

Table salt compound spotted on Europa

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Tara Regio is the yellowish area to left of center, in this NASA Galileo image of Europa's surface. This region of geologic chaos is the area researchers identified an abundance of sodium chloride. Credit: NASA/JPL/University of Arizona

A familiar ingredient has been hiding in plain sight on the surface of Jupiter's moon Europa. Using a visible light spectral analysis, planetary scientists at Caltech and the Jet Propulsion Laboratory, which Caltech manages for NASA, have discovered that the yellow color visible on

portions of the surface of Europa is actually sodium chloride, a compound known on Earth as table salt, which is also the principal component of sea salt.

The discovery suggests that the salty subsurface [ocean](#) of Europa may chemically resemble Earth's oceans more than previously thought, challenging decades of supposition about the composition of those waters and making them potentially a lot more interesting for study. The finding was published in *Science Advances* on June 12.

Flybys from the Voyager and Galileo spacecrafts have led scientists to conclude that Europa is covered by a layer of salty liquid water encased by an icy shell. Galileo carried an infrared spectrometer, an instrument scientists use to examine the composition of the surface they're examining. Galileo's spectrometer found water ice and a substance that appeared to be magnesium sulfate salts—like Epsom salts, which are used in soaking baths. Since the icy shell is geologically young and features abundant evidence of past geologic activity, it was suspected that whatever salts exist on the surface may derive from the ocean below. As such, scientists have long suspected an ocean composition rich in sulfate salts.

That all changed when new, higher spectral resolution data from the W. M. Keck Observatory on Maunakea suggested that the scientists weren't actually seeing magnesium sulfates on Europa. Most of the sulfate salts considered previously actually possess distinct absorptions that should have been visible in the higher-quality Keck data. However, the spectra of regions expected to reflect the internal composition lacked any of the characteristic sulfate absorptions.

"We thought that we might be seeing [sodium](#) chlorides, but they are essentially featureless in an [infrared spectrum](#)," says Mike Brown, the Richard and Barbara Rosenberg Professor of Planetary Astronomy at

Caltech and co-author of the *Science Advances* paper.

However, Kevin Hand at JPL had irradiated ocean salts in a laboratory under Europa-like conditions and found that several new and distinct features arise after irradiation, but in the visible portion of the spectrum. He found that the salts changed colors to the point that they could be identified with an analysis of the visible spectrum. Sodium chloride, for example, turned a shade of yellow similar to that visible in a geologically young area of Europa known as Tara Regio.

"Sodium chloride is a bit like invisible ink on Europa's surface. Before irradiation, you can't tell it's there, but after irradiation, the color jumps right out at you," says Hand, scientist at JPL and co-author of the *Science Advances* paper.

"No one has taken visible wavelength spectra of Europa before that had this sort of spatial and spectral resolution. The Galileo spacecraft didn't have a visible spectrometer. It just had a near-infrared spectrometer," says Caltech graduate student Samantha Trumbo, the lead author of the paper.

"People have traditionally assumed that all of the interesting spectroscopy is in the infrared on planetary surfaces, because that's where most of the molecules that scientists are looking for have their fundamental features," Brown says.

By taking a close look with the Hubble Space Telescope, Brown and Trumbo were able to identify a distinct absorption in the visible spectrum at 450 nanometers, which matched the irradiated [salt](#) precisely, confirming that the yellow color of Tara Regio reflected the presence of irradiated sodium chloride on the surface.

"We've had the capacity to do this analysis with the Hubble Space

Telescope for the past 20 years," Brown says. "It's just that nobody thought to look."

While the finding does not guarantee that this sodium chloride is derived from the subsurface ocean (this could, in fact, simply be evidence of different types of materials stratified in the moon's icy shell), the study's authors propose that it warrants a reevaluation of the geochemistry of Europa.

"Magnesium sulfate would simply have leached into the ocean from rocks on the ocean floor, but [sodium chloride](#) may indicate that the ocean floor is hydrothermally active," Trumbo says. "That would mean Europa is a more geologically interesting planetary body than previously believed."

The study is titled "Sodium [chloride](#) on the [surface](#) of Europa."

More information: Sodium chloride on the surface of Europa, *Science Advances* 12 Jun 2019: Vol. 5, no. 6, eaaw7123, [DOI: 10.1126/sciadv.aaw7123](#) , [advances.sciencemag.org/content/5/6/eaaw7123](#)

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