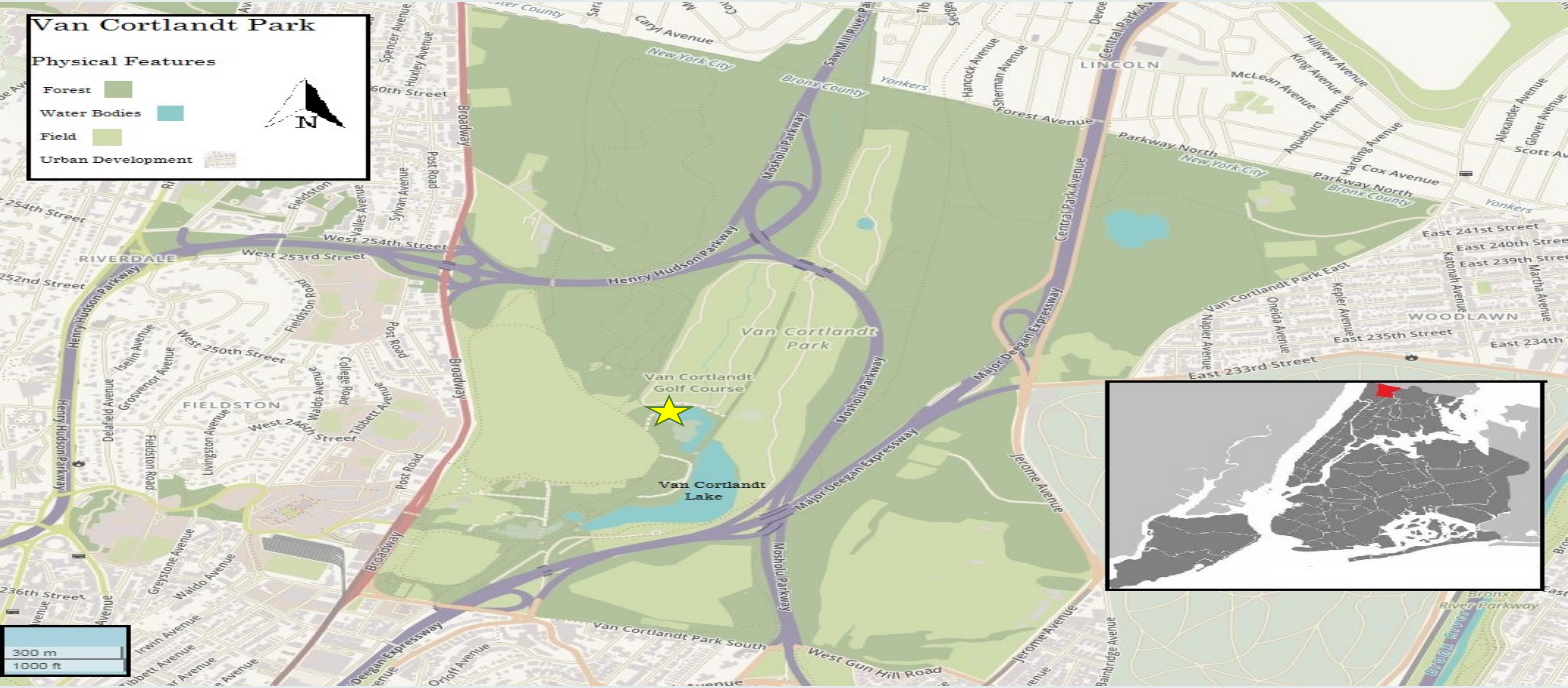
- LOI

- DIATOM ENUMERATION (COUNT 50 VALVES PER SLIDE)

# QUESTIONS?????

- HAS ORGANIC MATTER INCREASED OVER TIME
- HAS THE DIATOM COMMUNITY CHANGED SIGNIFICANTLY OVER TIME
- IS AN INCREASE IN OC CORRESPOND WITH A CHANGE IN DIATOM COMMUNITY
- ARE WE LIVING IN THE MOST DIVERSE ALGAL TIMES IN VAN CORTLANDT PARK
- DO NITCHZEA AND ALEOCHAUSARIA INCREASE OVER TIME

# Map of site



Van Cortlandt Park
Physical Features
Forest
Water Bodies
Field
Urban Development
N
Van Cortlandt Park
Van Cortlandt Golf Course
Van Cortlandt Lake
300 m
1000 ft

