



# Instrument Concepts for Europa Exploration (ICEE-2) Program

Mitch Schulte, Discipline Scientist  
Planetary Science Division  
NASA Headquarters





# Europa Lander SDT – Science Trace Matrix

Goals		Objectives	Notional Instruments					
			OCA	MLD	VS	CRSI	GSS	LISS
BIO-SIGNATURES	1. Search for evidence of life on Europa.	1A. Detect and characterize any organic indicators of past or present life.						
		1B. Identify and characterize morphological, textural, or other indicators of life.						
		1C. Detect and characterize any inorganic indicators of past or present life.						
		1D. Determine the provenance of sampled material.						
SURFACE HABITABILITY	2. Assess the habitability of Europa via in situ techniques uniquely available to a lander mission.	2A. Characterize the non-ice composition of Europa's near-surface material to determine whether there are indicators of chemical disequilibria and other environmental factors essential for life.						
		2B. Determine the proximity to liquid water and recently erupted materials at the lander's location.						
SURFACE PROPERTIES AND DYNAMICS	3. Characterize surface and subsurface properties at the scale of the lander to support future exploration.	3A. Observe the properties of surface materials and sub-meter-scale landing hazards at the landing site, including the sampled area. Connect local properties with those seen from flyby remote sensing.						
		3B. Characterize dynamic processes of Europa's surface and ice shell over the mission duration to understand exogenous and endogenous effects on the physicochemical properties of surface material.						

Instrument classes: organic compound analysis (oca), microscope for life detection (mld), vibrational spectrometer (vs), context remote sensing imager (crsi), geophysical sounding system (gss), lander infrastructure sensors for science (liss). LISS not called in ICEE-2.

Note: Goal 1 has been rescoped to focus on searching for biosignatures.



# Europa Lander SDT – Model payload

Instrument Class [mass allocation, unmarginined], Total = 42.5 kg (with margin)	Model Payload	
	Baseline	Threshold
Context Remote Sensing Instrument (CRSI) [4.3 kg, includes shielding]	2 identical multi-filter, focusable, visible to near-infrared, stereo overlapping cameras with narrowband filters equivalent to those of the Europa Multiple Flyby Mission EIS cameras	2 identical RGB, fixed focus, stereo overlapping cameras
Microscope for Life Detection (MLD) [5.4 kg]	Deep UV resonance Raman and optical microscope with fluorescence spectrometer	Atomic Force Microscope (AFM) with optical context imager
Vibrational Spectrometer (VS) [5.4 kg]		Raman Laser Spectrometer (RLS)
Organic Compositional Analyzer (OCA) [16.4 kg]	Gas Chromatograph Mass Spectrometer (GC-MS) with Chirality Analysis and Stable Isotope Analyzer (SIA)	Gas Chromatograph Mass Spectrometer (GC-MS) with Chirality Analysis
Geophysical Sounding System (GSS) [1.2 kg]	Broad-band seismometer	3-axis geophone



# ICEE-2 Program

---

NRA\* released: 17 May 2018

Step 1 Proposals due: 22 June 2018

Change in POC: 18 July 2018

Step 2 Proposals due: 24 August 2018

Submitted Proposals: 44 Step 2 Proposals were submitted, 43 of which were compliant and reviewed

Government Shutdown: 22 December 2018-25 January 2019

Awards announced: 8 February 2019

\*Reminder: This was an NRA, not an AO.



# ICEE-2 Program

- The Instrument Concepts for Europa Exploration (ICEE) 2 program supports the development of instruments and sample transfer mechanism(s) for Europa surface exploration. The goal of the program is to advance both the technical readiness and spacecraft accommodation of instruments and the sampling system for a potential future Europa lander mission.
- All awardees required to collaborate with the pre-project NASA-JPL spacecraft team and potentially other awardees.
- The ICEE 2 program also seeks to mature the accommodation of instruments on the lander, especially regarding the sampling system.
- While specific technology readiness levels (TRL) are not prescribed for the ICEE 2 program, instrument concepts must be at TRL 6 in the 2021/2022 timeframe.



# ICEE-2 Program

---

- Proposal Information Package (PIP) and Environmental Requirements Document (ERD) provided by JPL team.
  - Included information on resource constraints on lander.
  - Also included information for certain instrument classes.
- Use of resources considered in evaluation.



# ICEE-2 Selections

Fourteen proposals recommended for selection - Covers each class in Science Definition Team report model baseline payload, along with a sample handling instrument and two not in baseline

PI	Title	Instrument class	Institution
Byrne	Cold-Lightweight Imagers for Europa (C-LIFE)	CRSI	U. of Arizona
Bailey	Seismometer to Investigate Ice and Ocean Structure (SIIOS)	GSS	U. of Arizona
Murchie	Europa Lander Stereo Spectral Imaging Experiment (ELSSIE)	CRSI	JHU/APL
Panning	Europa Seismic Package	GSS	JPL
Grimm	Europa Magnetotelluric Sounder (EMS)	GSS	SWRI
Quinn	Europa Luminescence Microscope	MLD	NASA ARC
Arevalo	CORALS: Characterization of Ocean Residues and Life Signatures	OCA	U. of Maryland
Brinckerhoff	European Molecular Indicators of Life Investigation (EMILI)	OCA	NASA GSFC
Glein	MAss Spectrometer for Planetary EXploration-ORganic Composition Analyzer (MASPEX-ORCA) for Europa Lander	OCA	SWRI
Mathies	Microfluidic Organic Analyzer for Biosignatures (MOAB)	OCA	UC-Berkeley
Lambert	Compact Integrated Raman Spectrometer (CIRS)	VS	JPL
Malespin	Collaborative Acceptance and Distribution for Measuring European Samples (CADMES) System	Sampling system	NASA GSFC
Moldwin	Instrument Concepts for Europa Exploration (ICEE-2): Reduced SWAP +C Radiation Tolerant Magnetometer for Europa Lander	Magnetometer on a chip	U. of Michigan
Ricco	MICA: Microfluidic Icy-World Chemistry Analyzer	Wet inorganic chemistry	NASA ARC





# ICEE-2 Program

Award Date: 8 Feb 2019 to 14 awardees

Planned execution duration: 2 years

## Deliverables

Biannual:	Briefings via telecon with NASA program managers
End of Year 1:	Report on detailed spacecraft accommodation; progress reports
End of ICEE-2 Task:	Final Report (< 10 pages); Final Briefing at NASA HQ

Planning to have public workshops on Europa Lander/technology developments

Want entire community to have access to same information in case AO is issued

Format, dates, etc. TBD

Looking for best way to advertise/disseminate information

Questions regarding ICEE-2 Program?

