

This Just In...

The Latest News from Mars

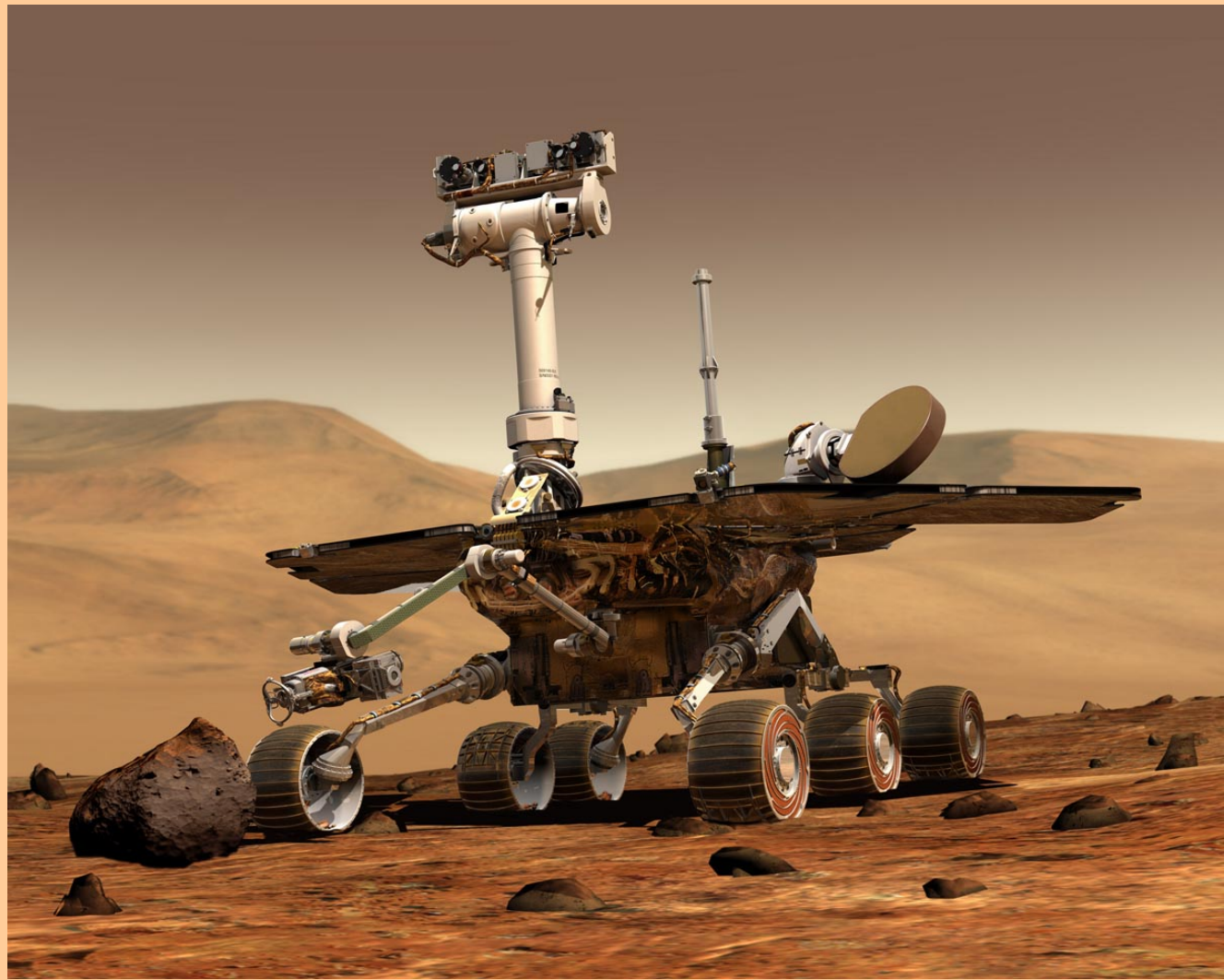
Philip Stooke



Hubble Space Telescope

**Our spacecraft
have been busy,
working at Mars
continuously
since 1997**

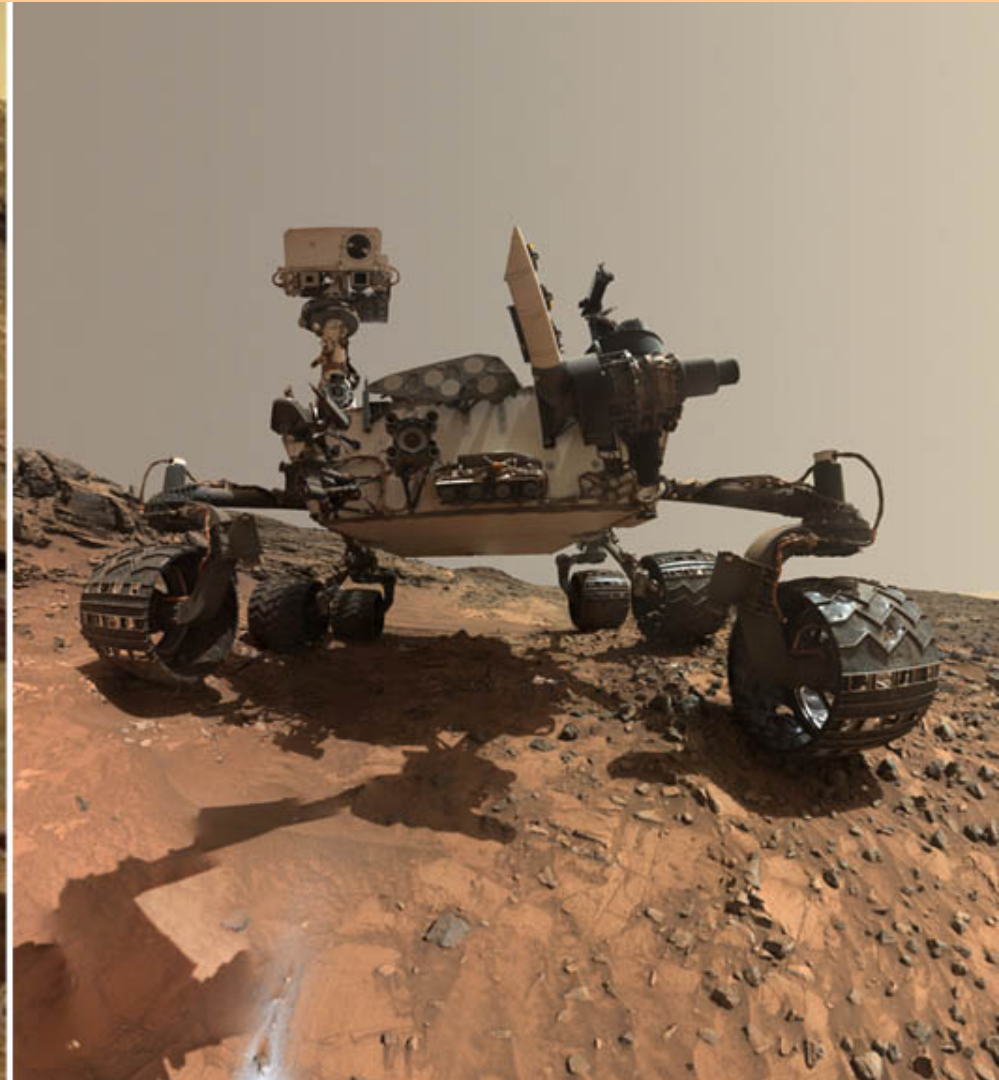
**Five spacecraft
are now operating
In orbit, and two
on the surface,
with more on
the way.**



So what's the latest news from Mars?

Who's working at Mars today?

NASA's rovers Opportunity and Curiosity



NASA's Orbiters:

2001 Mars Odyssey

Mars Reconnaissance Orbiter

MAVEN



ESA's Orbiters:

Mars Express

(Its lander Beagle 2
landed but failed to
operate in 2003)

ExoMars

Trace Gas Orbiter

(its lander Schiaparelli
is due to land on
19 October 2016)

ESA images



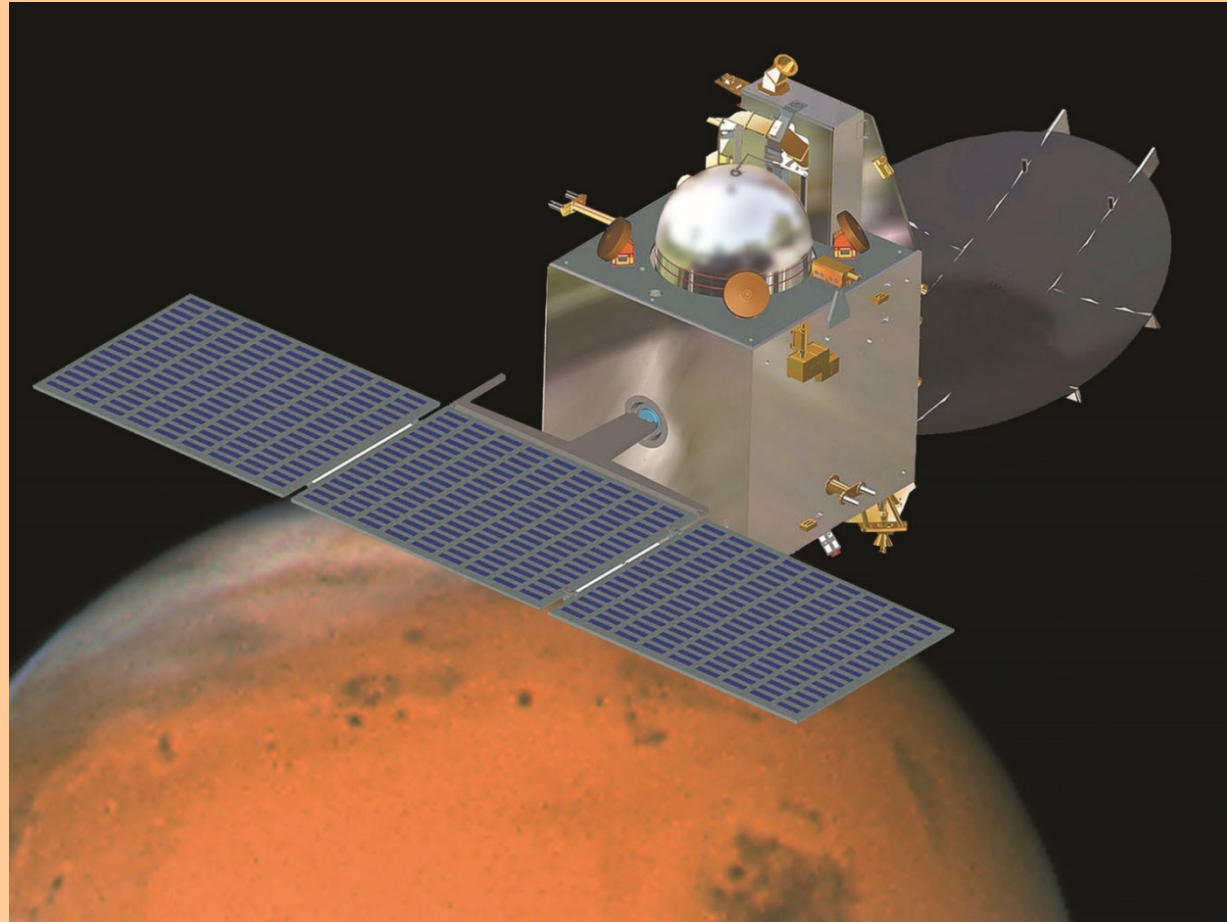
India's Orbiter:

MOM

(Mars Orbiter Mission)

Also called 'Mangalyaan'

ISRO image



Who's going next?

2018:

Insight (lander)

Red Dragon (lander)

2020:

NASA Mars 2020 rover

ESA ExoMars rover

Red Dragon (1 or 2)

Chinese orbiter and rover

UAE orbiter 'Hope'

(Mars is a busy place)

مسبار الأمل

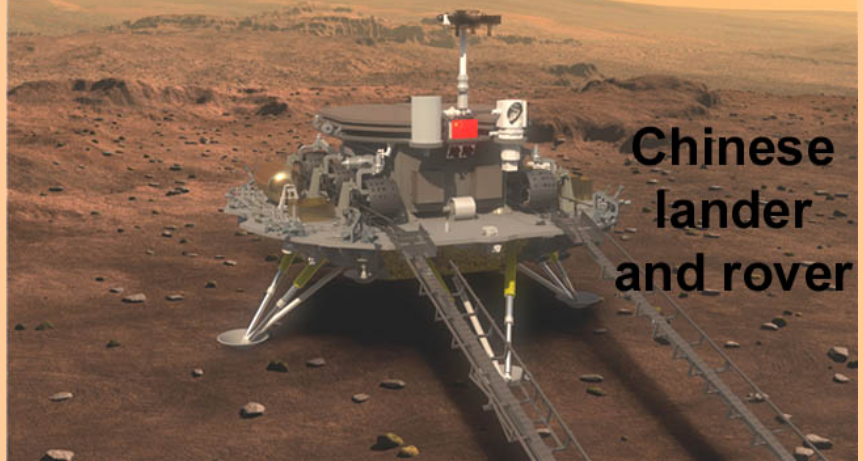
Hope



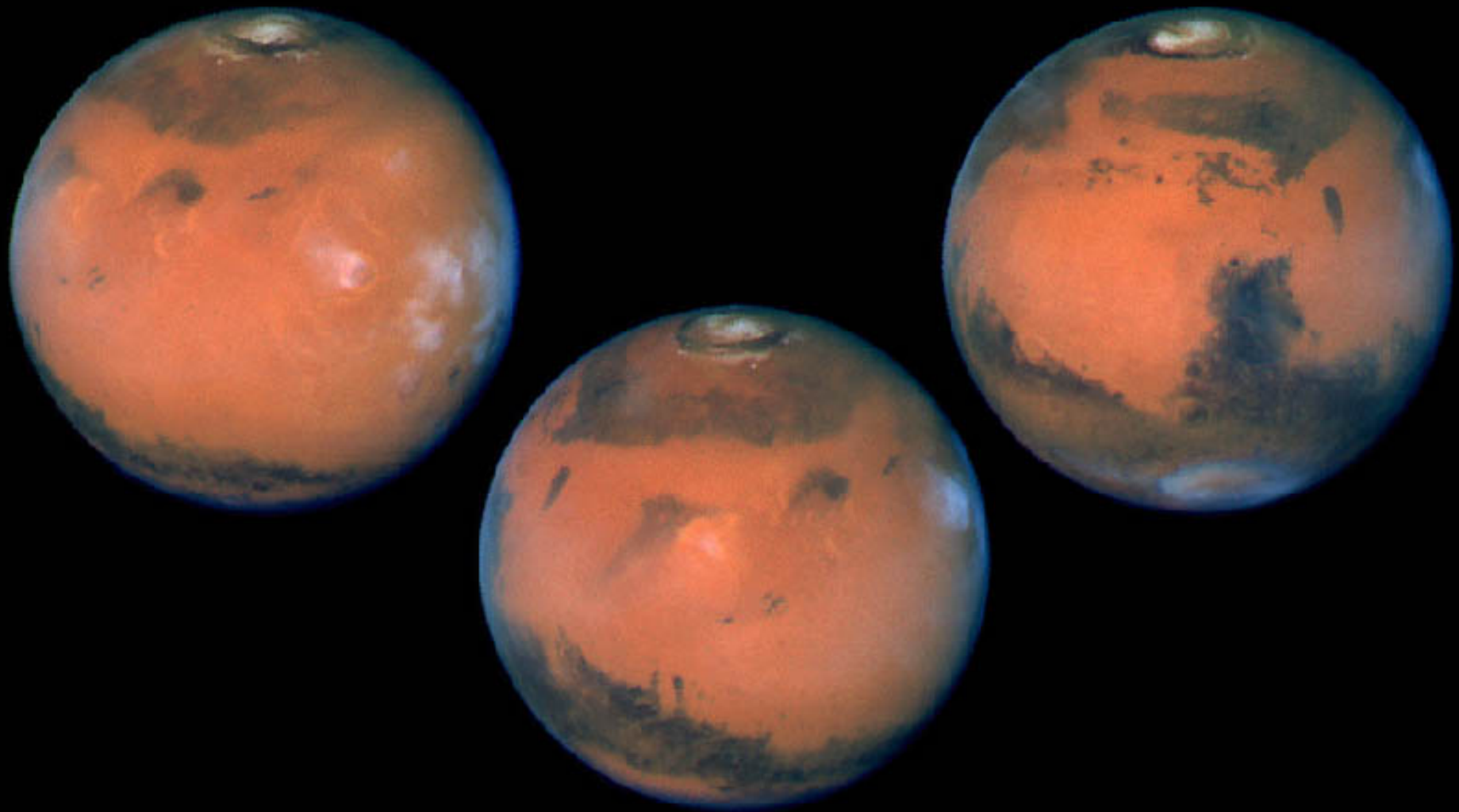
Red Dragon
(SpaceX)



