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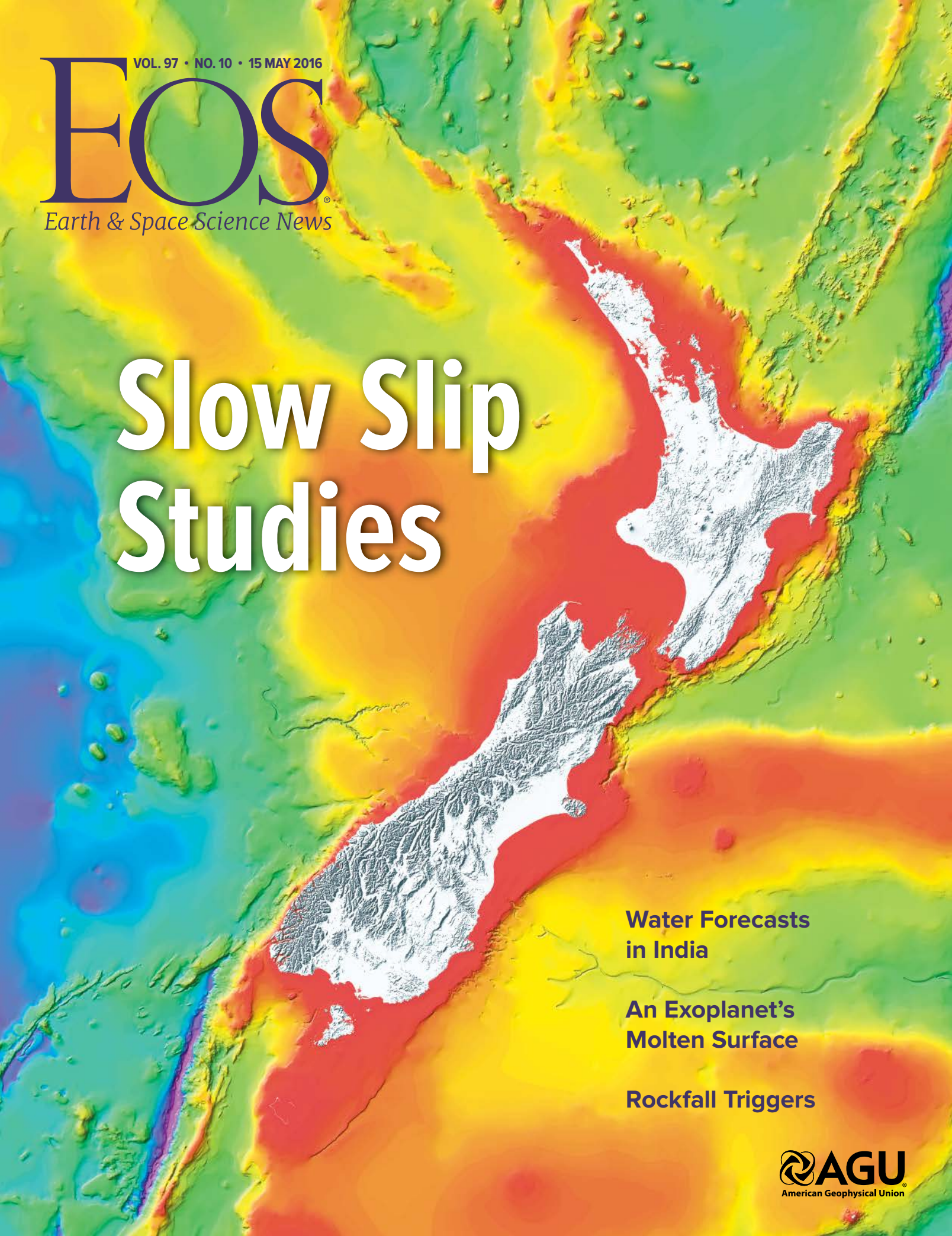

