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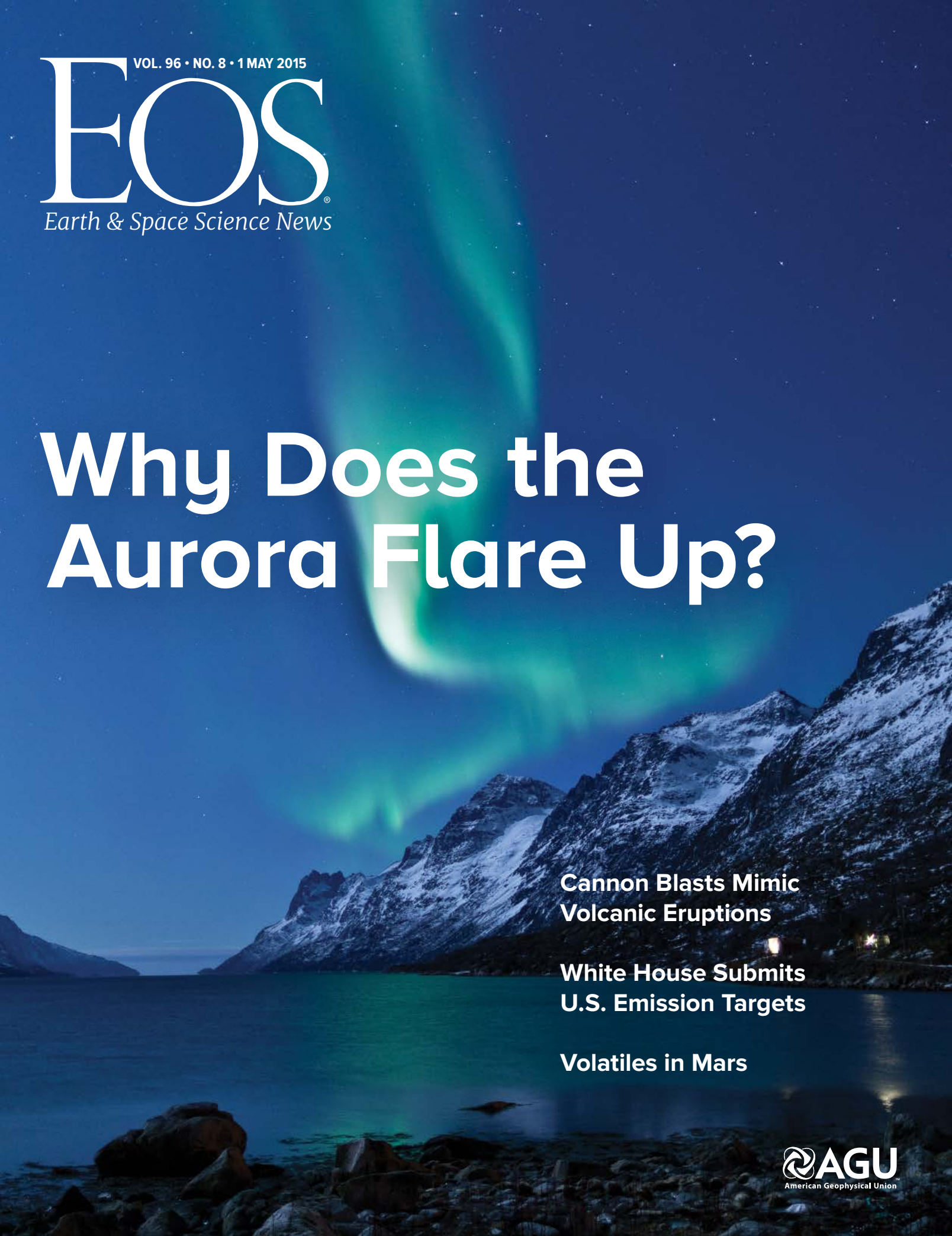


Why Does the Aurora Flare Up?

Cannon Blasts Mimic Volcanic Eruptions

White House Submits U.S. Emission Targets

Volatiles in Mars

AGU
American Geophysical Union

NASA Hopes to Find Strong Indications of Life Beyond Earth Soon

NASA's search for water and for habitable planets and moons in our solar system and galaxy could be on the verge of something big, agency scientists say.

"I think we are going to have strong indications of life beyond Earth within a decade, and I think we are going to have definitive evidence within 10 to 20 to 30 years," NASA chief scientist Ellen Stofan said at a 7 April briefing about the agency's investigation of water and habitable bodies. "We know where to look. We know how to look. In most cases, we have the technology, and we are on a path to implementing it."

"We are on the verge of things that people have wondered about for millennia: Are we alone? And here we are on the verge of finding that out," Stofan said. She noted that scientists now know of many other planetary bodies that could merit further investigation. "I will be quite surprised if we go interrogate these environments and don't find evidence of life. To me, that would be a really surprising scientific result. Finding life, to me, is not the surprising result. It would be the absence of life that would be the surprising result."

> "We are going to have strong indications of life beyond Earth within a decade."

"We are not talking about little green men. We're talking about little microbes," she added. "We are looking for the building blocks of life, organic material that might tell us that some process is going on."

Looking Within and Outside the Solar System

The search for water and habitable bodies has accelerated with numerous recent missions and findings.

For instance, within our Solar System, NASA scientists suggested in March that Mars once had as much water as the Arctic Ocean. The water could have covered almost half of the planet's northern hemisphere at more than 1.6 kilometers in depth in some locations, according to the scientists, who analyzed data from ground-based observatories. In addition, NASA's Curiosity rover discovered an ancient streambed, among other findings.