Chinese
lander
and rover



Hubble images



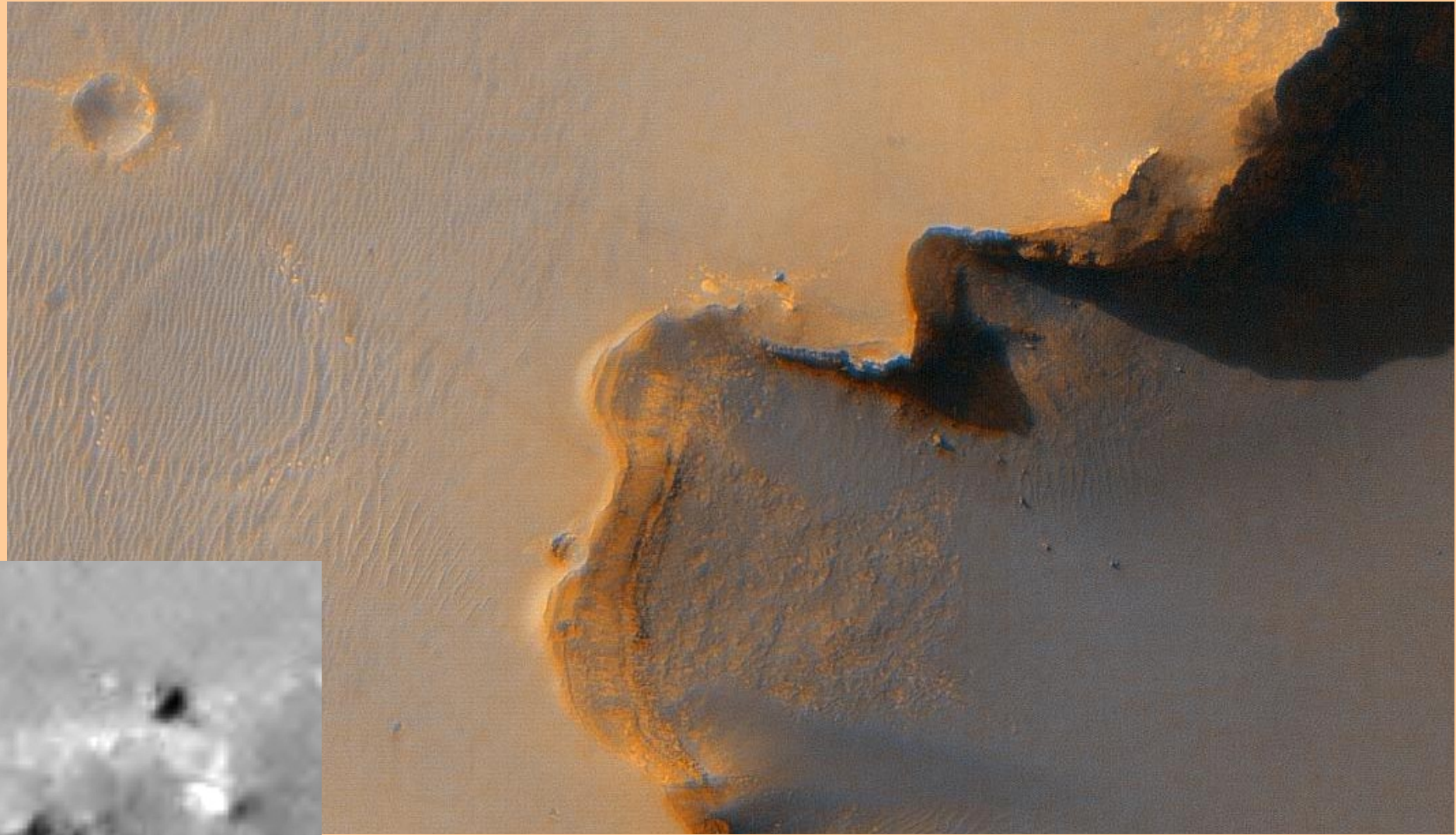
Mars at Opposition • March 10, 1997

HST • WFPC2

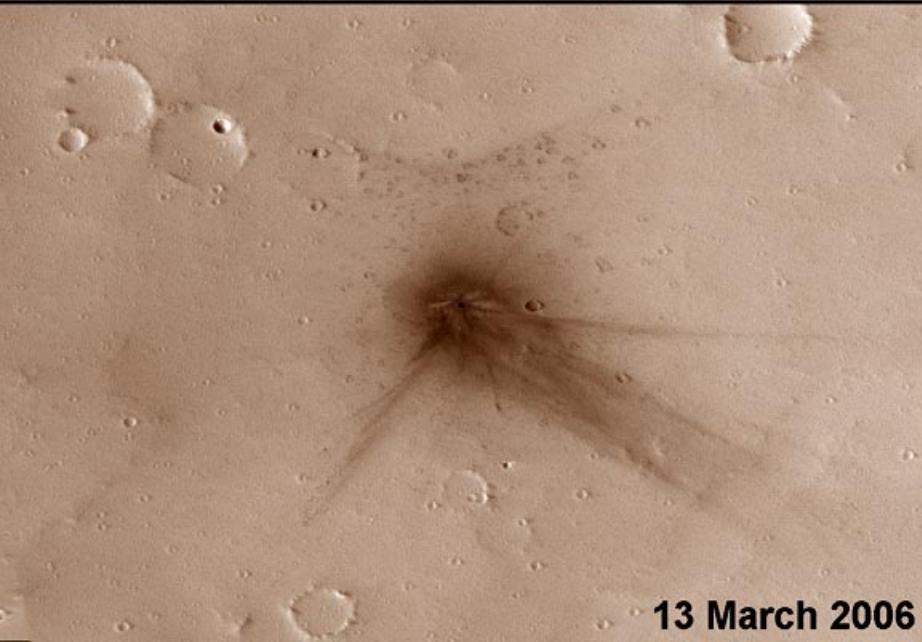
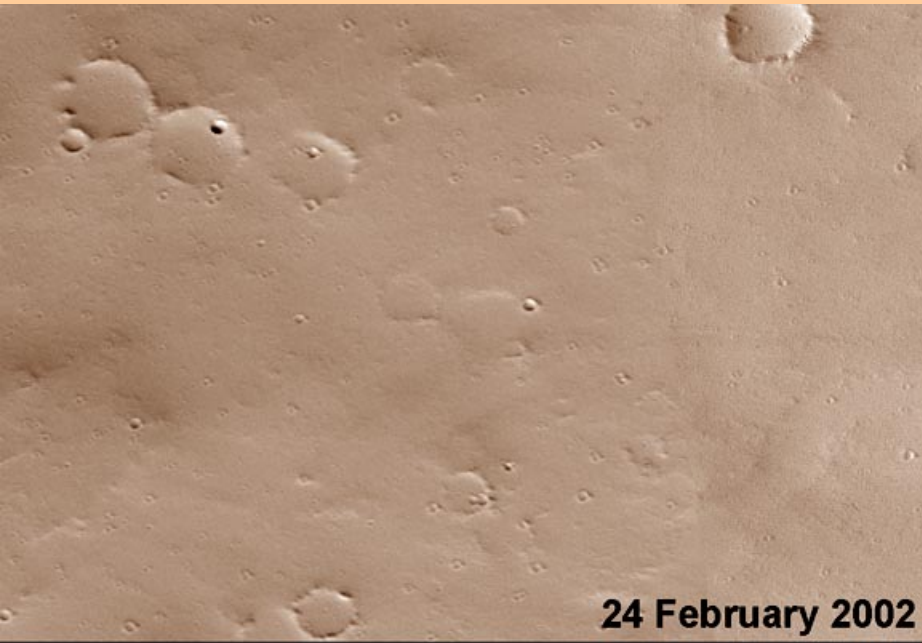
PRC97-09b • ST Scl OPO • March 24, 1997 • D. Crisp (JPL), the WFPC2 Science Team and NASA

Mars from Orbit

Mars Reconnaissance Orbiter has the highest resolution camera ever used at Mars. It can see things only 25 cm (10 inches) across.



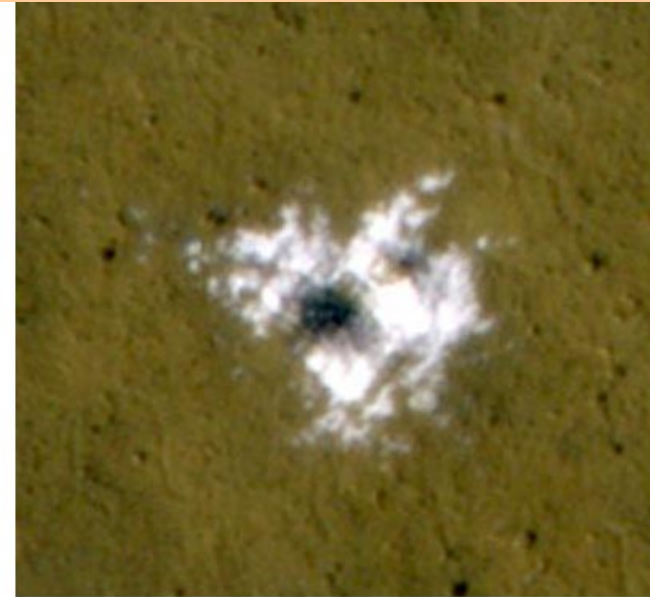
New craters – before and after pictures show them form



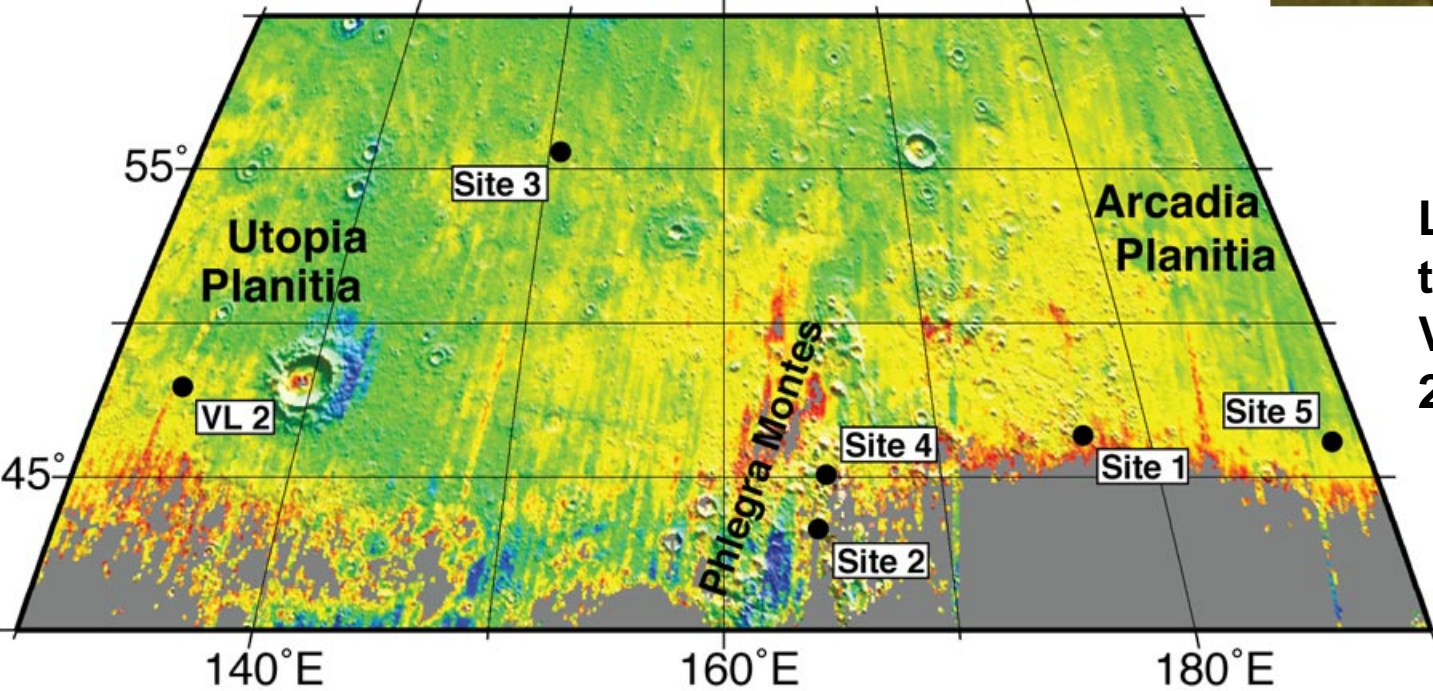
New craters uncover subsurface ice

Oct. 18, 2008

Jan. 14, 2009

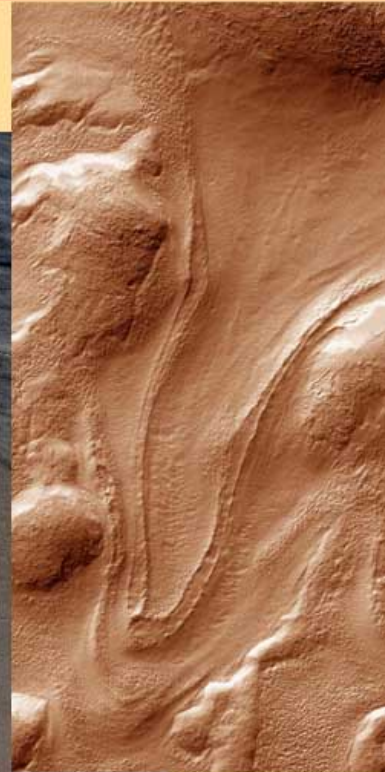


Ice Depth



Locations of ice in these small craters. VL2 is the old Viking 2 landing site

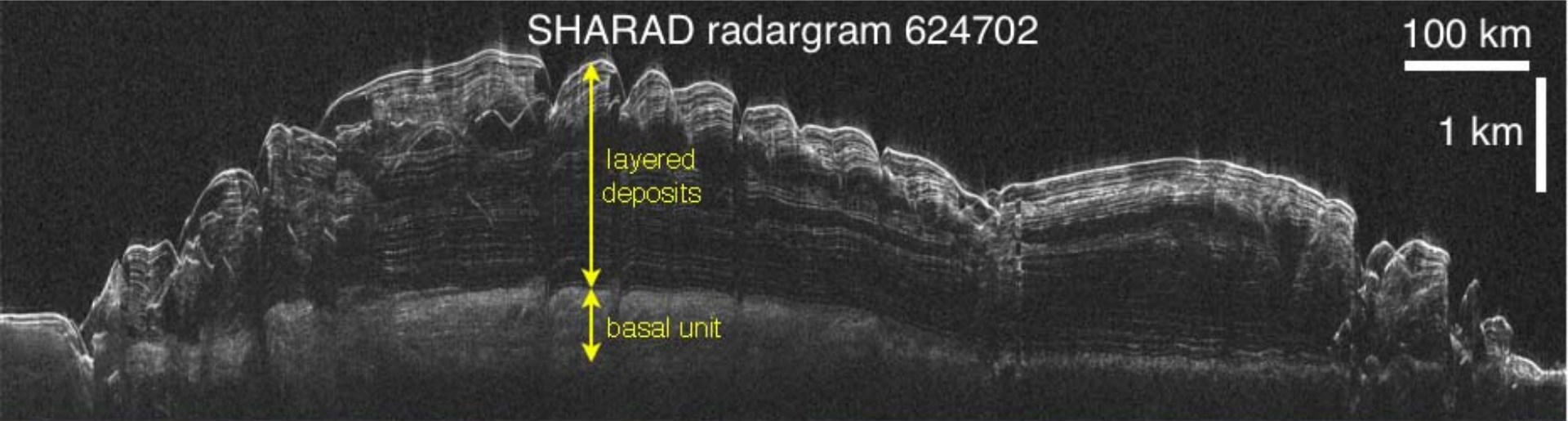
glaciers



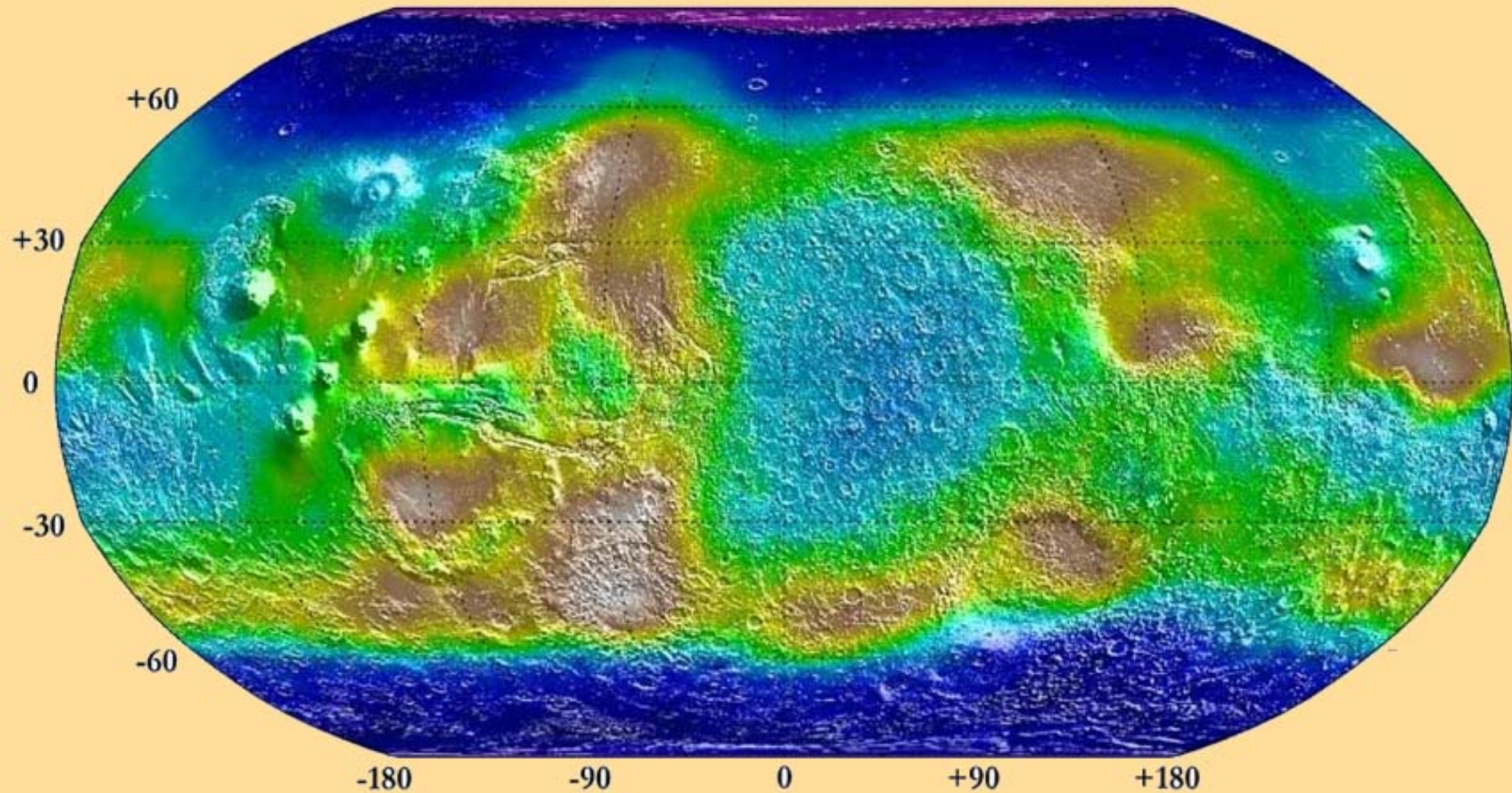
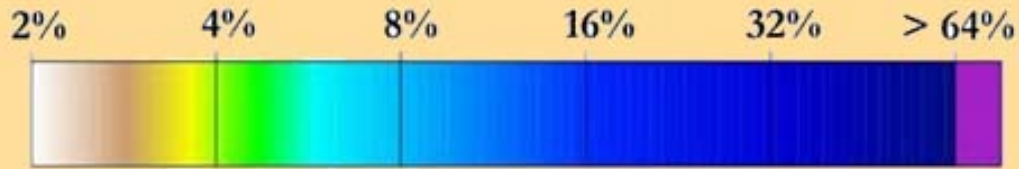
Gullies – flowing water?



