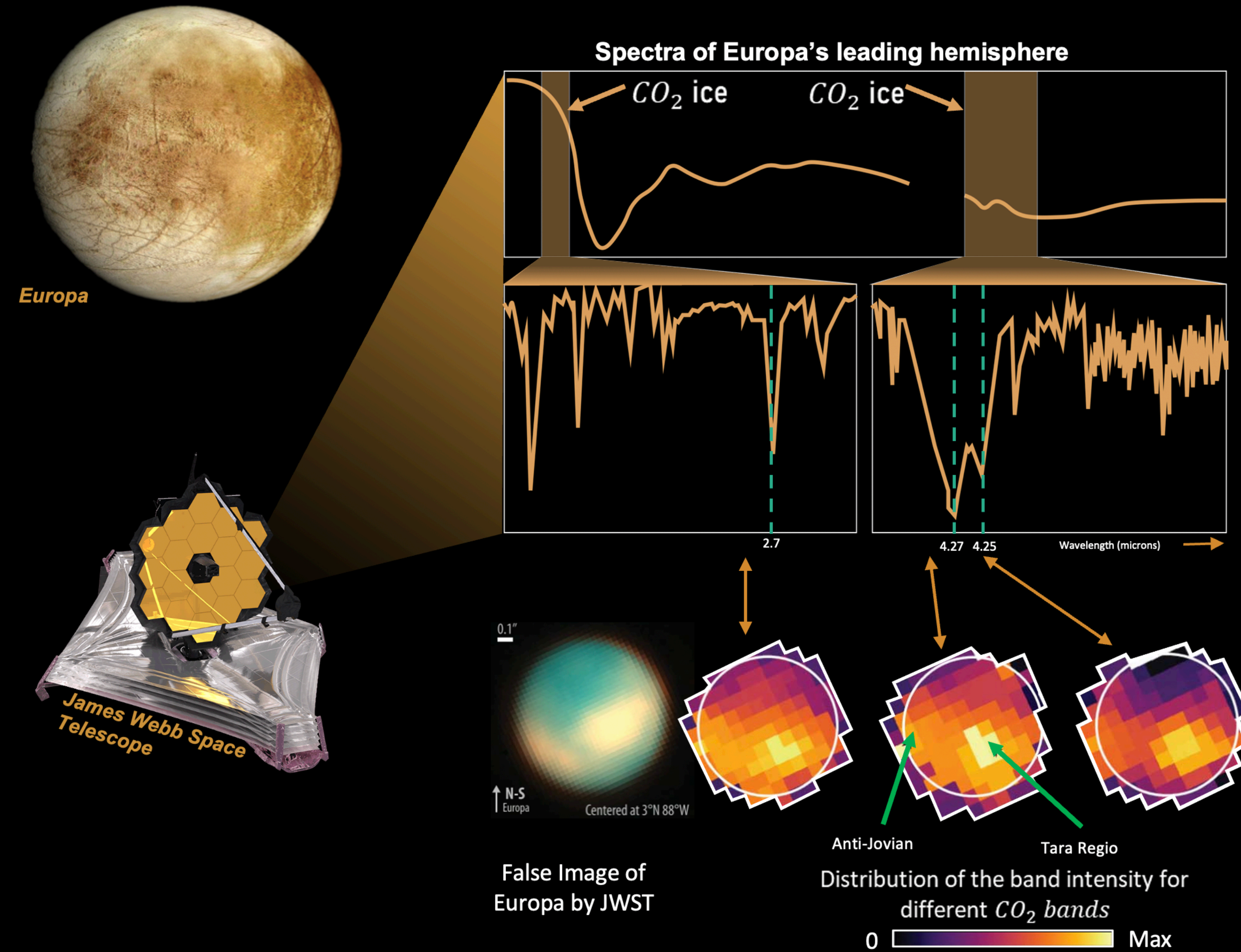


# Endogenous CO<sub>2</sub> ice mixture on the surface of Europa and no detection of plume activity



## Background

Jupiter's moon Europa possesses a subsurface ocean beneath its icy crust. Tidal heating may drive cryovolcanism and the formation of ice domes, providing pathways for subsurface materials to reach the surface. Surface materials on Europa may be *endogenous* (from Europa's subsurface) or *exogenous* (delivered by impacts or from Jupiter's magnetosphere). Europa's surface primarily consists of water ice, along with other various compounds like salts and carbon-bearing molecules. Distinguishing between *endogenous* and *exogenous* surface materials is crucial for understanding Europa's ocean.

## Experiments

In this study, the James Webb Space Telescope was used for observations of Europa on November 23, 2022. The observations included imaging with the **Near-Infrared Camera (NIRCam)** and spectroscopy with the **Near-Infrared Spectrograph (NIRSpec)**. The goal was to search for and to detect plume activity on Europa by analyzing narrow molecular infrared features that fluoresce in sunlight. Surface composition analysis and the search for recently deposited surface material was conducted by evaluating the reflectance spectra of Europa's surface features with NIRSpec.

## Results

- Localized CO<sub>2</sub> was found in high concentrations at Tara Regio region, suggesting the *presence of carbon in Europa's ocean*
- Surface CO<sub>2</sub> distribution suggests it was deposited relatively recently
- Methane (CH<sub>4</sub>), ethane (C<sub>2</sub>H<sub>6</sub>), and methanol (CH<sub>3</sub>OH) bands in Europa's C-H stretch region were **NOT** detected, suggestion *low or absent plume activity on Europa*
- The detection of Carbon, an essential element to life, in the subsurface ocean enhances the *potential habitability of Europa*

