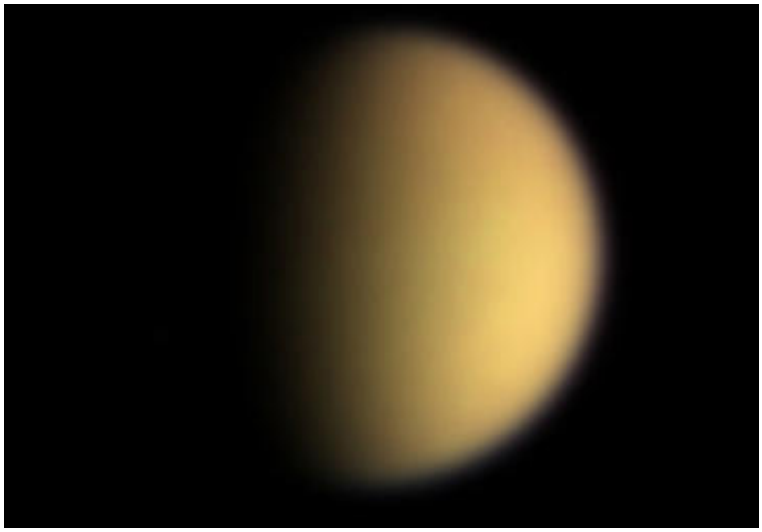
How Titan might be making DNA building blocks

Saturn's moon Titan has many of the components for life – but no liquid water. A new study shows how the moon's atmosphere might be producing the molecules that make up DNA anyway.



Chemical reactions in the orange atmospheric haze that surrounds Titan could be creating the molecules that make up DNA, according to a new study.

NASA/Reuters/file

By Pete Spotts, Staff writer / October 8, 2010

The orange hydrocarbon haze that shrouds Saturn's frosty moon Titan could be creating the molecules that make up DNA without the help of water – an ingredient widely thought to be necessary for the molecules' formation.

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What's more, it could be doing this with help from an unexpected source: another moon of Saturn some 610,000 miles away.

Just because Titan's atmosphere is creating these molecules doesn't mean that the molecules are combining to form life, caution the researchers from the US and France who conducted the experiments. But the results could prompt astrobiologists to consider a wider range of extrasolar planets as potential hosts

for at least simple forms of organic life, the team of scientists from the US and France suggests.

Moreover, the results could offer greater insight into how life on Earth formed.

Although Titan is far colder than the early Earth would have been, the makeup of its atmosphere is thought to be comparable to that of Earth's billions of years ago. The new findings suggest that on the early Earth, the planet's upper atmosphere – not just the so-called primordial soup on the surface – may have been the sources for these "prebiotic" molecules, amino acids and the so-called nucleotide bases that make up DNA.

"We're really starting to get a sense for what kind of chemistry an atmosphere is capable of" performing, says Sarah Hörst, a graduate student in planetary science at the University of Arizona, who led the research effort.

Titan's mystery molecules

The inspiration for the experiments came from NASA's Cassini spacecraft, which has detected large molecules at altitudes of some 600 miles above Titan's surface. But the molecules are so far unidentified because of limitations to the craft's instruments.

Lab instruments back on Earth, however, have no such limitations, so the team decided to replicate Titan's atmosphere in a large chamber at the temperatures present in the moon's upper atmosphere. To play the role of the sun's ultraviolet light hitting Titan's atmosphere, they used radio energy at a power level comparable to a modestly bright light bulb.

The UV light is important because it breaks up molecules such as molecular nitrogen or carbon monoxide in Titan's atmosphere, leaving the individual atoms to choose up different partners, forming new molecules.

The experiment yielded tiny aerosol particles. The team ran the particles through a sensitive mass spectrometer, which showed the chemical formulas for the molecules that made up the aerosols.

Ms. Hörst then ran the formulas past a roster of molecules biologically important for life on Earth. She got 18 hits, including the four nucleotides whose combinations form an organism's genetic information encoded in DNA.

In the end, she says, it appears to be less important that water is present to form these molecules than it is for some form of oxygen to be present in the mix of ingredients.

Enceladus's helping hand

On Earth, oxygen early in the planet's pre-life history would come in the form of carbon dioxide and carbon monoxide from volcanic activity, as well as from water released by volcanism and through meteor and comet impacts.

On Titan, the oxygen appears to be coming from Enceladus, an intriguing moon of Saturn in its own right because of icy geysers spewing into space from near its south pole. Some researchers think the geysers hint at a subsurface sea – or at least sizable deposits of slush – and a potential habitat for life.

Last year, researchers showed how water molecules ejected as part of Enceladus's geysers can be carried great distances through the Saturn system. Some of those oxygen-bearing molecules make their way to Titan's neighborhood.

If Titan's atmosphere indeed is forming nucleotides, amino acids, and perhaps other large biomolecules, and if this atmospheric chemistry factory is present on planets around other stars, that does not mean conditions there are right for combining these molecules in ways that lead to critters big or small, Hörst cautions.

On other planets and under other conditions, atmospheres "may not make these molecules," she says, "but they still might make other molecules" that life on Earth could could use.

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