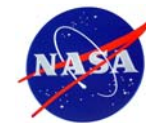


# Want good topography? Consider HRSC!

High Resolution Stereo Camera:  
A tool for landing site selection

**Ernst Hauber, G. Neukum, R. Jaumann, K. Gwinner,  
F. Scholten, H. Hoffmann, S. van Gasselt, T. Duxbury**





# *Overview*

**HRSC: overview and data products**

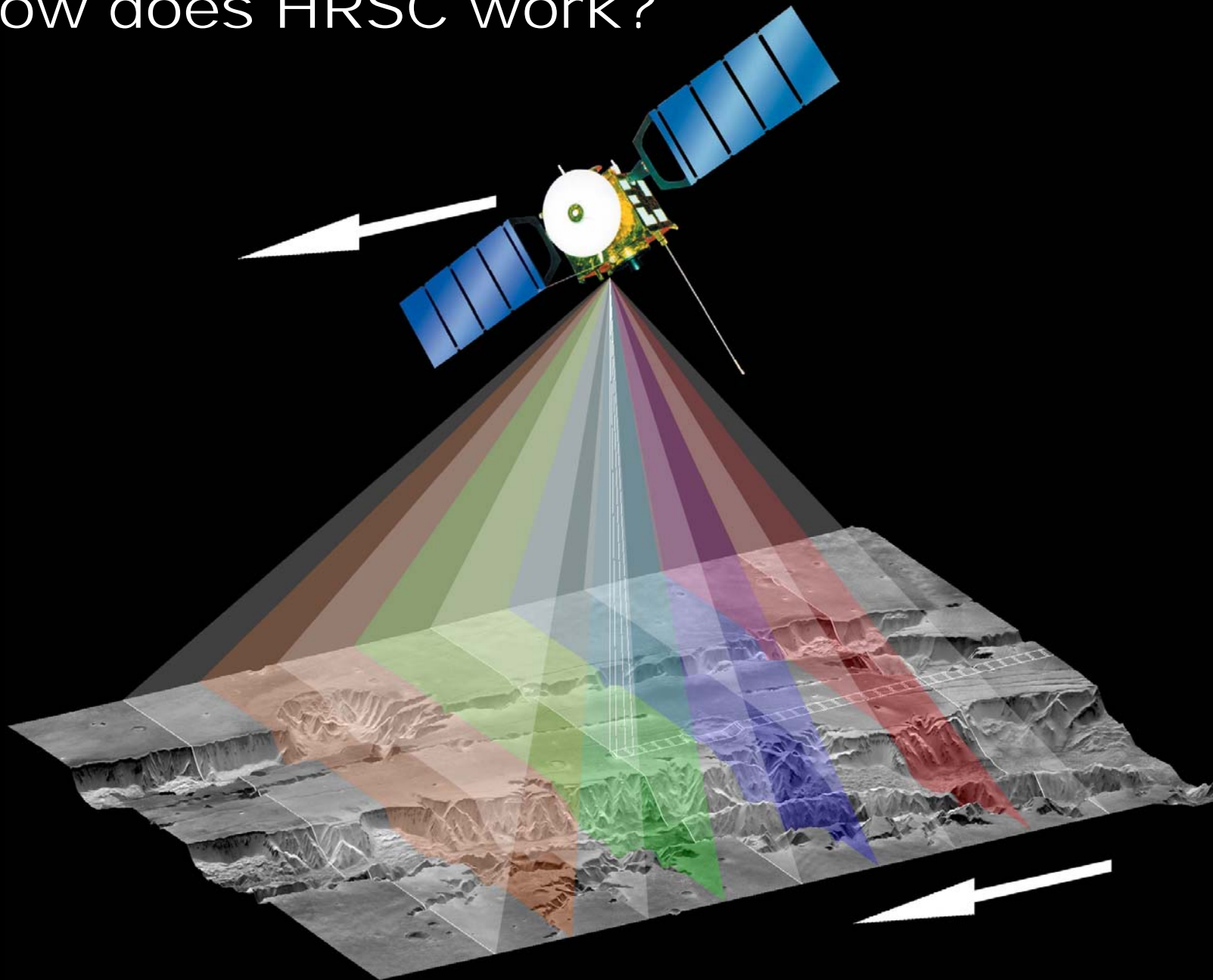
**HRSC : a “bridge” to landing sites**

**Examples and outlook**



Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

How does HRSC work?

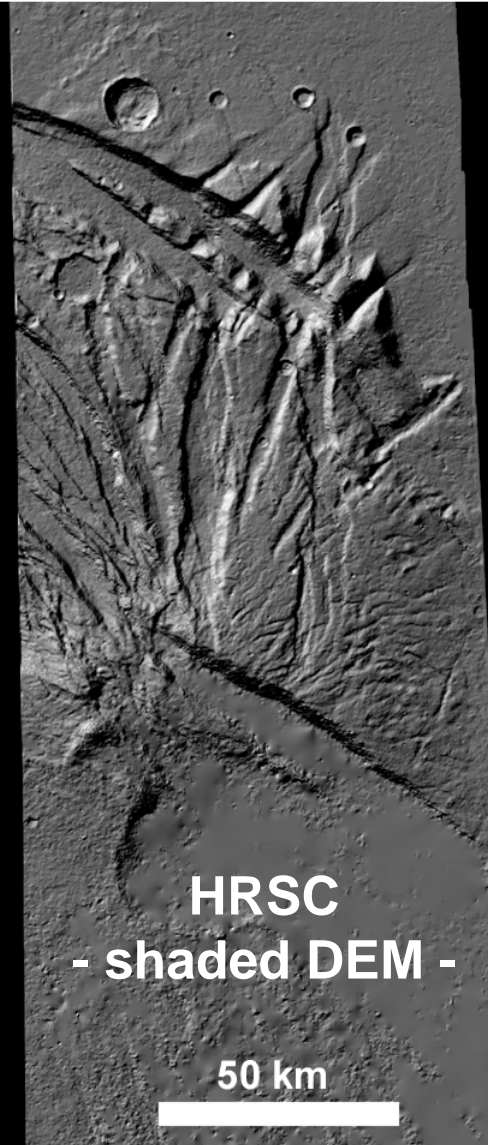
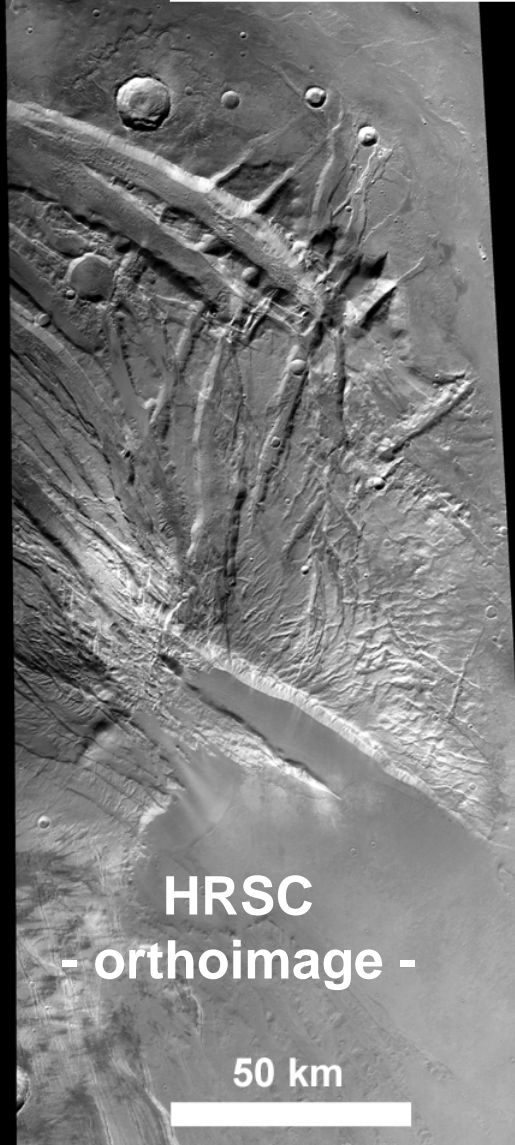


# Comparison to other surface data

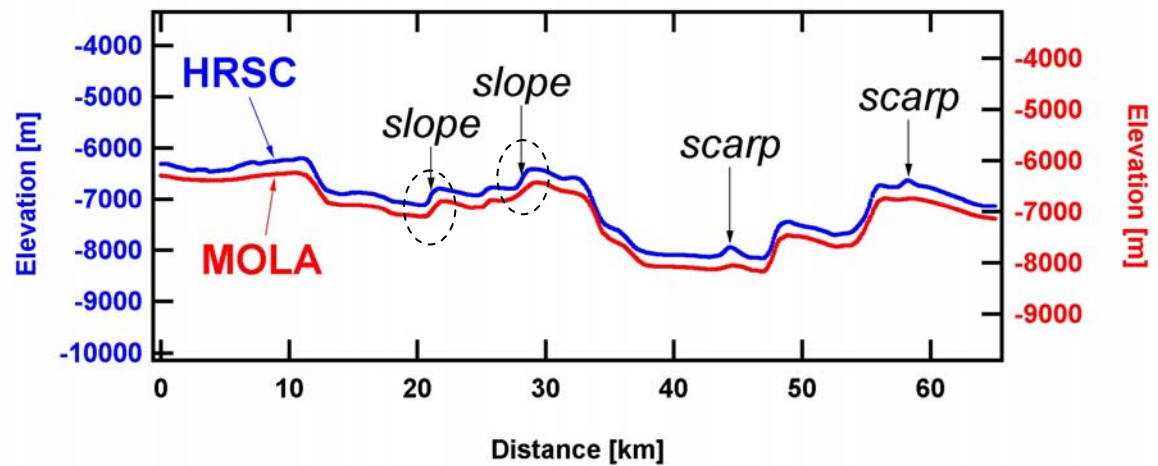
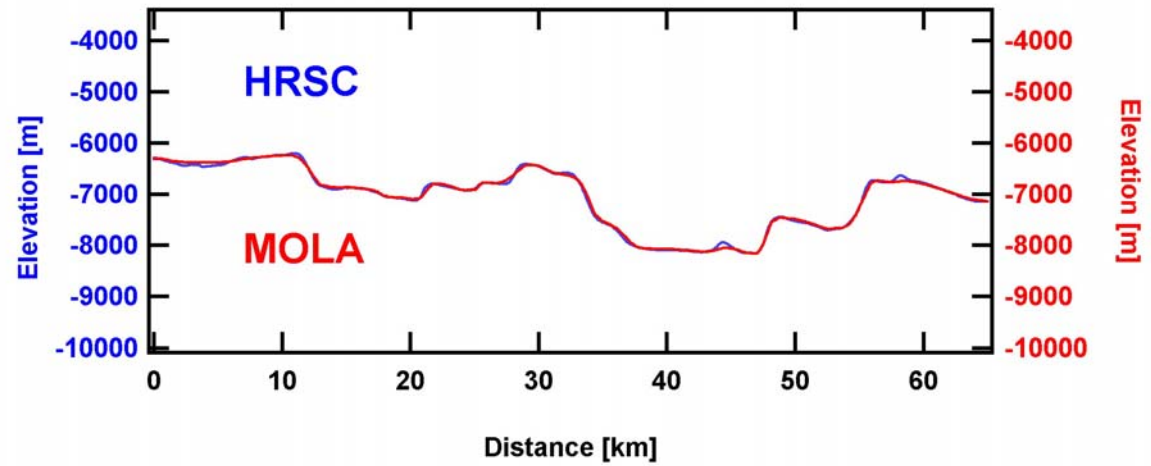
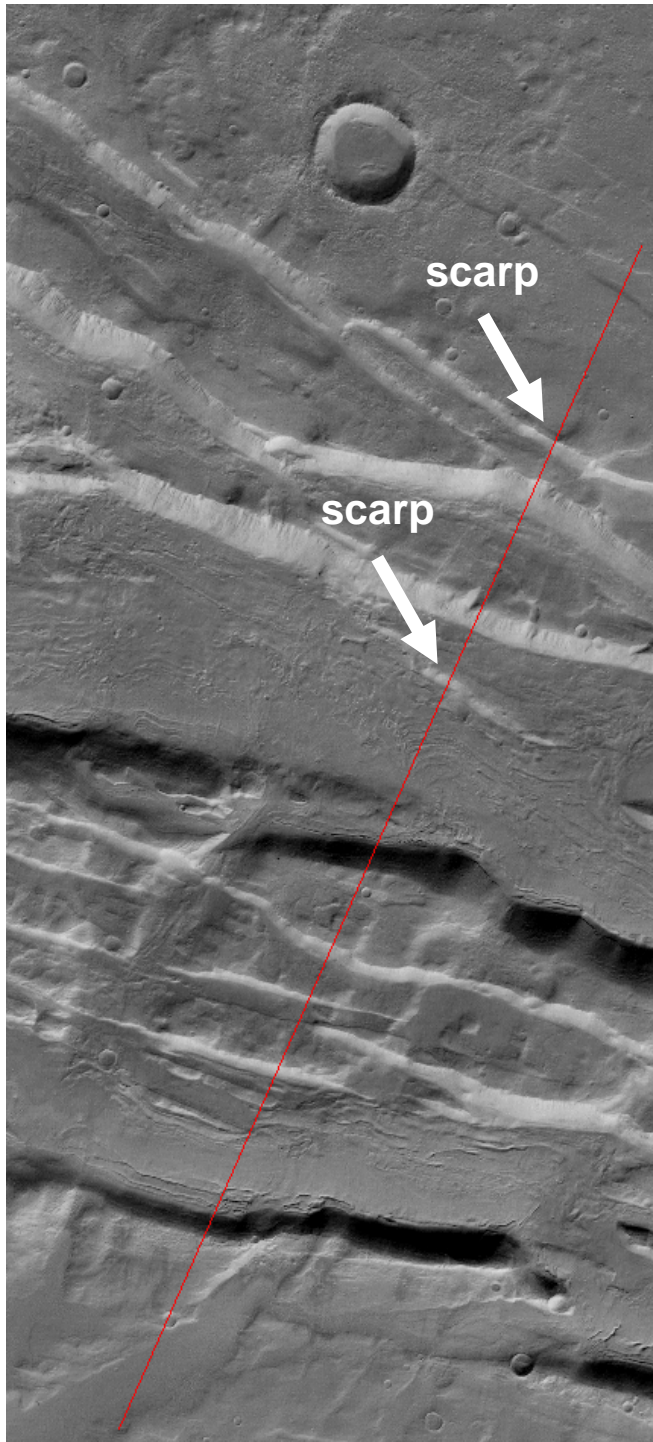
Camera	Resolution	Swath width	
<b>HRSC</b>	~11-12 m/pixel	~60 km <b>complete landing ellipse plus „to go“ area</b>	
MOC	~few meters/pixel <i>cPROTO</i> ("compensated Pitch and Roll Targeted Observation,") <1m/pixel	~3 km	
THEMIS-VIS	19 m/pixel or 38 m/pixel	~20 km	
HiRISE	30 cm/pixel	>6 km (red) >1.2 km (b/g/ near-IR)	
Context Imager MRO	8 m/pixel	40 km	
CRISM	18 m/pixel	~25 km	

