Monday, Dec. 1

Syllabus, class notes, and homeworks are at:
www.as.utexas.edu → courses → AST 301, Lacy

Reading for this week: chapter 18

The help session this week will be Wednesday at 5:00 in GRG 424.

The greenhouse effect

By blocking some of the outgoing infrared radiation and returning it to the Earth, molecules in the Earth's atmosphere force the temperature of the surface of the Earth to rise until the outgoing flow of energy matches the incoming flow.

This is the greenhouse effect.

Because of the greenhouse effect, the surface of the Earth is warm enough for us to live here.

Only about on half of the radiation emitted by the surface of the Earth escapes to carry heat away from the Earth.

As a result, the average temperature of the surface of the Earth is warm enough for life.

A Simpler Explanation

When you put a blanket over you in bed, the blanket slows down the escape of the heat your body is generating so you are warmer.

The Earth's atmosphere acts much like a blanket, slowing down the escape of the heat we receive from the Sun.

The Earth's atmosphere increases the average temperature of the surface of the Earth from about -20^{o}F to +50^{o}F.

By the end of this century will have about doubled the abundance of the greenhouse gasses in our atmosphere.

Fortunately, this will not add another 70^{o}F to the temperature, but it will add about 10^{o}F.

That temperature rise will have a serious effect on people, especially those living in the equatorial countries.

How will we solve the problem?

To stop the warming we must stop using fossil fuels.

That will require new technology.

But that will take awhile.

Since the CO_2 we put into the atmosphere will take over 1000 years to be removed, how much fossil fuel we use until we find ways to produce energy without using fossil fuels will affect people for a long time.

We can cut our use of fossil fuels by using fuel-efficient cars and appliances, and simply by using those thing less.

Topics for this week

What have we learned from the recent missions to Mars and Saturn?

How does Mars differ from the Earth? How do we explain those differences?

What evidence do we have that Mars once had liquid water on its surface? Why is there none now?

How do Jupiter and Saturn differ from the terrestrial planets?

Describe the major moons of Jupiter and Saturn.