# BREIF HISTORY OF LAKE

- Tibbetts Brook was Dammed 1699 for milling purposes (Saw and Grist Mill).
- 2016 FVCP confirm Hypereutrophic status of lake through weekly water monitoring
- 14 acres (Lake), 4miles (Brook)
- Main part of lake dredged
- Historically few to no paleo studies in VCP

# WHY USE CORE DATA

- HISTORICAL INFORMATION
- CONTEXT
- LARGE SCALE DYNAMICS AND COMMUNITY STABILITY
- UNDERSTAND EUTROPHICATION (WHEN AND HOW LONG)
- INFORM PREDICTIVE BASED MODELING

# THE CORE

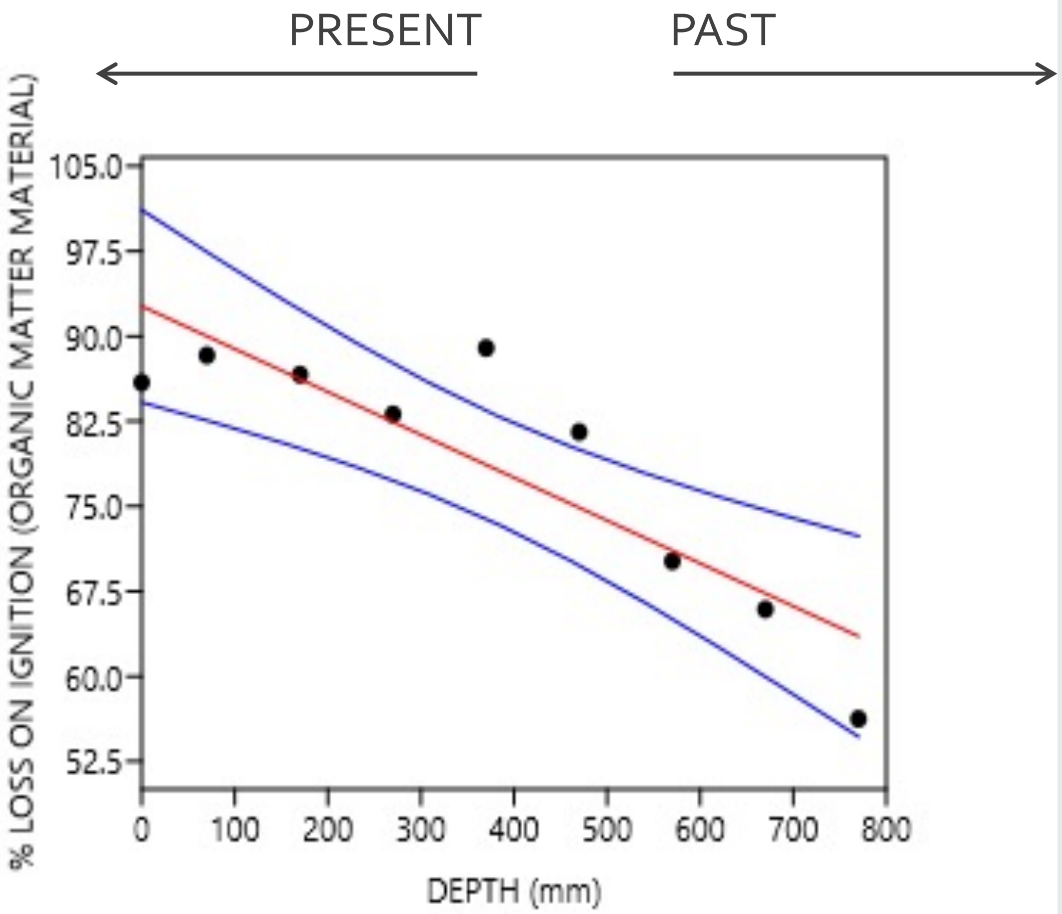
# INITIAL OBSERVATIONS OF PHYSICAL FEATURES

