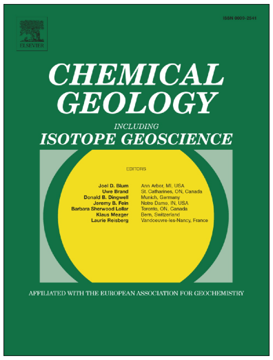

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A.H. Mine, A. Waldeck, G. Olack, M.E. Hoerner, S. Alex, A.S. Colman

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Microprecipitation and $\delta^{18}O$ analysis of phosphate for paleoclimate and biogeochemistry research

Mine, A.H., Waldeck, A., Olack, G., Hoerner, M.E., Alex, S.,and Colman, A.S.

Abstract

Phosphate oxygen isotope ratios provide a powerful tool for paleoclimate reconstruction and the study of phosphorus biogeochemistry in aquatic systems. The temperature dependent offset between the oxygen isotope composition of phosphate and water in biogenic minerals and in solutions has been used extensively in paleoclimate research and the study of phosphorus cycling in aquatic and soil environments. Sample sizes are small in many applications, e.g., serial sampling of mammalian tooth enamel for paleoseasonality studies, the use of conodont elements for climate and ocean $\delta^{18}O$ reconstruction, or the isolation and analysis of dissolved phosphate from marine and freshwater environments in biogeochemistry studies. This has pushed the development of techniques that allow for processing and analysis of a few micromoles of phosphate.

Current approaches to phosphate oxygen isotopic composition ($\delta^{18}O_p$) determination require purification of phosphate as silver phosphate (Ag_3PO_4). The techniques for the final precipitation of Ag_3PO_4 fall into two categories: slow vs. rapid microprecipitations. We have tested both and identify artifacts that impact measured $\delta^{18}O_p$ values resulting from commonly used methods for rapid Ag_3PO_4 precipitation. In particular, commonly used methods are prone to (a) incomplete precipitation of phosphate, with associated isotopic fractionation, and (b) the production of silver oxide contaminants whose oxygen isotope composition is sensitive to the $\delta^{18}O$ of water used to prepare the precipitation reagent solution. These artifacts are commonly