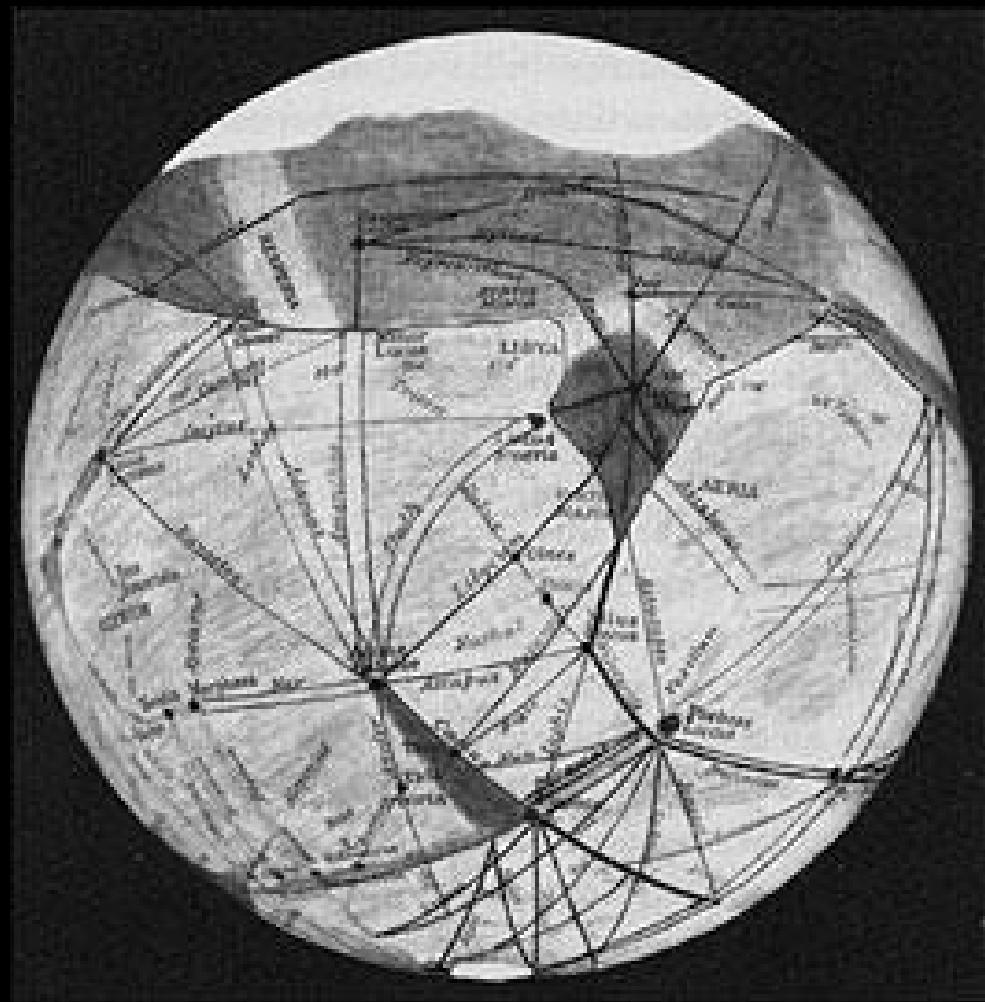
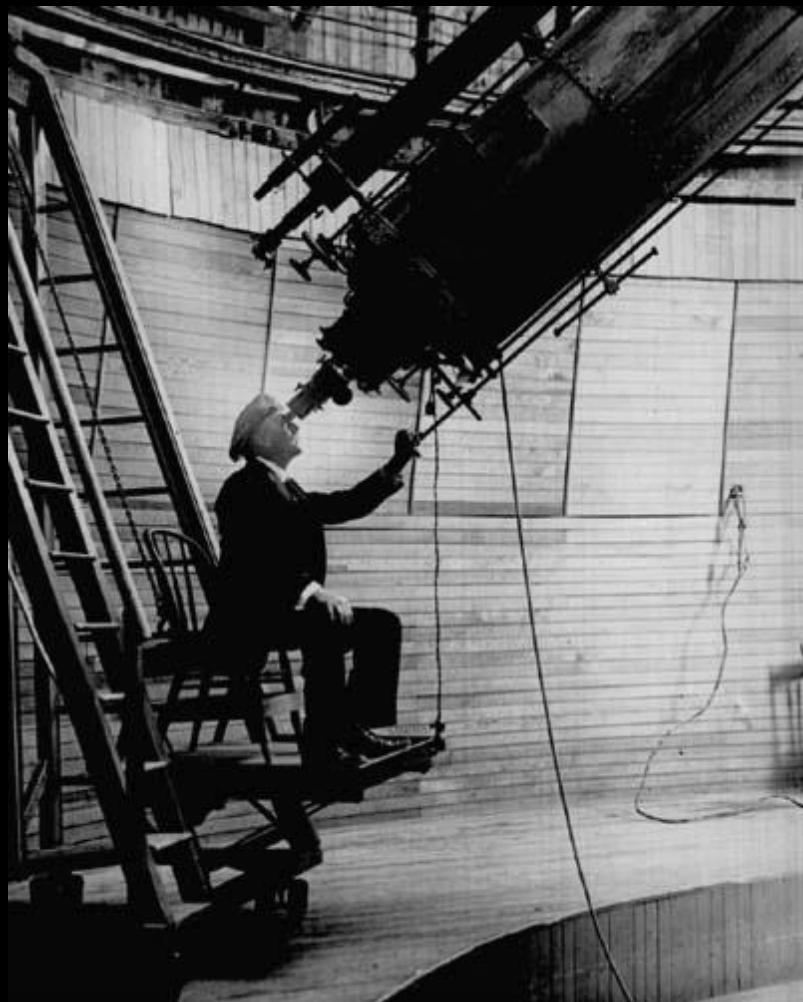
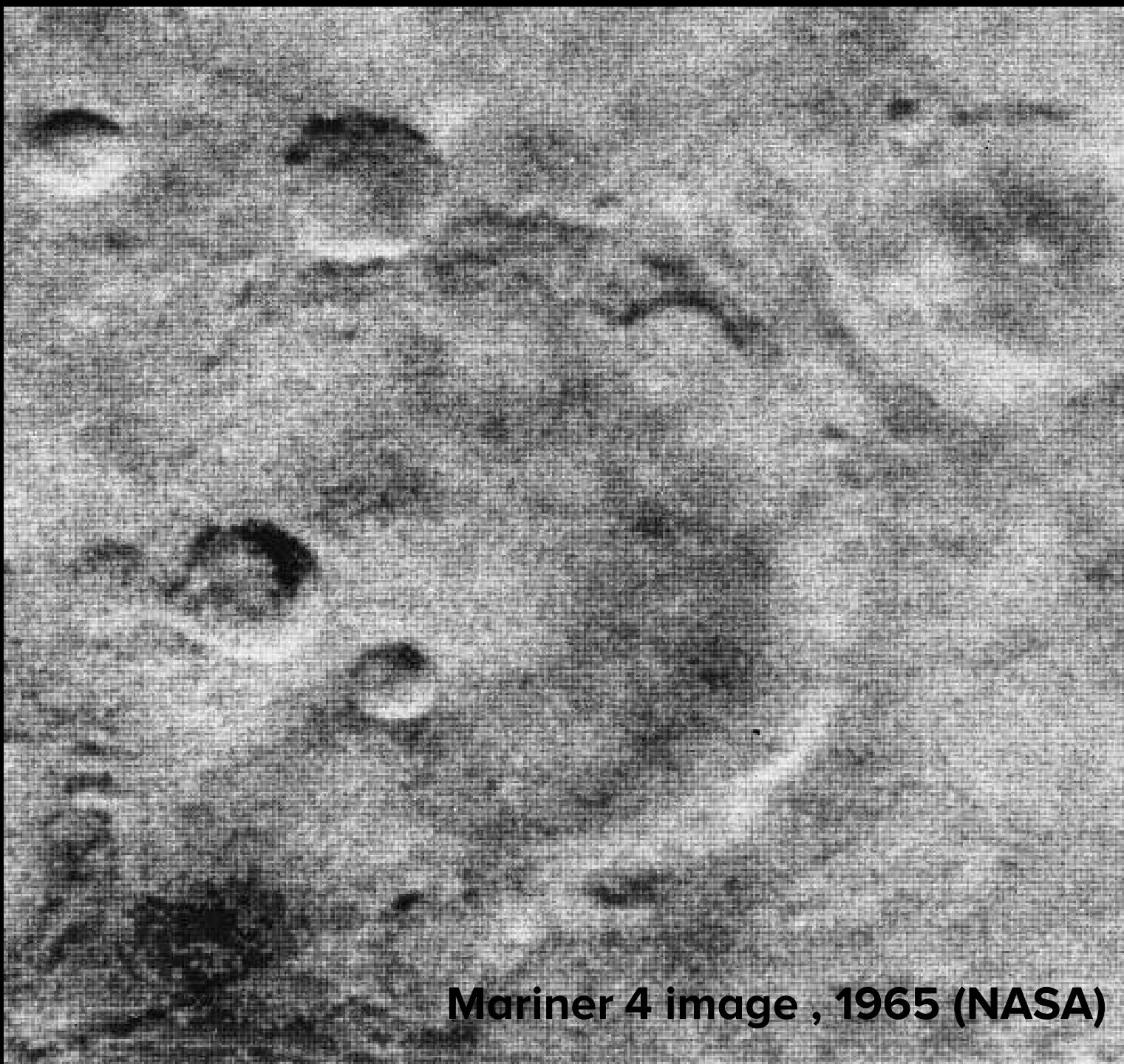


Life on Mars: Past, Present and Future?



