Phosphorus (P) is a critical element for biochemical systems. The bulk geochemistry of this element is limited today to inert and insoluble orthophosphate (PO\(_4^{3-}\)). However, P geochemistry on the early Earth may have been strongly influenced by impact-delivered extraterrestrial material. Extraterrestrial material delivered on the order of 10\(^8\) kg of reduced P minerals to the surface of the Earth per year during the late heavy bombardment ~3.9 Ga. Reduced P minerals like schreibersite, (Fe,Ni)\(_3\)P, were oxidized by water on the surface of the Earth, releasing phosphite (HPO\(_3^{2-}\)), pyrophosphate (P\(_2\)O\(_7^{4-}\)), and hypophosphate (P\(_2\)O\(_6^{5+}\)), among others (Pasek and Lauretta 2005). Additionally, phosphite radicals produced during the oxidation are capable of phosphorylating organics (Pasek et al. 2007). Furthermore, some bacteria (~1% of all bacteria species) are capable of metabolizing reduced P compounds (White and Metcalf 2004). Given the paucity of reduced P in the environment today, this ability may reflect the P chemistry of the early Earth. These clues and others highlight the relevance of reduced P to early Earth geochemistry.

Here I present the results of several experiments that demonstrate that reduced phosphorus as phosphite forms pyrophosphate and triphosphate at room temperature under simple conditions (5-10% yield). I also present the results of a series of stability experiments that estimate the longevity of hypophosphate to determine the utility of this compound as a geologic marker for the presence of reduced P. These results are placed in the context of early Earth models.