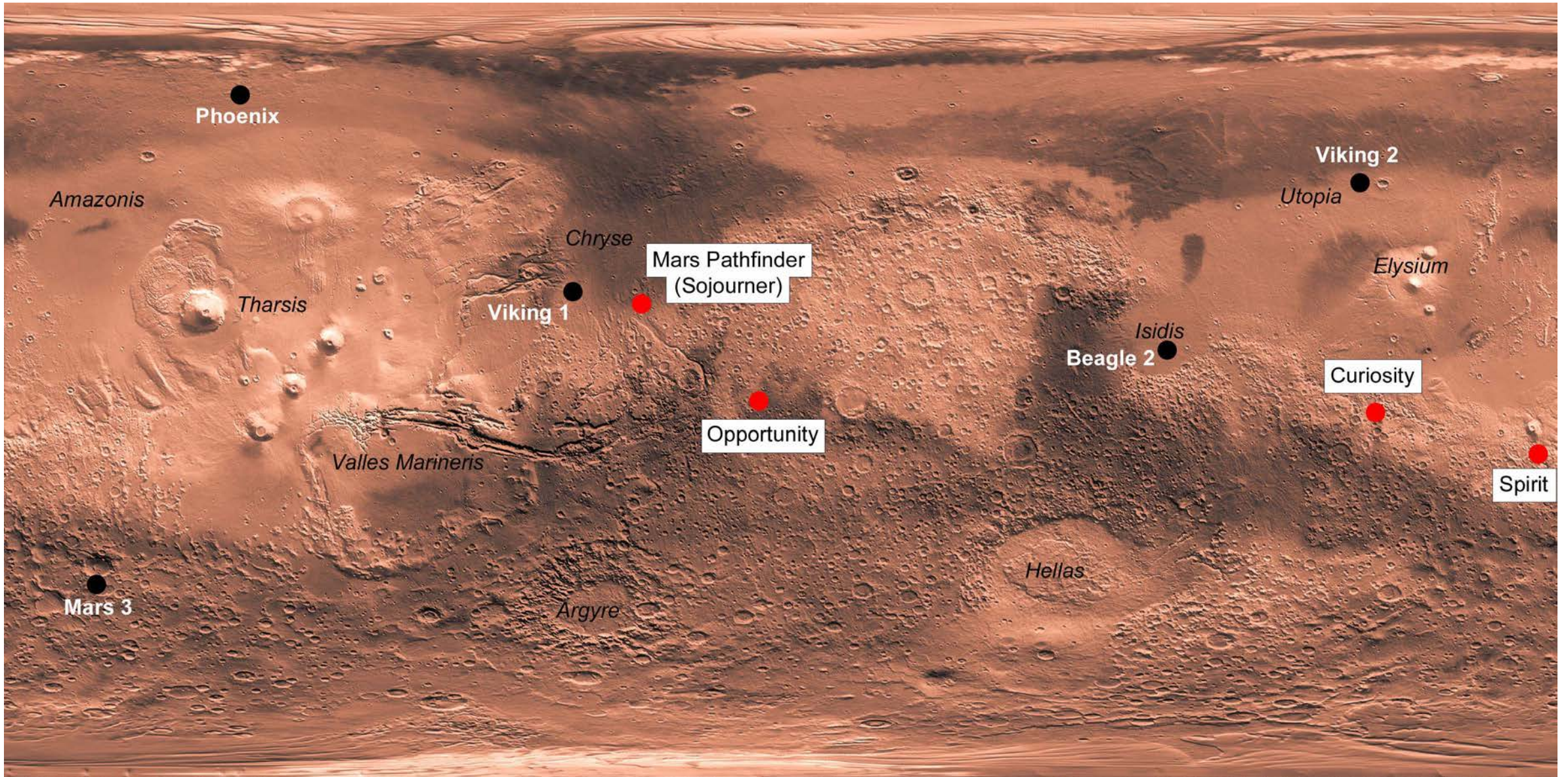
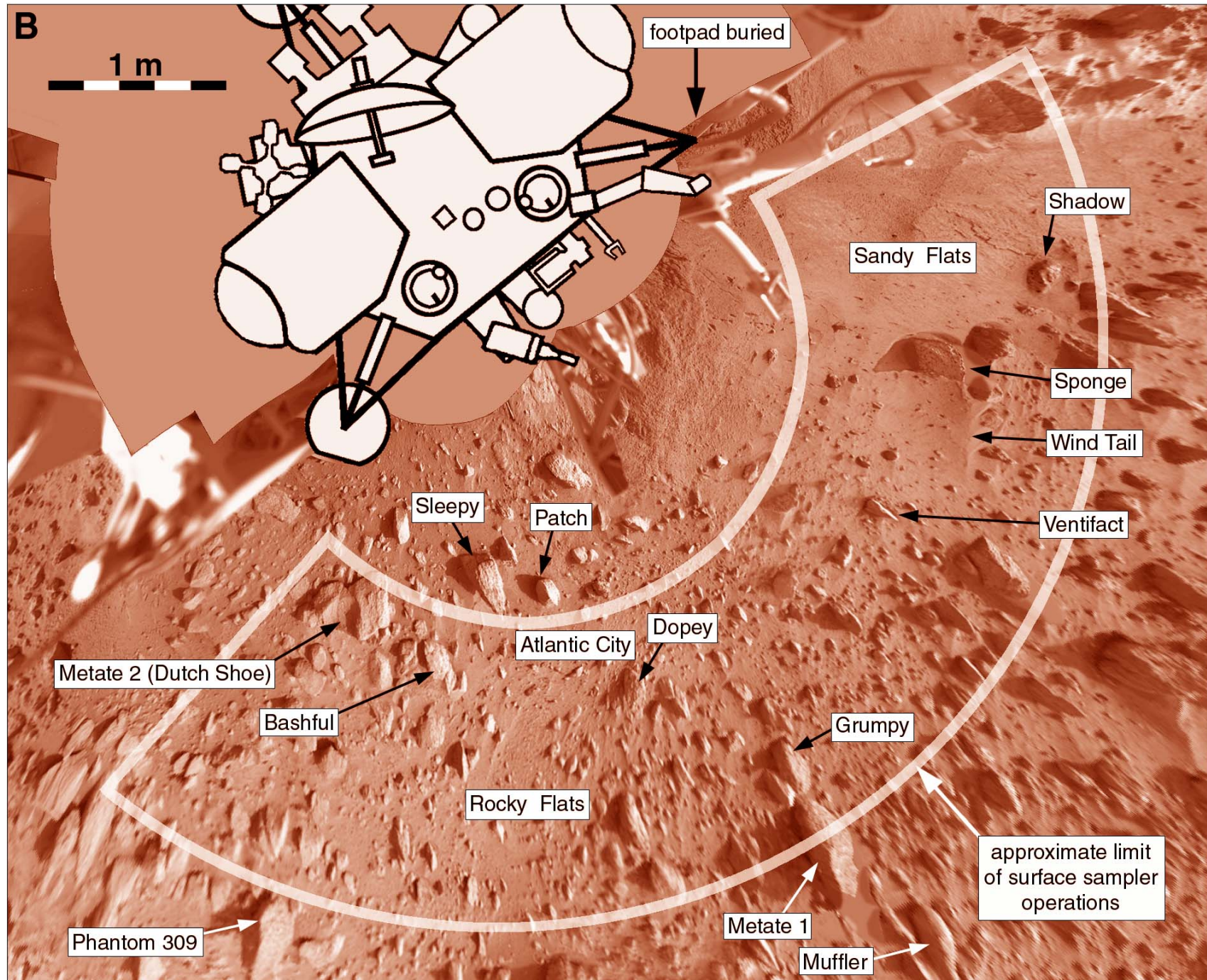


