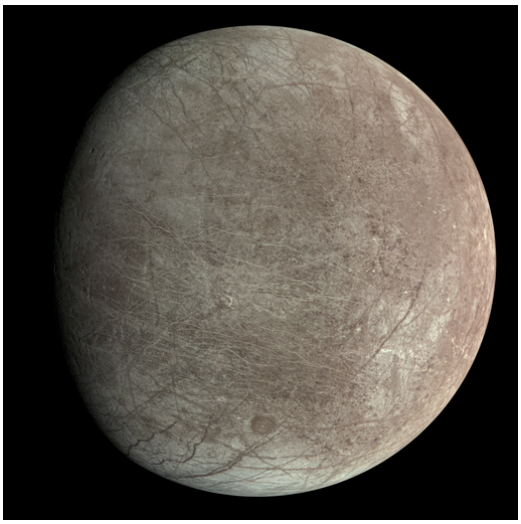
Advanced topics in the Solar System

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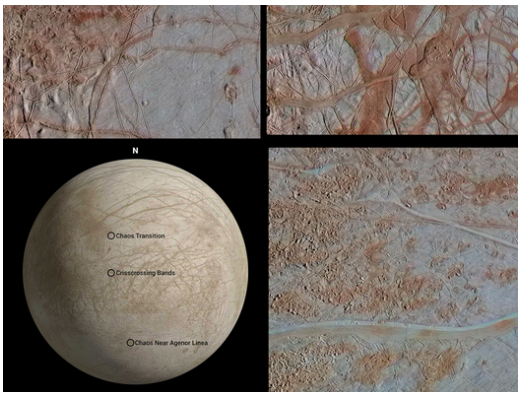
Europa – Full of water, full of life? / Europa – plná vody, plná života?

Basic Facts about Europa

Europa is the smallest and least massive of Jupiter's four Galilean moons (as discovered by Galileo Galilei). It is observable from Earth using common binoculars and is a planetary-mass moon, slightly smaller and slightly less massive than the Moon. It is an icy moon, as such, it exhibits a relatively young surface shaped by tidal heating. Recently, it's become the centre of attention due to it having conditions supportive of life as we know it on Earth.



Europa, as imaged by the Juno spacecraft, in September 2022



Tidal heating: explained

In a system of two bodies near each other, say a planet and a moon, where the moon is much lighter than the planet, tidal forces are observed, because the gravitational force on the closer side of the moon is stronger than on the more distant side of the moon. This causes internal friction of the moon and, by conversion of energy, heat.

The Ice Shell and Hidden Ocean

The surface of Europa is made out of water ice and the current scientific consensus is that underneath that shell there is a subsurface ocean of liquid water.

Because Europa's surface temperature is around -200 degrees Celsius, the ice making up its crust is as hard as granite. The ice surface is crisscrossed by reddish-brown cracks called lineae and is estimated to be quite young, especially compared to other moons in the Solar System.

Europa only has a rather thin atmosphere made out of oxygen, but in 2013 scientists announced that Europa might be actively venting water into space, just like Enceladus. This would mean the moon is geologically active, further strengthening its case as a plausible habitat for life.

Scientists think Europa's ice shell is 15 to 25 kilometres thick, floating on an ocean 60 to 150 kilometres deep. So while Europa is only one-fourth the diameter of Earth, its ocean may contain twice as much water as Earth's global ocean.

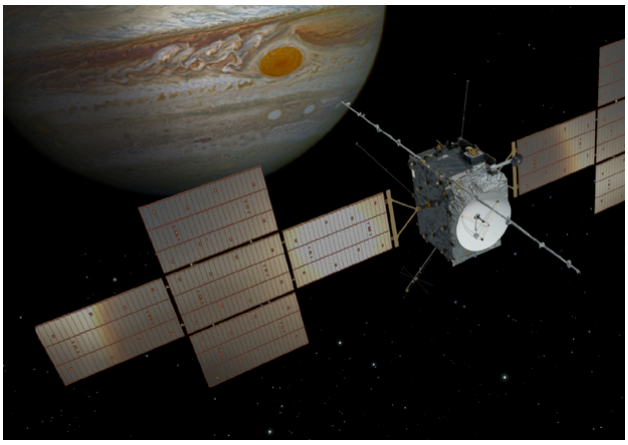
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European take – Mission Juice

