Juno mission spots most powerful volcanic activity on Io to date

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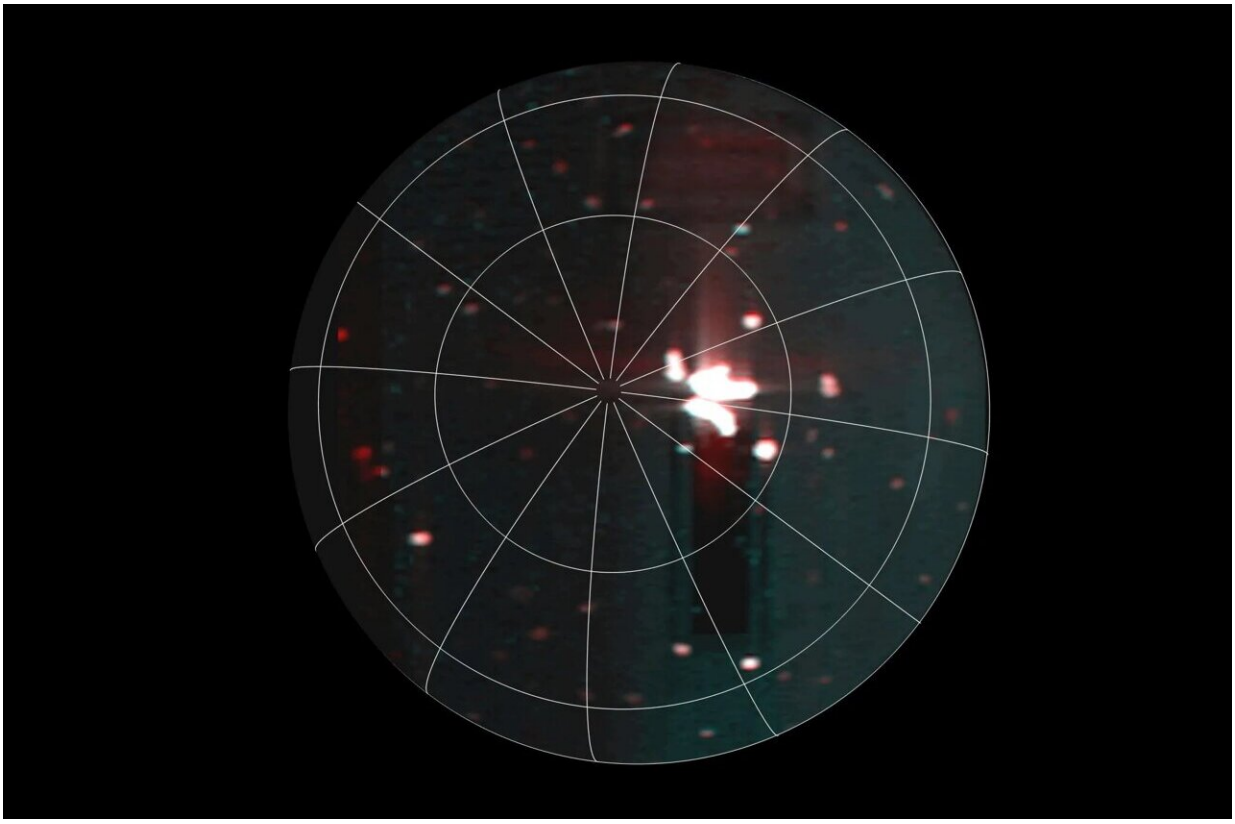


A massive hotspot—larger the Earth's Lake Superior—can be seen just to the right of Io's south pole in this annotated image taken by the JIRAM infrared imager aboard NASA's Juno spacecraft on Dec. 27, 2024, during the spacecraft's flyby of the Jovian moon. Credit: NASA/JPL-Caltech/SwRI/ASI/INAF/JIRAM

Even by the standards of Io, the most volcanic celestial body in the solar

system, recent events observed on the Jovian moon are extreme.

Scientists with NASA's Juno mission have discovered a volcanic hot spot in the southern hemisphere of Jupiter's moon Io. The hot spot is not only larger than Earth's Lake Superior, but it also belches out eruptions six times the total energy of all the world's power plants. The discovery of this massive feature comes courtesy of Juno's Jovian Infrared Auroral Mapper (JIRAM) instrument, contributed by the Italian Space Agency.

"Juno had two really close flybys of Io during Juno's extended mission," said the mission's principal investigator, Scott Bolton of the Southwest Research Institute in San Antonio. "And while each flyby provided data on the tormented moon that exceeded our expectations, the data from this latest—and more distant—flyby really blew our minds. This is the most powerful volcanic event ever recorded on the most volcanic world in our solar system—so that's really saying something."