Mars landing sites



Viking 1

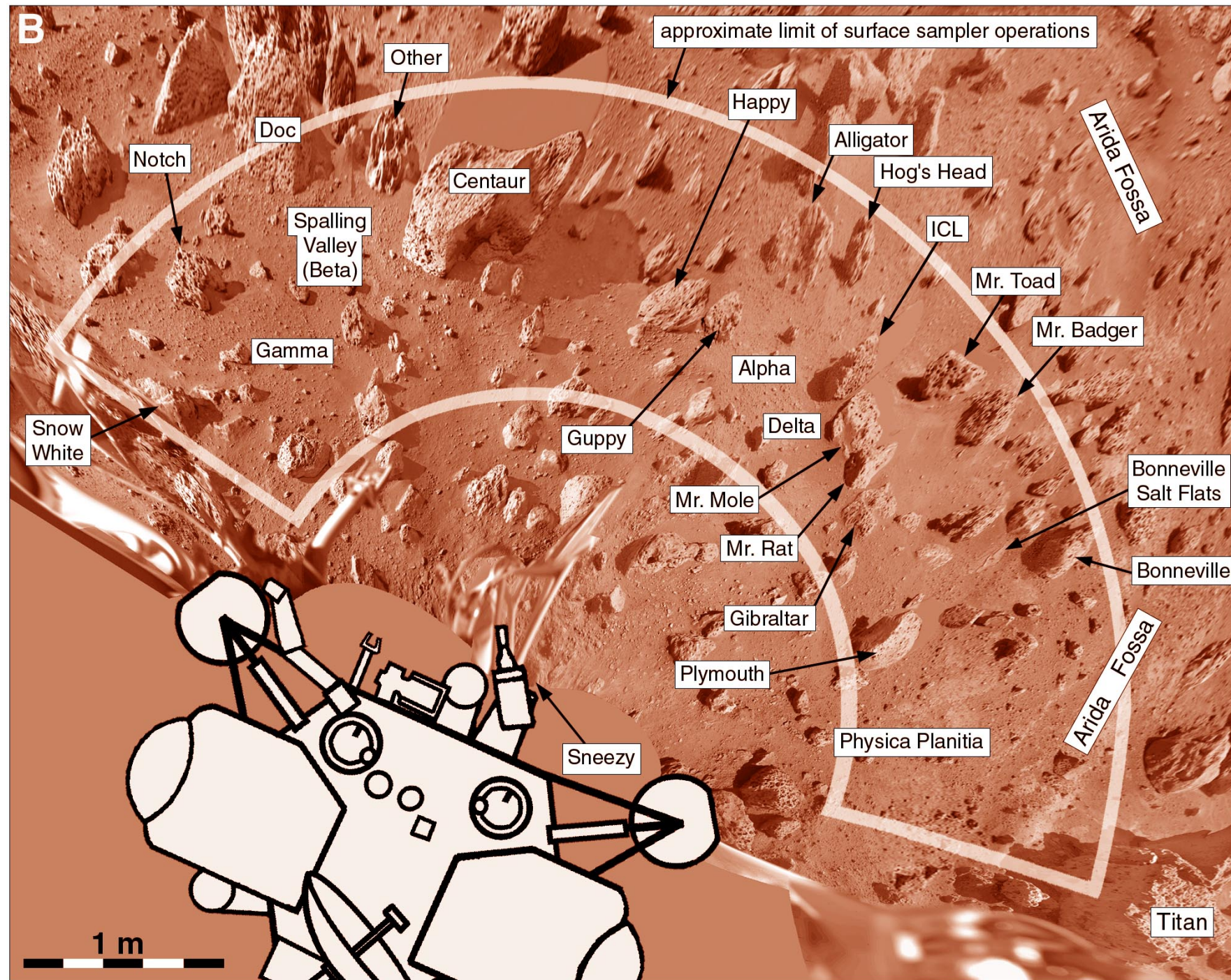
First fully successful landing, July 20, 1976.
Looking for life.



Viking 2

the backup
lander also
succeeded.

