

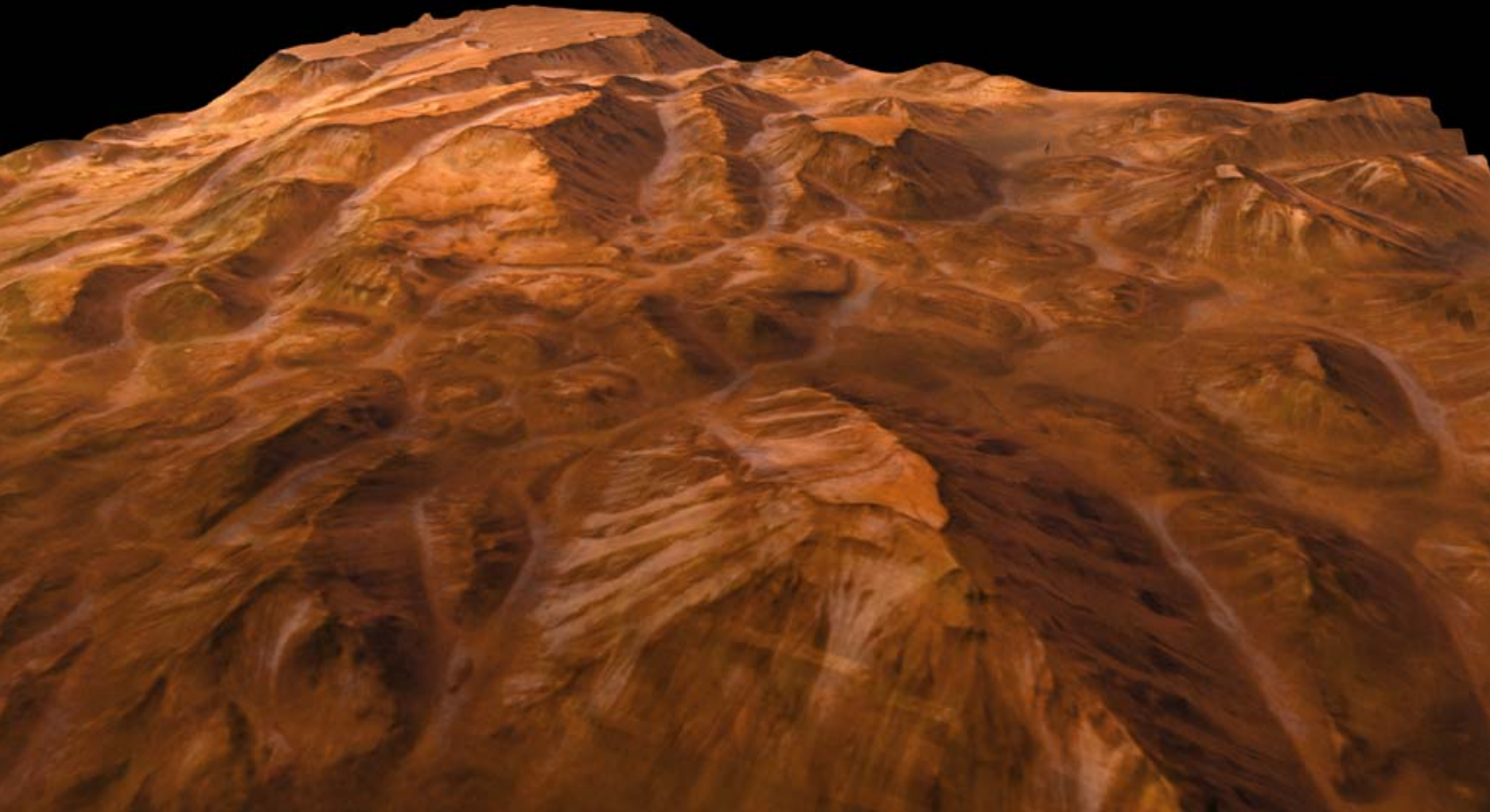
# Mars Express

## Very close to an exciting World

Ralf Jaumann  
and the  
High Resolution Stereo Camera Team

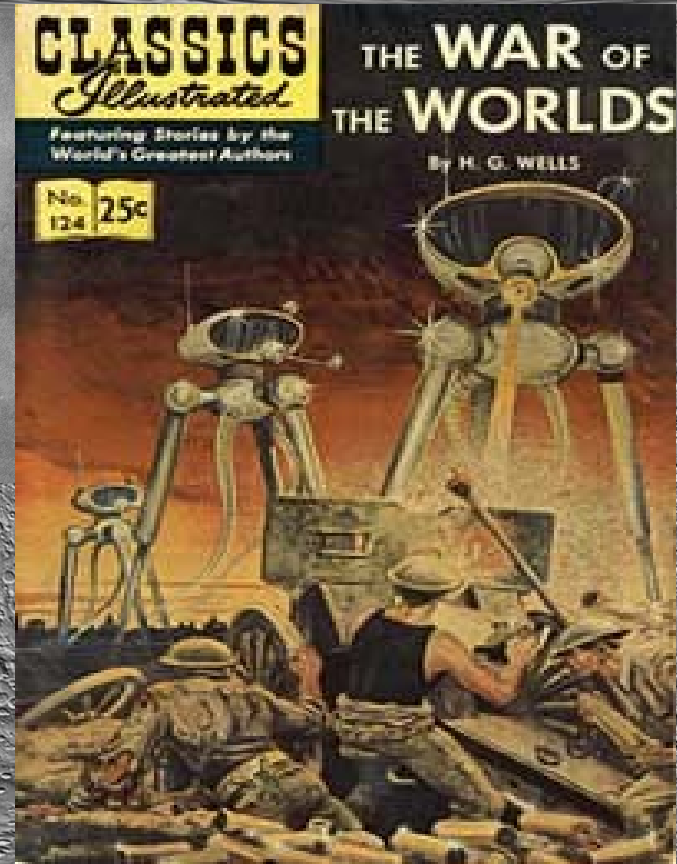
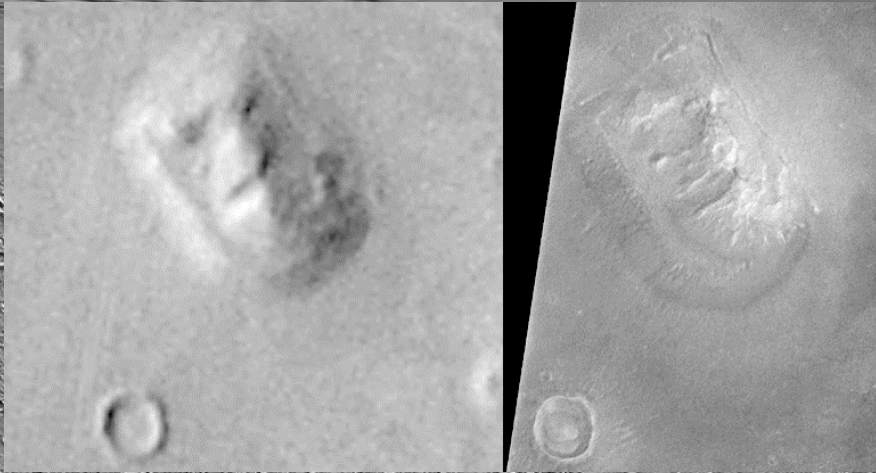
Deutsches Zentrum für Luft- und Raumfahrt e.V.  
Institut für Planetenforschung Berlin-Adlershof  
and  
Gerhard Neukum, Freie Universität Berlin

**Was Mars a habitable world?**





# Life on Mars .... ????



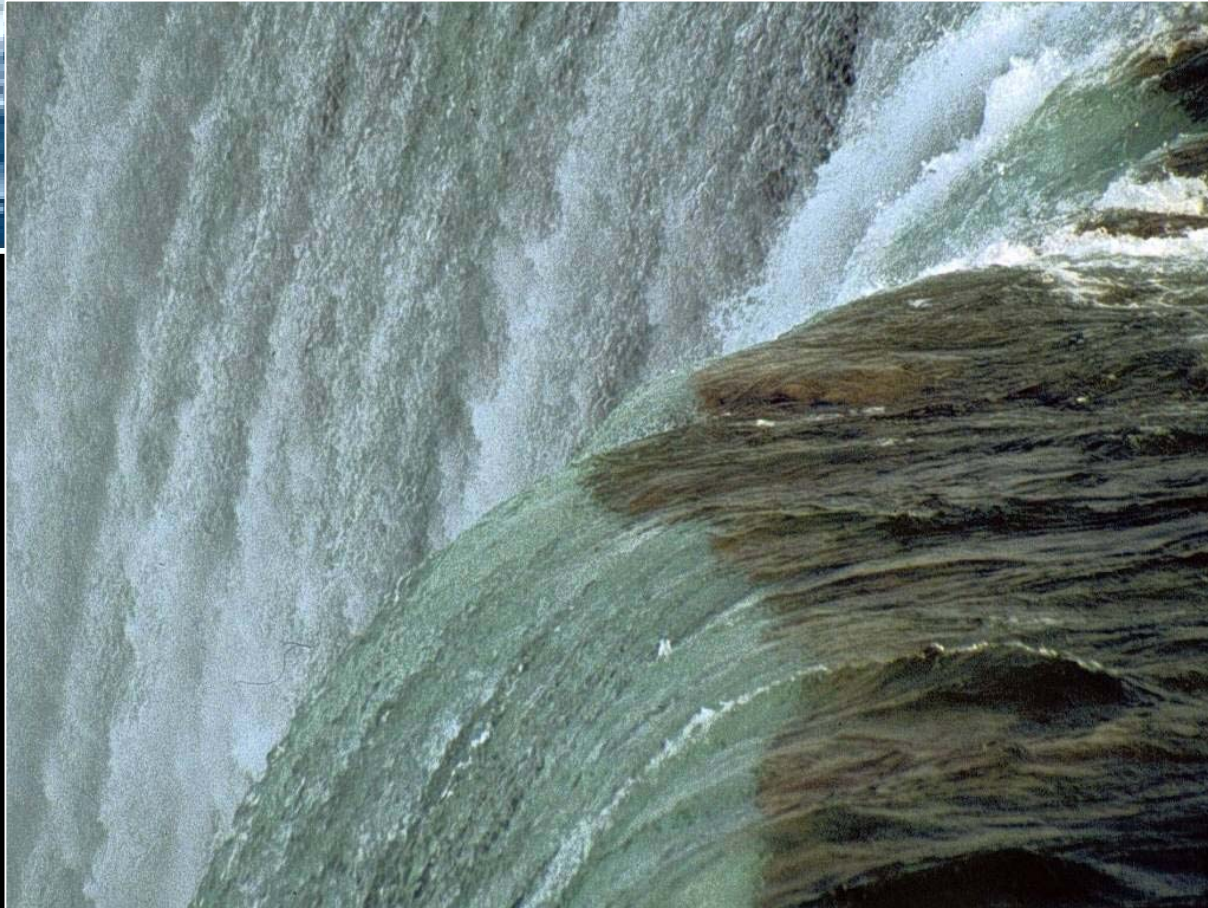
# What is needed for life?

