SYNTHESIS AND CORROSION OF SCHREIBERSITE AND POSSIBLE IMPLICATIONS FOR ORIGIN OF LIFE.

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Abstract: We present the synthesis of an analog of the meteoritic mineral schreibersite with formula $(Fe,Ni)_3P$, believed to be a prebiotic source of reactive phosphorus which led to the origin of life (Pasek and Lauretta, 2005). The mineral was synthesized by mixing stoichiometric proportions of iron, nickel and phosphorus and heating in a tube furnace at 820°C for approximately 235 hours in an argon atmosphere, a modification of the method of Skála and Drábek (2002). The mineral was characterized using x-ray diffractometry, x-ray photoelectron spectroscopy, micro-raman spectroscopy and electron microprobe analysis (Pirim et al., 2014). Characterization indicates that both schreibersite, with approximate formula Fe_2NiP and the mineral, nickel phosphide $FeNi_2P$ were synthesized.

We also present the results of corrosion experiments of the synthesized mineral in prebiotically relevant solutions: seawater and sulfidic water, in both air and argon. After corrosion, the solutions were analyzed using P-31 NMR spectroscopy and high performance liquid chromatography attached to an inductively coupled plasma mass spectrometer (HPLC-ICP-MS) to determine phosphorus speciation as well as concentrations of phosphorus present in solution (Pasek et. al., 2013). As expected from previous studies, the NMR and HPLC-ICP-MS results indicated the presence of orthophosphate, phosphite, pyrophosphate and hypophosphate in the corrosion solutions (Pasek and Lauretta, 2005). The HPLC-ICP-MS results indicate that the extent of corrosion of the mineral, measured by the concentration of phosphorus released, depends on the ionic strength of the solution, as well as the presence or absence of the chelating agent.

Finally, we report the successful phosphorylation of prebiotic molecules, such as choline, using synthesized schreibersite (Gull et. al., 2014).

References:

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