

# **A record of reduced phosphorus across a Paleoarchean impact event: Implications for phosphorus bioavailability on the early Earth**

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Phosphate limits biological productivity in large parts of the modern ocean [1]; however, whether or not phosphate was bio-limiting on the early Earth is unresolved [2,3]. In particular, frequent impact events may have temporarily increased the supply of bioavailable phosphorus [4]. Furthermore, impacts could have delivered reduced forms of phosphorus, such as phosphite, that are highly soluble in liquid water [5]. To test this hypothesis, we investigated samples across the S2-impact spherule bed in the Mendon Formation of the upper Onverwacht Group and from the Mapepe Formation of the Fig Tree Group the Barberton Greenstone Belt in South Africa (3.26 Ga), where recent work documented an increase in the total phosphorus reservoir in the aftermath of the impact event [4]. We applied an EDTA-NaOH leaching technique to bulk rock powders and analysed the extracts by coupled ion chromatography and inductively-coupled mass spectrometry (IC-ICPMS) to separate phosphate (P(V)), pyrophosphate (PP(V)), phosphite (P(III)) and hypophosphite (P(I)) [6]. Our results reveal that a small fraction of phosphite is present throughout the section, including in the lead-up to the spherule bed, but the total phosphite abundance and phosphite/phosphate ratio increases above the impact spherules. Our data have two important implications: First, they suggest that phosphite was a constituent of Archean seawater, possibly independently from meteorite impacts. This background level of phosphite may have been generated by metamorphic and/or biological processes. Second, impacts likely enhanced the supply of phosphite to the surface ocean, either by dissolution of the bolide itself or by enhancing phosphite upwelling from the deep ocean. Reduced phosphorus may thus have contributed to the sustenance of the early biosphere.

## **References:**

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