- Biochemical reservoirs (C, H, O, N, S, P)
  - Large reservoir, or continuous source
- Reactive solvent (-> water)
  - Somewhere, anywhere,
- Flux (-> water)
  - Mechanisms for mixing all of the above
  - At least episodically
- Source of energy
- Time





# Phases of H<sub>2</sub>O



# Habitability with time

Time (Ga)

Distance (AU)

Venus

Earth

Mars

Sun

Habitable  
Zone

Zur Anzeige wird der Q<sub>i</sub>  
Dekompressor „TIFF (Unkomprimiert)“  
benötigt.







# Mars Express

ESA's 1<sup>st</sup> mission  
to another planet



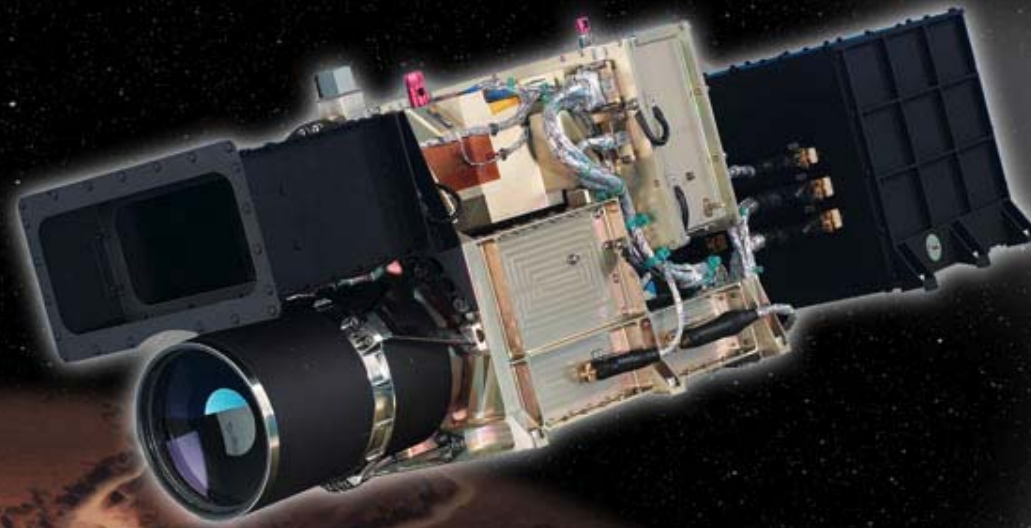
launch: 2 June 2003 –  
arrival: 25 December 2003



# HRSC

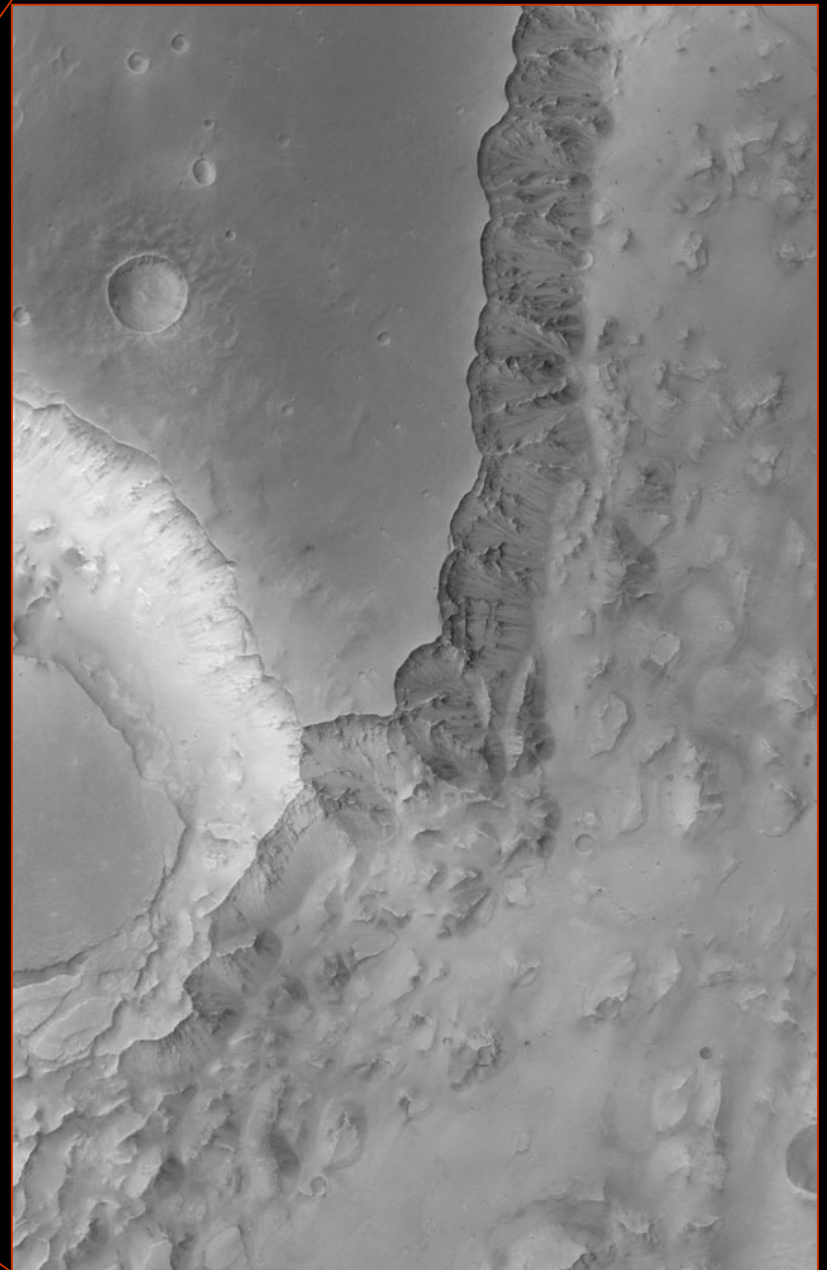
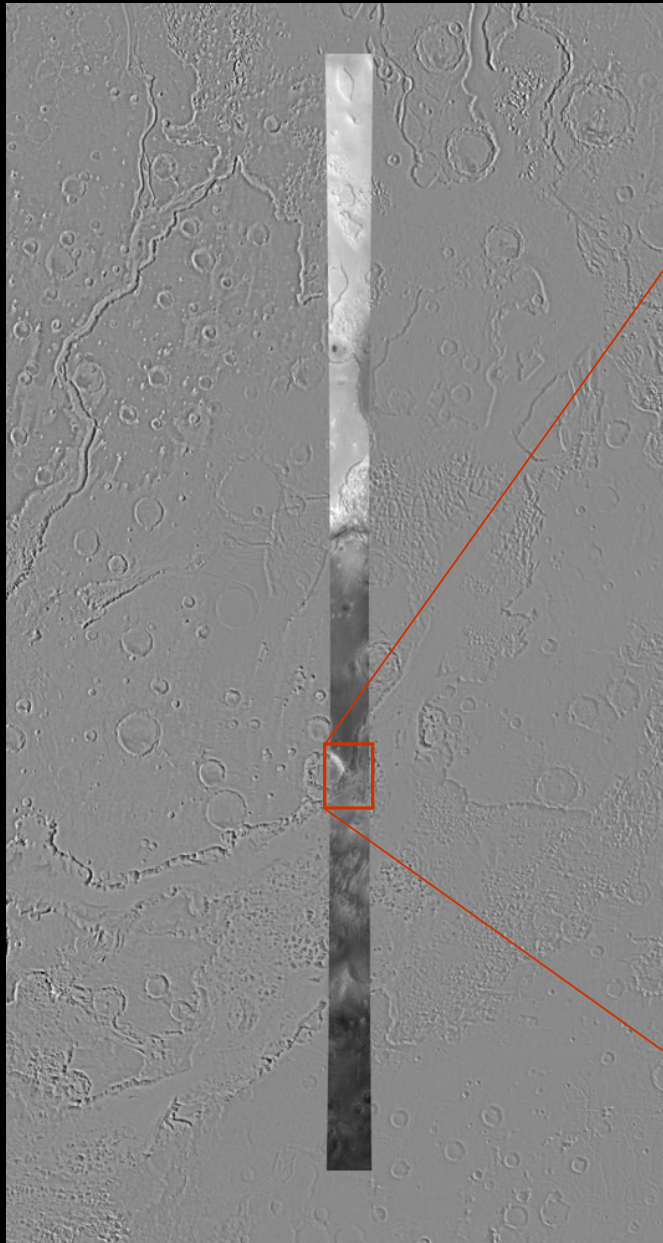