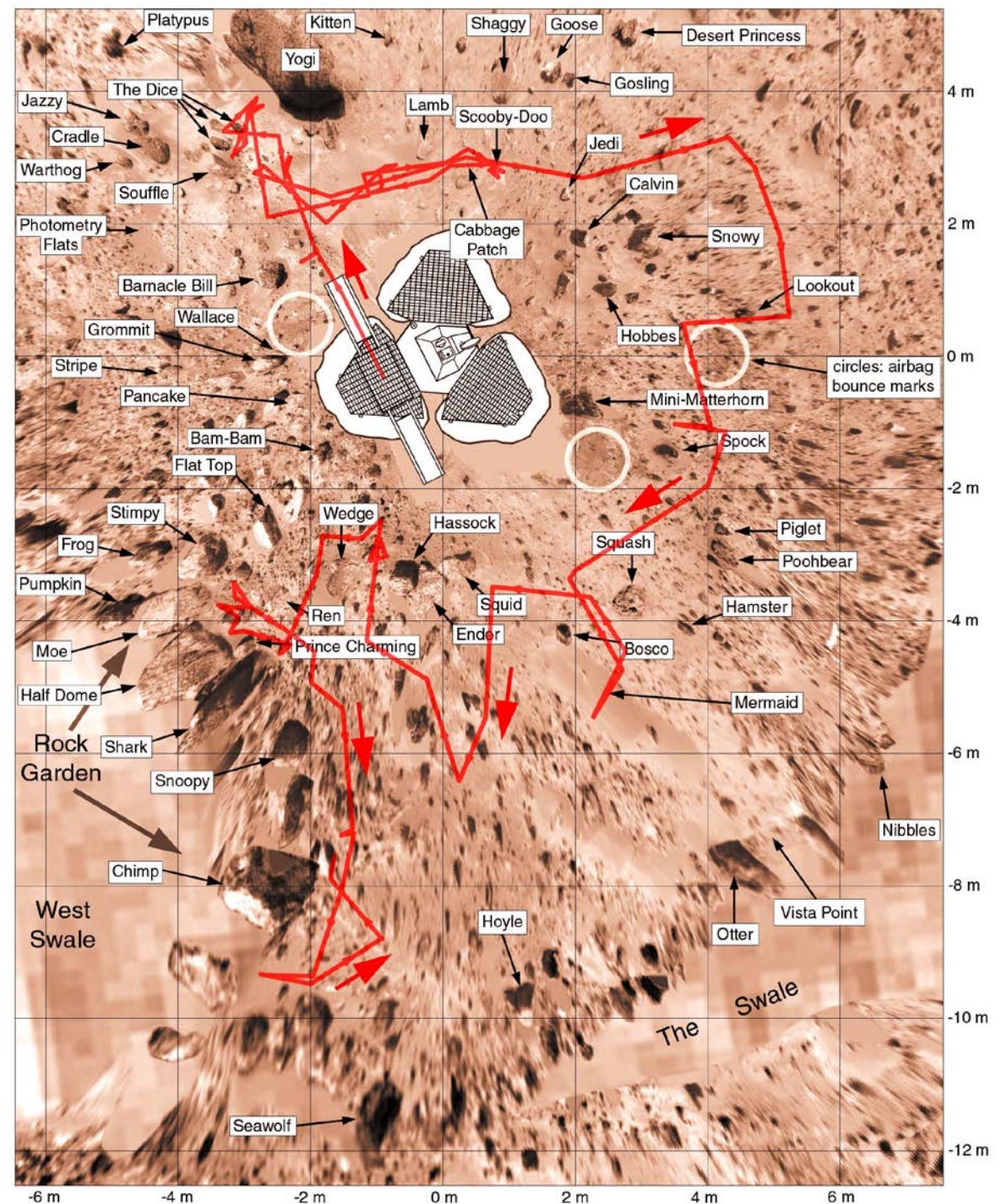
*“ ... amazed we
really got two
landers down
safely”*
(Gerry Soffen)



Pathfinder

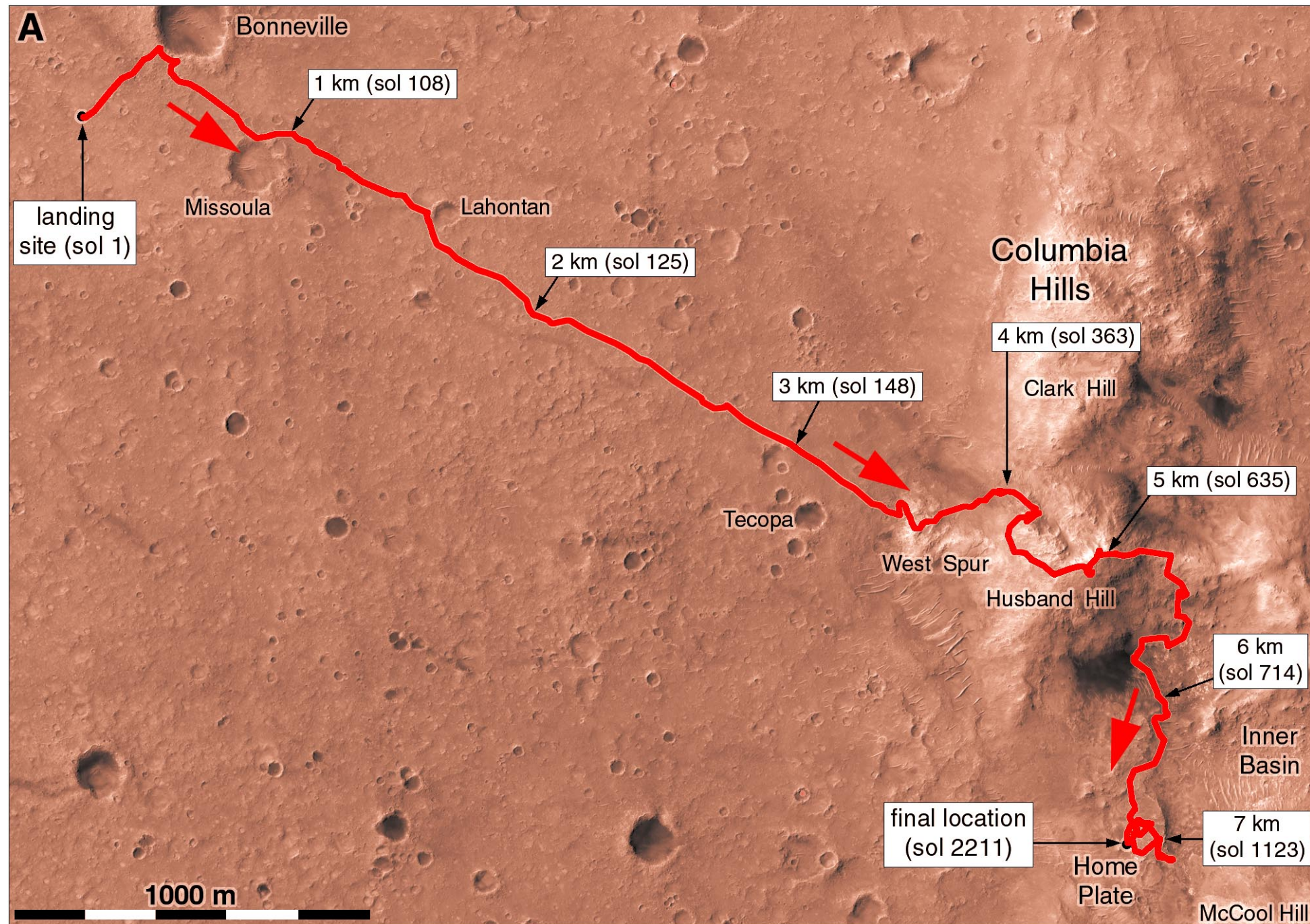
First successful
rover on Mars,
1997.

Engineering
test mission
with limited
science.