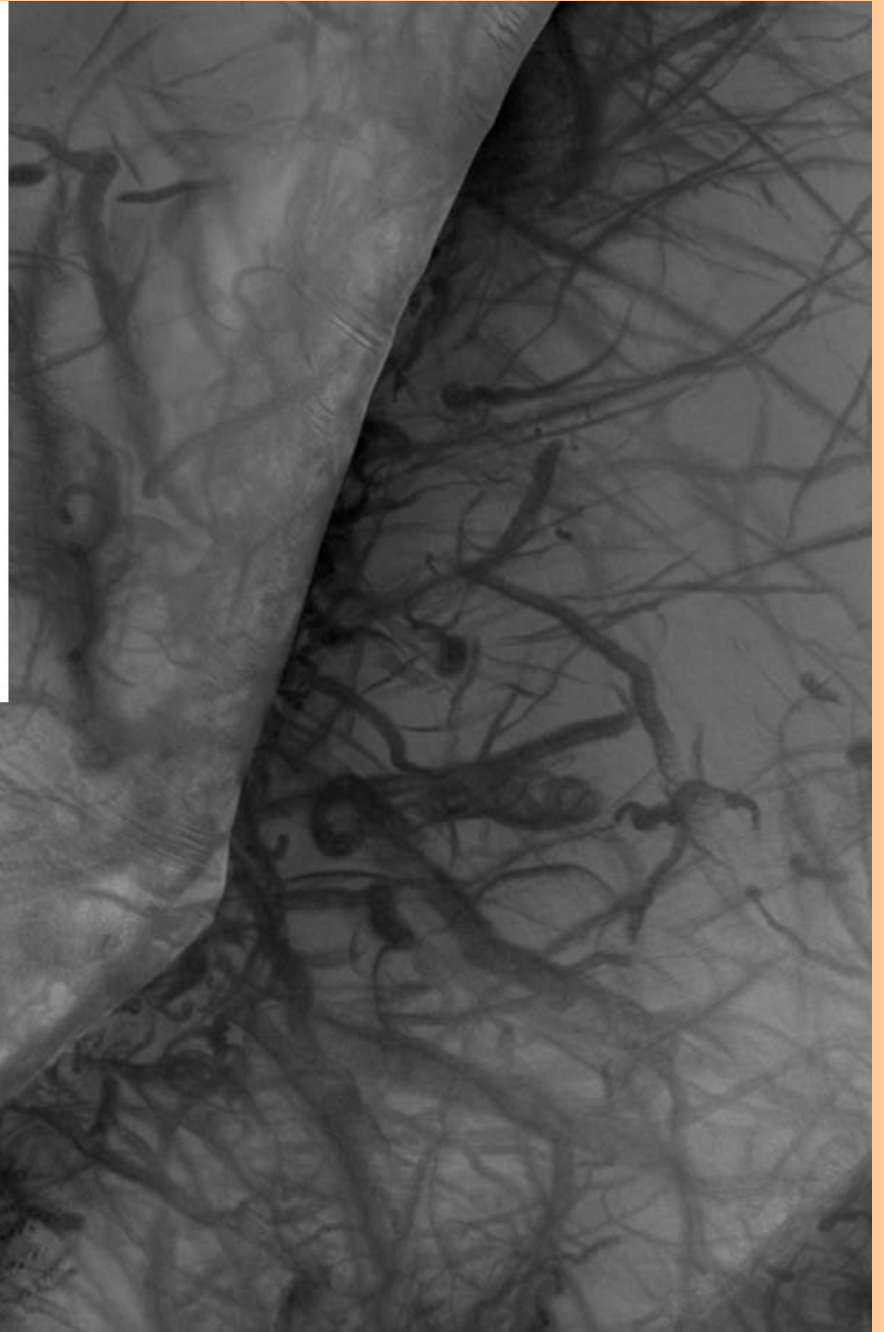
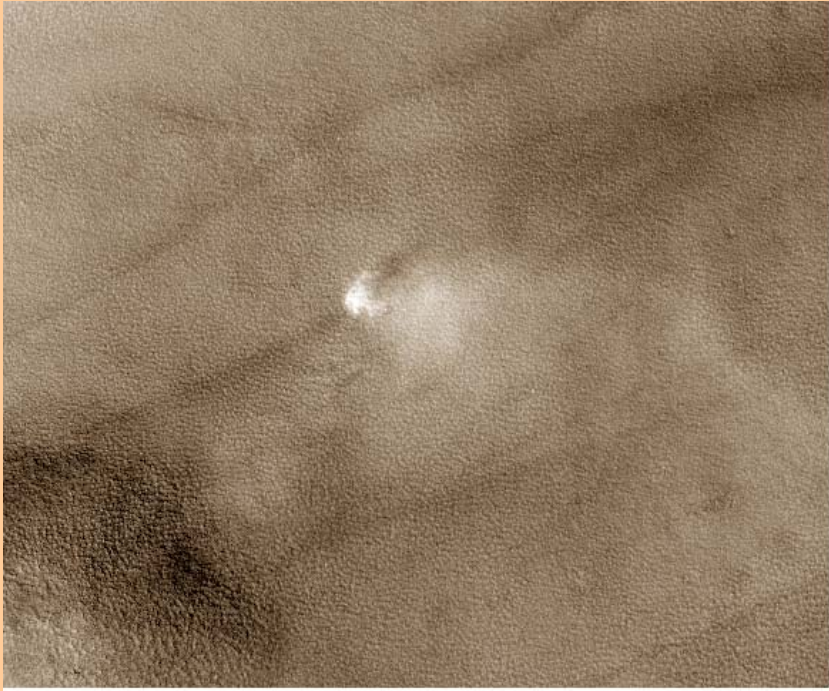
Radar sounding of polar ice layers



Odyssey - water mapped from orbit



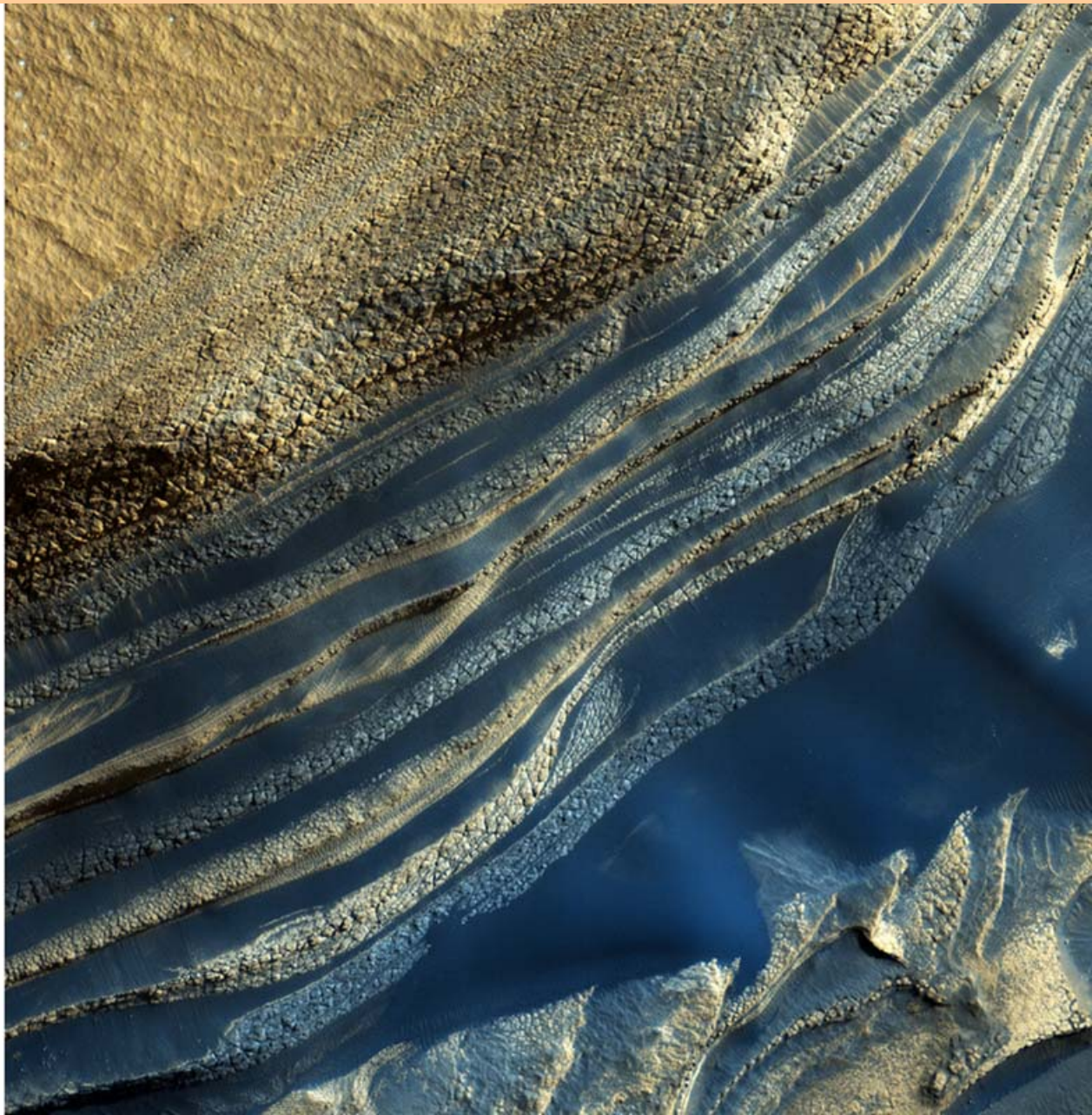
Dust devil tracks



Polar landslides - caught in the act



Polar ice, layered sediments



Phobos – a small moon of Mars, only 20 miles across

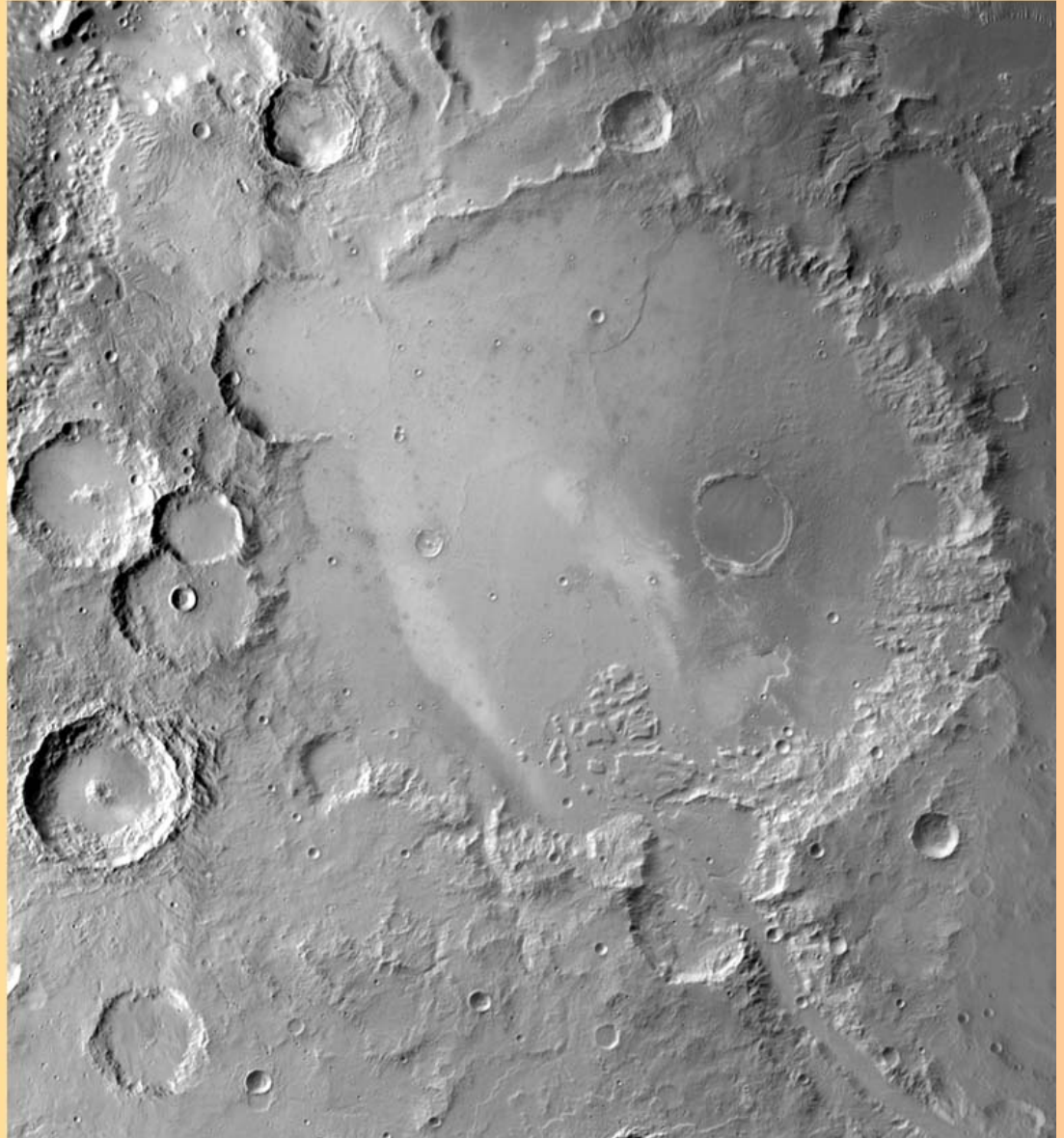


Deimos – 12 miles across and very smooth

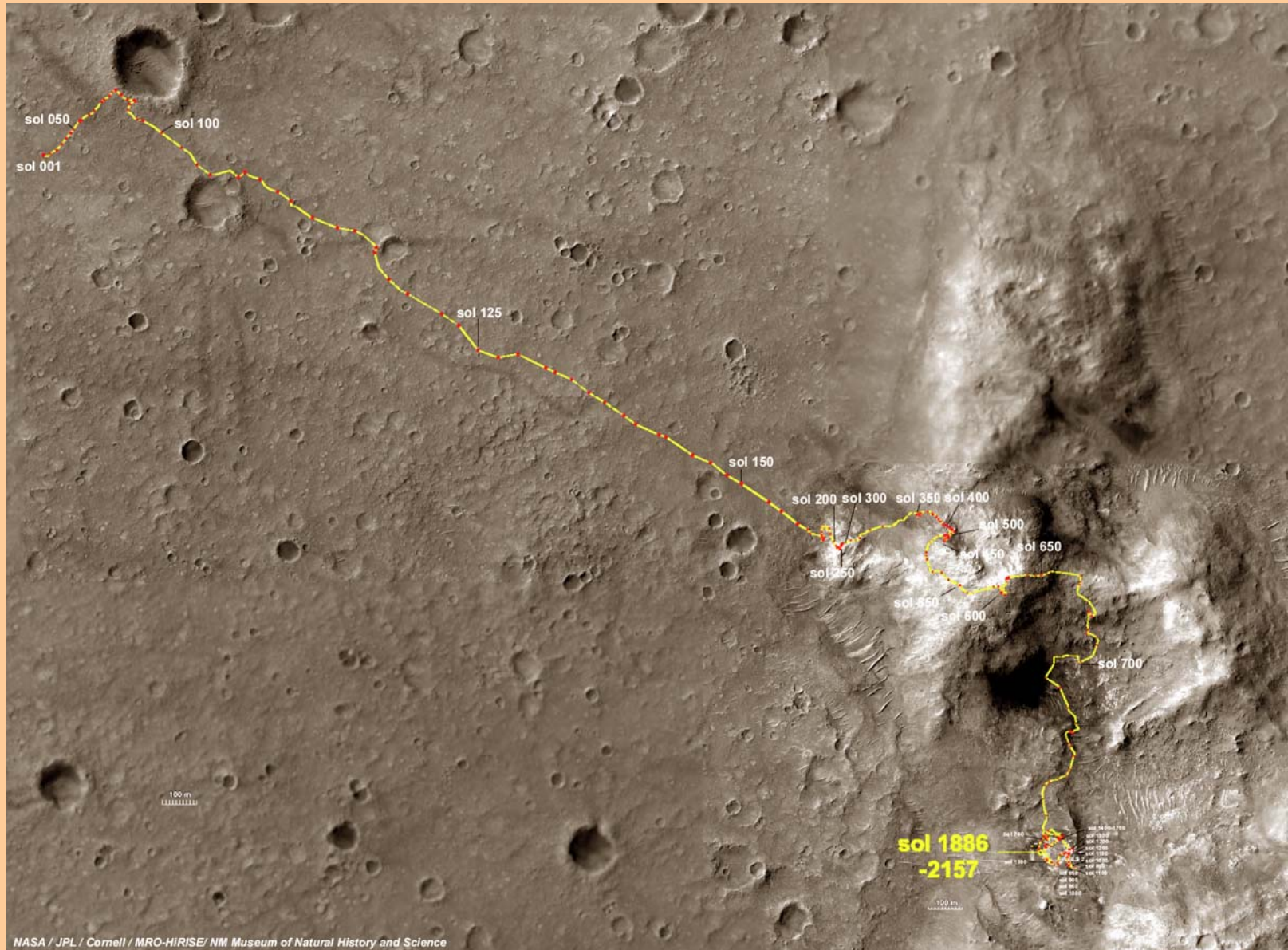
The moons of Mars may be a target for human exploration before Mars itself



Spirit rover landing site - Gusev crater, a dry lake bed?



