Research project: Geological mapping and 3D Geo-Modeling of Martian and Mercurian fault networks

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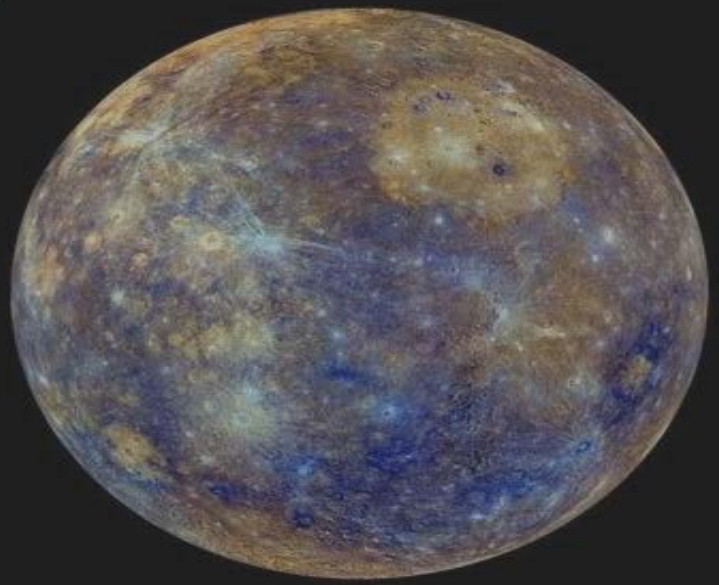
34° Cycle

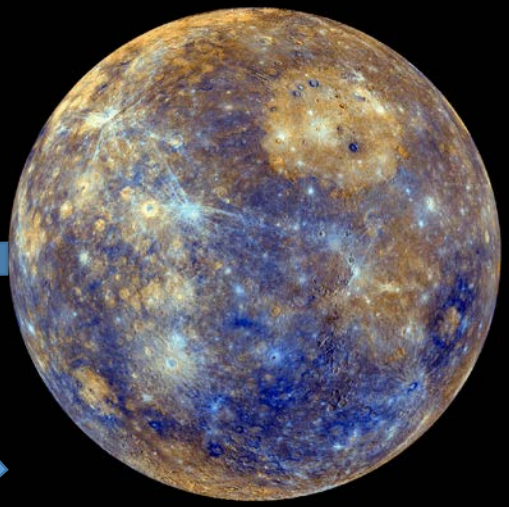
Corso di SCIENZE TECNOLOGIE E MISURE SPAZIALI

Curricoli: Misure meccaniche per l'ingegneria e lo spazio,

Centro di Ateneo di Studi e Attività Spaziali "Giuseppe Colombo" - CISAS



Mars and Mercury:
Best electors for future robotic and human mission



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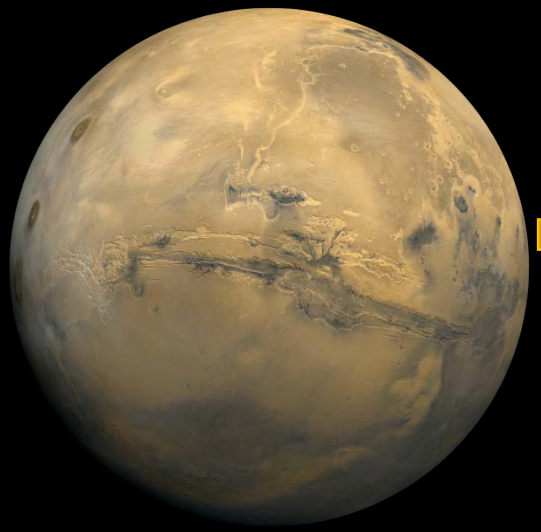


-Poorly reaching by a spacecraft and explored
-The one with the oldest surface
-Largest daily variation in the surface temperature.
-similar to the geology of the Moon :
--) Comparative analogues terrains
--) Impact craters with similar morphological elements
-Basaltic rocks , smooth plains
-Lobate scarps and Strike slip faults
-Large impact basin :Caloris Planitia and Rembrandt.

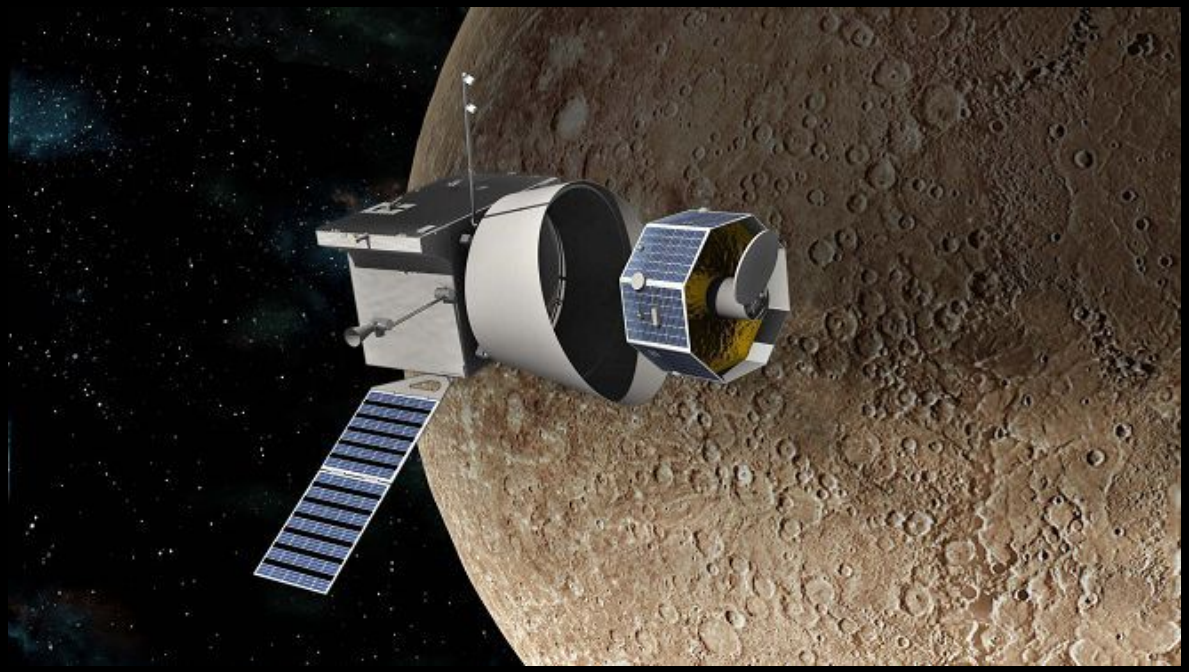
- Subsurface Ice water
-Methane
-The largest canyon on the solar system : Valles Marineris
-The highest shield volcano on the Solar System : Olympus Moon
-Basaltic and sedimentary rocks
-Salts, Oxygen, Hydrogen…

