Chemical evolutions and temperatures of the early Earth's surface

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Recent findings suggest that life may have originated at high-temperatures reaching 100 C, although the temperature of the early Earth's surface when life originated remains uncertain. The theory of the hot origins of life is based on:

(1) The early Earth's atmosphere may have been composed of a dense CO2 atmosphere, which could keep the Earth's surface temperature near 100 C.
(2) Isotopic data of oxygen in sedimentary rocks suggest a temperature of the early Earth's surface reaching 100 C.
(3) Many kinds of organisms have been discovered near hydrothermal vents and some organic compounds have been abiotically synthesized in simulated hydrothermal conditions.
(4) According to rRNA phylogeny, hyperthermophiles are considered to be at the base of the phylogenetic tree.

It should be noted, however, that biomolecules are unstable at high-temperature. We have investigated the hydrolytic stability of hydrogen cyanide, which is thought to have been important for the origins of life, in a variety of temperature and pH conditions. The results suggest that hydrogen cyanide could not have polymerized to form bioorganic compounds in the Earth at high-tempeartures.1,2)

Here, it is proposed that the temperature of the early Earth's surface when life originated may have been below that of its freezing point. A cold Earth may represent more suitable conditions for the origins of bioorganic compounds.

1) S. Miyakawa, H. J. Cleaves and S. L. Miller, Origins Life Evol. Biosphere 32 (2002) 195-208.
2) S. Miyakawa, H. J. Cleaves and S. L. Miller, Origins Life Evol. Biosphere 32 (2002) 209-218.