# High Resolution Stereo Camera





# HRSC – High Resolution

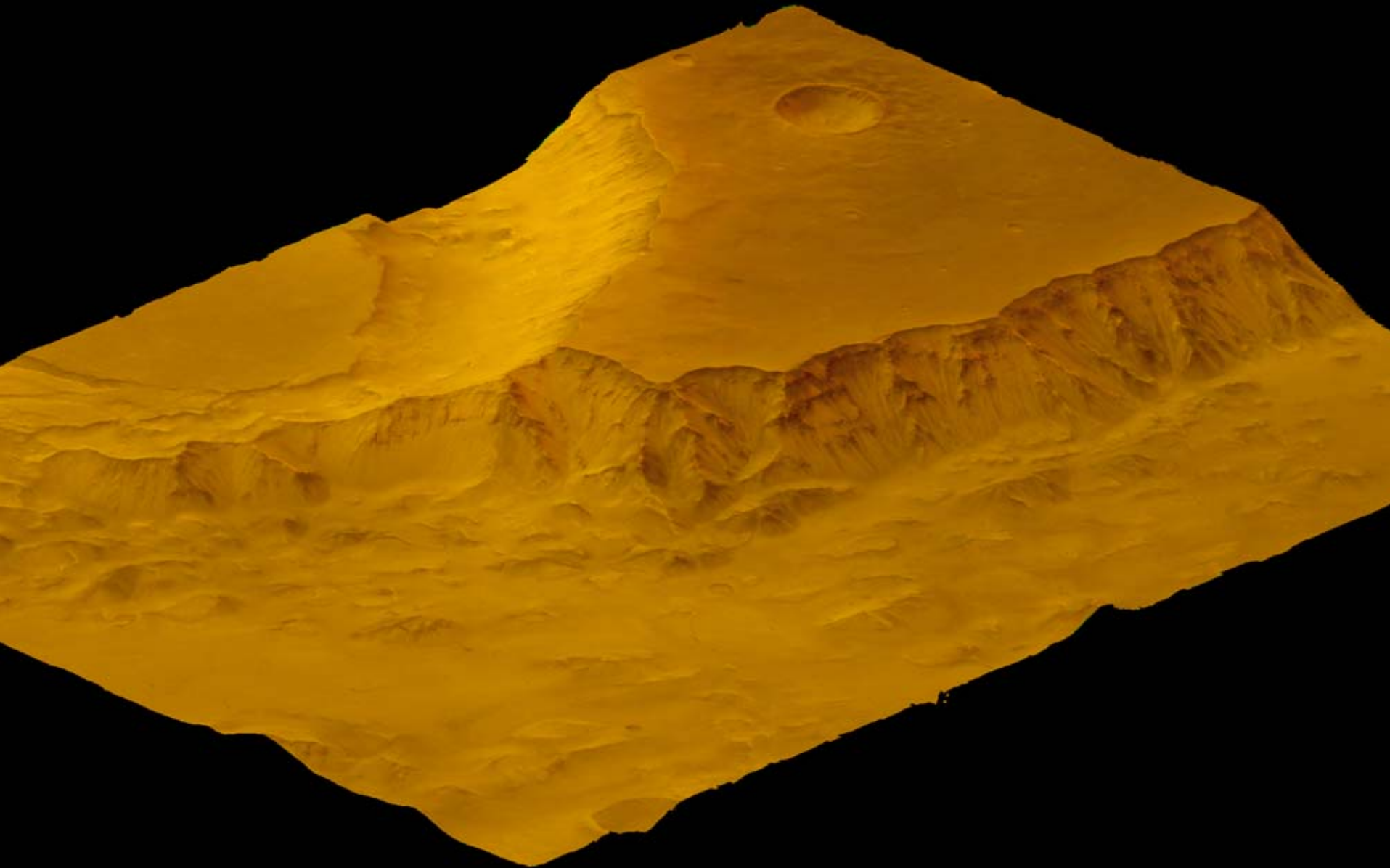


**Color**





# 3D-Visualisation

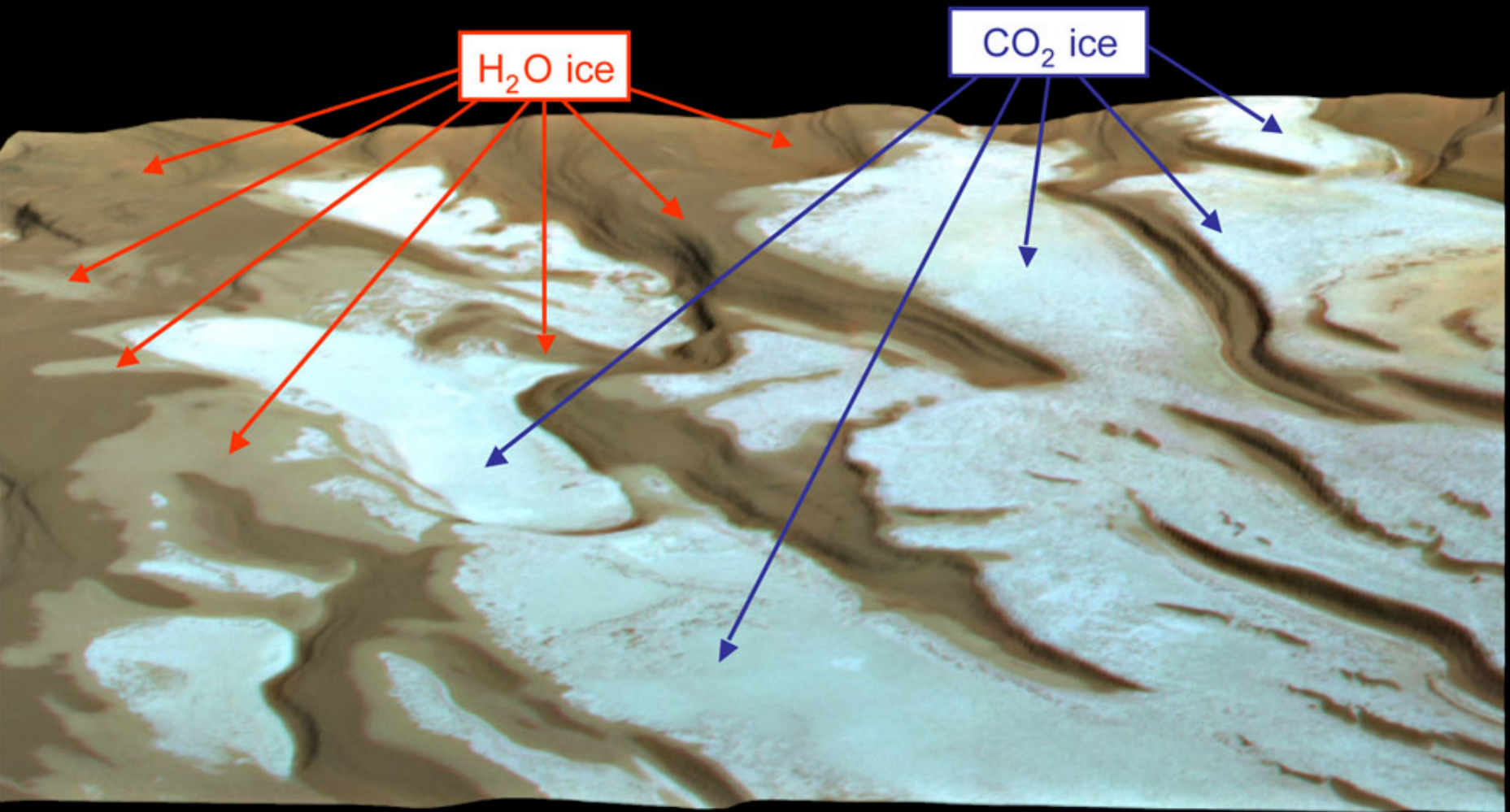


# Dunes in Argyre





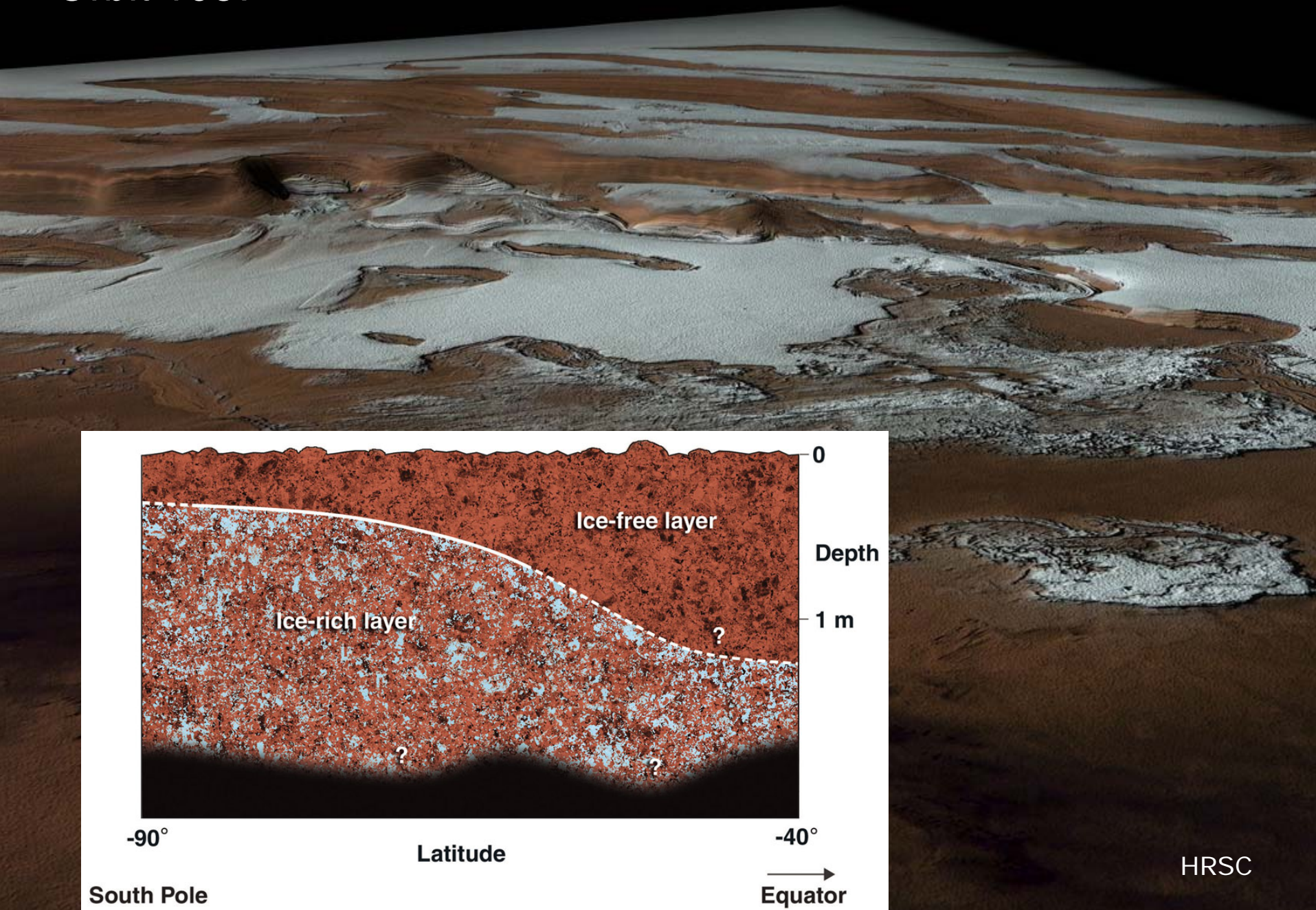
OMEGA composition / HRSC 3D imaging



Mars – South Pole



# Orbit 1087







← N

10 km

Surface expression of subsurface water/ice ...

HRSC

Medusae Fossae





Surface expression of subsurface water/ice ...

← N  
10 km

5 km

HRSC



← N

10 km

Surface expression of  
subsurface water/ice ...