Mars movie

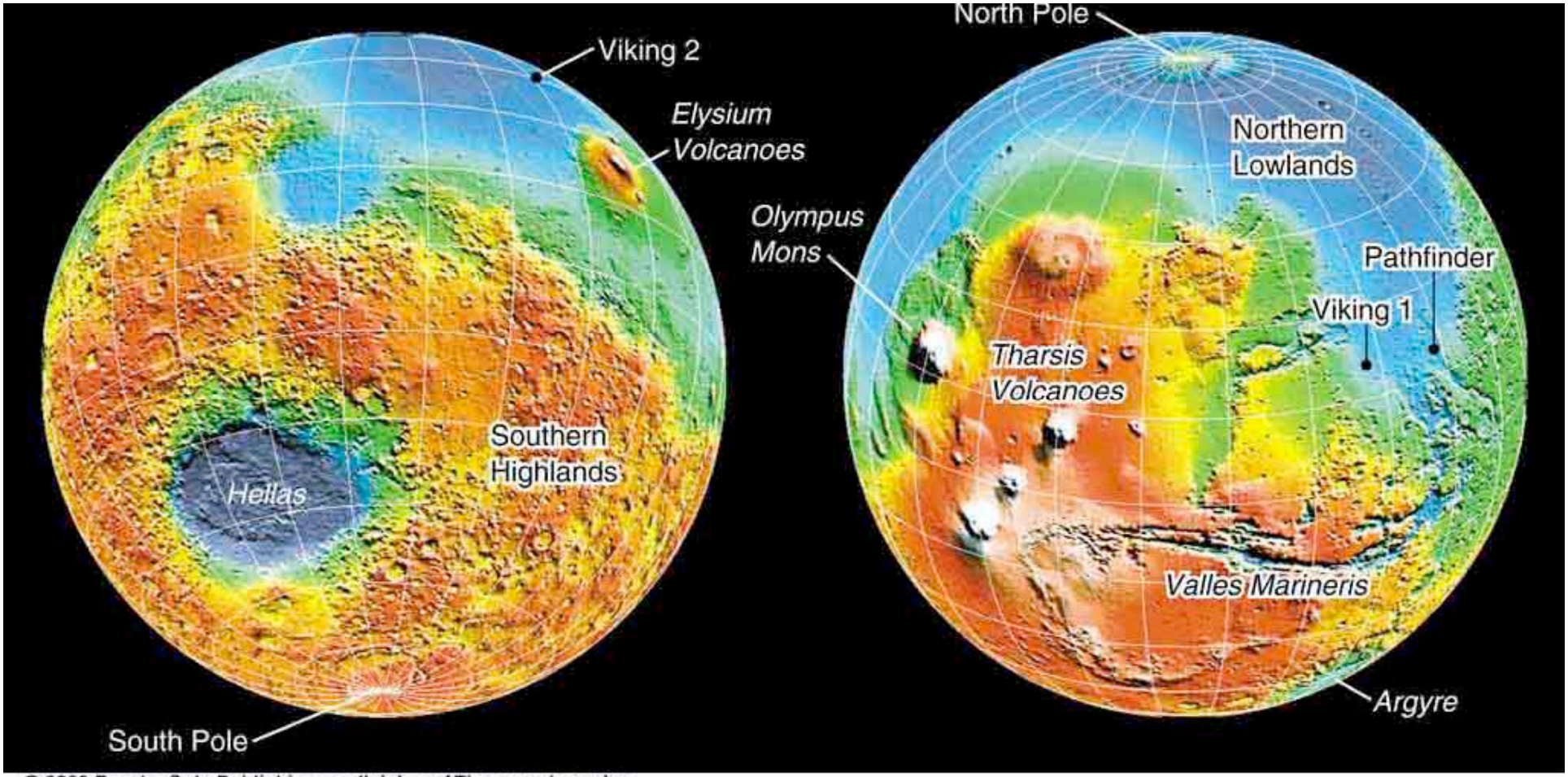
The data are from the Viking orbiters.

