**Emergence of life at anoxic geothermal fields**

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The protein synthesis machinery, which preceded the Last Universal Cellular Ancestor (LUCA), as well as some other key cell systems, require cytoplasmic $[K^+]/[Na^+]$ ratio > 1.0 [1], which, in modern cells, is maintained by ion-tight cellular membranes and ion pumps. The very first organisms were unlikely to have such appliances, so that the inorganic chemistry of modern cytoplasm is believed to reflect the chemistry of the habitats of the first cells [1,2].

Building on the measured $[K^+]/[Na^+]$ > 1.0 at vapor-dominated zones of inland geothermal systems, we have suggested that the first cells could have emerged in the pools and puddles of primordial anoxic geothermal fields, where the elementary composition of the condensed vapor would resemble the internal milieu of modern cells [1].

Earlier it was shown that the abiotic formation of amino acids, sugars and nucleotides is favored by high levels of cyanide/formamide, borate, as well as the UV light [3-10]. Anoxic geothermal fields, as putative cradles of life, were suggested to host versatile catalysts, sulfides of transition metals in the first line, and sources of organic matter [1]. Even modern, oxidized terrestrial geothermal fields are rich in volatiles, such as ammonia, phosphorous compounds, borate and cyanide, which are needed for diverse abiotic syntheses. The primordial geothermal fields should have been conducive to condensation reactions and also enable the involvement of solar light as an energy source and selective factor that would have favored the accumulation of (poly)nucleotides [1,7,10,11].

The concept of ancient, habitable anoxic geothermal fields [1], fully hypothetical until recently, got strong support after ancient hot spring deposits had been discovered in the 3.48 billion year old Dresser Formation, Pilbara, Western Australia [12]. In addition to diverse preserved oldest biosignatures, the Dresser hot spring setting also are characterized by high levels of many key elements (C, Zn, B, P, and N), as predicted for the anoxic geothermal fields in [1].

It would be discussed how the discovery of the oldest biosignatures at primordial, anoxic geothermal fields [12] paves the way to a consensus scenario of the terrestrial origin of life.

## References

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