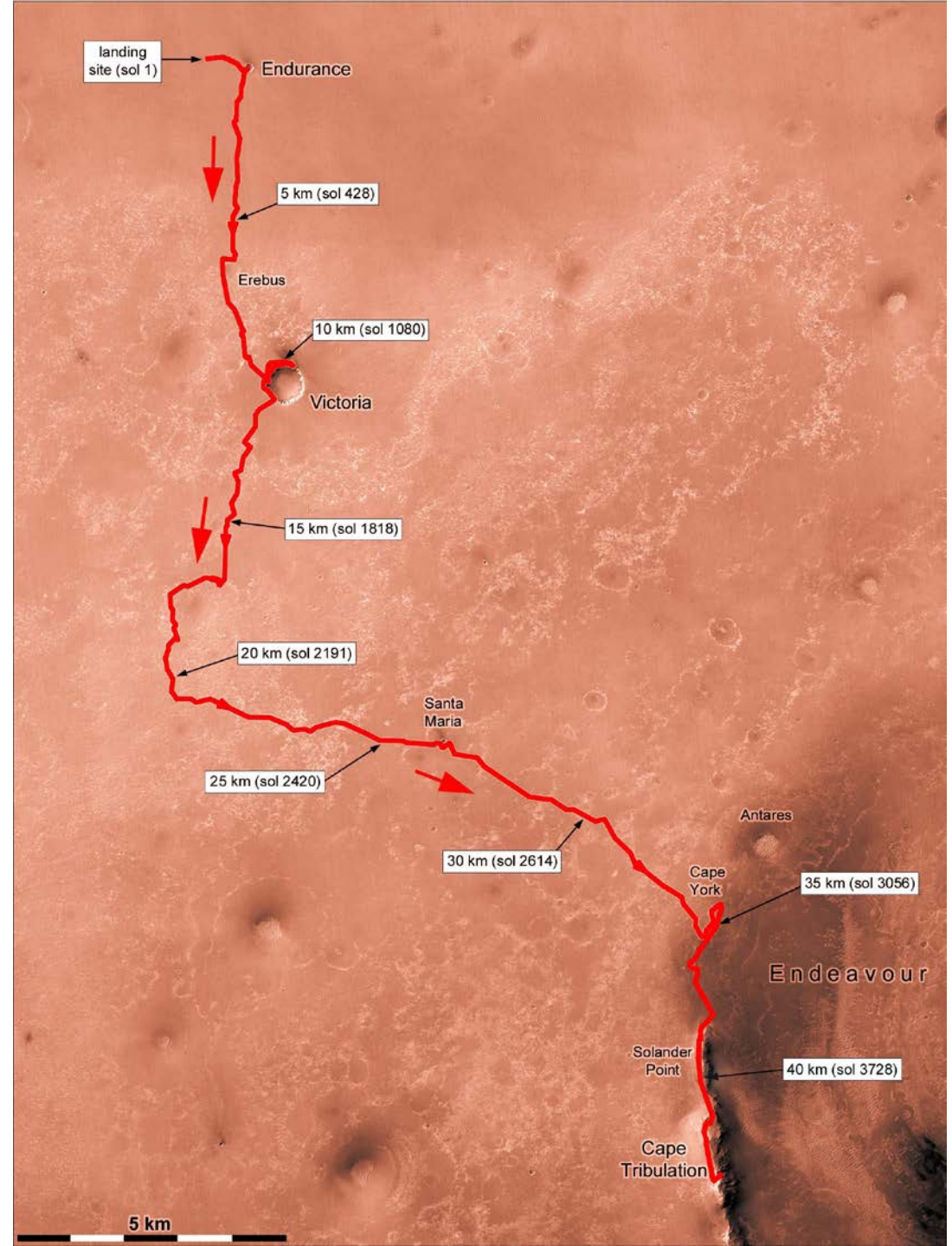
Mars Exploration Rover *Spirit*

7 km drive
over 7 years,
2004-2010.
Looking for
evidence of
past water
on Mars.



