Visible and Near-Infrared spectral analysis of several hollows on Mercury

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Thesis: Nature des épisodes volcaniques à la surface de Mercure.

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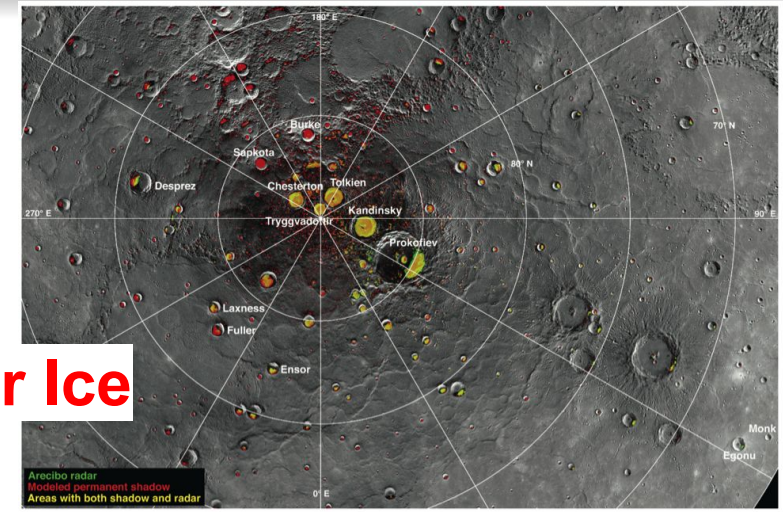
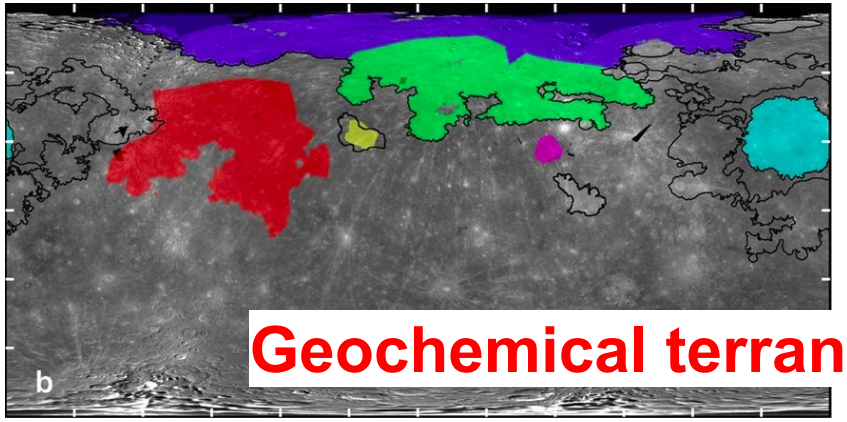
esa

Why Mercury ?