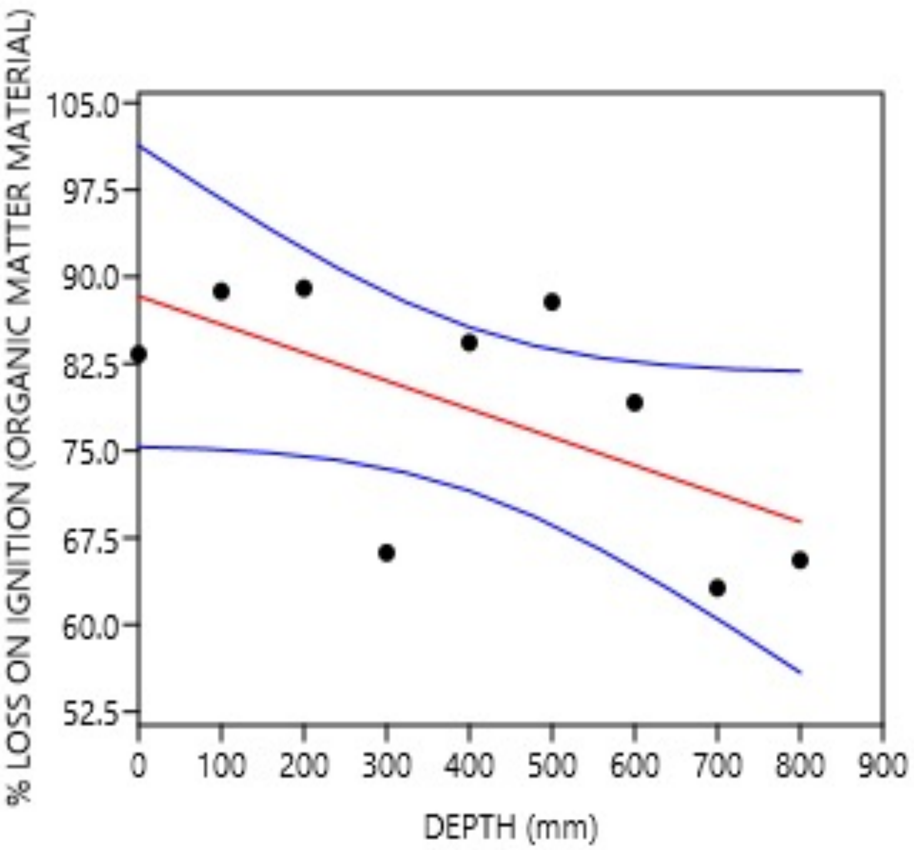
- Clear visual evidence of a material transition at ~60cm
- Darker towards the present indicative of more organic material
- Bands present

# LOSS ON IGNITION

USING HEAT (550) TO COMBUST MATERIAL  RESULTING IN AN ESTIMATE OF ORGANIC MATERIAL

# LOSS ON IGNITION RESULTS CORE 1 &CORE 2



# THE CONSEQUNCES OF INCRESING ORGANIC MATTER

Glacial history brings $CaCO_3$ calcium-magnisuim biocarbonate rich waters

$CaCO_3$ inverse relationship with OC

pH decrease in pore water

>20% organic matter (Dean 1997)

Dissolved OC higher then particulate
Particulate is dominant with some dissolve absorption through clay material

