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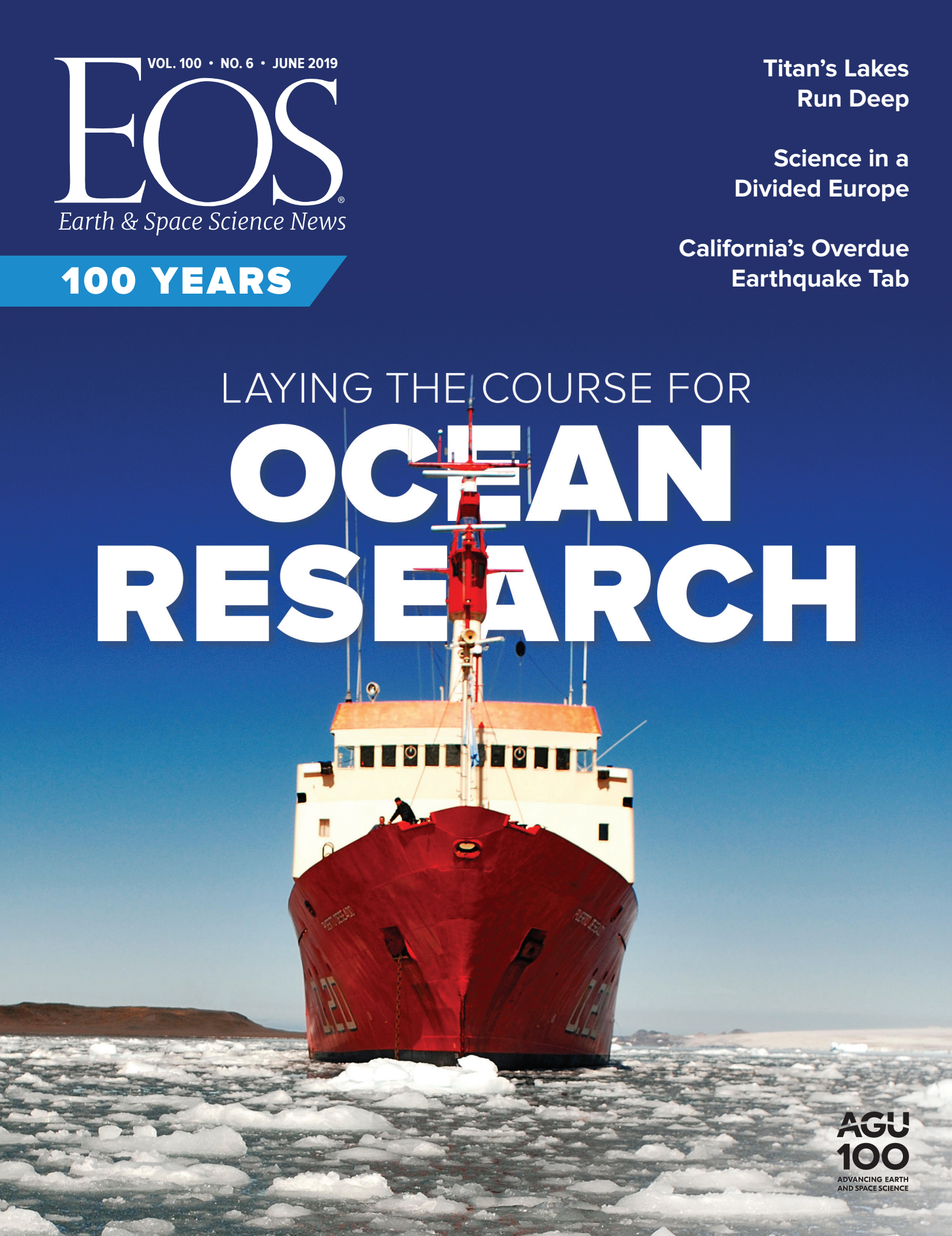