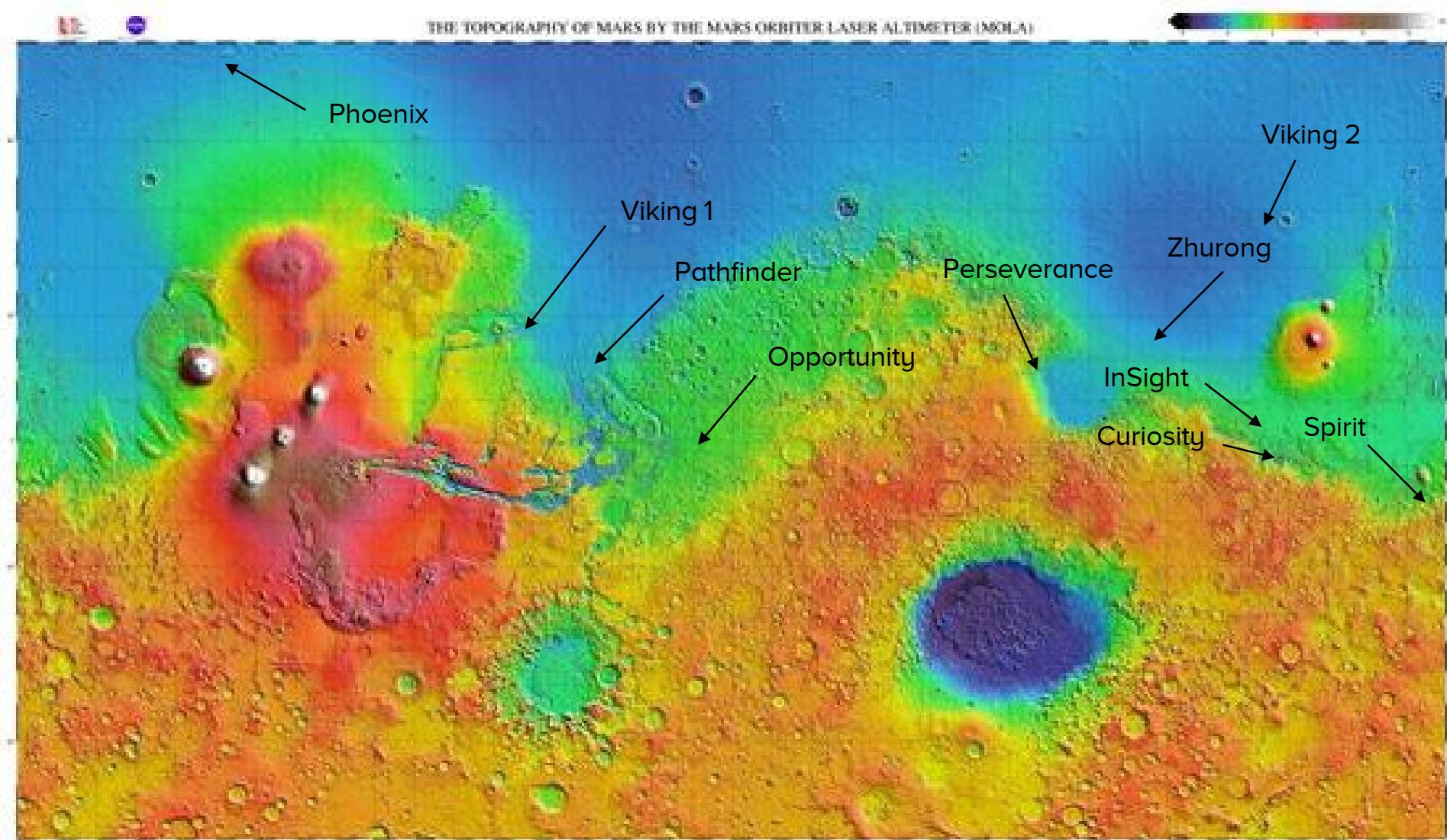
Percival Lowell's Canals





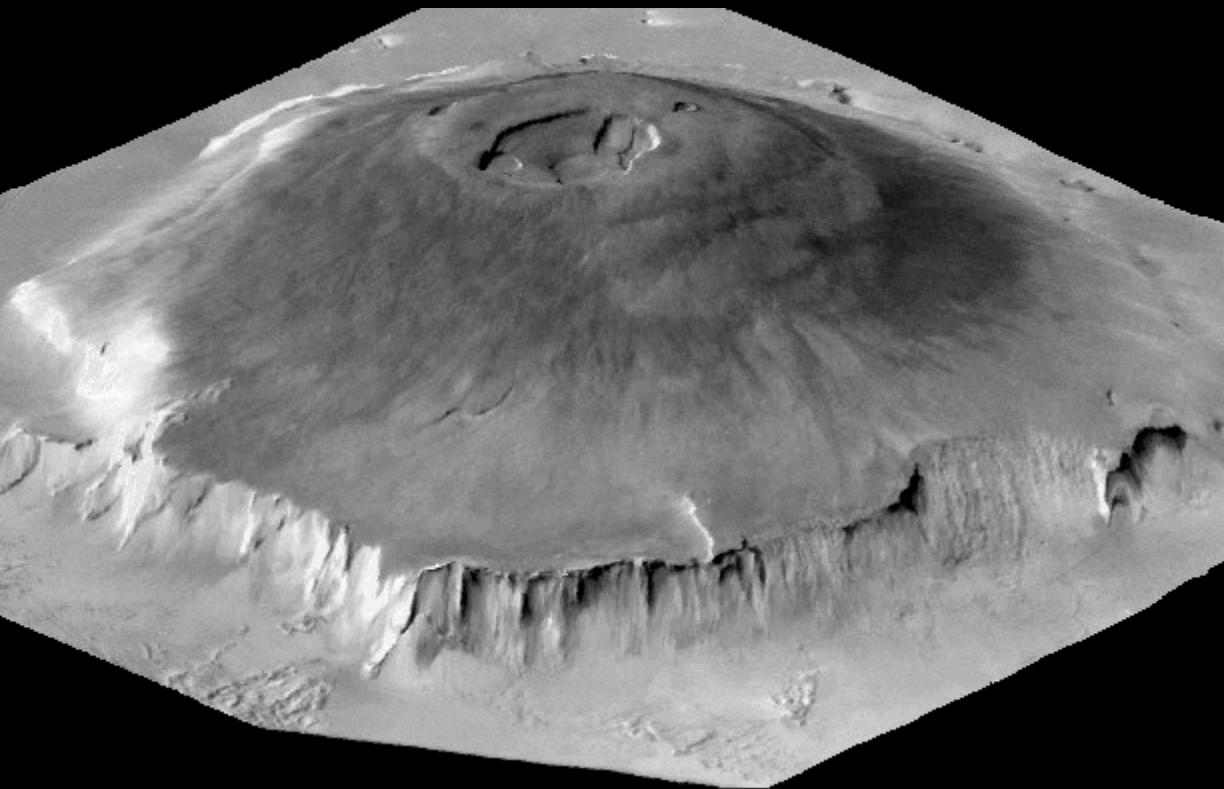
Mariner 4 image , 1965 (NASA)