HRSC

Medusae Fossae



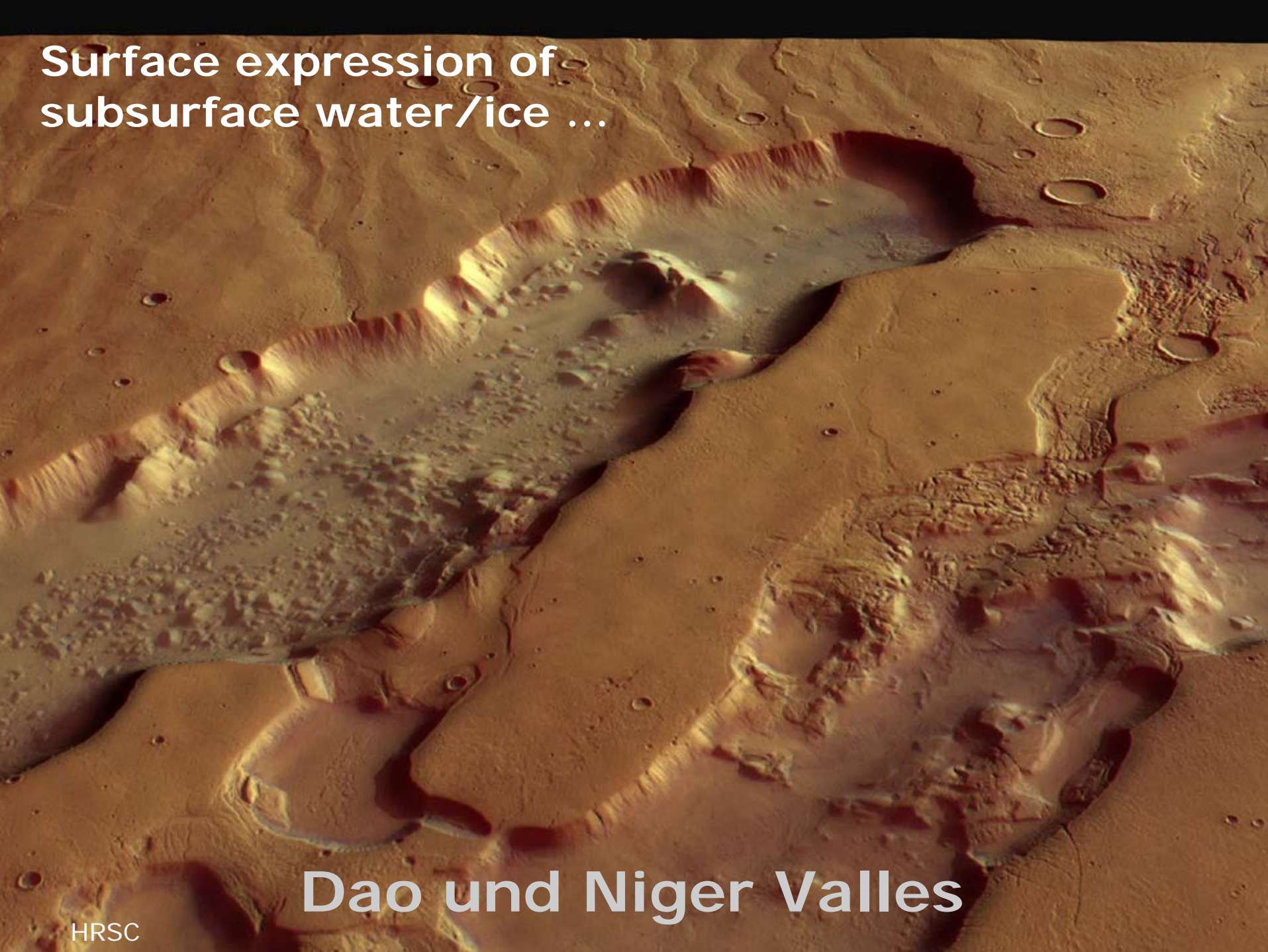
← N  
10 km

# Surface expression of subsurface water/ice ...





Surface expression of  
subsurface water/ice ...



Dao und Niger Valles



Surface expression of  
subsurface water/ice ...



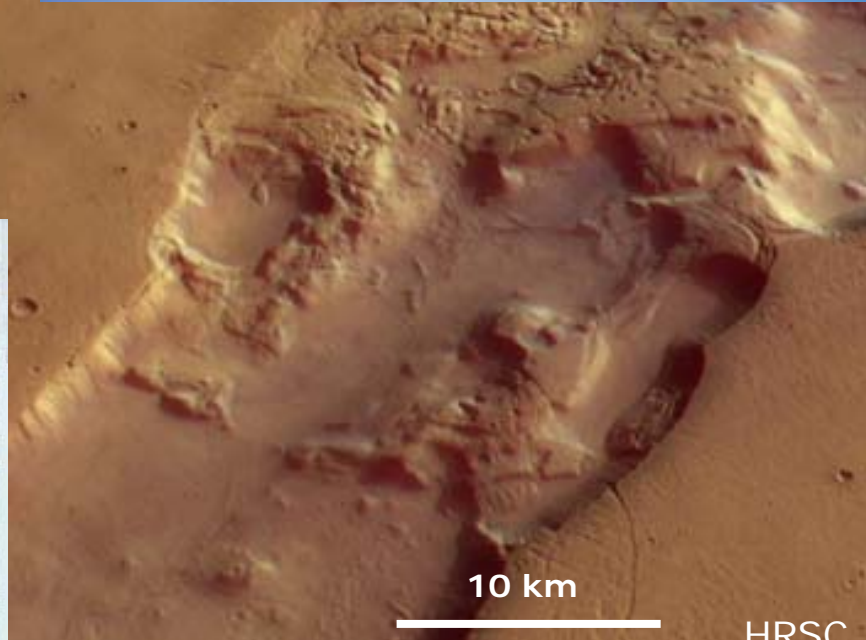
10 km

HRSC

Erosion by catastrophic flooding



Surface expression of subsurface water/ice .



Erosion by catastrophic flooding



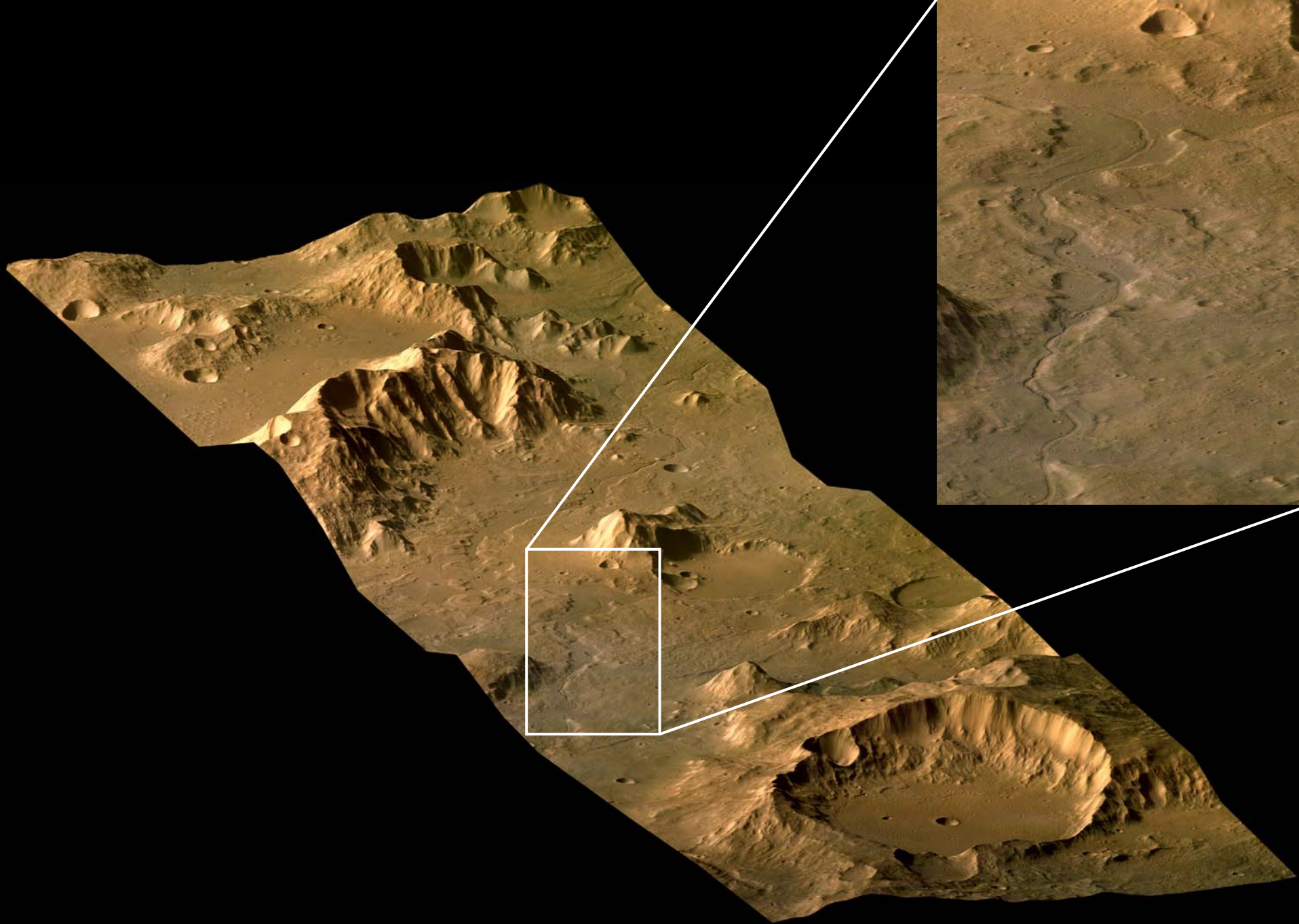
Orbit 286:  
Mangala Valles

Expression of water  
on the surface ...