Spirit looks for lake sediments – but finds only lava flows in the plains.



Bonneville crater, Columbia Hills

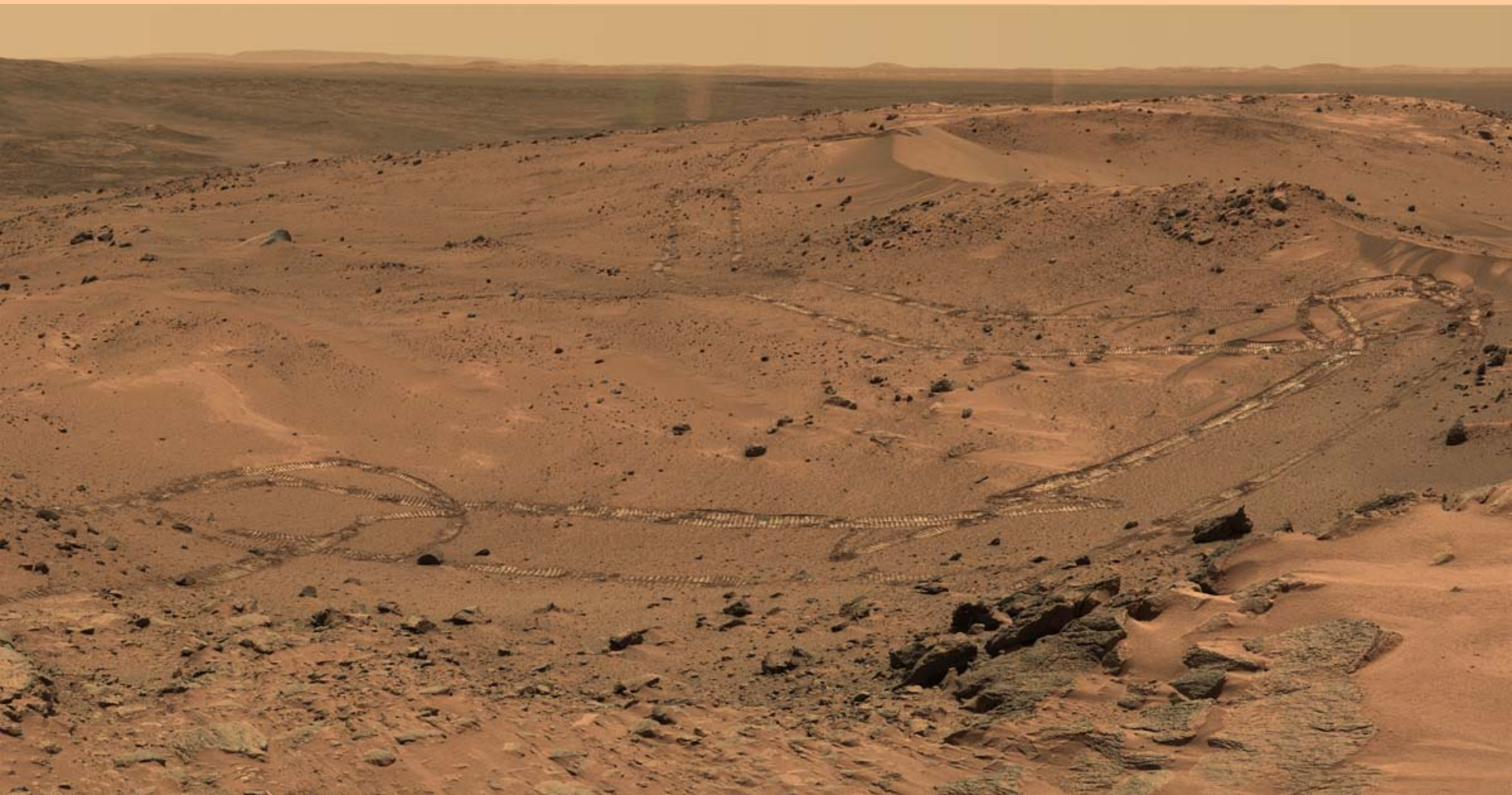
Did the crater dig up buried sediments? Are the hills old rocks rising up through the plains?



Hilltop view

Some of the rocks in the hills show signs of water in their minerals

(see the dust devils out on the plain)

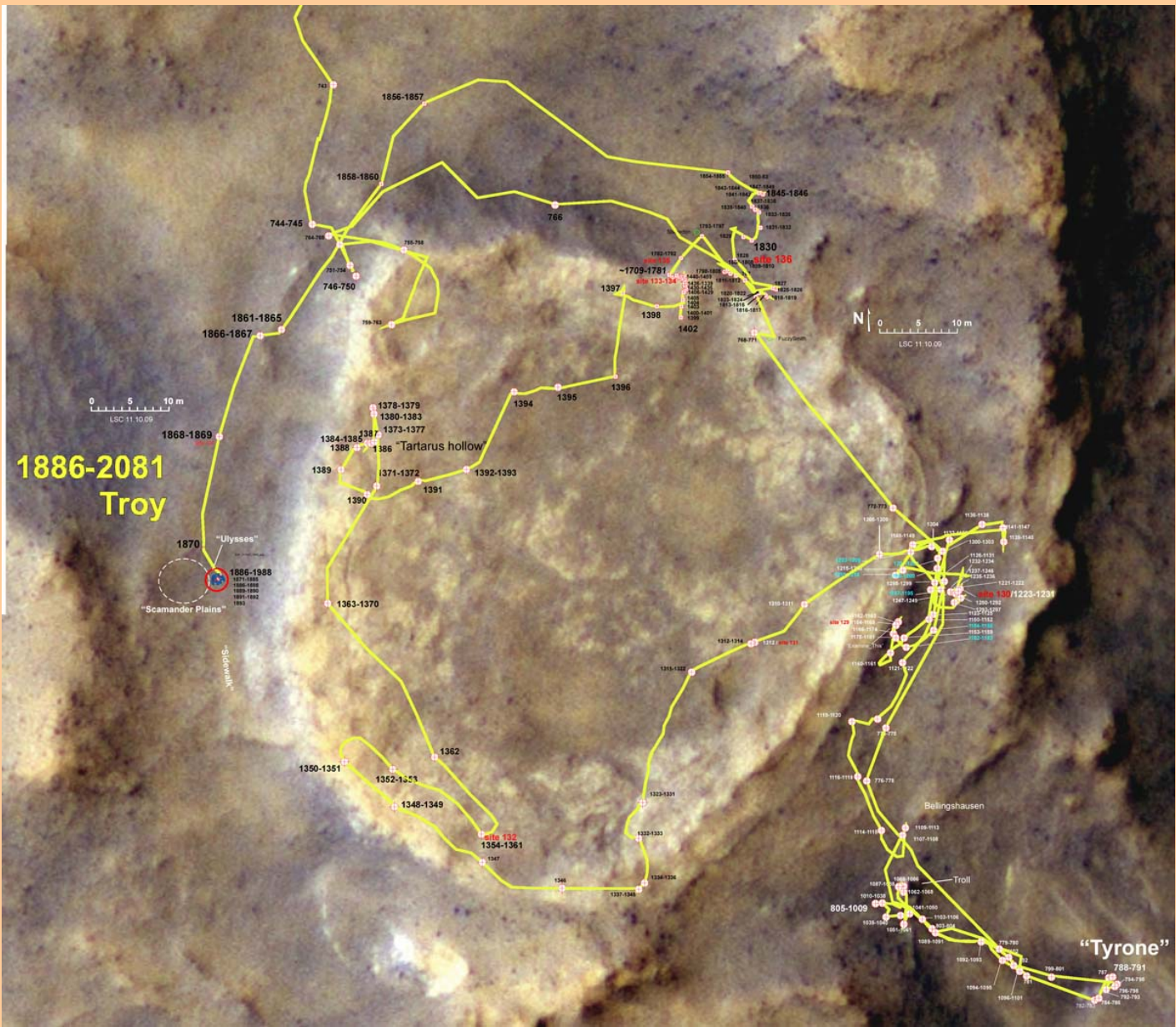


Dust devils - movie

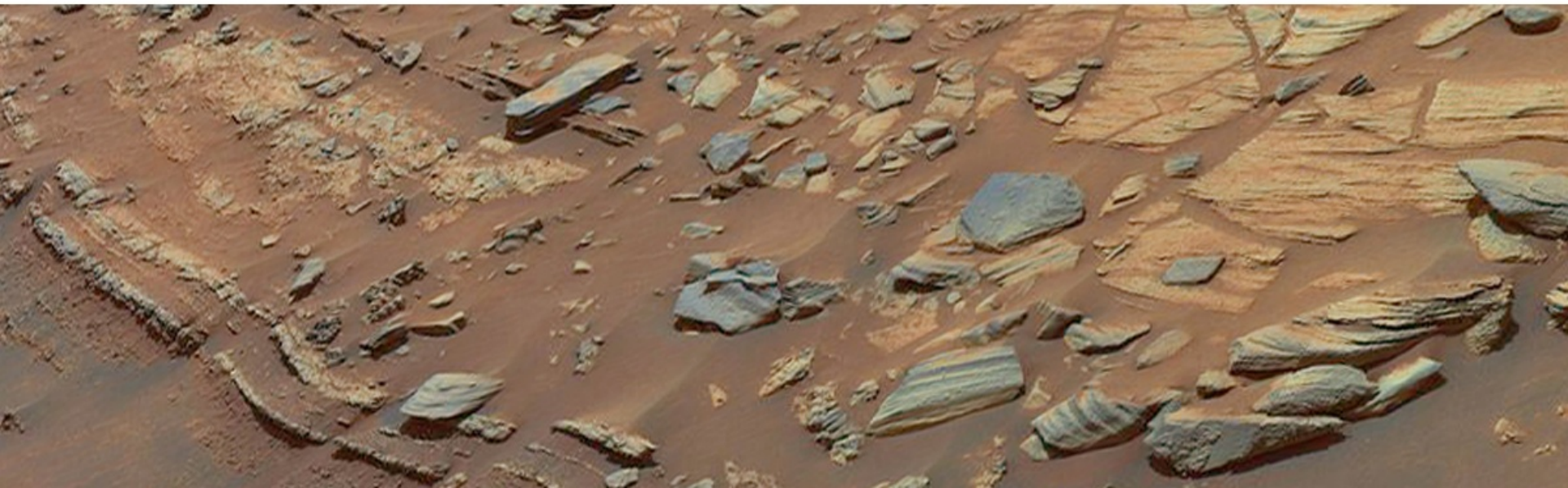
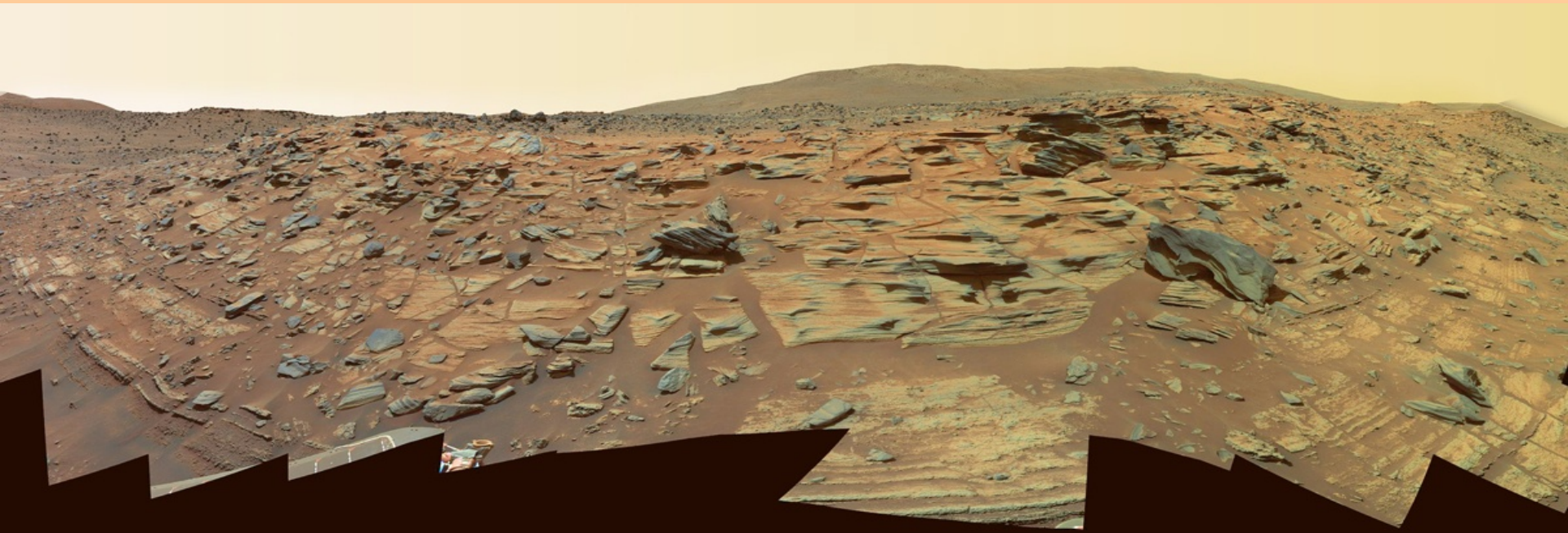