# Comparison HRSC - MOLA

## Acheron Fossae, NW Tharsis



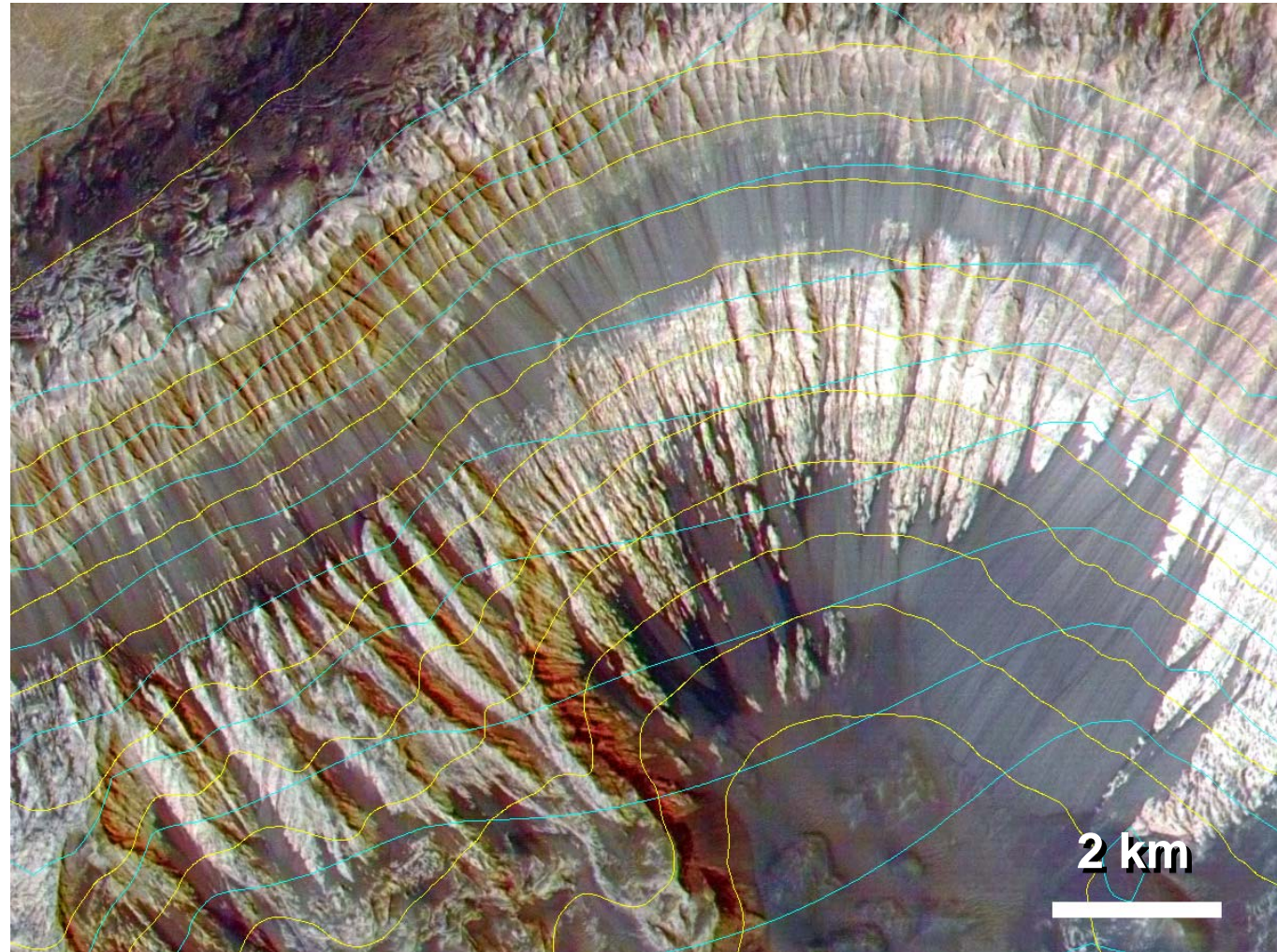
# Topographic profiles

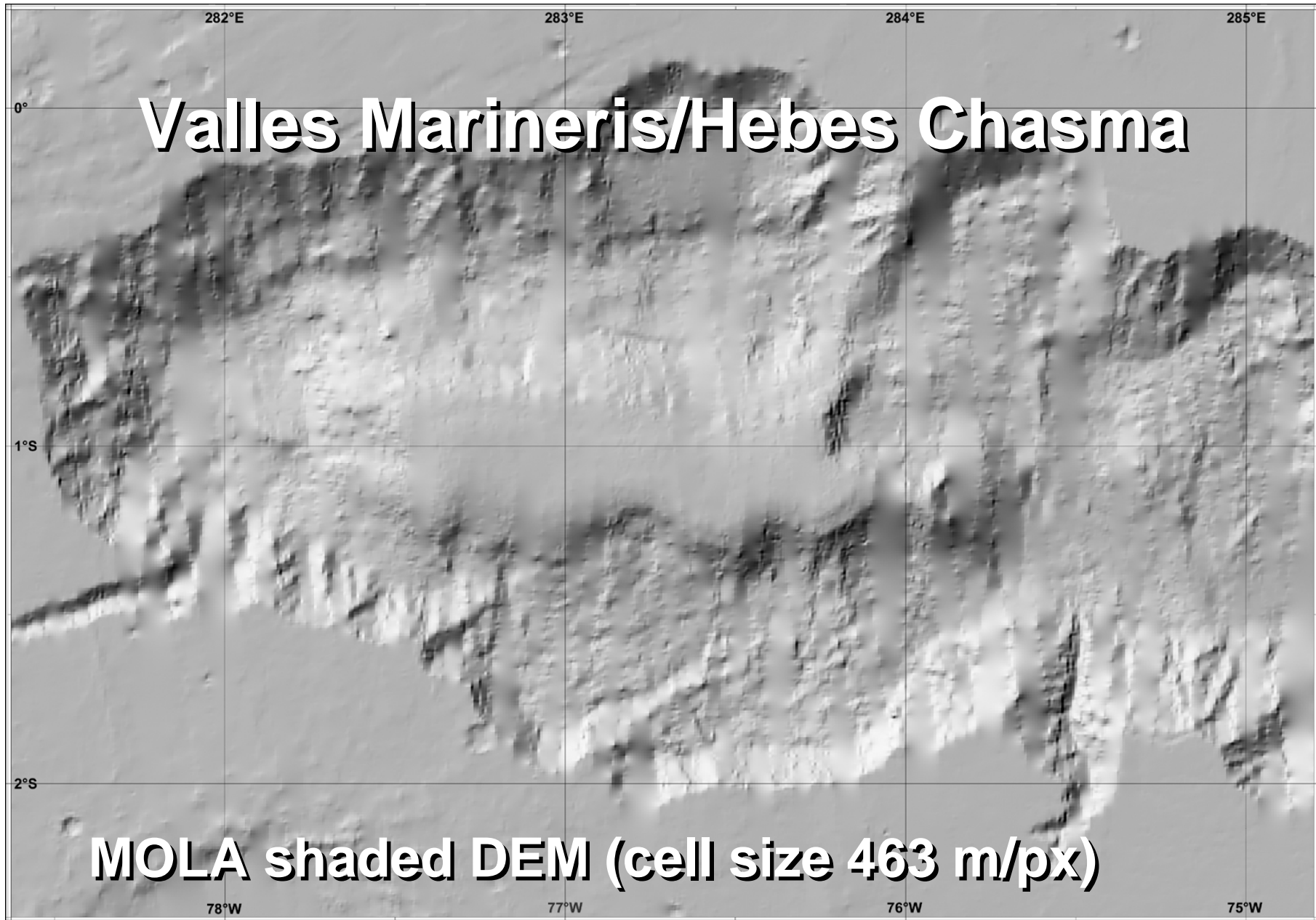


# Comparison HRSC - MOLA

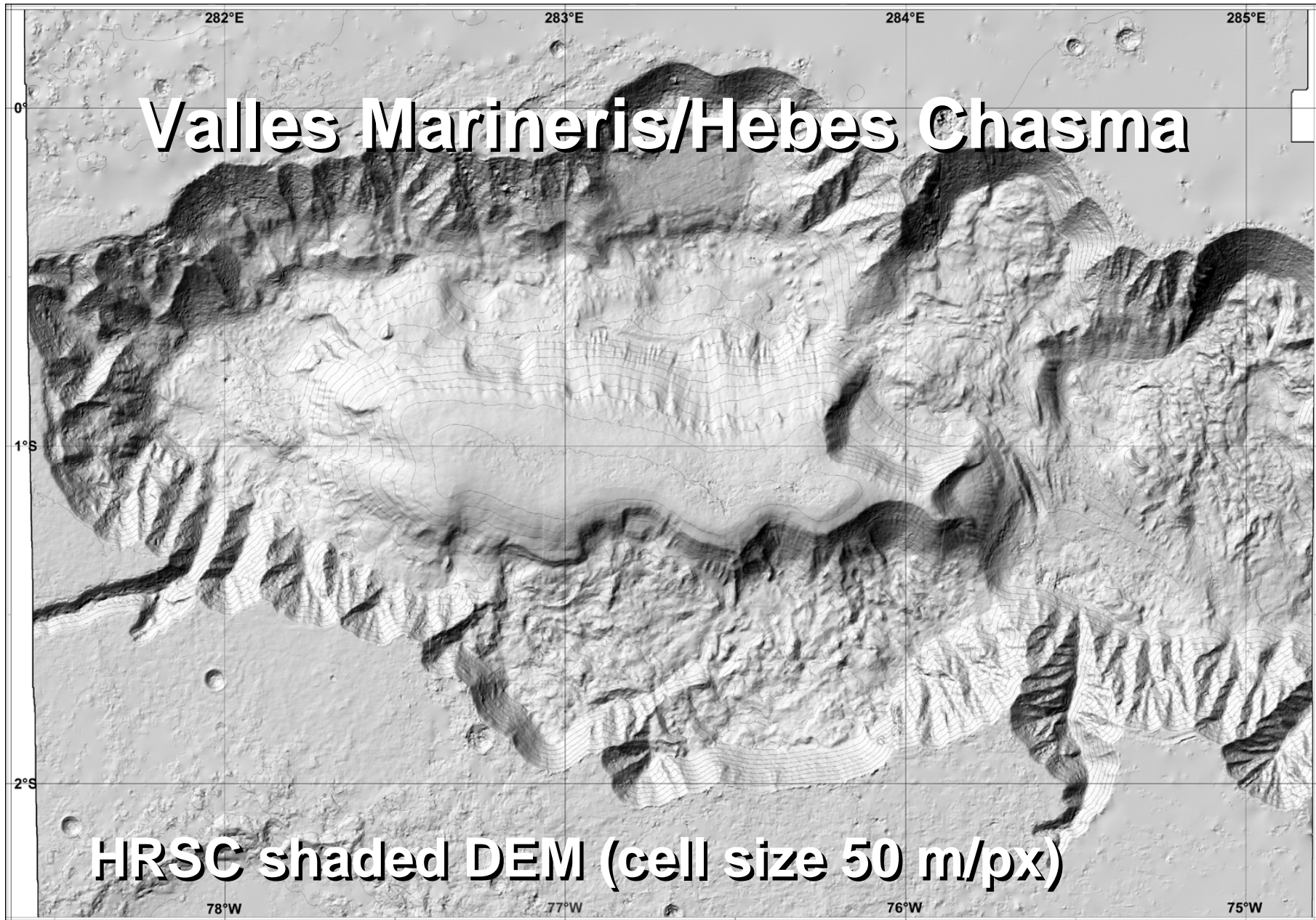
**MOLA**

**HRSC**

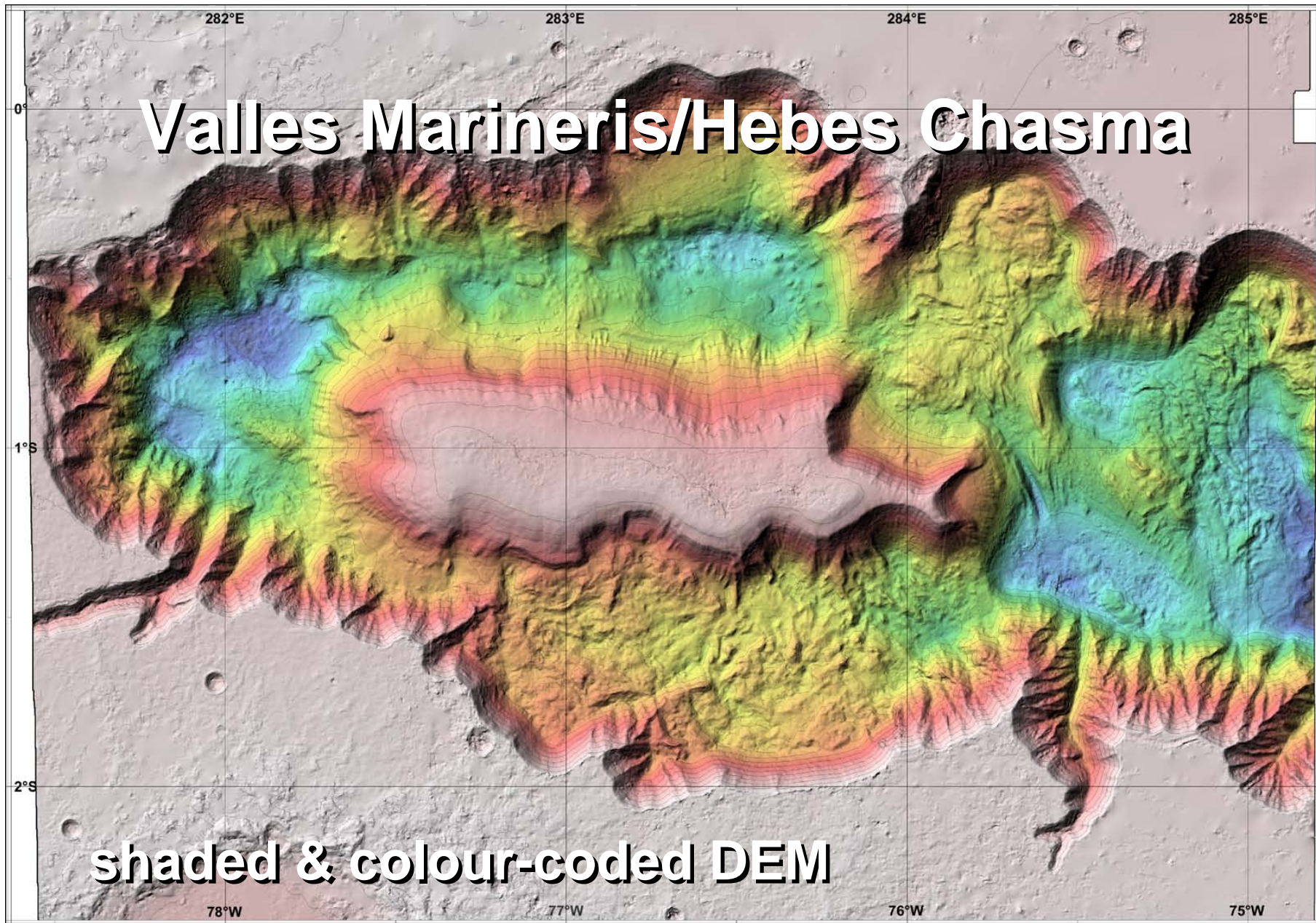




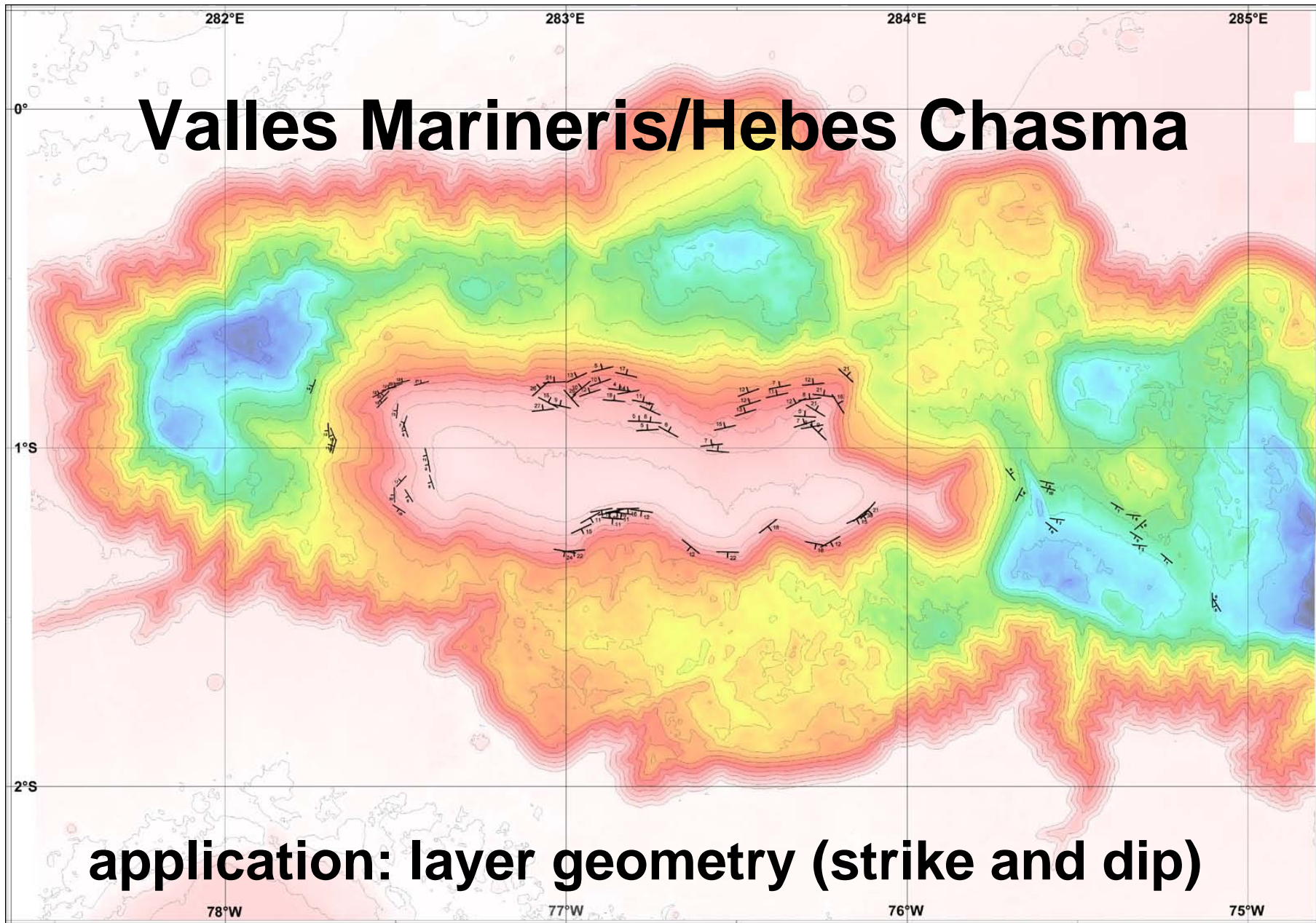




# Valles Marineris/Hebes Chasma



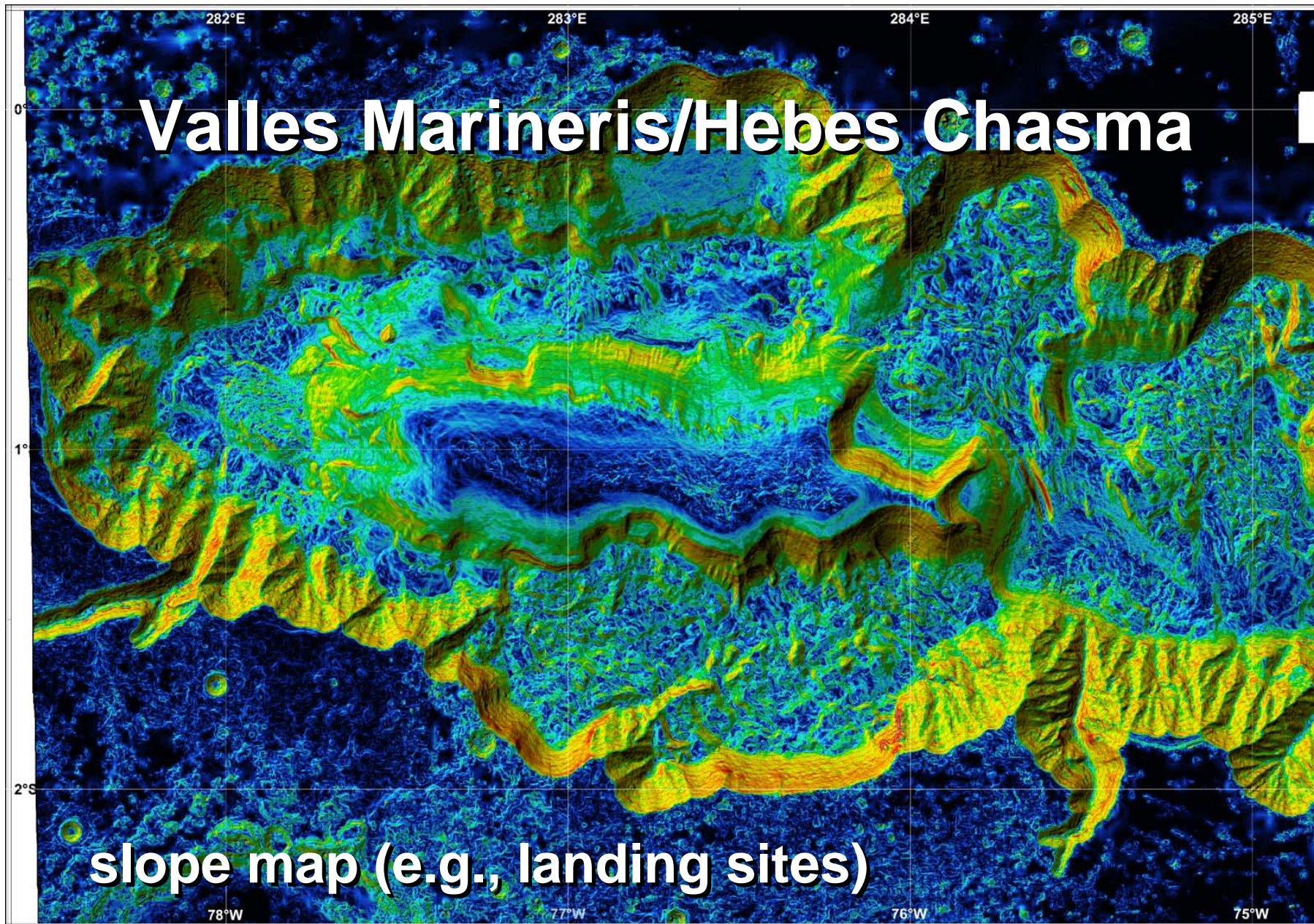
# Valles Marineris/Hebes Chasma



**application: layer geometry (strike and dip)**



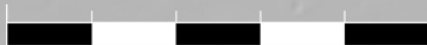
# Valles Marineris/Hebes Chasma



# Melas Chasma

**MOLA: shaded DEM**

50 km



# Melas Chasma

HRSC: shaded DEM

50 km

N



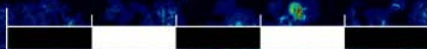
Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

