# Exobiology of icy satellites

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At the beginning of 2004 the total number of discovered planets near other stars was 119. All of them are massive giants and met practically in all orbits. In "a habitable zone" (from 0.8 up to 1.1 AU) at less 11 planets has been found, starting with HD 134987 and up to HD 4203. It would be naive to suppose existence of life (in unique known to us amino-nucleic acid form) on the gas-liquid giant planets. Nevertheless conditions for onset and evolutions of life can be realized on hypothetical satellites extrasolar planets. All giant planets of the Solar system have a big number of satellites (61 of Jupiter, 52 of Saturn, known in 2003). A small part of them consist very large bodies, quite comparable to planets of terrestrial type, but including very significant share of water ice. Some from them have an atmosphere. E.g., the mass of a column of the Titan's atmosphere exceeds 15 times the mass of the Earth atmosphere column. Formation (or capture) of satellites is a natural phenomenon, and satellite systems definitely should exist at extrasolar planets. A hypothetical satellite of the planet HD 28185, with a dense enough atmosphere and hydrosphere, could have biosphere of terrestrial type (within the limits of our notion about an origin of terrestrial biosphere). As an example, we can see on Titan, the largest satellite of Saturn, which has a dense nitrogen atmosphere and a large quantity of liquid water under ice cover and so has a great exobiological significance. The most recent models of the Titan's interior lead to the conclusion that a substantial liquid layer exists today under relatively thin ice cover inside Titan. The putative internal water ocean along with complex atmospheric photochemistry provide some exobiological niches on this body: (1) an upper layer of the internal water ocean; (2) pores, veins, channels and pockets filled with brines inside of the lowest part of the icy layer; (3) the places of cryogenic volcanism; (4) set of caves in icy layer connecting with cryovolcanic processes; (5) the brine-filled cracks in icy crust caused by tidal forces; (6) liquid water pools on the surface originated from meteoritic strikes; (7) the sites of hydrothermal activity on the bottom of the ocean. We can see all conditions needed for origin and evolution of biosphere – liquid water, complex organic chemistry and energy sources for support of biological processes - are on the Saturnian moon. Galileo spacecraft has given indications, primarily from magnetometer and gravity data, of the possibility that three of Jupiter's four large moons, Europa, Ganymede and Callisto have such oceans also. The existing of liquid water ocean within icy world can be consequences of the physical properties of water ice, and they neither require the addition of antifreeze substances nor any other special conditions. On Earth life exists in all niches where water exists in liquid form for at least a portion of the year. Possible metabolic processes, such as nitrate/nitrite reduction, sulfate reduction and methanogenesis could be suggested for internal oceans of Titan and Jovanian satellites. Excreted products of the primary chemoautotrophic organisms could serve as a source for other types of microorganisms (heterotrophes). Subglacial life may be widespread among such planetary bodies as satellites of extrasolar giant planets, detected in our Galaxy.