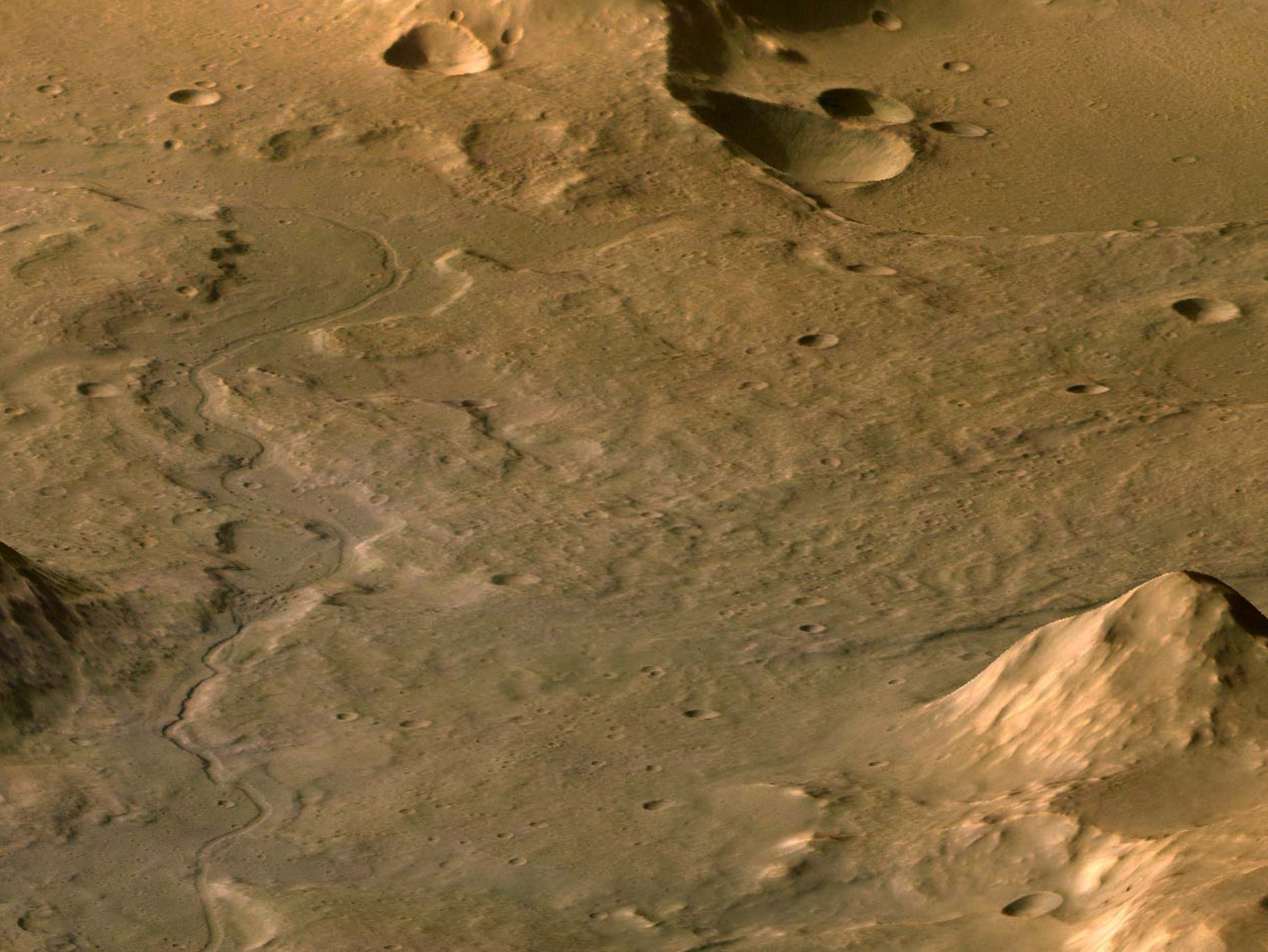
HRSC





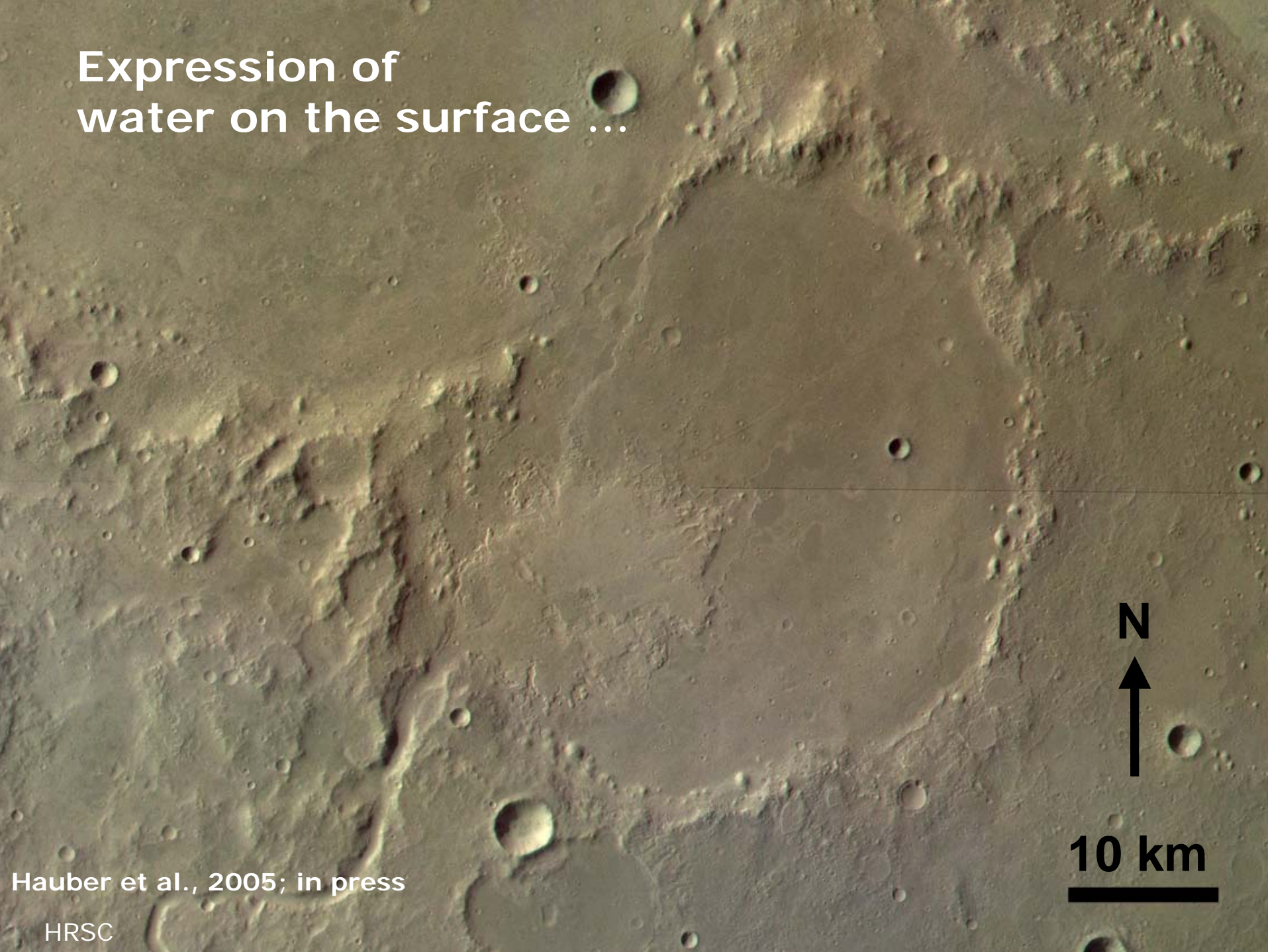








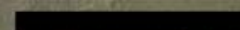
# Expression of water on the surface ...