Most carbon comes from autochthanus inputs

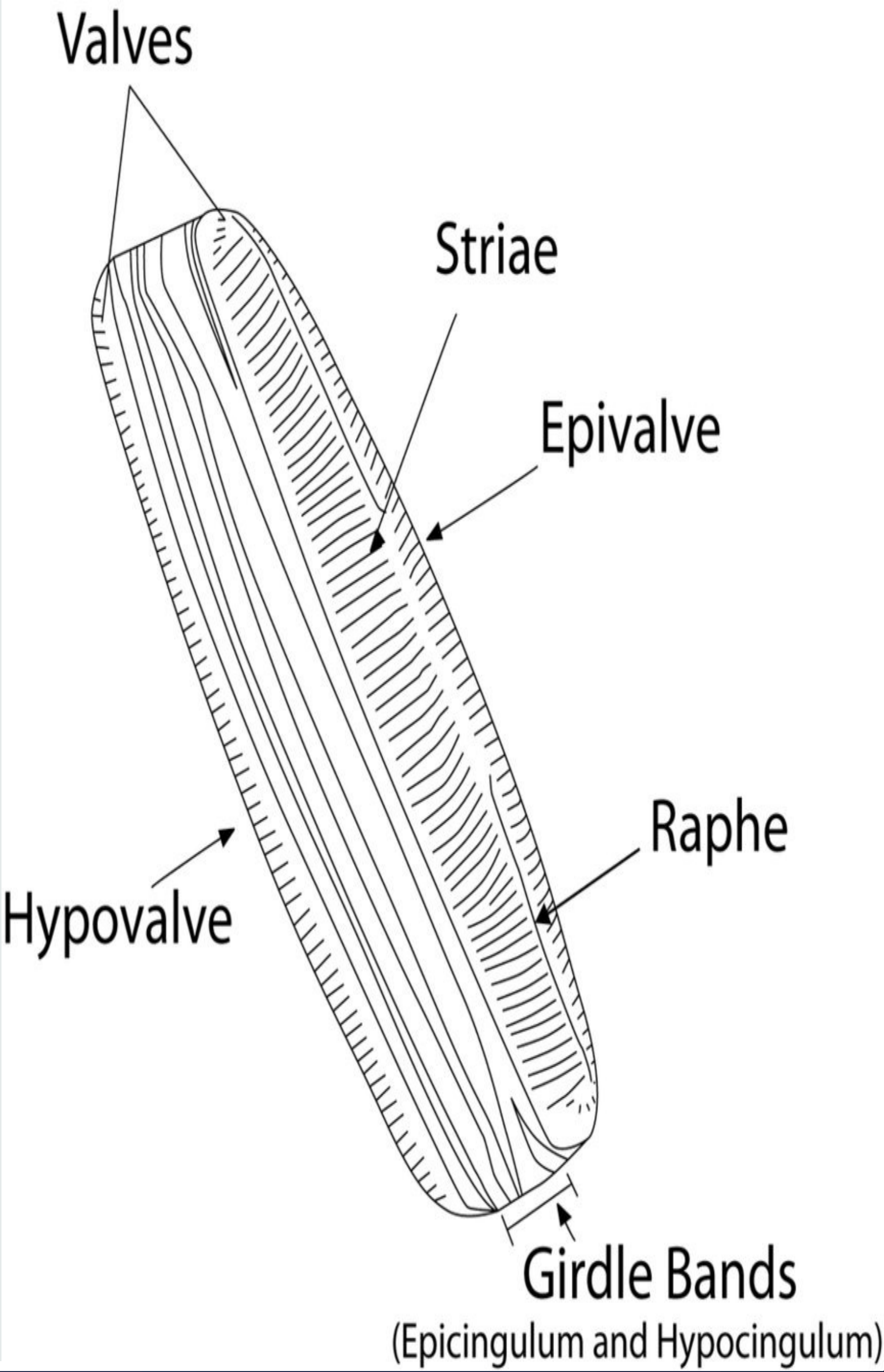
BIOTIC INFLUENCES

CLIMATE INFLUENCES

# DIATOMS

# DIATOMS

- Microscopic unicellular algae
- Flexible morphology based around lines of symmetry
- Oceans, lakes and rivers; marshes, fens and bogs; damp moss and rock faces
- Diatoms ~ account for as much as 20% of global photosynthetic fixation of carbon (Mann 1999)
- The silica of the diatom cell wall is resistant to decay, although it will begin to dissolve once its organic coating has been stripped off. Once incorporated into silica-rich sediments, however, frustules may survive for hundreds to millions of years and can be used to monitor changes in freshwater or marine environments.



