Prospects for P-bearing Molecules in Cometary Atmospheres

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Phosphorus is a key element in all known forms of life and phosphorus-bearing compounds have been observed in space (e.g., [1-4]). Phosphorus is ubiquitous in meteorites, albeit in small quantities, with phosphates being found in stoney meteorites and phosphides have been identified in iron meteorites. It has been detected as part of the dust component in comet Halley [5] but searches for P-bearing species in the gas phase in comets have been unsuccessful [6]. Based of its moderate cosmic abundance (eighteenth most abundant element, [P]/[N] = 4 x 10^{-3}) and the positive identification of P-bearing species in the interstellar medium (such as, PN, PC, HCP and PO), we would expect simple molecules, diatomics (like PH, PO, PC, PS), triatomics (like HCP and PH_2), and possibly other polyatomics (like phosphine PH_3 and diphosphine P_2H_4), to exist in cometary ices, hence released into the gas phase upon ice sublimation.

We will present results from the first quantitative study of phosphorus-bearing molecules in comets using our fluid dynamics model with chemistry of cometary comae [7] to identify likely species containing P to aid in future searches for this important element in comets, possibly shedding light on issues of comet formation (time and place) and matters of the prebiotic to biotic evolution of life.

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