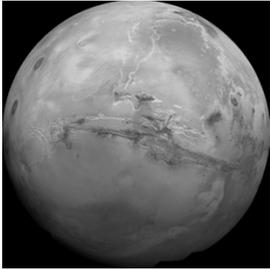


# Lecture 26: The Deserts of Mars

Lecture 26  
**The Deserts of Mars**



Astronomy 141 – Winter 2012

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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 CO<sub>2</sub> atmosphere, and polar caps of H<sub>2</sub>O and CO<sub>2</sub> 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.

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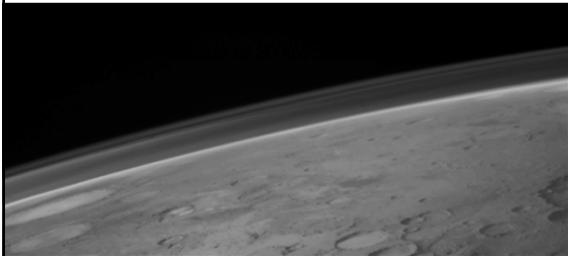
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The Atmosphere of Mars is thin, dry, and composed of mostly carbon dioxide.

95% CO<sub>2</sub>, 2.7% N<sub>2</sub>, 1.6% Argon  
Traces of H<sub>2</sub>O vapor (0.03%)



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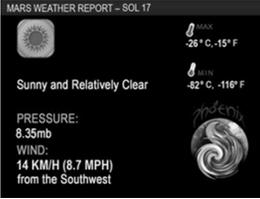
# Lecture 26: The Deserts of Mars

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



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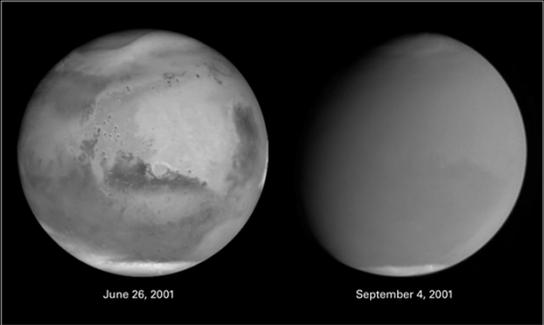
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June 26, 2001      September 4, 2001

**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

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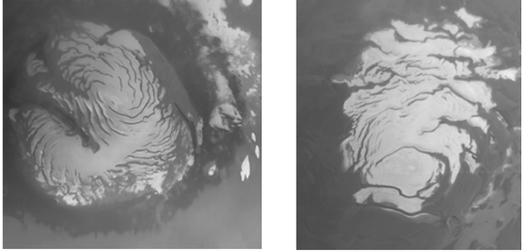
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The North and South poles of Mars are capped by deposits of H<sub>2</sub>O and CO<sub>2</sub> ices mixed with dust.



**North Pole**      **South Pole**

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# Lecture 26: The Deserts of Mars

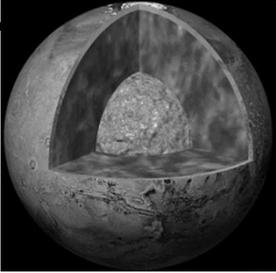
Mars is small and cooled off very quickly

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



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



Red = highlands Blue = lowlands [MOLA data]

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Plains of Gusev Crater  
(Spirit Rover)



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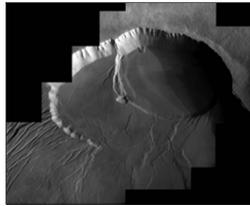
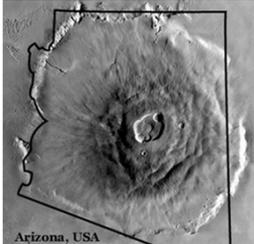
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# Lecture 26: The Deserts of Mars

*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

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

Valles Marineris:

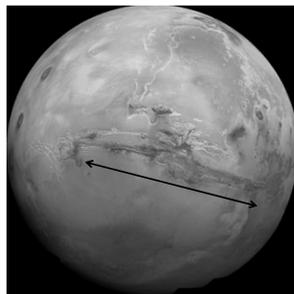
Vast canyon (rift valley)

4000 km long

2-7 km deep

up to 600 km wide.

