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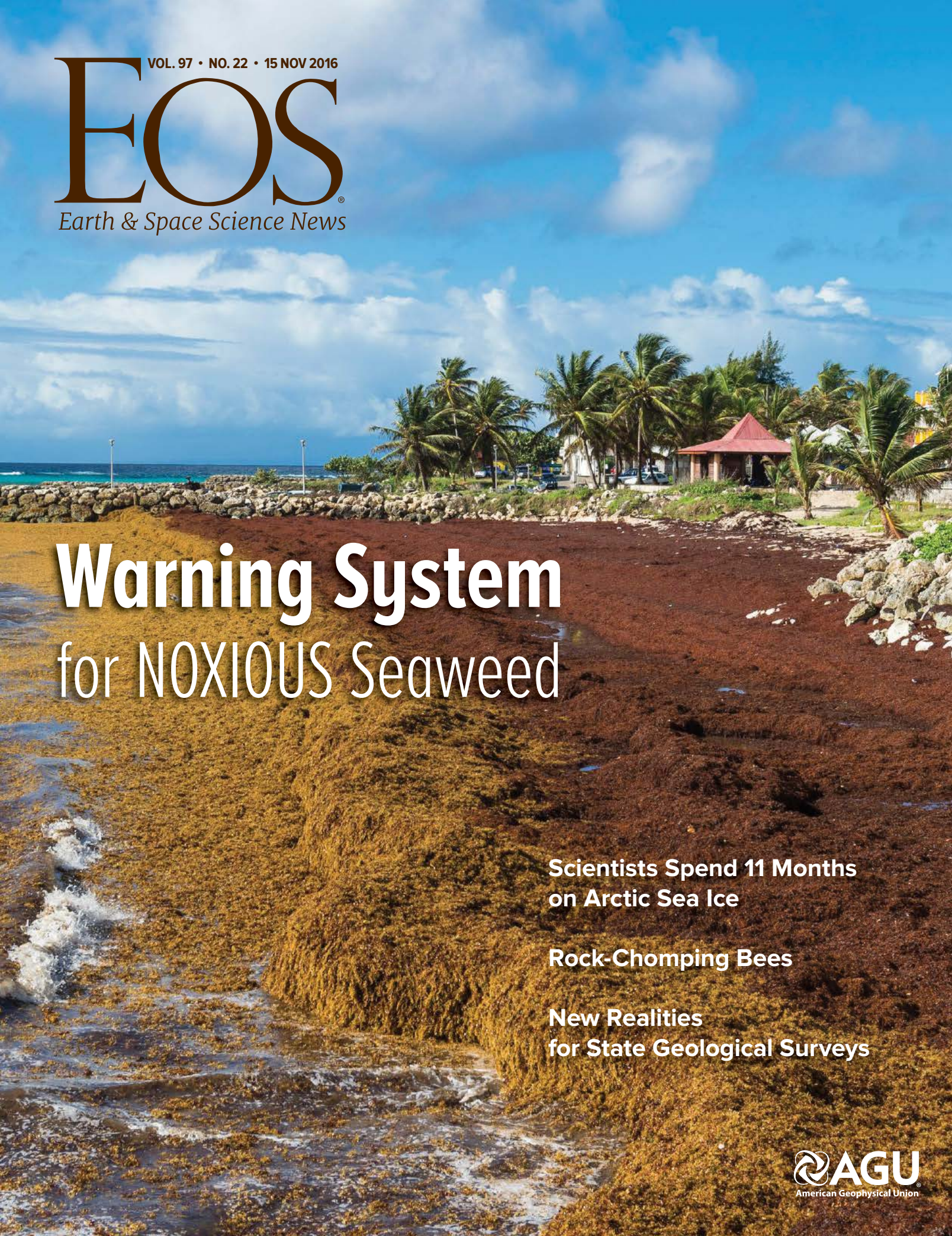


Warning System for NOXIOUS Seaweed

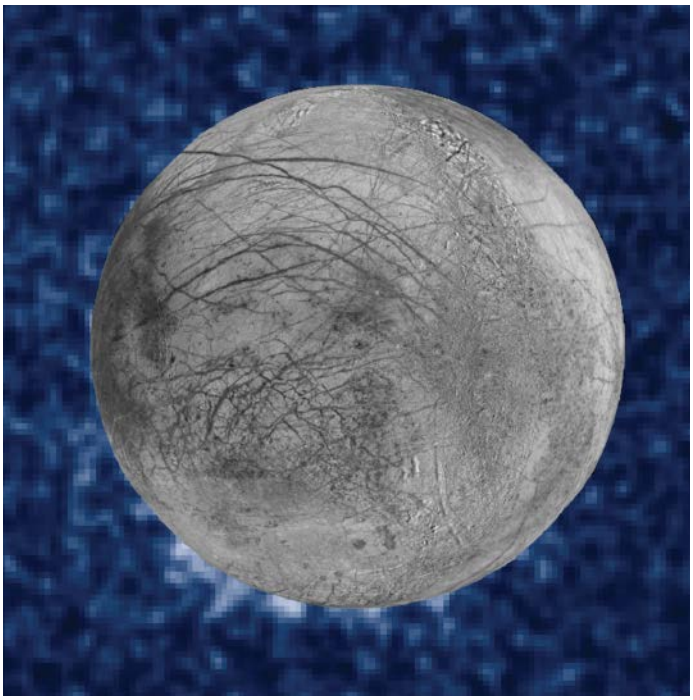
Scientists Spend 11 Months on Arctic Sea Ice