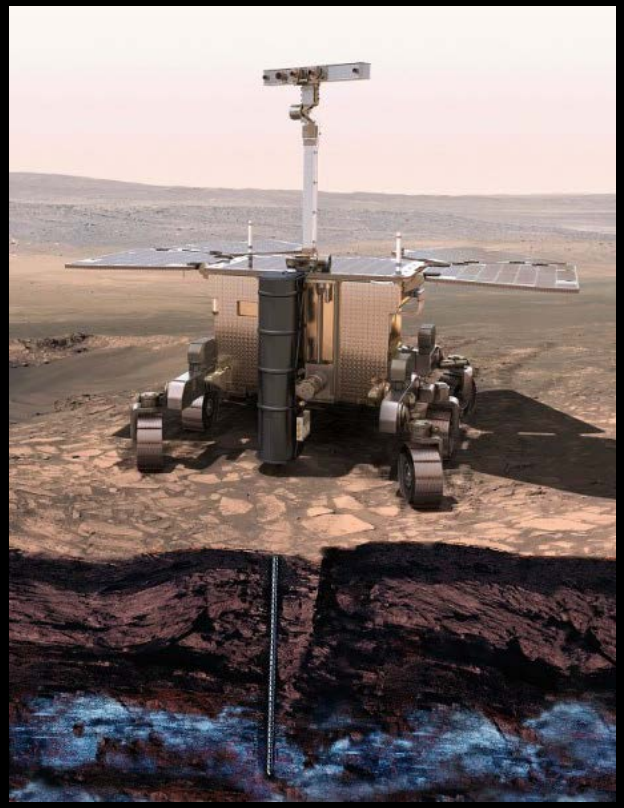
What a Scientific question that I'm going to solve?

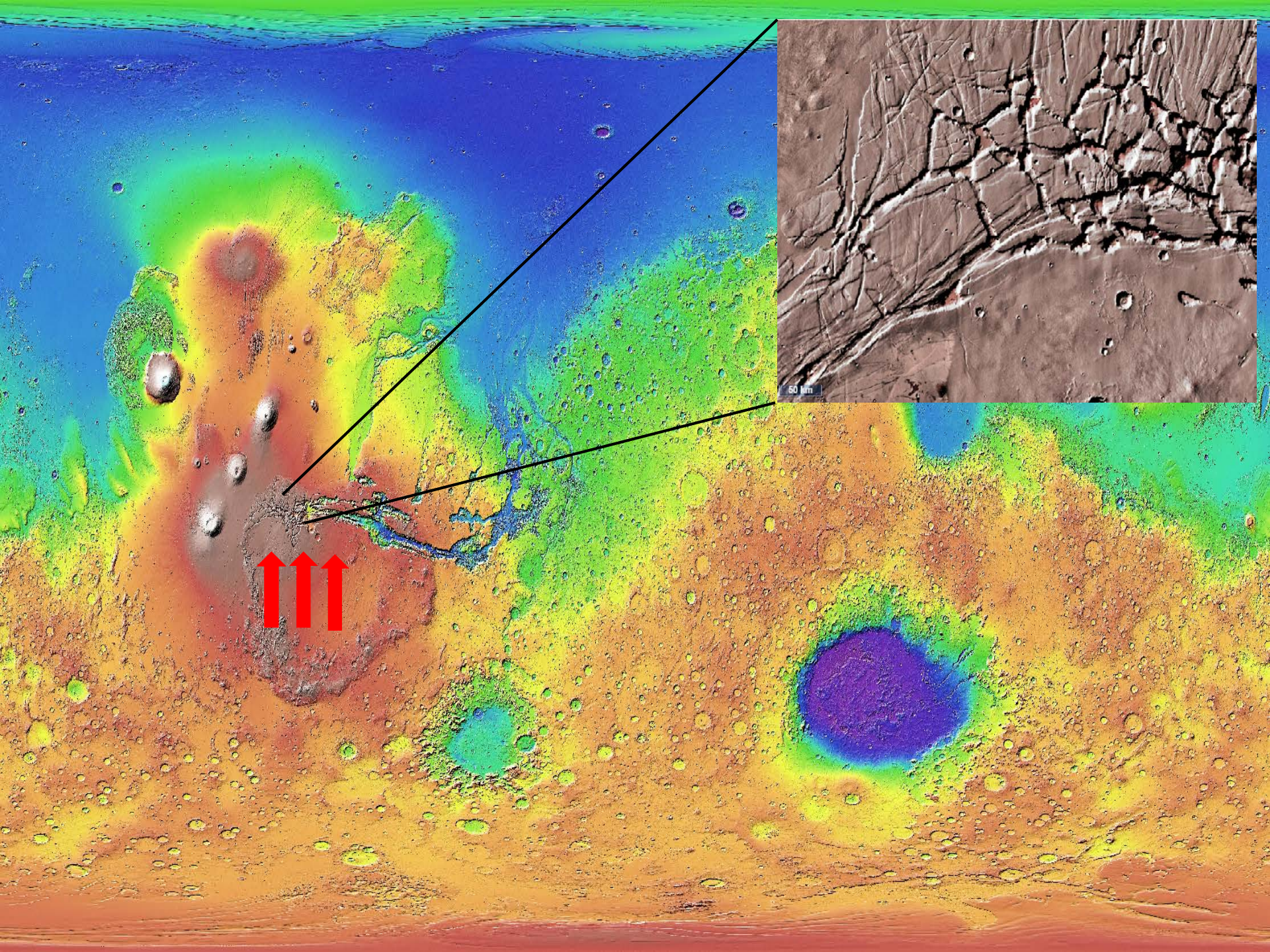
In the upcoming years, Mars and Mercury will be the favorite sites for the ESA exploration of the Inner Solar System (i.e. BepiColombo mission to Mercury , which is already launched on 20 of October 2018, and EXoMars mission whose rover will be launched in July 2020).