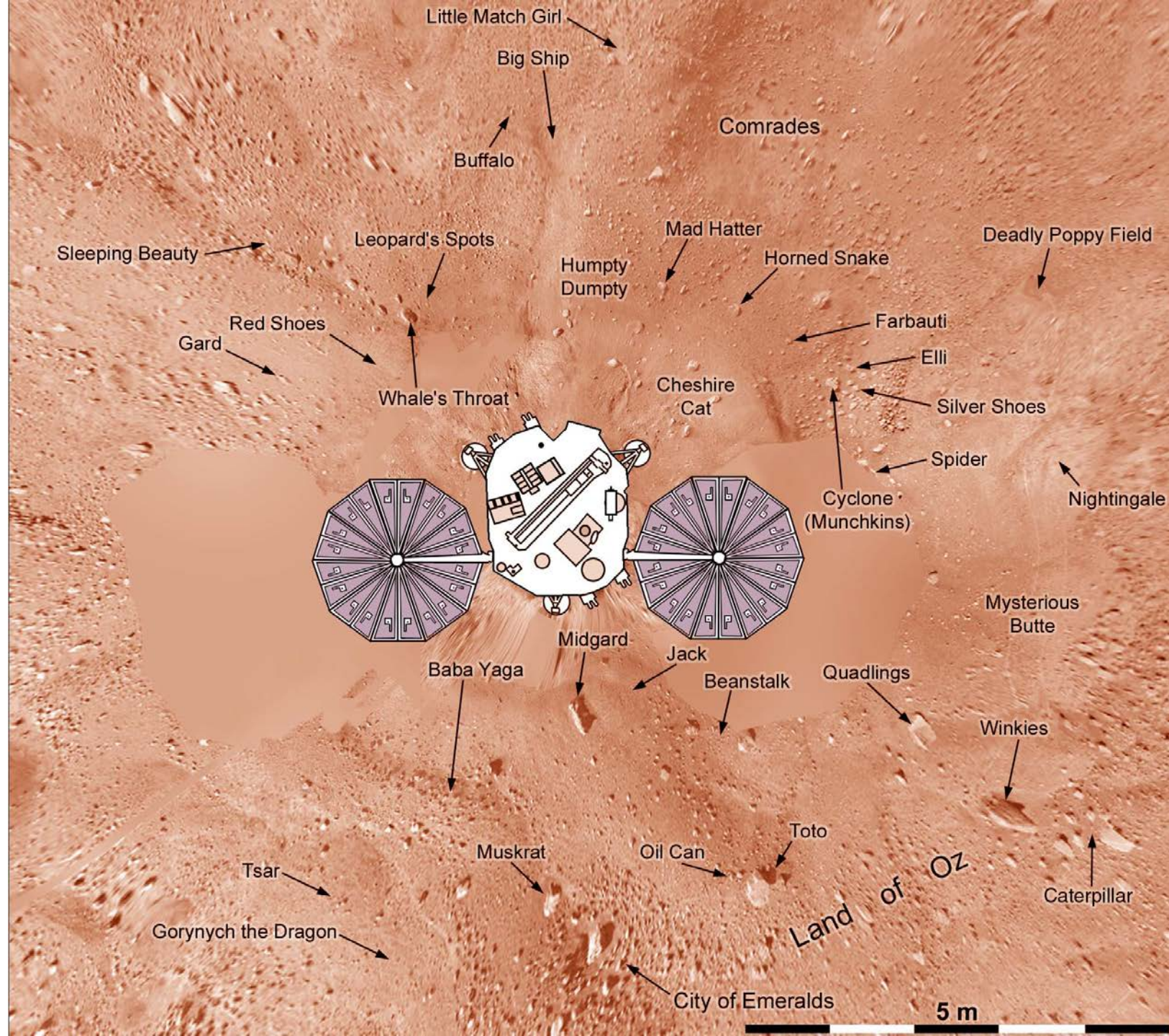
Mars Exploration Rover *Opportunity*

42 km drive over 12
years, 2004-2015.
Looking for evidence
of past water on
Mars.



Phoenix

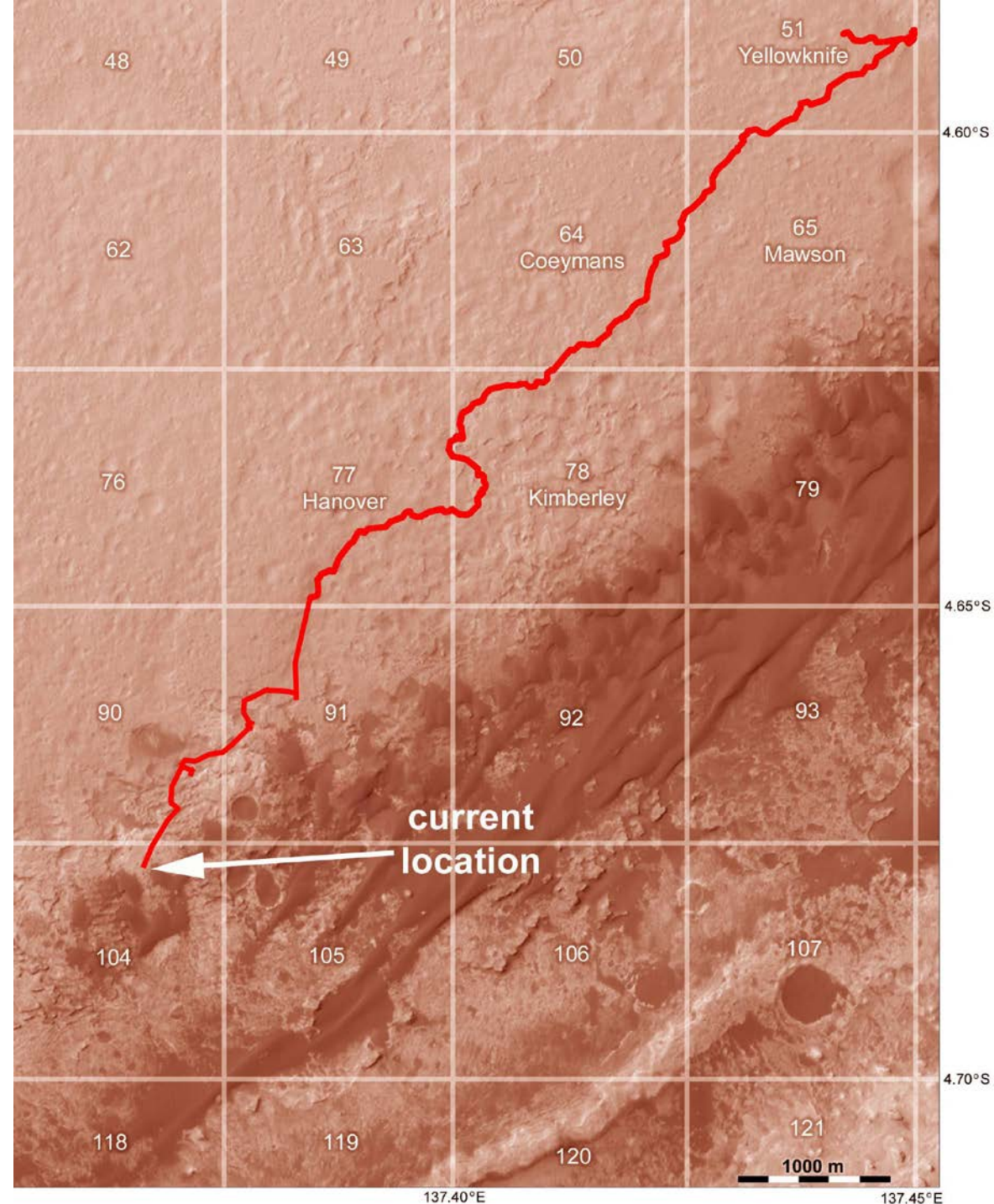
Static lander
searching for
ice in the soil,
2008.