Home Plate – a small volcanic vent

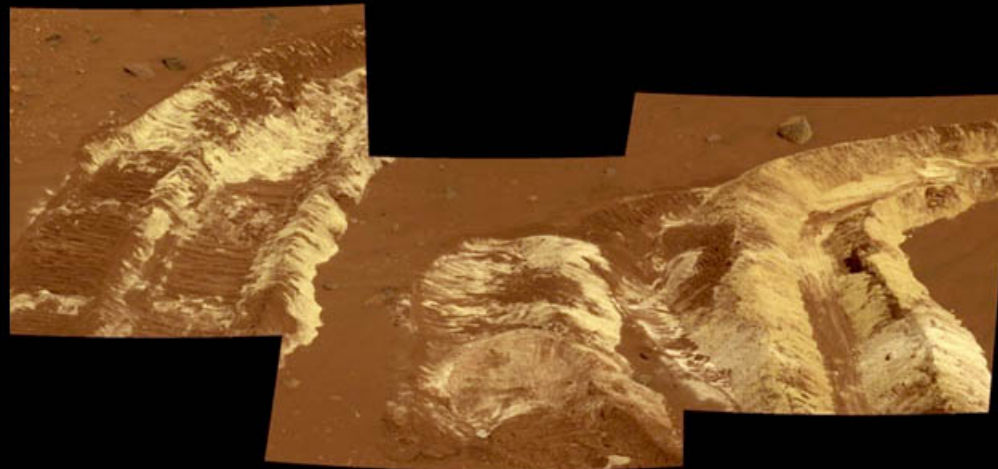
End of the road for Spirit



Layers of volcanic ash, once soaked with water



Salty soil – minerals deposited by water

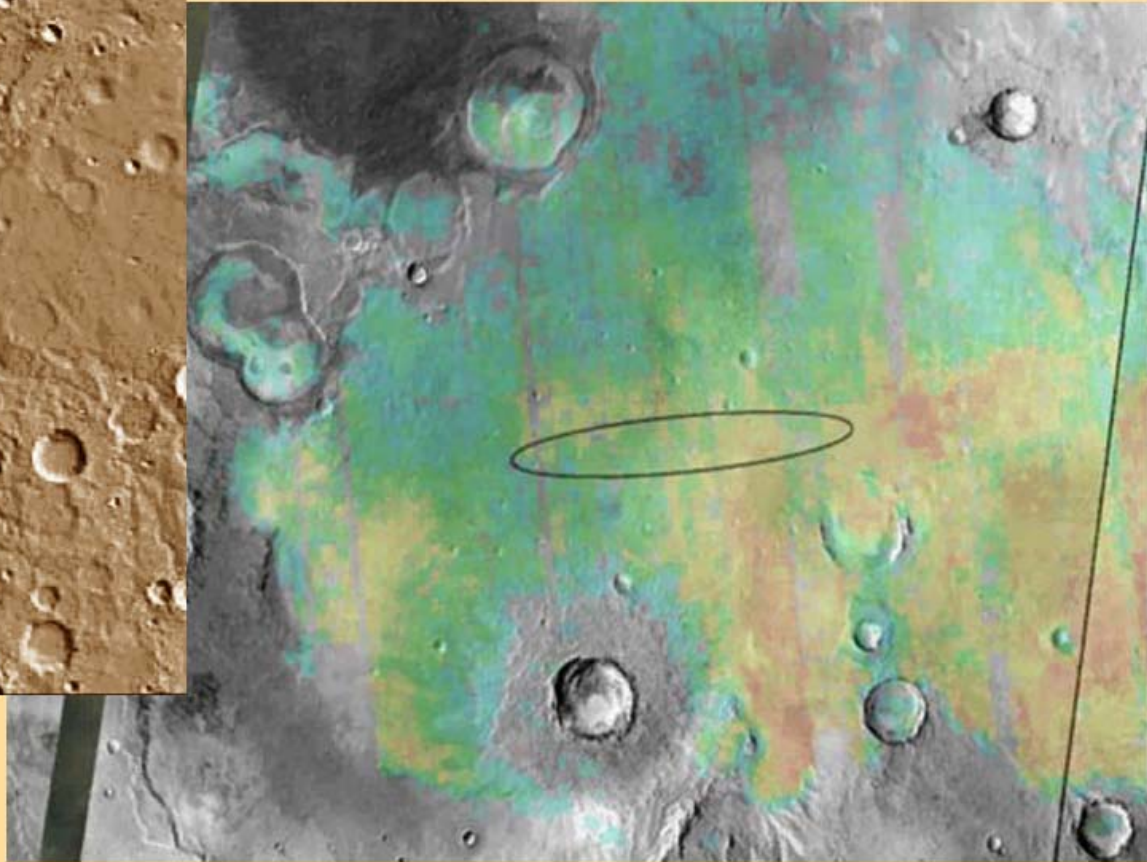
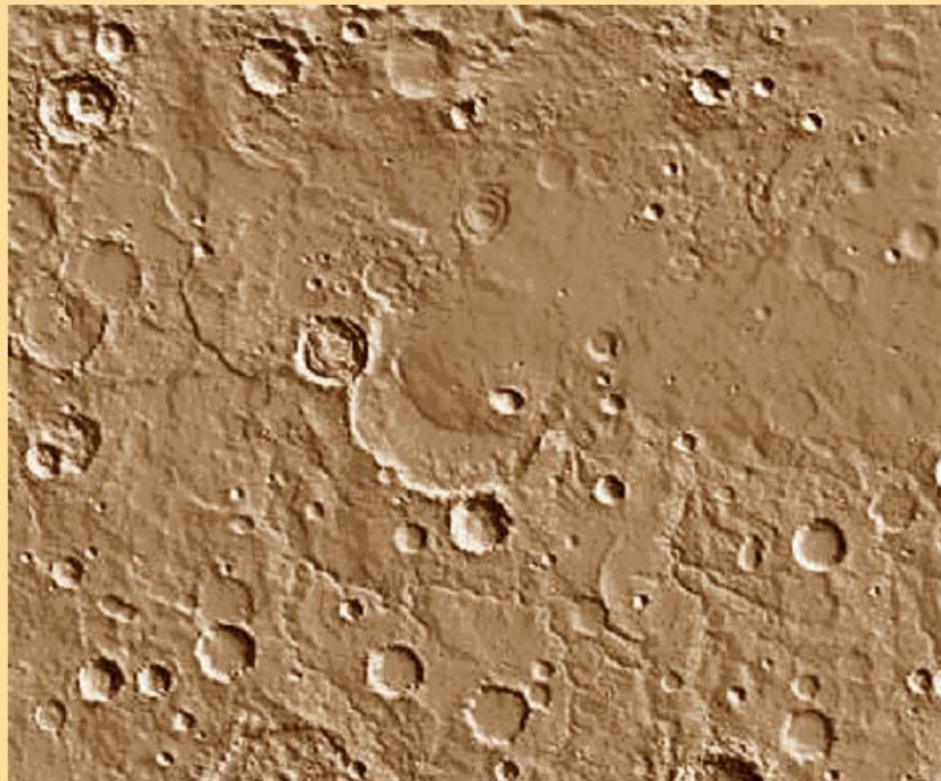


After Home Plate – Spirit was to drive to von Braun,
But it got stuck in sand, and stopped working in 2010.
No lake bed sediments, but signs of water in minerals and soil

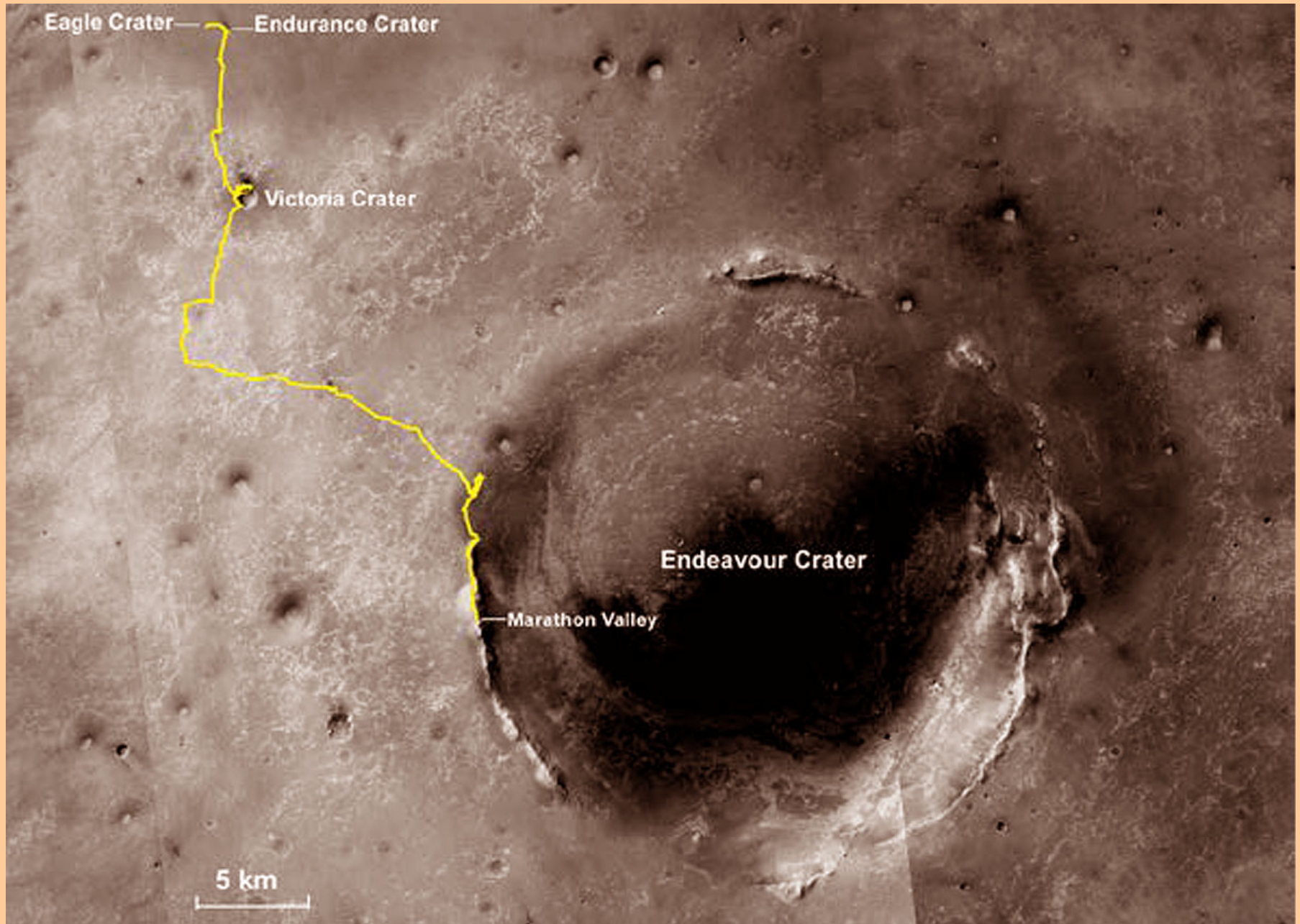


Opportunity landing site

Meridiani – smooth plains rich in hematite (iron oxide) – suggesting water in the past

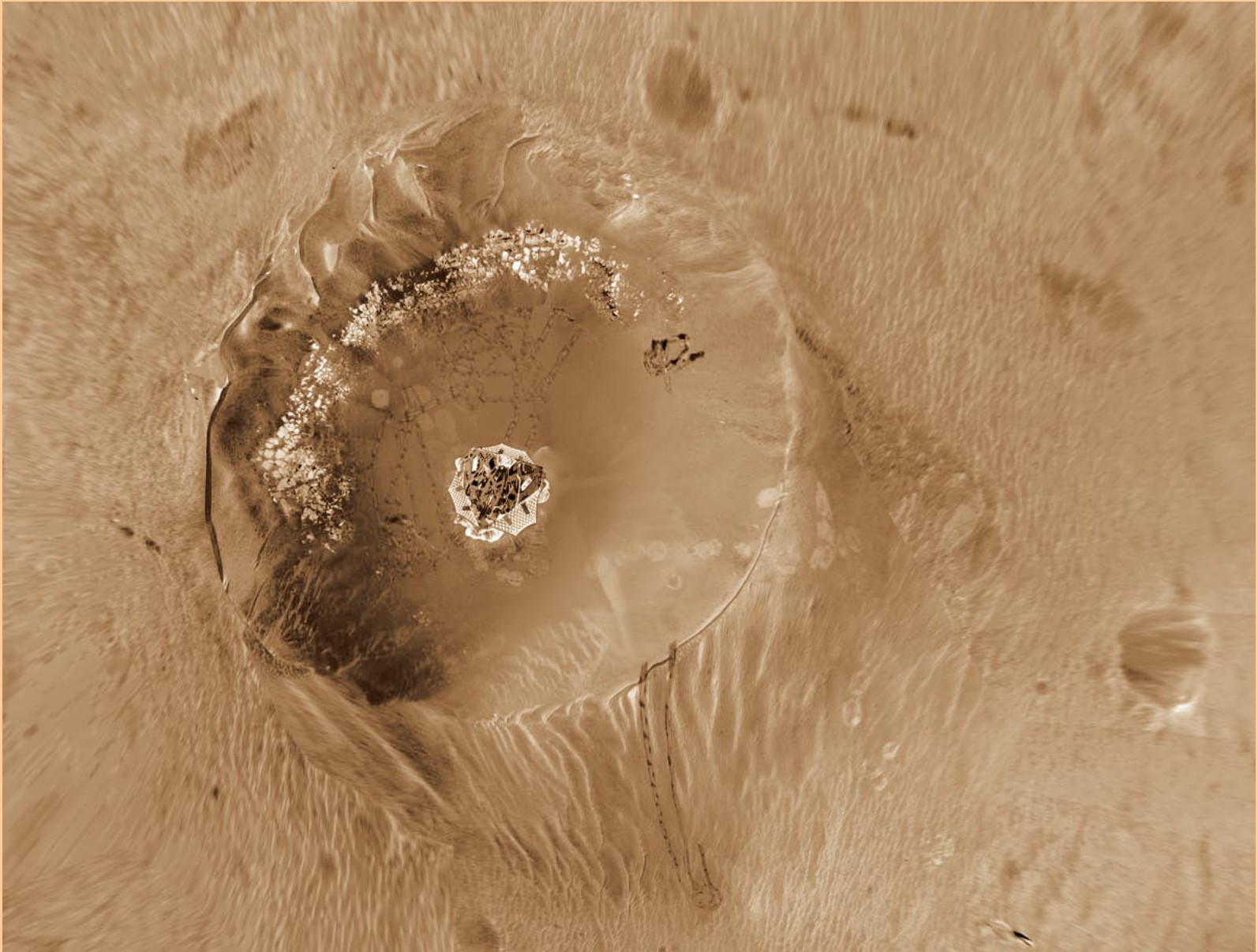


Opportunity route map



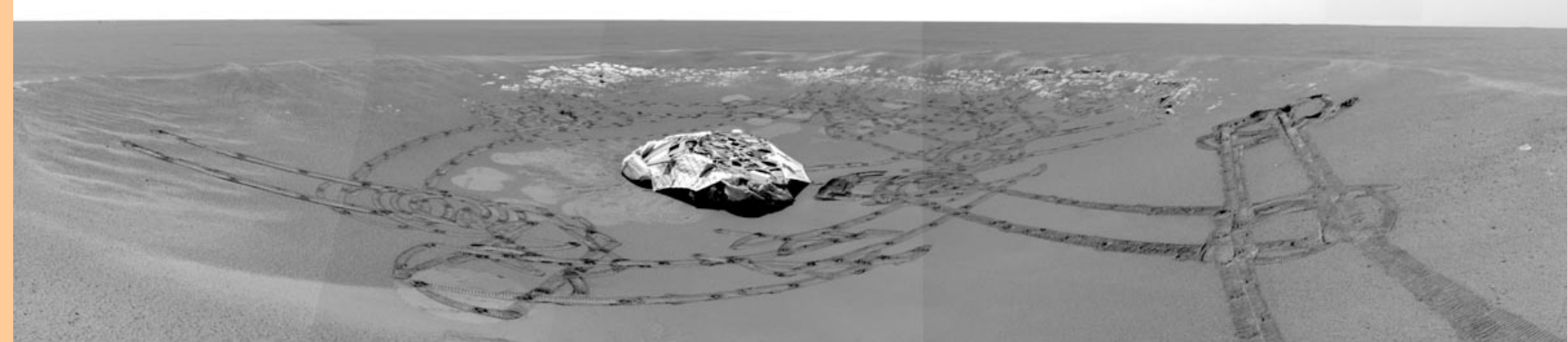
Opportunity in Eagle crater

– the lander came to rest in front of a rocky outcrop



Exploring Eagle crater

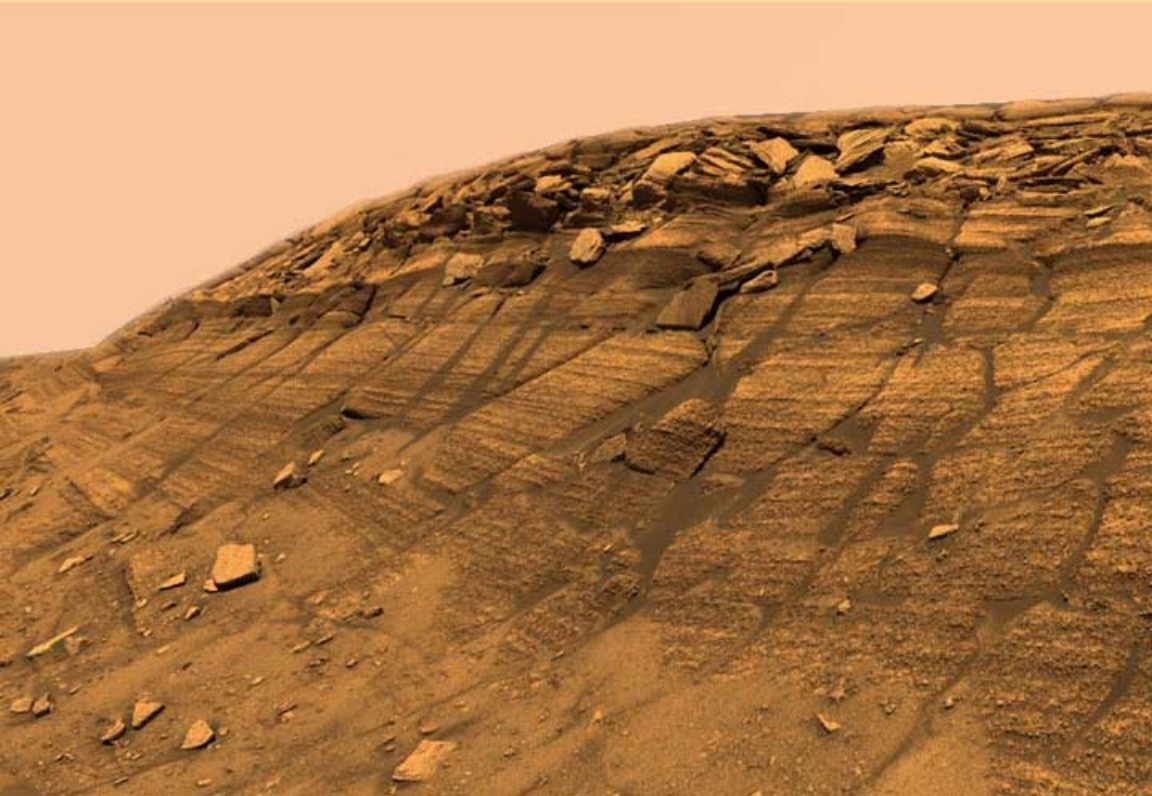
Eroding rocks contain 'blueberries' – pea-sized balls of hematite deposited as wet sandy soil dried out