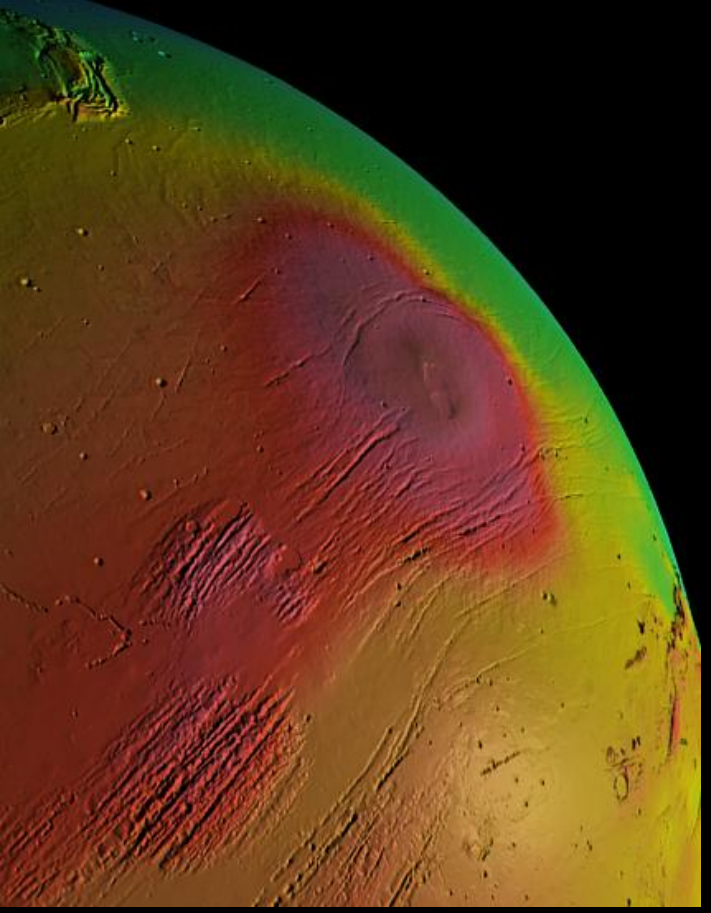
In this frame my work will focus on :

- The faults networks in Valles Marineris.
- One of the NON-Mapped quadrangle on Mercury.