- High bulk density
- Magnetic field
- Volatile species
- Compressional features

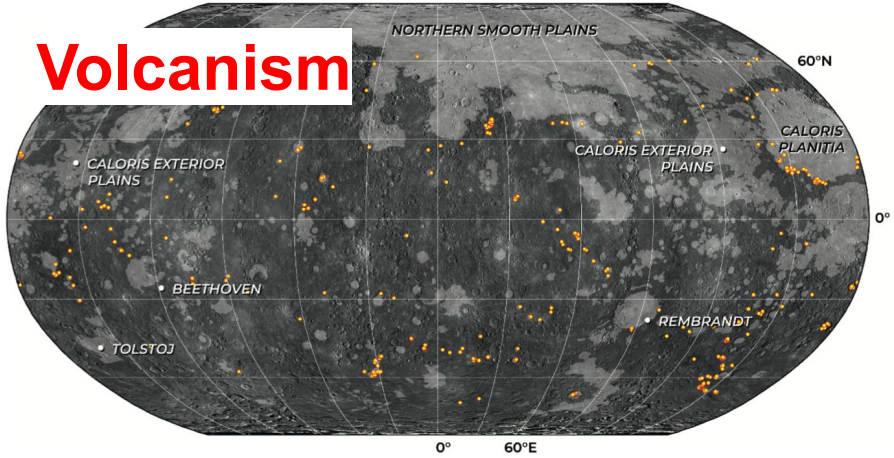


Water Ice



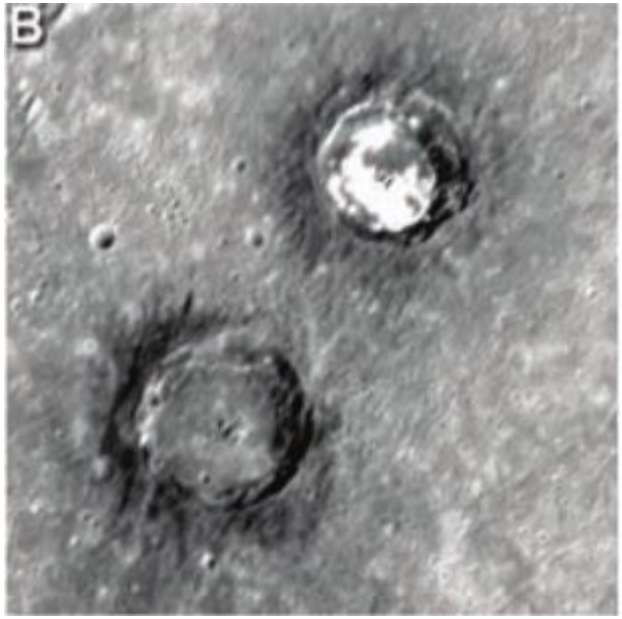
Geochemical terranes

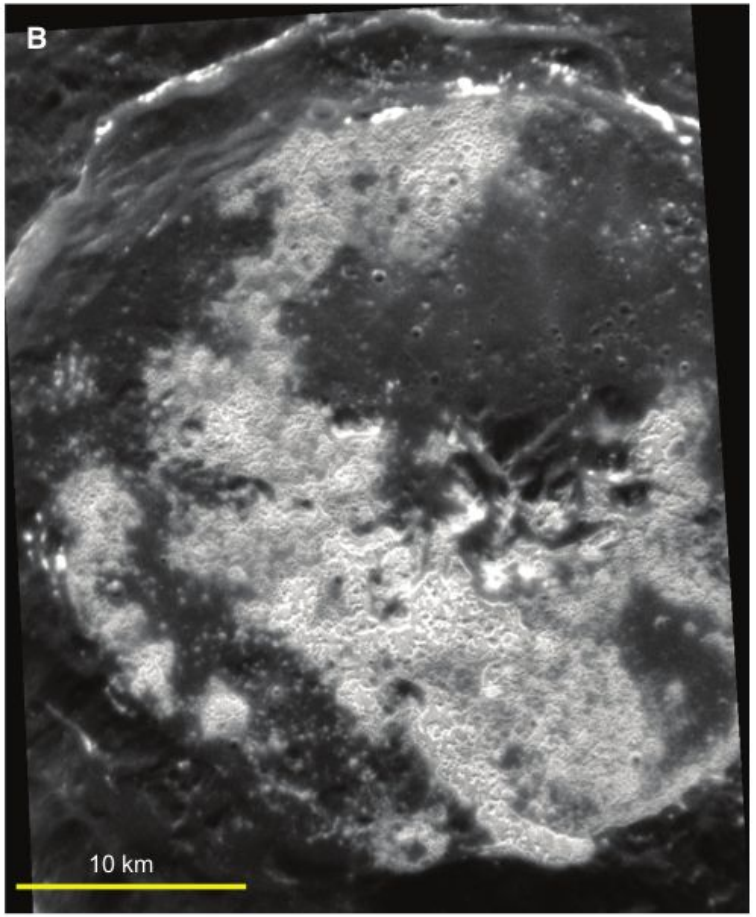
Volcanism



Bright crater floor deposit (BCFDs)

Robinson et al., (2008)

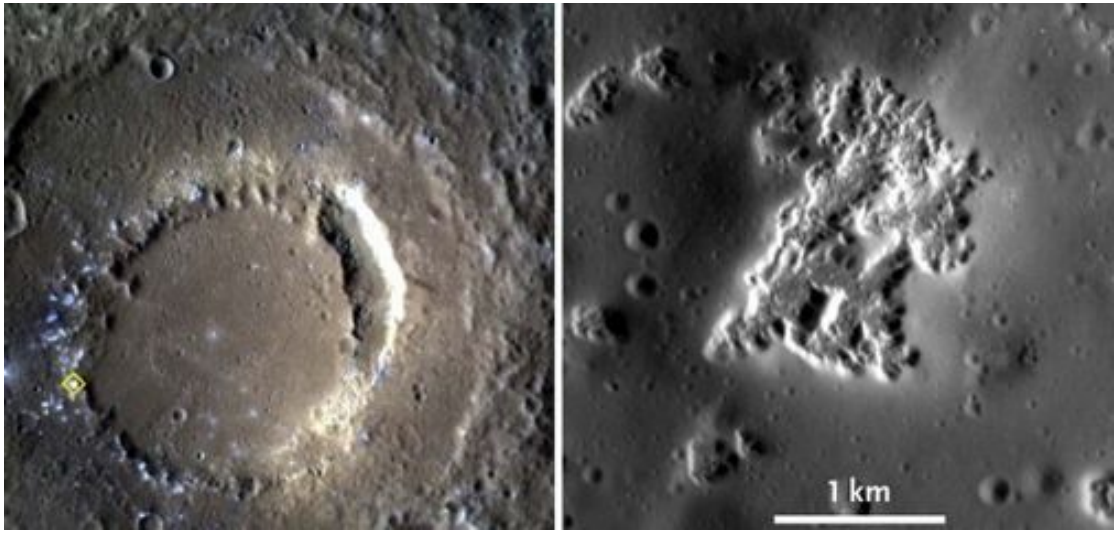




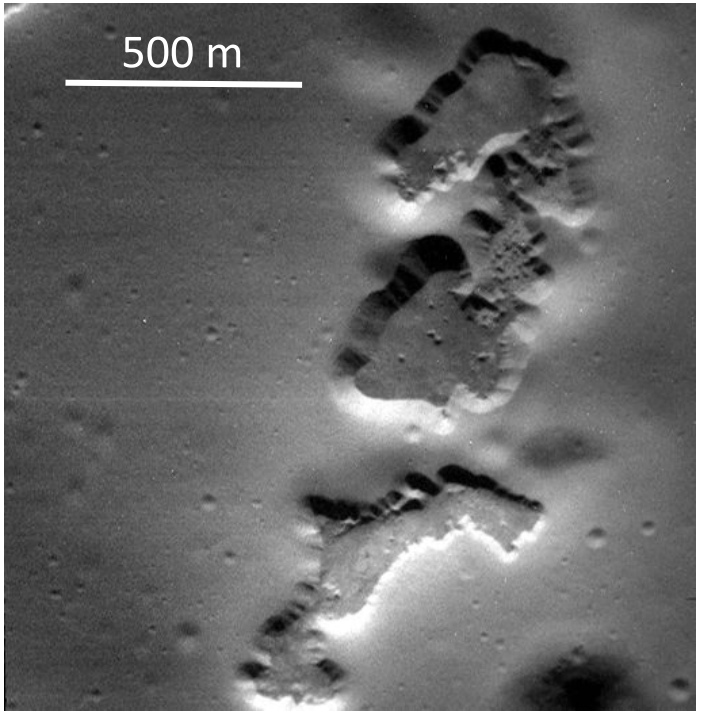
Blewett et al., (2011)

High resolution images obtained by MESSENGER → BCFDs composed of several small depressions

Hollows



Figures: Hollows on Scarlatti impact crater ring.



NASA/Johns Hopkins University Applied Physics Laboratory /Carnegie Institution of Washington

- Fresh appearance
- Small depressions surrounded by bright halo
- Shallow with flat floor

Hollows

Geological settings:

- Low reflectance material
- Crater/basin floors, walls, terraces, central peaks, ejectas
- Close to explosive volcanism deposits

Blewett et al., (2011)