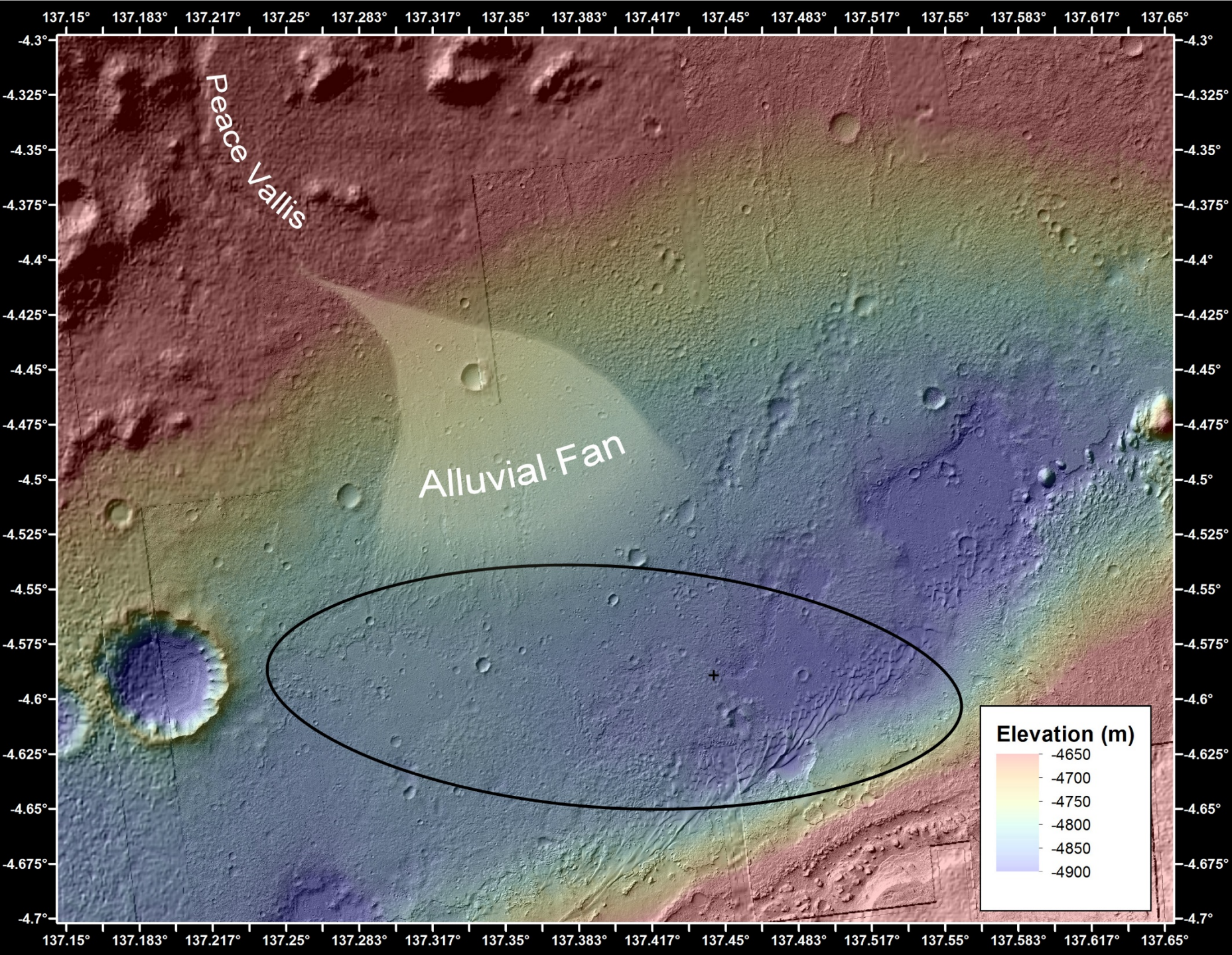
Mars Science Laboratory *Curiosity*

12 km in 3 years,
2012-2015.