N



10 km



Hauber et al., 2005; in press

HRSC

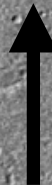


Orbit 894

Xanthe Terra  
11.9°N, 313.2°E

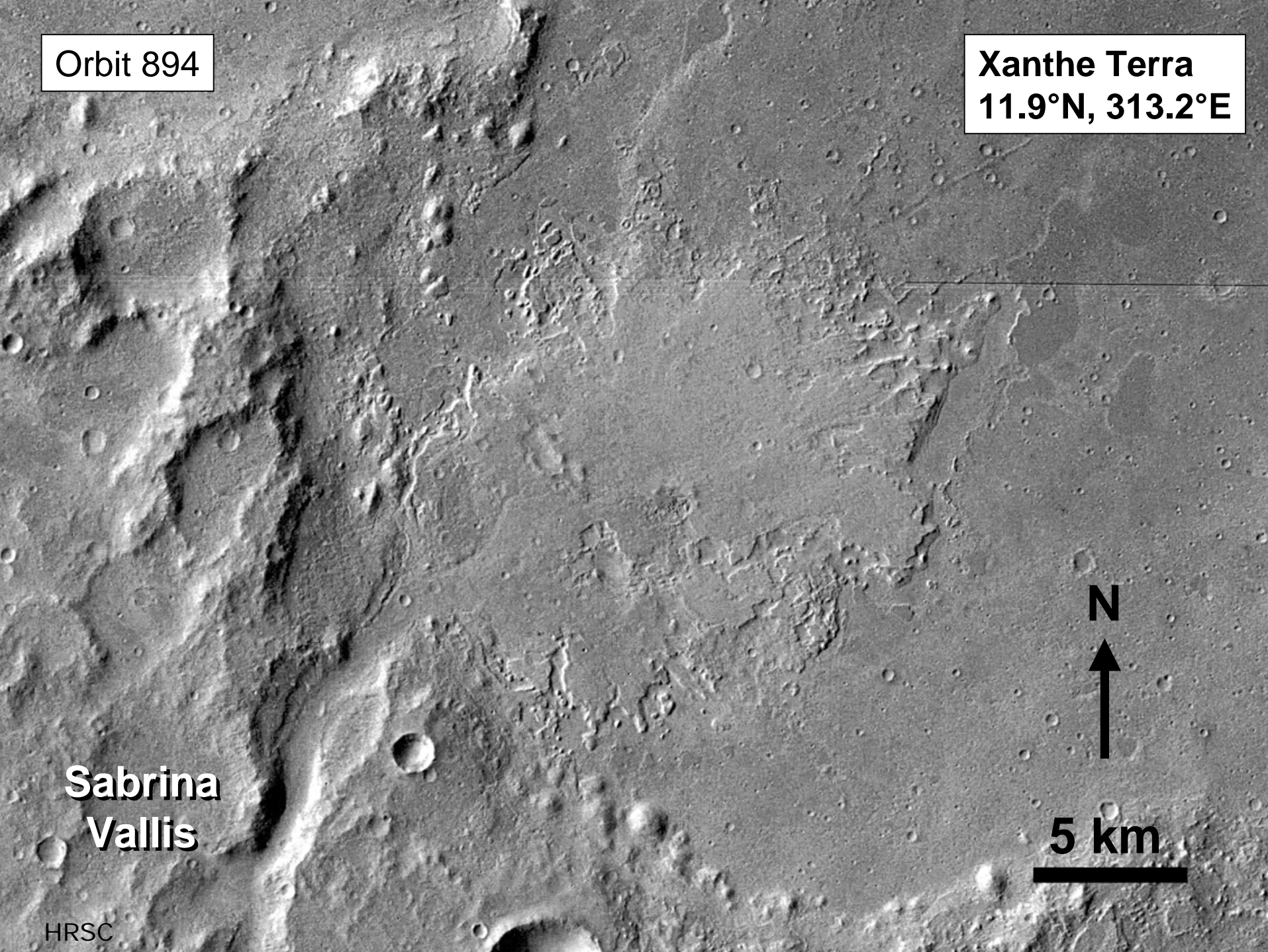
Sabrina  
Vallis

N



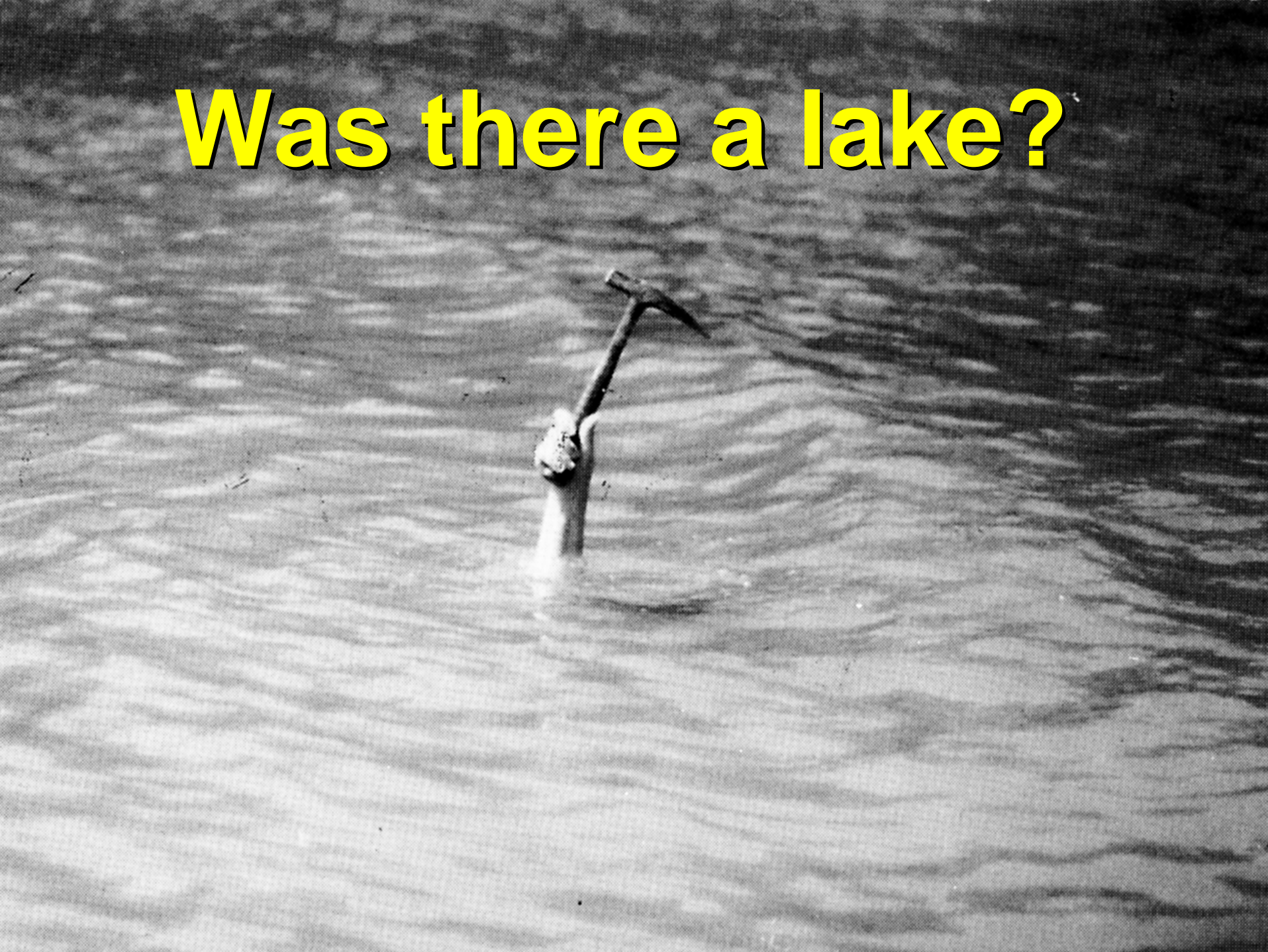
5 km

HRSC

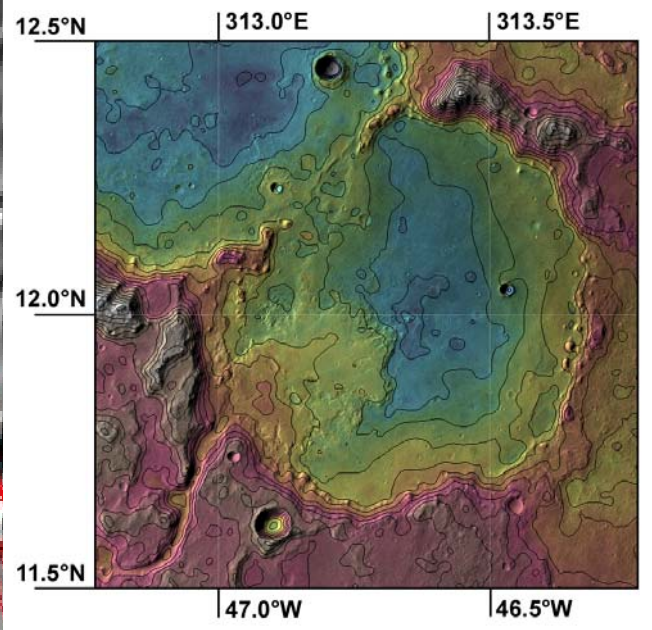
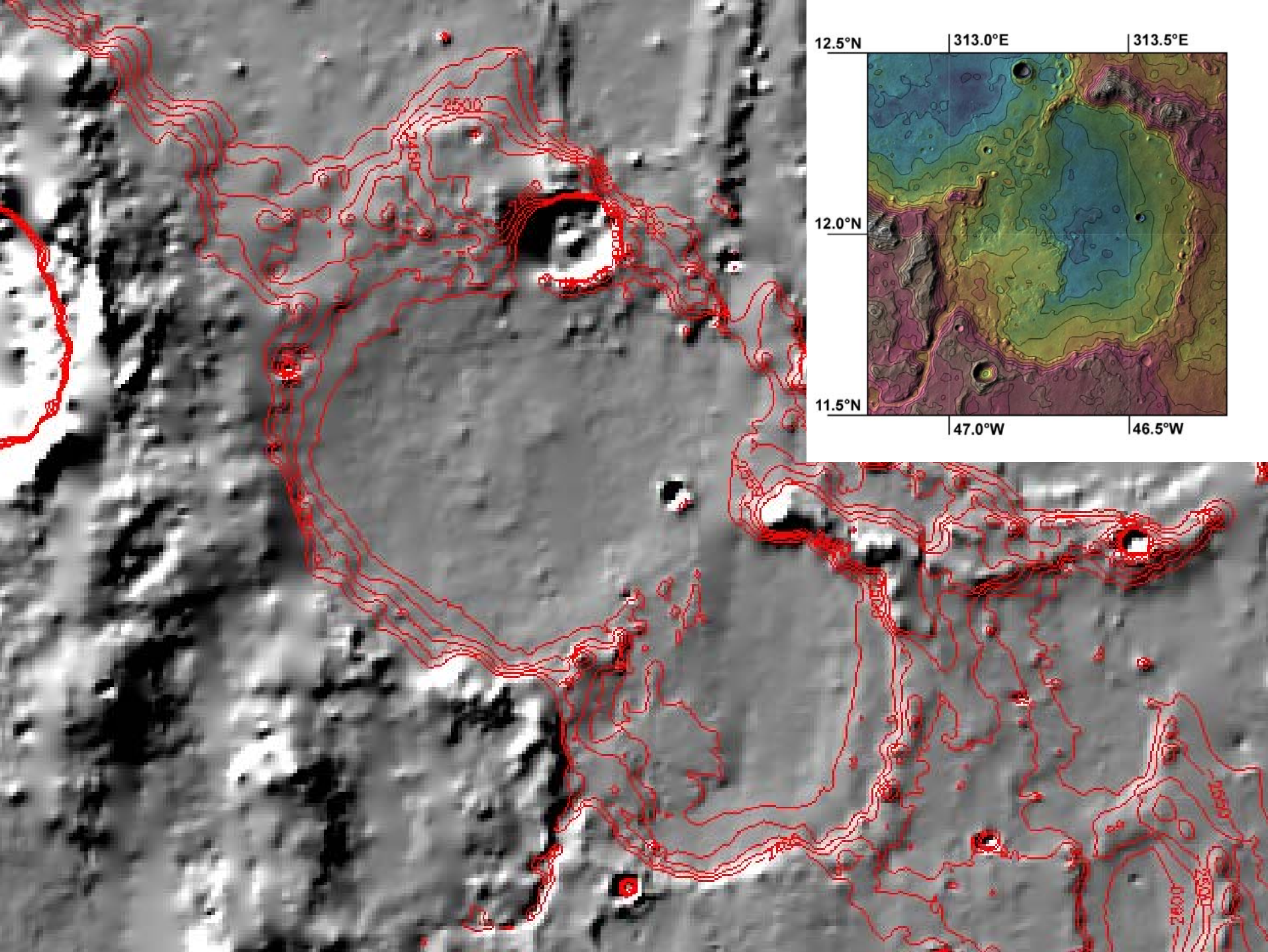




**Was there a lake?**







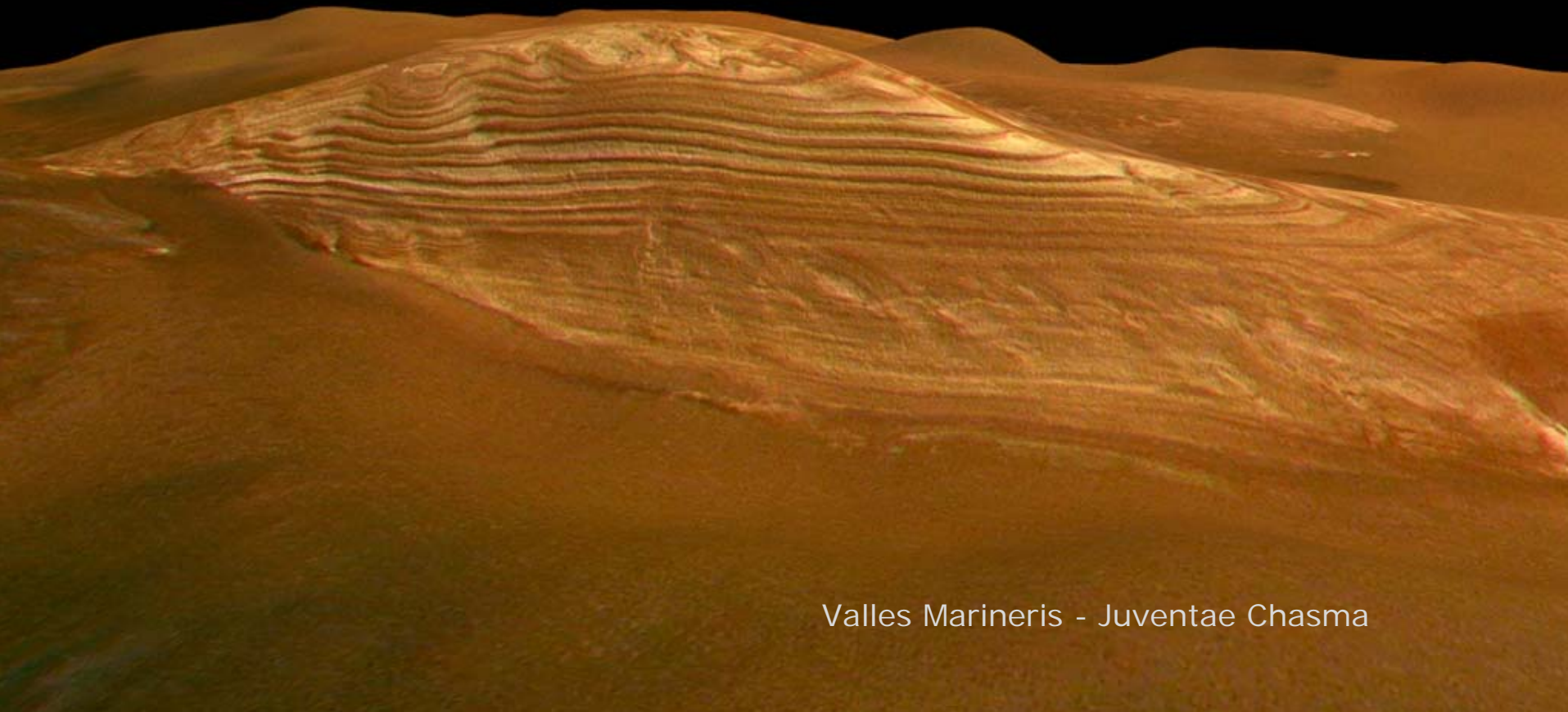
Valles Marineris - Juventae Chasma

Expression of  
water on the surface ...