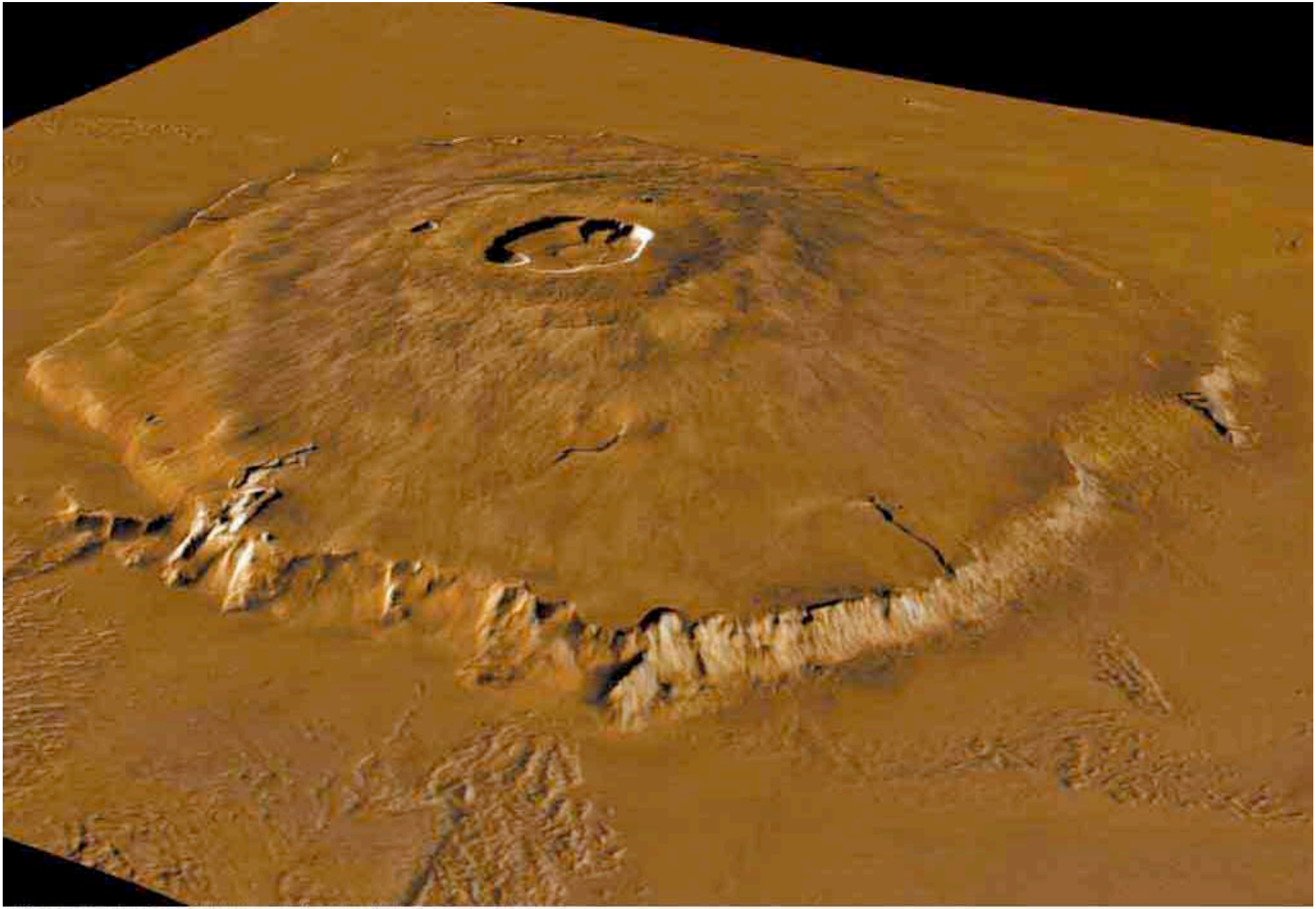
Vertical scale is exaggerated by a factor of 5.