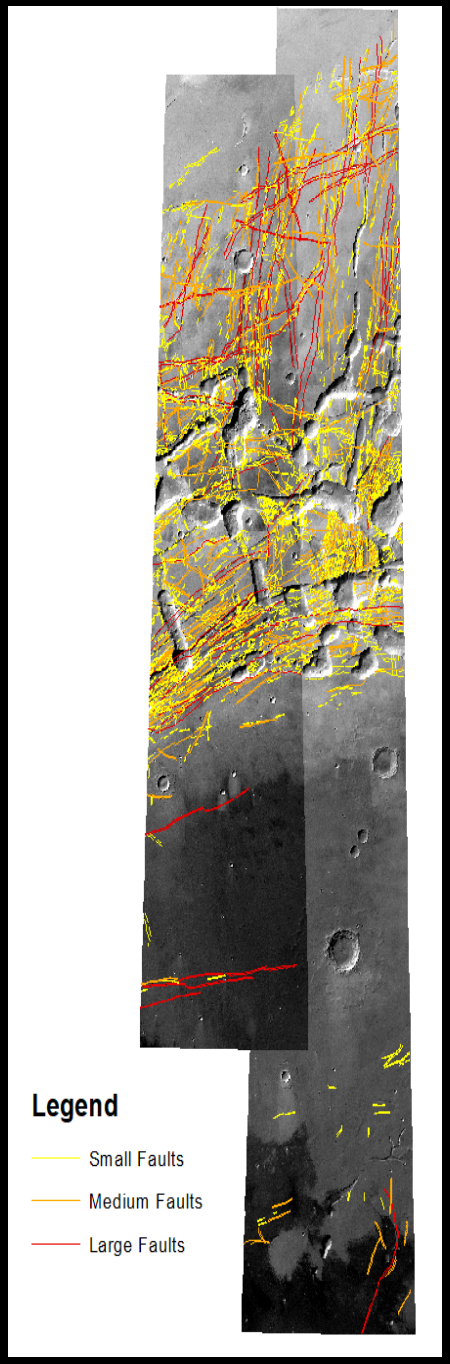


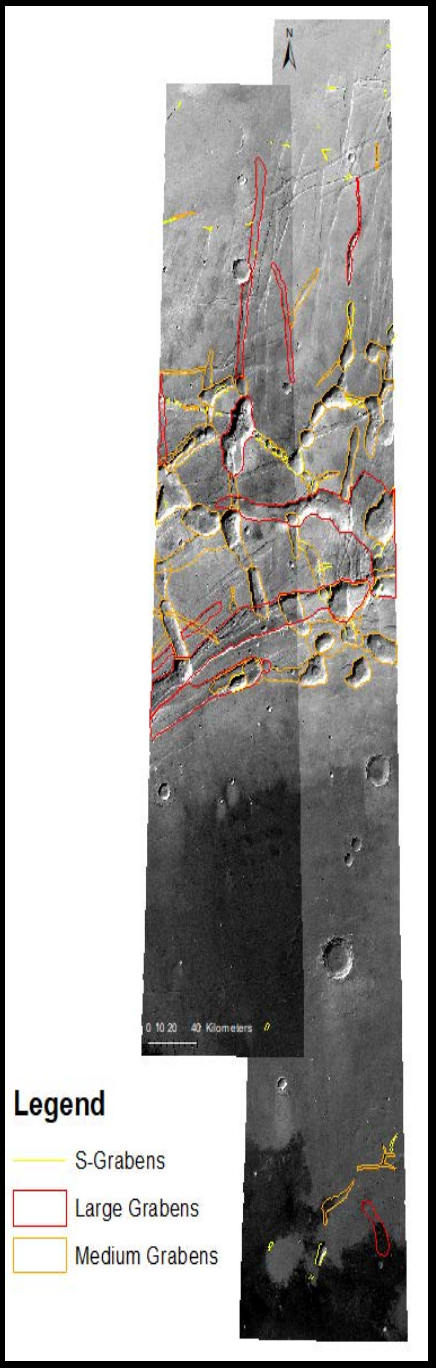


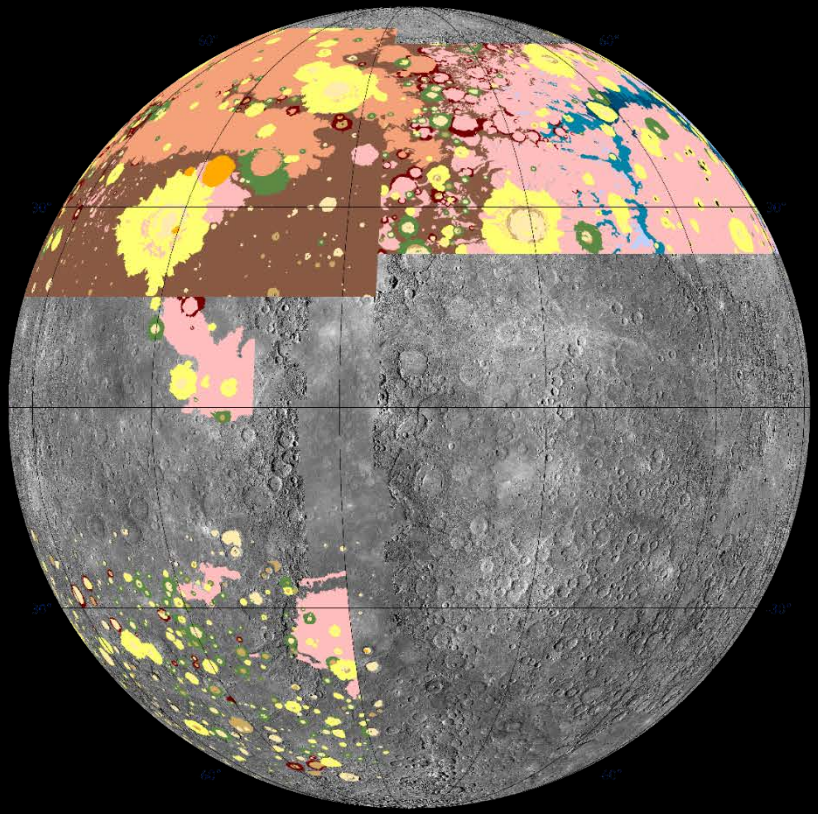

50 km

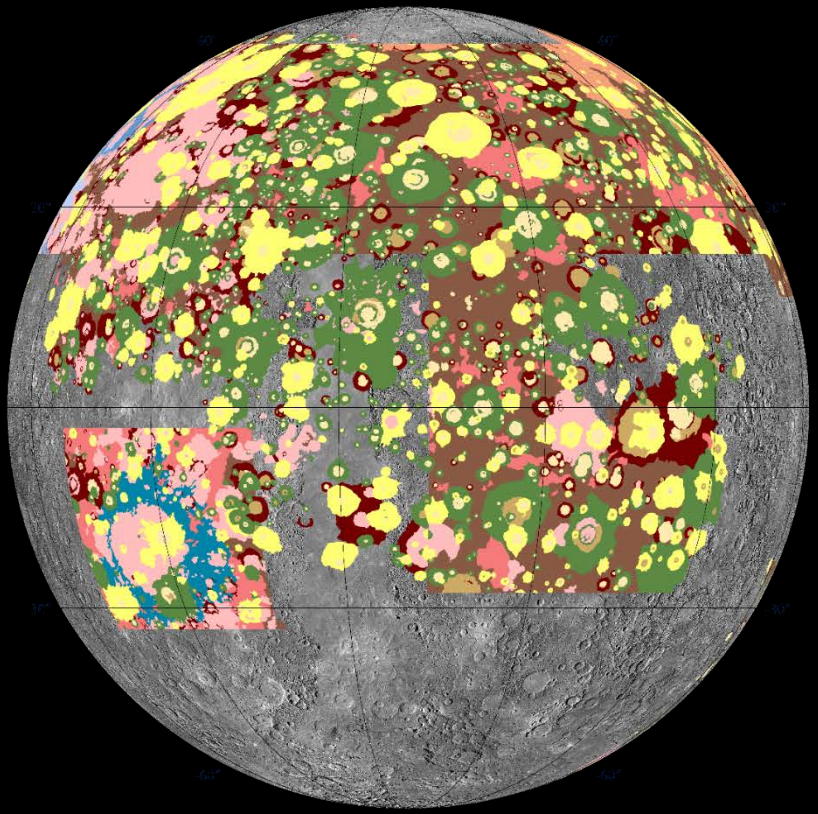


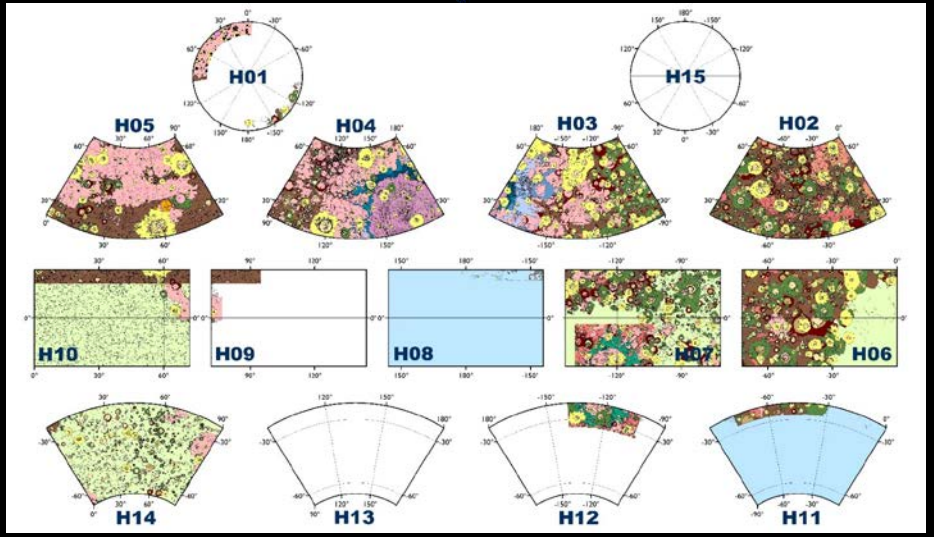
My main research goal is to clarify some specific fracture and fault networks. These features are extremely important to understand the processes that modify the