Mars Geography

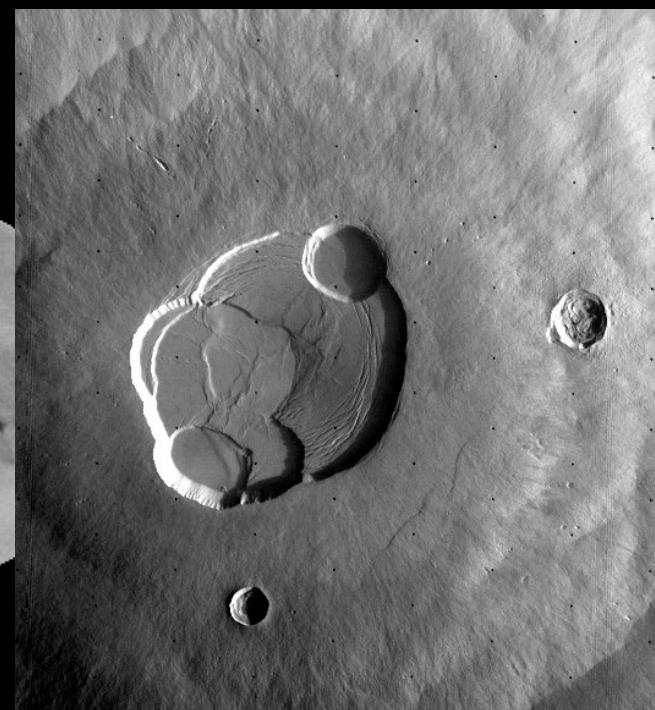


Olympus Mons

3D model

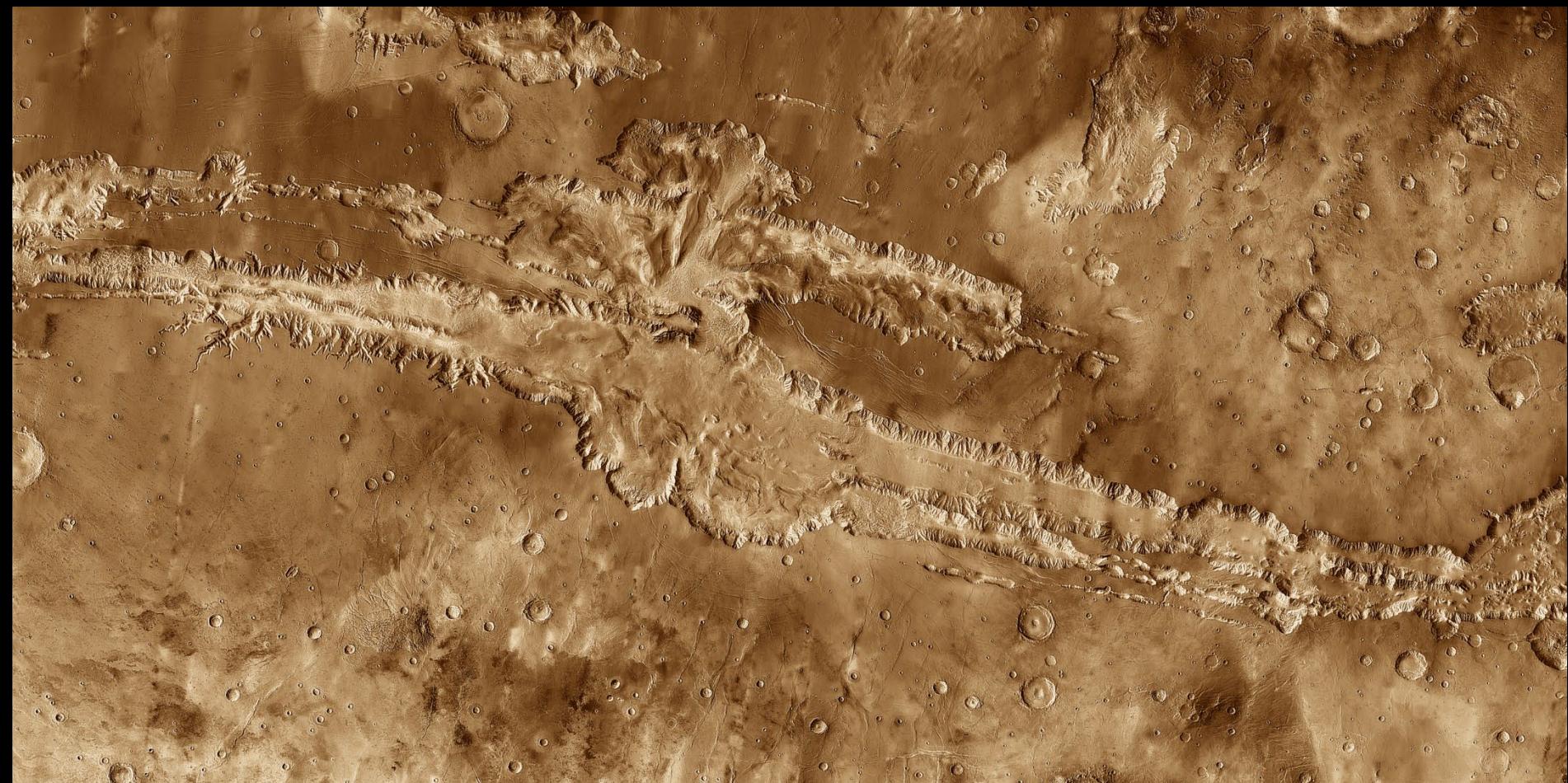


Caldera



NASA JPL

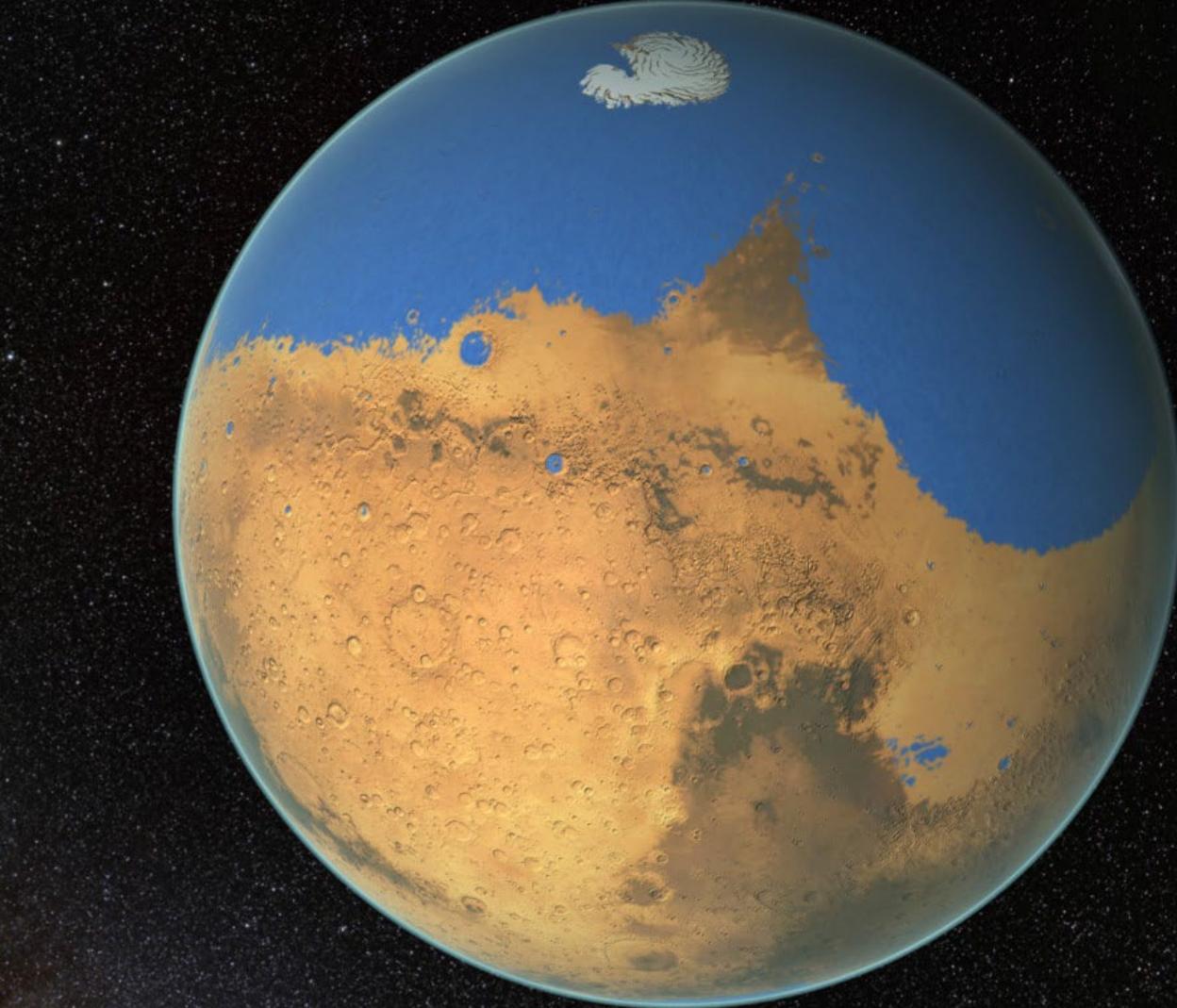
Valles Marineris



~3,000 km

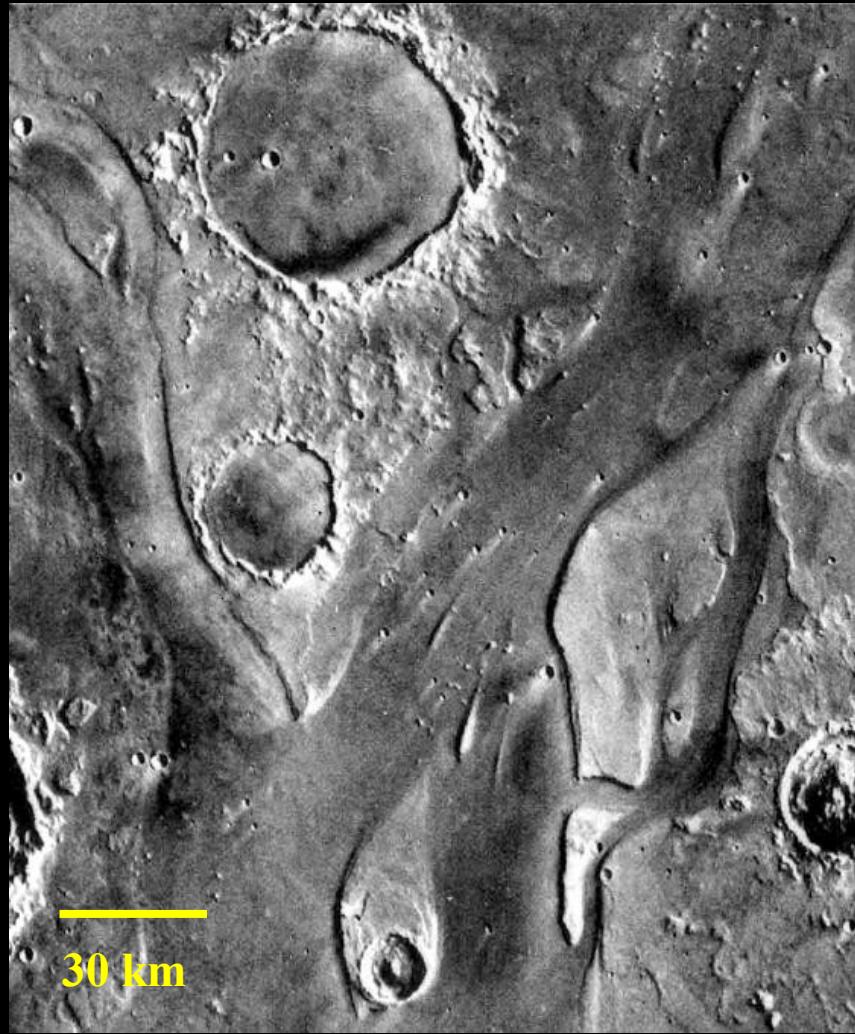
NASA Mars Exploration Program: composite from Thermal Emission Imaging System (THEMIS), a visible-light and infrared-sensing camera on NASA's Mars Odyssey orbiter