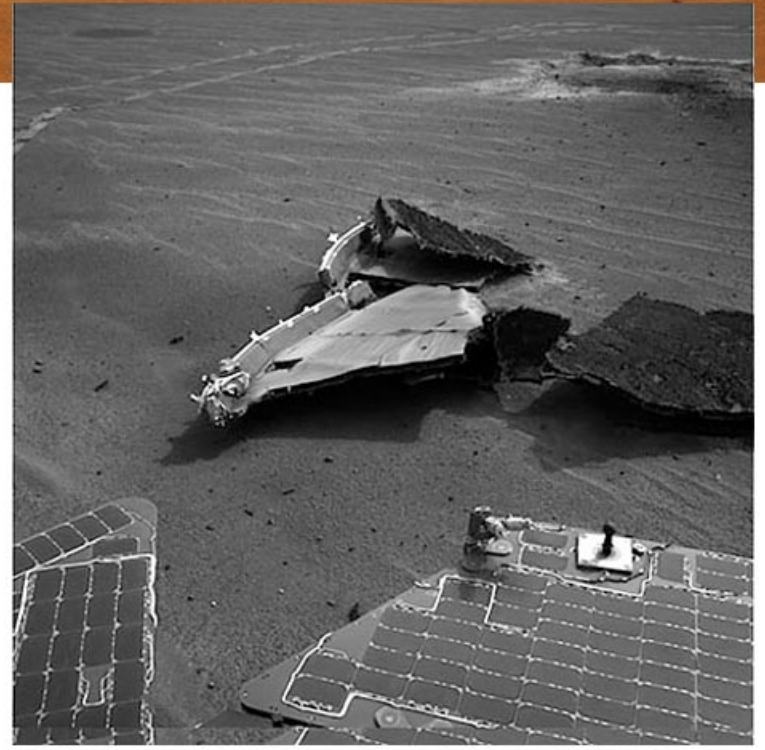
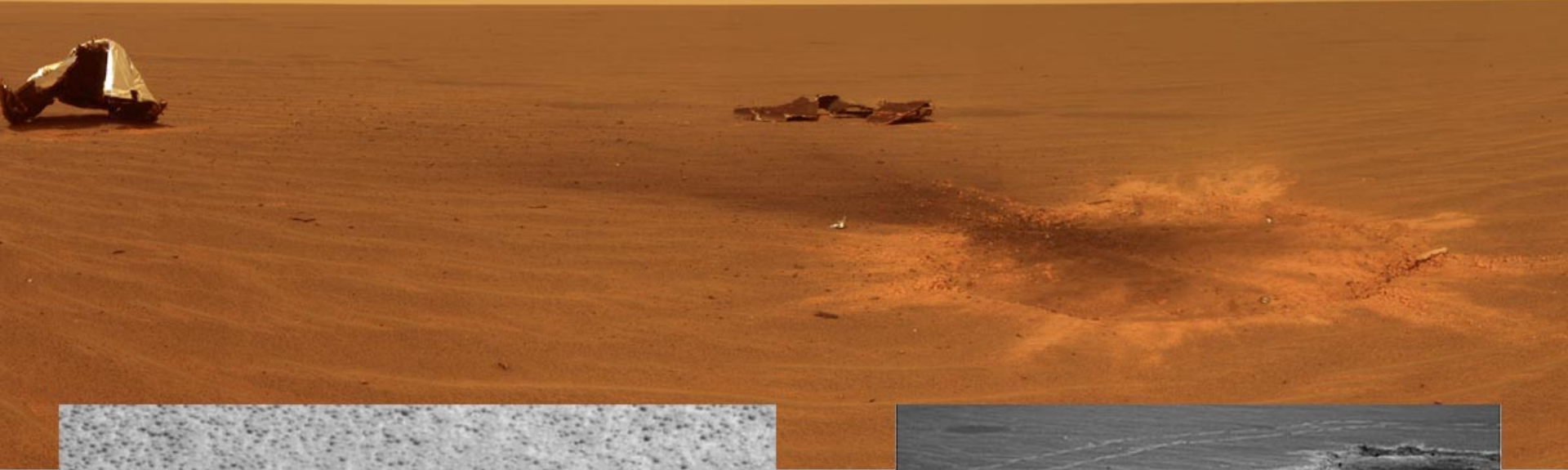
Endurance crater's interior cliffs

- a larger cross-section through the rocks

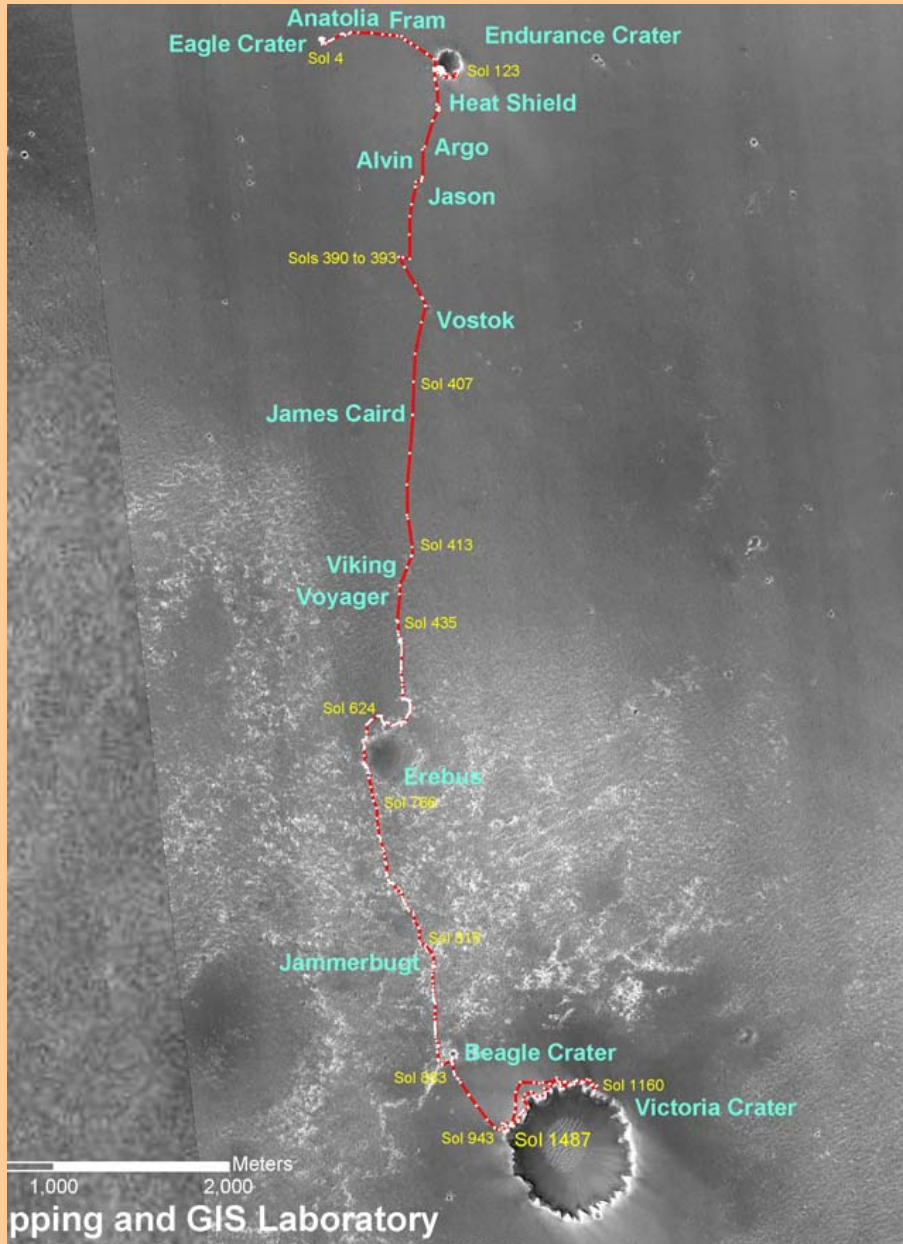
Deeper layers were more
affected by water



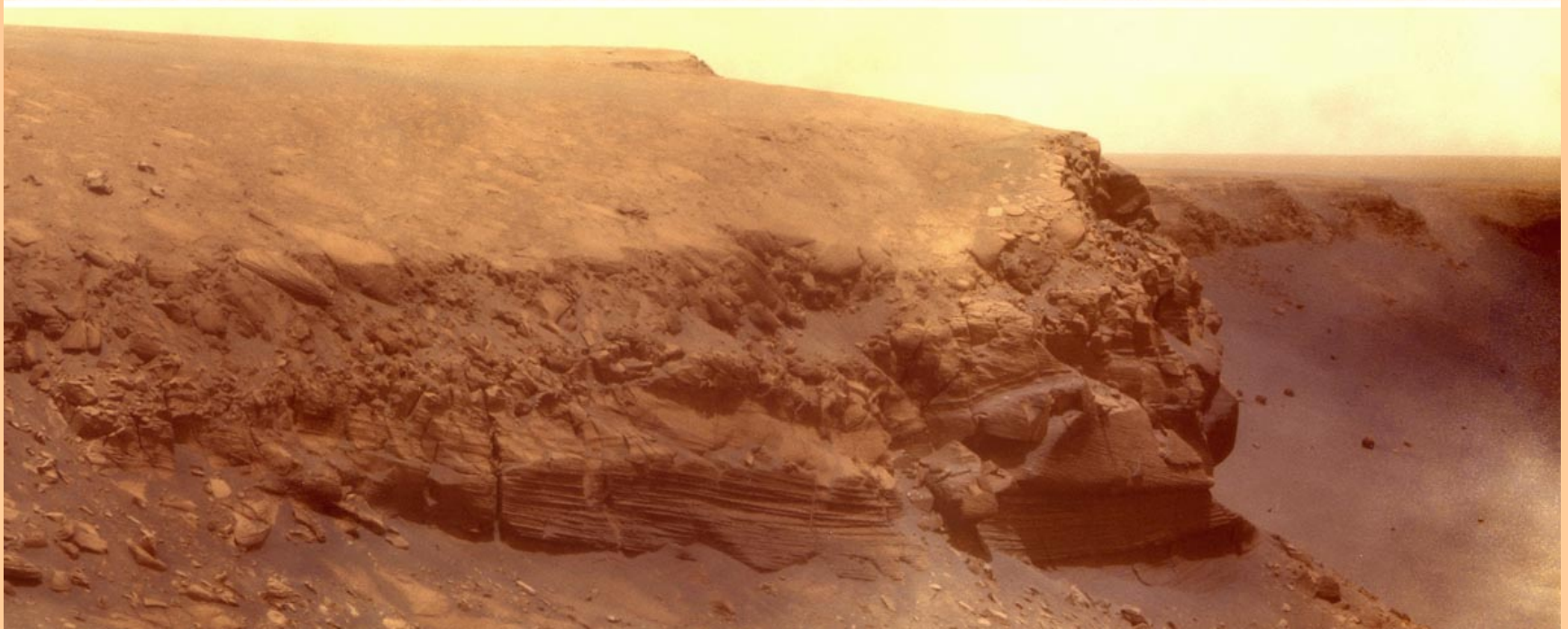
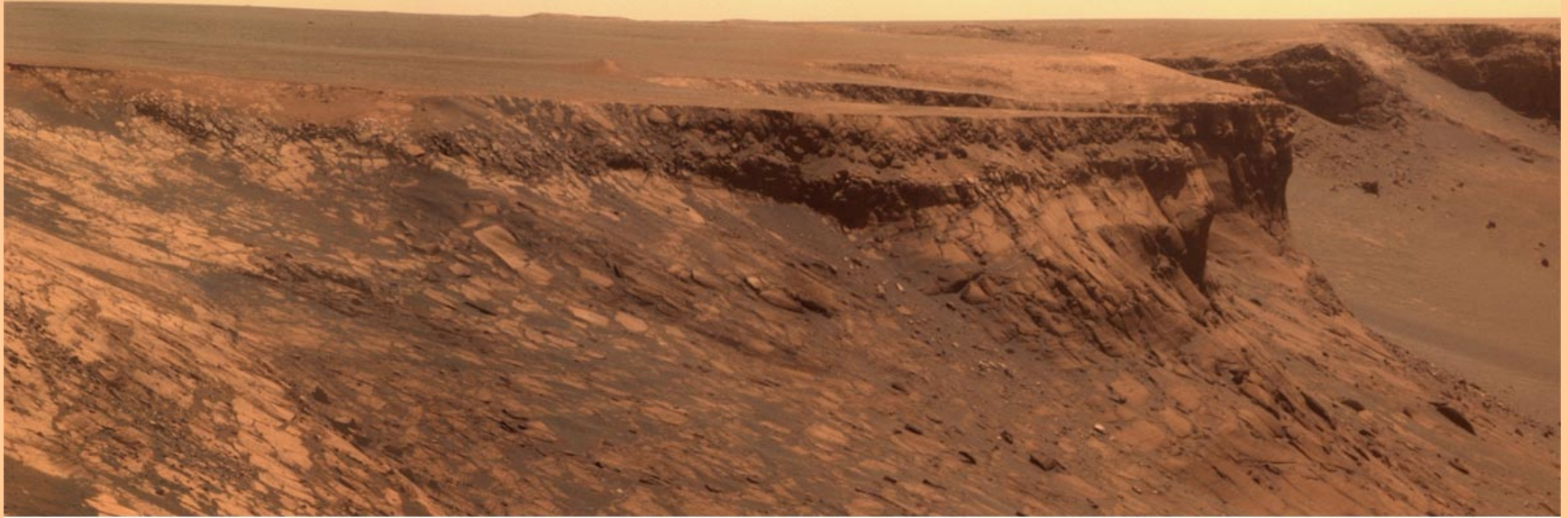
South of Endurance - the heatshield and a meteorite



South to Victoria – to get a deeper cross-section

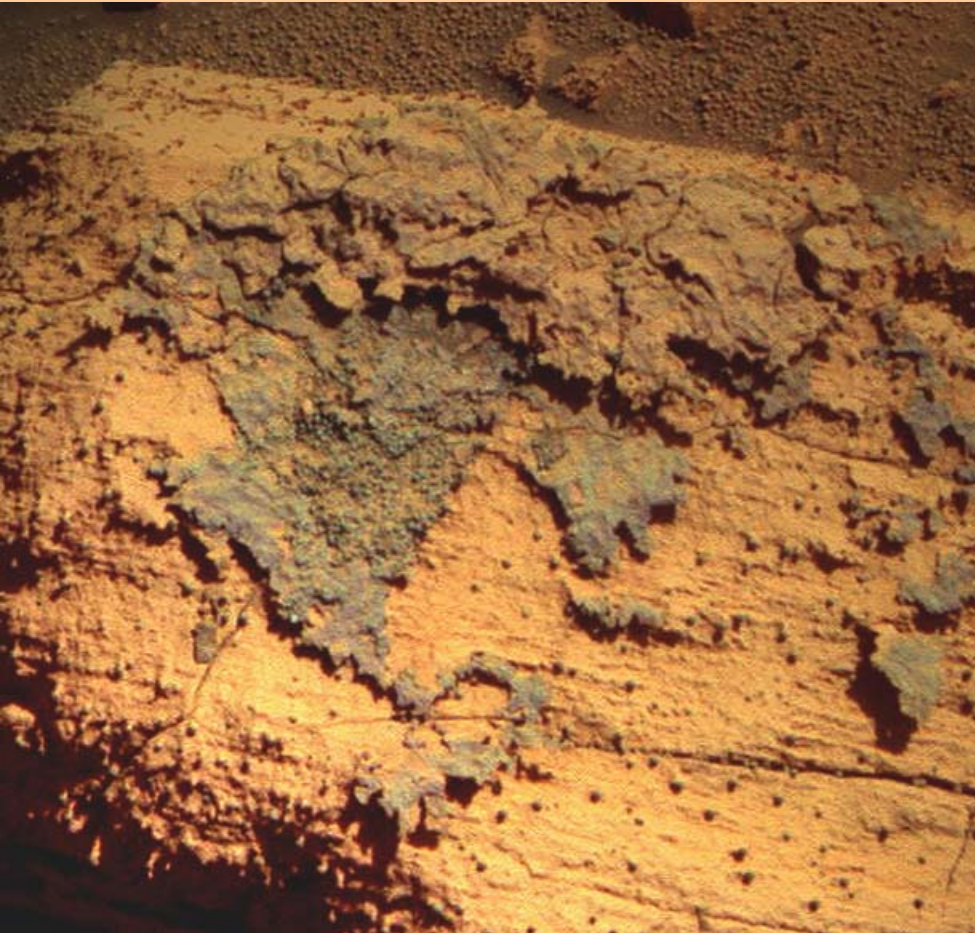


The cliffs of Victoria – solidified sand dunes



On to Endeavour – finding strange rocks and meteorites

Endeavour crater was expected to show different rocks again, older and with more signs of water.