surface of planetary bodies, their geodynamic activity through time and hence their evolutionary history.



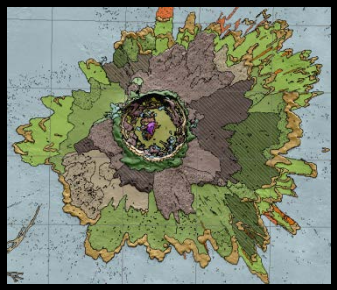






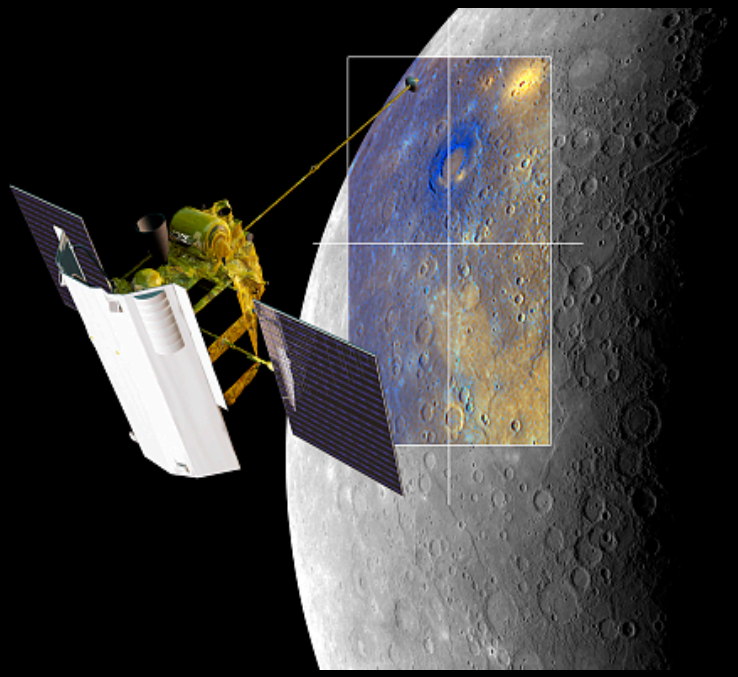


For the selected quadrangle, I will delimit different fractures, geological units, surfaces features, basins, Dunes, craters materials...etc, to carry out a full geological map.