Rock-Chomping Bees

New Realities for State Geological Surveys

AGU American Geophysical Union

New Images Give More Proof for Europa's Plumes



NASA/ESA/W. Sparks (STScI)/USGS Astrogeology Science Center

A black-and-white composite image of Europa from the 1990s era Galileo mission overlays a recent blue-and-white image by the Hubble Space Telescope. Patches and streaks of white along the lower rim of Europa may indicate the presence of plumes of water vapor, observers said.

What could be towering plumes of water vapor that rise as high as 200 kilometers above the icy surface of Jupiter's moon Europa appear as no more than a few grainy pixels when viewed from Earth. Nonetheless, new images from the Hubble Space Telescope strengthen previous evidence that these otherworldly fountains do exist.

The results add to a long saga of interest in Europa. Ever since the Galileo mission discovered Europa's subsurface ocean in 1996, the intriguing moon has held the attention of both scientists and nonscientists as a space oddity—notably, one that might have the potential for life because of its liquid water.

If these plumes do exist, they would likely open the door to other avenues of investigation, according to Louise Prockter, director of the Lunar and Planetary Institute in Houston, Texas.

"It's potentially great if [the images] do show plumes from Europa…because that means Europa's subsurface is coming to us. We could sample the subsurface material without digging through ice," she said in an interview. Prockter, a former member of the Galileo Europa Mission, was not involved in the new Europa study.

Taking a Different View

The team of scientists, led by William Sparks, a researcher at the Space Telescope Science Institute in Baltimore, Md., used a novel method to acquire an independent corroboration of the plumes that they say is statistically significant.

The plumes were discovered by Lorenz Roth and his coauthors in 2012 when they surveyed a silhouette of Europa against the background of space for spectral lines of hydrogen and oxygen—indicators of water (see http://bit.ly/2012-plumes). Sparks and his colleagues, however, made their observations as Europa passed in front of its mother planet Jupiter, as Sparks explained at a late September press conference.

Exoplanet discoverers commonly use this method, called transit photometry, to find their quarry against the backdrop of the star it orbits. The technique relies on a simple principle: When an object moves in front of a light source, it blocks out part of that light. The amount of this occlusion can tell observers about the exoplanet, in much the same way that a shadow can tell them about the object that cast it.

Here the task was slightly different. Sparks and his team used Jupiter as a light source but went beyond just detecting dimmed light. Instead, Jupiter's glow provided a sufficiently smooth background against which potential plumes from Europa could be viewed.

The team took its photos of Europa's transit of Jupiter in 2014, but processing them to achieve adequate resolution to spot the plumes took months and months. By using a method different from that used for the original discovery, Sparks and his team gave further credence to the possibility that the plumes exist. They published their findings in the *Astrophysical Journal* on 29 September (see http://bit.ly/ApJ-29Sept).

"These are different approaches, but they complement each other," senior Hubble project scientist Jennifer Wiseman said during the press conference. Wiseman did not participate in the research but served as the transit observers' Hubble science expert.

Three of the 10 images the team made show signs of plumes, all in the same region. Still, Sparks urged caution, warning that the result was not 100% verifiable, in part because Hubble is at its technological limits and lacks the capacity to observe in greater resolution.

But most scientists are in agreement that at the very least, the results are cause for optimism. "Now an independent group using an independent technique seemed to have detected the same thing in more or less the same place," said Francis Nimmo, a professor at the University of California, Santa Cruz, and a collaborator on the first sightings in 2012.

Uncovering Mysteries

If Europa's plumes are really there, they could potentially reveal the secrets of the subsurface ocean to which they may be connected. They could also possibly help expand scientists' understanding of how planets, and icy satellites in particular, form and continue to exist, added Nimmo, an editor of AGU's *Journal of Geophysical Research: Planets.*

Enceladus, a moon of Saturn, had its own plumes confirmed about a decade ago. "What it's telling you is it's not too hard for icy bodies to hang on to their oceans," he said. "Enceladus is tiny, yet somehow, it has an ocean and that ocean has presumably lasted for billions of years."

Although NASA plans to send a spacecraft to Europa in the next decade and the James Webb Space Telescope promises better views of the moon after it becomes operational in 2018, scientists are relying until then on the Hubble Space Telescope for their sharpest views of the ice-encrusted moon.

"We can't fly a mission up close, so the next best thing is to use the Hubble Space Telescope to study Europa from afar," said the director of NASA's Astrophysics Division, Paul Hertz, at the press conference.

By **Daniel Garisto,** Science Writing Intern