

Lava Lamp Moon: The Search for Life on Europa May Just Have Gotten Easier

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The surface of Jupiter's second moon is one of the most twisted, chaotic, and intriguing surfaces in the solar system. Delicate, sinuous cracks weave across the whole of Europa; tilted blocks of ice, miles high, break the surface. Scientists have found evidence of cryo-volcanoes (volcanoes that erupt ice and slush instead of lava) and the Galileo spacecraft has collected gravity measurements showing that a deep ocean of liquid water exists under miles of icy crust. With so many phenomenal surface features, it is no wonder that astronomers have overlooked the tiny dark blotches that spot the face of the moon. Yet these blotches may be one of the most interesting - and useful - aspects of Europa yet discovered.



Lenticulae: The odd reddish splotches in the center of this image may be the key to finding life on Europa. The splotches, or lenticulae, may represent areas of warm water from Europa's underground ocean. ([Click](#) to view larger image)

Courtesy of [Galileo Project, NASA](#)

Freckles blanketing Europa

The Galileo spacecraft revealed these blotches, termed "lenticulae," from the Latin word for "freckles," when it photographed Europa between 1997 and 2000. Only about 10 kilometers in diameter (a small distance on a planetary scale), the lenticulae are a dusty red color, and often bulge from the ice like elaborate igloos.

Until recently, astronomers have been unable to explain the lenticulae blanketing Europa's

surface. But in October 2002, a team of researchers at the University of Colorado, Boulder, hypothesized that the lenticulae are upwellings of warm water from Europa's ocean, 13 miles under the surface. Beneath the dark red "freckles" may be narrow channels that act as elevators, transporting warmer ocean waters up to the surface, and colder surface water down under the ice in slow convection currents.

The lava-lamp idea

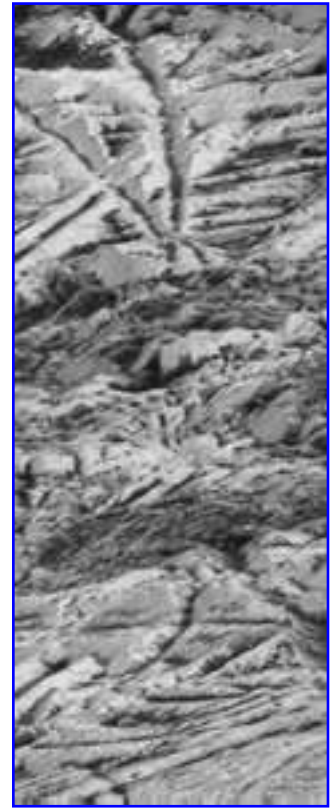
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"Europa acts like a planetary lava lamp, carrying material from near the surface down to the ocean," said Dr. Robert Pappalardo, leader of the Colorado team.

The team's lava-lamp idea has interesting implications. Since the discovery of Europa's underground ocean, numerous researchers have proposed countless theories about ways in which life forms could survive under the ice. If

surface-to-ocean "elevators" exist, they could transport organisms and nutrients from the ocean to the surface and back again, albeit slowly. The elevators may provide nutrients to organisms living under the ice sheet, or they may transport "hibernating" organisms to the surface, where more sunlight is found.

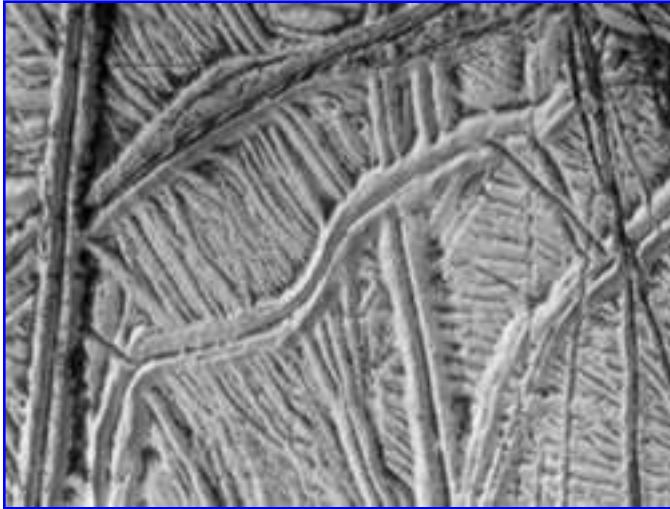
On Earth, scientists have long known that organisms living in Arctic ice go into hibernation for long periods of time until conditions improve. Similarly, Pappalardo has proposed that organisms living under the Europa ice sheet may also go into hibernation for lack of an energy source (such as sunlight). Yet, if such organisms were to get caught in Europa's lava-lamp action, they could be transported to the sunlit surface, where they may come out of hibernation and flourish.



Proposed missions to the frozen moon

Theories about life on Europa are necessarily speculative, but this has not stopped researchers from formulating ways to test for life on this enigmatic moon. Since the discovery of Europa's ocean, astronomers have proposed several missions that would search for evidence of life on and beneath the frozen moon's ice. One proposed mission is a type of space-faring submarine that would land on Europa, then heat itself until it melted through the ice. Once through to the ocean below, it would make chemical measurements of the water, and search for evidence of life. The problem with this lander is that it would have to burn through the ice crust - 13 miles deep.

Jagged and broken surface: In addition to extensive ice ridges, enormous blocks of ice chaotically break Europa's surface. This image shows mountains of ice on the small moon. ([Click](#) to view larger image)
Courtesy of [Galileo Project, NASA](#)



Ice ridges: Europa's surface is like a giant ball of twine - but each thread is a ridge of solid ice, kilometers high. This image shows many intersecting ice ridges. ([Click](#) to view larger image)

Courtesy of [Galileo Project, NASA](#)

Pappalardo. "Sampling the surface composition may provide direct insights into the nature of the ocean deep below, and could plausibly reveal dormant organisms if they exist within Europa."

One of NASA's top priorities

Recently, the National Research Council's Space Studies Board labeled the proposed Europa Geophysical Explorer (EGE) mission one of NASA's top priorities. Such a craft would orbit Europa, mapping its surface and using U.S. Navy techniques to determine the varying depths of the ocean beneath the ice. This explorer would also serve as a scout, identifying possible landing sites for a future mission.

Ironically, funding for the EGE does not yet exist, and probably won't for several years. Since the EGE's price tag was quickly rising to over a billion dollars, NASA cut the last proposed Europa orbiter in June 2002.

The price of any mission to Jupiter's second moon would be high. While an orbiter would by far be the cheapest type of mission, it would have little chance of finding direct evidence of life - one of the primary reasons NASA is so anxious to go to the moon. Fortunately, if researchers are able to verify Europa's lava-lamp

Yet fueled by the new discovery of Europa's lava-lamp features, the lander's 13-mile crust excursion may be avoided altogether. Under the lenticulae, the ice would be thin, and a lander would not have to burn far to hit water. Once through the ice, the lander would be able to ride the lava-lamp motions down into the ocean, where it would search for evidence of life and analyze the chemistry and physics of the underground realm.

Pappalardo and his team have proposed using a lander to search for evidence of life on top of one of the "freckles." If organism-rich waters are convected to the surface, then it is possible that organic compounds or organisms themselves could be found on or near the lenticulae.

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action, the costs and complexity of future lander proposals would be significantly reduced, and a mission to the moon may become a real possibility in the not too distant future.

References and suggested reading

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