# Melas Chasma



slope map

50 km

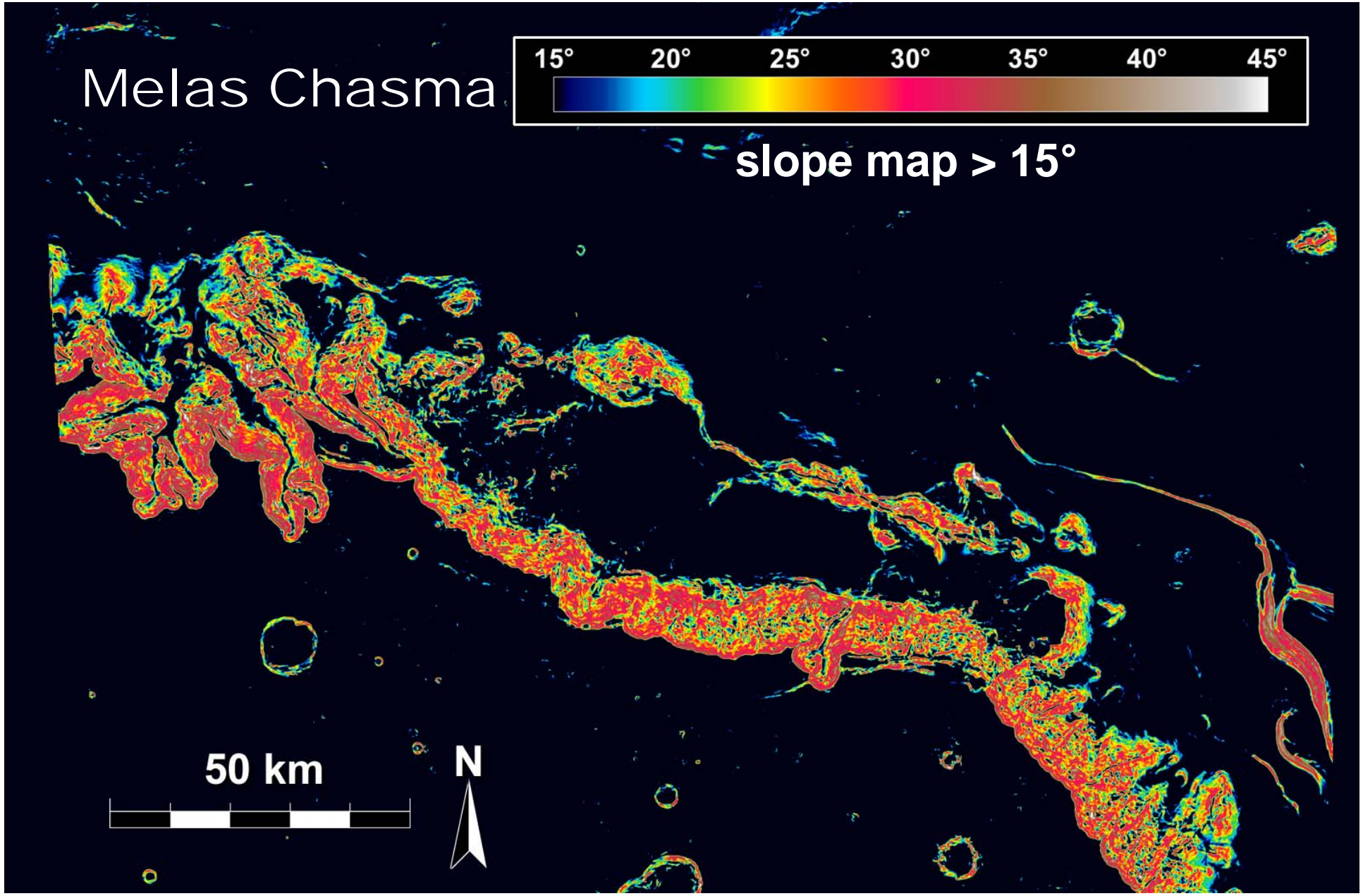


Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

# Melas Chasma

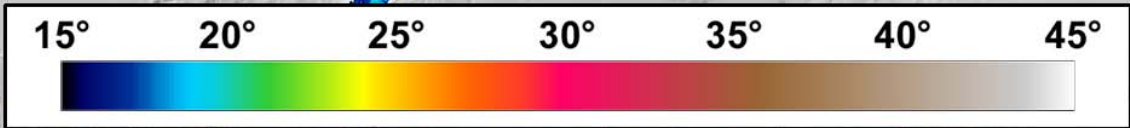


slope map > 15°

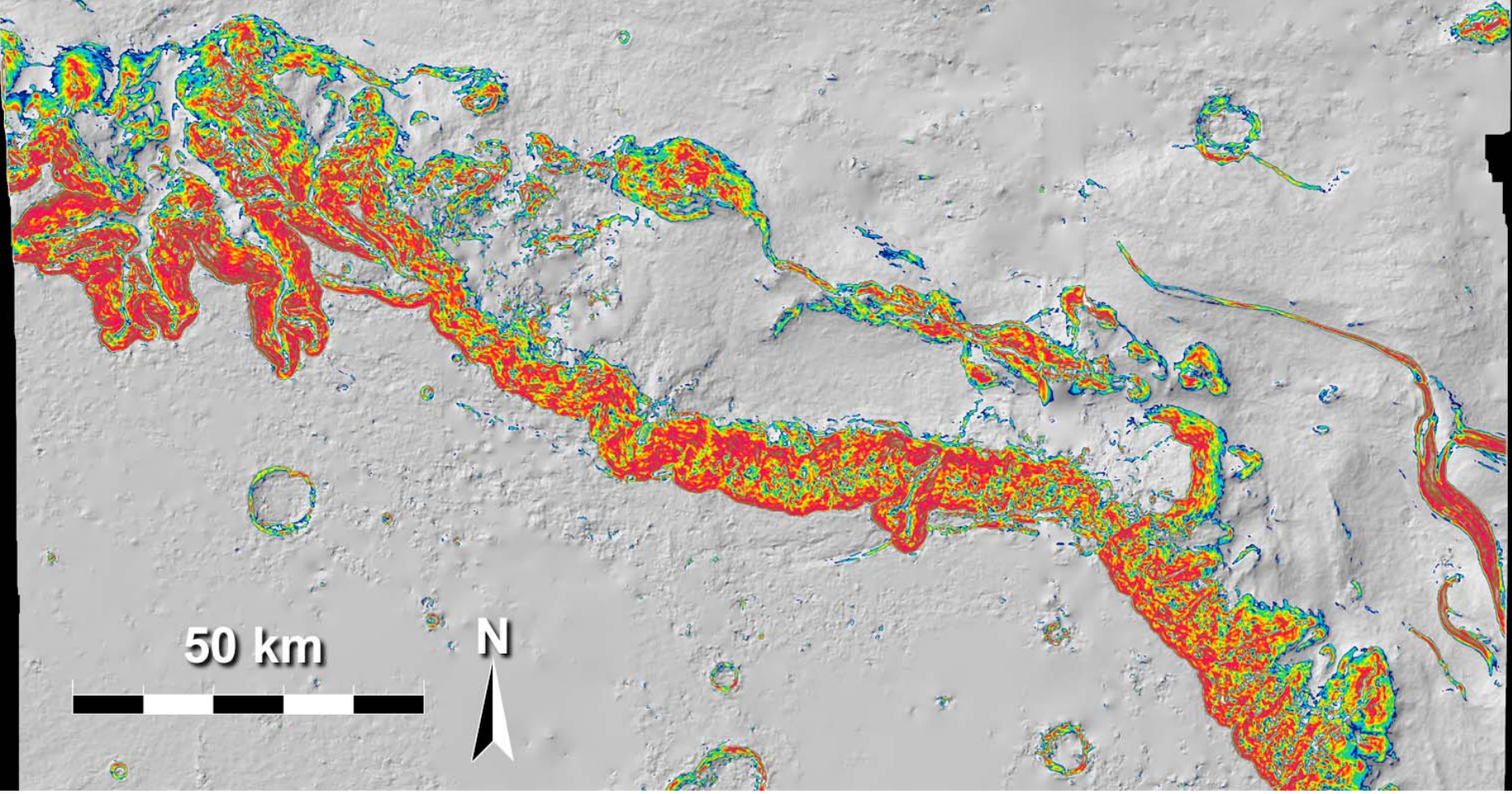




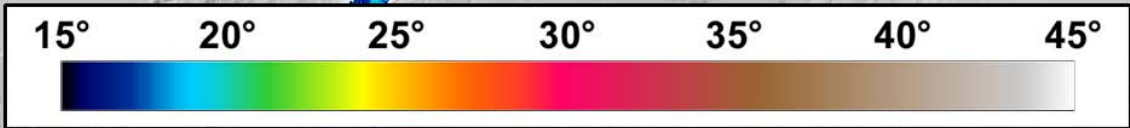
# Melas Chasma



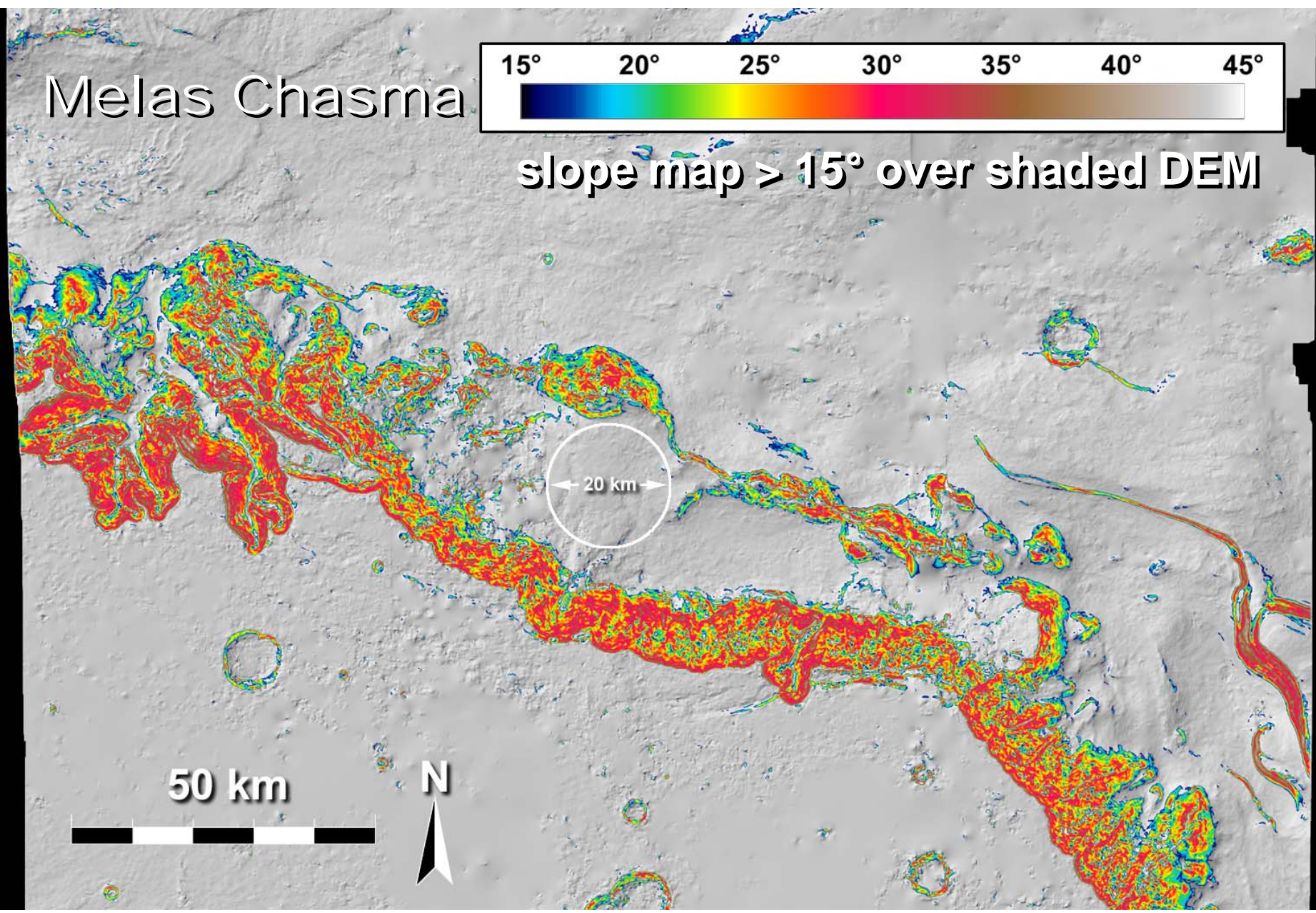
slope map > 15° over shaded DEM



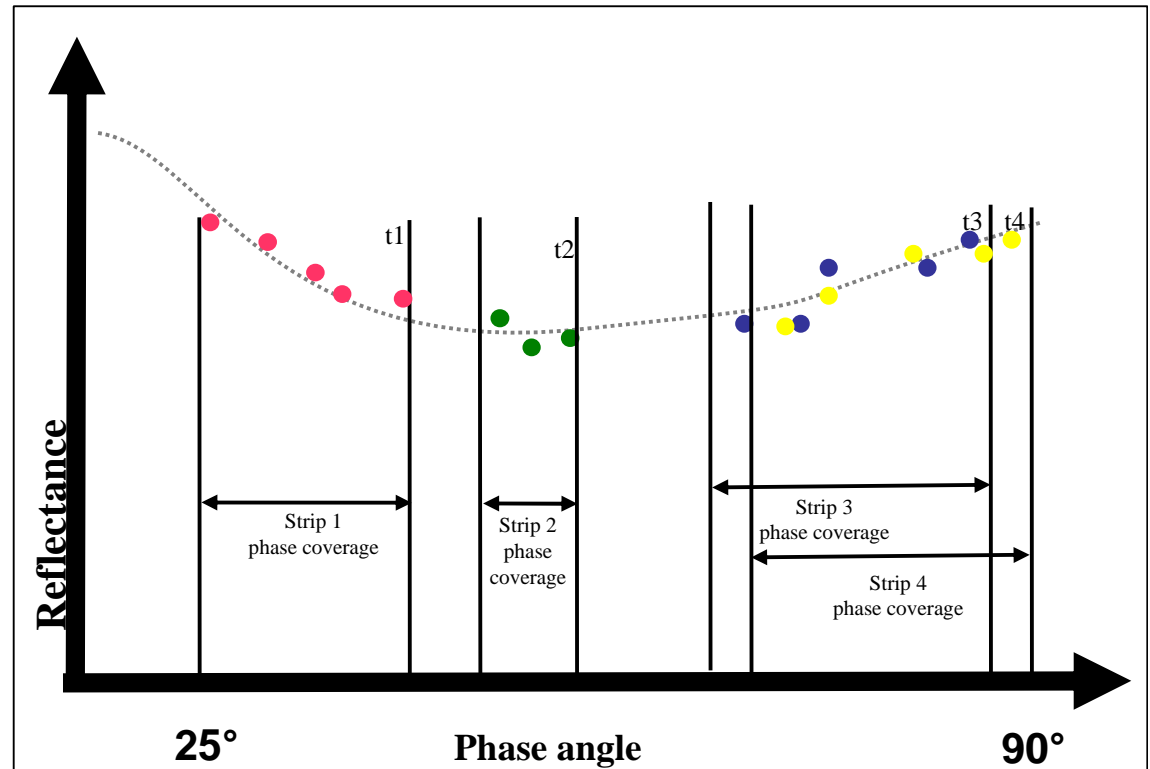
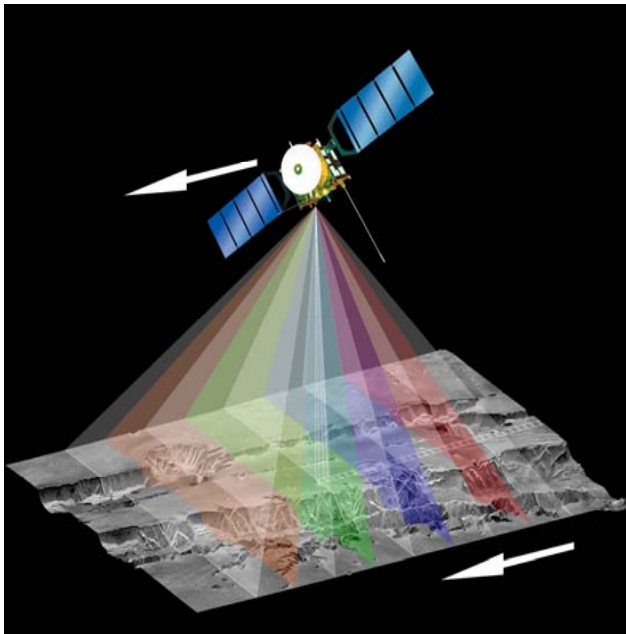
# Melas Chasma



slope map > 15° over shaded DEM



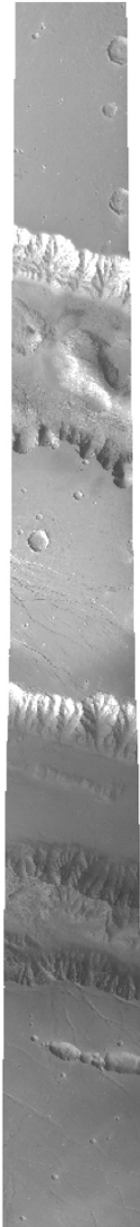
# Surface roughness by HRSC photometry



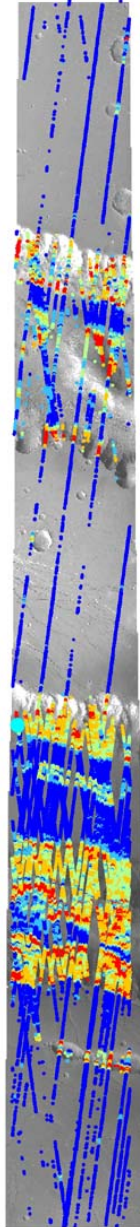
Orbit: 72 24 637 / 648

- USE OF LEVEL 4 HRSC products (orthorectification, DTMs, registration procedures)
- Orbital information reveals significant variations of the surface physical properties, consistent with the in situ observations (Gusev floor / Columbia Hills) → Johnson et al., 2006; Arvidson et al., 2006; Squyres et al., 2006):