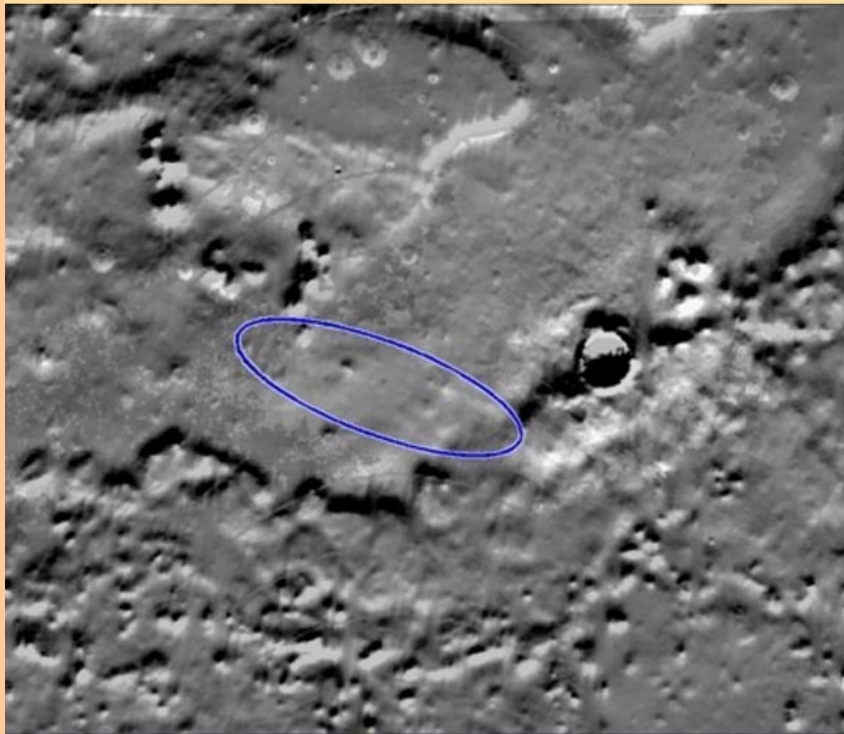
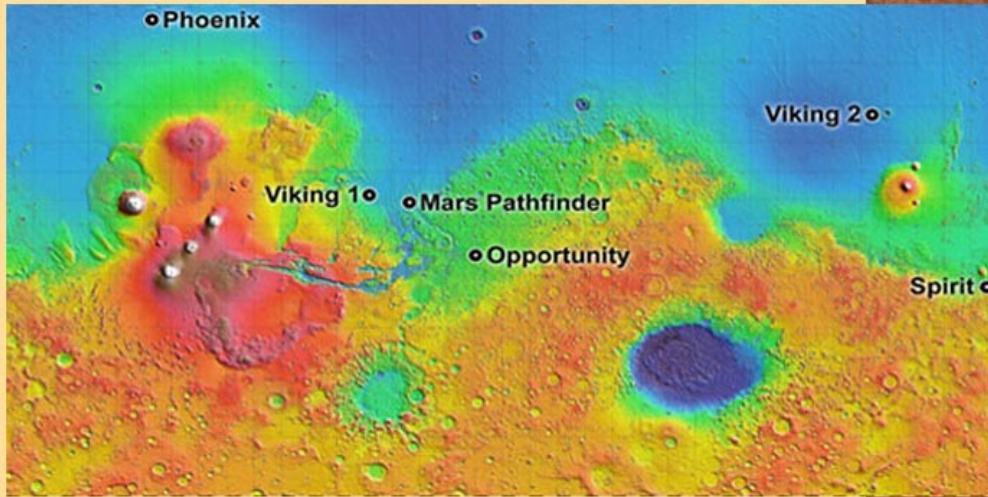
Endeavour crater – layers of clay

Clay indicates the presence of water long ago.

12 years on, Opportunity is still exploring.



Phoenix landing site



Phoenix – most recent Mars landing.

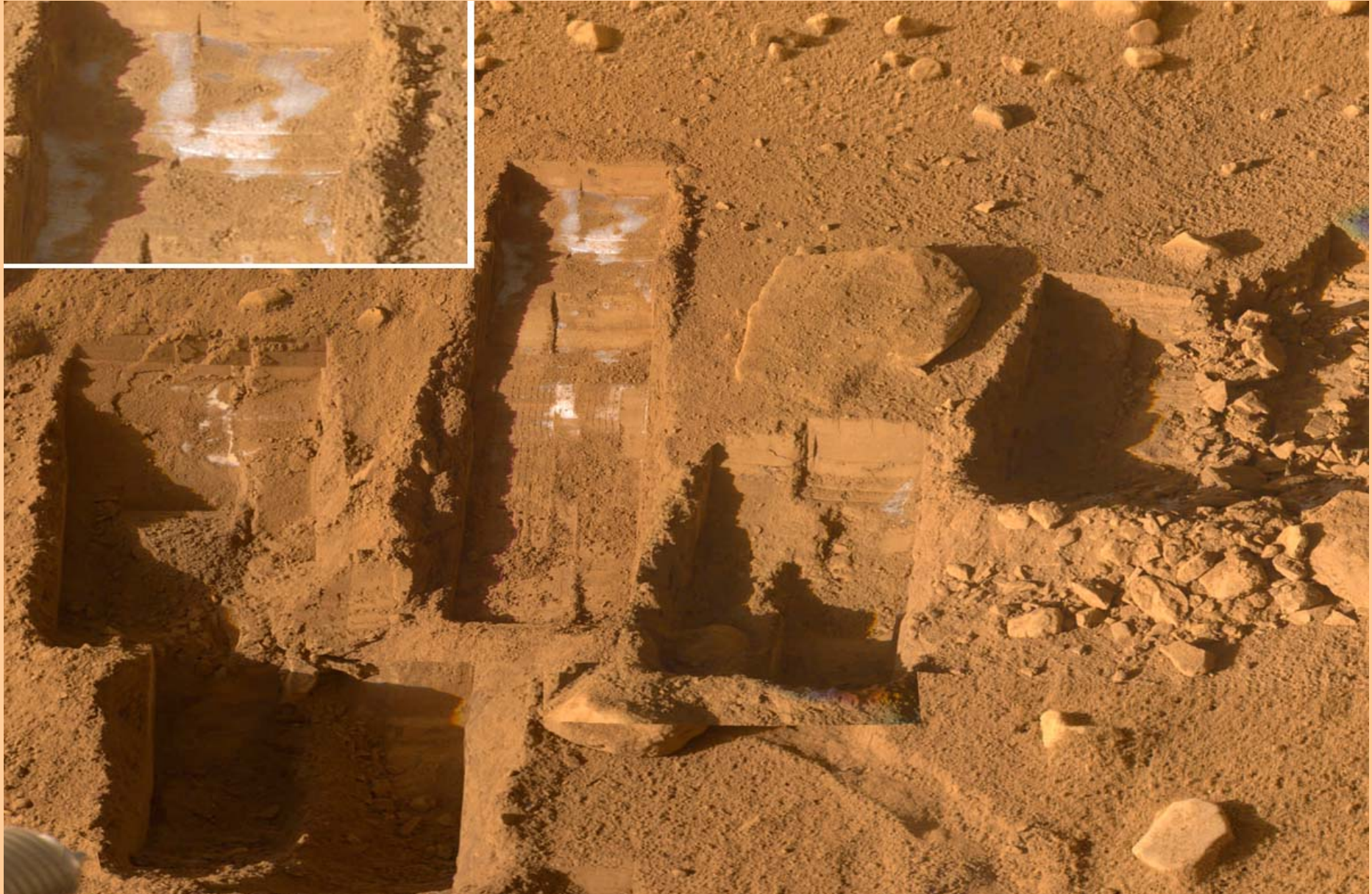
Landed May 25, 2008, mission ended November 2008.

Goal – dig down into that buried ice



Phoenix trenches – ice under a few cm (2 inches) of soil.

Analysis showed the soil was salty, alkaline, like deserts on Earth



Phoenix images – ice under the spacecraft itself.

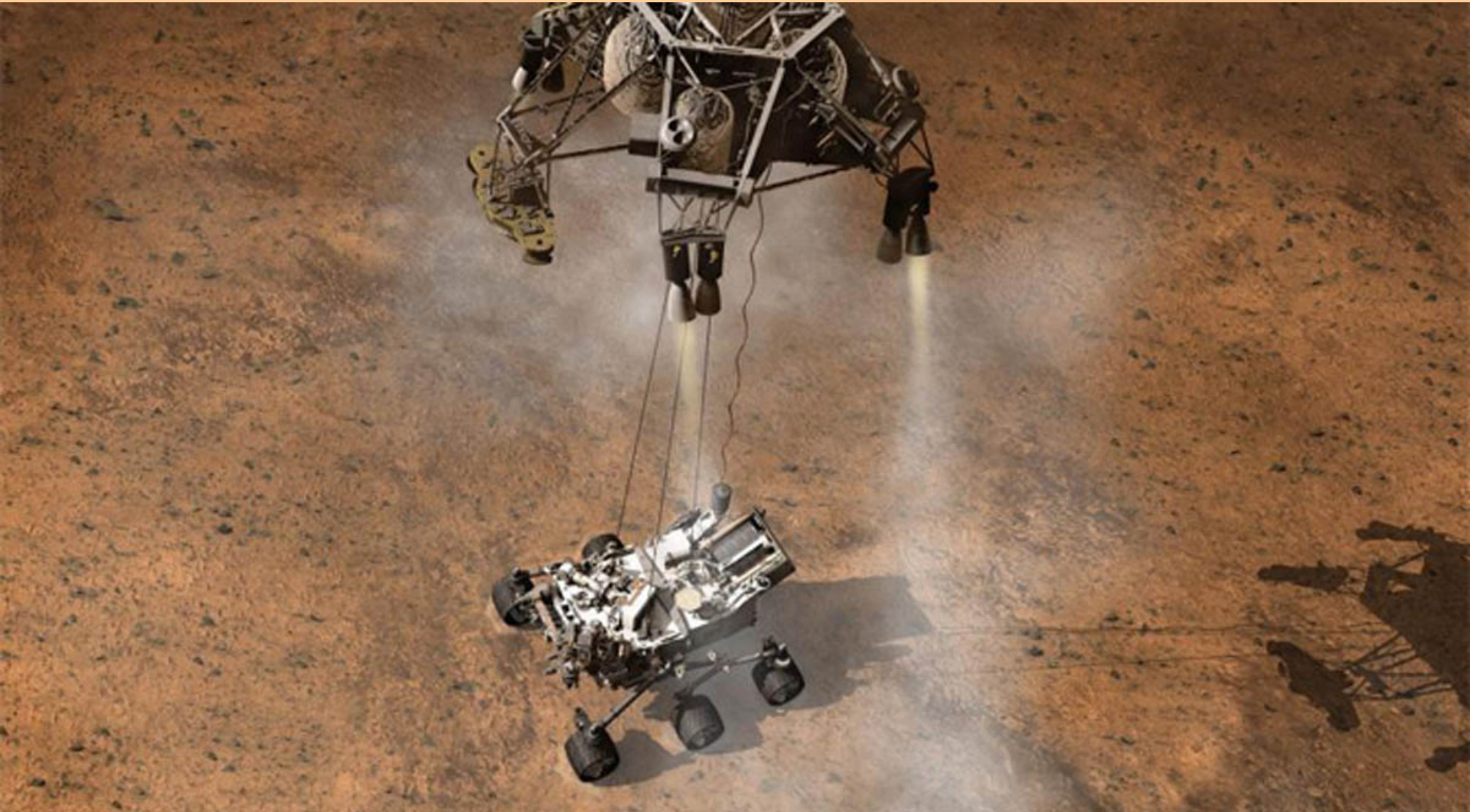
Soil was blown away by the small landing rockets.



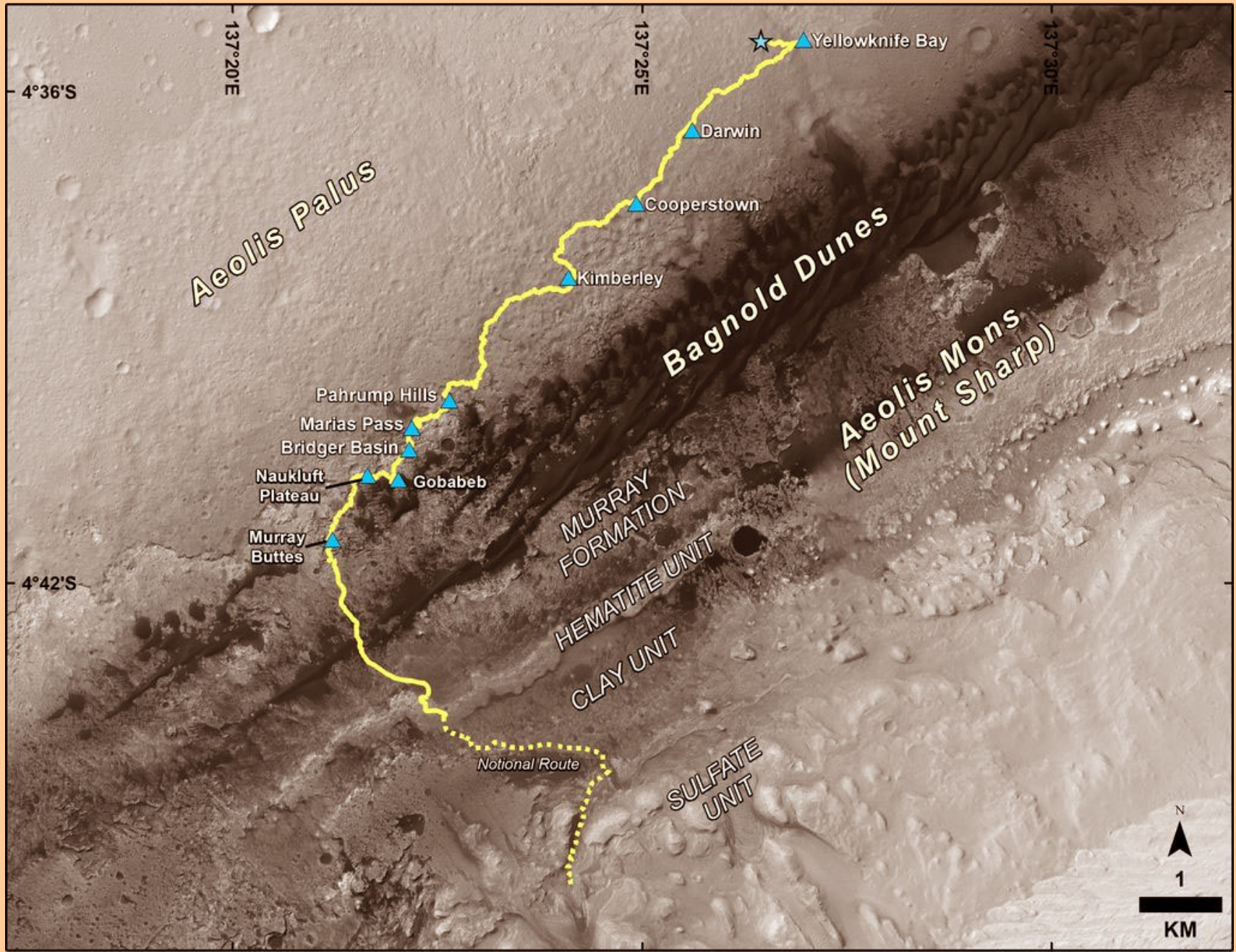
Curiosity rover (Mars Science Laboratory)

Landed in 2012 to look for places where life might have been possible (habitable environments).

(landing by 'Skycrane')



Curiosity route map



A landing site like no other...

(Curiosity is on its way to these hills, will arrive in about 2018)



Dramatic desert landscape

(these rocks formed as sediments in shallow lakes)



Dramatic desert landscape

Other rocks formed as floods of debris and water washed down from the hills in the background, now being slowly eroded by the wind



So - the news from Mars is 'water everywhere'

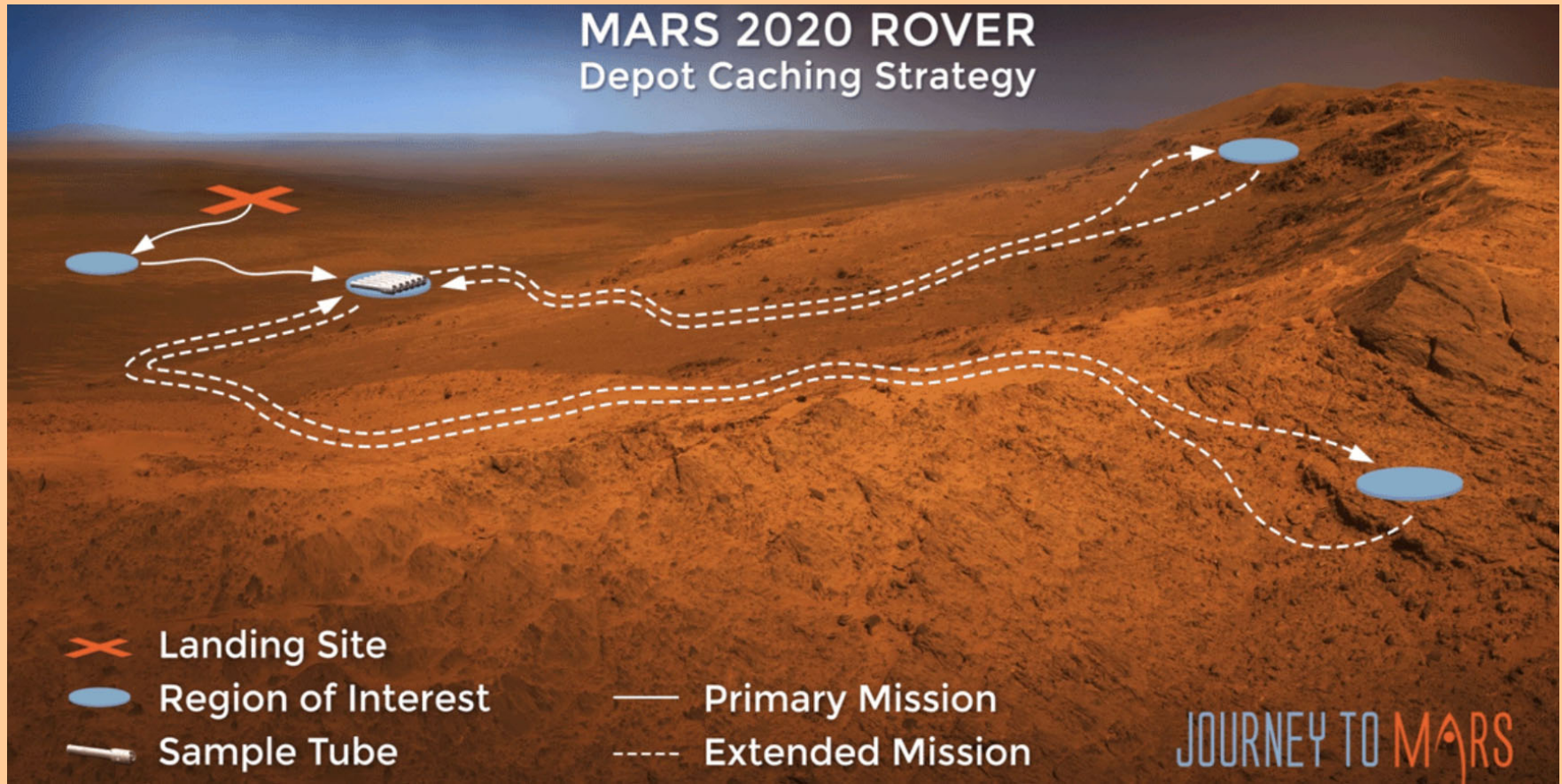
Orbiters see evidence for water and ice everywhere

The rovers found evidence for water long ago

Phoenix found ice in the soil today

Next step – Mars 2020 rover:

start collecting samples to bring back to Earth



One day people may go to Mars, but that's a long way off.