Slow Slip Studies

Water Forecasts in India

An Exoplanet's Molten Surface

Rockfall Triggers

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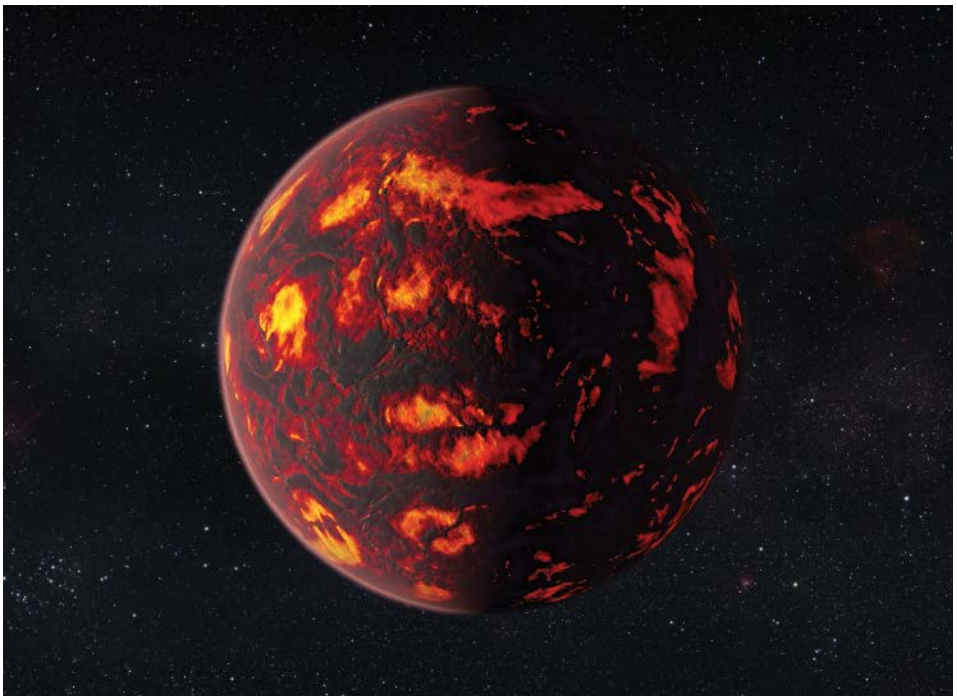
Space Telescope Findings Suggest Molten Planetary Surface



ESA/Hubble, M. Kornmesser

An artist's representation of 55 Cancri e, which orbits a star 40 light-years from Earth in the Cancer constellation. The planet, which has an 18-hour "year," may have lava flowing over much of its surface.

One of the closest super-Earths, 55 Cancri e, may have flowing lava over a vast expanse of its surface according to a new thermal map—the first of its kind.

The exoplanet resides in a solar system 40 light-years away from ours and orbits its star every 18 hours, 70 times closer to it than Earth is to the Sun. It is no surprise that the planet is roasting, but over the past decade perceptions of 55 Cancri e have changed dramatically.

When scientists discovered the planet in 2004, they were unsure whether it was a smallish gas giant or a large rocky planet. In 2011 the planet's transit—when it passes between its star and the Earth—revealed that it was roughly twice the size of Earth and about 8 times the mass, putting it into the super-Earth category.

At the time, measurements suggested a thick atmosphere of water vapor or carbon dioxide surrounding a rocky inner body. However, that theory was scrapped when better measurements of the planet ruled out water vapor in the atmosphere.

Other scientists then suggested the planet consisted of primarily carbon—as opposed to the Earth's oxygen-rich interior—in the form of graphite and diamond, and thus it was dubbed the "diamond planet" (see http://bit.ly/Diamond-Planet). These findings have also been called into question.

