



Looking for Life in the Ocean Worlds of the Outer Solar System

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Interest in searching for life in the outer solar system has intensified recently with the new start of the Europa Multiple Flyby Mission and the insertion through a NASA community announcement of an Ocean Worlds (Titan and Enceladus) theme in the list of possible New Frontiers Missions. As part of a Discovery proposal called “Enceladus Life Finder”, or ELF, a multidisciplinary team of scientists led by the authors developed a set of measurements for determining the habitability of Enceladus’ internal ocean and the presence of biological activity therein, obtained by flying through Enceladus’ plume. We call this set of measurements “Life’s intrinsic forensic evidence”, or LIFE. The LIFE protocol is implemented by flying two mass spectrometers through the plume –one optimized for gas and the other for ice. The measurements and information derived therefrom cut to the heart of what biological activity does that distinguishes it from abiotic processes. They also tightly constrain the essential parameters of ocean habitability including pH, redox state, available free energy and temperature of any active hydrothermal systems on the floor of the Enceladus ocean. In addition to Enceladus, such a protocol is applicable to Europa should deep-seated plumes be present there, Further, with appropriate modifications from terrestrial-type biochemistry, LIFE is potentially applicable to testing for exotic biochemistries in the seas of Titan. In this talk we will focus on the basic concept of the LIFE protocol and explain its application to each of these bodies.