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# ENCELADUS REVISITED: NEW VISIONS FOR CUTTING COSTS AND RISKS IN EXPLORING THE SUBSURFACE OCEAN

**Abstract**

Since Cassini's groundbreaking discoveries are pin-pointing towards a subsurface, possibly life harbouring ocean on Saturn's moon Enceladus, it seems imperative to peek below its icy shell.

Due to Saturn's gravitational grip, Enceladus is a highly active object. Thus, there is a very likely chance for failure, e.g. sudden structural changes within the ice layer could stop a mission before any data is collected. Cost-benefit-risk evaluations between plume and ocean exploration underlined that any realistic project going that far into space (with no real option to correct unforeseen events) leaves no choice but to make it as bulletproof and efficient as possible. To achieve this goal, we went for extreme minimisation: reducing as many mechanical parts as possible, optimising the shape and used materials, battery life and size. Furthermore, we created a whole new design for communicating from within the ocean up to the carrier craft.

We came up with an unprecedented transport and orbiting vessel, plus a revolutionary new landing method. The last can deliver a whole fleet of micronised autonomous submarines (subs) relatively hassle-free through the ice whenever an access window into an active cryo-volcanic vent gets detected by the orbiter – a scenario eliminating many challenges and obstacles of traditional landers, mechanics, drilling or melting tools. Once inside the ocean, the subs will explore the unknown for as long as their power supplies will allow. Although we aim to reach the assumed hydrothermal fissures and their structures, all subs can perform their tasks even if they get stuck along the way, e.g. in ice cracks or water pockets.

Due to the significant number of subs delivered, they can operate in several groups equipped with different instruments onboard. In addition to LIDAR technology and an array of different camera types (including microscopic imaging), all subs can analyse a vast catalogue of molecules, search for serpentinisation and identify cell-like structures.

Enceladus is a category V protected world; hence its environmental safety and hypothetical organisms are our uppermost priority. Consequently, all subs work as encapsulated devices, including their movement apparatus and instruments, except for a sample entry lock. Samples taken will be analysed on a one-way path and kept inside the device. Moreover, the submarines and the orbiter are retrievable from the moon's environment.

Please note: This concept is adaptable to target Europa or both ocean worlds in one mission.