Summers, David P.; Carl Sagan Center, SETI Institute

Dr. Summers has an extensive back ground in Astrobiology and C_1 chemistry, photochemistry, catalysis, surface chemistry and electrochemistry. He has several years experience in electrochemical CO_2 reduction/CH_4 oxidation. He has worked on experimentally modeling various aspects of the abiotic chemistry/fixation of nitrogen and carbon for over 15 years including a paper in Nature on reduction of nitrate/nitrite to ammonia and modeling of the kinetic of reactions in the early ocean. He has been involved in the Ames Martian meteorite program, particularly with regard to sample handling. Dr. Summers has been working on the application of ^{125}I labeling and Multiphoton Detection to a number of problems of NASA interest, including protein detection for the Biomolecular Systems Research Program, to help understand the responses of organisms to environmental changes, and to detect microbial metabolism, for the NAI Director's Discretionary Fund to understand survival in extreme environments. He has been involved in the study abiotic isotopic fractionation as a benchmark the detection of life. As part of the SETI institutes participation in the Astrobiology Institutes he experimentally simulated the prebiotic fixation of atmospheric nitrogen on Mars.

Dr. Summers works at NASA Ames research center under cooperative agreement between NASA and the SETI Institute. His current projects involve to study how energy transduction may have occurred in the prebiotic or protobiological stages of life and to (with ^{125}I labeling) detect microbes and microbial contamination for the search for life and planetary protection.

Education:

1979-1984: **Massachusetts Institute of Technology;** **Ph. D. Inorganic Chemistry**

1975-1976: **State University of New York at Albany;** **B.S. Chemistry**

Professional Experience:

1993-present: SETI Institute, Principal Investigator working at the Ames Research Center, supported by the exobiology program, studying the prebiotic fixation of nitrogen and carbon dioxide and its relation to other reactions of prebiotic interest including both laboratory work and kinetic modeling. Established sampling handling procedures for the NASA/Ames Martian meteorite project to look ALH84001. Worked on the application of MultiPhoton Detection for the state-of-the-art detection of organic material in extraterrestrial materials including the detection of microbial activity in cells and the detection of proteins. Studied the isotope fractionation of abiotic reactions to better understand stable isotope fractionation as a tool for life detection. Studied Experimentally the fixation of nitrogen on early terrestrial planet.

1990-1992: Ames Research Center, Senior National Research Council Fellow in exobiology program studying the prebiotic fixation of nitrogen.

1984-1989: SRI International, Electrochemist in the Materials Research Laboratory

working on new electrochemical routes and mechanisms for the heterogeneous electrocatalytic reduction of carbon dioxide and oxidation of methane for energy production and fuel cell applications. Also worked on the vapor phase deposition and electrodeposition of semiconductor thin films for solar cell applications.

Membership in Technical Committees and Professional Societies: American Chemical Society, International Society for the Study of the Origin of Life, Division of Planetary Sciences

Inventions: Two patents and an invention disclosure.

Selected Publications

- "The Electrochemical Reduction of Aqueous Carbon Dioxide at Electroplated Ru Electrodes. Investigations toward The Mechanism of Methane Formation." Karl W. Frese Jr. and David P. Summers, *Catalytic Activation of Carbon Dioxide, ACS Symposium Series No. 363*, p. 155-170, American Chemical Society: Washington, DC, 1988.
- "Mechanistic Aspects of the Electrochemical Reduction of Carbon Monoxide and Methanol to Methane at Ru and Cu Electrodes." David P. Summers and Karl W. Frese Jr., *Electrochemical Surface Science, Molecular Phenomena at Electrode Surfaces, ACS Symposium Series No. 378,* p. 518-527, American Chemical Society: Washington, DC, 1988.
- "Reduction of Carbon Dioxide to Methane at Copper Foil Electrode." Karl W. Frese Jr. and David P. Summers, Electrochemical Society Symposium Series, Electrochemical Society: Pennington, New Jersey, 1988.
- "Prebiotic Ammonia from Iron(II) Reduction of Nitrite on the Early Earth.", David P. Summers and Sherwood Chang, *Nature,* **365**, 630-633, 1993.
- "Sources and Sinks for Ammonia and Nitrite on the Early Earth and the Reaction of Nitrite with Ammonia", David P. Summers, *Origins of Life and Evolution of the Biosphere*, **29**(1)33-46, 1999.
- "Ammonia Formation by the Reduction of Nitrite/Nitrate by FeS: Ammonia Formation under acidic conditions", David P. Summers, *Origins of Life and Evolution of the Biosphere*, **35**(3)299-312, 2005.
- "Nitrogen Fixation on Early Mars and Other Terrestrial Planets. Experimental Demonstration of Abiotic Fixation Reactions to Nitrite and Nitrate.", David P. Summers and Bishun Khare, Astrobiology, **7**(2)333-341, 2007**.**
- "The Abiotic Fixation of Nitrogen on Terrestrial Planets: Experimental Results and their Implications.", David P. Summers, Bishun Khare, and Ranor C. Basa, Invited Talk, COSPAR 2008.
-"Energy Transduction Inside of Amphiphilic Vesicles: Encapsulation of Photochemically Active Semiconducting Particles", David P. Summers & Juan Noveron, Origins of Life and Evolution of the Biosphere, 39(2)127-140, 2008.