EPSC Abstracts
Vol. 10, EPSC2015-319, 2015
European Planetary Science Congress 2015


# Mapping Imaging Spectrometer for Europa (MISE)

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## Abstract

The Mapping Imaging Spectrometer for Europa (MISE) instrument is designed to be able to unravel the composition of Europa, and to provide new insight into the processes that have in the past and continue to shape Europa, and on the habitability of Europa's ocean. The MISE design is the result of collaboration between NASA's Jet Propulsion Laboratory (California Institute of Technology) and the Applied Physics Laboratory (John Hopkins' University). JPL's Discovery Moon Mineralogy Mapper (M3) on Chandrayan-1 and APL's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) comprise the technical basis for MISE. Internal JPL and APL investments in conjunction with NASA support under the ICEE program has allowed for instrument technology development and testing to achieve a design which would perform in Europa's radiation environment and meet potential sterilization requirements due to planetary protection.

## 1. Science Goals

The MISE instrument is designed to enable the identification and mapping of organics, salts, acid hydrates, water ice phases, altered silicates, and radiolytic compounds at global (≤ 10 km), regional (≤ 300 m), and local scales (~ 25 m) (Figure 1). Mapping the composition of specific landforms is critical to understanding surface and subsurface geologic processes, including recent or current activity. High spatial resolution compositional mapping is also essential for detecting small outcrops of organics and salts. Distribution maps of astrobiologically relevant compounds and their geologic context can be used to assess whether Europa's ocean is capable of supporting life. MISE could provide fundamental information on where future Europa landers would have the highest probability of detecting evidence of life.

## 2. Instrument Description

The MISE design is for a high-optical throughput pushbroom imaging spectrometer that could observe effectively throughout a flyby or in orbit around Europa. It is designed to operate within Europa's challenging radiation environment and deal with both radiation noise and total integrated dose. MISE would cover a spectral range from 0.8–5 µm at 10 nm/channel, with an instantaneous field of view (IFOV) of 250 µrad/pixel and a swath width of 300 active pixels (Figure 2). The 0.8–2.5 µm region is essential for quantifying hydrates and bulk surface composition, while the 3–5 µm region is required for

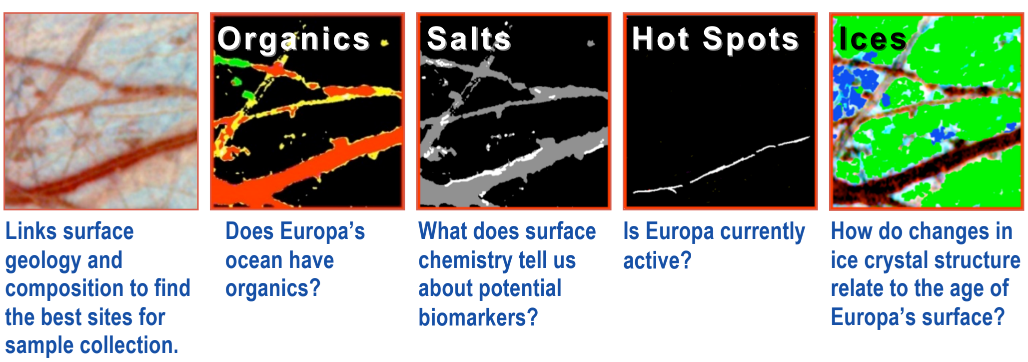


Figure 1: Example compositional maps from imaging spectroscopy that can be used to determine the distribution of key compounds.

detecting low abundances of organics, most radiolytic products, and discriminating salts from acid hydrates. These longer wavelengths can also be used to measure thermal emissions from currently active regions.

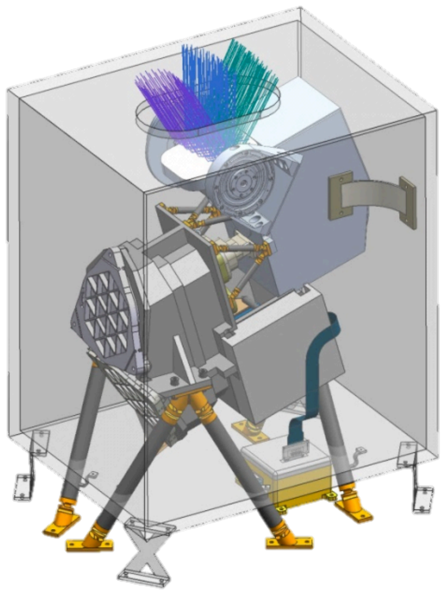

Figure 2: Model of the MISE Instrument Design.

## 3. Radiation and Planetary Protection Impacts on Design.

Instrument performance was required to meet potentially stringent planetary protection requirements and to operate in the Europa radiation environment. To achieve this confidence that the instrument design would work at Europa in the expected radiation environment, a prototype spectrometer was built and tested in multiple bean lines (Figure 3 and 4). The prototype included slit, grating, order sorting filter, and focal plane array utilizing the same materials and processes that MISE design incorporated. The test data was used to calibrate radiation models of expected radiation noise for the design so that appropriate levels of shielding could be utilized. The prototype also underwent a planetary protection bakeout to ensure that the design was compatible with dry heat microbial reduction (Figure 5).

## Acknowledgements

The MISE instrument designed has benefitted from the work of a large number of JPL and APL engineers. Many thanks to the following for their contributions toward the design: Aboobaker Asad, Carl Bruce, Ernisto Diaz, Len Dorsky, Michael Mercury, Timothy Neville, Jose Rodriguez, Andy Santo, Elizabeth Smith, Byron Van Gorp, and Daniel Wilson.

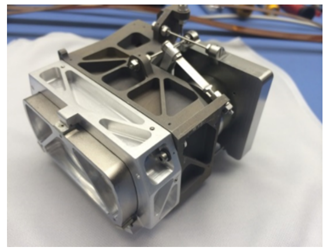

Figure 3: Prototype Spectrometer.

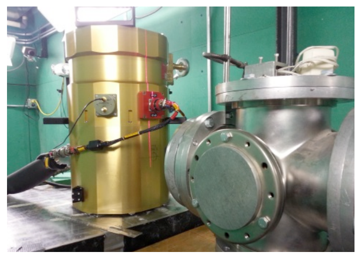

Figure 4: Prototype in radiation beamlines.

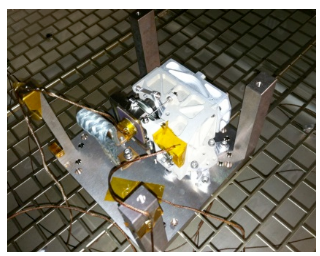

Figure 5: Prototype undergoing planetary protection bakeout.