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Possibility of Life in Titan

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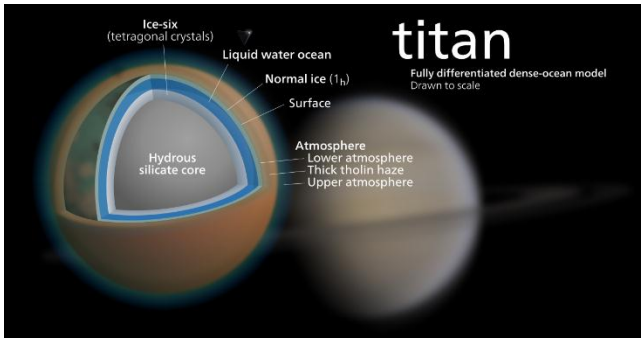
Abstract

Astrobiology, a branch of life science, has shown possibility of life in celestial bodies including titan. Titan comprises of earth-like dense nitrogen atmosphere and liquid methane on its surface which acts as solvent to interact molecules with movement. Carbon and nitrogen which is present in titan are the major components from which various life supporting complex molecules arises. Complex molecules like acrylonitrile, sugar, amino acids and many more are present there which is best candidate for protocell. The ultimate goal of our research is to detect methane-based oxygen-free life forms at such low temperature having different structure and metabolism than those which have been recognized yet. Azotosome, a nitrogen body, is capable of forming and functioning in liquid methane at cryogenic temperature may survive there. Like we have adapted ourselves to the environment of the Earth, may some aliens have adapted themselves to the environment of Titan making use of hydrocarbon as requisites of life. So, to disclose its mystery a space craft should be send. In a spacecraft we might as well use spectroscopies and apply Bragg's law and grating for the identification of molecules and structures on the surface through structural fingerprints and chemicals in all forms. Due to insulating icy surface, there is no heat transfer between core and atmosphere such that core may be warm. So, applying cryobot we can penetrate the icy crust to investigate life beneath the surface. Thus, titan has a huge possibility of life in a chemistry different than the Earth.
Keywords: - Titan, Spacecraft, Azotosome, Cryobot, Life, Methane, Molecule, Aliens, spectroscopies

Introduction

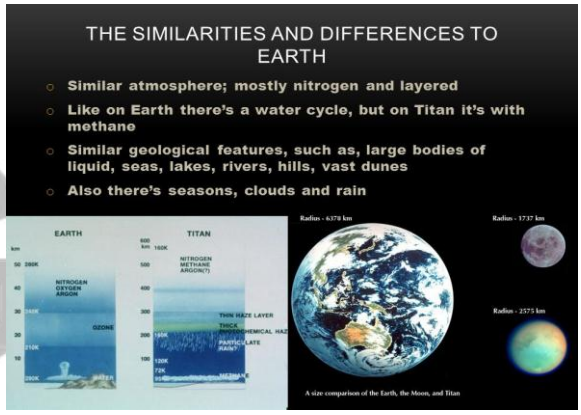


As we all know that titan, the largest satellite of Saturn and the second largest satellite of whole solar system is the only moon to have a very earth like stability and meteorological features. Titan is primarily composed of ice and rocky material. Under the upper atmosphere there is thick tholin haze below it there is a layer of normal ice. At the inner core there is hydrous silicate core covered with liquid water ocean. The atmosphere of Titan is largely nitrogen; minor components lead to

the formation of methane and ethane clouds and nitrogen-rich organic smog. The climate including wind and rain creates surface features similar to those of Earth, such as dunes, rivers, lakes, seas (probably of liquid methane and ethane), and deltas, and is dominated by seasonal weather patterns as on Earth. Titan's methane cycle is analogous to Earth's water cycle, at the much lower temperature of about 94 K. Titan orbits Saturn once every 15 days and 22 hours. Like the Moon and many of the satellites of the giant planets, its rotational period (its day) is identical to its orbital period. Titan is the only known moon with a significant atmosphere, and its atmosphere is the only nitrogen-rich dense atmosphere in the Solar System aside from Earth's. Titan's atmospheric composition is nitrogen (97%), methane, hydrogen with trace amounts of other gases. There are trace amounts of other hydrocarbons, such as ethane, diacetylene, methylacetylene, acetylene and propane, and of other gases, such as cyanoacetylene, hydrogen cyanide, carbon dioxide, carbon monoxide, cyanogen, argon and helium.

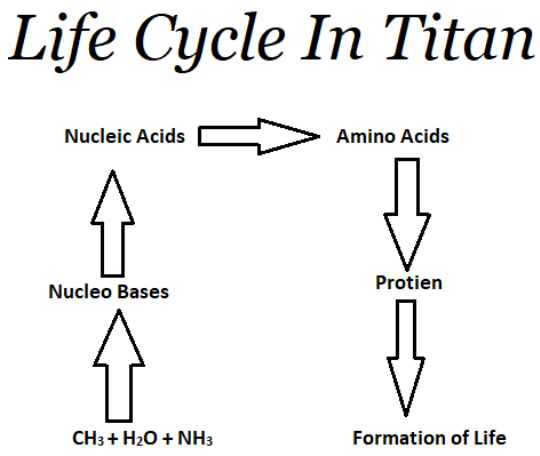
Similarity of Environment with Earth

Like water on the Earth, Titan has lakes of liquid methane which made Titan our subject of enthusiasm. It also comprises of earth-like dense nitrogen atmosphere. Cassini-Huygens discovered lakes on Titan refilled by seasonal rain from hydrocarbon clouds like water cycle on the Earth. Also, titan has similar geographical features such as large bodies of liquid, seas, lakes, rivers, hills, vast dunes, etc. It has been suggested that life could exist in the lakes of liquid methane on Titan, just as organisms on Earth live in water. Such organisms would inhale H_2 in place of O_2, metabolize it with acetylene instead of glucose, and exhale methane instead of carbon dioxide.