Jupiter's icy moons Ganymede, Europa, and Callisto show evidence of oceans beneath their surfaces, as do Saturn's moons Enceladus and Titan. The Obama administration's fiscal year 2016 budget request to Congress supports the formulation and development of a Europa mission.

Outside of our solar system, the Kepler space observatory mission's search for habitable planets has detected 4633 candidate planets and has confirmed 1019 as of early April. The Transiting Exoplanet Survey Satellite, scheduled to launch in 2017; the James Webb

NASA

Panelists (left to right) John Grunsfeld, associate administrator for NASA's Science Mission Directorate; Jim Green, director of NASA's Planetary Science Division; Jeffery Newmark, interim director of NASA's Heliophysics Division; Paul Hertz, director of NASA's Astrophysics Division; and Ellen Stofan, NASA chief scientist.

Space Telescope, on target for a 2018 launch; and the planned Wide-Field Infrared Survey Telescope (WFIRST) mission could advance the discovery of more extrasolar planets.

"Where Is Everybody?"

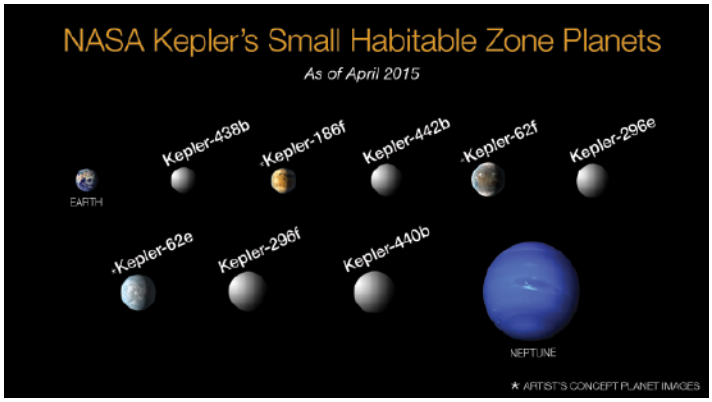
John Grunsfeld, associate administrator for NASA's Science Mission Directorate, said that Kepler has led to the understanding that we live in a galaxy and a universe filled with solar systems. Within these, he explained, many planets may resemble Earth: rocky planets in a potentially habitable zone.

"We are finding somewhat surprisingly that our universe [and] our galaxy are filled with habitable environments," Grunsfeld said. "It really does beg the question, 'If there are so many places that life could exist, where is everybody?' That's part of the question of are we alone. Of course, we have only been a spacefaring world for little over 50 years. I think it is amazing that we have made so much progress in such a short period of time," he added.

"In our own solar system, we have a chance of finding that there might have been past life on Mars, or evidence of current microbial life, sometime in the next generation of explorers," he said. Looking beyond our solar system, Grunsfeld said that the generation of telescopes after Webb could provide a high-precision spectrum from the atmosphere of a planet orbiting a nearby star "that would provide solid evidence that there is some sign of life out there."

Galaxy Is "a Soggy Place"

Paul Hertz, director of NASA's Astrophysics Division, said that our galaxy is "a soggy place," as is our solar system. He said that water has been detected in many locations, including in interstellar clouds in which planetary and star systems form. "But the place that we are most interested in looking is at worlds in 'habitable zones' around stars other than our Sun," Hertz said.



NASA

Small planets within habitable zones, identified by the Kepler mission.

The habitable zone, Hertz said, is "a fuzzy concept" that scientists argue about. Generally, the zone is considered to be a region of space around a star where one would expect to find liquid water on the surface of a planetary body, he said. However, within our solar system, Venus and Mars each arguably fall within the habitable zone, but neither currently has liquid water on its surface, he said. Some of the icy moons of Jupiter and Saturn, which fall outside of the traditional definition of the habitable zone, may have liquid water.

> "You can't write down a formula for [the habitable zone], but you know it when you see it."

Regarding the habitable zone, Hertz concluded, "You can't write down a formula for it, but you know it when you see it."

The Solar Wind

A number of factors could help to determine whether a planet or moon might be habitable, including the body's atmosphere and whether it has a magnetic field. Jeffery Newmark, interim director of NASA's Heliophysics Division, said the interaction of the solar wind with planets "is crucial for our understanding of the lifecycle of water on these planets and indeed the habitability throughout the universe."

He said that although Mars may have been covered by water 3–4 billion years ago, the absence of a significant Martian magnetic field may have allowed the solar wind to interact directly with Mars's upper atmosphere and "strip away the atmosphere and water" from the planet.

An Exciting Time

Jim Green, director of NASA's Planetary Science Division, said the study of the magnetic field and its interaction with the solar wind is an important element for understanding how Earth's magnetic field might have protected our home planet over the millennia. "We are now understanding how complicated yet connected the kinds of phenomena—like gravity, like rocky bodies, like magnetic fields, and like water—are playing in developing an environment for life and also maintaining it for long periods of time."

Green said this is an exciting time for the search for water and habitable planetary bodies, with the scientific community making enormous progress on many fronts. Green noted, for instance, a series of findings about icy moons around Jupiter and Saturn that "changes our perspective of where habitable zones are completely" because they can be around giant planets in addition to being around stars.

He also focused on Mars rovers. The Curiosity rover is poised to make more discoveries on Mars, Green said, adding that the next Mars rover, equipped with ground-penetrating radar and other instrumentation, is set to launch in 2020. That new rover would rigorously investigate another potentially habitable region on that planet. "Man, I don't know what we're going to find there," he said.

By **Randy Showstack,** Staff Writer