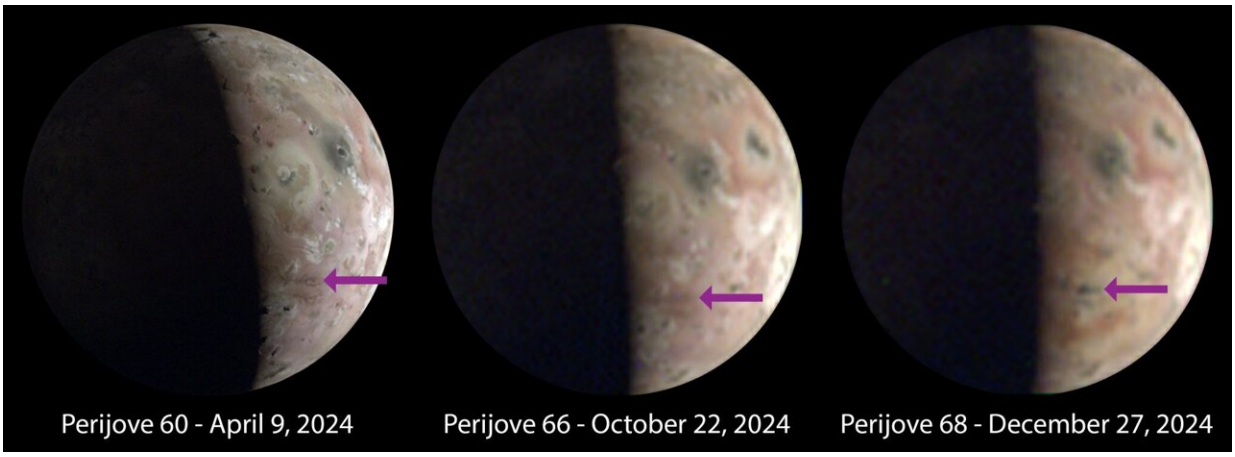
The source of Io's torment: Jupiter. About the size of Earth's moon, Io is extremely close to the mammoth gas giant, and its elliptical orbit whips it around Jupiter once every 42.5 hours. As the distance varies, so does the planet's gravitational pull, which leads to the moon being relentlessly squeezed. The result: immense energy from frictional heating that melts portions of Io's interior, resulting in a seemingly endless series of lava plumes and ash venting into its atmosphere from the estimated 400 volcanoes that riddle its surface.

Close flybys

Designed to capture the infrared light (which isn't visible to the human eye) emerging from deep inside Jupiter, JIRAM probes the gas giant's weather layer, peering 30 to 45 miles (50 to 70 kilometers) below its cloud tops. But since NASA extended Juno's mission, the team has also used the instrument to study the moons Io, Europa, Ganymede, and

Callisto.

During its extended mission, Juno's trajectory passes by Io every other orbit, flying over the same part of the moon each time. Previously, the spacecraft made close flybys of Io in December 2023 and February 2024, getting within about 930 miles (1,500 kilometers) of its surface. The latest flyby took place on Dec. 27, 2024, bringing the spacecraft within about 46,200 miles (74,400 kilometers) of the moon, with the infrared instrument trained on Io's southern hemisphere.



Images of Io captured in 2024 by the JunoCam imager aboard NASA's Juno show significant and visible surface changes (indicated by the arrows) near the Jovian moon's south pole. These changes occurred between the 66th and 68th perijove, or the point during Juno's orbit when it is closest to Jupiter. Credit: NASA/JPL-Caltech/SwRI/MSSS Image processing by Jason Perry

Io brings the heat

"JIRAM detected an event of extreme infrared radiance—a massive hot spot—in Io's southern hemisphere so strong that it saturated our

detector," said Alessandro Mura, a Juno co-investigator from the National Institute for Astrophysics in Rome. "However, we have evidence that what we detected is actually a few closely spaced hot spots that emitted at the same time, suggestive of a subsurface vast magma chamber system. The data supports that this is the most intense volcanic eruption ever recorded on Io."

The JIRAM science team estimates the as-yet-unnamed feature spans 40,000 square miles (100,000 square kilometers). The previous record holder was Io's Loki Patera, a lava lake of about 7,700 square miles (20,000 square kilometers). The total power value of the new hot spot's radiance measured well above 80 trillion watts.

Picture this

The feature was also captured by the mission's JunoCam visible light camera. The team compared JunoCam images from the two previous Io flybys with those the instrument collected on Dec. 27. And while these most recent images are of lower resolution since Juno was farther away, the relative changes in surface coloring around the newly discovered hot spot were clear. Such changes in Io's surface are known in the planetary science community to be associated with hot spots and volcanic activity.

An eruption of this magnitude is likely to leave long-lived signatures. Other large eruptions on Io have created varied features, such as pyroclastic deposits (composed of rock fragments spewed out by a volcano), small lava flows that may be fed by fissures, and volcanic-plume deposits rich in sulfur and sulfur dioxide.

Juno will use an upcoming, more distant flyby of Io on March 3 to look at the hot spot again and search for changes in the landscape. Earth-based observations of this region of the moon may also be possible.

"While it is always great to witness events that rewrite the record books, this new hot spot can potentially do much more," said Bolton. "The intriguing feature could improve our understanding of volcanism not only on Io but on other worlds as well."

Provided by NASA

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