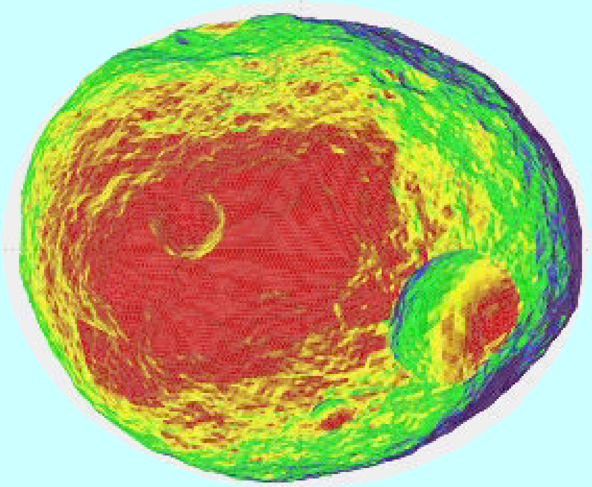
THERMAP
A thermal mapper for Marco Polo



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Paris, 18-20 May, 2009

Scientific objectives for mid-IR

From the ESA Sci-RD document

Determine the surface temperature to an accuracy of 5 K (goal 1 K):

- @ 10 m resolution for the global characterization
- @ 10 cm resolution for the sampling sites

⇒ **Derive thermal inertia to an accuracy better than 10 %**

⇒ **Derive the thermal skin depth**

Identify mineral features:

- @ 10 m resolution for the global characterization
- @ 10 cm resolution for the sampling sites

Instrument requirements

To meet the scientific objectives, the instrument must be able to:

Perform a temperature map of the entire surface
- At different time: one map every degree (= every min)
- At different emission angle: every 10 deg (from 0 to 90 deg)

Perform a spectroscopic map of the entire surface
- At a spectral resolution R~70

Achieve a spatial resolution of:
- 10 m @ 2 km for the global characterization
- 10 cm @ 200 m for the local characterization

⇒ Good and fast imaging capabilities

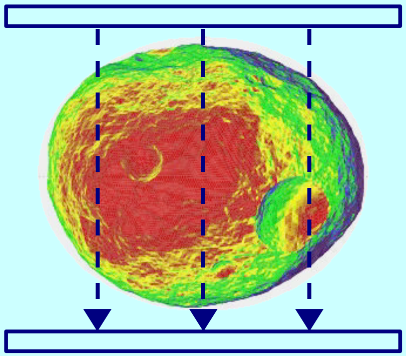
⇒ Reasonable spectroscopic capabilities

Instrument concepts

Spectroscopy

R~70 can be achieved with a classical slit spectrometer (Offner grating)

Three possibilities to perform images



Use the S/C to scan, with a slit spectrometer (DI HRI-IR)

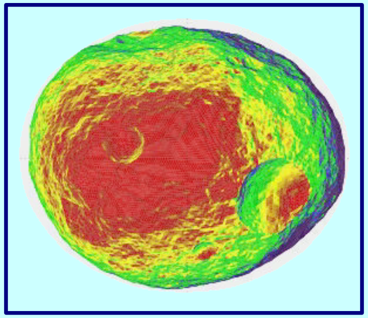
- Pros: All the spectrometers benefit from this
  Lead to more simple spectrometer design
- Cons: Rely on the S/C for imaging

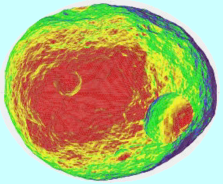
Use a scanning mirror, with a slit spectrometer (VIRTIS)

- Pros: Does not require S/C pointing capabilities
- Cons: Another mechanism, in addition to the calibr. pointing unit

Use a second channel for imaging, in addition to the spectro channel

- Pros: Guarantee excellent imaging capabilites
  Cross-checked measurements (2 channels)
- Cons: Slightly more mass