Water on Mars

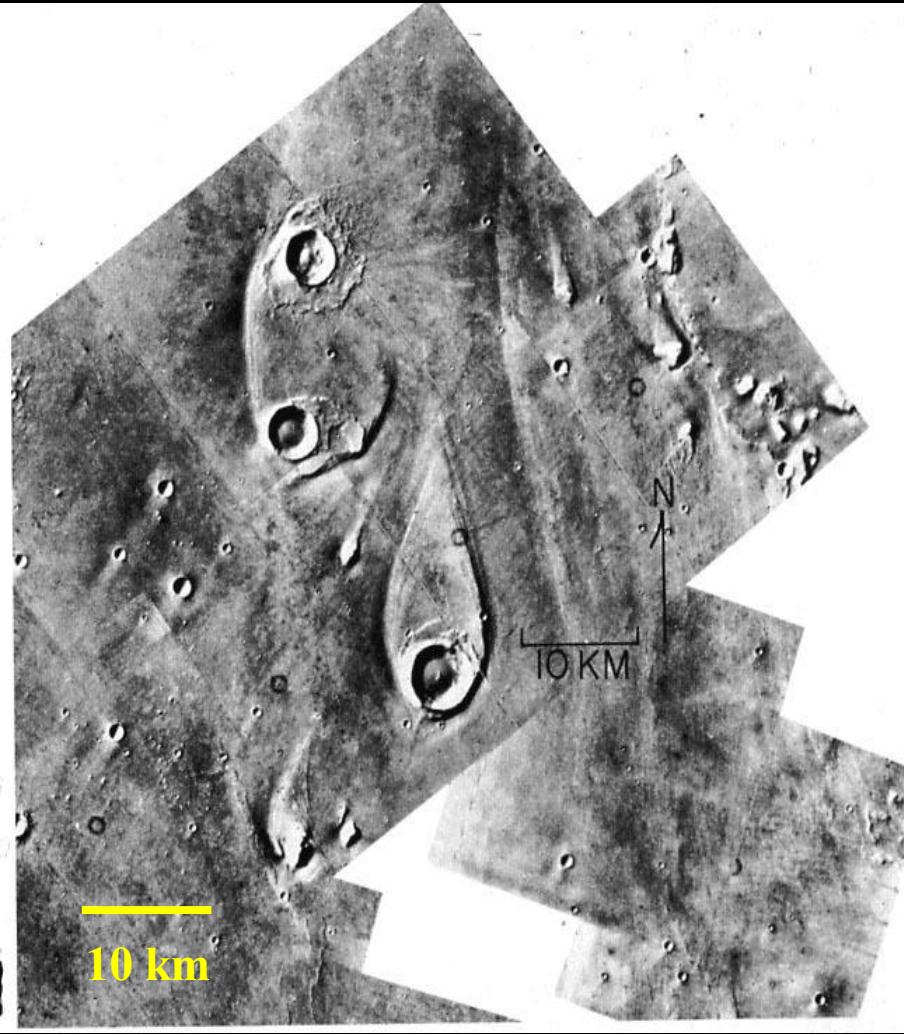


Simulation from NASA's Goddard Space Flight Center

Outflow channels



30 km



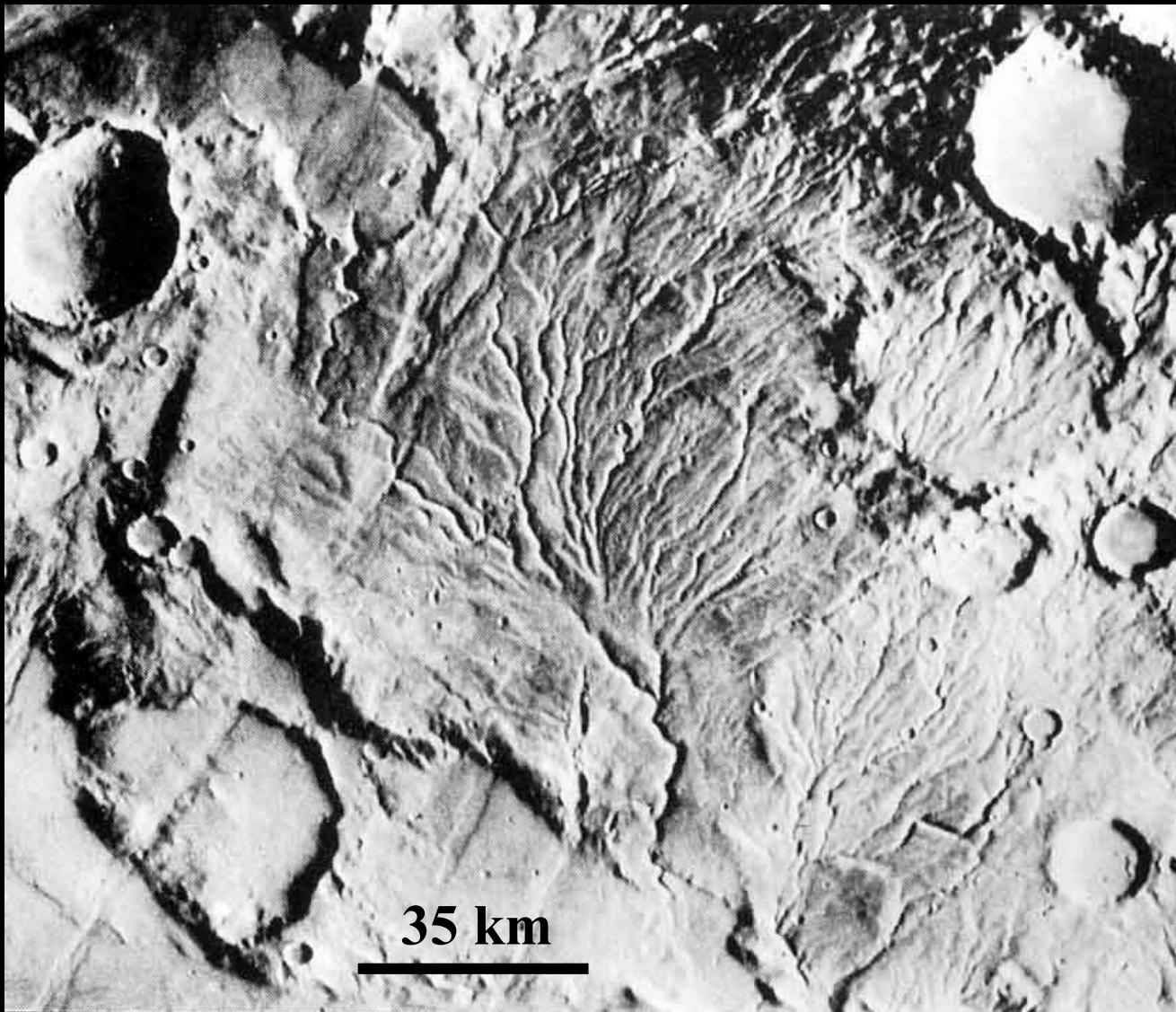
10 km

Rivers

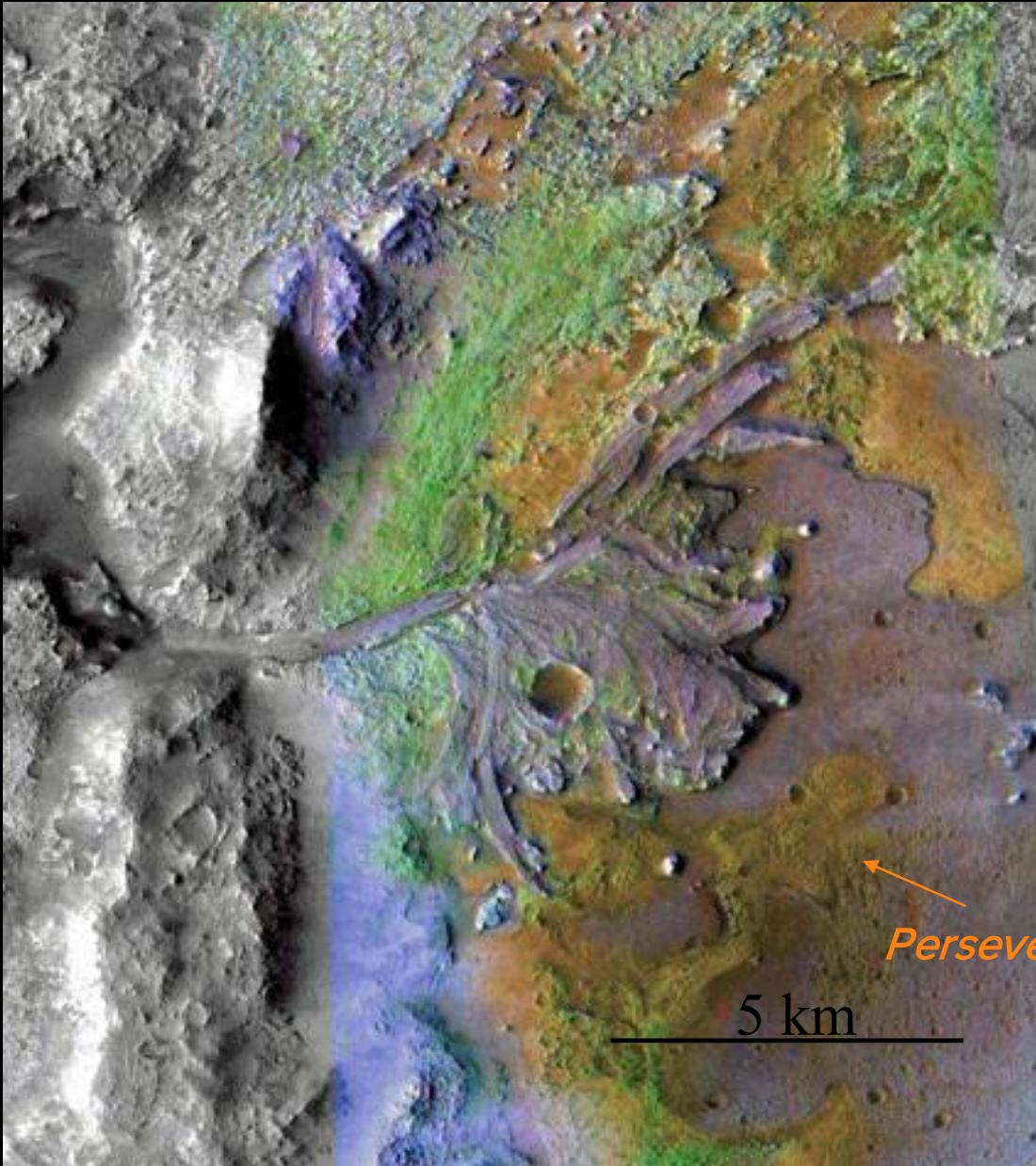


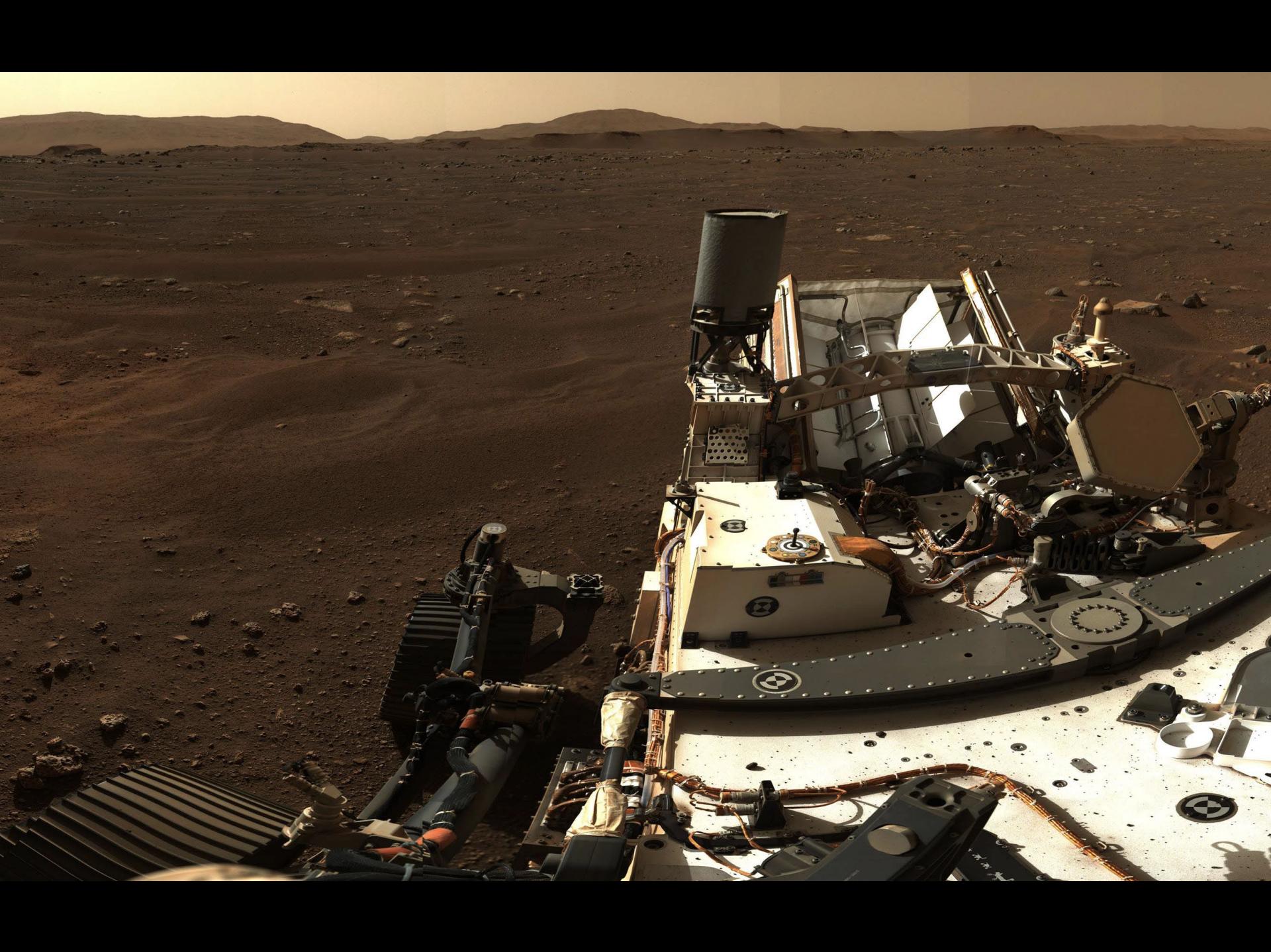
Nirgal Vallis

Rainfall on Mars?



Lakes and deltas





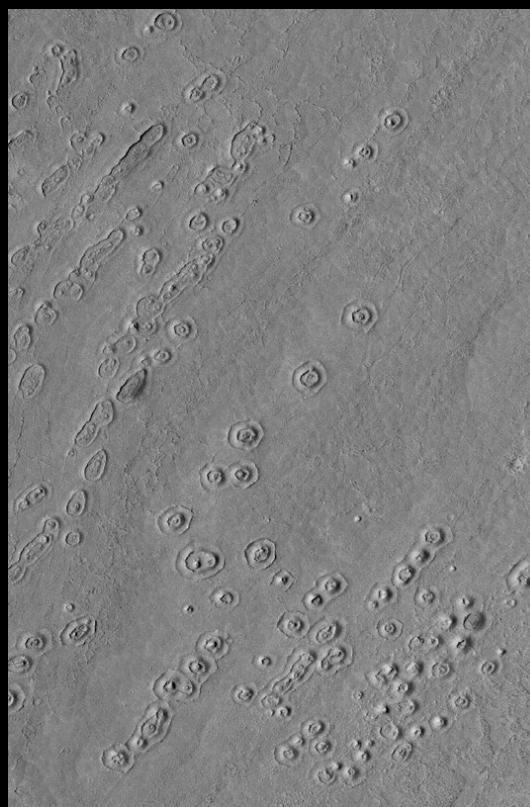
~3km

Recent Water?