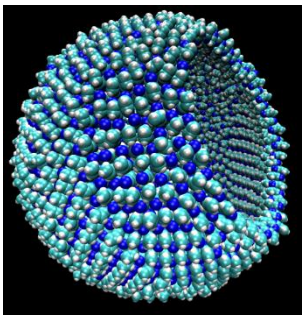


Formation of Life in Titan

Several experiments have shown that with an atmosphere similar to that of titan, UV-radiations and electrons, complex molecules, and polymer substances like tholins can be formed. Through the dissociation of Nitrogen and methane, hydrogen cyanide and acetylene can be formed. From different chemical complex organic molecules are formed in titan which to the formation of organic haze in atmosphere. DNA would disintegrate in a methane sea but the complex molecules form in titan's atmosphere, such as long chain hydrocarbon and nitrogen containing mix known as tholin may have spawned and alien genetic code. These organic once cooked in undersea hydrothermal vents could generate stable soluble chemicals called polyether that could serve as the genetic blueprint for life in titan.

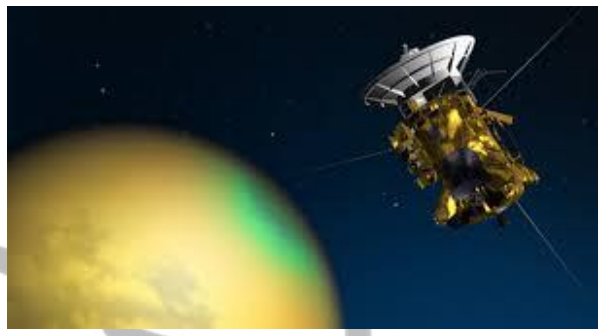


Methane Based Life



Like in earth, there may be the presence of life in titan because of its environmental similarities. Azotosome, a nitrogen body capable of functioning in liquid methane in titan's condition was composed of acrylonitrile, a small molecule containing carbon, hydrogen and nitrogen may present in titan. It is predicted to have stability and flexibility in liquid methane comparable with that of phospholipid bilayer (the type of cell membrane possessed by all life on earth). So, the most promising compound we found is an azotosome based on acrylonitrile – a colorless, poisonous, liquid organic compound present in the atmosphere of Titan. The acrylonitrile azotosome showed good stability, a strong barrier to decomposition, and a flexibility similar to that of phospholipid membranes on Earth.

Way to Explore Life in Titan



As a spacecraft is a machine design to fly in outer space which is use for a variety of purposes, including communications, earth observation, meteorology, navigation, space colonization, planetary exploration, and transportation of human and cargo. It's worth sending a space craft to Titan to disclose its mystery. In the spacecraft, we might as well use Spectroscopies and apply Bragg's law and grating for the identification of molecules and structures on the surface through structural fingerprints and chemicals in all forms. Further, spectroscopy technique can be used to observe vibrational, rotational, and other low freqency modes in the surface of titan which help to explore the possibility of life in titan. Cryobot is one of the surface controlled instrumented vehicles designed to penetrate polar ice sheets by meltling it. Volcanos are the weak places where we can employ cryobot to penetrate the icy crust and investigate dielectric, seismic and acoustic properties and try to uncover more information from the beneath the surface.

Future Possibilities of Life in Titan

In future, when sun enters into its red giant phase, the infrared frequencies can enter into its atmosphere due to which the haze in titan's upper atmosphere will be depleted, lessening the anti-greenhouse effect on the surface which leads methane come into play and may warm the titan as it is a greenhouse gas. This may make titan favorable for life.

During red giant phase the temperature of other celestial bodies will be very high but as the titan is very away from the sun, its temperature will be suitable for living. So, these conditions together could create a habitable environment and could persist for several hundred million years.

Conclusion

Research is never completed as there is always a room for improvement, so this is an enhancement upon the study of life in Titan which we have done till now. Titan meets the absolute requirements for the presence of life: it is not in thermodynamic equilibrium, it has abundant carbon—bearing molecules at the surface and there is a plausible liquid substance in which biological activity may be mediated. Moreover, there are a wide range of possible habitats for exotic biota extending to depths of several hundred kilometers into Titan's interior; Titan could be home to numerous, separate ecosystems, with completely independent evolutionary histories (or else their only connection lies in the distant past when Titan formed). This combination of factors makes Titan an extremely enticing object for astrobiological research. As our research may not provide the answers of all the queries but it will definitely provide the future lead in the field of astrobiology.

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