MiniGrant - RSN3

OSSERVATORIO ASTRONOMICO DI PADOVA

INAF ISTITUTO NAZIONALE DI ASTROFISICA

RIFTS: Role of Icy FracTured Surfaces.

Unveiling the hidden subsurface through fractal, structural and compositional analyses

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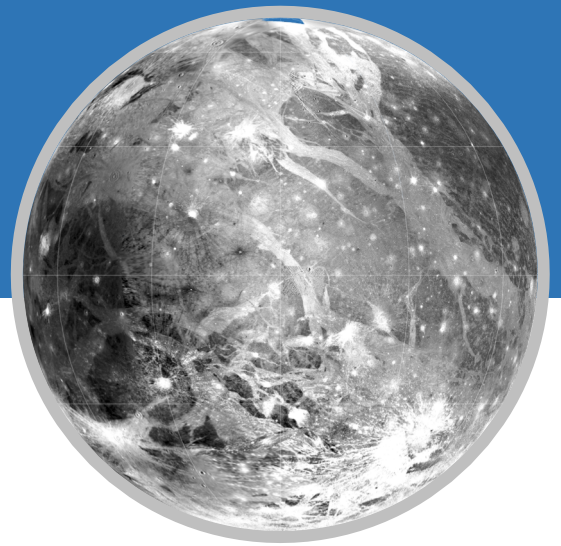

RIFTS|Objectives of the project

Investigate the fractured surfaces of icy bodies that have hosted, and/or are still hosting a liquid/frozen water ocean or water pockets (on Ganymede, Europa and Ceres)

Methods

Fractal analysis

determine the depth at which a liquid or frozen ocean is located (or water pockets). This will also reveal the different mechanical behavior of internal structure layers.

Ganymede **Europa** **Ceres**

Structural analysis

infer the stress fields responsible for fractures development and the role of fractures in fluid circulation, providing further insights into icy body's interior

Ganymede **Europa** **Ceres**

Compositional analysis

characterize the material in close proximity to the fractures or constituting vents and, in turn, infer the internal mineralogical composition (study specific ROI encompassing fractures and perform high-resolution geological maps that will be correlated with compositional results).

Ganymede **Europa** **Ceres**

Target: completed, partially completed, not completed

RIFTS | Deliverables, Milestones and Critical Aspects

Summary of Deliverables	
TASK: Fractal and fluid percolation analysis, OUTPUT: - Fractures analysis, in terms of length and self-similar clustering; - Fluid percolation model; - Presentation of the results at international conferences.	Ganymede Europa Ceres
TASK: Structural geology analysis (tectonics), OUTPUT: - Mapping of fractures coupled with spatial and azimuth analyses; - Stress field responsible for fractures formation; - Tectonic models for the investigated icy bodies; - Presentation of the results at international conferences.	Ganymede Europa Ceres
TASK: Compositional analysis and spectral modelling, OUTPUT: - Mapping of fractures; - High-resolution geological maps; - Comparison between high-res geological maps and spectral clustering results; - Spectra analysis to retrieve the composition of surface materials; - Comparison between spectral results and laboratory spectra (spectra modelling); - Presentation of the results at international conferences.	Ganymede Europa Ceres
OUTPUT: peer reviewed publications on international journals.	Done

Refereed publications (2):

- *Lucchetti, A., Dalle Ore, C., Pajola, M., et al., (2023), Icarus, 401, 115613.*
- *Rossi C., Lucchetti, A., Massironi, et al., (2023), Icarus, 390, 115305.*

Conference Proceedings (2):

- *Lucchetti, A. et al., Uranus Flagship workshop, 2023.*
- *Lucchetti, A. et al., EPSC-DPS 2023.*

- ✓ Methodologies and different techniques on data analysis have been developed and well-tested.
- ✓ **Ganymede** → Nippur Sulcus fractal analysis, Structural analysis of Galileo Regio, Multidisciplinary analysis (geomorphological and compositional) of Melkart crater performed.
- ✓ **Europa** → data are noisy and it is difficult exploiting the foreseen analysis (ongoing collaboration with INAF colleagues and DLR to find a possible solution) → ***critical***
- ✓ **Ceres** → Fractal analysis on Dantu and Occator craters is **on-going** *(structural and compositional analysis available in literature).*
- ✓ provide scientific findings that could be useful in supporting the observation campaign of future mission exploration → **on-going**