Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.32361

Understanding Anthropogenic-forcing of Phosphorus Dynamics from Headwaters to Basin Bottom

JOSHUA J. LEMONTE[1], AUSTEN LAMBERT[2], BARRY BICKMORE[1] AND GREG CARLING[1]

[1]Brigham Young University
[2]Stanford University

The global phosphorus cycle significantly influences water quality and ecosystem health. Although the total P in freshwater systems is a small compared to other P pools, lakes, particularly for closed basins, are P accumulation points as P moves “downhill” from geogenic, biogenic, or anthropogenic sources. Thus, even activities near the headwaters can influence P loading in basin-bottom lakes. Phosphorus is a nonrenewable resource essential for all life. Anthropogenic alterations to the P-cycle have led to widespread P pollution, and the unsustainable management of P has led to the threat of global depletion of P resources. One such source of human alteration to the P-cycle is phosphate rock mining. This work combines an effort to quantify the extent of P enrichment near the headwaters of the Uinta Mountains in Utah, USA, with systematic quantification of P loading and partitioning in the basin-bottom Utah Lake, a large alkaline eutrophic freshwater lake. The combined geospatial and geochemical approach of this study shows that surface soil P concentrations were found to be enriched above naturally occurring levels up to 6.5 km from mining activity (enrichment factor (EF) > 1.5), with the most significant enrichment occurring within the first 3 km (EF > 2). Sorption experiments conducted with sediment from across Utah Lake reveal that as pH increases the favorability of P-sorption also increases, while the maximum number of available P-binding sites decreases. This approach seeks to highlight the interconnected nature of elemental dynamics within a catchment.