Exploring Closed-ecology Life Support System Capabilities through Origin-of-Life Processes

Zachary Adam
Department of Aero/Astronautics Engineering
University of Washington
Box 352400, Seattle, WA 98195-2400
USA
voodrbar@u.washington.edu

Human space exploration is severely limited by the scarcity of available nutrients throughout the solar system. It may be possible to generate biologically assimilable organic and inorganic compounds using industrialized origin-of-life processes, freed from Archean paleoenvironmental-analog constraints, and employing the use of catalysts and photosensitizers to assist the homolytic dissociation of reactants. This abiotic synthesis could form the basis for consumptive independence of spaceflight colonies by producing biospherically supportive polymers from volatiles produced or harvested on extraterrestrial surfaces. Other highly reactive monomers and polymers formed through free radical recombinant processes could provide a useful suite of chemicals to space colonies that would not have to be stowed and transported from Earth. A systematic, wide-ranging investigation of the feasibility of utilizing likely available volatiles and appropriate catalysts is outlined. The primary goal is to produce a robust, versatile, and ultimately space-faring life support technology capable of replenishing long-term organic carbon losses of an enclosed biosphere.