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# EAPS Planetary Lunch Colloquium Series (PICS)

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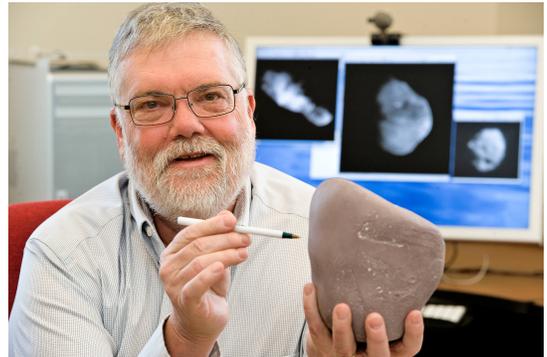
Tuesday, October 2<sup>nd</sup>  
12:30pm  
54-517

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## Impact Chemistry and the Origin of Life

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Most discussions of global environmental effects of large impacts focus on changes deleterious to extant life. However, impacts may also produce changes that enhance or even create conditions beneficial to the origin of life. Many other authors have discussed impact delivery of organic molecules, and some have shown the shock synthesis of prebiotic molecules such as amino acids during impact. My former student Abby Sheffer's and my past work on the chemistry of impacts demonstrated that strong chemical reduction occurs in impact melt ejecta (spherules and melt droplets; tektites). Here I focus on the element phosphorus (P), whose role is crucial in biology as the backbone of DNA and RNA, and in metabolic biochemical energy transfer. Matt Pasek previously showed that reduced P readily enters into interesting biological compounds with organic molecules in aqueous solution, and that these reduced P compounds may generate structures similar to sugar phosphates, which are critical to life as we know it. In this talk I argue that impact reduction of P transforms terrestrial and meteoritic phosphates bearing an oxidation state of +5 to the lower redox states of +3 (phosphites) and 0 as an alloy with metal (phosphides). I base this argument on studies of fulgurites—glasses formed by cloud- to-ground lightning—that bear phosphides and phosphites as major carriers of P. Fulgurite chemistry frequently parallels that of impact glasses. Additionally, thermodynamic calculations show that separation of an O-rich vapor from a melt readily results in the transformation of phosphate to phosphites and metal phosphides. These results are confirmed by the presence of metal phosphides within tektites. The impact reduction of phosphates followed by global dispersal of reduced P in the form of glassy droplets likely played a major role in the origin of life on Earth and perhaps on other young planets.



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