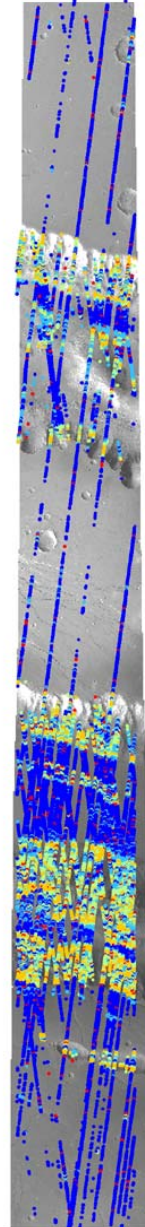
HRSC orthoimage



MOLA tracks on HRSC slopes



MOLA tracks on MOLA slopes



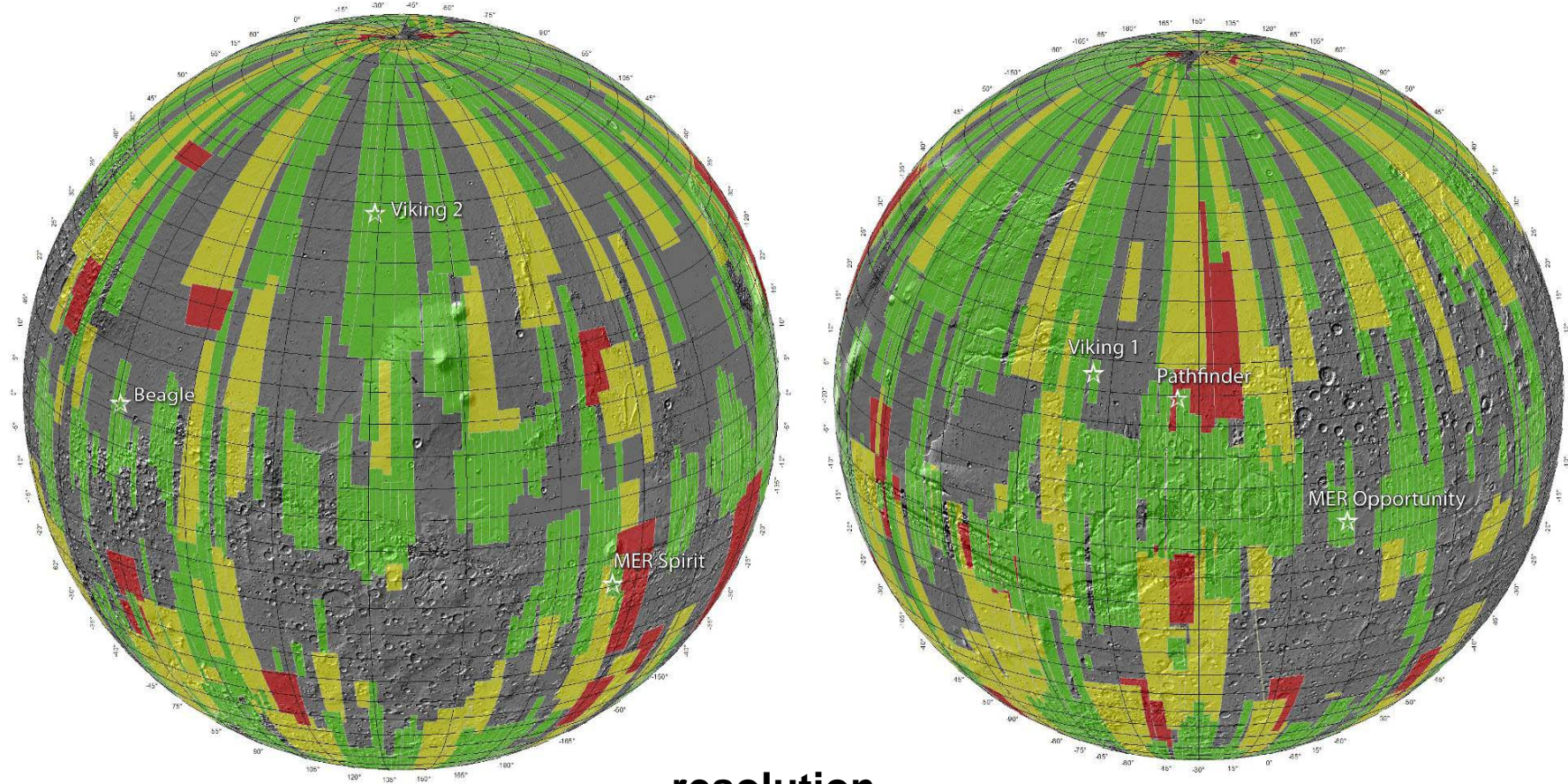
## MOLA pulse width

### *slope correction with HRSC DEM*

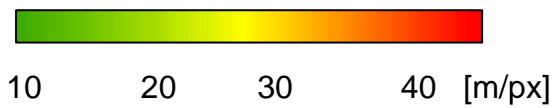
- MOLA pulse width correlates with surface roughness
- analysis requires correction for slopes
- MOLA footprint diameter is ~150 m → correction with smaller-scale slopes from HRSC DEM might provide more accurate results



