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Using δ\textsuperscript{18}O to track PO\textsubscript{4} entering the Western Basin of Lake Erie

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**Objective:** Develop novel methods of tracking DRP throughout watersheds

- Collaborative study on methods to identify sources of and reduce PO\textsubscript{4} contributing to algal blooms in Lake Erie
- Lake Erie algal blooms are dependent upon river P but which watersheds, rivers, and tributaries are contributing most?

**Stable Isotopes**

- Only one stable isotope of phosphorus (\textsuperscript{32}P), but three stable isotopes of oxygen (\textsuperscript{16}O, \textsuperscript{17}O, \textsuperscript{18}O)
- Strong P-O bond in phosphate molecules make it possible to analyze oxygen isotope ratios to determine phosphate sources in a watershed
- Ratios only change via biological processing

**Field Methods**

- 3 major watersheds: Maumee, Portage, and Sandusky
- 14 sample sites:
  - 3 in the Portage (convergences of major tributaries), 3 at river mouths, 2 within the Western Basin
  - 10 to 20 liters of water per sample
- Lake samples were collected with the help of the George Bullerjaan Lab (BGSU) and the Tom Bridgeman Lab (UT).

**Results and Conclusions**

- 1. δ\textsuperscript{18}O values from samples taken at low/summer flow conditions (July 2016) were more representative of the stream itself.
- 2. δ\textsuperscript{18}O values from samples taken at high flow conditions (April 2017) were more representative of various sources of PO\textsubscript{4} in runoff, producing results more relevant for mixing models.

- This is an indication that phosphates entering the stream during low flow have higher residence time and opportunity for biological processing, as well as the opposite for high flow conditions.

- To make progress towards developing effective methods of decreasing P contributing to the growth of algal blooms, it is necessary to create a better understanding of the origins of this P as well as a method for following it throughout watersheds.

**Lab Methods**

- Samples are filtered and processed using method described in depth in McLaughlin et al. 2004
- Complex procedure consisting of a series of dissolutions and precipitations to produce solid silver phosphate
- 0.6-0.8mg Ag\textsubscript{2}PO\textsubscript{4} weighed into silver capsules to be sent to the DEVIL Lab at Duke university for δ\textsuperscript{18}O analysis

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image.png}
\caption{Diagram showing δ\textsuperscript{18}O of fertilizer samples were significantly higher than those of wastewater effluent and livestock manure.}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image2.png}
\caption{Map showing data points reported here are from a subset of sample locations approximately 2km apart in the Portage River, just upstream of Fostoria. We found evidence of similar spatial patterns among these close-proximity sample sites, δ\textsuperscript{18}O variations are seen near the wastewater treatment facility as well as near a golf course. These variations show an initial spike in δ\textsuperscript{18}O followed by a gradual decrease, probable evidence of biological processing.}
\end{figure}