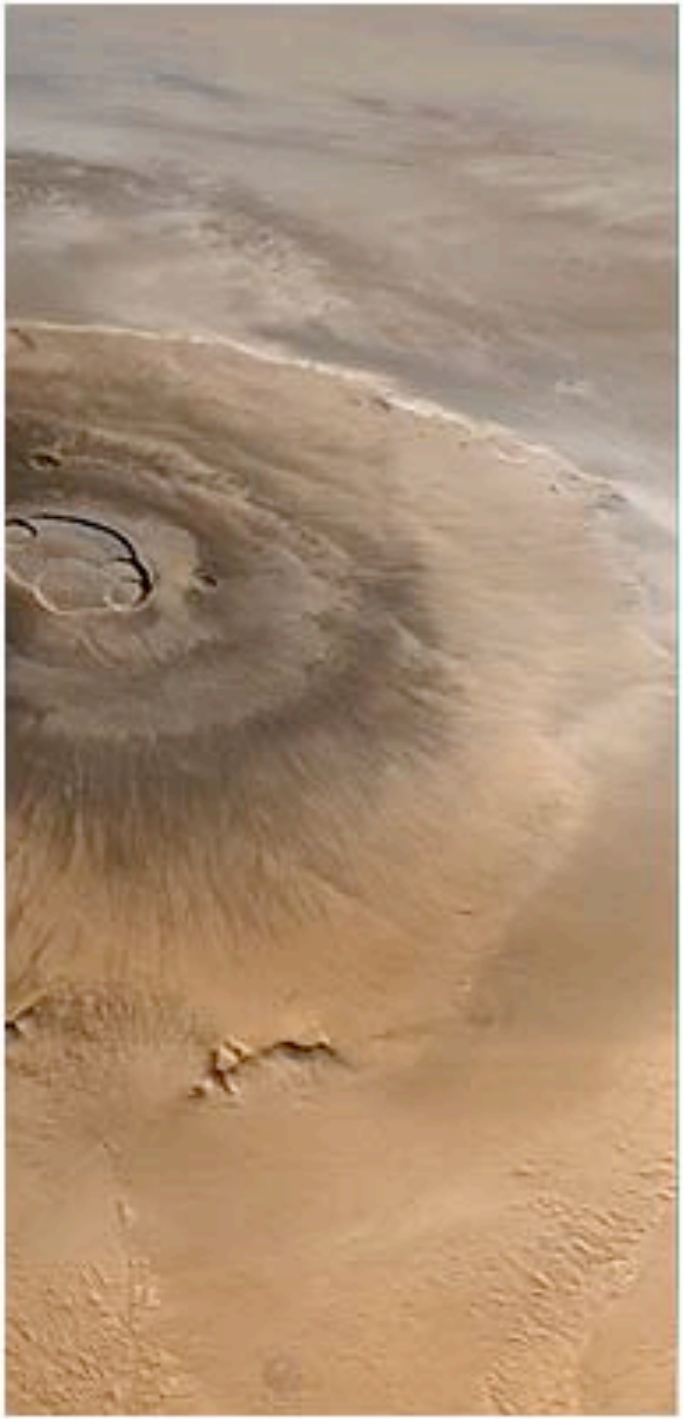
The “flight” goes over Valles Marineris, the Tharsis volcanoes, and Olympus Mons.