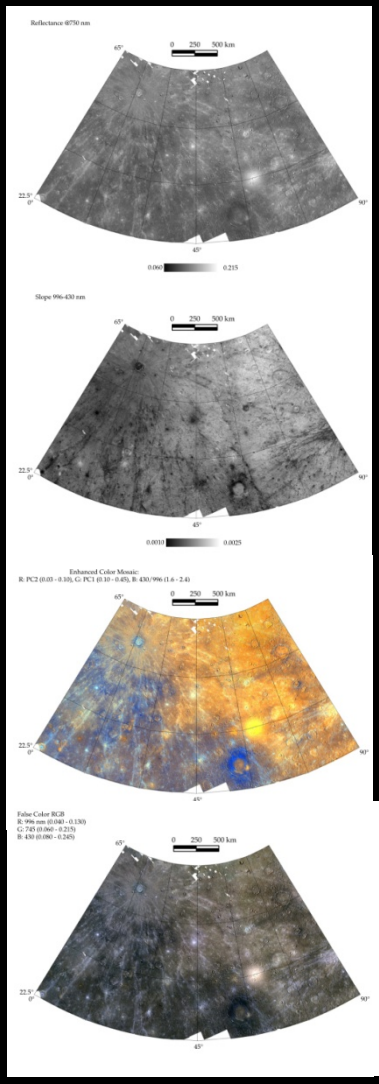


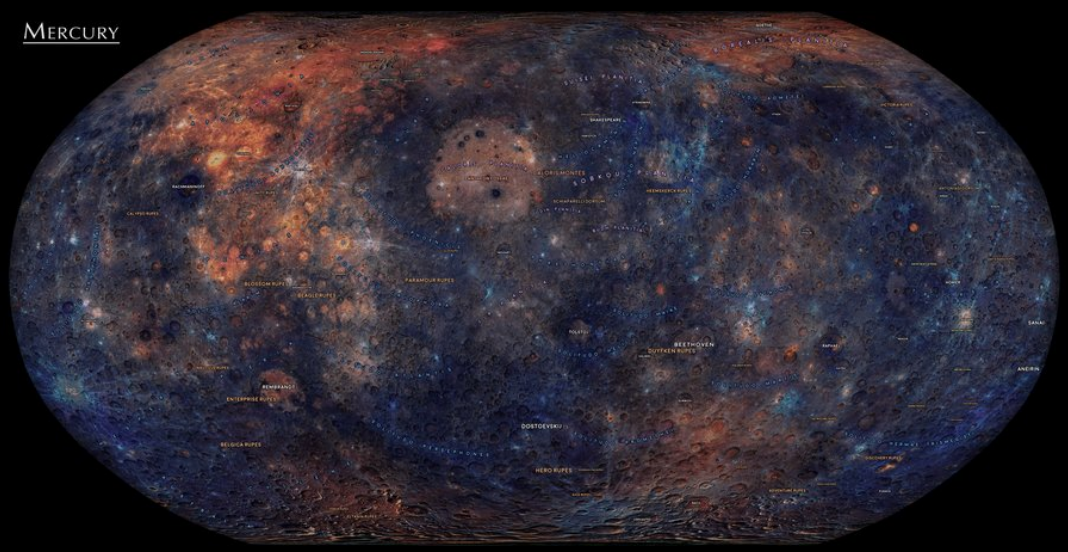
Data and methods

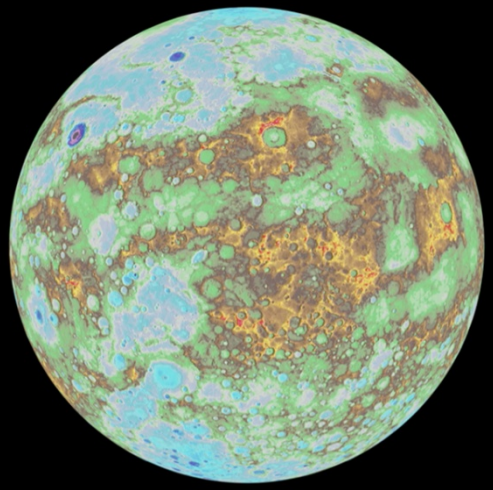
For my PhD work I will use data coming from the Mercury Dual Imaging System (MDIS) mounted on the MESSANGER spacecraft for Mercury and data provided by the HRSC (Mars Express Spacecraft, 12-13m/Pixel of spatial resolution), CTX (Mars Reconnaissance Orbiter, 5.2m/Pixel of spatial resolution), HiRISE (Mars Reconnaissance Orbiter, 30-60m/Pixel of spatial resolution) and CASSIS (ExoMars Spacecraft, 4.6m/Pixel of spatial resolution) cameras for Mars. I will focus on the combination of different dataset to produce and study DEMs and to create 3D Geo-Models as key to conceptualize the inner crustal structures of these planetary bodies.

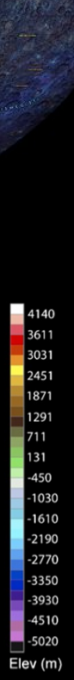


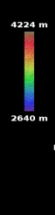
The 3D Geo-modelling is a key solution to better conceptualize the infrastructure and reconstruct some geological phenomena in the main to interpret the processes related to the modification on the surface and the subsurface.

