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Introduction: Chemosynthetic (chemotrophic) communities, which live in environments barren of free oxygen and light, are good candidates to develop prominent living systems in the Solar System. These communities, based on organic carbon-fixing microorganisms, are widespread on the Earth nowadays as well as during its history. The capability of these biological communities to live in environments without light, oxygen, and under harsh conditions make them capable to undergo different planetary settings and give them a high chance to be the starting point of life. Fossil microbial documents, has traced back the history of life on Earth to its early stages, 3.8 billion years (Ga) ago (Schopf, 1983; Schopf and Klein, 1992; Schidlowski, 1993;). The adaptive strategies developed by microbes as early Earth inhabitants, during the geologic time, and in present-day ecosystems are extremely wide. They comprise adaptations useful for colonizing every possible habitat, including those unfavorable to higher organisms. The extreme environments in which microbes can survive and develop, are characterized by a wide range of physico-chemical conditions (Horikoshi and Grant, 1998). Two main types of chemosynthetic communities occur on the Earth: the one related to hydrothermal activity (hot spring, deep-sea vents) and those linked to methane vents (mud volcanoes, cold seeps). The first ones should be connected with volcanic activity and occur where carbon dioxide (and other gases) reach the surface in the mid-oceanic ridges and in other volcanogenic settings, whereas the latter are associated with surface releases of subsurface methane, which can be biogenic or abiogenic in origin. Chemosyntehitc ecosystems flourish around methane clathrate on the sea bed, where they form distinctive communities that may sustain more complex life forms.

Astrobiological potential: The characteristics of the chemosynthetic ecosystems suggest their high astrobiological potential. Their ability in developing in extreme conditions for other ecological communities and their dependence on the availability of specific chemical compounds may be the basis for their formation and development in Solar System bodies. Hydrothermal vents may occur in several settings in active terrestrial (rocky) planets. However, volcanic and hydrothermal activity is less possible in icy bodies, where volcanism is probably due to cold water-related "magmas". In that case, cold vents, induced by methane (as free gas, or water-gas mixture, or clathrate) is a possible candidate for the formation of chemosynthetic ecosystems. These ecosystems leave deposits that, a part from the peculiar biota, have both a lithological and morphological signature. Carbonates are extensively present in cold-seep deposits. These carbonates have a peculiar isotopic signature. Cold vents are associated with a variety of mineralisations. In both cases, these deposits would show distinctive morphologies that are under study in both fossil and modern record. Usually, these deposits form relief as mounds, mud volcanoes, chain and it is extremely important to analyse the fossil examples because (a) they give the possibility for detailed analyses without the use of remotely controlled devices (submarines, robots, etc), and (b) they may provide some hints about the fossilization processes that may occur in other planetary bodies. Due to their independence on the presence of oxygen and light, chemosynthetic ecosystems may be present in Solar System bodies without atmosphere and far from the Sun. Europa and Titan are good candidates. The Europa crust and its hydrosphere are probably rich in gas hydrates, which are the best substratum for chemosynthetic biota. Possible superficial gas and gas hydrate releases may form ecosystems at the surface that may be observed by remote sensing. Titan shows an atmosphere extremely rich in methane, a compound that is at the base of a wealth of chemosynthetic ecosystems.

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