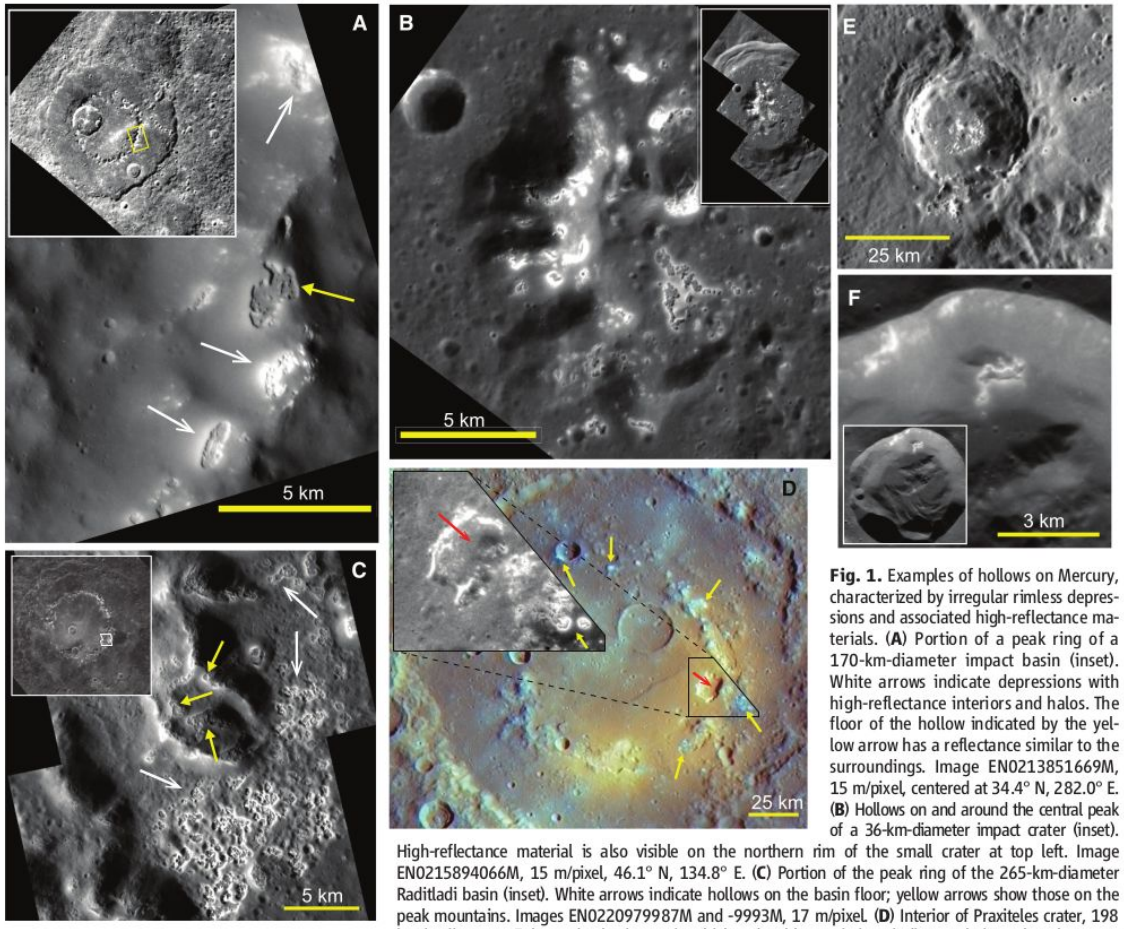
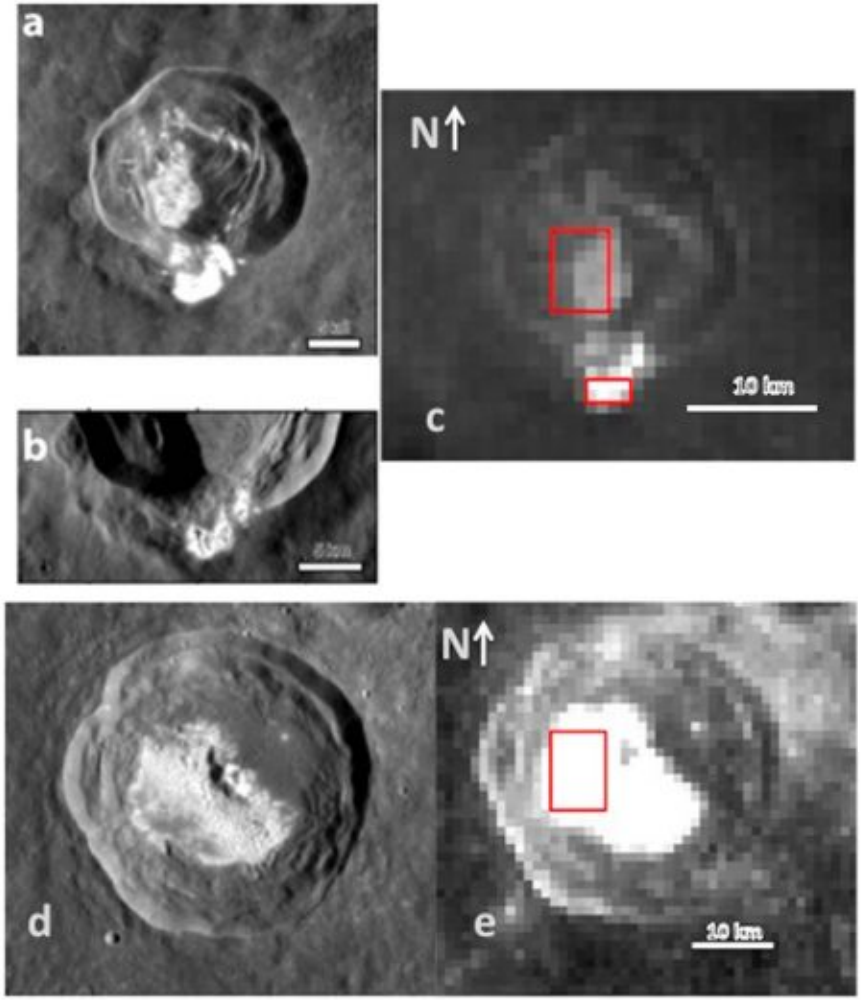
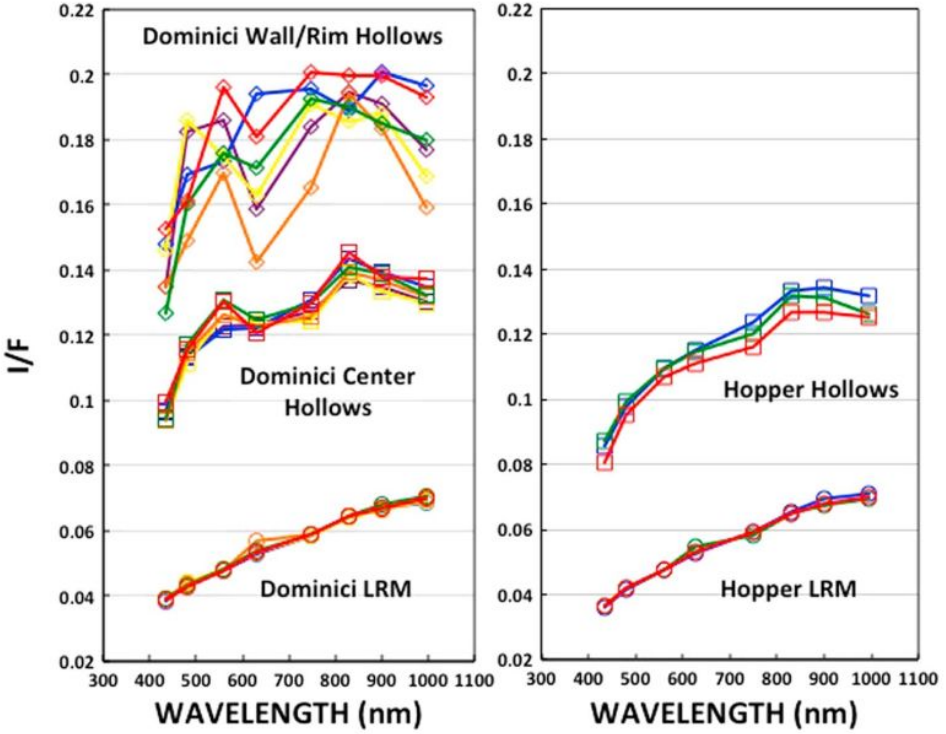


