

**EVIDENCE FOR ABUNDANT PHOSPHATE MOBILITY IN POTENTIALLY HABITABLE EARLY ENVIRONMENTS ON MARS.** E. M. Hausrath<sup>1</sup>, C. L. Bartlett<sup>1</sup>, and C.T. Adcock<sup>1</sup> University of Nevada, Las Vegas, Department of Geoscience, Las Vegas, NV 89154-4010 [Elisabeth.Hausrath@unlv.edu](mailto:Elisabeth.Hausrath@unlv.edu).

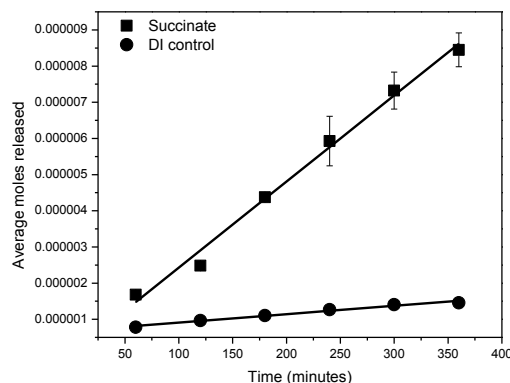
**Introduction:** Phosphate is a critical nutrient on Earth, present in ATP, DNA, RNA and phospholipid membranes [1]. The presence of phosphorus may also be critical to potential prebiotic chemistry, either as phosphate [2] or a more reduced form such as phosphite [3]. However, the predominant phosphorus-containing minerals in martian meteorites, and therefore presumably also on Mars, merrillite and Cl-bearing apatite [4], are different from the predominant phosphorus-bearing minerals on Earth. Therefore, in order to understand phosphorus availability on Mars, we need to understand phosphate release from Mars-relevant minerals.

We have previously measured phosphate release from the Mars-relevant minerals merrillite and chlorapatite under abiotic, inorganic conditions [5], as well as from potentially important amorphous phosphates [6]. However, the environments in which phosphate release would have been most relevant to early martian habitability likely did not contain solely abiotic, inorganic solutions and phosphate mineral surfaces. Instead, early martian environments likely contained abundant organic matter delivered by carbonaceous chondrites and interplanetary dust particles [7]. We are therefore measuring dissolution of Mars-relevant phosphate minerals in the presence of relevant prebiotic organic compounds.

**Methods:** High purity chlorapatite and merrillite were synthesized and prepared as previously described [5, 8]. Acid-washed batch reactors were filled with an appropriate aliquot of mineral and solution containing the organic-containing or inorganic solution to be tested. Organic compounds were chosen based on the composition of interplanetary organic compounds [9], as well as organic degradation products likely present on the martian surface [10]. After termination of the experiments, solution samples were filtered (0.45  $\mu\text{m}$  filter), acidified, and measured for cation concentrations by Atomic Absorption Spectroscopy (AAS) and phosphate concentrations by Ultraviolet-Visible Spectroscopy (UV-VIS).

**Results and Discussion:** Our previously published results indicate that the dissolution rates of the Mars-relevant minerals chlorapatite and merrillite are significantly faster than the dominant terrestrial igneous phosphate-containing mineral fluorapatite [5]. These results suggest that the phosphate concentrations of early martian environments may have been more than twice those of Earth, with P release from water-rock interactions on Mars potentially >45x higher than on

Earth [5]. Our ongoing dissolution experiments in the presence of organic compounds relevant to early Mars suggest enhanced release in the presence of at least some organic compounds (Figure 1). Phosphate availability may therefore be significant in potentially habitable early environments on Mars.



**Figure 1.** Moles released (average of duplicates) from merrillite in the presence of succinate-containing solution, or the control containing deionized water at the same pH.

**Conclusions:** Phosphate release from the Mars-relevant minerals merrillite and chlorapatite is higher than from the dominant igneous phosphate-bearing terrestrial mineral fluorapatite in abiotic inorganic solutions [5]. In addition, ongoing experiments indicate enhanced release in the presence of at least some important prebiotic organic compounds may be higher than in inorganic solutions, suggesting abundant phosphate release in potentially habitable early martian environments.

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