

## Insights on the Late-Stage Evolution of Glacial Lake Ojibway

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Meltwater released at the southern margin of the Laurentide ice sheet during the last deglaciation led to the development of Lake Ojibway in NE Ontario and NW Quebec. The late-stage evolution of Lake Ojibway was marked by ice (Cochrane) readvances, while recent mapping of low-elevation lakeshores indicate abrupt drawdowns of Ojibway lake level prior to its final discharge into Hudson Bay ~8200 cal yr BP. Additional late-stage events are also suggested by the presence of thick (10-15 cm) bands of massive silt that truncate Ojibway rhythmites. This silt band is in turn overlain by ~1 m of rhythmites. Although this sequence suggests the occurrence of drainage episode(s), the late-stage history of Lake Ojibway remains inadequately documented. Here we report results from the study of 12 Ojibway sediment sequences that contain the silt band.

Grain-size analyses of bulk Ojibway rhythmites (winter and summer beds) show a textural composition consisting of 73% clay (<2 µm) and 25 % of fine silt (2–8 µm), with the remaining material being composed of medium silt (8–16 µm). This contrasts with the thick silt band that consist primarily of ~54–86% of fine to coarse silt (2–63 µm), with the clay fraction typically representing < 20%. The detrital carbonate content of rhythmites samples shows values ranging from 0.72 to 2.02%, while silt band samples commonly show a slight increase with respect to the bounding rhythmites, going from 1.85 to 3.34%. Ostracods were extracted from specific sediment intervals for oxygen isotope ( $\delta^{18}\text{O}$ ) measurements. Preliminary results indicate that ostracods from the silt band and underlying rhythmites have  $\delta^{18}\text{O}$  values ranging from -23.26 to -25.04 ‰ (vs VPDB), typical of glacial meltwater. In contrast, the rhythmites overlying the silt band show  $\delta^{18}\text{O}$  ranging from 10.03 to 16.62 ‰.

Interpretation of the results is still limited at this stage of the study. Nonetheless, the textural changes reported could be associated with a drainage episode(s) that was followed by a deepwater phase(s). Alternatively, this *drainage varve* (?) could represent a drastic change in the sediment supply (or source) to the lake. This appears to be supported by the increase in detrital carbonate of the silt band. Because the Ojibway basin lies primarily on crystalline bedrock, the presence of detrital carbonate in Ojibway sediments is commonly attributed to the late-glacial dynamics (meltwater runoff or ice readvances) of the decaying ice in Hudson Bay, which is underlain by carbonate rocks. Any explanation for the origin of this silt band and associated compositional changes must also take into account the sharp change in  $\delta^{18}\text{O}$  composition obtained for the sediments overlying the silt band, which shows an evolution towards post-glacial values. Upcoming  $^{14}\text{C}$  ages from the ostracods extracted from the silt bands and bounding rhythmites should also help refining our understanding of these events.

## A surface complexation model for the copper-bacteria-iron oxide system

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Laboratory experiments were performed to track the fate of dissolved Cu and Fe at a fixed pH of 5.2 during the gradual, incremental oxidation of dissolved Fe(II) and precipitation of iron oxide in the presence of *Anoxybacillus flavithermus* cells. The experimental data reveal significant and complex controls on Cu immobilization, related to progressive changes in 1) ratio of Cu to dissolved Fe(II) concentration, inferred to result from competition for bacterial sorption sites; 2) ratio of precipitated iron oxide to bacteria, inferred to result from desorption of Fe(II) initially associated with the bacterial surface; and 3) reaction time, inferred to result from Cu complexation by increasing quantities of biogenic dissolved organic matter. Surface complexation models were developed to describe the experimental data, with constraints on reaction mechanisms provided by polarography and X-ray absorption spectroscopy. Differential pulse polarography demonstrated that Cu complexes form with dissolved organic ligands in filtered bacterial suspensions. The concentration and Cu complexation capacity of these bacterial exudates could be quantified and related to the conditions and history of the suspensions. The bacterial exudates significantly inhibited Cu adsorption onto the bacterial cells but slightly enhanced adsorption onto the iron oxide under the experimental conditions. X-ray absorption spectra were collected at the Cu K-edge on the bacterial exudates and wet pastes of the bacteria, the iron oxide, and the bacteria-iron oxide composites. The EXAFS data suggest that Cu complexation by the bacterial exudates involves binding by carboxyl or phosphate sites. The EXAFS data also show that under the experimental conditions Cu in the solid phase is associated predominantly with carboxyl structures on the bacterial cell walls, not with bacterial phosphoryl structures or with binding sites on the iron oxide. This study demonstrates that the immobilization of metal cations in bacteria-bearing settings should not be examined independently of progressive oxidation, hydrolysis and precipitation of iron.