Fig. 1. Examples of hollows on Mercury, characterized by irregular rimless depressions and associated high-reflectance materials. (**A**) Portion of a peak ring of a 170-km-diameter impact basin (inset). White arrows indicate depressions with high-reflectance interiors and halos. The floor of the hollow indicated by the yellow arrow has a reflectance similar to the surroundings. Image EN0213851669M, 15 m/pixel, centered at 34.4° N, 282.0° E. (**B**) Hollows on and around the central peak of a 36-km-diameter impact crater (inset). High-reflectance material is also visible on the northern rim of the small crater at top left. Image EN0215894066M, 15 m/pixel, 46.1° N, 134.8° E. (**C**) Portion of the peak ring of the 265-km-diameter Raditladi basin (inset). White arrows indicate hollows on the basin floor; yellow arrows show those on the peak mountains. Images EN0220979987M and -9993M, 17 m/pixel. (**D**) Interior of Praxiteles crater, 198 km in diameter. Enhanced-color image in which red-to-blue variations indicate relative color; the green channel is a measure of overall albedo (*34*). Hollows (yellow arrows) appear bright blue; the large depression (red arrow) is a likely volcanic vent and the source of the reddish pyroclastic deposit. Inset is image EN0211416219M (53 m/pixel), showing details of the bright depressions. (**E**) High-reflectance depressions on the floor, walls, and rim of a partially degraded 25-km-diameter impact crater. Image EN0213154023M, 149 m/pixel, 23.3° N, 179.4° E. (**F**) Portion of a morphologically fresh 15-km-diameter crater (inset) with bright material on the upper wall and hollows on a wall slump. Image EN0218374376M, 18 m/pixel, 66.5° N, 153.2° E.

Hollows spectral features



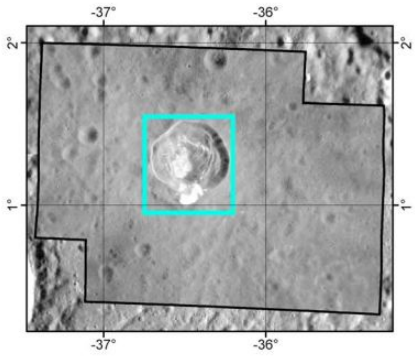


Vilas et al., (2016)

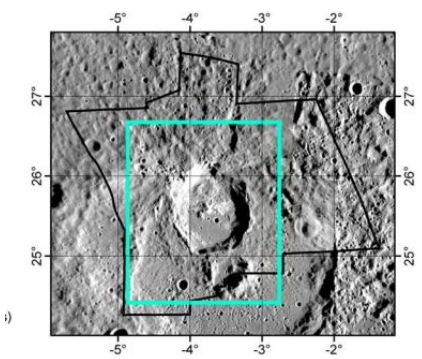
- None expected absorption band between 558 and 828 nm.

