



## Habitability from a microbial point of view

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We examine here the definition of habitability from the point of view of primitive, anaerobic microorganisms noting that the conditions of habitability are different for the appearance of life, for established life, and for life in dormant mode [1]. Habitability in this sense is clearly distinguished from the “prebiotic world” that precedes the appearance of life. The differences in the conditions of habitability necessary for life to appear, for life to flourish and for dormant life entrain differences in spatial and temporal scales of habitability. For the origin of life, the ingredients carbon molecules, water, nutrients and energy need to be present on time scales applicable for the origin of life ( $10^5$  to a few  $10^6$  y ?), necessitating the spatial scales of a minimum of  $\sim 100$  km. Established life can take advantage of short-lived habitats (hours, days) to much longer lived ones on spatial scales of  $100\text{s } \mu\text{m}$  to cm, whereas dormant life can survive (but not metabolise) in extreme environments for very long periods (perhaps up to millions of years) at microbial spatial scales ( $100\text{s } \mu\text{m} - \text{mms}$ ). Thus, it is not necessary for the whole of a planet or satellite to be habitable. But the degree of continued habitability will have a strong influence on the possibility of organisms to evolve. For a planet such as Mars, for instance, microbial habitability was (perhaps still is) at different times and in different places. Habitable conditions conducive to the appearance of life, established life and possibly even dormant life could co-exist at different locations.

Reference:

[1] F. Westall, D. Loizeau, F. Foucher, N. Bost, M. Bertrand, J. Vago, & G. Kminek, *Astrobiology* 13:9, 887-897 (2013).