Athabasca Vallis

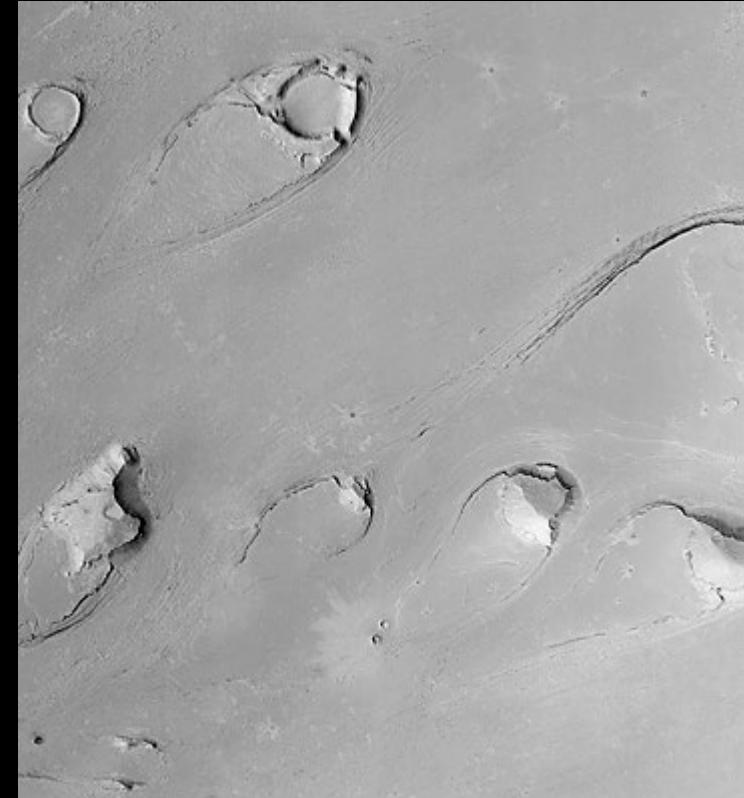
‘Circles’

~1.3km



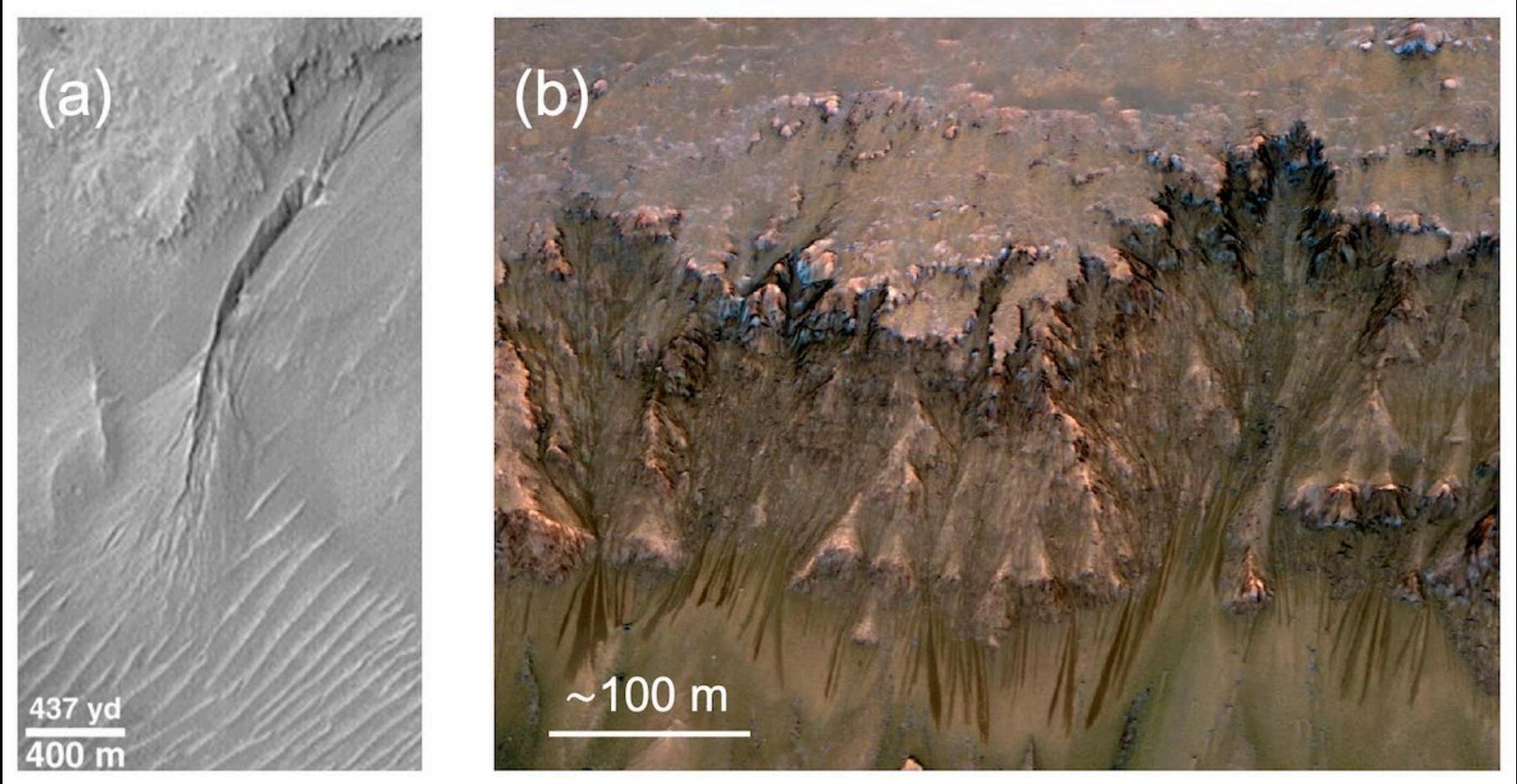
‘Islands’

~13km



Recent Water?

Recurring Slope Lineae (RSL)



MRO/HIRISE/NASA

A prediction about life.....



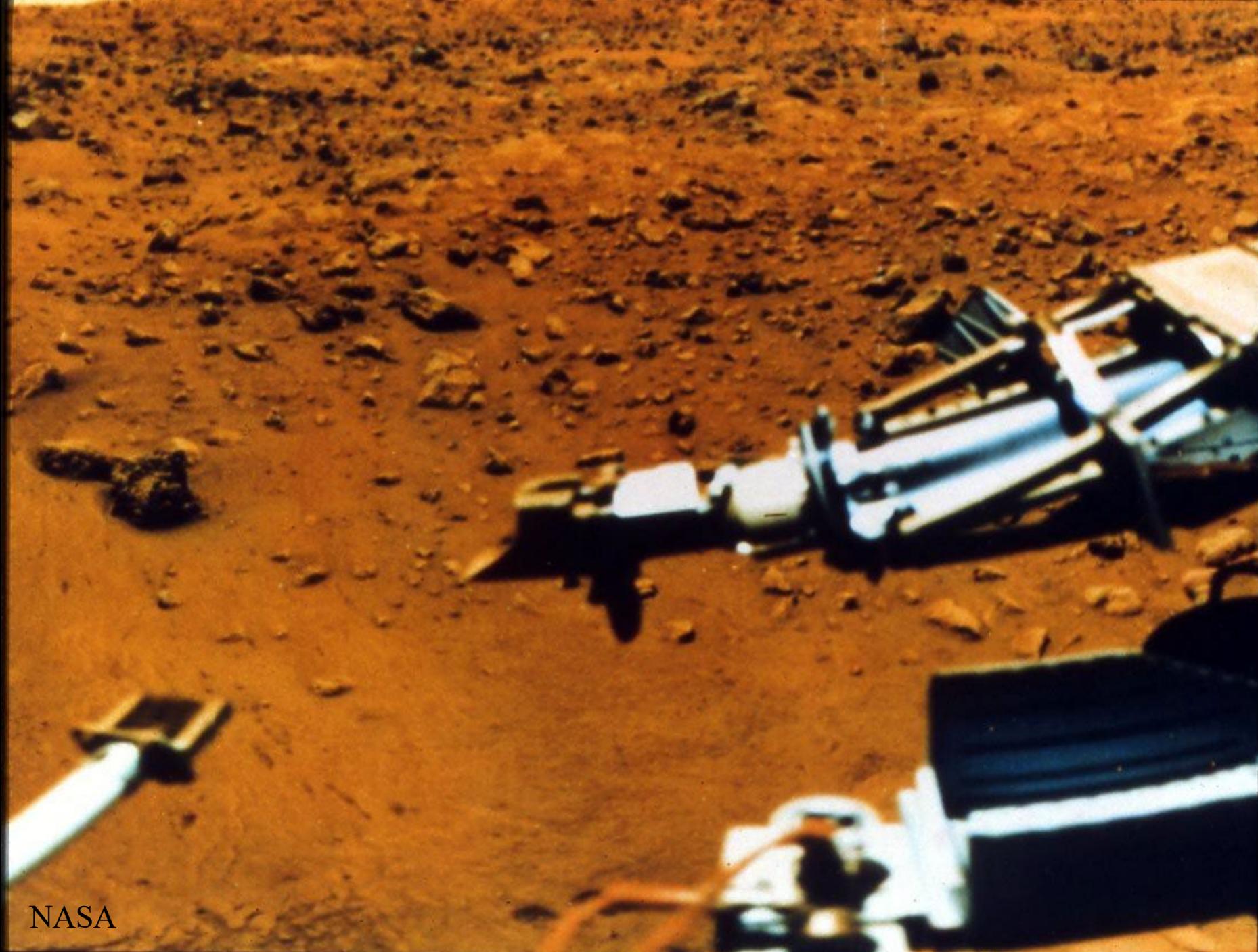
“ Life is almost bound to arise wherever physical conditions are similar to those that prevailed on our planet some four billion years ago..... ”

Christian de Duve (*Vital Dust: Life as a Cosmic Imperative*; 1995).