Hollows spectral features

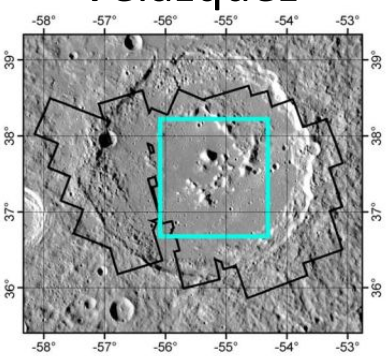
Dominici

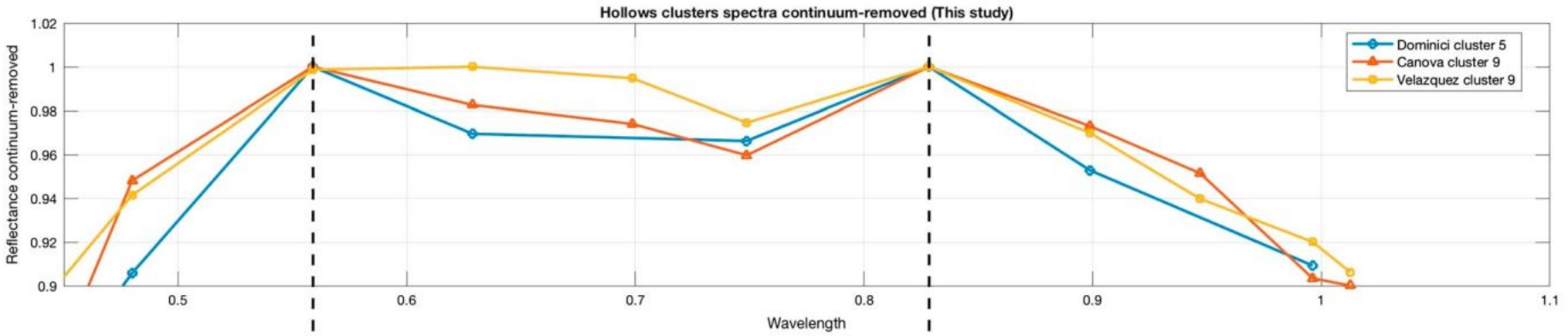


Canova



Velazquez



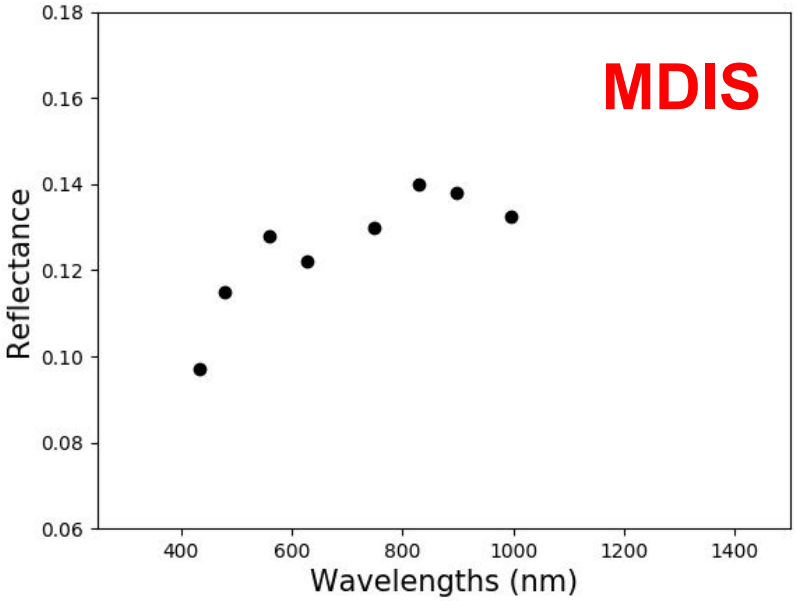


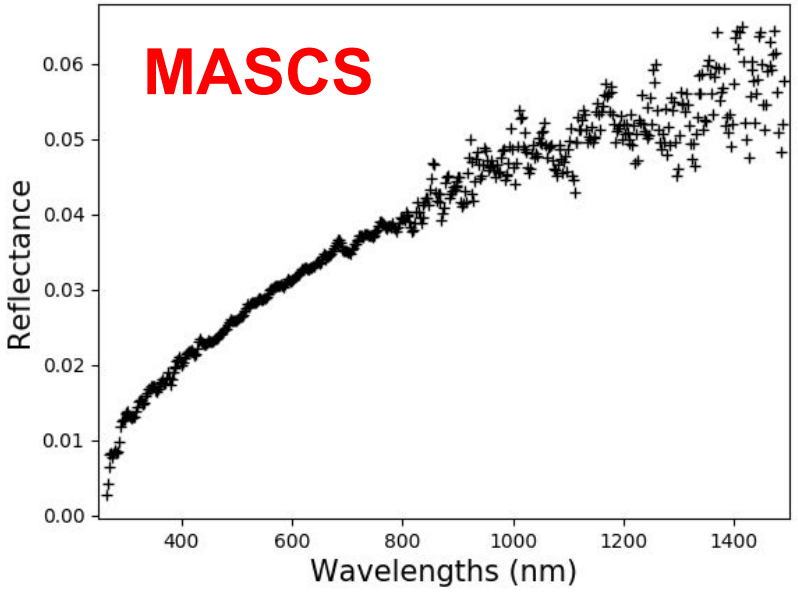
Lucchetti et al., (2018)

- Possible absorption band between 558 and 828 nm (4%)
- Presence of sulfides ?

Limitation of the spectral analysis

	Spatial resolution	Spectral resolution	Spectral range
MDIS*	8 m to 7 km per pixel	around 60 nm	433 - 1012 nm
MASCS**	0.1*3 km to over 6*7 km	5 nm	300 - 1400 nm

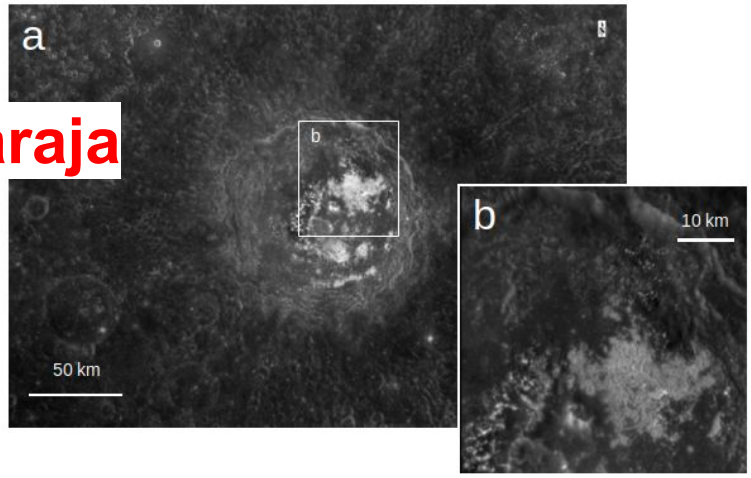




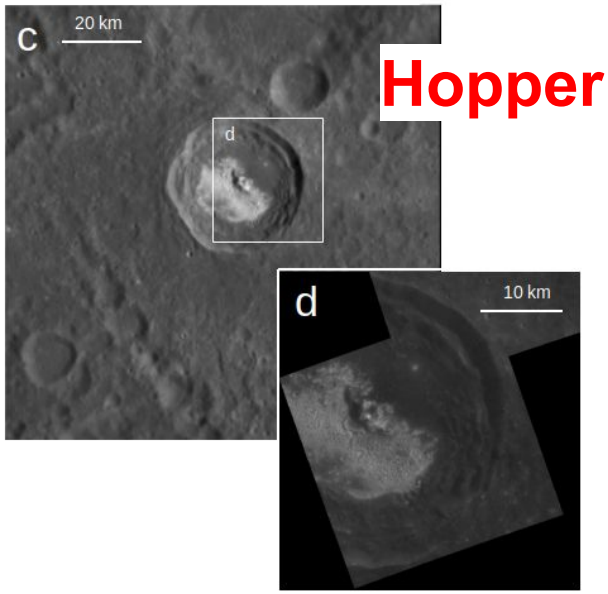
*MDIS: Mercury Dual Imaging System
**MASCS: Mercury Atmospheric and Surface Composition Spectrometer.