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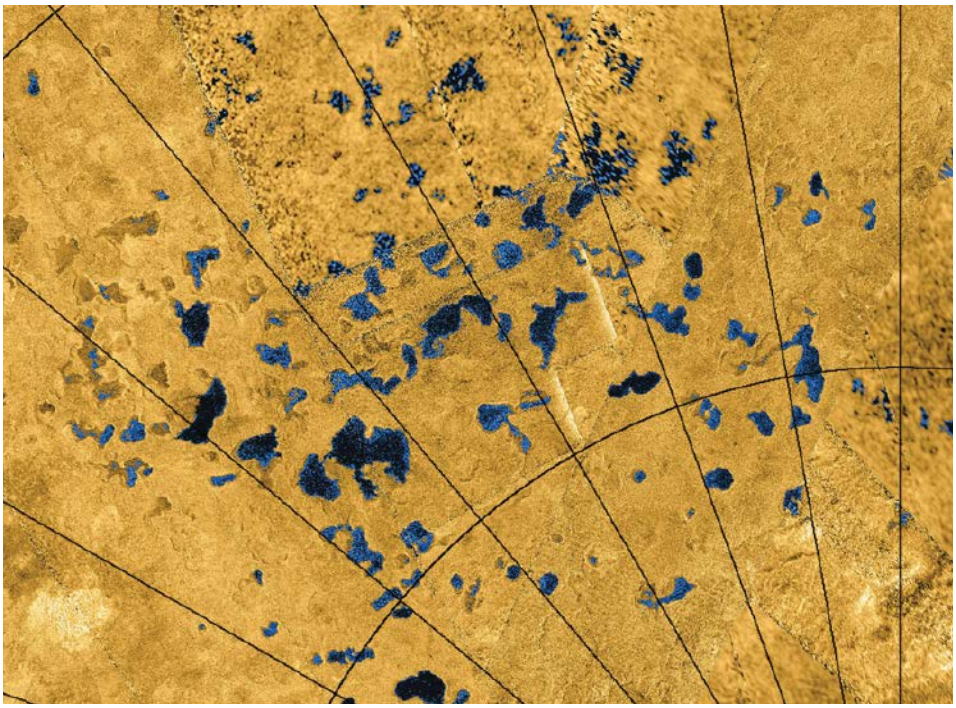
ADVANCING EARTH AND SPACE SCIENCE

Titan's Northern Lake District Has Hidden Depths



A radar map of the lake district near Titan's northern pole. These data from NASA's Cassini spacecraft are falsely colored to highlight areas with liquid hydrocarbons on the surface (blue-black) and areas that are dry (tan) and are overlaid with a geographic grid (black lines). Credit: NASA/JPL-Caltech/ASI/USGS

Titan's north pole is home to the majority of its lakes and seas. Recent analysis of data collected by NASA's Cassini spacecraft revealed that these lakes rest high above sea level yet plunge deep, are filled with methane, and may change with the seasons.

"These new measurements help give an answer to a few key questions," Marco Mastrogiuseppe, a planetary scientist at the California Institute of Technology in Pasadena, said in a statement about the discovery. "We can actually now better understand the hydrology of Titan."

Mastrogiuseppe is the lead author of a 15 April paper in *Nature Astronomy* that discusses the lakes' elevation, depth, and composition (bit.ly/titan-lakes). Another paper, led by Shannon MacKenzie, in the same journal shows how a few northern lakes seemed to disappear as spring set in (bit.ly/seasonal-surface).

"One possibility is that these transient features could have been shallower bodies of liquid that over the course of the season evaporated and infiltrated into the subsurface," MacKenzie, a planetary scientist at the Johns Hopkins University Applied Physics Laboratory in Laurel, Md., said in a statement.

Sounding It Out

During its flybys of Saturn's largest moon, Cassini used its radar instrument to sound out how deep the northern hemisphere lakes are and determine their composition. Mastrogiuseppe's team confirmed for the first time that the northern lakes are primarily filled with liquid methane—about 70%—which had not been directly measured before.

This composition is starkly different from the composition of the only major lake in the southern hemisphere, Ontario Lacus, which is mostly filled with liquid ethane.

The radar data also revealed that Titan's lakes sit hundreds of meters above sea level and that some are more than 100 meters deep. With lake beds so high above sea level, these lakes must be replenished by rainfall, not subsurface liquid flow, the team argues.

"Every time we make discoveries on Titan," Mastrogiuseppe said, "Titan becomes more and more mysterious."

Phantom Lakes

Although some of Titan's northern lakes stretch deep below ground, others seemed to come and go.

MacKenzie and her team identified lakes seen in radar data collected during Titan's winter. Infrared data taken 7 Earth years later, after Titan's vernal equinox, showed that three of those were no longer consistent with having surface liquid.

The researchers suggested that these "phantom lakes" were merely shallow ponds during winter. As Titan warmed into spring, either the ponds quickly evaporated—maybe because the liquid was more purely methane—or the liquid drained into the ground.

Either scenario would help scientists paint a fuller picture of Titan's "hydrologic cycle," which affects the moon's subsurface geochemistry, seasonal weather, and climate evolution.

"MacKenzie et al. suggest lake shoreline changes probably due to subsurface flow, and so do Mastrogiuseppe et al.," Rajani Dhingra, a recent Ph.D. from the University of Idaho in Moscow, told *Eos*.

Dhingra, who has studied Titan's precipitation and was not involved with this work, said that both studies "suggest the importance of subsurface flows and infiltration. The sad part is, we still have not constrained the infiltration rates on Titan," which a follow-up mission to Titan might measure, she added.

This study "shows the value of extending the Cassini mission beyond its initial 4-year lifetime to cover a substantial range of Saturn's seasonal cycle," Bonnie Buratti, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, told *Eos*. Buratti was not involved with this research.

One thing is clear, MacKenzie's team wrote: The phantom lakes don't last for long, so they probably have few nutrients and are unlikely to support life.

"The lakes may not be as habitable as thought," Buratti said. "If they dry up, there isn't time for organics to accumulate there."

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