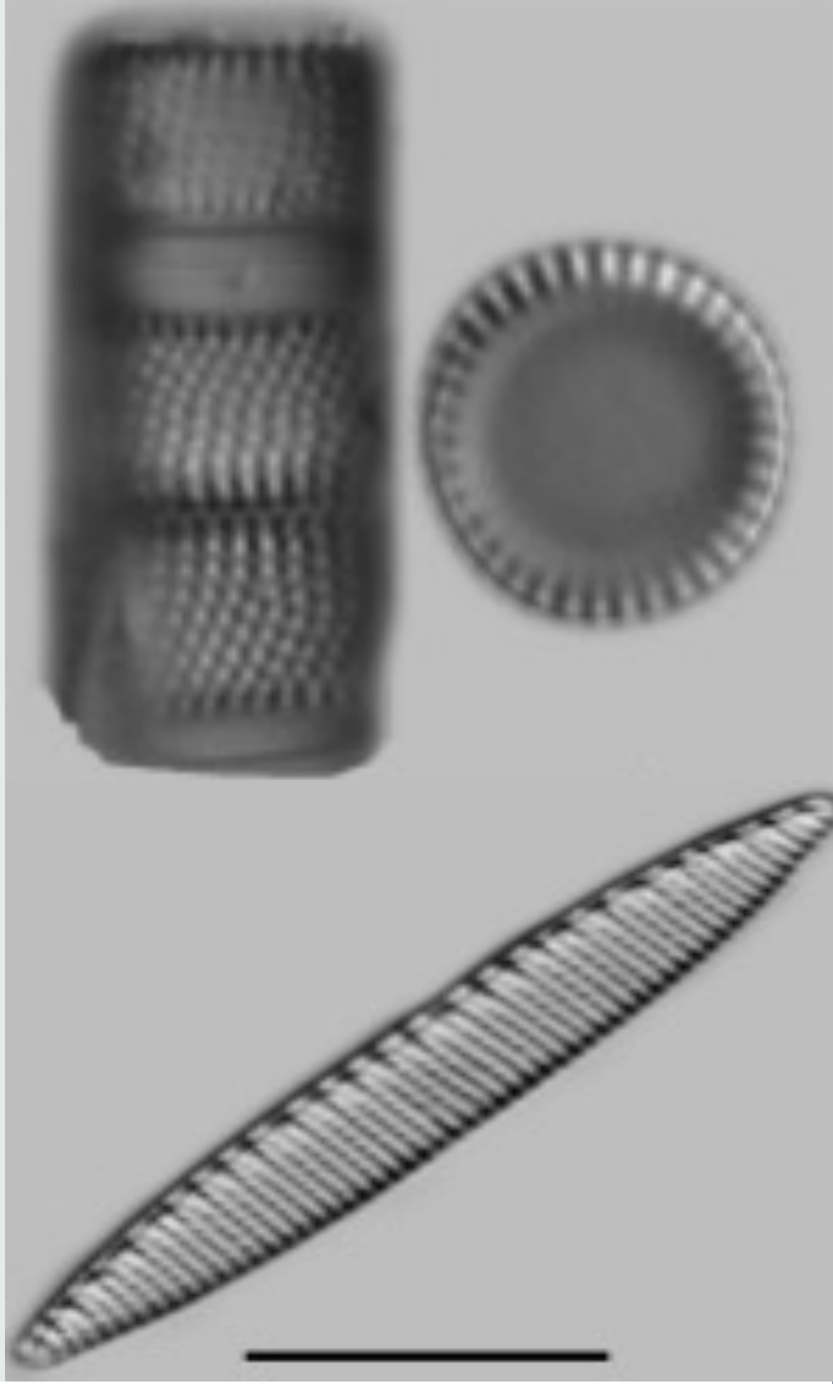
# Diatoms as Indicators of Eutrophication

- *Nitzschia* and *Aulacoseira*

- Low silica high phosphorus conditions  increase *Nitzschia*
- (Stager et al 2009)

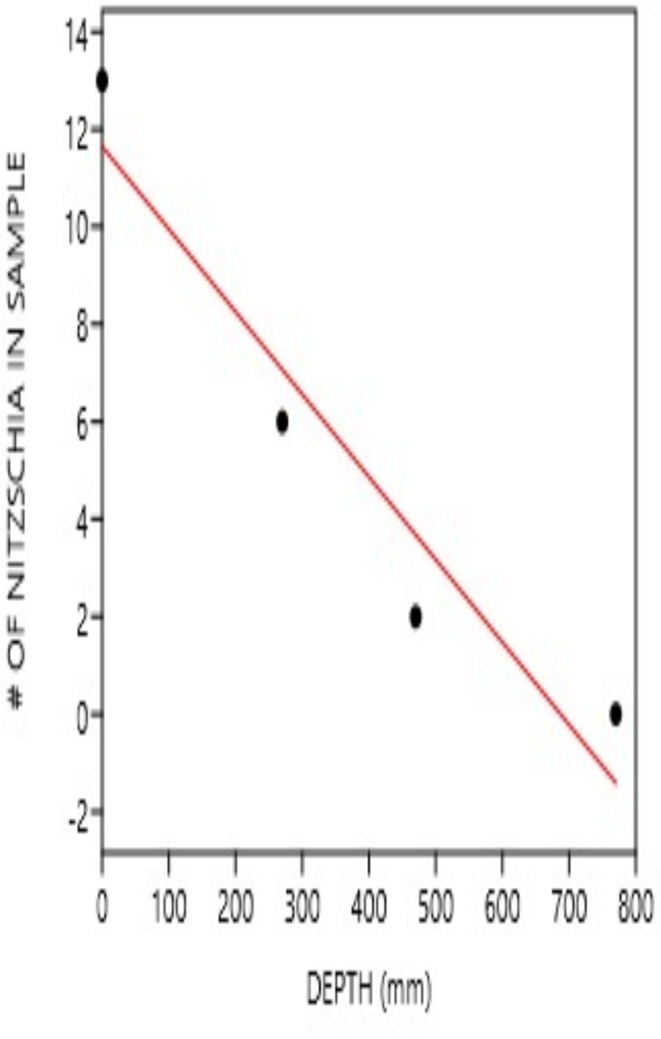
- *Aulacoseira* higher silica requirement

