

Prebiotic synthesis in volcanic discharges: exposing porous ash to volcanic gas atmospheres

Tuesday 11 February 2020 15:12 (18 minutes)

The question about the origin of life and the emergence of the first organic molecules is still unraveled. Lightning has been considered as a potential energy source for the emergence of life or alternatively as a potential energy source for the synthesis of first organic molecules. One of the most prominent abiotic synthesis experiments are the discharge experiments performed in 1953 by Miller and Urey [1] under simulated reducing atmosphere conditions. The presence of volcanic ash has been largely neglected in this early study and in addition new theories about the composition of the Early Earth's atmosphere have been developed.

Volcanism associated with volcanic lightning provides a possible energy source, a variety of different, including reducing volcanic gases and possible catalysts to synthesize a variety of primitive organic molecules. Volcanic ash particles are known for their porosity, high surface area and high surface reactivity. During explosive volcanic eruptions, the occurrence of volcanic lightning has frequently been observed. Recent laboratory studies successfully recreated volcanic lightning under laboratory conditions [2,3]. As main mechanisms for the electrification of ash particles within volcanic plumes and laboratory experiments triboelectrification and fractoemission were identified [2,3,4]. Volcanic plumes themselves provide a high variety of volcanic gases including, but not limited to reducing ones, and therefore may enlarge the spectrum for possibly available gas compositions in the Early Earth exposed to volcanic lightning.

Over the last decades new theories about the composition of the Early Earth's atmosphere have been developed. This calls for a new series of discharge experiments including more oxidizing or slightly reducing atmosphere conditions in the presence of volcanic ash.

We will present first insights from volcanic discharge experiments under different atmosphere compositions, varying in CH₄, H₂S, CO₂, CO and H₂O composition to mimic some first Early Earth conditions. Special focus is given to the role of ash particles as catalysts and compartment provider and the variety and influence of gas composition on the yield of organic compounds.

[1] Miller, S.L. (1953). A production of amino acids under possible primitive earth conditions. *Science*,117,528-529.

[2] Cimarelli, C., Alatorre-Ibargüengoitia, M.A., Kueppers, U., Scheu, B. and Dingwell, D.B. (2014). Experimental generation of volcanic lightning. *Geology*,42,79-82.

[3] Gaudin, D. and Cimarelli, C. (2019). The electrification of volcanic jets and controlling parameters: A laboratory study. *EPSL*,513,69-80.

[4] James, M.R., Wilson, L., Lane, S.J., Gilbert, J.S., Mather, T.A., Harrison, R.G. and Martin, R.S. (2008). Electrical charging of volcanic plumes. *Space Science Reviews*,137,399-418.

Authors: SPRINGSKLEE, Christina (University of Munich); STEINER, Thomas (Technical University of Munich); GEISBERGER, Thomas (Technical University of Munich); Dr SCHEU, Bettina (University of Munich); Dr HUBER, Claudia (Technical University of Munich); Prof. EISENREICH, Wolfgang (Technical University of Munich); Dr CIMARELLI, Corrado (University of Munich); Prof. DINGWELL, Donald Bruce (University of Munich)

Presenter: SPRINGSKLEE, Christina (University of Munich)

Session Classification: Atmospheric Processes

Track Classification: Atmospheric Processes