**THE EUROPA LANDER MISSION CONCEPT AND SCIENCE GOALS – HIGHLIGHTING ICE PROPERTIES AND SURFACE ACTIVITY.** K. P. Hand[1] (khand@jpl.nasa.gov), A. E. Murray[2], J. Garvin[3], S. Horst[4], W. Brinkerhoff[3], K. Edgett[5], T. Hoehler[6], M. Russell[1], A. Rhoden[7], R.A. Yingst[8], C. German[9], B. Schmidt[10], C. Paranicas[11], D. Smith[12], P. Willis[1], A. Hayes[13], B. Ehlmann[1,14], J. Lunine[13], A. Templeton[15], K. Nealson[16], B. Christner[17], M. Cable[1], K. Craft[11], R. Pappalardo[1], A. Hofmann[1], T. Nordheim[1], C. Phillips[1], [1]Jet Propulsion Laboratory, Caltech (khand@jpl.nasa.gov), [2]Desert Research Institute & Univerity of NV, Reno, [3]Goddard Space Flight Center, [4]Johns Hopkins University, [5]Malin Space Science Systems, [6]NASA Ames Research Center, [7]Arizona State University, [8]Planetary Science Institute, [9]Woods Hole Oceanographic Institution, [10]Georgia Tech., [11]Applied Physics Laboratory, Johns Hopkins, [12]Massachusetts Institute of Technology, [13]Cornell University, [14]Caltech, [15]CU Boulder, [16]University of Southern California, [17]University of Florida.

## Introduction

In June of 2016 NASA convened a 21-person team of scientists to establish the science goals, objectives, investigations, measurement requirements, and model payload of a Europa lander mission concept. The Europa Lander Science Definition Team (SDT), following a charter from NASA HQ, refined these requirements into a viable Europa Lander mission concept, and published the Europa Lander Study 2016 report (Europa Lander, 2016). Since the completion of the SDT report, the Europa Lander mission concept team at JPL has refined the mission concept through a Mission Concept Review (MCR), and subsequently through the advice and oversight of an external advisory board. This board was active during the Summer and Fall of 2017, and a final report was presented to NASA HQ in the late Fall of 2017. The Europa Lander mission concept team is currently addressing guidance from NASA HQ in terms of technologies and mission architecture. The science of the mission concept has remained largely constant with respect to the 2016 SDT Report.

## Europa Lander SDT Science Goals

The NASA HQ Europa Lander SDT Charter goals, in priority order, were as follows:

1. Search for evidence of life on Europa.
2. Assess the habitability of Europa via in situ techniques uniquely available to a lander mission.
3. Characterize surface and subsurface properties at the scale of the lander to support future exploration of Europa.

Within Goal 1, the SDT developed four Objectives for seeking signs of life (i.e., biosignatures). These include the need to: a) detect and characterize any organic indicators of past or present life, b) identify and characterize morphological, textural, and other indicators of life, c) detect and characterize any inorganic indicators of past or present life, and d) determine the provenance of Lander-sampled material. Within the Goal 1 investigations and measurement requirements there are more than seven distinct and complementary approaches for detecting potential biosignatures within material sampled from Europa's surface and near- subsurface.

Goal 2 focuses on Europa's habitability and ensures that even in the absence of the detection of any potential biosignatures, significant ocean-world science is still achieved. The objectives within Goal 2 are to: a) **characterize the non-ice composition** of Europa's near-surface material and determine whether there are **indicators of chemical disequilibria**, and b) **determine the proximity to liquid water and recently erupted materials at the lander' s location.**

Goal 3 ensures that the landing site region is quantitatively characterized in the context needed for Goals 1 and 2, and that key measurements about Europa's ice shell are made to enable future exploration. The objectives for Goal 3 include the need to: a) observe the properties of surface and near-surface materials and sub-meter-scale landing hazards at the landing site, including the sampled area (connecting local properties with those seen from precursor Europa flyby remote sensing), and b) characterize dynamic processes on Europa's surface and ice shell over the mission duration to understand exogenous and endogenous effects on the physiochemical properties of surface and shallow sub-surface materials.

## Ice Properties and Surface Activity

Following these objectives, the Europa Lander would: (1) enable physical and chemical characterization of any plume deposits sampled on the surface, (2) characterize the local topography, (3) search for evidence of interactions with liquid water on the surface including cryovolcanic extrusions and evidence for active plumes, (4) search for subsurface water bodies and proximal cryovolcanic conduits, and (5) measure the thickness of the ice shell.

## Implications and Science Return

The Europa Lander mission concept is capable of achieving a suite of measurements such that if potential biosignatures are present on Europa's surface they could be detected at levels comparable to those found in benchmark environments on Earth, and further, that even if no potential biosignatures are detected, the science return of the mission will significantly advance our fundamental understanding of Europa's chemistry, geology, geophysics, and habitability.

## References

https://solarsystem.nasa.gov/docs/Europa_Lander_SDT_Report_2016.pdf