Protolife in Shadowed Lunar Fumaroles

GREEN, JACK Department of Geology, California State University, Long Beach; Long Beach, California 90840, U. S. A.

There is abundant evidence for lunar calderas and associated fumarolic activity. Fumarolic fluids contain the ingredients for protolife. From spectroscopic data from lunar transients and Precambrian terrestrial analogs, these fumarolic fluids could include H_2O, CO_2, CO, N_2, Cl, H_2, H_2S, HCN, CH_4 and NH_3, some with high concentrations in the early Precambrian. In lunar shadow most of these fluids if over a centimeter thick would be retained as ices for over a billion years. Many ammonium compounds when cooled in the presence of formaldehyde (HCHO) would produce proteinoid microspheres hosting alanine. Formaldehyde can be formed in several energy-producing reactions and would be stable in shadow. Adenine, a building block of nucleic acids can be created by cooling ammonium cyanide. In Fischer-Tropsch catalysis, formaldehyde reacting with fumarolic kaolin can form ribose, a sugar. Ribose with adenine produces adenosine. Soluble polyphosphates with adenosine could then form a metabolic energy source ATP. Lower surface pressures would lower boiling points of pre-biotic agents such as formic acid producing an optimal temperature for organic growth. Lesser gravity would promote slower bubble rise rates enhancing reactivity especially if filmed with iron sulfide such as troilite. Bubble biofilms could provide both energy and a charged interface for bonding and evolution of pre-biotic metabolists. Finally tungsten in fumarolic fluids can form enzymes essential in the evolution of thermophile Archaea.