Possibilities for Life on Mars

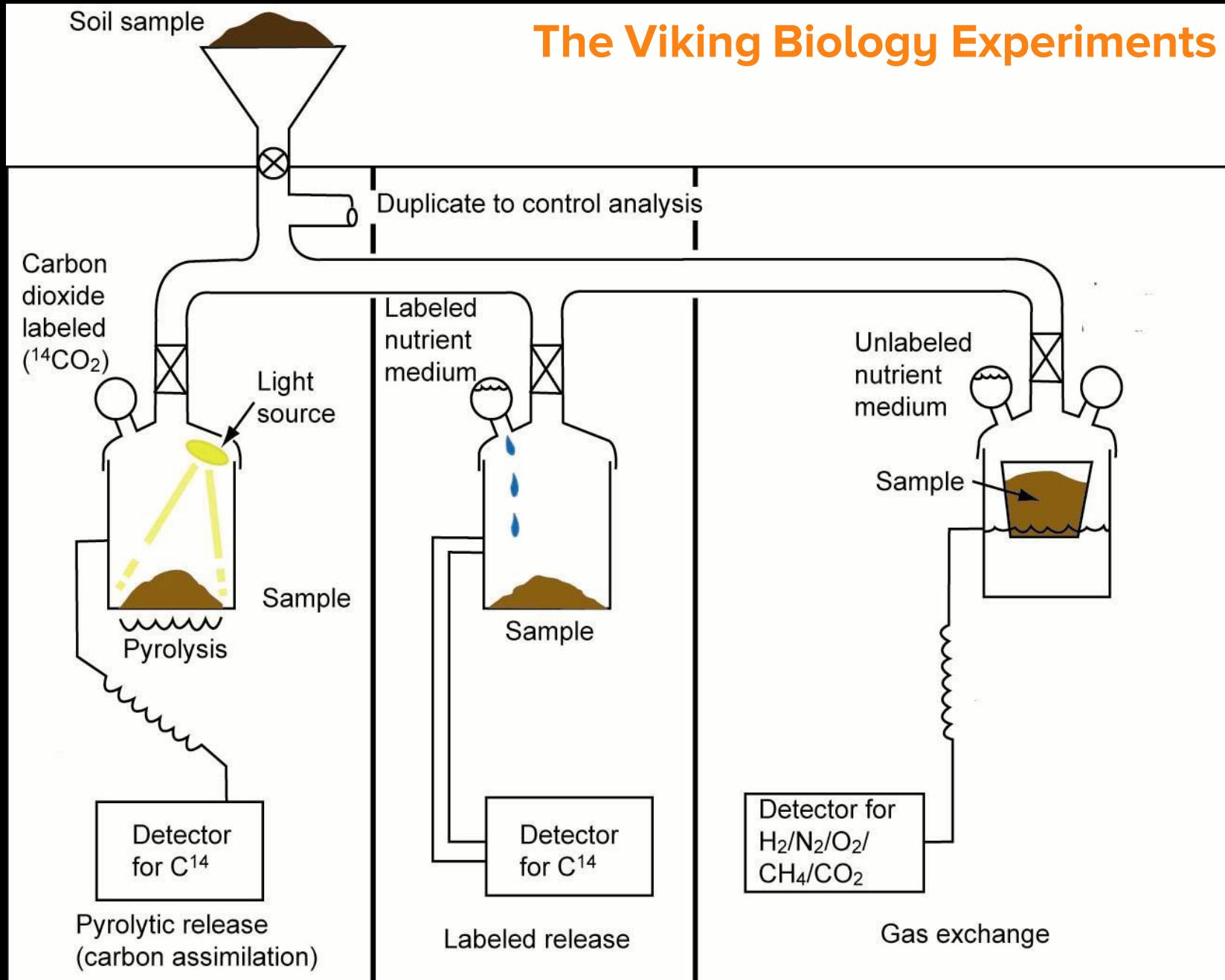
- Extant near-surface (microbial) life.
- Extant life deep in the crust.
- Extinct life (fossils)



