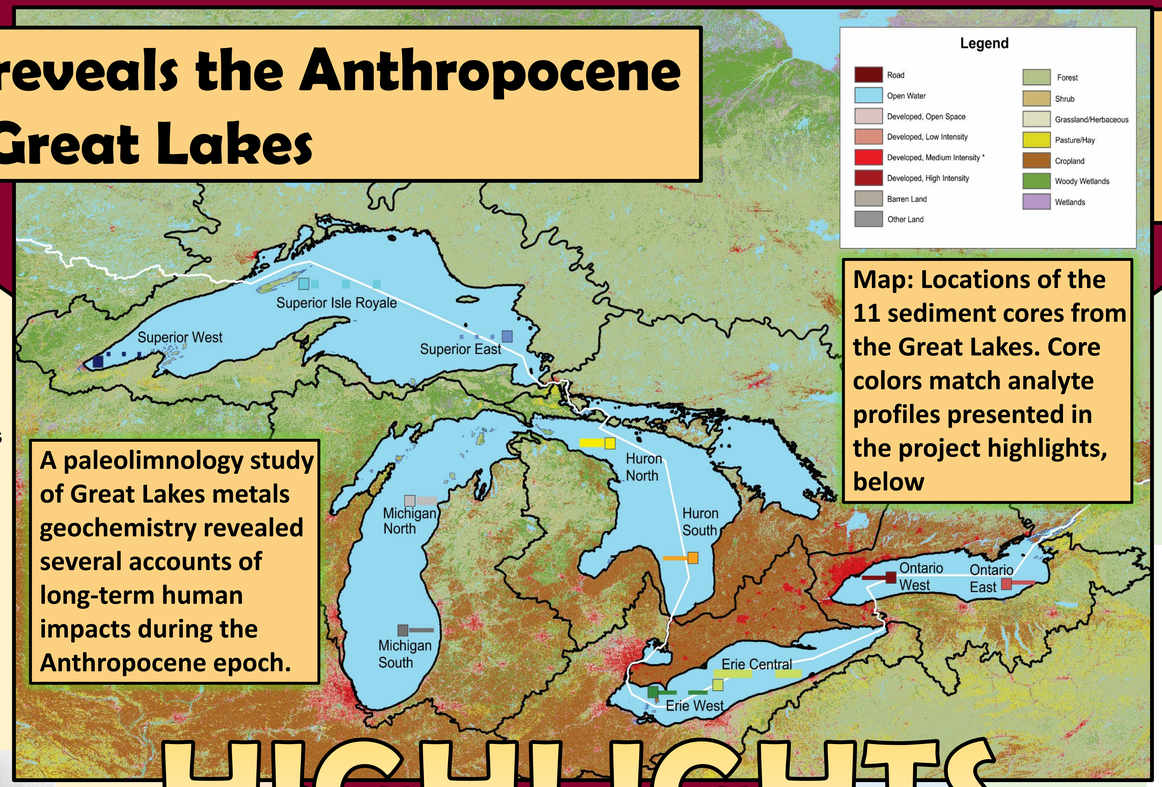
Sediment geochemistry reveals the Anthropocene history of metals in the Great Lakes

Meagan N. Aliff
Euan D. Reavie
Sara Post
Lawrence Zanko

Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover



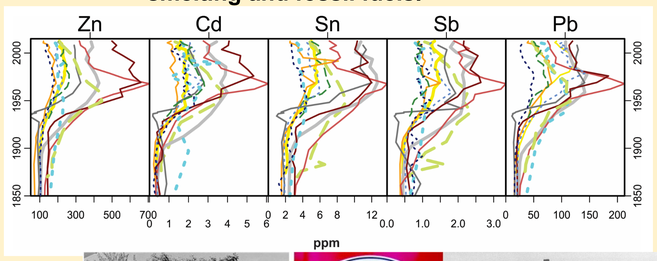
A paleolimnology study of Great Lakes metals geochemistry revealed several accounts of long-term human impacts during the Anthropocene epoch.