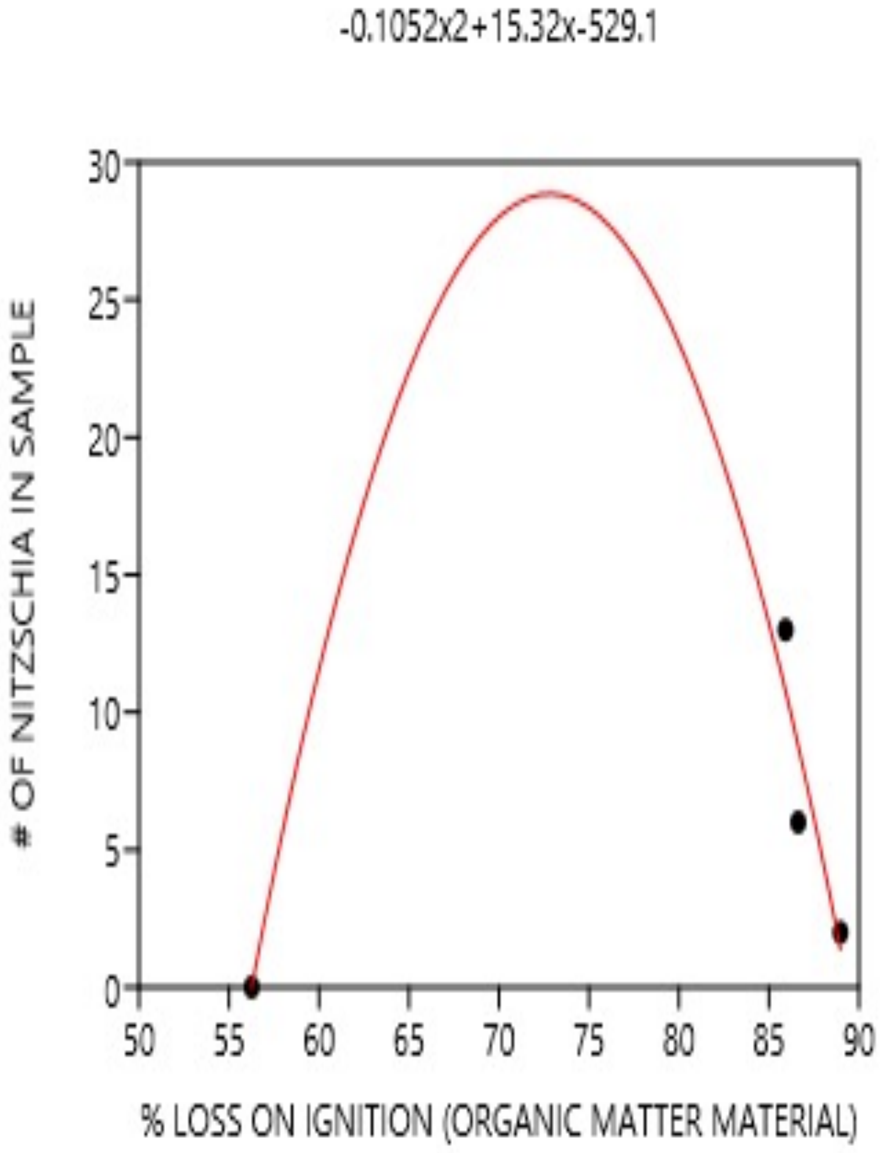
**ARE *NITZSCHIA* MORE ABUNDANT IN PRESENT SEDIMENT?**



