Thursday, November 7, 2024

2024 Clapp Lecture

Lessons in Chemistry for Earth's Atmosphere

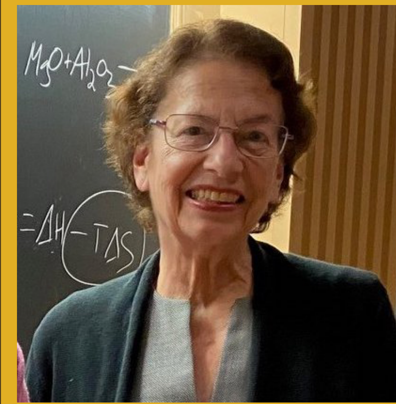
The Earth, a planet rotating with a tilted axis around the Sun, is a photochemical reactor powered by energy from the Sun. This presentation will discuss chemistry occurring in the complicated natural environments of the contemporary and ancient Earth's atmosphere. The focus will be fundamental chemical processes driven by sunlight, in which simple organic materials react in gas phase, with water and in/on water to generate chemically complex products needed for life and a habitable planet. On ancient Earth, before life existed, chemistry had to have generated biomolecules needed for life and had to have done this in the absence of biology, specifically in the absence of enzymes which accomplish such tasks today. This presentation will discuss the differences and similarities in the composition of ancient and contemporary Earth's atmosphere, describing the necessary concepts and methods for identifying and studying chemical problems in such environments.

Friday, November 8, 2024

Chemistry Colloquium

Multiphase organic chemistry in the natural environment

Inspired by atmospheric measurements, which have established that atmospheric chemistry occurs in many phases and at interfaces, my group explored the unique reaction environments presented by aqueous environments including water-air interfaces. Surface reflection spectroscopies (IRRAS and UVRES) were developed to study interfacial chemistry. The organic chemistry and photochemistry at the water surface is described using results of surface reflection spectroscopy. The special morphological and chemical properties of organic films on aqueous solutions will be discussed with reference to atmospheric aerosols, sea surface microlayers, cloud and fog droplets. The surface of water on aqueous drops and at the sea surface provides a special and unique reaction environment with qualitatively different thermodynamic and kinetic properties from bulk aqueous solutions. Examples will be presented with results of surface reflection studies following chemistry initiated at the water surface leading to increase in the chemical complexity of the system. Multiphase photochemical mechanisms will be presented by which a-keto acids react in aqueous environments to form organic radicals, which then recombine to form larger, more complex lipids. The relevance of this chemistry to reactions in the natural environment will be discussed.



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"University of Colorado, Boulder, Colorado ~Professor of Chemistry and Biochemistry; Fellow, The Cooperative Institute for Research in Environmental Sciences (CIRES). Teaching and research program follows an interdisciplinary path using chemical physics to understand the reactivity of planetary atmospheres, including those of contemporary and ancient Earth. Experimental spectra have provided insight into large-scale atmospheric phenomena. For example, spectroscopy uncovered sunlight-driven reactions for chlorine dioxide, with implications for polar ozone loss. Her lab has shown that red light-initiated reactions not previously expected to contribute to atmospheric chemistry can significantly change the paradigm in the field. Studies of light-initiated sulfuric acid reactions are solving long-standing mysteries of measured stratospheric aerosol concentrations and sulfur dioxide vertical profiles on Earth and, more recently, on Venus. "

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