Hydrogen peroxide found on Jupiter's moon Ganymede in higher latitudes

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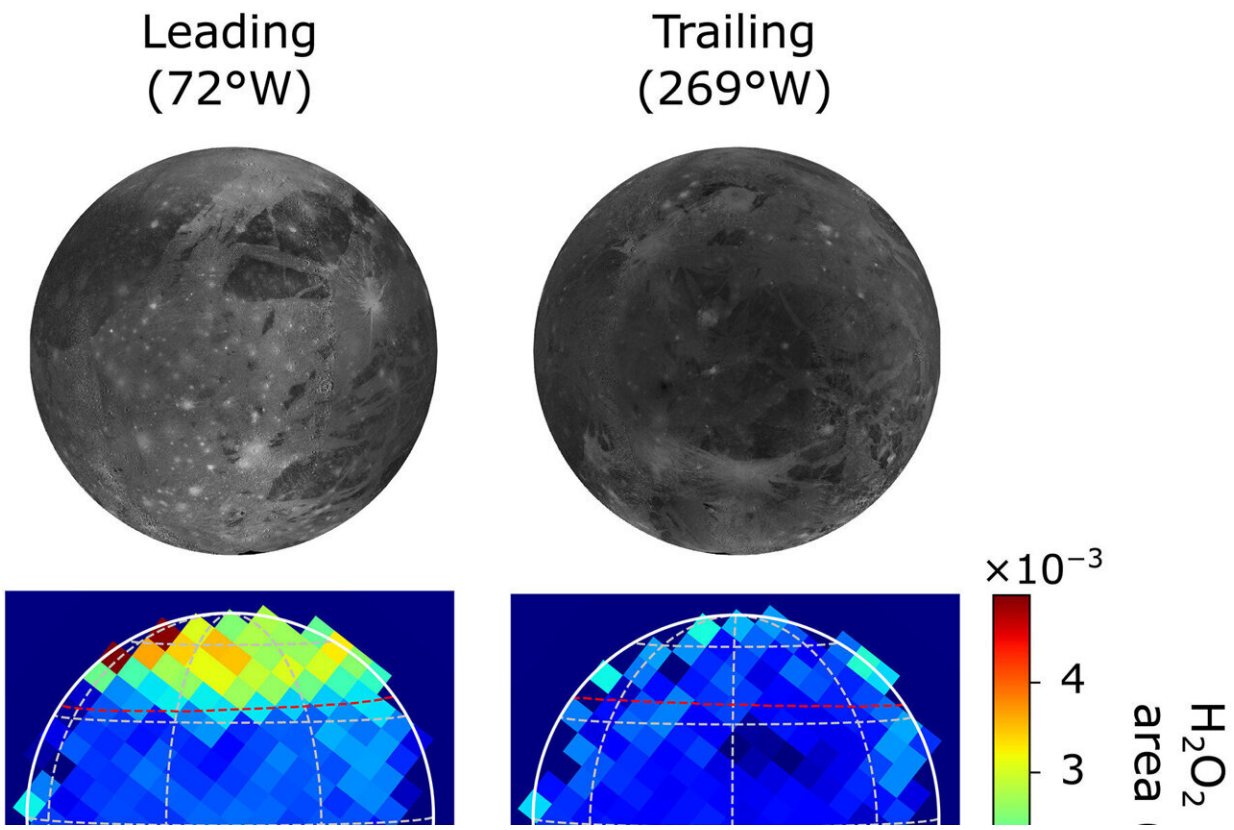

Maps of Ganymede's 3.5 μm H_2O_2 absorption compared to those of the 3.1 μm Fresnel peaks of water ice and corresponding projections of the U.S. Geological Survey *Voyager-Galileo* imaging mosaic. H_2O_2 appears constrained to the upper latitudes, particularly on the leading hemisphere, which exhibits sharp boundaries at approximately ±30° to 35° latitude. These boundaries are roughly coincident with the onset of Ganymede's polar frost caps and with the latitudes at which most of the impinging Jovian magnetospheric particles can access the surface. Maps of the Fresnel reflection peak of water ice, which generally track

the distribution of ice deduced from shorter-wavelength water bands, also show the areas of greatest H_2O_2 on the leading hemisphere to be enriched in water ice. The trailing hemisphere shows comparatively weak Fresnel reflections and, overall, less-icy spectra. This hemispheric dichotomy in water ice may help explain the leading/trailing contrast in H_2O_2, while the overall polar H_2O_2 distribution may reflect a combination of precursor water availability and temperature and/or radiation intensity effects. The approximate average boundary between open and closed field lines from are included as red dashed lines. The 60°S, 30°S, 0°N, 30°N, and 60°N parallels are also included in gray for both hemispheres. The leading-hemisphere map includes the 45°W, 90°W, and 135°W meridians, while the trailing-hemisphere map shows those for 225°W, 270°W, and 315°W. Credit: *Science Advances* (2023). DOI: 10.1126/sciadv.adg3724

An international team of space scientists has found evidence that hydrogen peroxide on Ganymede, Jupiter's largest moon, exists only on its higher latitudes. For their research, reported in the journal *Science Advances*, the group studied data from the James Webb Space Telescope (JWST).

For many years, researchers theorized that hydrogen peroxide existed on Ganymede, but it took a prior team studying data from the JWST to find it. In this new effort, the research team analyzed new data sent back by the telescope to learn more about the surface of the moon and its hydrogen peroxide.

Ganymede is the largest moon in the solar system, but it has not received nearly the attention given to another of Jupiter's moons, Europa, whose features and characteristics make it far more likely to have harbored life at some point in time. But prior research has shown that the influence of Jupiter's magnetic field on many of its moons could indicate a strong probability of hydrogen peroxide on Ganymede. This is because of its

likely impact on the water-ice irradiation process on its surface.

Prior research has shown that both Ganymede and Europa are impacted by radiation from Jupiter's magnetosphere—it bombards the surface of both moons, converting water ice into other compounds such as oxygen, ozone and hydrogen peroxide. In this new effort, the researchers studied data from the JWST NIRSpec Integral Field Unit.

The team found a 3.5-micrometer absorption band showing the presence of hydrogen peroxide in the northern parts of the moon, mostly on the side facing directional orbit. They also observed oxygen mostly seen in lower latitudes and on the opposite side of the moon. The findings show a stark contrast between Ganymede and Europa—on Europa, most of its hydrogen peroxide is located near its equator.

The team notes that their findings are part of a larger process geared toward better understanding how Ganymede's magnetic field influences its own surface chemistry.

More information: Samantha K. Trumbo et al, Hydrogen peroxide at the poles of Ganymede, *Science Advances* (2023). DOI: 10.1126/sciadv.adg3724