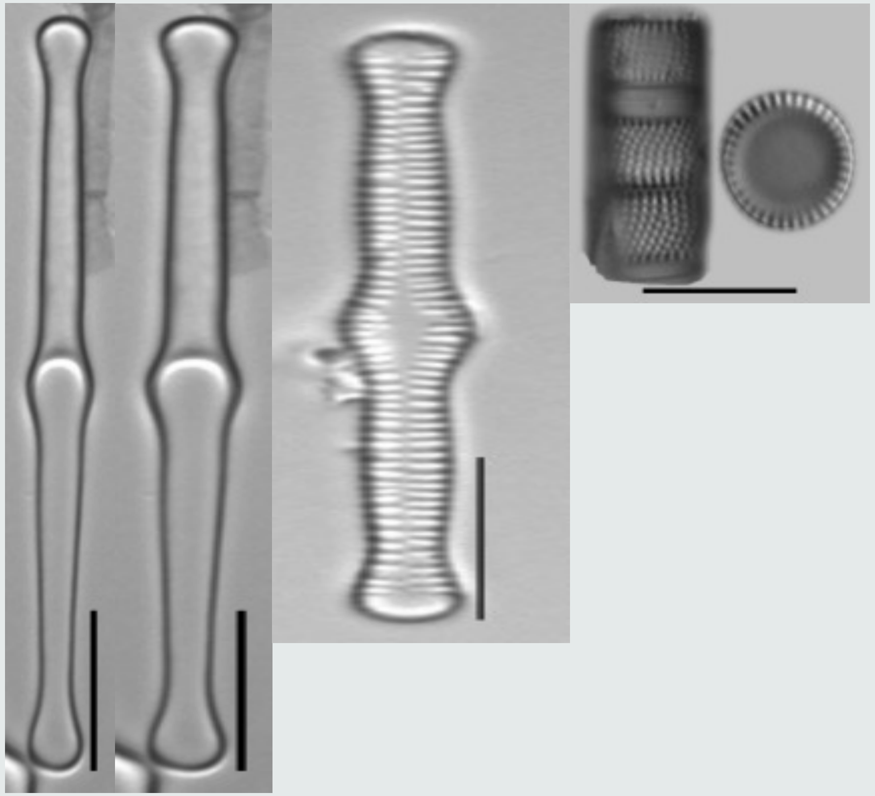
# DIATOM COMMUNITY DIVERSITY THROUGH TIME

