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Did iron-oxidizing chemolithotrophic bacteria play a role in the formation of early phosphorites?

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The oxygenation of Earth's atmosphere allowed for the diversification of metabolisms to include the use of oxygen and its derivatives as terminal electron acceptors, as in the chemolithotrophic oxidation of sulfide or ferrous iron. A growing number of oxygen-utilizing chemolithotrophs are being found to accumulate intracellular polyphosphate as an energy reserve that allows them to adapt to fluctuating redox conditions in their distinctive gradient habitats. Polyphosphate metabolism by chemolithotrophic bacteria is also thought to play an important role in the formation of phosphatic mineral deposits. Polyphosphate accumulation was recently discovered in marine twisted-stalk-forming iron bacteria. Here we present fossil evidence of iron-oxidizing bacteria preserved as filamentous iron oxides within phosphatic Paleoproterozoic stromatolites. The filaments include twisted stalks similar to those produced by modern iron-oxidizing bacteria, including those that accumulate polyphosphate. The association of fossil iron-oxidizing bacteria with some of the oldest known phosphorites might be explained by the ancient utilization of polyphosphate by chemolithotrophs in a world with burgeoning oxygen-Fe(II) gradients, providing evidence for a potential connection between Earth's oxygenation, polyphosphate metabolism, and the onset of phosphogenesis.