WHAT WAS THE ROLE OF SUBMARINE HOT SPRINGS IN THE ORIGIN OF LIFE?

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The discovery of hydrothermal vents at oceanic ridge crests and the appreciation of their importance in the element balance of the oceans is an important recent advance in marine geochemistry. It is likely that such vents were present in the oceans of the primitive earth, and more water may have flowed through them than at present because of the greater heat flow from the interior of the primitive earth. Submarine vents must have played a role in the chemistry of the primitive ocean in at least two areas: a) the regulation of the concentration of some elements in the ocean; and b) the decomposition of the organic compounds synthesized in the atmosphere and oceans of the primitive earth. The steady state of oceanic synthesis and vent destruction can be used to estimate the concentration of amino acids in the primitive ocean (Stribling and Miller, 1988).

The proposal (Corliss, Baross and Hoffman, 1981) that the origin of life took place in the vents by a rapid process of organic compound synthesis, polymerization, and organization of the polymers into a living organism has been criticized as being inconsistent with the known high temperature properties of organic compounds (White, 1984; Miller and Bada, 1988). The high temperatures of the vents (350 ° C) do not synthesize organic compounds and polymers, they destroy the organic compounds and hydrolyze the polymers. In addition, making polymers is not equivalent to synthesizing a living organism. Pyrolysis reactions played a role in the prebiotic synthesis of aromatic hydrocarbons (Friedmann et al., 1970), phenylalanine, tyrosine (Friedmann and Miller, 1969) and tryptophan (Friedmann et al, 1971). However, these pyrolysis reactions are at higher temperatures (800-1200 ° C) in the gas phase and involve the rapid quenching of the reaction (Miller et al, 1976).

Lower temprature (~40 ° C) vents have been proposed as being important in the origin of life (Russell et al, 1988; Nisbet, 1989). Such waters do not occur near the submarine vents except from the mixing of 350 ° water with the cold sea water. Some water is heated to 40° but not much higher near volcanoes and other places, but such water should not be called vent water in this context because it is quite different from that of the 350° submarine vents. In any case there is little to be gained in prebiotic synthesis from such processes since the same chemistry would take place at 40° as at 0°. The rates would be faster but the yields from the 40° reaction would be much less than the slower reaction at 0° because of the smaller volume of 40° waters.

If lukewarm vent water, and not the ocean as a whole, came in contact with minerals that catalysed critical prebiotic reactions, as proposed by both Nisbet and Russell et al., our argument could change. It is not feasible to evaluate this possibility until the minerals and reactions are named. It is to be noted that an important role in prebiotic chemistry for minerals and clays has so far not been demonstrated.

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