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Author: Mr. Brent Sherwood
Caltech/JPL, United States, brent.sherwood@jpl.nasa.gov

Prof. Jonathan Lunine
Cornell University, United States, jlunine@astro.cornell.edu
Mr. John Elliott
National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory, United States, jelliott@jpl.nasa.gov
Prof. Sascha Kempf
University of Colorado Boulder, United States, sascha.kempf@lasp.colorado.edu
Mr. Travis Imken
Jet Propulsion Laboratory, United States, Travis.Imken@jpl.nasa.gov
Dr. Peter Kahn
Jet Propulsion Laboratory, United States, skibum@jpl.nasa.gov
Mr. Andreas Frick
(country is not specified), *(email is not specified)*
Mr. Daniel Belter
Jet Propulsion Laboratory, United States, Daniel.J.Belter@jpl.nasa.gov
Ms. Kelli McCoy
Jet Propulsion Laboratory, United States, Kelli.J.Mccoy@jpl.nasa.gov
Dr. David Oh
Jet Propulsion Laboratory - California Institute of Technology, United States, david.y.oh@jpl.nasa.gov
Dr. J. Hunter Waite
Southwest Research Institute, United States, Hwaite@swri.edu
Mr. Michael Dinicola
Jet Propulsion Laboratory, United States, Michael.Dinicola@jpl.nasa.gov

SYLPH: LIFE DETECTION IN A EUROPA PLUME

Abstract

An investigation and system concept is described, that would equip NASA's ocean-worlds flagship mission (aka Clipper, in development now) to directly sample the chemistry of an ocean plume at Europa. Cassini discoveries at Enceladus indicate that space-flight instruments available today can exquisitely measure the composition of ice grains, dust grains, and gas in an ocean plume, revealing the ocean's habitability and even detecting chemical signatures of extant life with multiple, independent tests. Episodic ocean plumes at Europa are unlikely to be confirmed before Clipper's launch in the early 2020s. As an "insurance policy" for this possibility, Sylph is designed to perform the only plume measurement that Clipper itself cannot make: mass spectrometry of large ice grains (frozen ocean spray), which fall out of the plume 20 km below Clipper. Sylph is a rad-hard, terrain-guided AutoNav free-flyer. Its small size (45 kg and about as big as a home-grill propane tank), simple instrument (a small, twin version of Clipper's own particle analyzer SUDA), and modularity allow it to be brutally sterilized during assembly. Initialized by Clipper and deployed from a biobarrier cocoon eight hours before a plume fly-through, Sylph

drops down to 2-5 km altitude, skimming along the moon's surface to make a 3-second pass through the densest part of the plume. Cation and anion mass spectra, and AutoNav images, are relayed to Clipper within 30 minutes; the sterile probe eventually impacts Europa. Using mass spectra of the grains (from Mini-SUDA on Sylph) and gas (from MASPEX on Clipper), members of the Clipper science team can perform a comprehensive life-detection investigation at Europa that NASA vetted in 2015 (for Enceladus). The first Sylph would cost about $85M; copies would cost less, and Clipper could carry two or three.