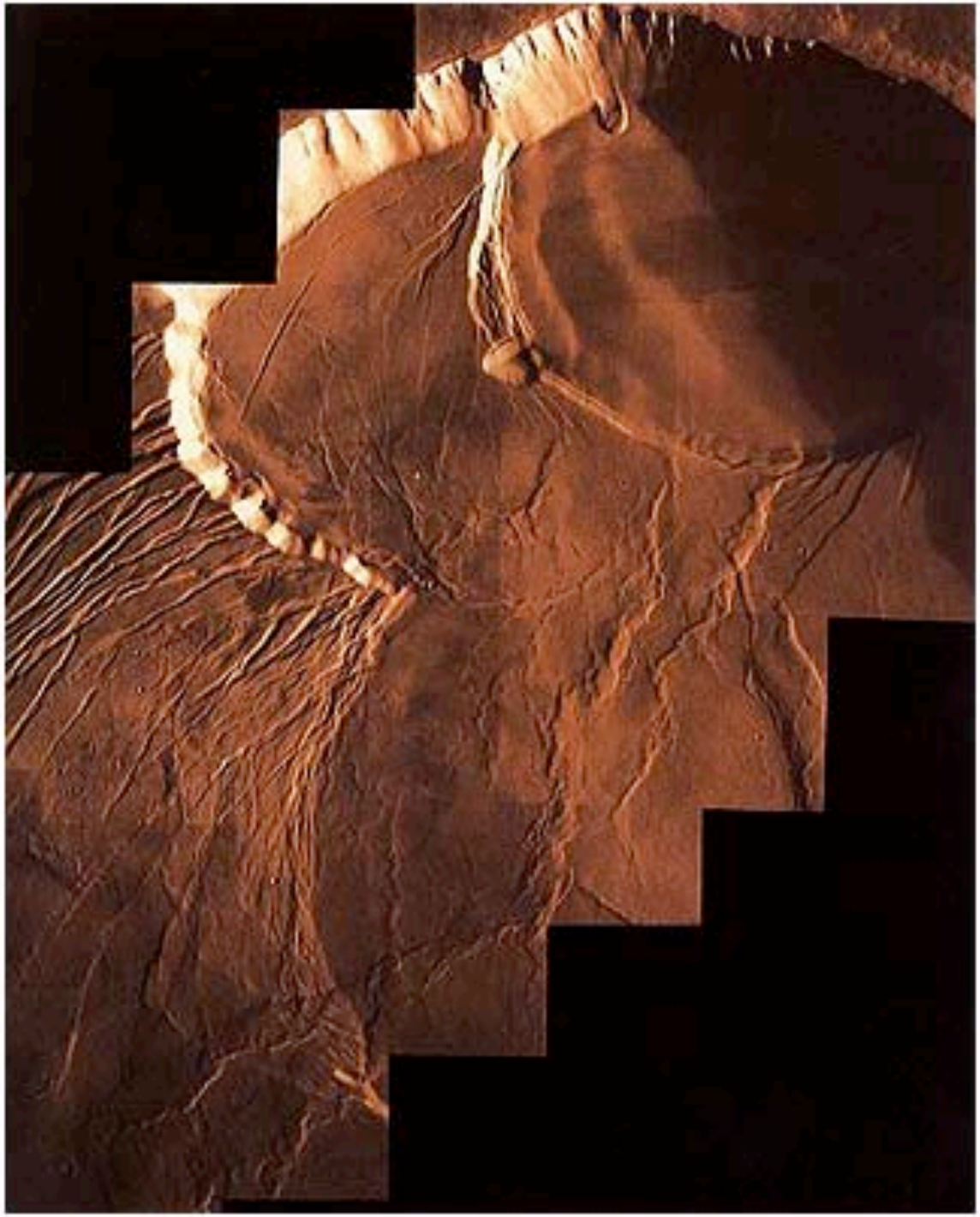
Valles Marineris may have been cut by water, and is 1800 miles long.

