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SPACE EXPLORATION OF ICY MOONS TO DETERMINE THEIR ASTROBIOLOGICAL POTENTIAL

Abstract

Besides Mars, currently under extensive exploration (with orbiters like Mars Express, ExoMars/TGO, Al-Hamal and various rover missions on the surface like Mars2020/Perseverance and Tianwen-1), the large satellites of the gas giants Jupiter and Saturn, at orbits beyond the snow-line and the traditional "habitability zone", have been revealed as extremely astrobiologically interesting bodies by missions like Galileo, Cassini-Huygens and Juno, presenting promising conditions for habitability and the development and/or maintenance of life.

Jupiter's Europa and Ganymede show indications of harboring liquid water oceans under their icy crusts, which, in the case of Europa, may be in direct contact with a silicate mantle floor and kept warm through time by tidally generated heat. Around Saturn, Titan and Enceladus, were found to possess organic chemistries with seasonal variations, unique geological features and internal liquid water oceans [1]. The icy satellites provide a conceptual basis within which new theories for understanding habitability can be constructed.

In view of many questions remaining unanswered [2], these bodies will be further investigated in the future by missions in the giant planets systems. Future exploration towards the Galilean satellites include missions such as ESA's JUpiter Icy moons Explorer (JUICE, [3]) (whose main target is Ganymede and will be launched in 2023 for arrival in the jovian system in 2031) and NASA's Europa Clipper mission. For a return to Titan, NASA has recently selected the Dragonfly mission [4] and other concepts are being studied. I will focus on the new scientific insights that will be offered by JUICE and Dragonfly.

References

Coustenis, A., 2021. "The Atmosphere of Titan". In Read, P. (Ed.), Oxford Research Encyclopedia of Planetary Science. Oxford University Press.

Nixon, C. A., et al., 2018. PSS, 155, 50-72.

Coustenis, A., Witasse, O., Erd, C., 2021. The JUICE mission: expectations and challenges. Fall issue of The Bridge on space exploration, Sept. 2021, Vol. 51, issue 3, pp. 41-50. https://www.nae.edu/260902/The-JUICE-Mission-Challenges-and-Expectations

Barnes, J. et al., 2021. The Plan. Sci. J., 4, 18.