Hollows observations with MASCS

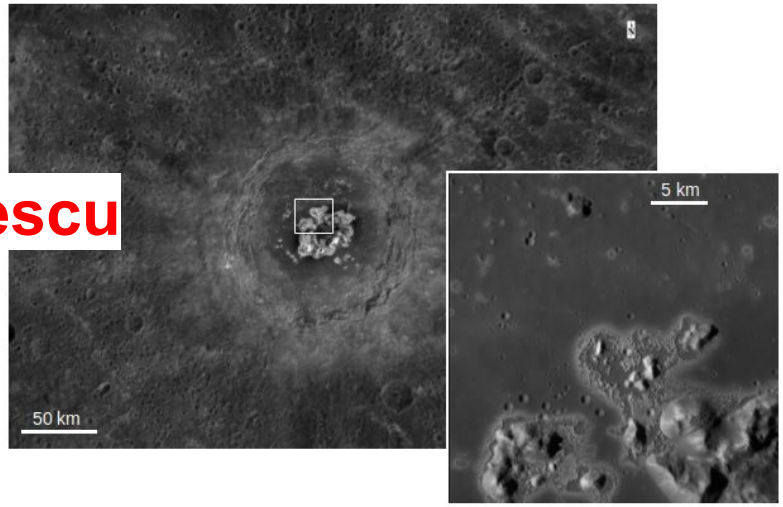
Tyagaraja



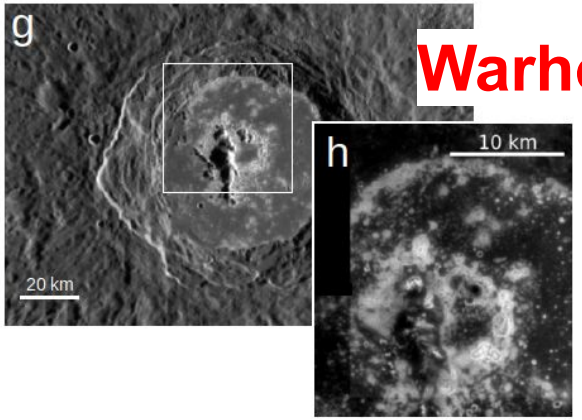
Hopper



Eminescu

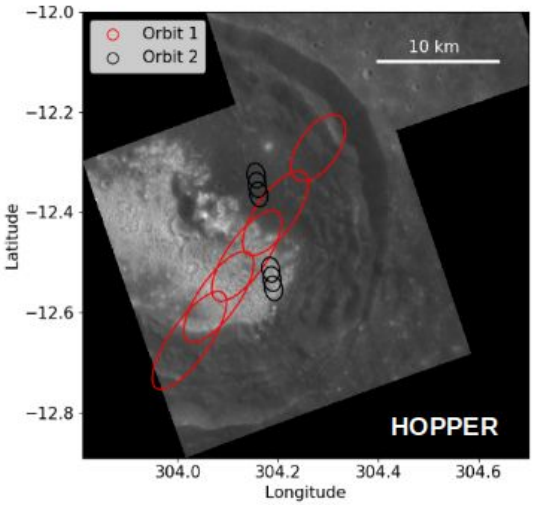


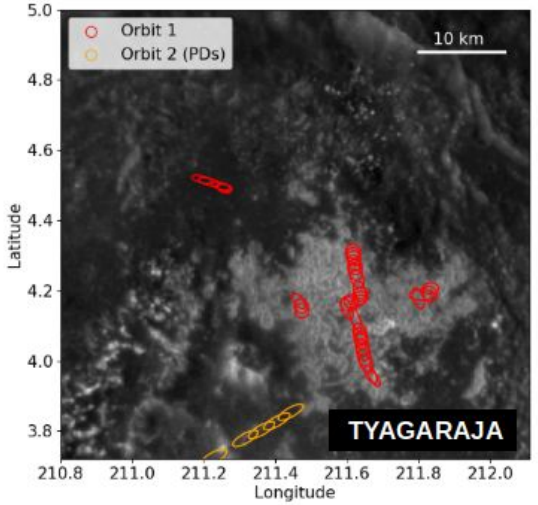
Warhol

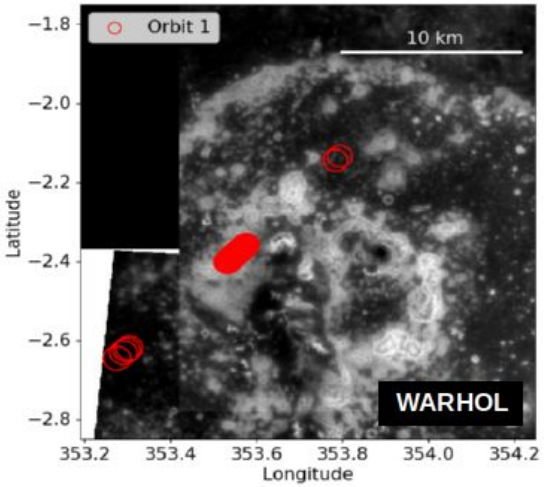


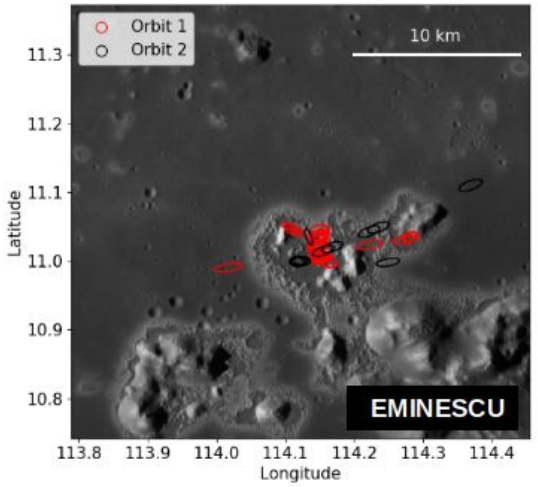
Hollows observations with MASCS

- Spatially resolved hollows



