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# Enceladus: a cradle of life of the Solar System?

Leszek Czechowski
Poland (lczech@op.pl)

According to [1]: "For life to have emerged [...] on the early Earth, a sustained source of chemically transducible energy was essential. The serpentinization process is emerging as an increasingly likely source of that energy. Serpentinization of ultramafic crust would have continuously supplied hydrogen, methane, [...] to off-ridge alkaline hydrothermal springs that interfaced with the metal-rich carbonic Hadean Ocean" (see also [2]).
We consider here conditions for origin of life in the early Enceladus and later proliferation of the life.

Mass of serpentinite: The serpentinization on the Earth is often considered with hydrothermal activity in neovolcanic zones along mid-oceanic spreading centers. The total length of present spreading centers is $\sim$80 000 km. However, only in small part of them the hydrothermal activity really occurs. Even if in Hadean oceans the hydrothermal activity was more widespread, still only small part of terrestrial rocks could be serpentinized.
After [3] we consider the following reaction of serpentinization:
Mg2SiO4 (forsterite) + $MgSiO_3$ (enstatite) + $2H_2O$ –> Mg3Si2O5(OH)4 (antigorite).
[4] considered the process of differenrtiation and core forming in Enceladus. He found that the result of differentiation is a relatively cold core of loosely packed grains with water between them. At that time, there is not mechanism of removing the water. Since terrestrial rocks are permeable up to the pressure of $\sim$300 MPa then the entire core of Enceladus was probably permeable for liquids and gases. This could lead to formation of extensive hydrothermal convective systems. Note that in Enceladus most of silicate could be serpetenized (contrary to the Earth). It indicates that total mass of serpententinized silicate in Enceladus could be larger than on the Earth.

T-p conditions in Enceladus: The pressure in the center of Enceladus is $\sim$2.3 107 Pa that correspond to pressure on the depth 2300 m in the terrestrial ocean. The evolution of temperature in the Enceladus interior for the first a few hundreds Myr is given in [4] It is possible that for hundreds of Myr the conditions in the interior of Enceladus were more favorable for origin of life than on the Earth.

Proliferation of life: We do not know the probability of life origin. The life could be a common phenomenon originating in relatively short time if conditions are favorable. However, it is possible also that the life had originated only one time in the Universe. If this option is true then the transport of primitive organism is critical. The low gravity of the Enceladus and its volcanic activity make this transport possible. Note that the low temperature of plumes does not kill the organism. The primitive bacteria could leave the Enceladus with volcanic jets in the same way as particles of the E ring. Therefore it is possible that the Enceladus was a cradle of the life in the Solar System.

Acknowledgments
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References:
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