Looking for geological
evidence of habitable
environments



2012: Curiosity
landing site:
smooth and
safe, but 10
km from
science targets



Curiosity
landing site:
smooth and
safe



First target:
Yellowknife
Bay



First target:
Yellowknife
Bay



First target:
Yellowknife
Bay: drill at
John Klein

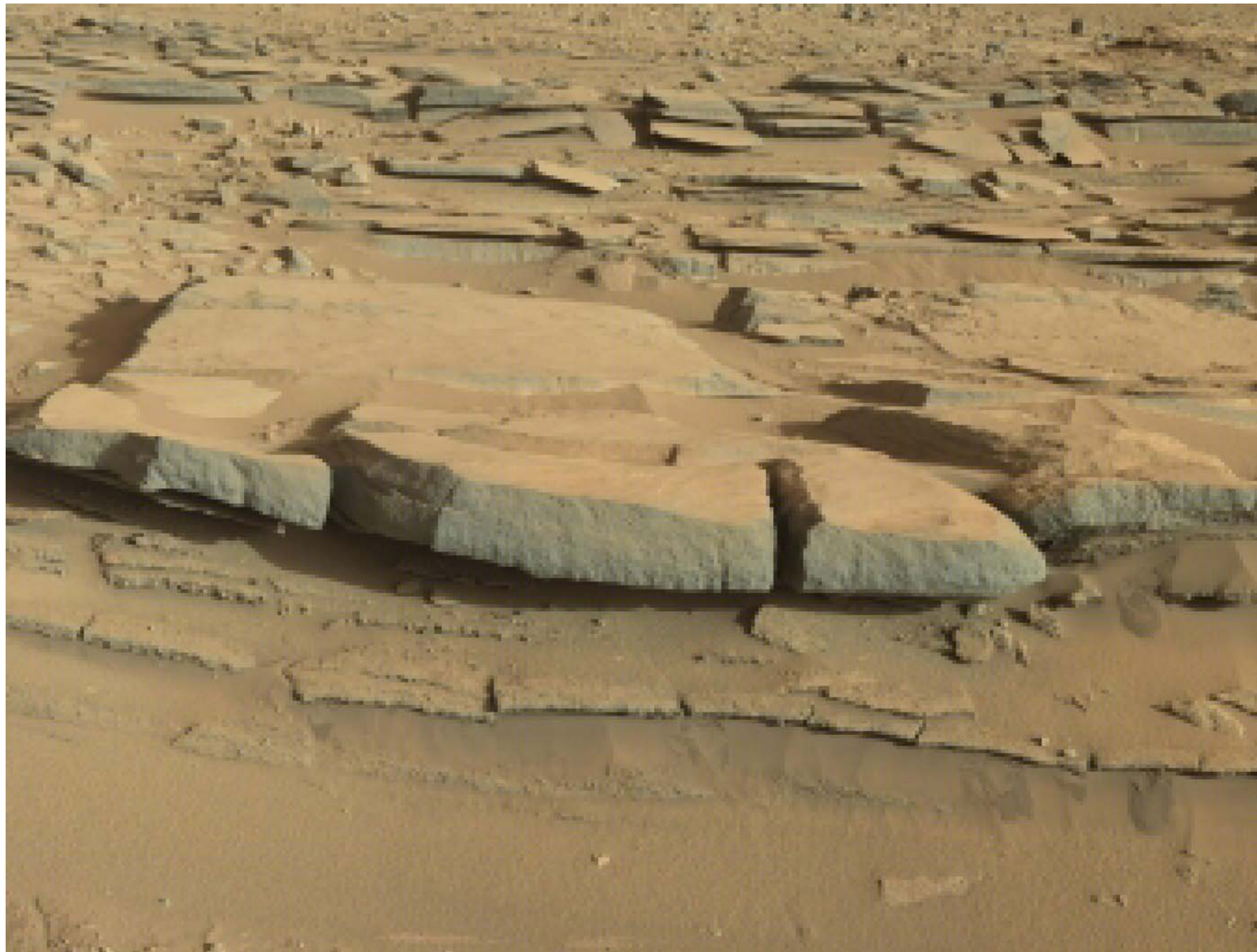
result:
Yellowknife
Bay was once
a lake



Conglomerate
rocks:
deposited by
running water



Many layers of rock, each one tells a story of the past



Many layers of
rock, each one
tells a story of
the past



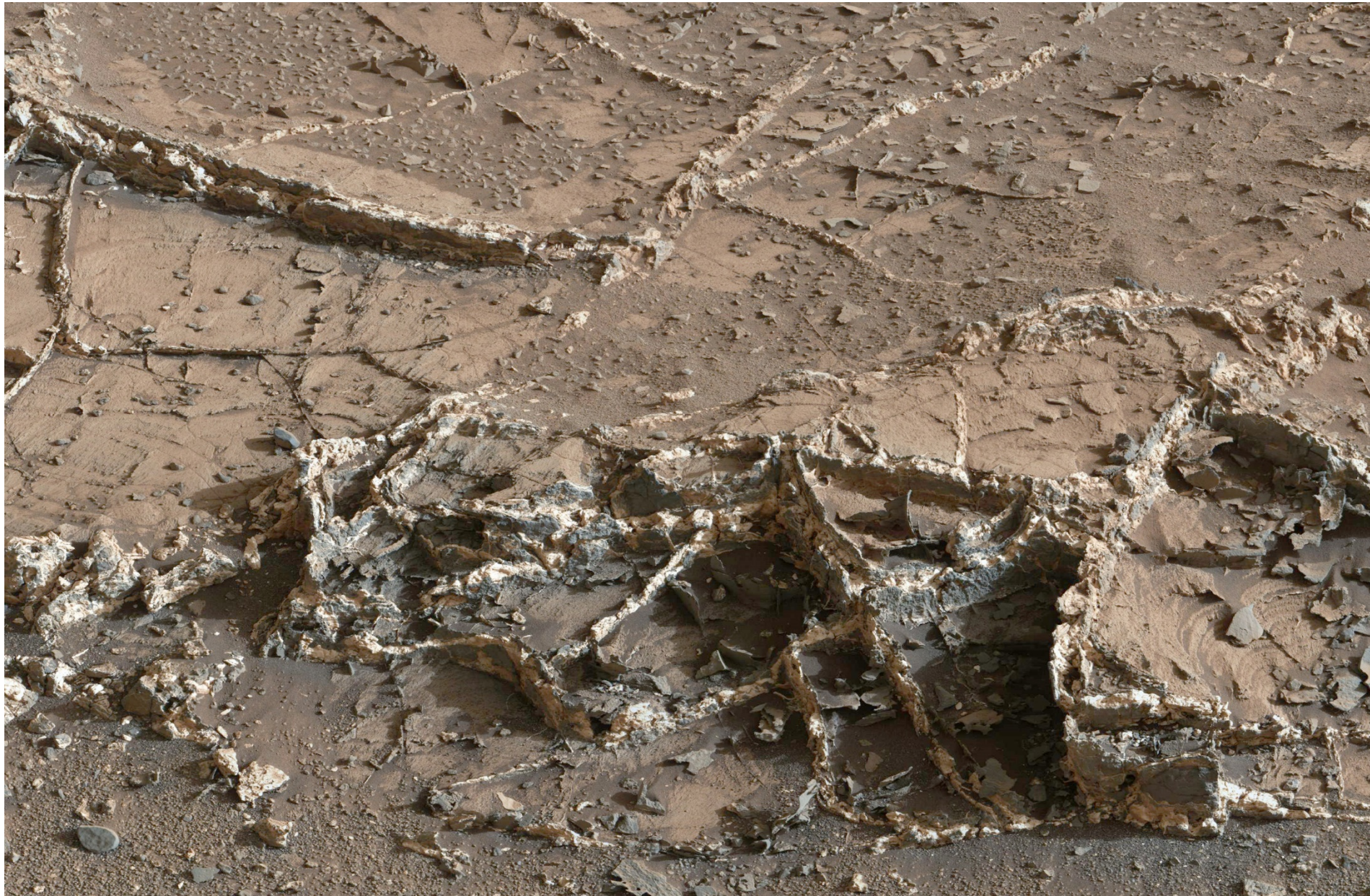
Some rocks are cracked, and some of the cracks are filled with other minerals left by water flowing through the cracks.



Some rocks are cracked, and some of the cracks are filled with other minerals left by water flowing through the cracks.