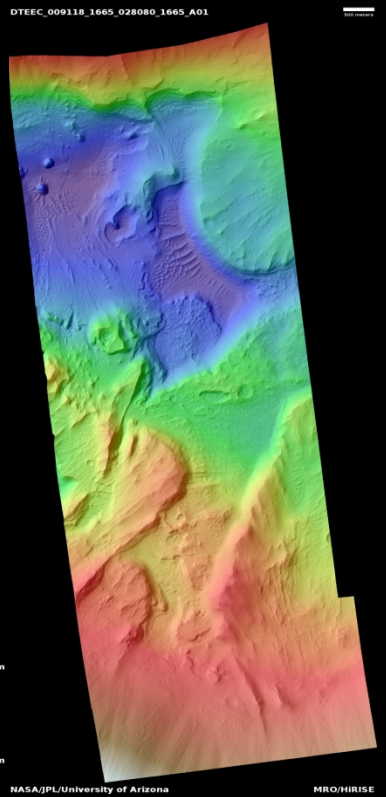












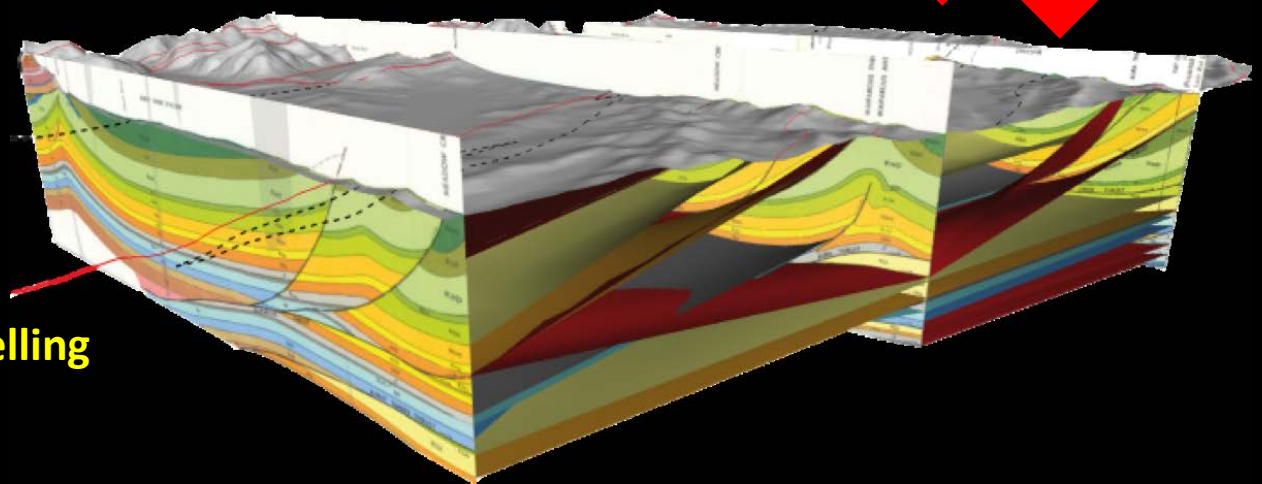
DTMs and HR images

Stratigraphic, tectonic and geodynamic knowledge

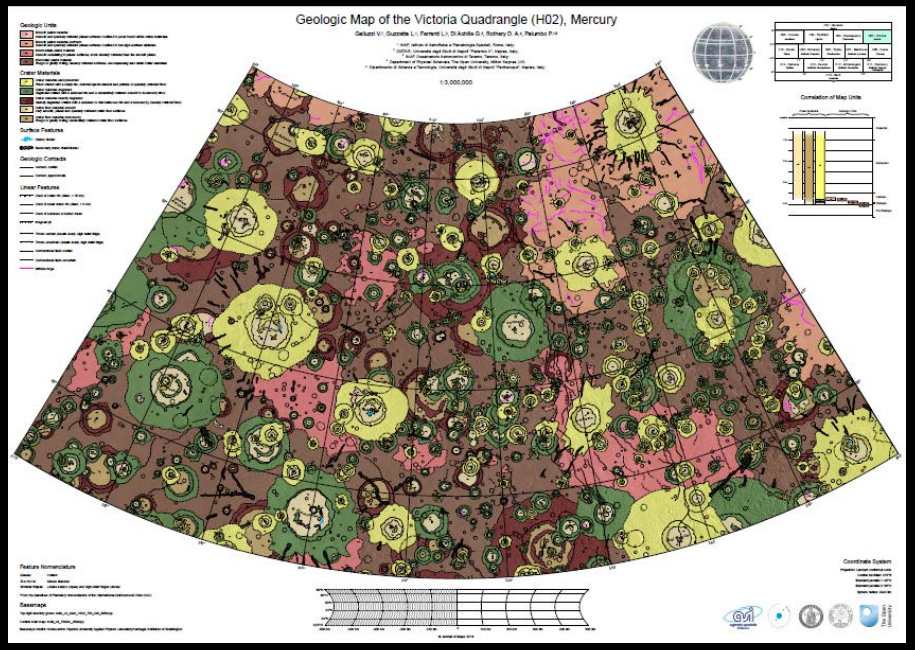
Spectral and mineralogial data

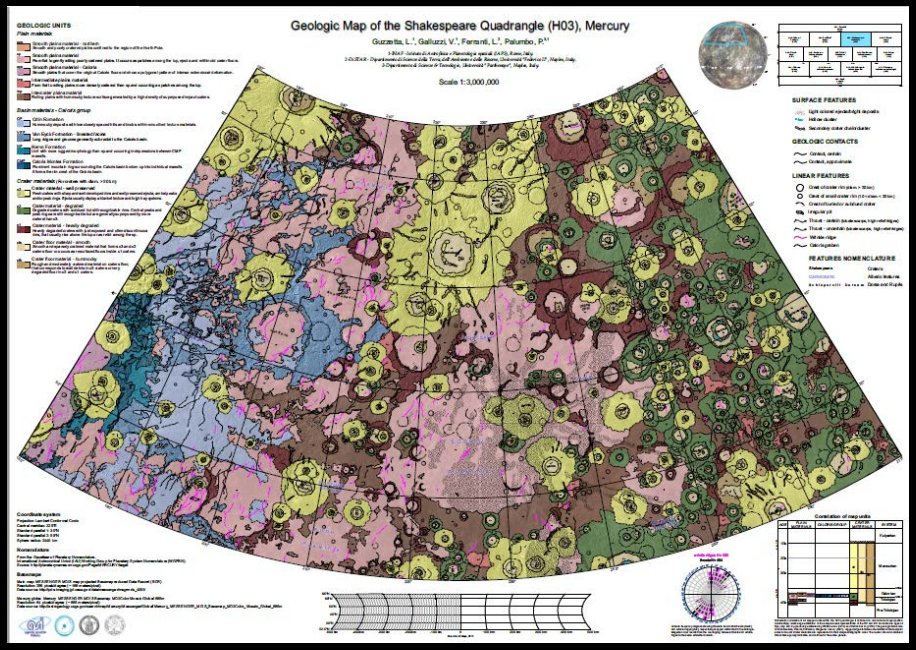
Combination

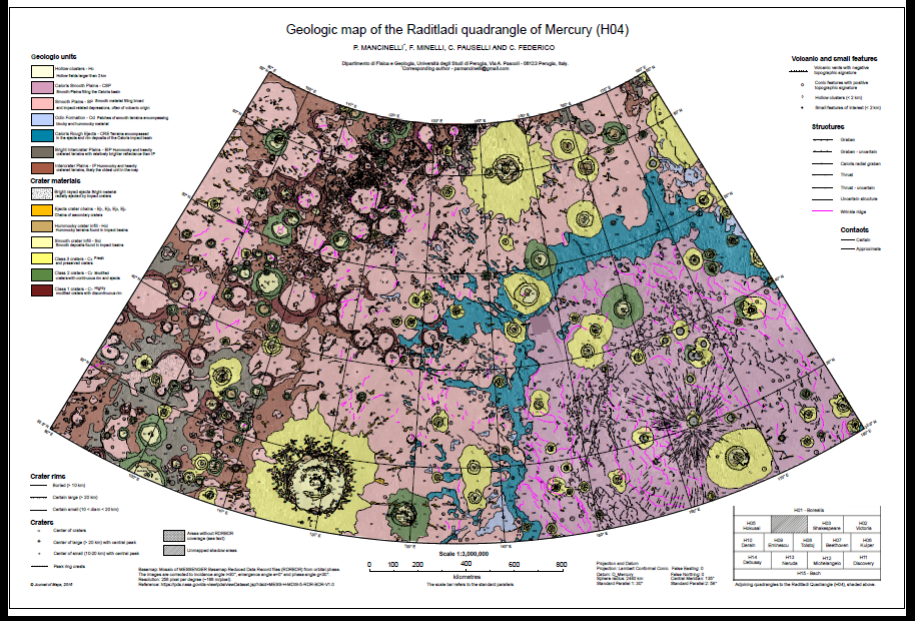
Both in Martian and Mercury cases,fractures and faults are used for subsurface fluid circulation,which in the case of Mars can be associated to methane release and in the case of Mercury to explosive pyroclastic activity.



3D-Modelling


Geologic Map of the Victoria Quadrangle (H02), Mercury
Geologic Units
Crater Materials
Surface Features
Geologic Contacts
Linear Features
Feature Nomenclature
Basemap
Correlation of Map Units
Coordinate System


Geologic Map of the Shakespeare Quadrangle (H03), Mercury
GEOLOGIC UNITS
Plain materials
Basin materials - Calorian group
Crater materials
Coordinate system
Nomenclature
Basemap
SURFACE FEATURES
GEOLOGIC CONTACTS
LINEAR FEATURES
FEATURES NOMENCLATURE
Correlation of map units


Geologic map of the Raditladi quadrangle of Mercury (H04)
P. MANCINELLI*, F. MINELLI, C. PAUSELLI AND C. FEDERICO
Geologic units
Crater materials
Volcanic and small features
Structures
Contacts
Crater rims
Craters
Scale 1:3,000,000
Kilometres

The duration of the project

Three years, in which the main tasks are writing at the following:

For the first year:

- Collect of Data and bibliography research.
- Get a solid knowledge of the techniques of Mapping and the 3D Geo-Modeling.
- Mapping the faults networks on Noctis Labyrinthus-Mars.
- Interpretation of the results carried out.
- Get started mapping of the chosen quadrangle on Mercury.

For the second year:

-Finish the Geological mapping of the selected quadrangle on Mercury.

-Carry out 3D Geo-Modeling for some areas of interest on Mercury's quadrangle.

- Interpretation of the results carried out.

For the third year:

- Exploitation of all the results carried out.
- Compilation of the thesis and work reports.

Thank you for your Attention