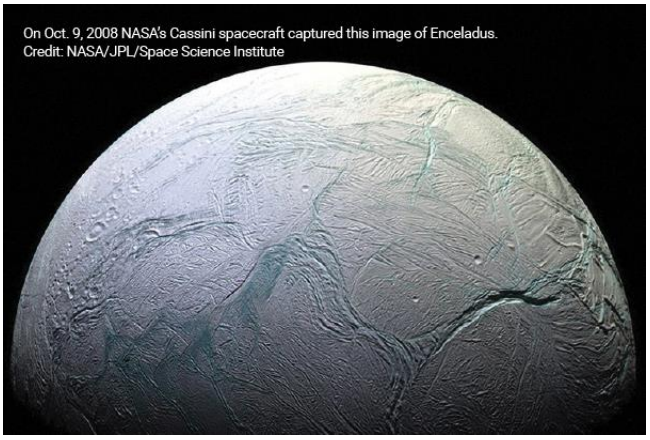
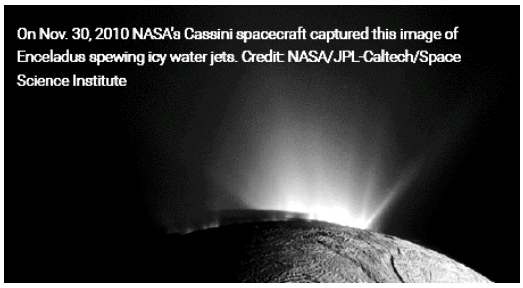

On Oct. 9, 2008 NASA's Cassini spacecraft captured this image of Enceladus. Credit: NASA/JPL/Space Science Institute

ScienceWatch – The Search for Extraterrestrial Life

"The next step is clear — we need to go back to Enceladus to see if the habitable ocean is actually inhabited." – N. Khawaja

I hope to live long enough to see the biggest headline ever, **"LIFE FOUND ELSEWHERE!"** In recent years the existence of extraterrestrial life in our own solar system has become more probable and it's most likely to show up on the moons of two gas giants.

Enceladus, a moon of Saturn, and Europa, one of Jupiter's moons have water, a necessity for life as we know it. Both are covered by a salty subsurface ocean ten of miles deep and capped by a crust of ice several miles thick. Both contain a core, rocky for Enceladus, iron for Europa. Both cores flex due to the intense gravitational pull of their mother planet which generates heat. This internal "tidal heating" not only yields a liquid ocean on the otherwise super cold moons, but it produces geysers.


On Nov. 30, 2010 NASA's Cassini spacecraft captured this image of Enceladus spewing icy water jets. Credit: NASA/JPL-Caltech/Space Science Institute

In 2010 NASA's Cassini spacecraft orbiting Saturn captured images of geysers on Enceladus spewing ice grains into space. In 2012 the Hubble Space Telescope captured images suggestive of geysers discharging water from Europa's surface. Other data collected from Cassini established that Enceladus has five of the six essential elements for life: carbon, hydrogen, nitrogen, oxygen and sulfur. But scientists were unable to find phosphorous, an essential component of DNA and RNA.

Now a report in the June 15, 2023 issue of *Nature* says Enceladus has plenty of phosphorus. A team led by Frank Postberg and Nozair Khawaja, planetary scientists at Freie Universität Berlin, Berlin, Germany, examined data generated by Cassini's Cosmic Dust Analyzer as the probe flew by Enceladus. The analyzer determined the mass and chemical composition of dust clouds arising from ice grains as they hit a metal plate.

Cassini's measurements showed that some of the particles have the molecular masses of sodium phosphates. By preparing lab samples with different forms and concentrations of phosphorous to match Cassini's results the scientists found that Enceladus's ocean has 1,000 times more phosphorous in the form of sodium phosphates than earth's oceans.

"No one would be surprised if there's phosphate in the rock of Enceladus. There's phosphates on comets … it is not a big deal," said Postberg. "The big deal is that it is dissolved in the ocean, and with that, [it's] readily available for the potential formation of life."

What kind of life might exist miles below the ocean's surface where sunlight never penetrates? We already know. In 1977 scientists discovered deep ocean vents on earth spewing super-heated, mineral-rich water. An entire community lives around the vents based on chemosynthesis not photosynthesis and many scientists believe that life on earth began here. Vent microbes (bacteria) form the base of the food web. They combine carbon dioxide, hydrogen sulfide and oxygen, gaining energy to make sulfur, water and sugar (food). Other vent microbes (methanogens) gain energy without oxygen by combining carbon dioxide and hydrogen, yielding methane as a byproduct.

In 2017 Cassini found carbon dioxide, hydrogen and methane in Enceladus's geyser plumes indicating that methanogens may exist at the bottom of Enceladus's ocean.

NASA is planning missions to Europa and Enceladus. The Europa Clipper will launch in 2024 and reach Jupiter in 2030. It will search for liquid water near the surface and measure the distribution and chemical composition of hot spots it finds for a future landing. The Orbilander mission to Enceladus will launch in the late 2030's. It will orbit the moon for several years sampling its geyser plumes for biomolecules and then land on the surface in the 2050's to search for further evidence of life.

I hope to live long enough...

Saul Scheinbach