- Earth and Mars are positioned for us to make the trip every two years.**
- It would take 8 months to get there.**
- The planets are not in the right positions for the journey home.**
- Take a long trip home or wait for the right time for a short trip.**
- In both cases the round trip takes 2 - 3 years.**

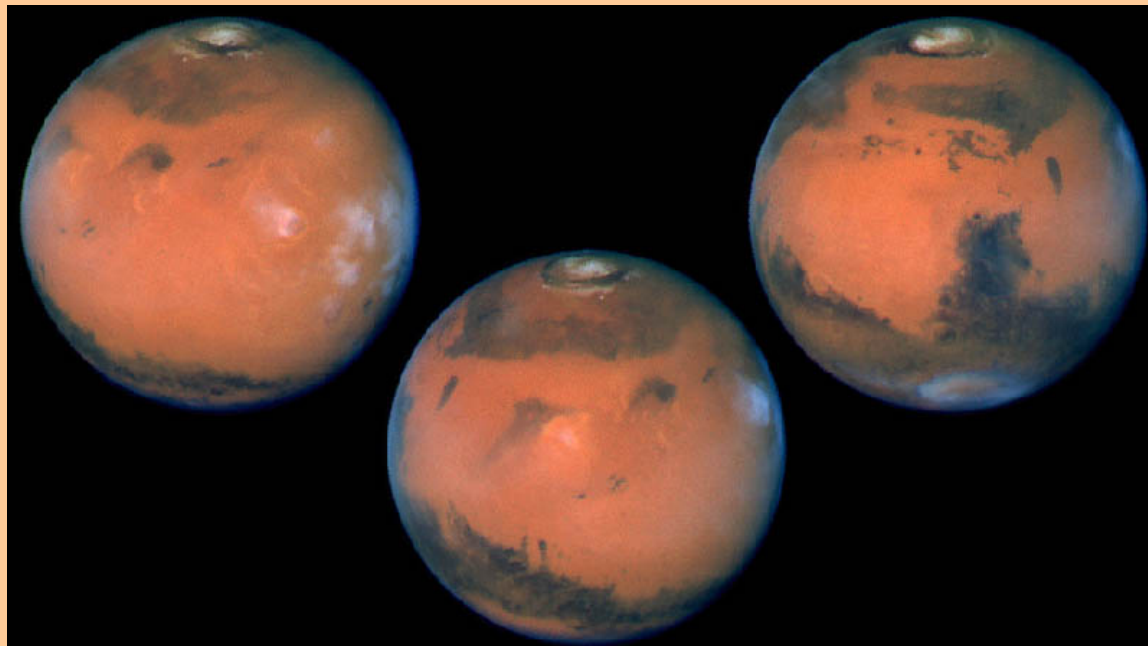
The tentative plan: people visit the moons of Mars in about 2035.

A Mars landing would happen later.

End

Thanks for your interest in Mars.

Philip Stooke



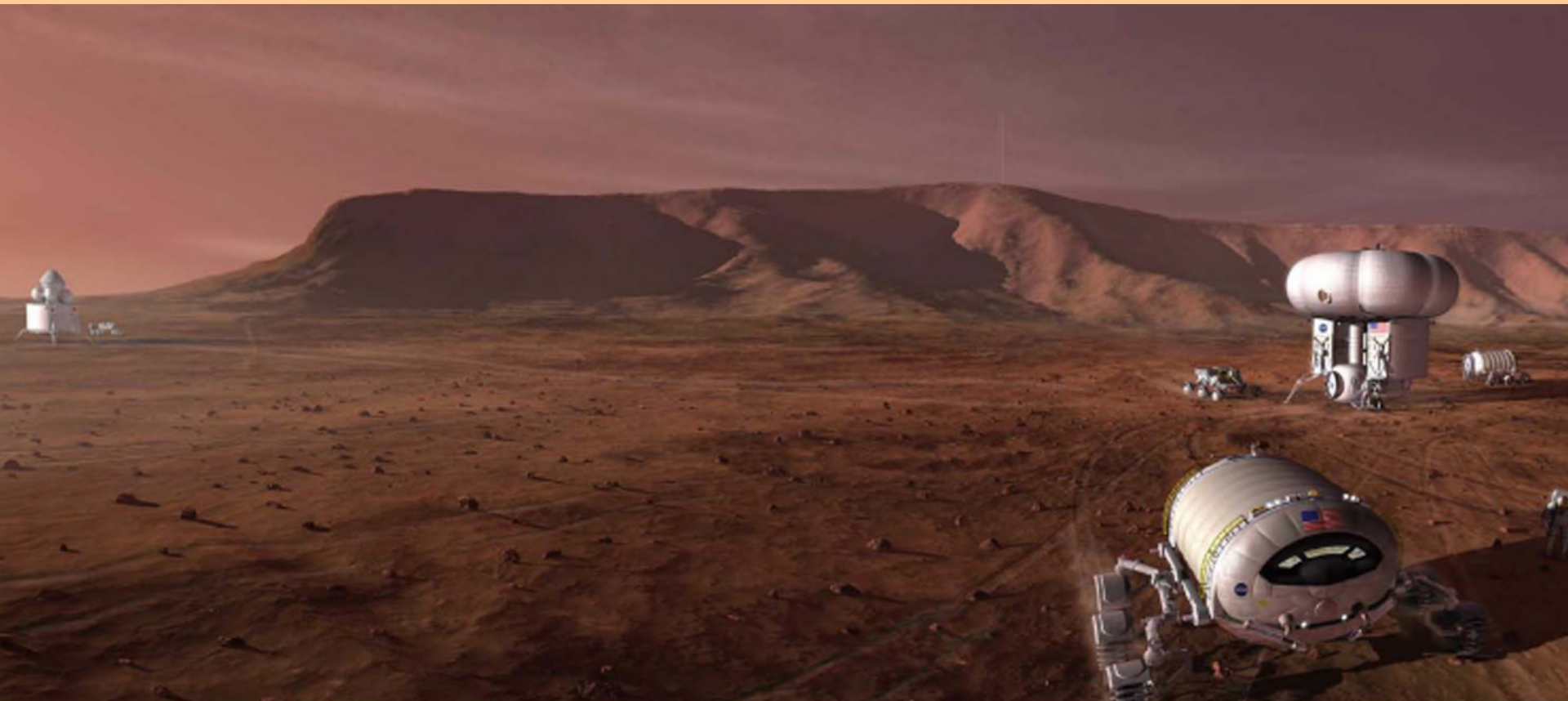
Mars at Opposition • March 10, 1997

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PRC97-09b • ST ScI OPO • March 24, 1997 • D. Crisp (JPL), the WFPC2 Science Team and NASA

A giant leap – to Mars

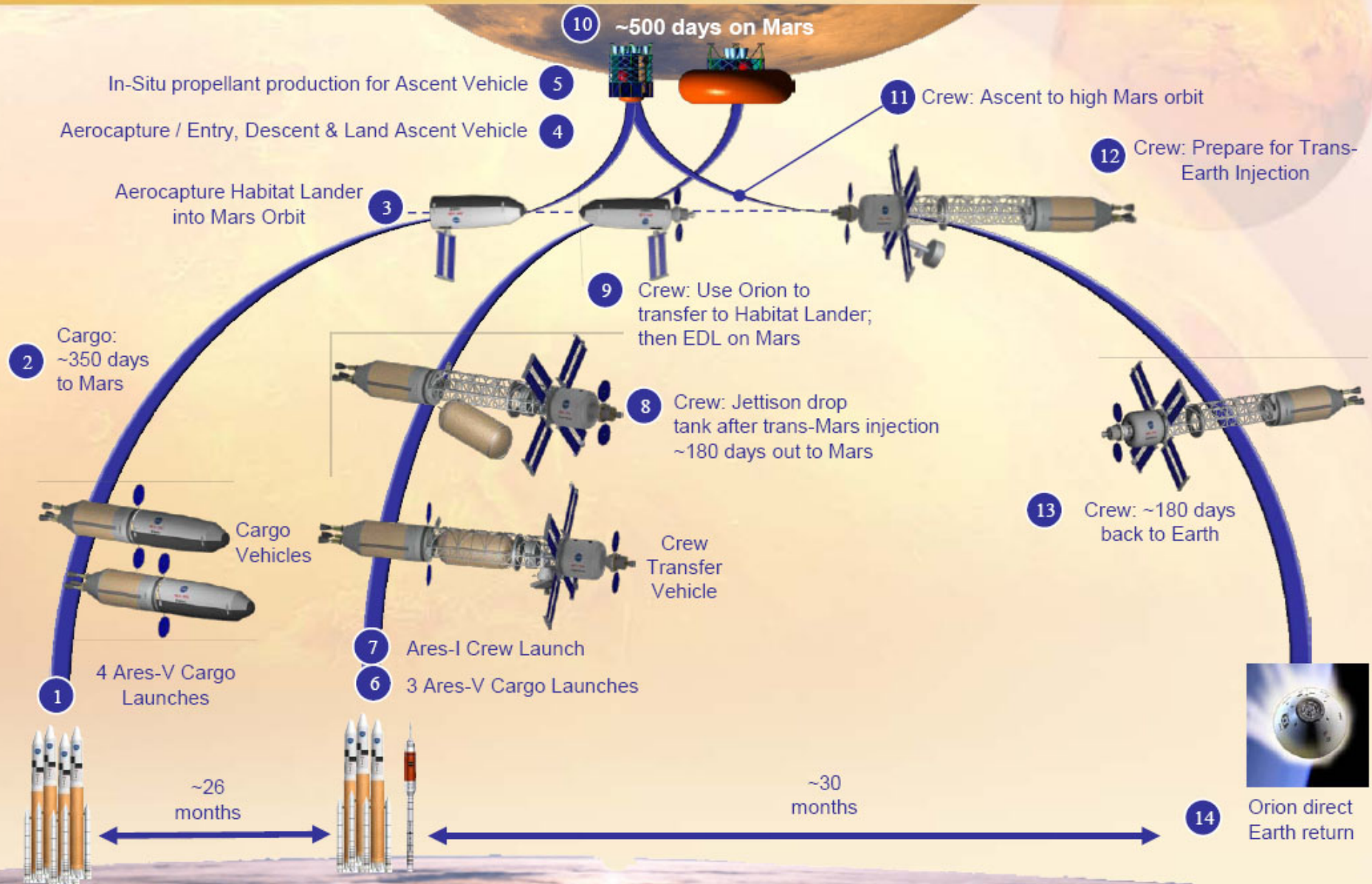
- We are not ready to do this yet, but it is probably in our future.





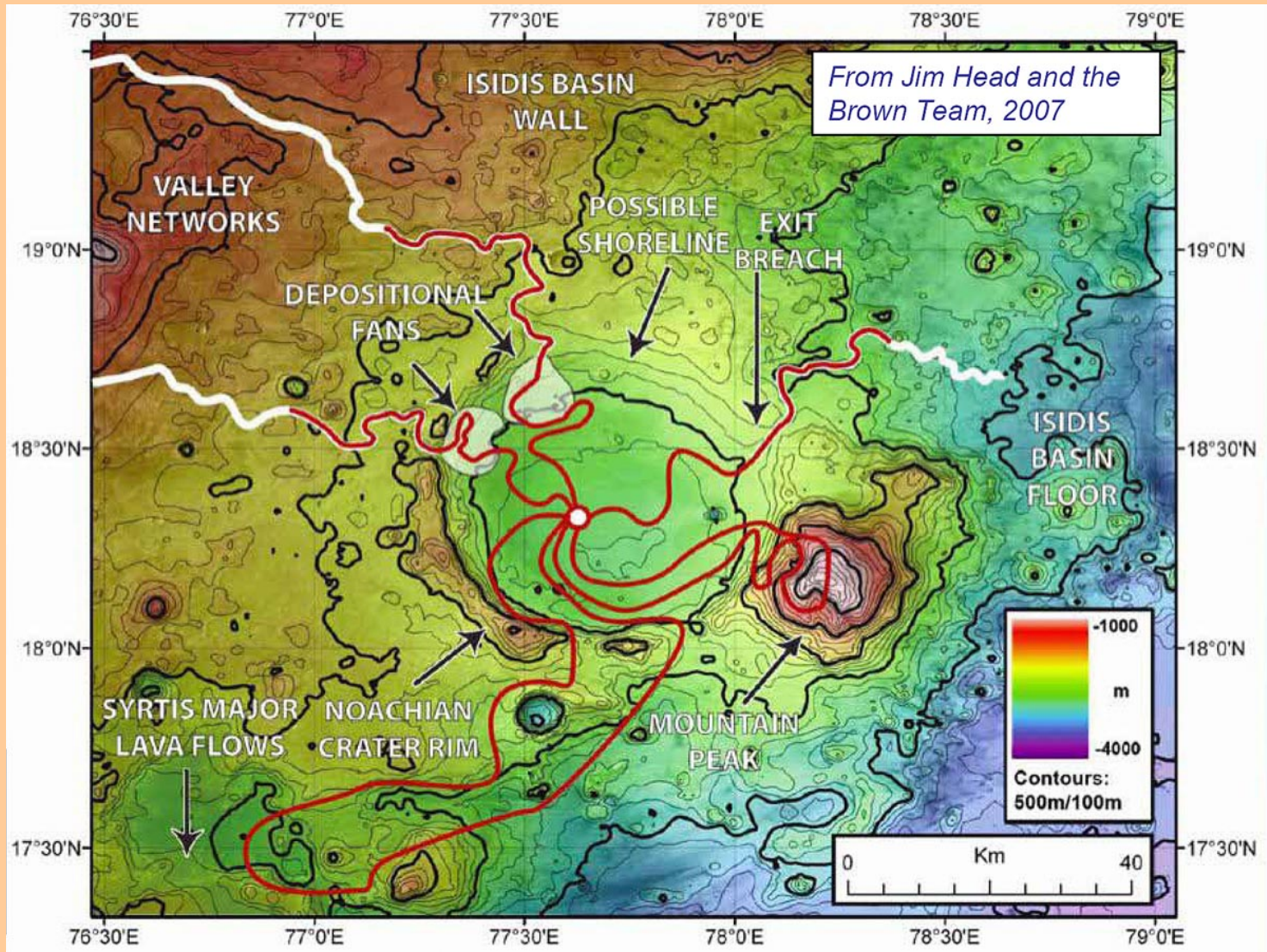
Mars Design Reference Architecture 5.0 Mission Profile

NTR Reference Shown



Planning the scientific exploration of Mars

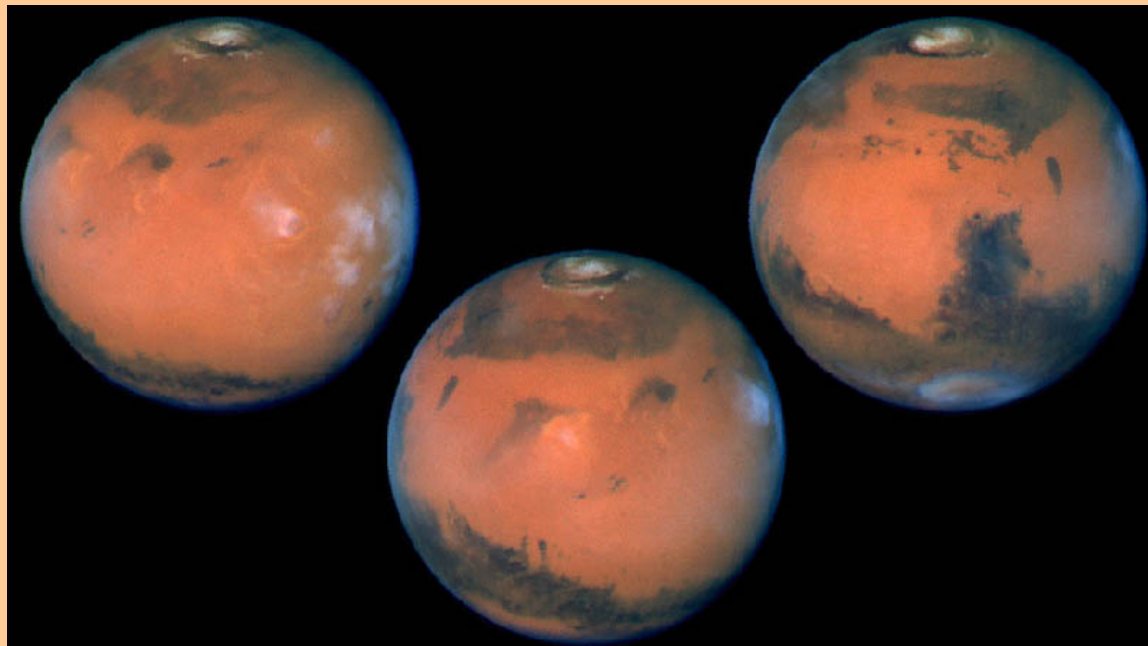
A big study in recent years suggested long stays on Mars at three different sites, with rovers to allow long distance exploration from the base camp.



End

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