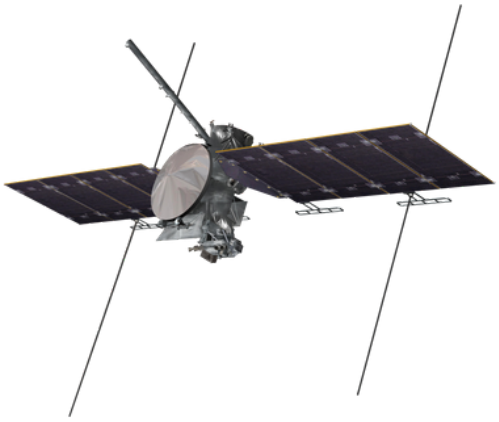
In April 2023, ESA launched the mission Juice – Jupiter Icy Moons Explorer, which will make detailed observation of the giant red planet and its three large ocean-bearing moons, including Europa. First readings from its advanced remote sensing systems are expected in July 2031. Simultaneously, it is the first interplanetary spacecraft to the outer Solar System not launched by the United States, as well as the first probe set to orbit a moon different than Earth's. It aims to study the moons' potential to host extraterrestrial life.



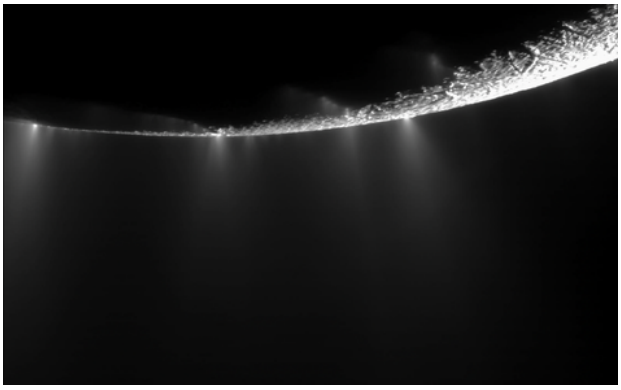
Juice: ESA artistic visual

American take – Europa Clipper

Then there is the Europa Clipper, a NASA mission which will conduct 49 close flybys of Europa, as low as 25 kilometres above the surface of the moon. It was launched in 2024 and should arrive in 2030. Its main scientific goal is to determine whether there are places below the surface of Jupiter's icy moon, Europa, that could support life. Clipper is also set to study the induced magnetic field around Europa as well as the water vapor ejected from its cryovolcanoes.



Europa Clipper: NASA JPL visual



Cryovolcanoes on Europa
courtesy of NASA

Cryovolcanoes

These are ice volcanoes that erupt water, ice crystals, and dissolved salts rather than molten rock like traditional volcanoes. Eruptions mostly consist of water, ammonia, methanol and salts. They are caused by tidal pressure and can be visible from space as illustrated on picture.

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The Discussion around Astrobiology

Europa is one of the top targets in the search for extraterrestrial life within our Solar System, mainly because it possesses a giant subsurface ocean of liquid water. Moreover, Europa is full of elements essential to life as we know it, such as carbon, nitrogen, hydrogen, oxygen, phosphorus and sulfur. This all comes with the very distinct problem of energy, because any microbes living in Europa's ocean will not be able to utilise light from the Sun, as it is impossible for said light to penetrate the thick crust of ice.

It goes without saying, therefore, that any microbial life form found in Europa's oceans will have to have found a different means of energy generation than photosynthesis. Because life on Earth is said to have begun deep in oceans in conditions similar to Europa's, these possible life forms could tell us a lot about how terrestrial life began and how we got here.

Dictionary

- binoculars (bɪˈnɒkjʊləz) - dalekohled
- to exhibit (tə ɪgˈzɪbɪt) - vykazovat, projevovat, vystavovat
- consensus (kənˈsensəs) - shoda, konsenzus
- underneath (ʌndəˈniːθ) - pod, vespod
- crust (krʌst) - kůra (planety), krusta
- granite (ˈgrænɪt) - žula
- venting (ventɪŋ) - unikání, tryskání, vypouštění
- ocean-bearing (əʊʃn̩beərɪŋ) - obsahující oceán
- extraterrestrial (ekstrətəˈrestriəl) - mimozemský
- to conduct (tə kənˈdʌkt) - provádět, vést
- to penetrate (tə ˈpenɪtreɪt) - proniknout, pronikat
- terrestrial (təˈrestriəl) - pozemský, suchozemský

Why is Europa the most promising place to find life in our Solar System?

Write here...

If you're done, write in your notebook...

Do you know of any other places in our System with similarly great prospects?
What building blocks are essential to life, in your opinion?
Take a guess, will those missions find life on Europa? Defend your stance.