

Could ice spikes on europa jeopardize a spacecraft landing? A study suggests so

November 21 2018, by Fariss Samarrai



These natural ice spikes, called penitentes – which are several feet tall – are located on a dry plain of Chile. Could similar features on a moon of Jupiter create landing hazards for a NASA mission? Credit: European Southern Observatory

Sometime in the early 2020s, NASA intends to launch a spacecraft that

will orbit and possibly even place a lander on Europa, a moon of Jupiter – an object of much interest because it could harbor conditions that are suitable for the development of life.

The [moon](#) has an icy surface, and astronomers believe, based on numerous studies, that there may be oceans of liquid water under that ice. Where there's water, there could be life – though likely in simple forms.

Called the Europa Clipper, the spacecraft will operate in a looping orbit around Jupiter to make repeating close flybys of Europa. The craft will be outfitted with a range of instruments to remotely survey and identify areas where liquid water might have reached the surface, possibly bringing with it chemical traces of life. The [space agency](#) also is considering [landing](#) a craft and conducting direct searches for water and life.

But where, exactly, should the craft land?

That is a question of interest to Alan Howard, a University of Virginia planetary geologist. Howard specializes in comparing geological features on Earth with those on planets and moons, such as Mars and Jupiter's Europa.

He and an international team of scientists recently published a paper in the journal *Nature Geoscience* that indicates some serious potential hazards for a spacecraft landing along Europa's equatorial region.

Howard and his colleagues argue that the equator on Europa very possibly may be studded with jagged ice spikes called penitentes – just like in some locations along Earth's equator. These spikes may be closely spaced and as tall as 50 feet, making a safe landing for the Clipper difficult to impossible.

"Because of the [spacecraft](#)'s particular orbit, it would be most fuel-efficient to land along the equator, but our study suggests that it may be better to consider a landing nearer to Europa's poles, even at the expense of requiring extra fuel," Howard said.

Penitentes occur at some dry, very high-altitude locations on Earth's equator in South America and Africa, where the sun shines directly down onto areas of ice – "cooking them," as Howard describes it, creating an unusual spiking effect called sublimation. This perpendicular bombardment of the sun's rays causes ice to evaporate rather than melt, forming uneven pits that gradually deepen as the light rays focus on the bottom, ultimately resulting in high points with steep edges – ice pinnacles pointing toward the sun.

There currently is no way to know for sure if penitentes exist on Europa, and the new study's conclusion is controversial in the research community, Howard said. Some astronomers are suggesting that even if penitentes do occur on that moon, it's also possible that they may be subjected to "space weathering" – caused by additional radiation from Jupiter, as well as meteorite strikes.

Howard believes, however, the rates of sublimation likely exceed that of any [space](#) weathering that may be occurring.

"The point of the study is to make suggestions as to what hazards a landing craft might face on the surface during the landing," Howard said. "We're suggesting that perhaps it might be prudent to plan a touchdown at a location other than along the equatorial belt."

More information: Daniel E. J. Hobbey et al. Formation of metre-scale bladed roughness on Europa's surface by ablation of ice, *Nature Geoscience* (2018). [DOI: 10.1038/s41561-018-0235-0](https://doi.org/10.1038/s41561-018-0235-0)

Provided by University of Virginia

Citation: Could ice spikes on europa jeopardize a spacecraft landing? A study suggests so (2018, November 21) retrieved 24 April 2024 from <https://phys.org/news/2018-11-ice-spikes-europa-jeopardize-spacecraft.html>

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