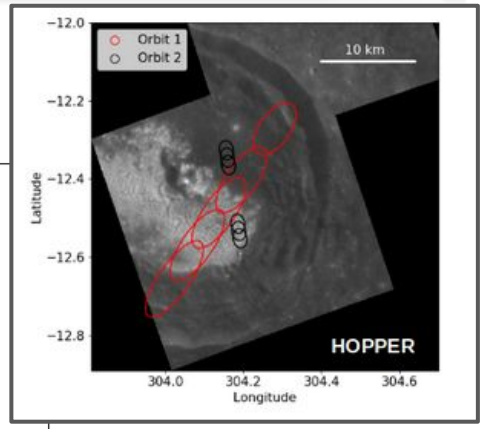


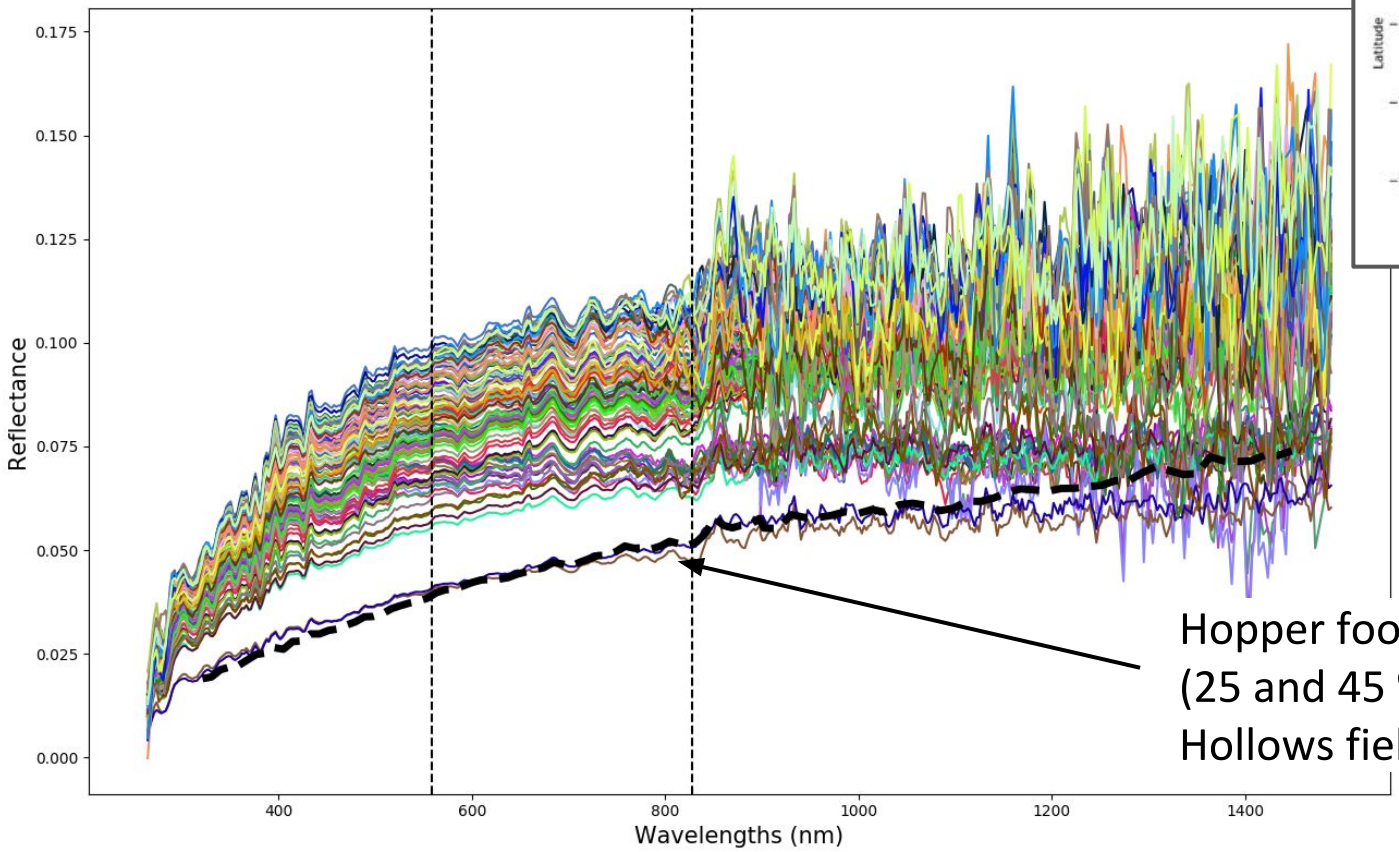




Hollows spectra

- 113 spectra of hollows

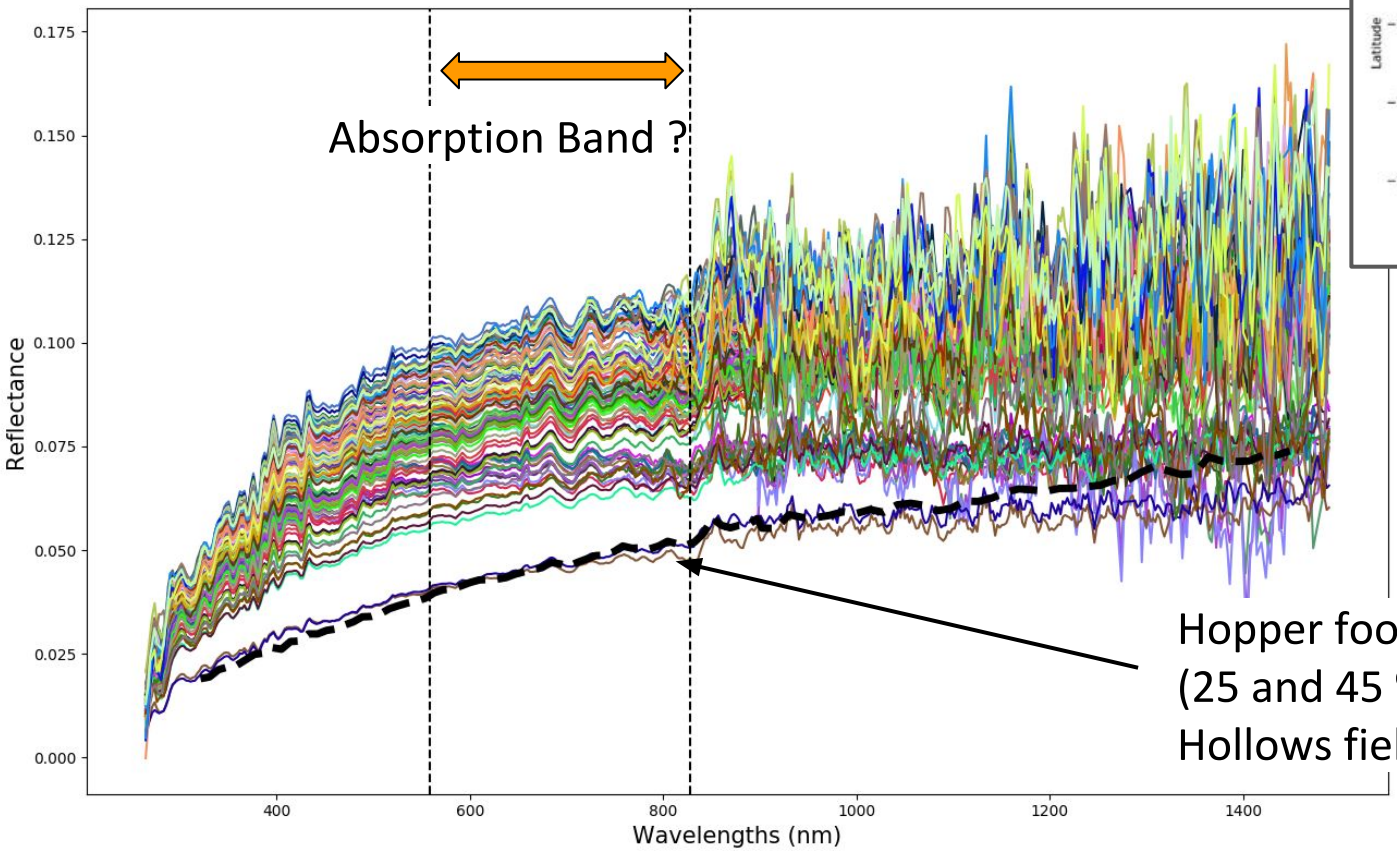


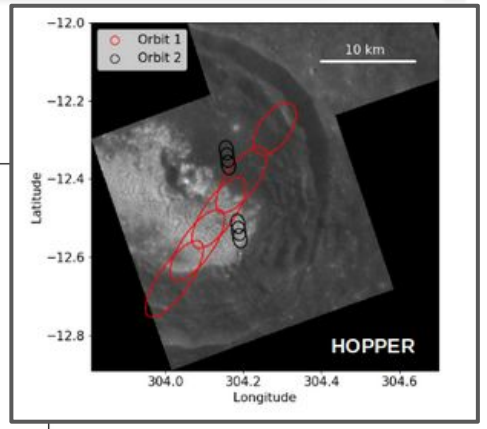


Hopper footprints (25 and 45 %) of Hollows field.

Hollows spectra

- 113 spectra of hollows

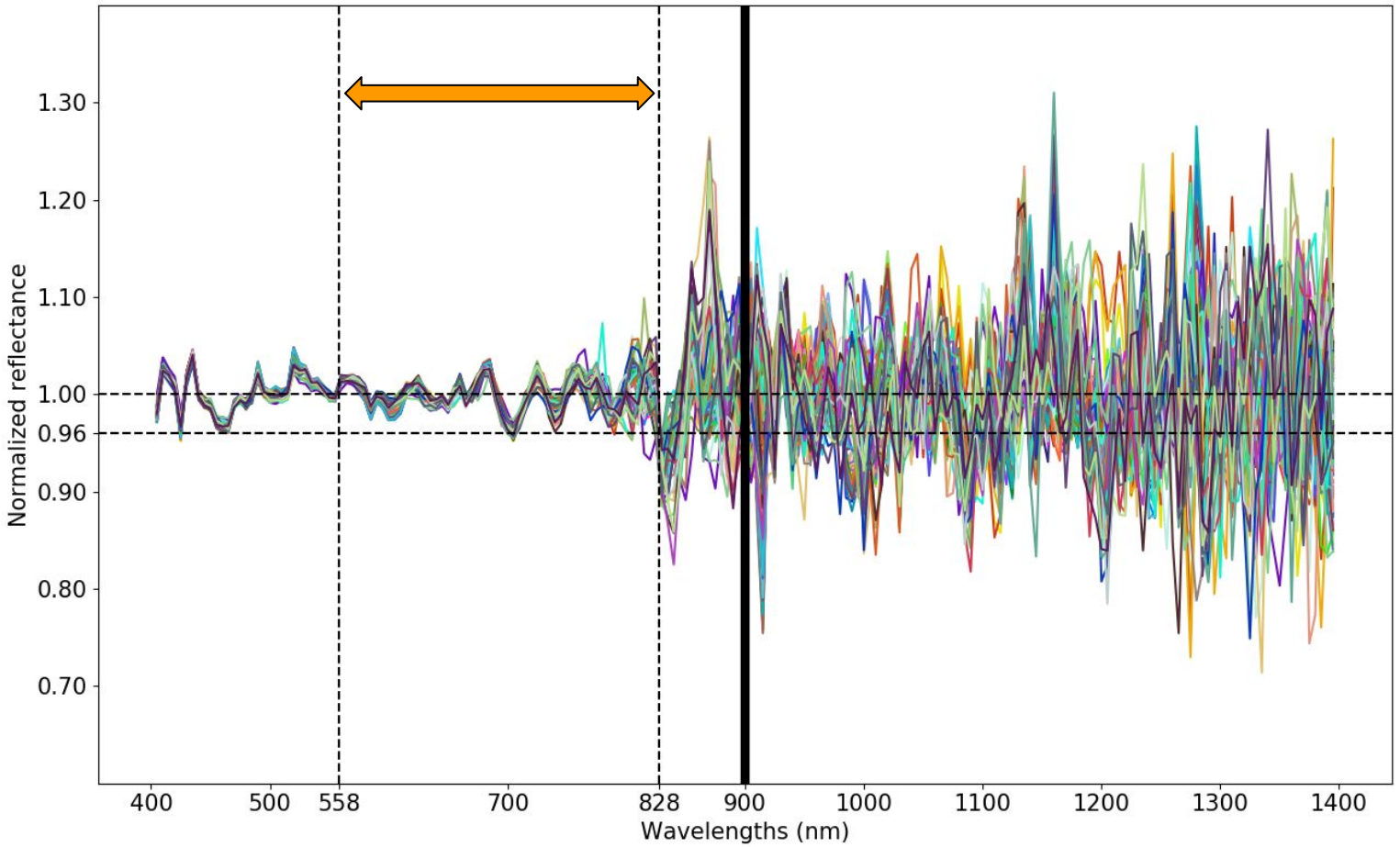




Hopper footprints (25 and 45 %) of Hollows field.

Hollows spectral features ?

- Continuum removed spectra (113)



Conclusion

Lack of absorption features:

1. **Calibration errors**
   In MDIS or in MASCS

2. **No sufficient concentration of pure sulfides**
   → 75 % of pure sulfides needed (Izenberg et al., 2014)

3. **Diversity in hollows material**

Vilas et al., (2016)