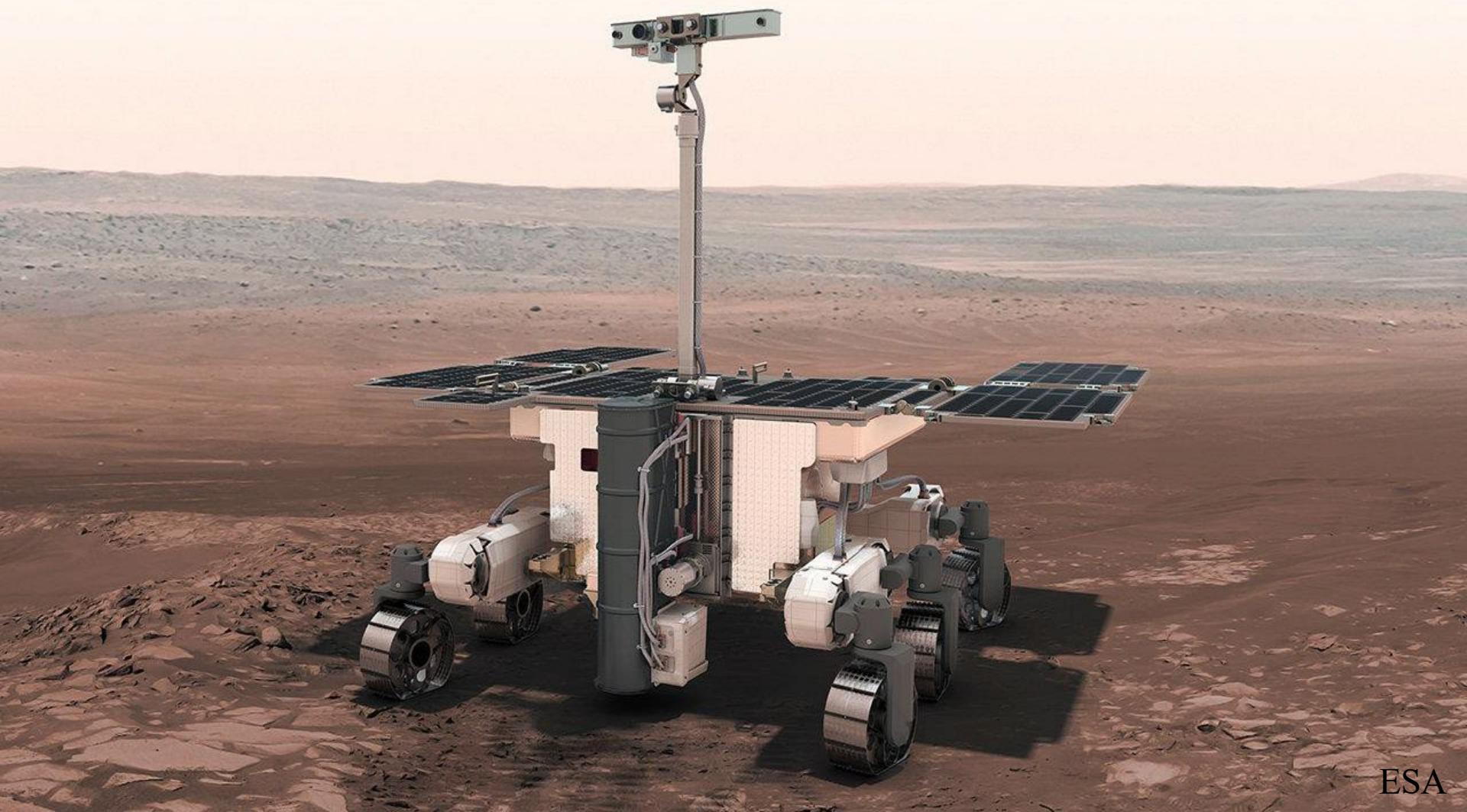


NASA

The Viking Biology Experiments

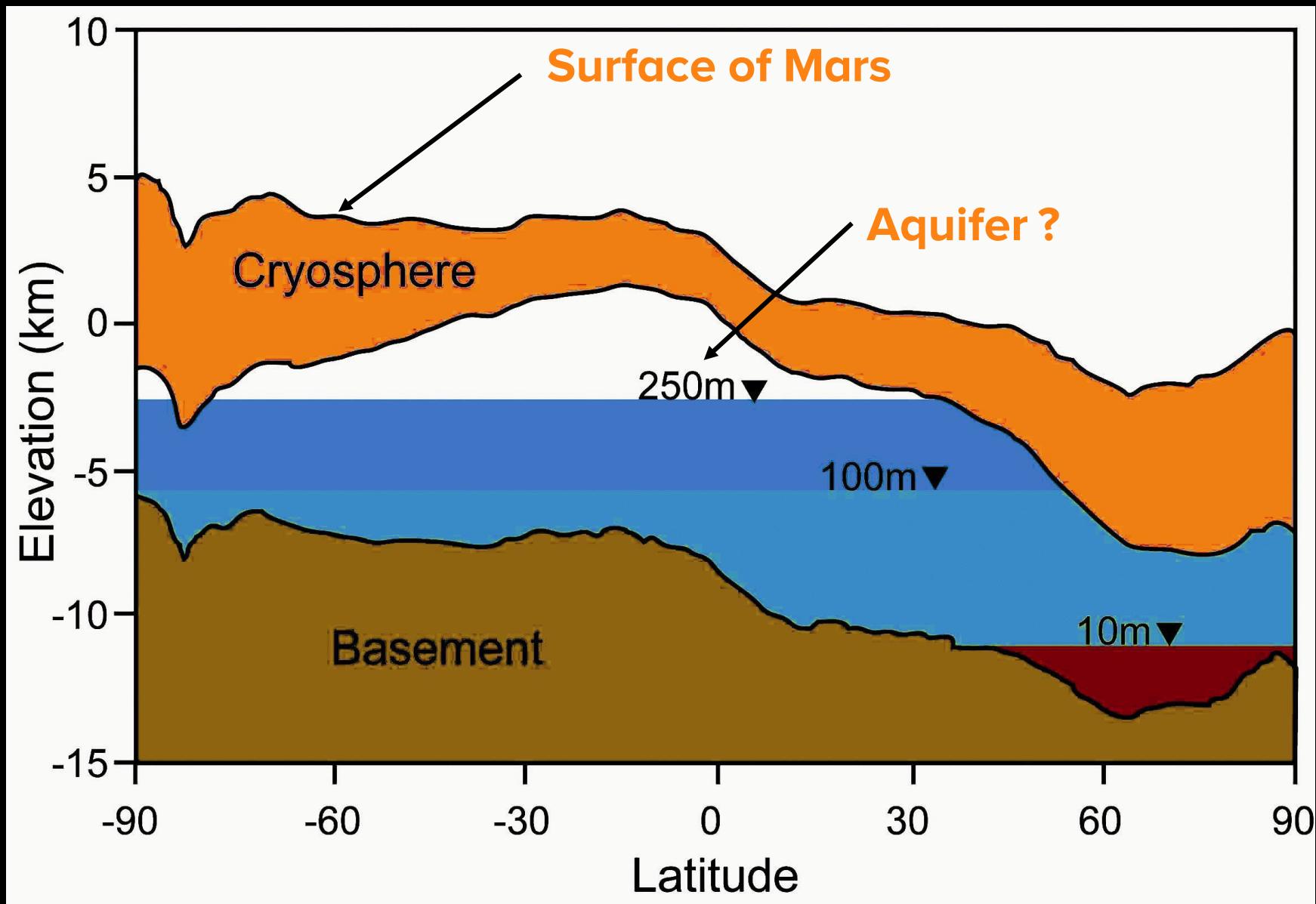


ESA's Rosalind Franklin rover



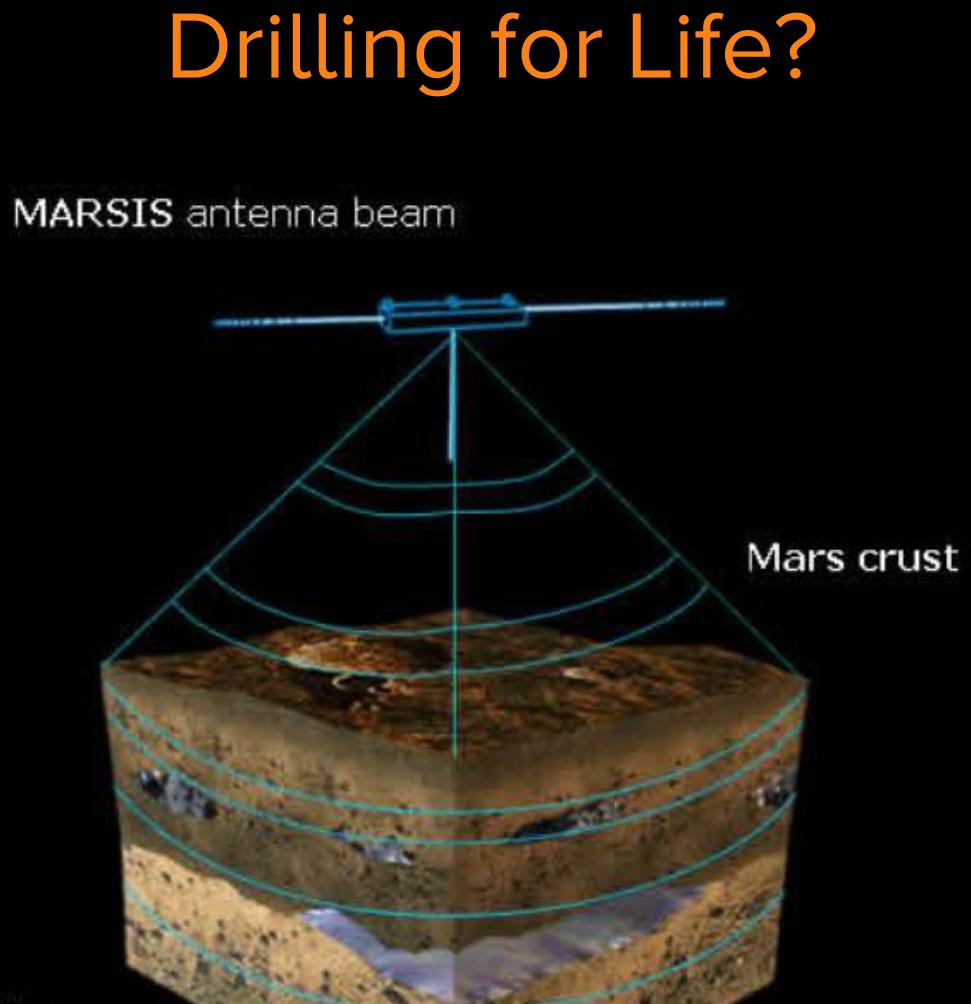
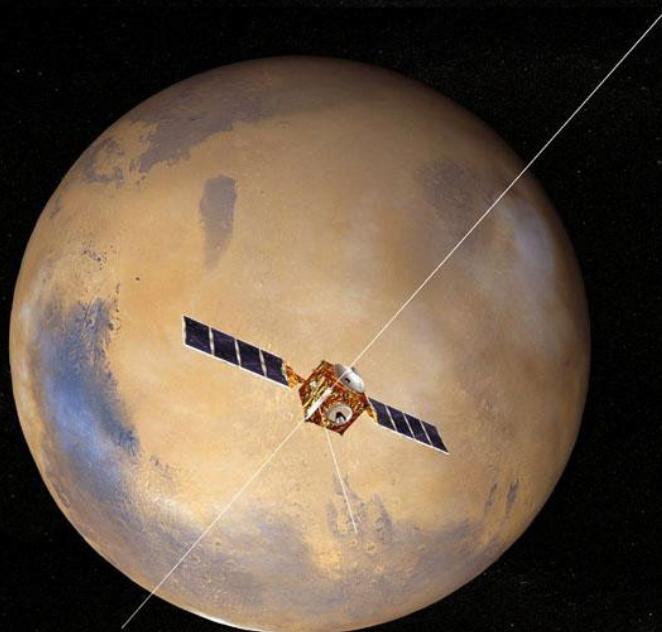
ESA

Deep sub-surface life?



The Columbia River Basalts



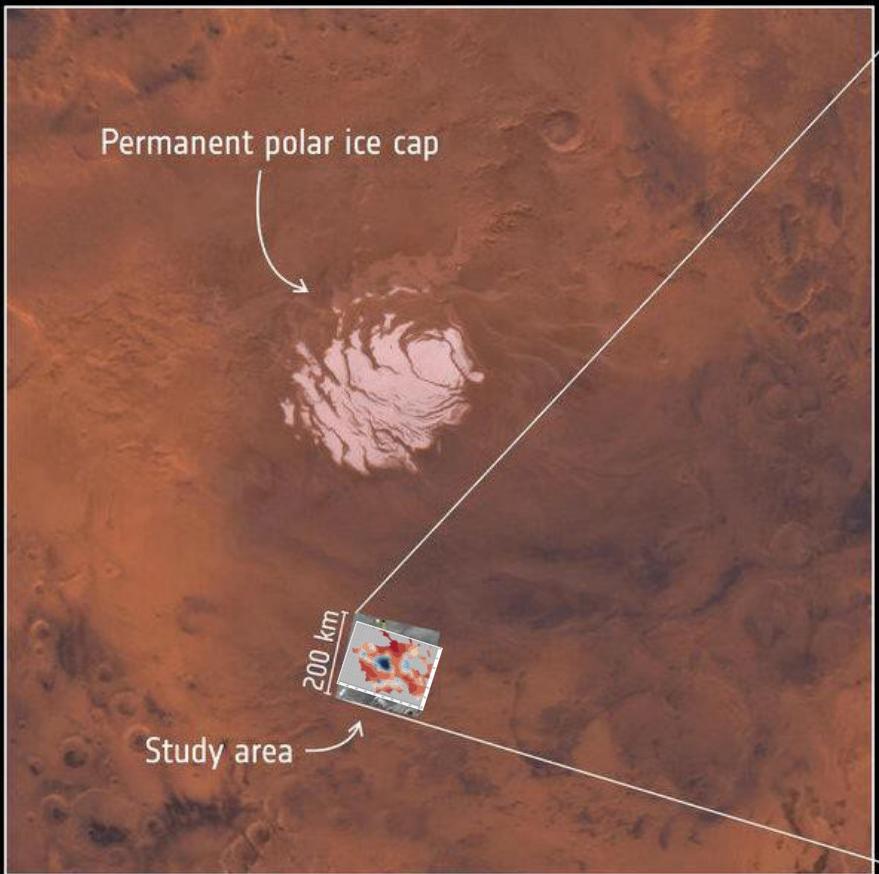


Drilling for Life?

Multiple subglacial water bodies below the south pole of Mars unveiled by new MARSIS data

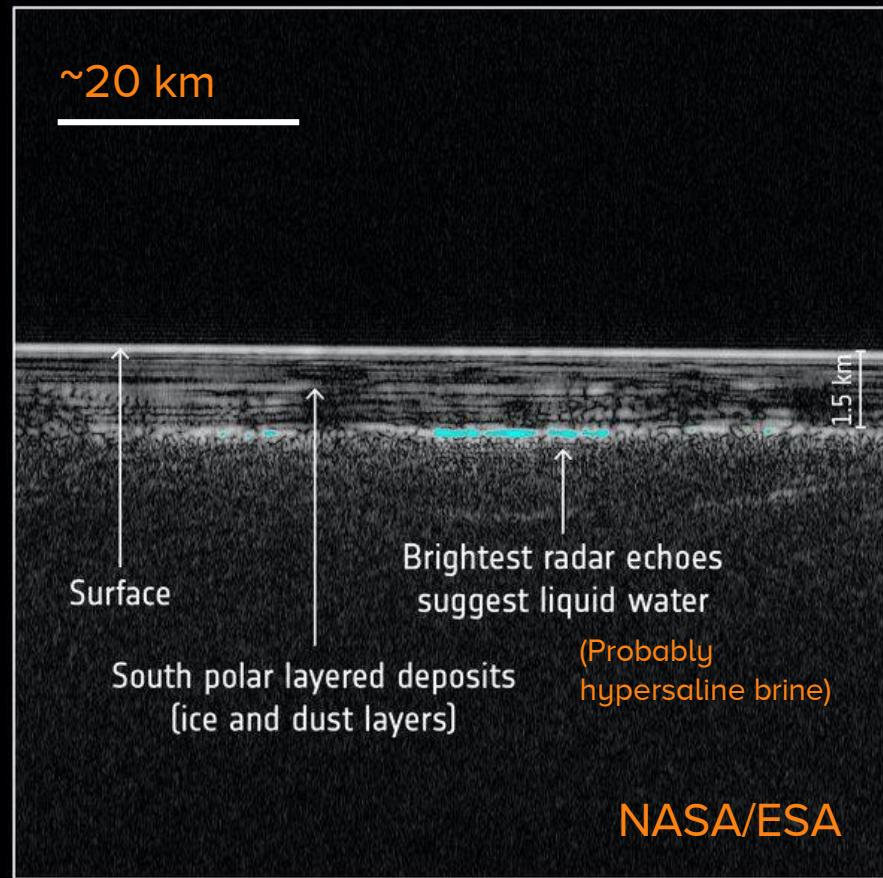
Sebastian Emanuel Lauro^①, Elena Pettinelli^①, Graziella Caprarelli^②, Luca Guallini^③, Angelo Pio Rossi^④, Elisabetta Mattei^①, Barbara Cosciotti^①, Andrea Cicchetti^⑤, Francesco Soldovieri^⑥, Marco Cartacci^⑤, Federico Di Paolo^①, Raffaella Noschese^⑤ and Roberto Orosei^③