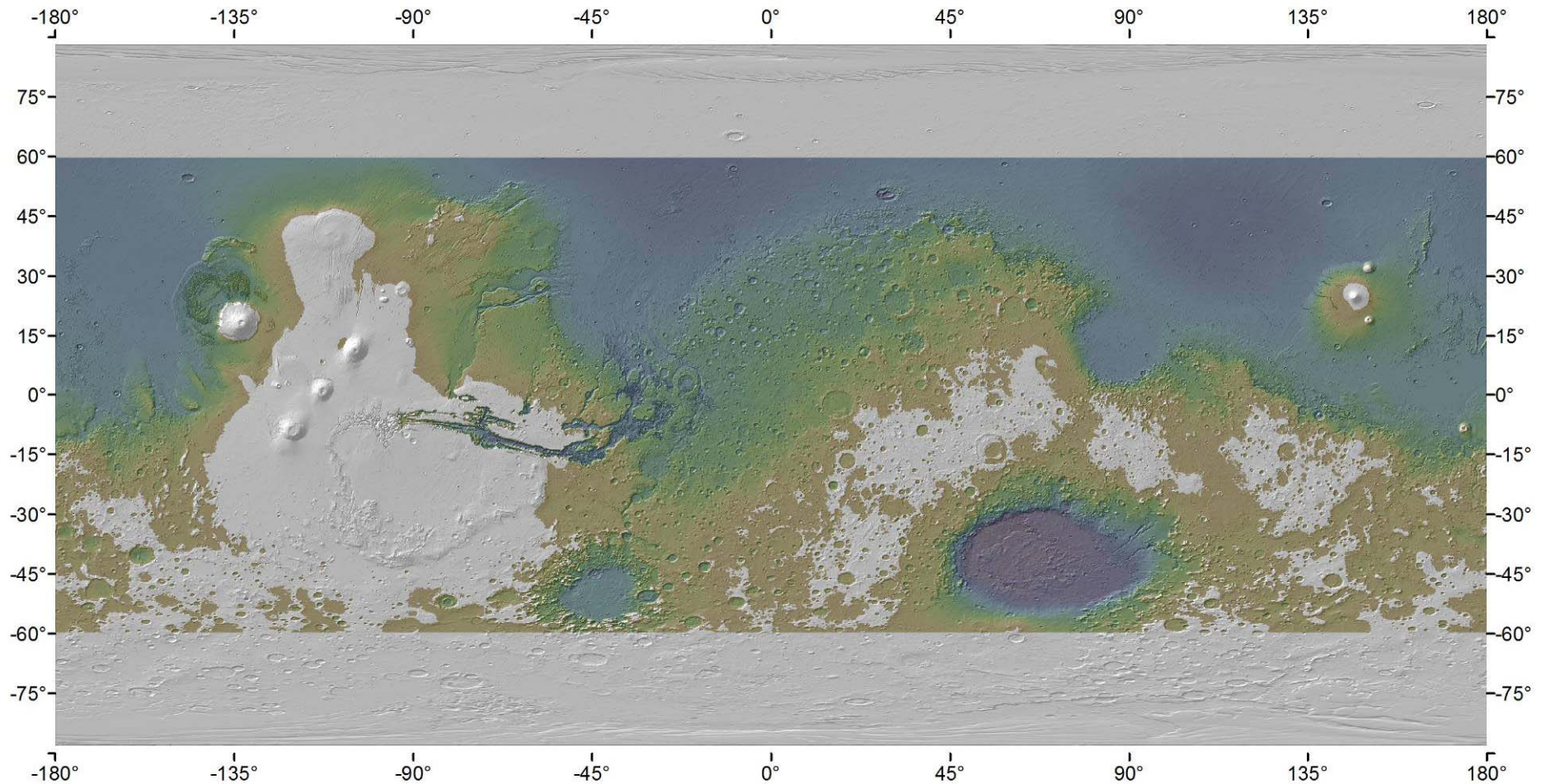
# Coverage and Former Landing Sites



resolution

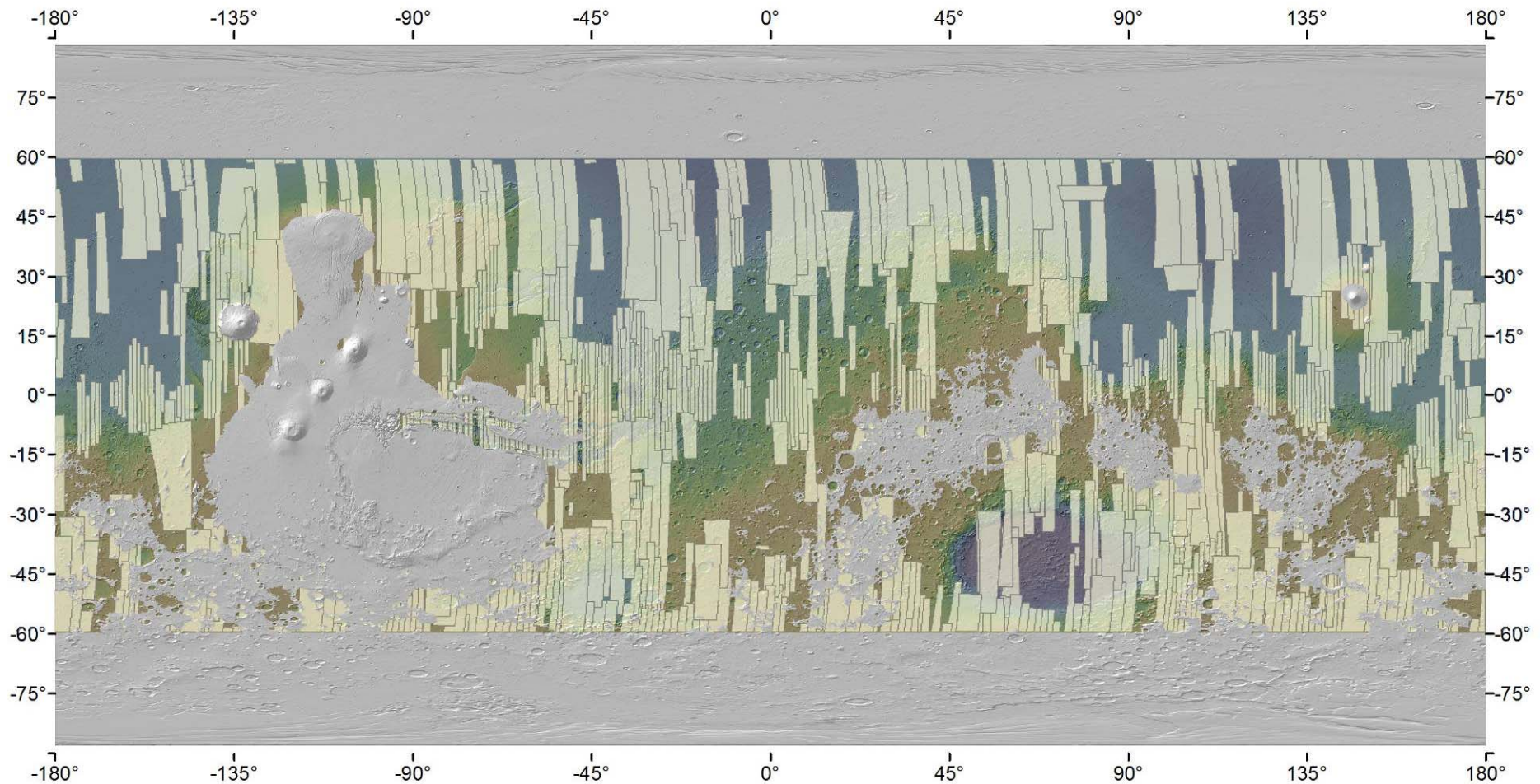


# Constraints on Landing Sites



**$\pm 60^\circ$  latitude and  $< 2$  km (MOLA)**

# HRSC Coverage up to orbit 2841



# Combination HRSC elevation – MOC images

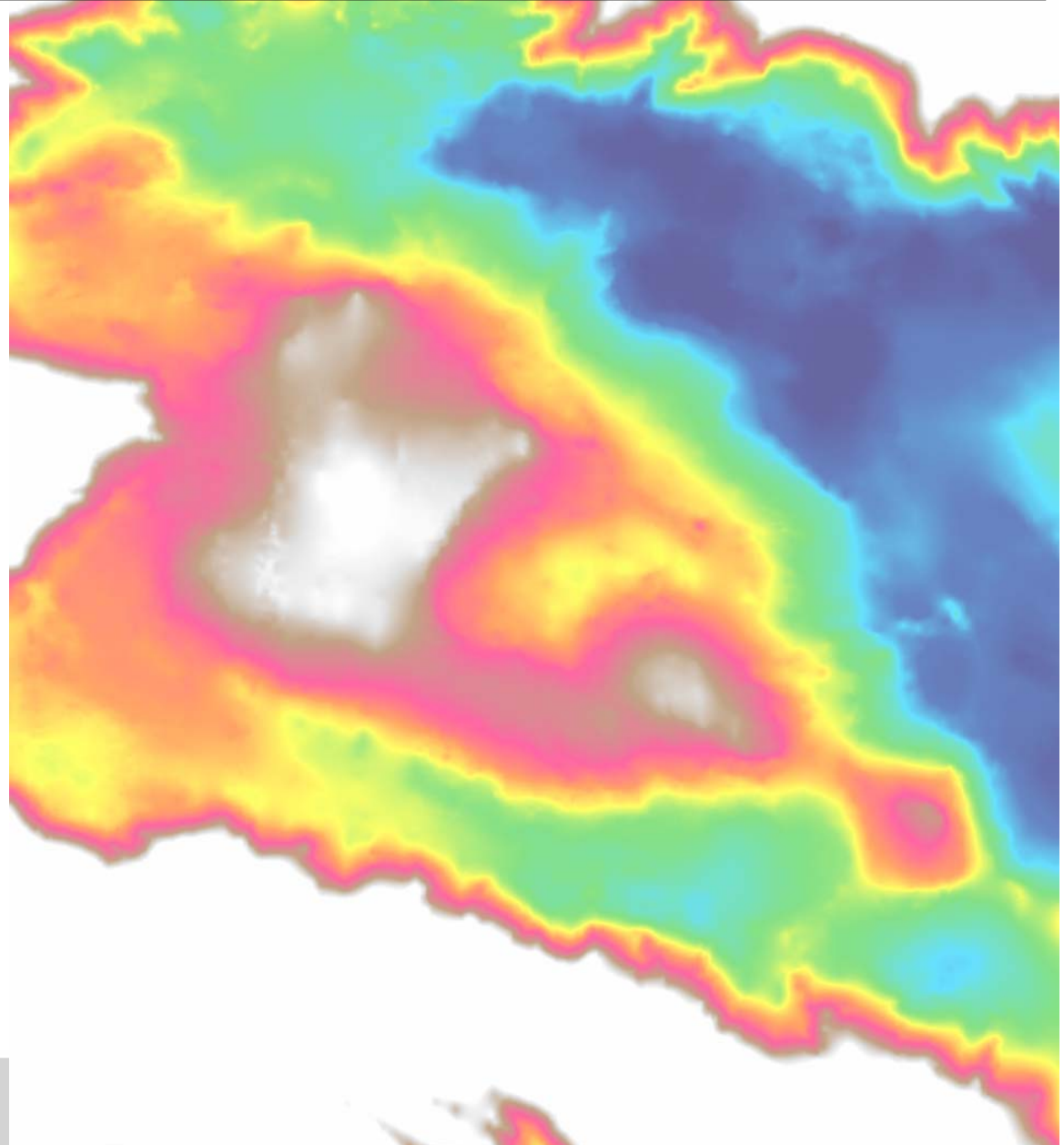
- a bridge to higher-resolution data





# Combination MOLA elevation - HRSC images

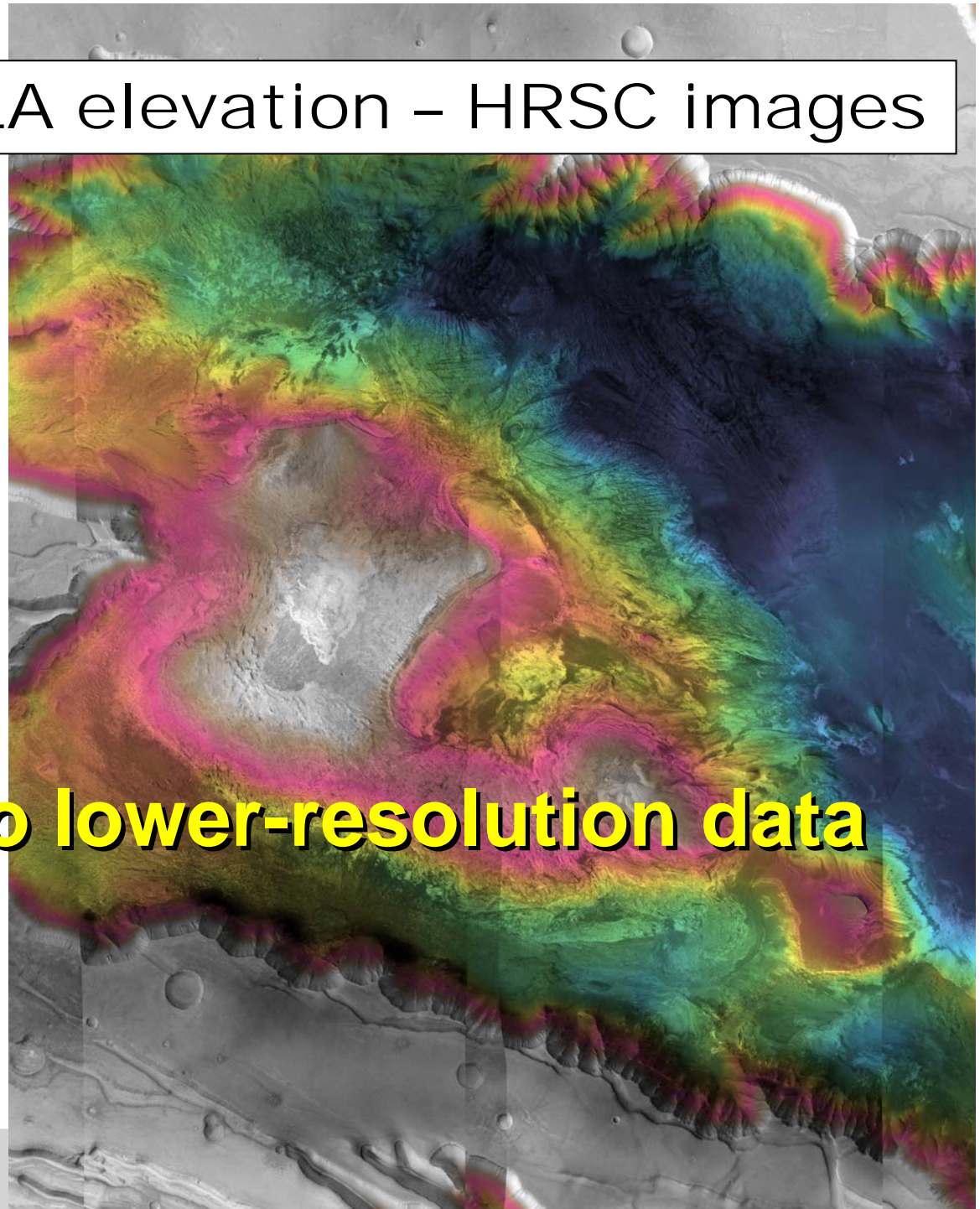
- **MOLA**



# Combination MOLA elevation - HRSC images

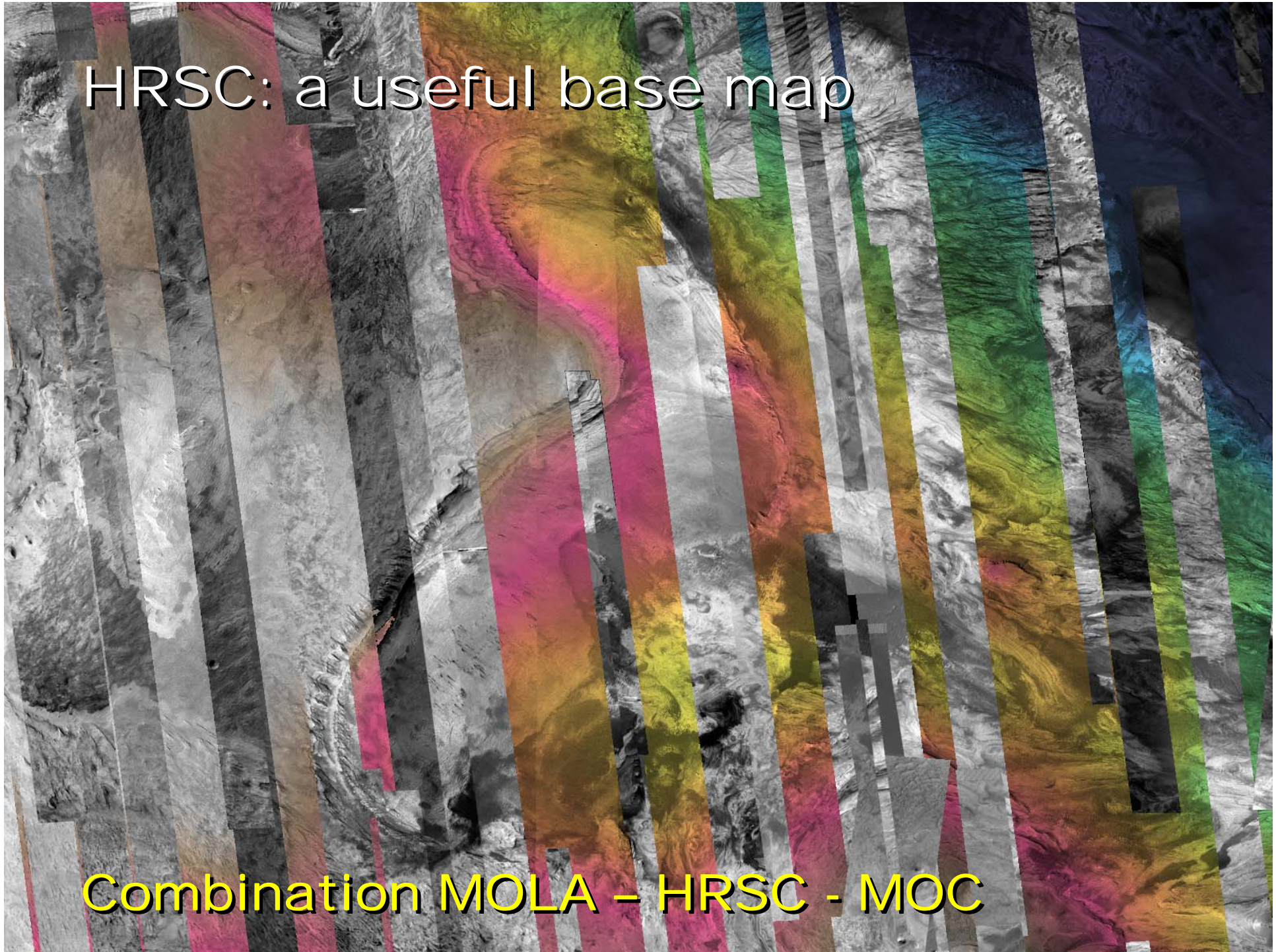
- MOLA
- HRSC

• a bridge to lower-resolution data



HRSC: a useful base map

Combination MOLA - HRSC - MOC

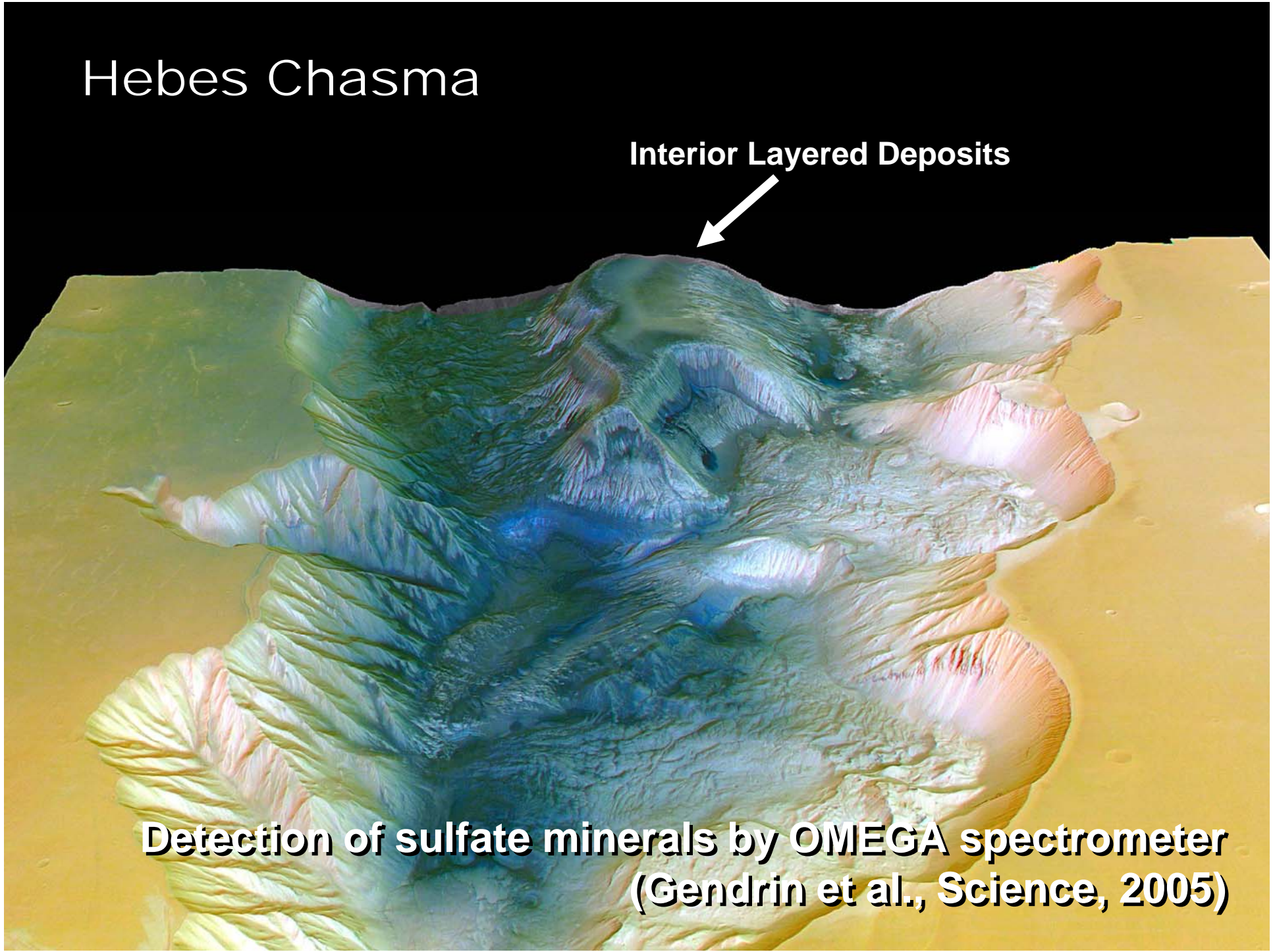