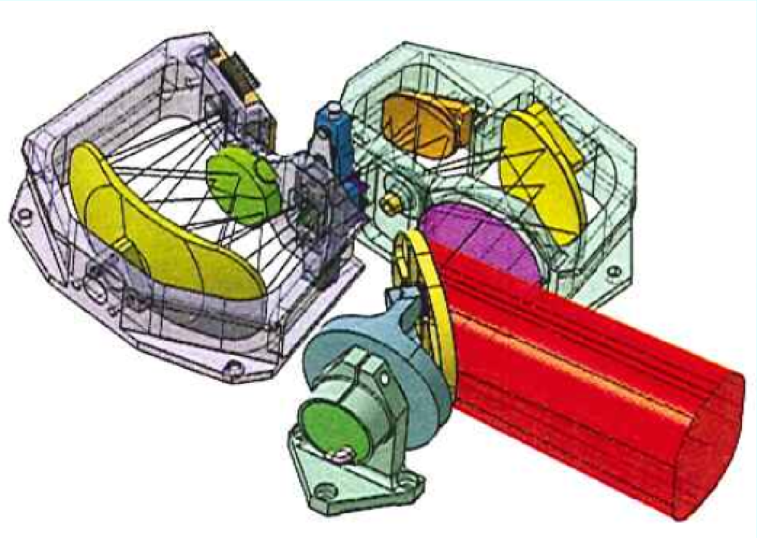




The heritage of MERTIS (BpC)

Characteristics:

- TMA + Offner relay
- 180 x 180 x 130 mm^3, 3.4 kg
- based on an uncooled microbolometer array from ULIS (7-15 µm)
- 2 thermopiles (7-14 µm, 14-40 µm)

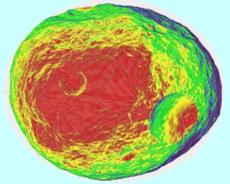


⇒ **Accuracy : NETD<1 K for T>100 K (T>245 K w/o thermopiles)**

⇒ **Spectral resolution of 78-156**

⇒ **Based on the pushbroom technique**

MERTIS is an excellent baseline but it needs imaging capabilites adapted to a fast rotating small body (no pushbroom).



Our current consortium

France

- LAM (Marseille): O. Groussin, P. Lamy, L. Jorda ⇒ PI institute
- LESIA (Paris): E. Lellouch ⇒ Scientific Co-I
- OCA (Nice): M. Delbó ⇒ Scientific Co-I
- CNES (Toulouse): A. Bardoux ⇒ Microbolometer array specialist

Germany

- DLR (Berlin): J. Helbert, J. Knollenberg. E. Kuehrt
  ⇒ MERTIS heritage and scientific CoIs

Spain

- IAC (Tenerife): J. Licandro, M. Serra Ricard, A. Oscoz
  ⇒ Electronics development and scientific CoIs

USA

- LPL (Tucson): D. Lauretta
  ⇒ Deputy PI of the OSIRIS REx mission (asteroid sample return)

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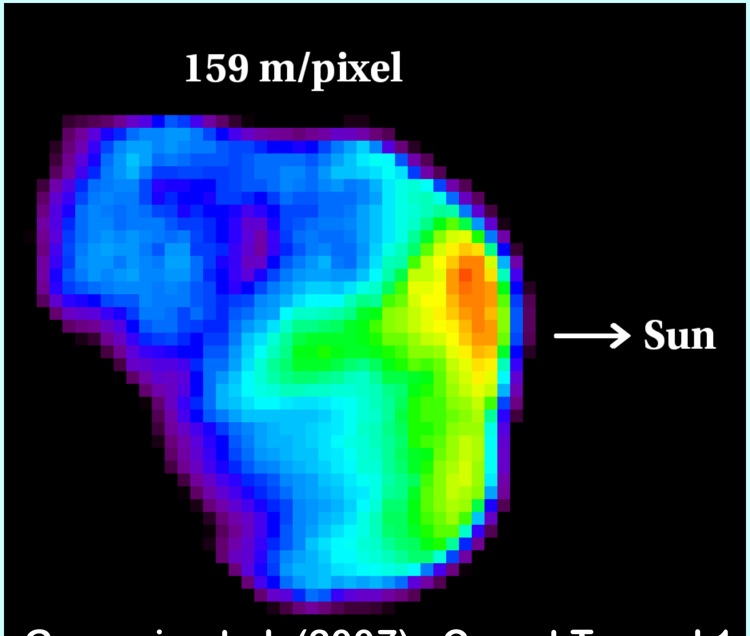
Conclusions

We strongly believe in the importance of an imaging channel and we continue our instrument design phase:

- optical and mechanical design
- expected performances, detailed detector characteristics
- electronics realization (see Licandro's presentation)

Deep Impact mission (2005)



Groussin et al. (2007) - Comet Tempel 1

Marco Polo (2019)