Energy Requirements for Abiotic Production of Phosphorous Compounds at the Ice-Schreibersite Interface

The Abbott-Lyon Lab is investigating the chemistry at the interface of simple ices and a meteoritic mineral analogue. Phosphorous is a key component of numerous biomolecules necessary for life. Lack of an abundance of biologically accessible mineral sources of phosphates on Earth, termed "The Phosphorous Problem," has led some origin-of-life scientists to look to extraterrestrial sources like meteoritic metal phosphides as possible sources of available phosphates. Schreibersite (Fe_2NiP) is a common mineral in iron meteorites and a plausible source of biologically accessible phosphorous. This study will measure how much energy is needed to form prebiotic phosphorous compounds at the ice-schreibersite interface. We will observe the reactions of water and methanol ices under controlled thermal radiation and electron irradiation in ultrahigh vacuum (UHV) conditions to model what an asteroid or meteor would experience in space. A UHV apparatus equipped with an electron gun and quadrupole mass spectrometer (QMS) coupled with reflection-absorption spectroscopy (RAIRS) will be used to measure changes in the surface of the schreibersite analogue and the species desorbing from it. The purpose of our research is to determine the potential inventory of phosphorous compounds that could have been delivered to the early Earth and to collect reference spectra that will be useful in interpreting data from current and future NASA space missions such as OSIRIS-Rex.