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Exploring the phosphorus content of the pre-4 Ga terrestrial crust

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The unique chemical characteristics of phosphorus (P), including its structure and geochemical abundance, make it well-suited as a critical nutrient for life [1, 2]. Phosphorus is necessary to form organisms' DNA/RNA and other internal supporting structures. While there are many origins of life models and no community consensus, one thing remains true: phosphorus would have been required since it is an essential element for life on Earth. Phosphorus availability on early Earth needs to be better established. Our minimal understanding of the endogenous cycling of P leads to an incomplete and fragmented picture of P cycling in the early Earth. We focus on characterizing the P content of the pre-4 Ga crust. We seek to address this by conducting temperature-dependent (P) partitioning experiments to derive partition coefficients between zircon and silicate (granitic) melt using an end-loaded piston-cylinder apparatus. Hydrous felsic melts in the SiO_2-Al_2O_3-Na_2O-K_2O-CaO-ZrO_2-P_2O_5-H_2O (Melt 1 and Melt 2) and SiO_2-Al_2O_3-Na_2O-K_2O-CaO-ZrO_2-P_2O_5-CaF_2-H_2O (Melt 3 and Melt 4) systems were chosen for this objective. Four distinct melt compositions with ASI values of 0.8 and 1.2 were prepared, including one P undersaturated peraluminous melt (Melt 1), one P undersaturated metaluminous melt (Melt 2), one P saturated peraluminous melt (Xenotime saturated; Melt 3) and one P saturated metaluminous melt (Fluorapatite and Xenotime saturated; Melt 4) to represent a range of crustal melt compositions. The H_2O content was fixed at ~ 10wt.% for all melt compositions for consistency. Experiments were conducted from 1300°C to 950°C at 1GPa. The concentration of P in zircon and melt was measured using an LA-ICPMS. Partition coefficients (D_P) were determined for each experiment. The experiments investigate potential [P] in ancient terrestrial melts that might have significant implications for the origin of life studies.

[1] Butusov, M., Jernelöv, A., Butusov, M. and Jernelöv, A., 2013. The Role of Phosphorus in the Origin of Life and in Evolution. *Phosphorus: An Element that could have been called Lucifer*, pp.1-12.

[2] Lang, C., Lago, J. and Pasek, M.A., 2018. Phosphorylation on the Early Earth. In Handbook of Astrobiology (pp. 361-369). CRC Press Florida.