Geochemical and hydrological processes controlling the behavior of arsenic in the groundwater-lake transition zone

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The fate of redox sensitive metal(loids) such as arsenic (As) at groundwater-lake interfaces is poorly understood. Groundwater-lake interfaces are characterized by highly dynamic flow patterns and mixing, and shifting redox and pH zones. As such they are hotspots for geochemical reactions. While previous studies have investigated the mobility of As in ocean and river environments, As cycling in nearshore lake environments has received less attention. Rivers, lakes and marine environments have different physical processes driving surface water exchange across the sediment-water interface, and the chemical composition of the recirculating surface water is different (e.g., seawater has high sulfate concentrations and ionic strength). There is a need to understand the behavior of As in lake environments with prior studies showing elevated As concentrations near the groundwater-lake interface (e.g. elevated As (> 20 µg/L) in the groundwater below the shoreline of Lake Erie). If As enrichment near the groundwater-lake interface is a naturally occurring and widespread phenomena it may have broad implications for As cycling in nearshore lake environments. The objective of this research is to provide a clearer understanding of the role of groundwater-lake interactions in controlling the occurrence and behavior of As in nearshore freshwater environments.

This study presents field data collected at seven different beaches on the Laurentine Great Lakes to evaluate the geochemical and hydrological factors controlling the behaviour of As. Elevated dissolved As (up to 60 µg/L) were observed below the sediment water interface 5-20 m offshore at four sites. Data suggest the high As concentrations may be associated with the accumulation of trace concentrations of lake-derived As on Fe oxides that precipitate below the interface.

Study findings are important for understanding the fate of As in nearshore lake environments and evaluating potential risks to water quality and receptors, and developing appropriate remediation actions.