Olympus Mons is 15 miles (75,000 ft) high and as wide as Missouri.









Why are Mars' volcanoes so big?

Olympus Mons is about 6 times as high and wide as Mauna Loa. (4 times if you measure Mauna Loa from the sea floor)

The other Tharsis volcanoes are also bigger than any on Earth or Venus.

What is different about Mars that causes its volcanoes to be so big?

Why are Mars' volcanoes so big?

Because the crust is not broken into moving plates, a mantle plume can continue feeding a volcano for a long time. (This must mean that the mantle plumes don't move. I don't know why they don't.)

In contrast, volcanoes over mantle plumes on Earth come in long chains. (The Hawaiian islands are the best-known example.)

An additional reason is that Mars' crust has hardened to a greater depth than Earth's, so it can support a bigger mountain. The Pacific sea-floor is slowly settling around Hawaii. I think settling like this explains the coronae on Venus.

And Mars' smaller gravity wouldn't cause volcanoes to settle as much as on Earth or Venus.

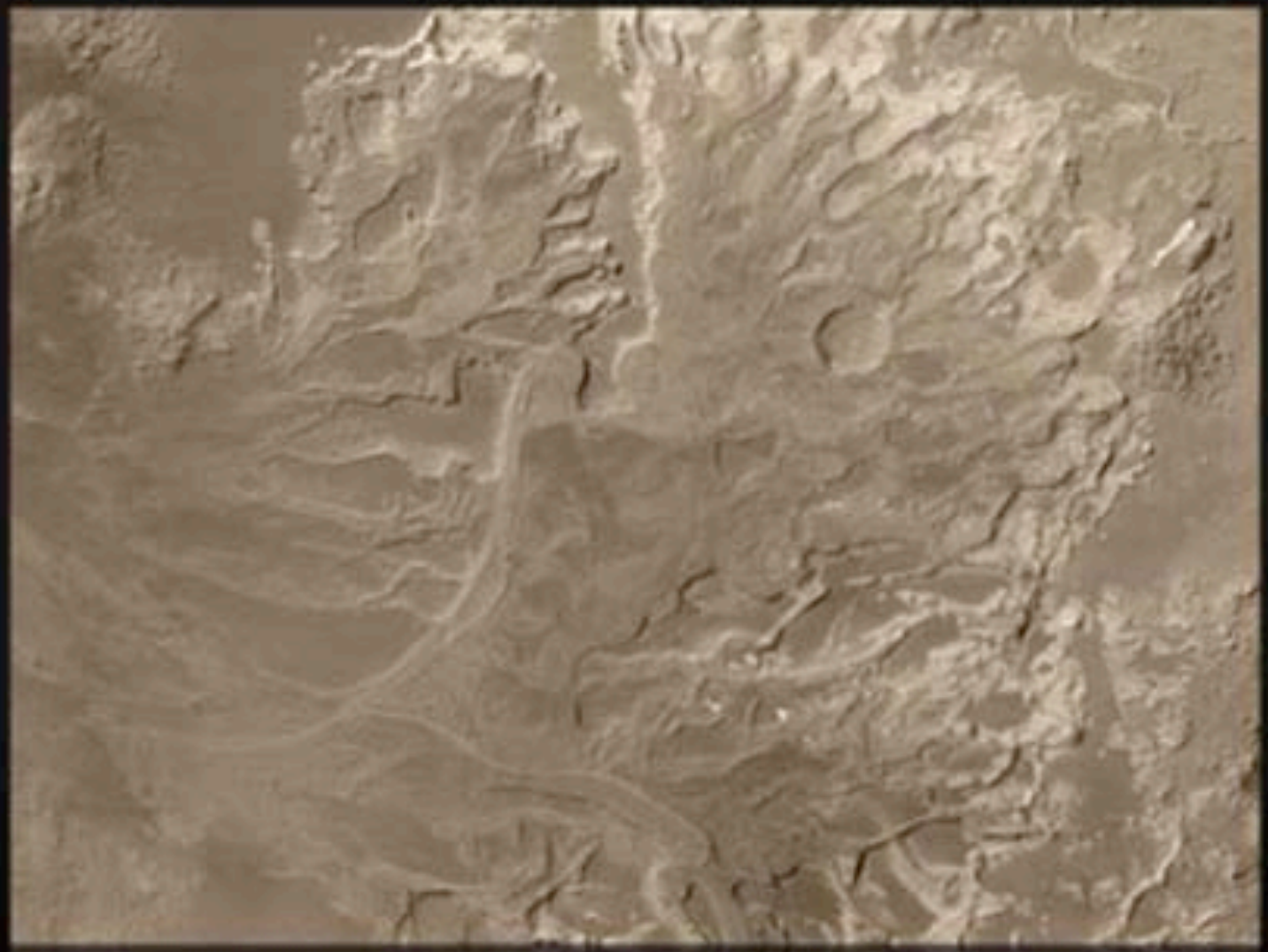
Liquid water on Mars?

It looks like there once was liquid water on Mars.

There are huge canyons (Valles Marineris is the biggest) that look like they were formed by flowing water.

Smaller channels look like they formed in floods, perhaps when ice dams broke.

Recent missions to Mars have found evidence that lakes or oceans once existed on Mars.



Eberswalde Delta

A fan-shaped area of interweaving, curved ridges. These features discovered by Mars Global Surveyor provide the first clear, "smoking gun" evidence that some valleys on Mars experienced persistent flow of a liquid with the physical properties of water over an extended period of time, as do rivers on Earth.

Why is there no liquid water now on Mars?

