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Exploring Enceladus on Earth: the case of the Strytan shallow water hydrothermal system

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As planetary exploration of Icy Moons and rocky planets is becoming an increasing reality, Enceladus has become one of the primary astrobiological targets [1]. The Cassini-Huygens mission, through plume analysis [2], has provided insights into Enceladus internal geological dynamics, revealing the presence of subsurface water oceans, hydrothermal vent activity, and thus potential habitability [3]. Due to the economical and technological challenges of space missions, terrestrial analogues play a crucial role in enhancing our understanding of extraterrestrial life, through the development of remote-sensing techniques and data analysis methodologies. Specific geothermal sites on Earth share similarities with hypothetical conditions beneath icy moon surfaces, making them valuable natural laboratories [4]. Located in Iceland, Strytan alkaline hydrothermal vent is considered a unique analogue for Enceladus vents due to the similar composition and expected origin process [5]. This study aims to understand the physiological adaptations of prokaryotic life inhabiting Strytan, through 16S rRNA amplicon sequencing, metagenomics, and high resolution geochemical analysis. Through experimental approaches, it is also possible to characterize microbial communities and assess extremophile resilience to Enceladus simulated conditions. We argue a possible development in the context of habitability and biosignature detection for future space missions to icy moons, expanding our knowledge on the physicochemical limits of life.

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