Map: Locations of the 11 sediment cores from the Great Lakes. Core colors match analyte profiles presented in the project highlights, below

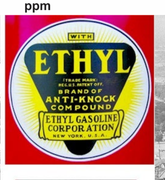
HIGHLIGHTS

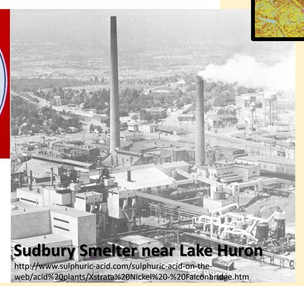
Fossil Fuels

Lead pollution is largely related to combustion of leaded gasoline; clearly this caused a rise in related sediment metals during the 20th century. Since enactment of Pb removal regulations in the 1970s Pb has declined in all of the sediment cores. Cd, Sn, Zn, and Sb follow similar patterns because these pollutants are associated with smelting and fossil fuels.



https://www.mikanet.com/museum/item.php?item=2034

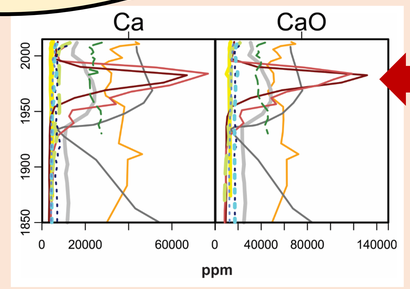




Sudbury Smelter near Lake Huron
http://www.sulphuric-acid.com/sulphuric_acid_on_the_web/acid%20plants/Xstrata%20Nickel%20-%20Falconbridge.htm

Whiting Events

A whiting event on Lake Ontario
https://earthobservatory.nasa.gov/images/81952/whiting-event-lake-ontario



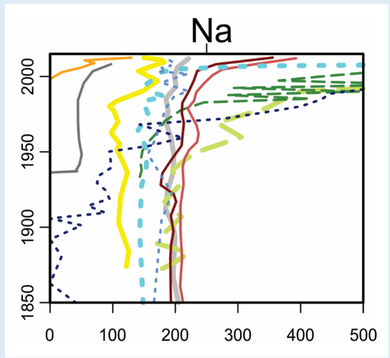
Lake Ontario cores had dramatic calcium profiles (reddish lines, left) noting heavy Ca deposition in the late 20th century.

Fluctuations in Ca compounds are probably related to large "whiting events", calcite precipitation during high primary productivity (algal blooms) during the summer months in the lake. Such observations were common in the 1970s and 1980s.

Salt Pollution

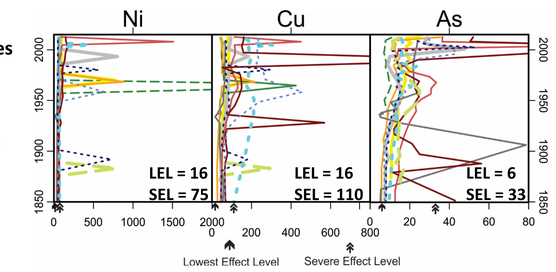
https://www.labmanager.com/news/2018/01/winter-road-salt-and-fertilizers-making-north-american-waterways-saltier

Clearly, salt pollution is a prevailing phenomenon in the Great Lakes. In particular, rock salt used for road deicing has led to increased salinity in lakes near major roadways of urban watersheds. The continuing rise in Na is apparent in all sedimentary profiles.



Sediment contamination guidelines are important for human and environmental health
https://www.marinelink.com/news/hotspots-restored-lakes379947

Metals guidelines based on the tolerances of benthic species.
LEL = marginally polluted
SEL = heavily contaminated



Sediment contamination guidelines help managers assess risk to biota and other water uses. In several cases (e.g. Ni, Cu, As, above) these guidelines were exceeded in the very oldest (pre-impact) sediments suggesting that their appropriateness is questionable. Perhaps "risk" is not always caused by anthropogenic influence!

Contamination Guidelines