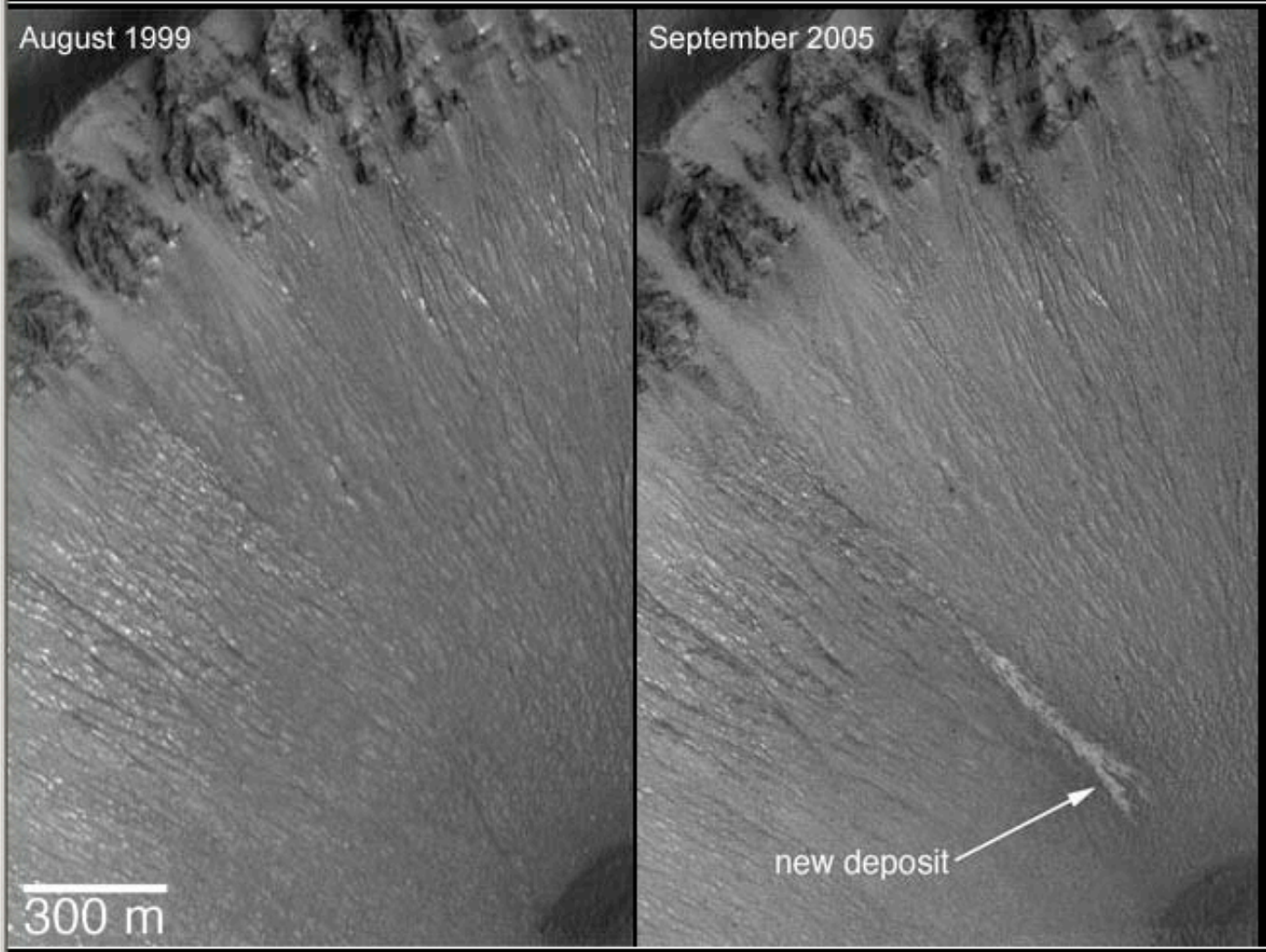
The boiling point of water depends on the pressure.

At sea level it is 212^{o}F. On a high mountain it can be 200^{o}F. At the low pressure of Mars' atmosphere it is below freezing. (The freezing point doesn't depend much on pressure.)

If ice is heated on Mars, instead of turning to liquid water, it evaporates.

Mars 360

Views of the Red Planet



New Gully Deposit

Before-and-after views where a gully flowed in a crater in the Centauri Montes region. The left image shows the crater in 1999 when no light-toned deposit was present. The right image was taken in 2005.

Images of this gully and one more, both taken by Mars Global Surveyor, suggest liquid water carried sediment in the past seven years. Liquid water is considered necessary for life, so the findings heighten intrigue about possible microbial life on Mars.

