



Prioritized Technology: Instruments to Locate Regions of Habitability from Orbit/Flyby

Technical Goal

- Determine elemental composition of a planetary surface with **< 10m*** spatial resolution and identify minor components with **< 1%** abundance*
- Identify signatures of newly deposited² surface organic molecules on a planetary surface with **< 10m** spatial resolution with 90% confidence
- Determine ice thickness with 10% depth resolution over 100 × 100 m area on surface
- Identify geological surface features indicative of subsurface-surface exchange at <10m spatial resolution
- Measure ice sheet surface uplift due to tidal flexing to < 1cm at 100m spatial resolution

** <10 m driven by desire to identify regions suitable for scientific interest or sample collection – remote sensing requirements depend on both instrumental performance and orbital/flyby parameters.*

Mission Applications

- Identification of regions within Ocean Worlds where biogenic molecules may be present on the surface within a lander-accessible depth in order to identify promising landing sites
- Identification of regions within Ocean Worlds where the ice shell is thin enough to make penetrating to the subsurface ocean feasible and where tidal flexing may bring water near the surface

Technical Status

Elemental composition (Gamma Ray Spectrometers)

- GRS/Mars Odyssey: spatial resolution ~120-300 km, Si, Fe, H, Cl, K, That precision 0.1-1%
- GRaND/Dawn: spatial resolution ~160 km (0.4*altitude), Fe and water-equivH with < 1% precision, K with 40 ppm precision, all in top 1 m, other elements harder
- Luna-Hmap: 2U instrument; spatial resolution 7.5 km (from 5 km altitude); up to 60ppm ± 12ppm H only in Permanently Shadowed Regions

Mineralogy/organics

- MISE/Europa Clipper NIR spectrometer
- VIR/Dawn VNIR spectrometer

Ice thickness

- REASON/Europa Clipper: 15-150 m/px; sounding depths 0.3 – 4.5 km (VHF), 1-30 km (HF)
- Europa Imaging System (EIS) WAC/NAC; 50 m down (global) to 0.5 m resolution (targeted areas)
- Europa Thermal Emission Imaging System (E-THEMIS) 5 x 22 m resolution from 25 km altitude; multiple spectral bands covering 7 - 70 μm, imaging vents 1-10 meter scale;

Ice Sheet uplift

- Earth-orbiting InSAR: spatial resolution 10-100 m; < 1cm vertical precision

MatISEE /PICASSO/ICEE-2/ COLDTech Programs