Analysis of the oxygen isotope composition of phosphate adsorbed onto Mars-analog clay minerals

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The phosphate shown to be abundant on Mars may contain isotopic signatures consistent with biological activity. Phosphate is heavily biologically cycled on Earth and is a compound found in metabolic and life-sustaining structures such as DNA, phospholipid membranes, and ATP. The isotopic composition of oxygen in phosphate molecules cycled through biotic processes have distinct isotope signatures (^{18}O:^{16}O expressed as $\delta^{18}O_P$) compared to abiotically cycled phosphate which is typically less enriched in ^{18}O. The presence of biological activity may be evidenced by $d^{18}Op$ values under two potential scenarios: (1) when the O isotopes in phosphate exchange and re-equilibrate with surrounding water through biological processing; and (2) when a shift in $\delta^{18}O_P$ values of >>1-2 permil occurs from the abiotic baseline established by oxygen isotope compositions of igneous phosphate minerals (*e.g.,* merrillite and apatite).

In this study, we will examine the oxygen isotope composition of phosphate that is adsorbed onto Mars-analog clay minerals. Previous work under abiotic conditions show that phosphate adsorbed onto iron oxide minerals can vary over time as an result of iron oxide recrystallization. Shifts in $d^{18}Op$ form an abiotic baseline may indicate whether Mars returned samples have been impacted by biologic activity. We have conducted phosphate adsorption experiments using Mars-analog clay minerals. Initial batch experiments have been performed using a 78 mM phosphate solution with 10 g/L of clay mineral (nontronite, Fe-rich allophane, and Fe-saponite) at a pH of 10. Depending on the type of clay mineral, results show up ~30% of our phosphate adsorbed over 40 hours of experimental reaction. To increase the amount of adsorbed phosphate we have performed pH_{pznpc} (point of zero net proton charge) on some of our clay minerals. Additional experiments have been set up under acidic to near-neutral pH and 30 mM phosphate. The new experiments will then be analyzed to understand the oxygen isotope ratio of the adsorbed and unadsorbed phosphate.