+ Full image and caption

Jet Propulsion Laboratory
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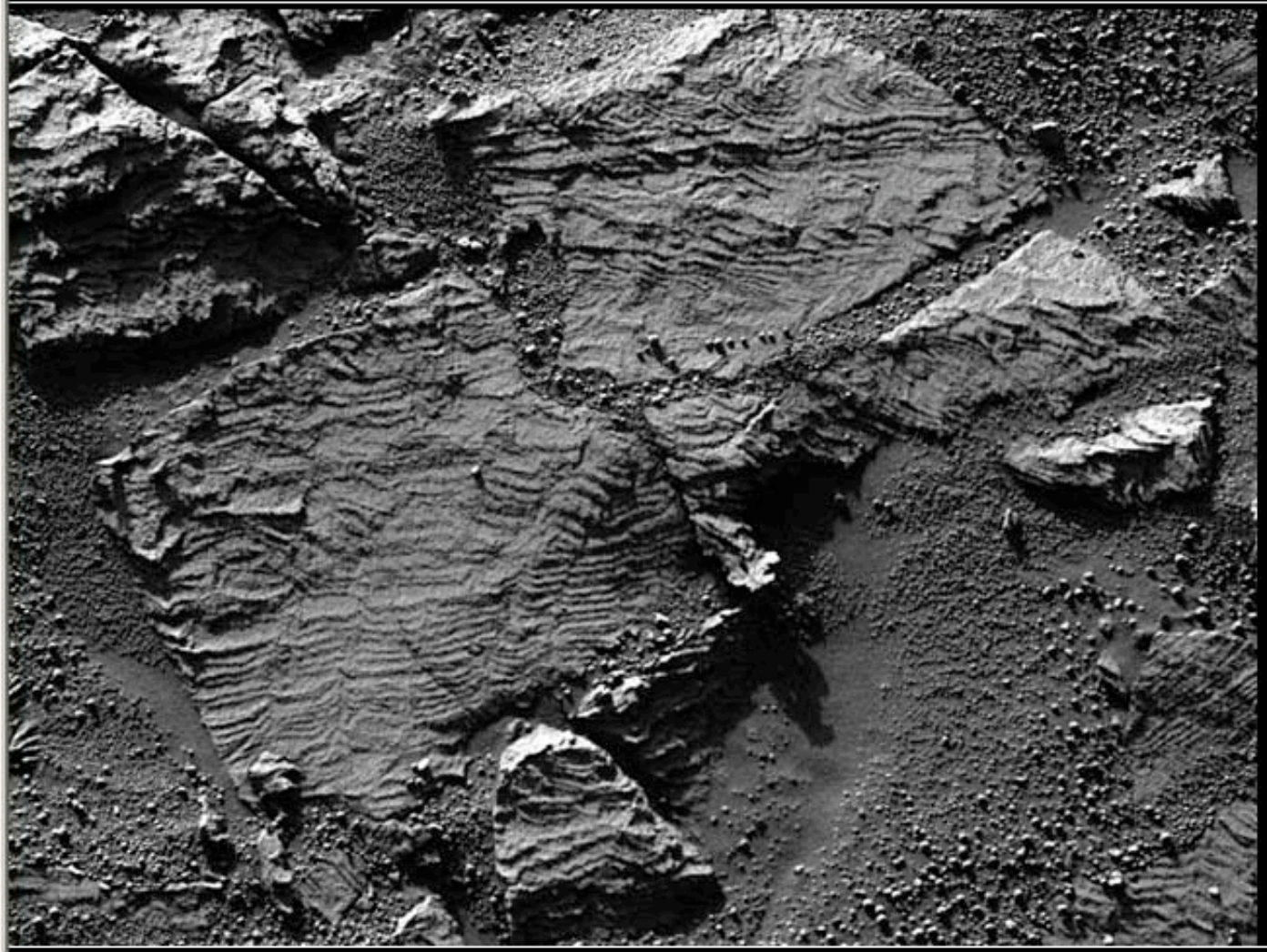
Mars 360

Views of the Red Planet



'Festoon' Pattern

Opportunity imaged distinctive, smile-shaped features called "festoons," seen on the surface of this rock. The detailed geometric patterns -- nested sets of concave-upward layers -- in sedimentary rocks imply the presence of small, sinuous sand ripples that form only in water on Earth.

Essentially, the festoons are the preserved remnants of tiny (centimeter-sized) underwater sand dunes formed long ago by waves in shallow water on the surface of Mars.

+ Full image and caption

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