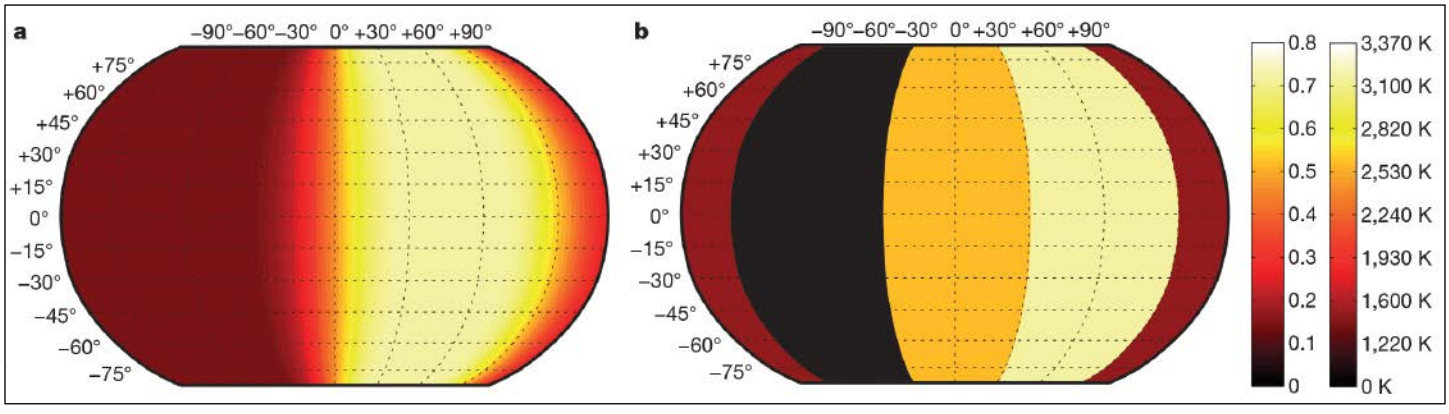
In a paper published in late March in *Nature* (see http://bit.ly/Super-Earth-map), researchers suggest something new—that the planet's surface could consist largely of flowing lava.

Super-Earths are all over the galaxy but are absent from our own solar system, so exploring this solar system diversity can give us clues about solar system formation and planet migration, said Brice-Olivier Demory, an astrophysicist at the University of Cambridge in the United Kingdom and lead author on the paper.

Lava World

Demory and his team used the infrared camera aboard the Spitzer Space Telescope, which orbits Earth, to observe 55 Cancri e. The telescope took millions of measurements of infrared light from the planet as it revolved multiple times around its star in 2013.

Because the planet is tidally locked, meaning that one side always faces the star and one side faces away—just like our own Moon—only the nightside was visible as the planet transited its star. The observers could view the dayside of 55 Cancri e only just before and just



Demory et al., 2016, doi:10.1038/nature17169

A longitudinal heat map of 55 Cancri e, created by Demory and his colleagues. The yellow portions represent hotter temperatures, which are offset from the center. This offset suggests the presence of flowing lava.

after the planet passed behind the star. The infrared camera is especially sensitive to temperature variation, which allowed the researchers to build the first thermal map of a super-Earth, Demory said.

Surprising Features

The map revealed surprising features reported in the new paper: First, the dayside temperature of 55 Cancri e, about 2700 kelvins (2427°C), surpassed its nightside temperature by about 1300 K (1027°C). This pattern casts doubt on the existence of a thick atmosphere, which would have circulated the heat relatively evenly around the planet, Demory said. Second, the researchers found that the hottest spot on the planet, which they expected to be centrally located on the dayside, appears about 41° of longitude to the east.

"We may have a bit of [heat] circulation on the planet, not from the atmosphere but mainly from lava," Demory explained. At the searing dayside temperatures, silicate-based rocks are molten—as they are below the crust on Earth. On 55 Cancri e's dayside, the researchers suggest the lava could be flowing almost like water. As the planet orbits the star, the lava would flow toward the nightside, where it would cool significantly and thicken, possibly even solidifying.

Large, gassy exoplanets called "hot Jupiters" exhibit similar flow dynamics of gases, Demory said, with a hot spot offset from the center.

> "The suggestion of lava flow is intriguing—this is something that has never been detected before."

"The suggestion of lava flow is intriguing—this is something that has never been detected before. If the response to this high-temperature environment really is extrusion of molten lava, this gives us information about the internal structure of this unseen planet," said Debra Fischer, an astronomy professor at Yale University in New Haven, Conn., who wasn't involved in the research. "The analysis is beautiful, and alternative explanations have been carefully considered."

Planetary Implications

"A study like this that hones in on one planet may seem limited in scope but is actually critical to our understanding of super-Earths because there are still only a handful of these planets that are characterizable in such detail," said Johanna Teske, an astronomer at the Carnegie Institution of Washington in Washington, D. C., who also wasn't involved in the paper.

Many more observations are needed to confirm the presence of lava and to better understand the planet, Demory said. The fact that super-Earths are relatively common in the galaxy makes "us wonder why we don't have any" in our own solar system, he continued. Studying planets like this is "paramount to better understanding our own origins."

By **JoAnna Wendel,** Staff Writer