The Prebiotic Geochemical Provenance of Semi-Aqueous Solvents

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Overcoming the "Phosphate Problem"

Phosphorus (P) is a cardinal factor in the formation of life. Abundant prebiotic P minerals not soluble in water [1]. Previous approaches to phosphorylation have been to use high temperatures [2], soluble/reactive P [3], and nonaqueous solvents [4]. We studied solvent mixture of urea (U), ammonium formate (AF) and water (UAFW) as it has been previously shown to aid in phosphorylation of adenosine [5].

Discussion of Results

In studying various ratios of the UAFW solvent we determined the liquid stability of the system is central to liberating P from hydroxylapatite. We found when AF exceeds the mole fraction of U (and water is not greater than 75%) then not only will the mixture remain a liquid, but a large percent of the P is liberated from hxdroylapatite. Thus, a potential avenue in overcoming the phosphorus "water problem" is presented through the UAFW system.

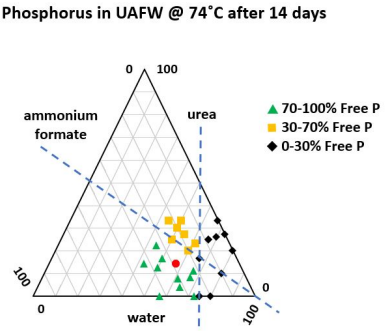

Fig. 1. The solubility of hydroxylapatite within the UAFW at varying mole percentages. Blue dashed lines depict the condition requirements for optimal yield. Red diamond indicates 1:2:4 molar ratio of UAFW

[1] Hazen (2013) Am. J. Sci.313, 807-843. [2] Ponnamperuma & Mack (1965) Science148,1221-1223. [3] Gibard et al. (2018) Nat. Chem10, 212-217. [4] Schoffstall (1976) Orig. Life7, 399-412. [5] Burcar et al. (2016) Angew. Chemie55, 13249–13253