# Hebes Chasma

Interior Layered Deposits



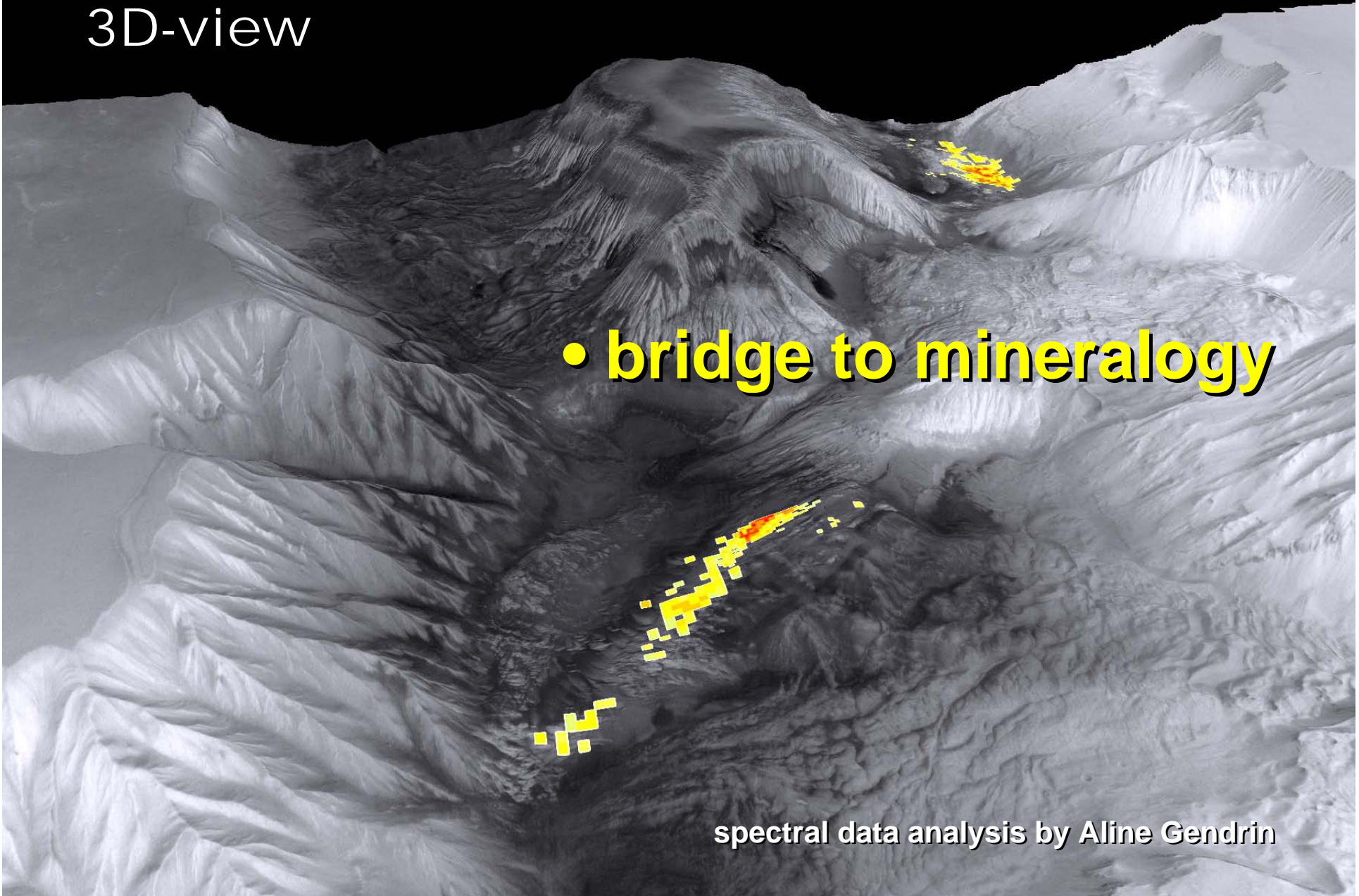
**Detection of sulfate minerals by OMEGA spectrometer  
(Gendrin et al., Science, 2005)**



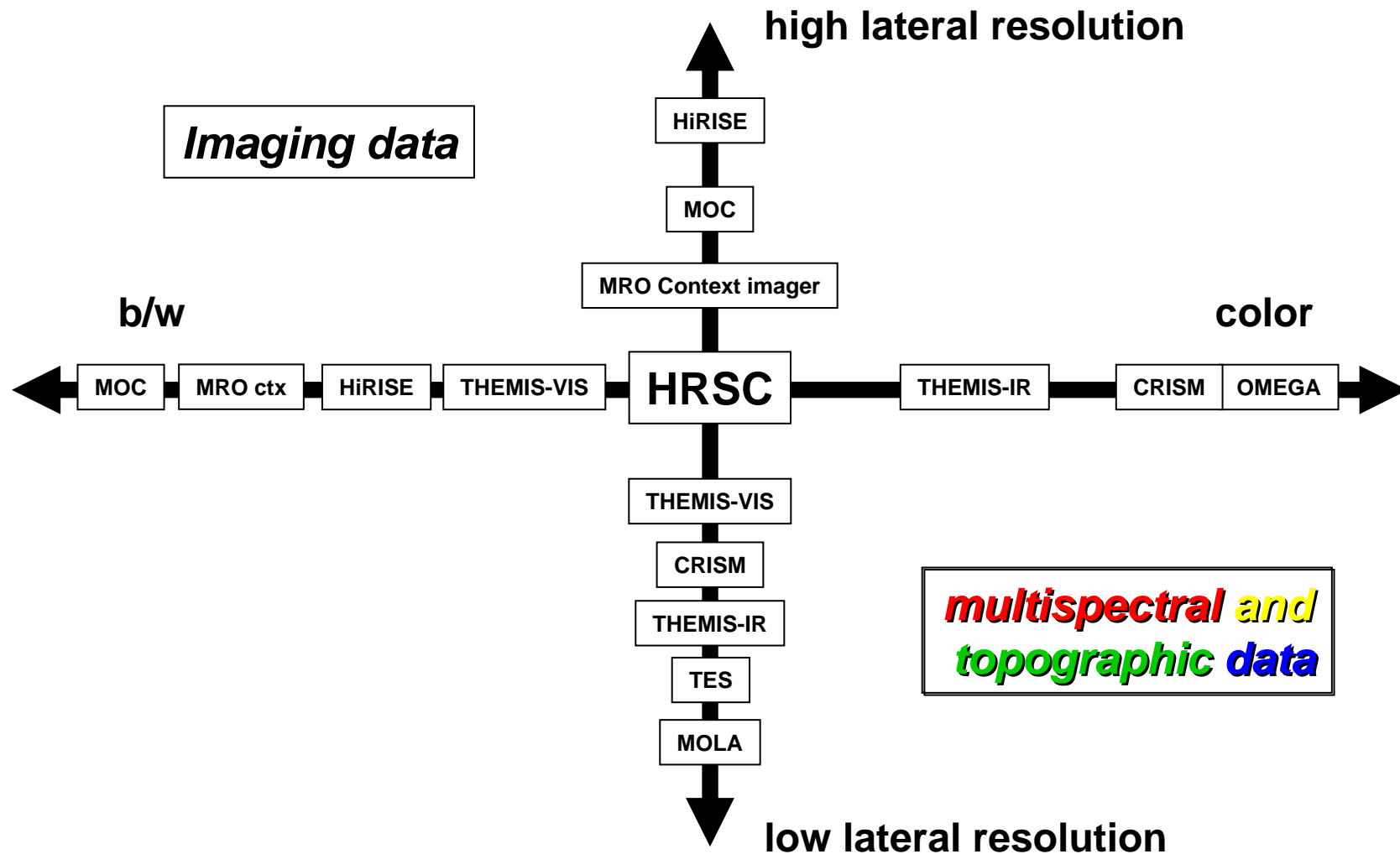
# OMEGA mineral classification on HRSC 3D-view

- **bridge to mineralogy**

spectral data analysis by Aline Gendrin



# HRSC as a bridge between data sets



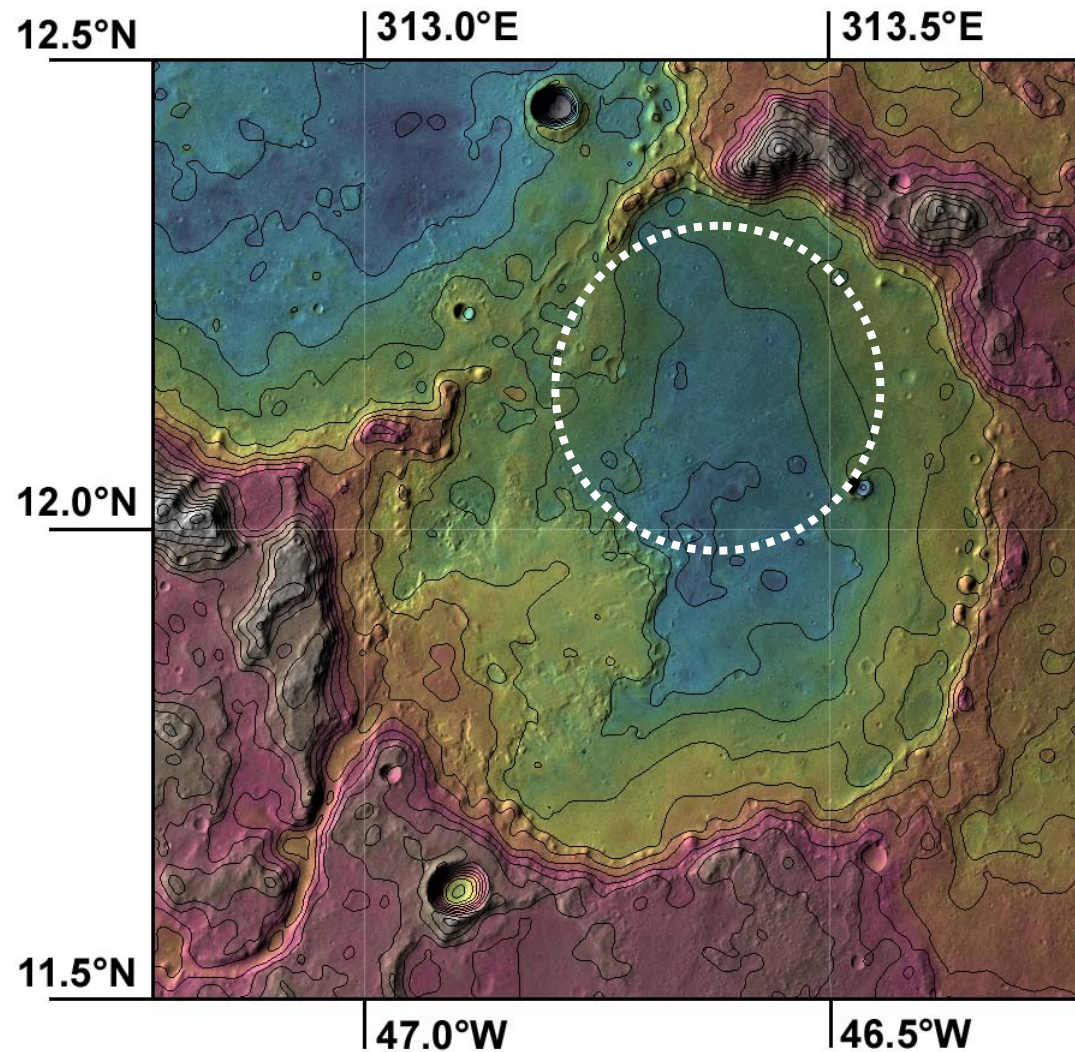


# The „show“ factor (public relations)

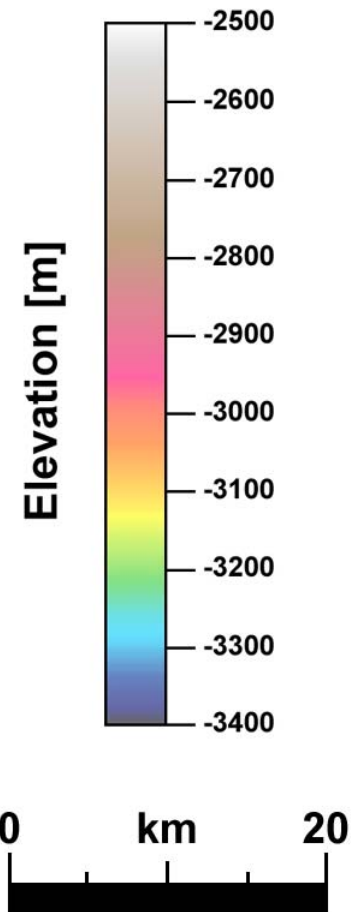
- a bridge to the public

*shown at ESA Press conference for context of OMEGA findings (sulfates); Nov. 2005*

# Examples: Crater paleolakes and fans or deltas



from Hauber et al., LPSC (2005)