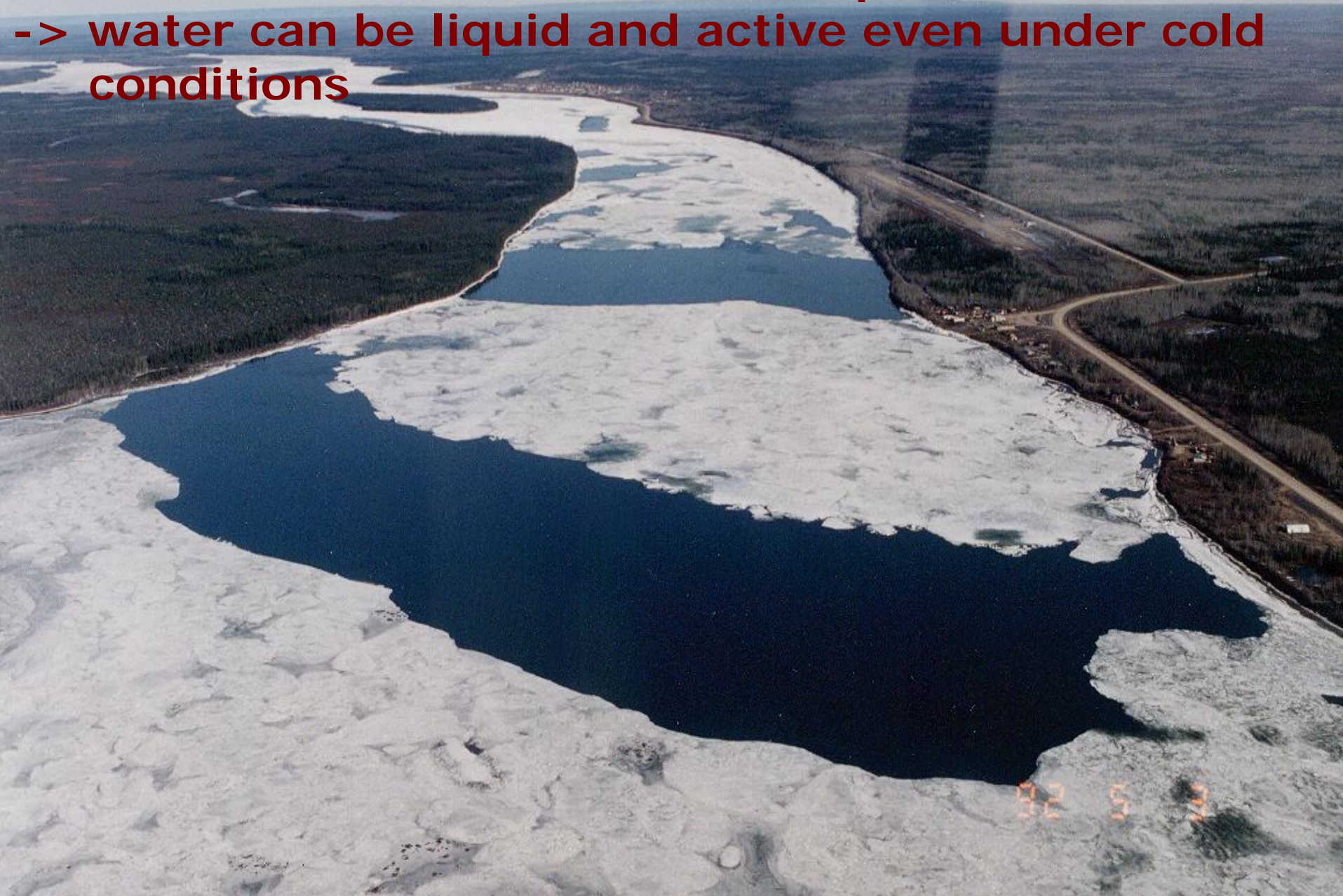
# Evidence for sedimentation



Valles Marineris - Juventae Chasma

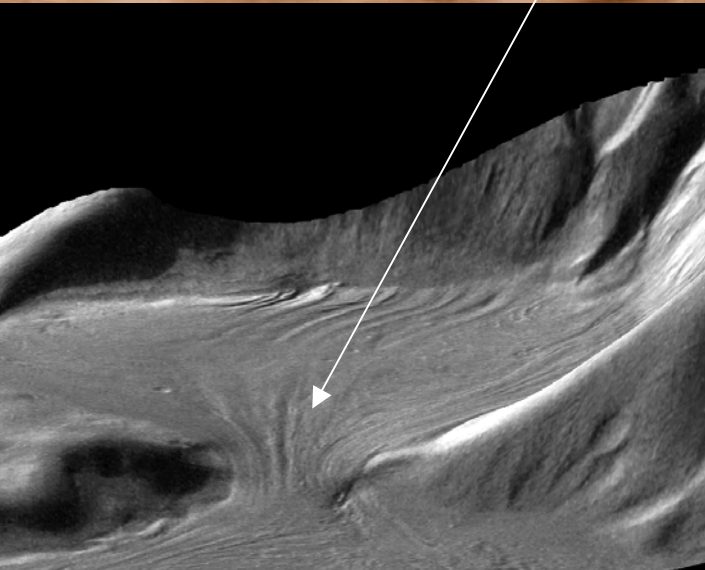


- > ice floating on water
- > bodies of water freeze from top to bottom
- > water can be liquid and active even under cold conditions



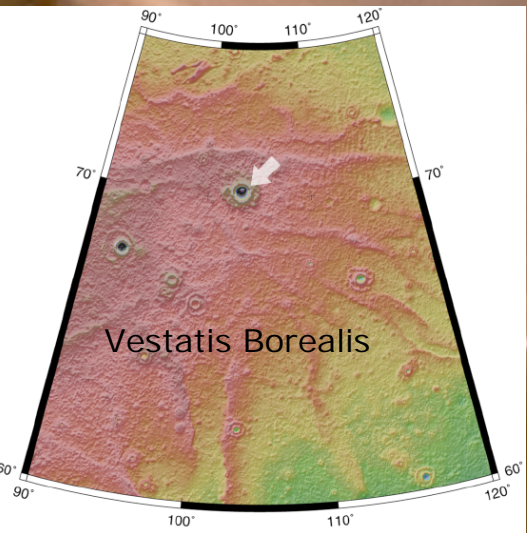
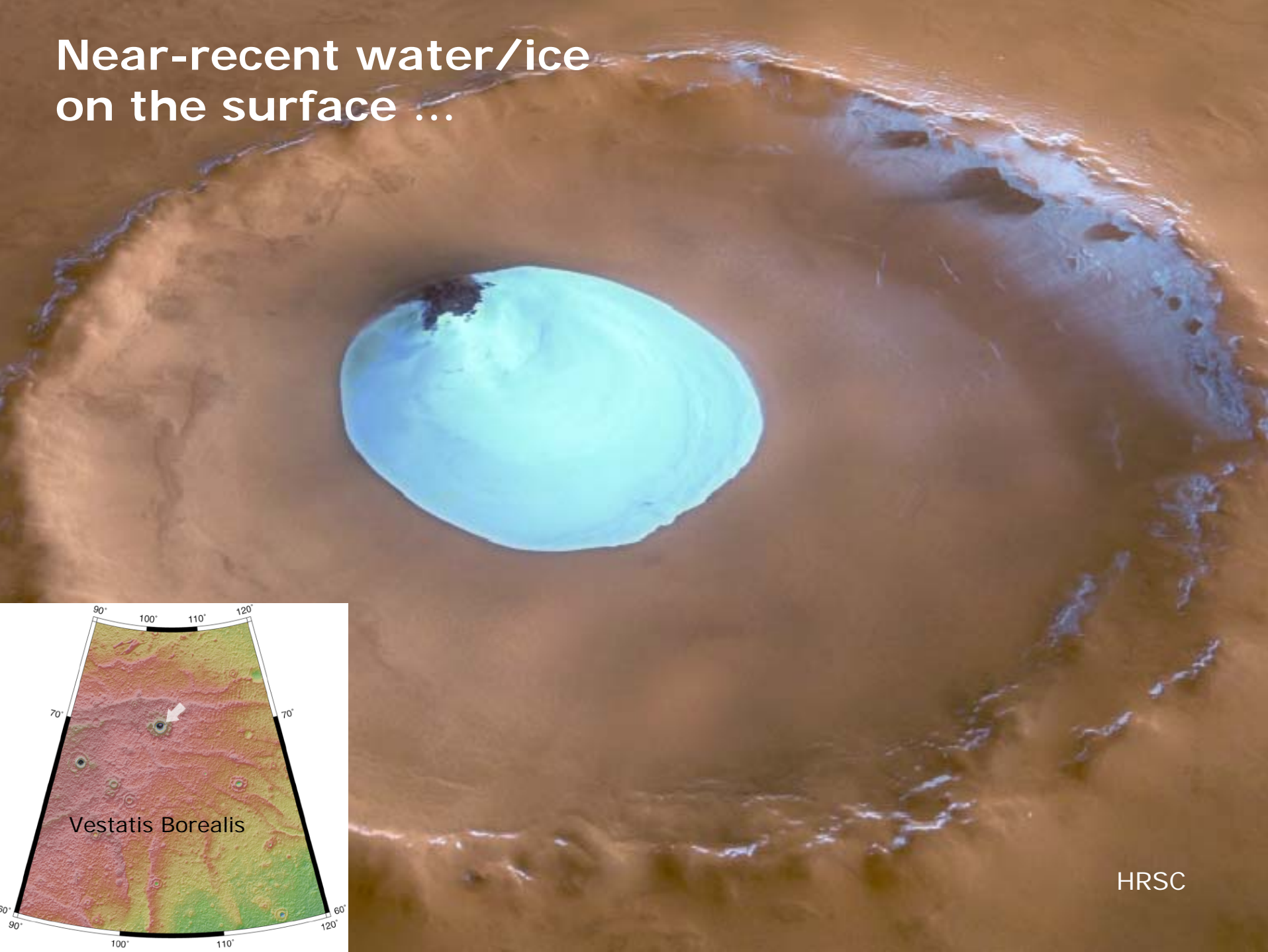


Expression of  
ice on the surface ...



HRSC

Near-recent water/ice  
on the surface ...



HRSC



An aerial photograph of a Martian landscape. The terrain is a mix of reddish-brown and tan colors, showing a complex network of channels and craters. A prominent, winding, light-colored channel, likely a dried-up riverbed, flows from the upper left towards the lower left. The surface is peppered with numerous impact craters of various sizes, some with distinct rims and shadows. In the upper right, there's a larger, more complex crater structure. The overall scene suggests a past period of liquid water on the planet's surface.