# ORGANIC MATTER AND EUTROPHIC DIATOMS

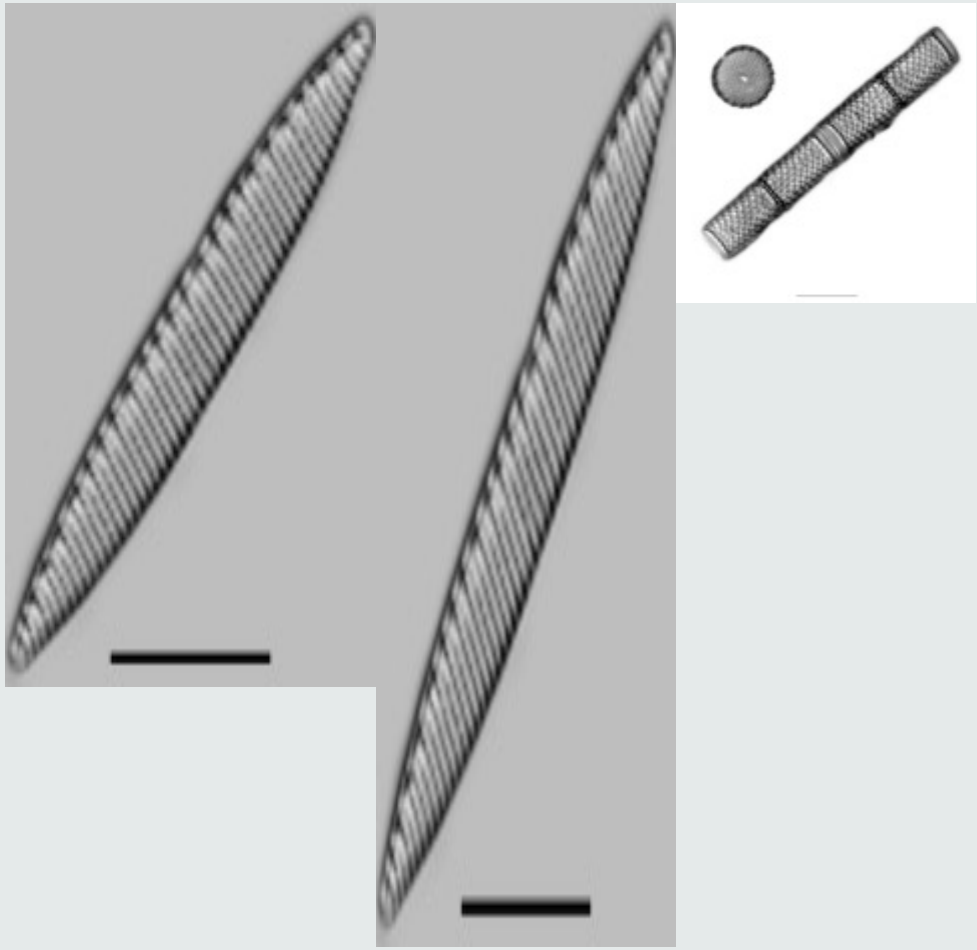


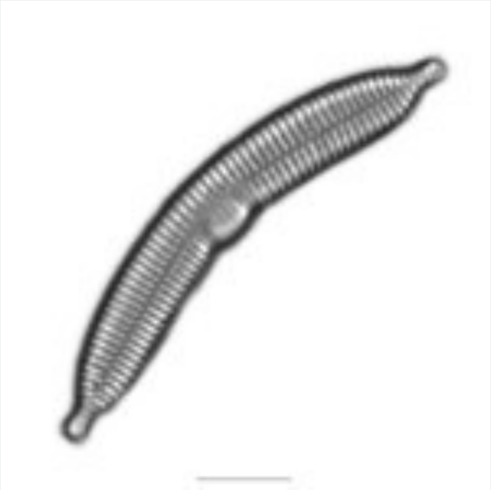



# PAST

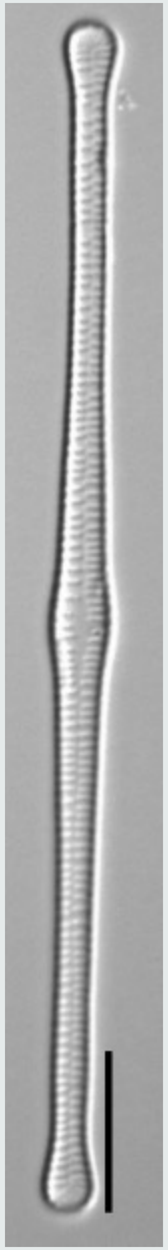


# PRESENT





# OVERALL FINDINGS



- CLEAR VISUAL EVIDENCE OF COLOR CHANGE WITH DEPTH
- LOW REOLUTION ORGANIC MATTER ETIMATES OVER TIME SUGGEST AN INCREASE OF 30% LIKLEY OVER THE LAST 100+ (100cm) YEARS.
- SURFACE LEVEL BENTHOS MATERIAL LOI ~85%
- THIS HAS IMPACTS FOR LOCAL CLIMATE
- DIATOM DENSITY,DIVERSITY, COMMUNITY STRUCTURE AND SIZE IS SIGNIFIGANLTY DIFFERENT.
- ***Nitzschia* and *Aulacoseira* (Indicators of eutrophication) are more abundant in present sediment providing algal evidence for a continual shift toward eutrophication**

# NEXT STEPS

MACROFOSSILS
CARBON DATING
PROBING FOR BETTER SPOT
HIGHER RESOLUTION SUB SAMPLING
USE XRF IN ORDER TO LOOK AT HEAVY METAL CONTAMINATION
PLANT POLLEN

ASSEMBLE A HIGH RESOLUTION DATA SET OF ECOSYSTEM HISTORY

EDUCATION CURRICULUM