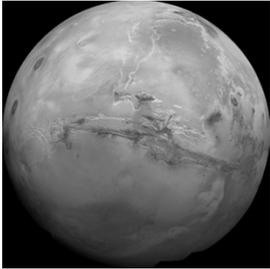


Lecture 26: The Deserts of Mars

Lecture 26
The Deserts of Mars



Astronomy 141 – Winter 2012

This lecture is about the properties of the desert planet Mars

Mars is the fourth planet from the Sun, and about half the size of Earth

Mars has a thin, dry CO₂ atmosphere, and polar caps of H₂O and CO₂ ice.

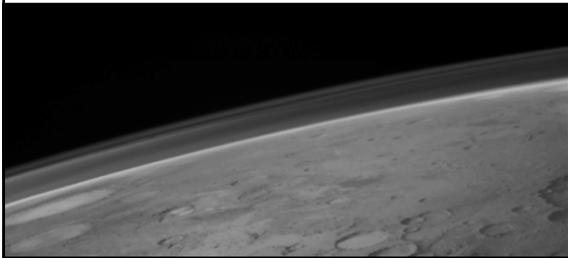
The surface of Mars is a dry, cold desert, with extinct volcanoes.

Evidence of past water flows, both floods and steady state, seen in the terrain, and substantial sub-surface ice deposits

Mars may have been warm and wet in its first Gyr or so.

The Atmosphere of Mars is thin, dry, and composed of mostly carbon dioxide.

95% CO₂, 2.7% N₂, 1.6% Argon
Traces of H₂O vapor (0.03%)



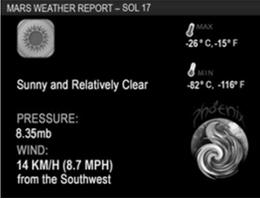
Lecture 26: The Deserts of Mars

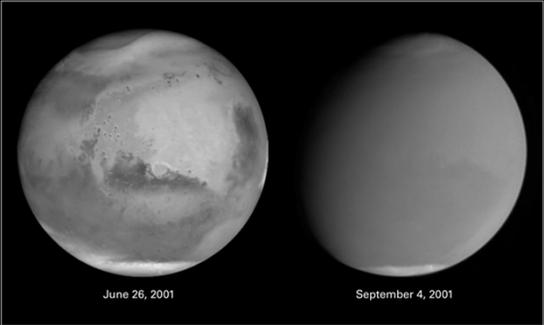
The weather on Mars is breezy and cold

Temperatures:
Daytime: 244 K (-20° F) max
Nighttime: 187 K (-123° F) min

Winds:
17 km/h (11 mph)
Gusts to 30km/h

Gusty winds sometimes lead to dust devils



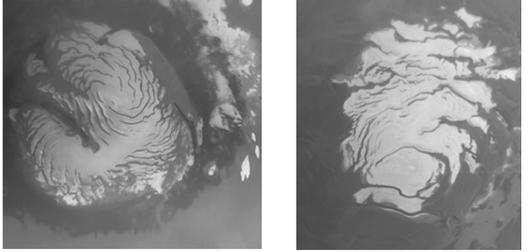


June 26, 2001 September 4, 2001

Mars • Global Dust Storm
Hubble Space Telescope • WFPC2

NASA, J. Bell (Cornell University), M. Wolff (SSI), and the Hubble Heritage Team (STScI/AURA) • STScI-PRC01-31

The North and South poles of Mars are capped by deposits of H₂O and CO₂ ices mixed with dust.



North Pole **South Pole**

Lecture 26: The Deserts of Mars

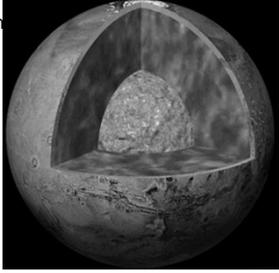
Mars is small and cooled off very quickly

Mantle solidified, ending tectonic activity and shutting down any magnetic fields.

Thick, cool, rigid crust

Primary crust:
shaped by impacts

Secondary crust:
shaped by volcanism

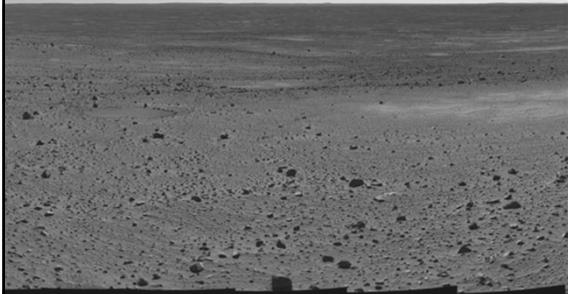


The Surface of Mars is a dry desert, with old, heavily cratered highlands and younger plains.