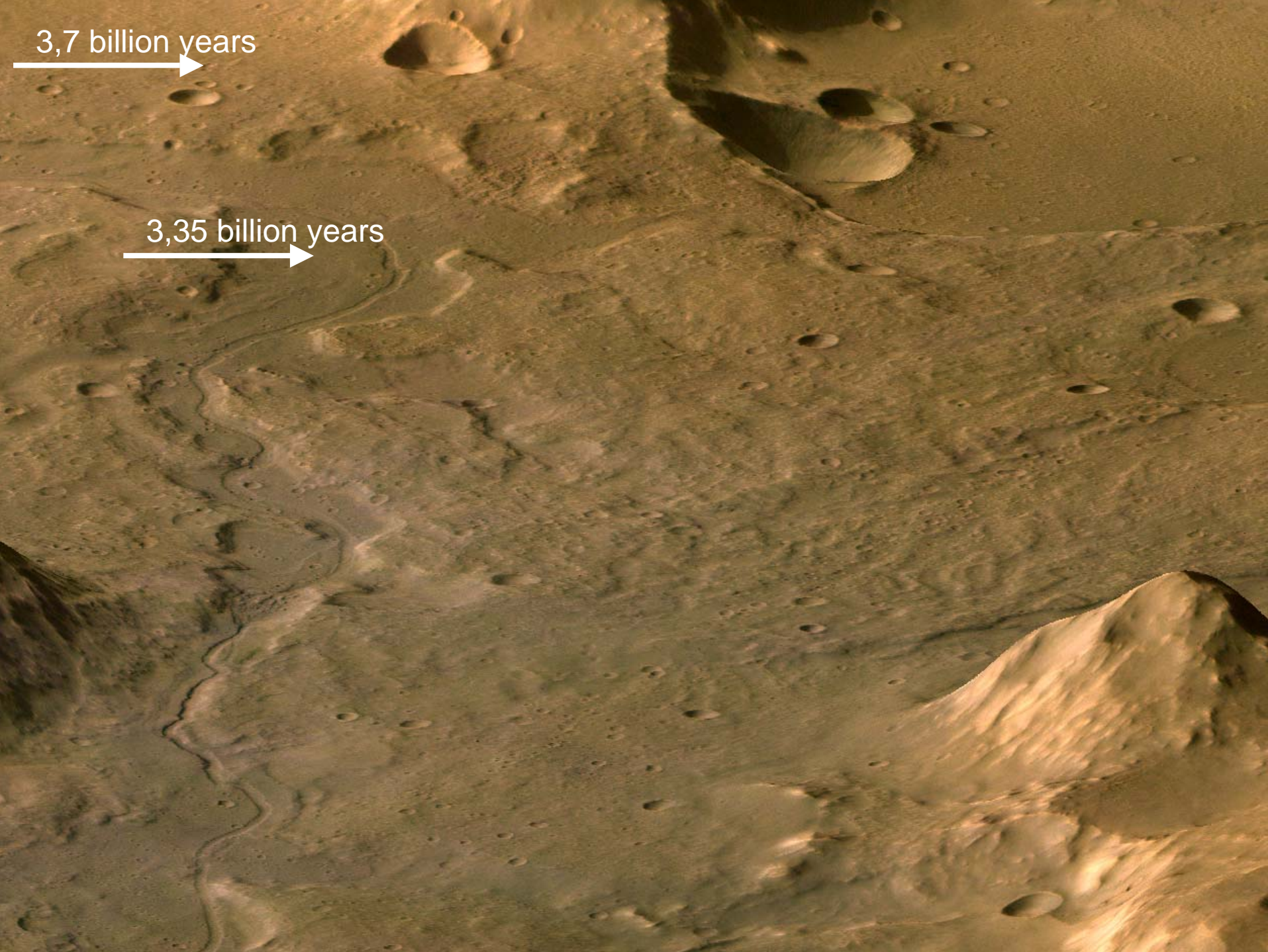
**Time:  
How long acted Water on the surface?**



3,7 billion years



3,35 billion years





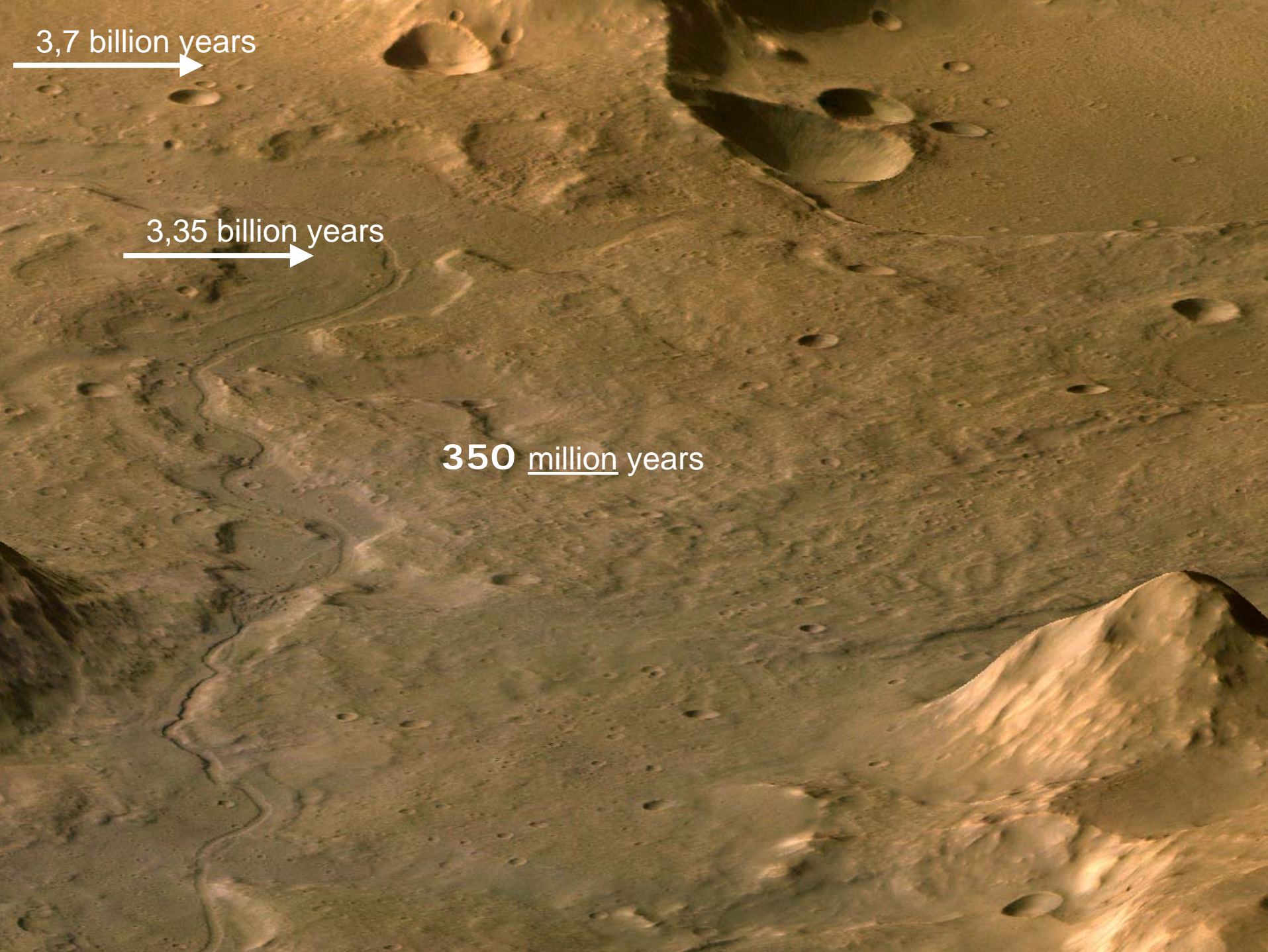
3,7 billion years



3,35 billion years



**350** million years








3,7 billion years

3,35 billion years

**350 Million years,  
but it needed only about 1 Mio. years  
to dig the valley**

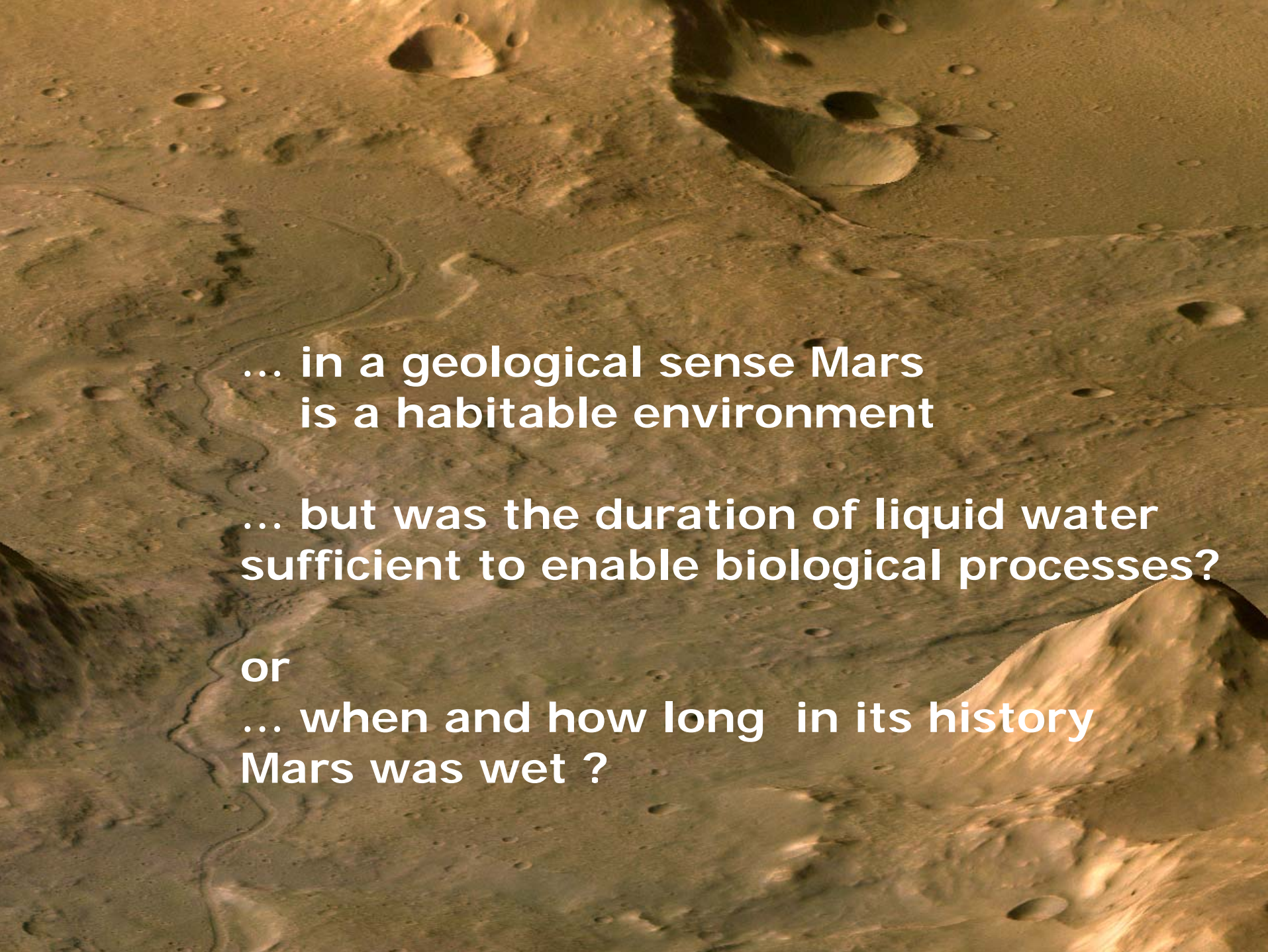
**-> it was only episodically wet**



An aerial photograph of the Martian surface, showing a vast, reddish-brown landscape. The terrain is characterized by a dense network of dry, winding river channels and numerous impact craters of various sizes. The lighting creates strong shadows, highlighting the rugged topography and the intricate patterns of the ancient waterways. The overall scene conveys a sense of a once-active, albeit now desolate, environment.

**... in a geological sense Mars  
is a habitable environment**





... in a geological sense Mars  
is a habitable environment

... but was the duration of liquid water  
sufficient to enable biological processes?

or

... when and how long in its history  
Mars was wet ?