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HABITABILITY IN THE SOLAR SYSTEM

Abstract

The concept of habitability is variable depending upon the kinds of life forms being studied. In the Solar System it is commonly agreed that the most likely forms of life on extraterrestrial bodies – in the past and perhaps still existing – are microbial. For microbial life, habitability can be defined in three ways: (1) conditions conducive to an origin of life, i.e. presence of carbon, liquid water in contact with certain minerals, essential elements and a source of energy, for periods of time ranging from $n \times 10^5$ to 1 or 2×10^6 y, (2) conditions that can host flourishing life that may be long term or even ephemerally short term (microbes are the archetypal opportunists), e.g. days, weeks, years, 10²-10³y, and (3) conditions in which microbes can survive in dormant mode. These different situations may give rise to a variety of habitability scenarios on geological time scales. It is thus possible, for instance on a planet such as Mars, for rocks to conserve the record of superimposed habitability conditions, as well as the background signal of prebiotic conditions. Changes in habitability with time on any extraterrestrial body will influence the potential for life to appear and evolve. The time-limited habitable conditions on Mars, for example, mean that life probably had little time to evolve and most likely remained in the very primitive stage – with important consequences for its detection. Furthermore, the eventuality of super-imposed signatures, the variability in potential habitability, as well as variability in the conservation of eventual traces of past/present life, will have great influence on strategies to search for traces of life in situ, and to collect and return samples for study on Earth.