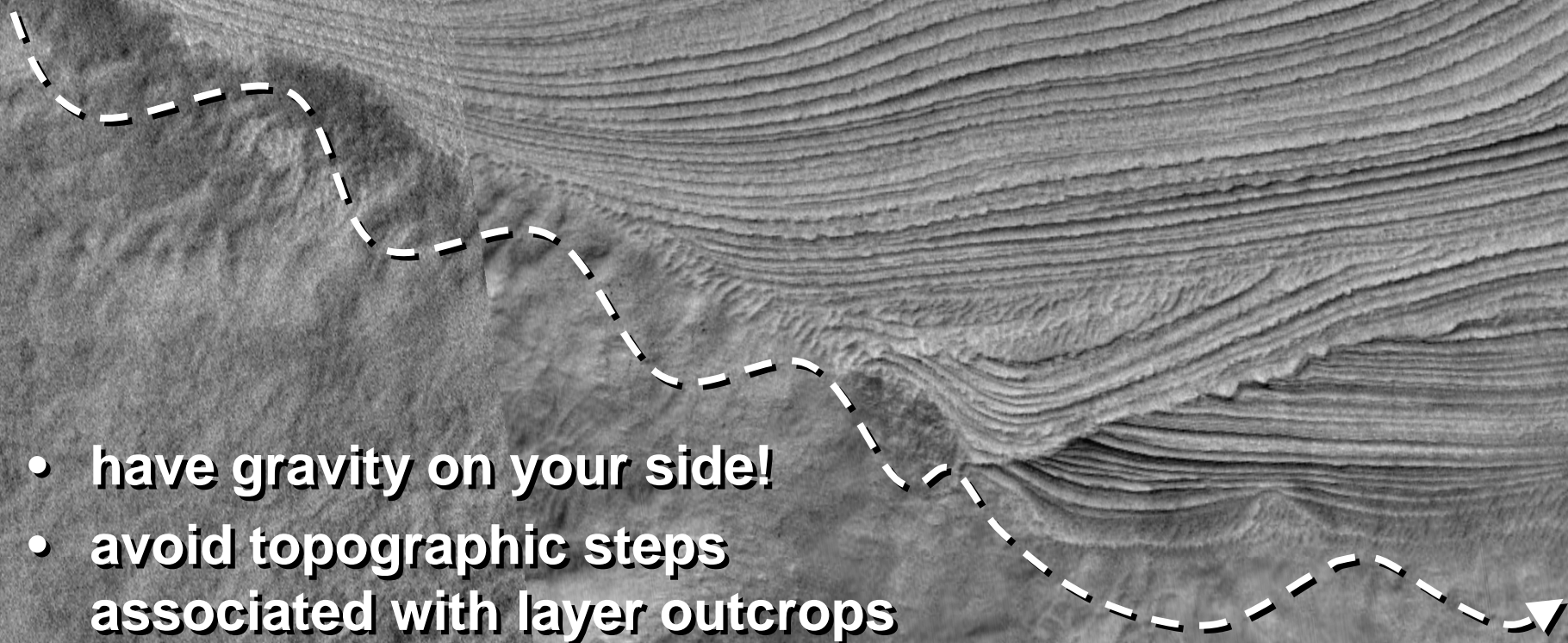


Drive down the stratigraphic sequence!

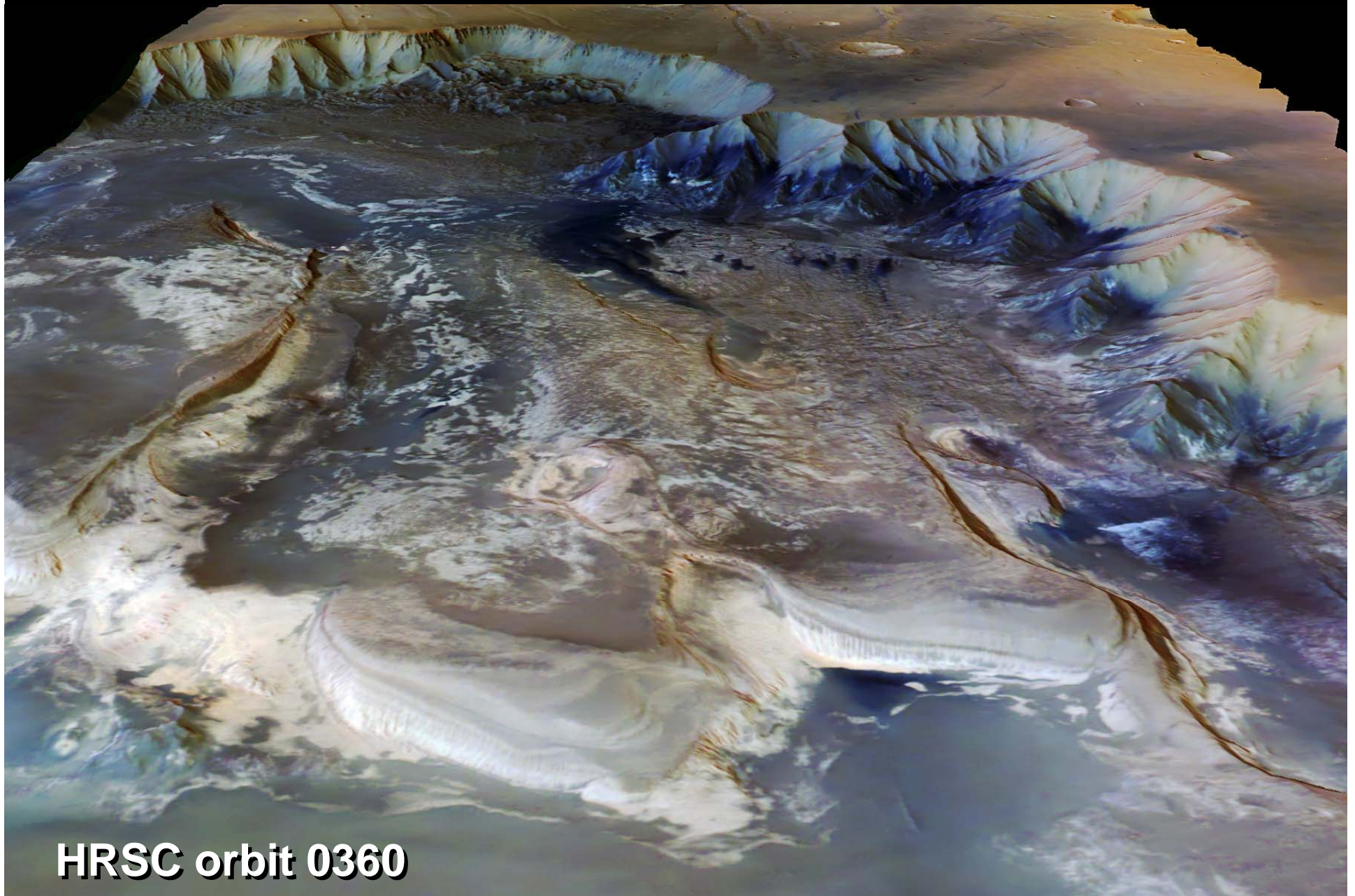
- **have gravity on your side!**
- **avoid topographic steps associated with layer outcrops**

1 km

MOC



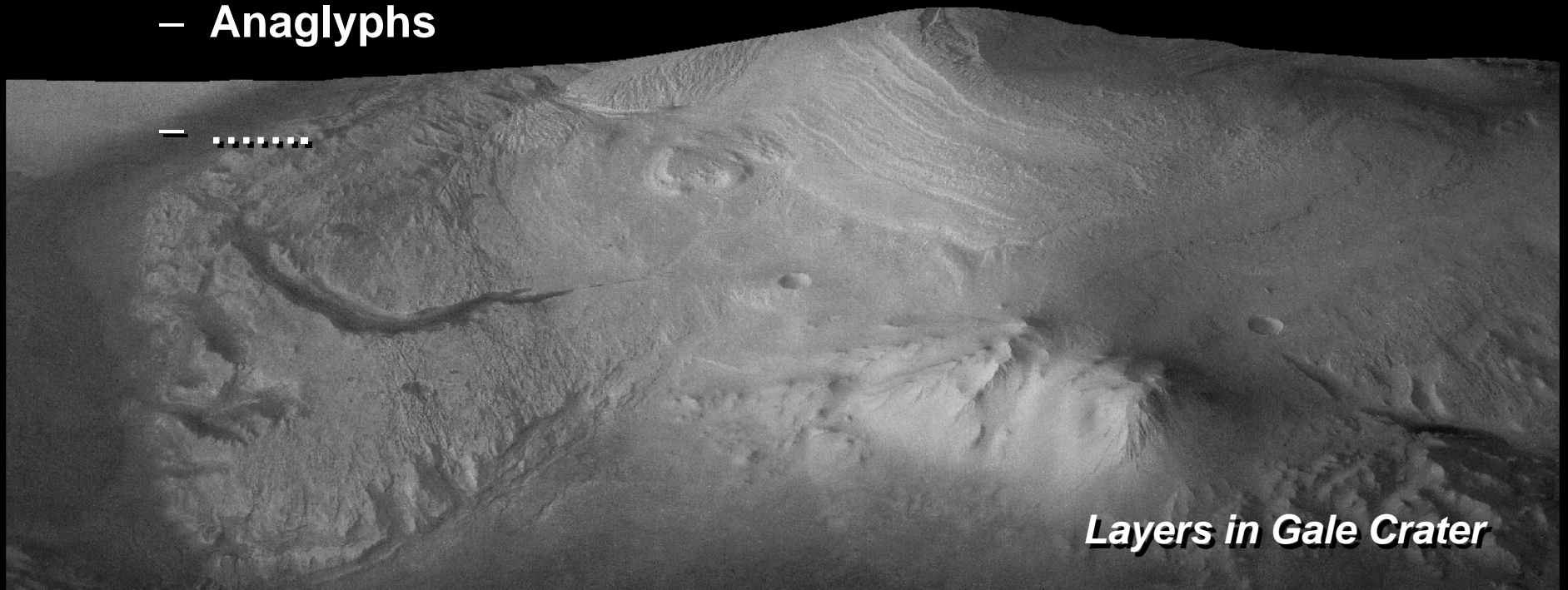
# Melas Chasma



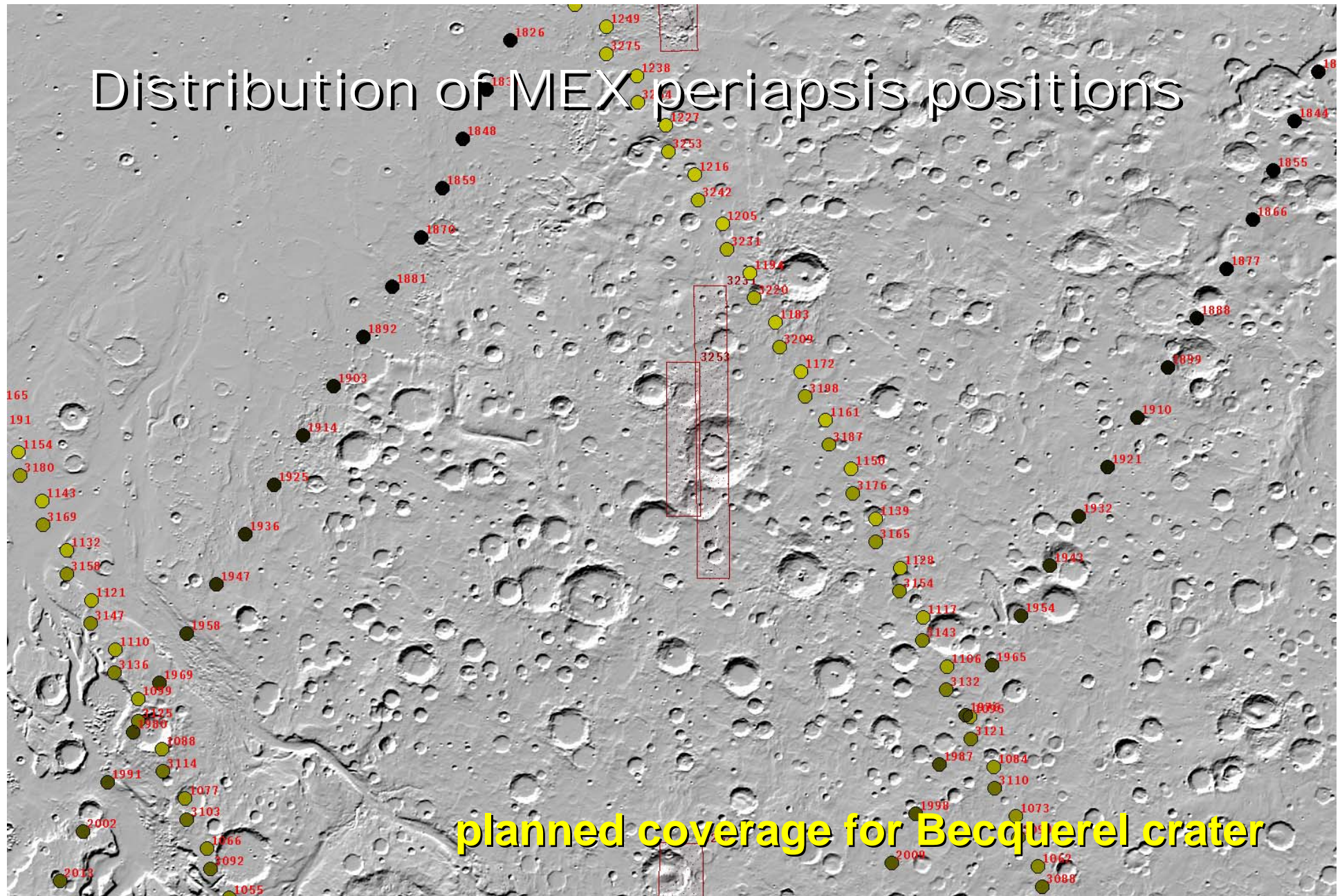
HRSC orbit 0360

# Specific HRSC Data Products for Landing Site Selection and Characterization

- **By request:**
  - **pecially processed high-resolution DTMs**
  - **Map-projected photometric and color data**
  - **Anaglyphs**



# Distribution of MEX periapsis positions



planned coverage for Becquerel crater



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there is often no second chance!

# Summary

- HRSC has very good local to regional topography, high-res color orthoimages, **and** large coverage (full MSL landing ellipse in one HRSC image!),  
*and it can also be*
- a bridge to lower-resolution data
- a bridge to higher-resolution imaging data
- a bridge to the public

# Outlook

- HRSC should actively take part in MSL landing site selection process from the beginning
- We are ready for suggestions to **observe possible MSL and ExoMars sites** – just let us know!
- Contact: **Ernst.Hauber@dlr.de** **gneukum@zedat.fu-berlin.de**