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



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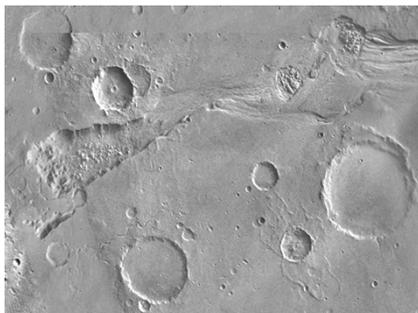
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Deep channels and flood plains are signs of sudden catastrophic flows in the distant past.



Head of the Ravi Vallis

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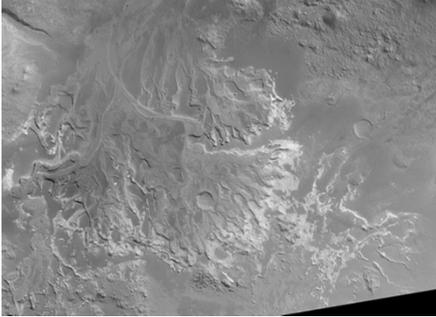
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# Lecture 26: The Deserts of Mars

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



Eberswalde Delta

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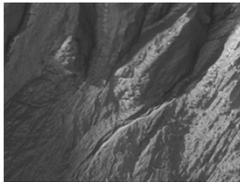
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Flow patterns are evidence of liquid water flows in the distant past.



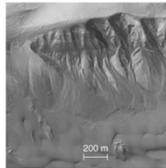
Evidence of rapid floods of water carving gullies

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.



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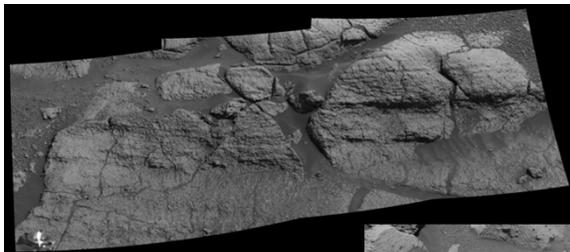
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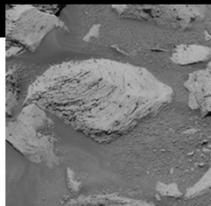
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Layered rocks, indicating water-deposited sediments, containing salts & hydrated minerals like Hematite.



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# Lecture 26: The Deserts of Mars

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:

H<sub>2</sub>O freezes out (frozen into saturated rocks)

Remaining CO<sub>2</sub> & N<sub>2</sub> escape low gravity of Mars

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

Result: thin, cold, dry, CO<sub>2</sub> & N<sub>2</sub> atmosphere

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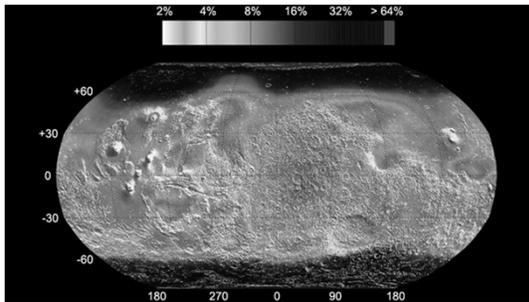
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Water on Mars today is in the form of sub-surface ice...



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

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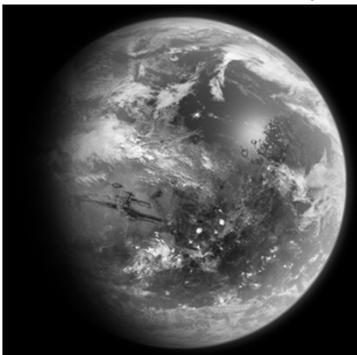
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There is now significant evidence that Mars may have been warm and wet in the distant past.



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