Red = highlands Blue = lowlands [MOLA data]

Plains of Gusev Crater
(Spirit Rover)

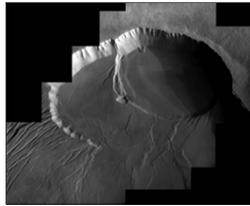
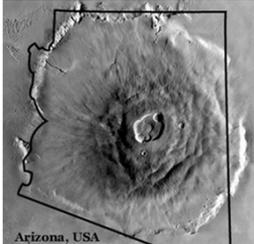


Lecture 26: The Deserts of Mars

Olympus Mons is the largest volcano in the Solar System.

Stationary hotspot

One big shield volcano instead of a chain of smaller volcanoes.



24 km high
600 km across
Last erupted ~300 Myr ago

The surface terrain of Mars is cut by numerous valleys and channels.

Valles Marineris:

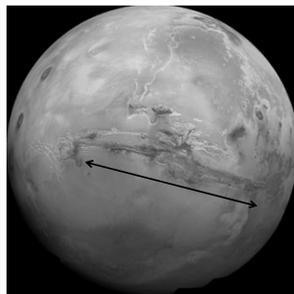
Vast canyon (rift valley)

4000 km long

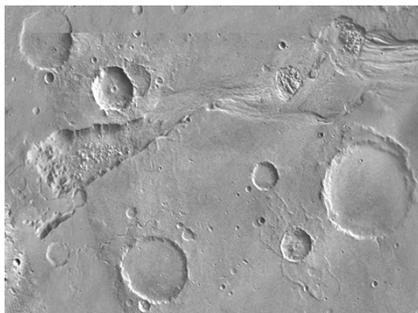
2-7 km deep

up to 600 km wide.

Formed by faulting
(crust pulling apart),
not water erosion.



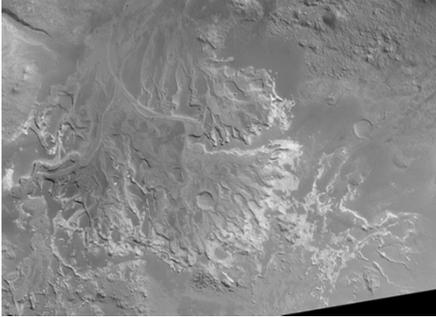
Deep channels and flood plains are signs of sudden catastrophic flows in the distant past.



Head of the Ravi Vallis

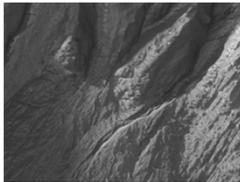
Lecture 26: The Deserts of Mars

Also see some signs of ancient steady-state flows, including meandering river beds and deltas.



Eberswalde Delta

Flow patterns are evidence of liquid water flows in the distant past.



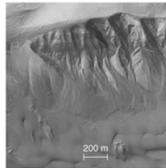
Evidence of rapid floods of water carving gullies

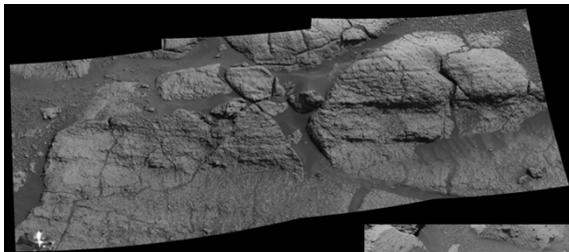
Layered sedimentary terrain (like Grand Canyon)

Steady-state flows like rivers

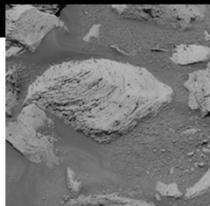
Impact craters over the flows indicates that some are quite old – few 100 Myr.

Others are more recent, perhaps a few Myr.





Layered rocks, indicating water-deposited sediments, containing salts & hydrated minerals like Hematite.



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Mars should have been warm enough for liquid water during its first 1 Gyr

Started with a primordial atmosphere like Earth & Venus

As Mars cooled:

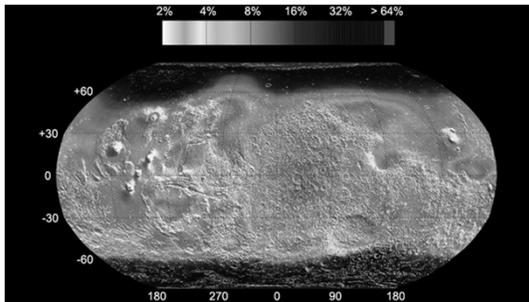
H₂O freezes out (frozen into saturated rocks)

Remaining CO₂ & N₂ escape low gravity of Mars

Lack of a magnetic field allowed the Solar Wind to accelerate atmosphere loss.

Result: thin, cold, dry, CO₂ & N₂ atmosphere

Water on Mars today is in the form of sub-surface ice...



Polar ice was expected, but substantial low-latitude ice was not

There is now significant evidence that Mars may have been warm and wet in the distant past.