Mars south polar region

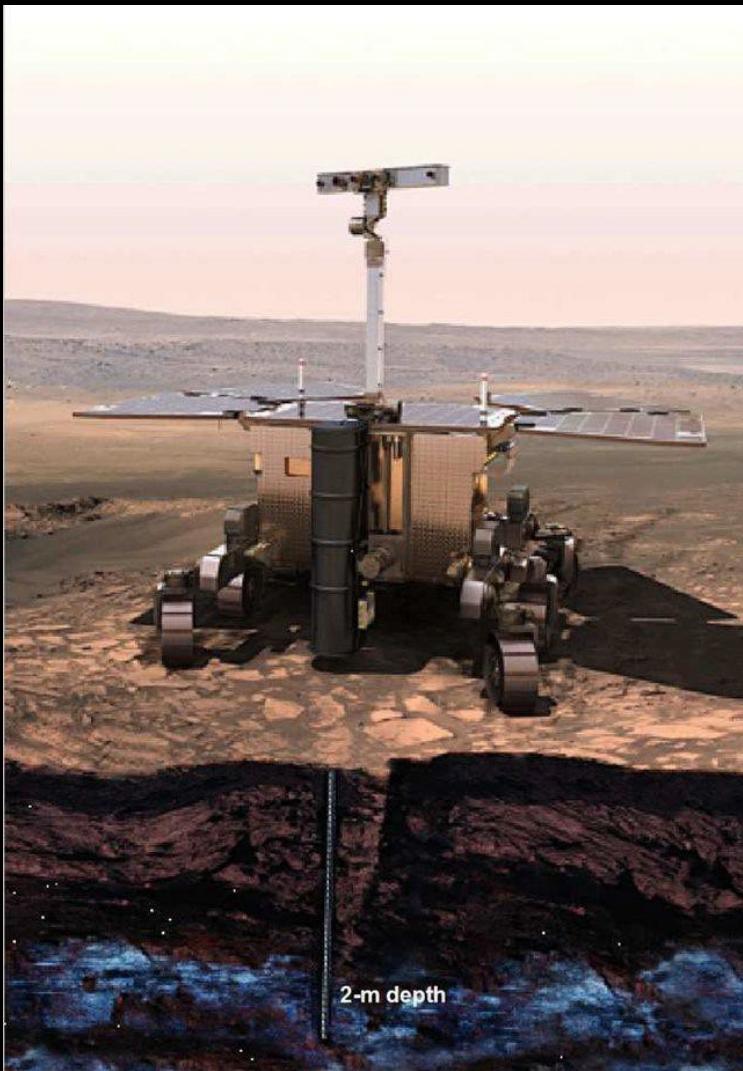


S. Lauro et al,
Nature Astronomy, 5, 63-70
(2021)

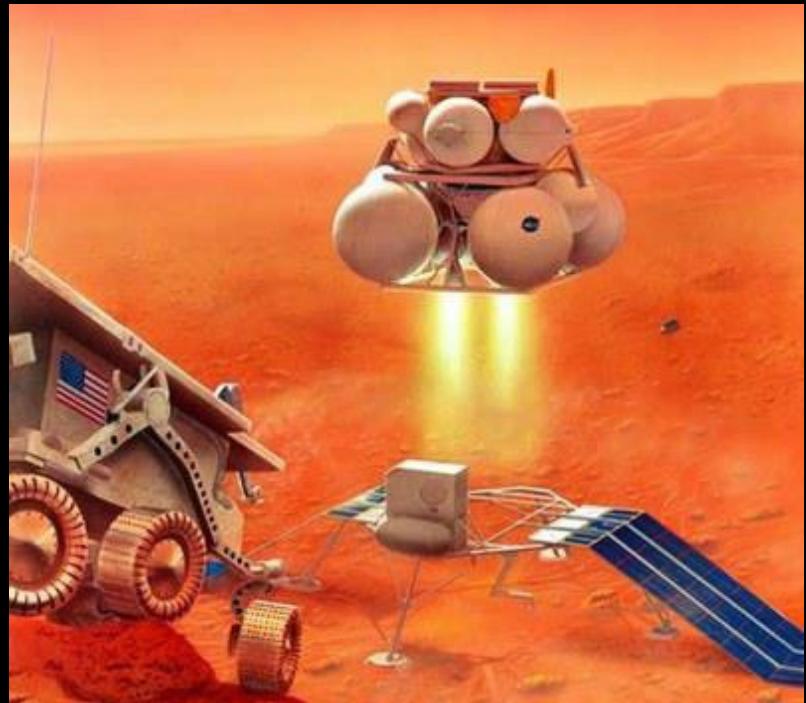
Radar image of subsurface



Future searches for near-surface life on Mars

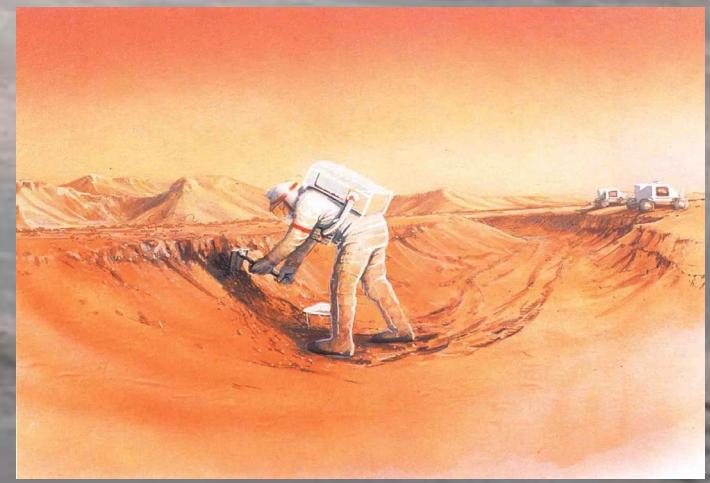
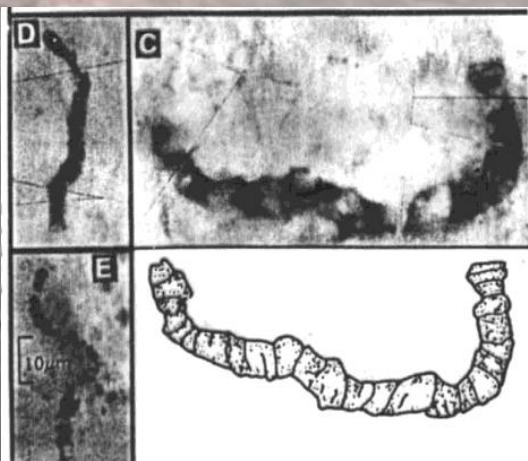


ESA's ExoMars rover (earliest 2028...)



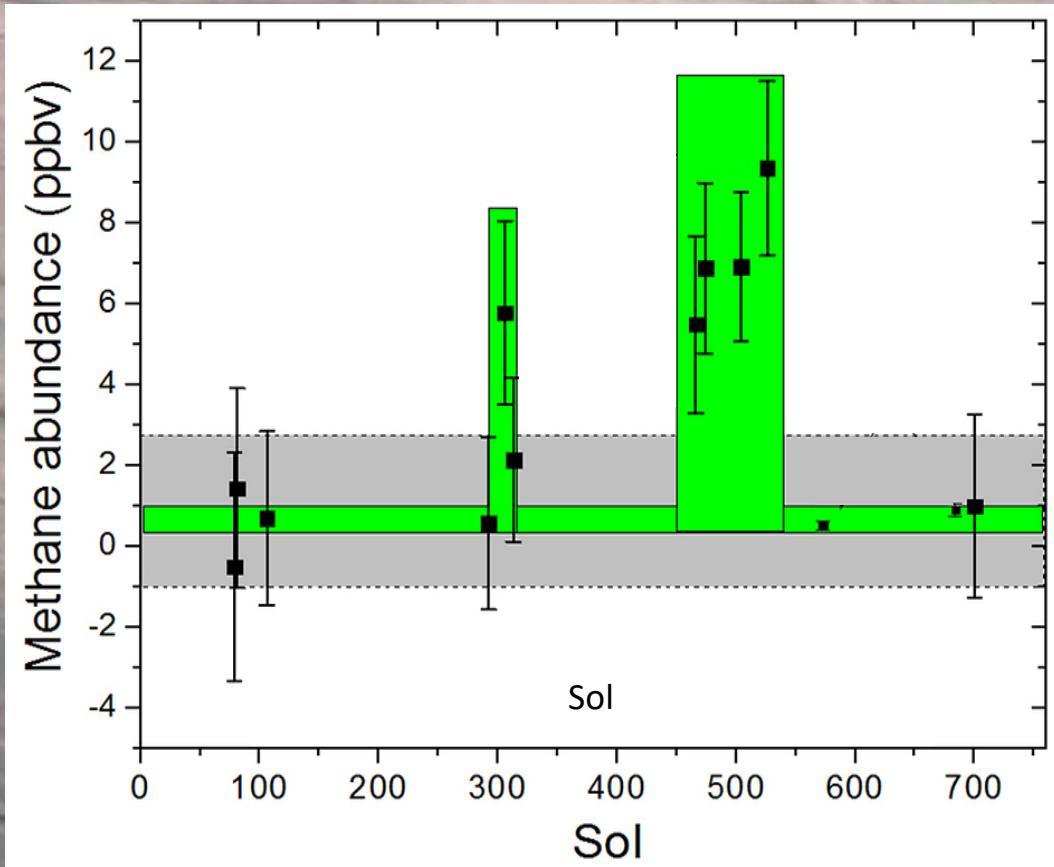
Sample Return (c.2030?)

Searching for fossils on Mars?



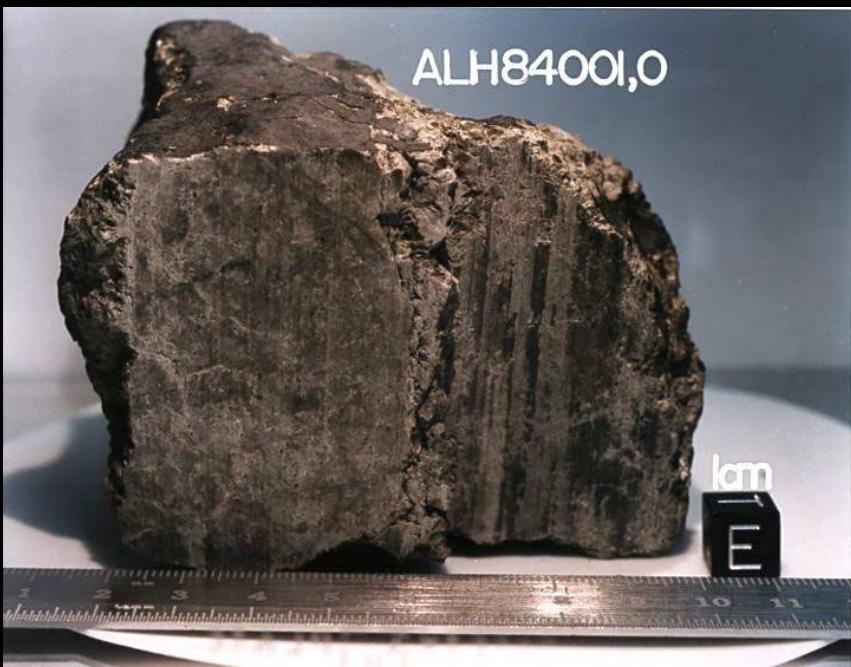
NASA

Organics and CH₄ in Gale Crater?



NASA

(The dreaded) ALH 84001



The Martian meteorite ALH 84001
(NASA).



Microscope view of carbonate globules within ALH 84001 (NASA).



US President Bill Clinton delivers
remarks on ALH 84001 (1996)

NASA

Wider implications of life on Mars

If evidence for life, whether extinct or extant, is found on Mars the scientific implications will be profound. It will first be necessary to try to establish whether the life is indigenous to Mars or has been transported from Earth to Mars (or vice versa) by meteorites.

If life did arise independently on Mars, then the fact that it did so twice on neighbouring planets in the same solar system would imply that it likely to be common on planets of other stars (as Christian de Duve has already predicted).

On the other hand, should we determine that life never evolved on Mars, even though 3 to 4 billion years ago the environment was probably similar to that under which life arose on Earth, we may have to admit that life is difficult to establish and hence likely to be rare in the Universe.