Prebiotic synthesis in volcanic discharges: lightning, porous ash and volcanic gas atmospheres

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The emergence of the first organic molecules as a fundamental step in the prebiotic assembly of life remains enigmatic. Lightning has been considered as a potential energy source for the synthesis for first organic molecules. The iconic abiotic synthesis experiments: the discharge experiments performed in 1953 by Miller and Urey [1] under simulated reducing atmosphere conditions were conducted in the absence of any geomaterial substrate. Further, new views about the composition of the Early Earth’s atmosphere have been developed which require a revisiting of the Miller experiment.

Volcanic lightning associated with volcanism provides a possible energy source, a variety of different 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 significant surface reactivity. 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 atmosphere.

Recent laboratory studies have successfully recreated near-vent volcanic lightning under laboratory conditions [2,3]. We will present first insights from volcanic discharge experiments under different atmospheric compositions, varying in CO₂ and N₂ composition to mimic some first Early Earth conditions. Special focus is given to the role of ash particles as a catalyst and container as well as the influence of gas composition on the yield of organic compounds.