The filled
cracks are
called *veins*,
more
evidence of
water on Mars



Destination:
hills with
many layers of
rock, with
different
compositions



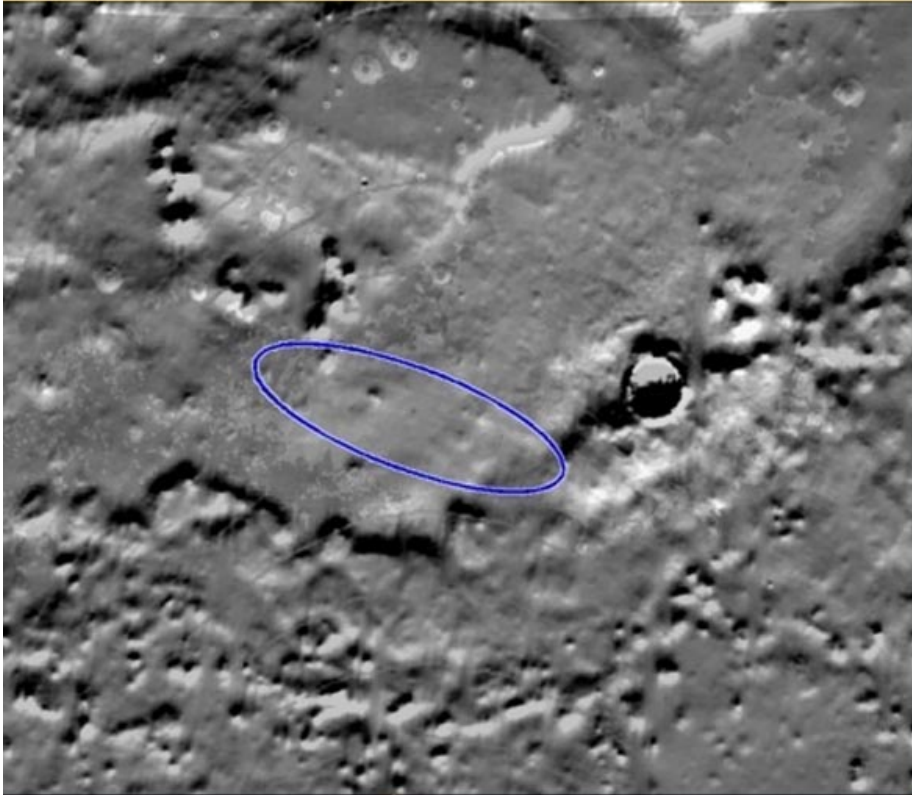
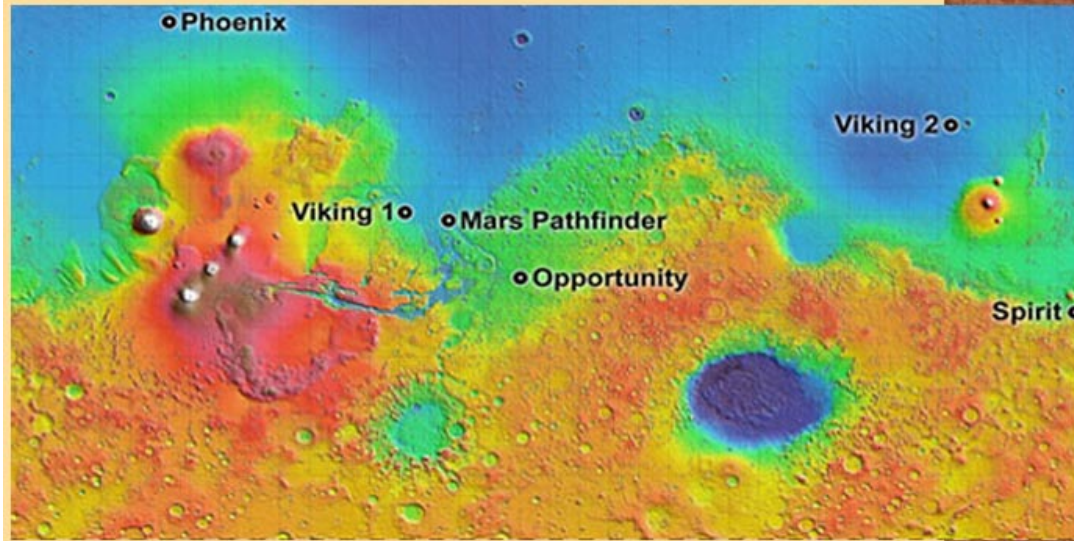
Destination:
hills with
many layers of
rock, with
different
compositions



2008:
Phoenix: sent
to find ice in
subarctic soil

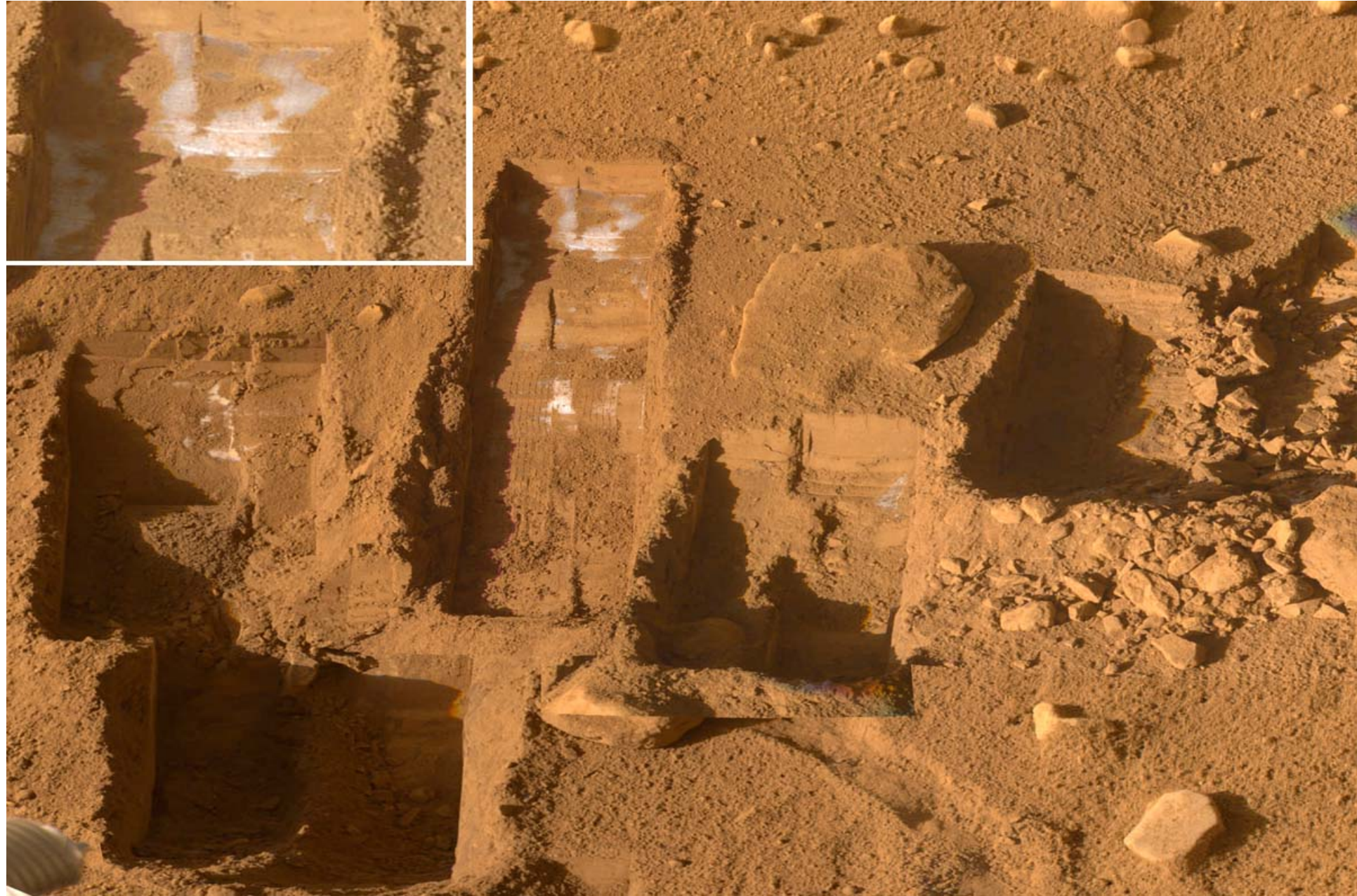


2008:
Phoenix: sent
to find ice in
subarctic soil



Phoenix dug in the soil and found ice only 10 cm down.

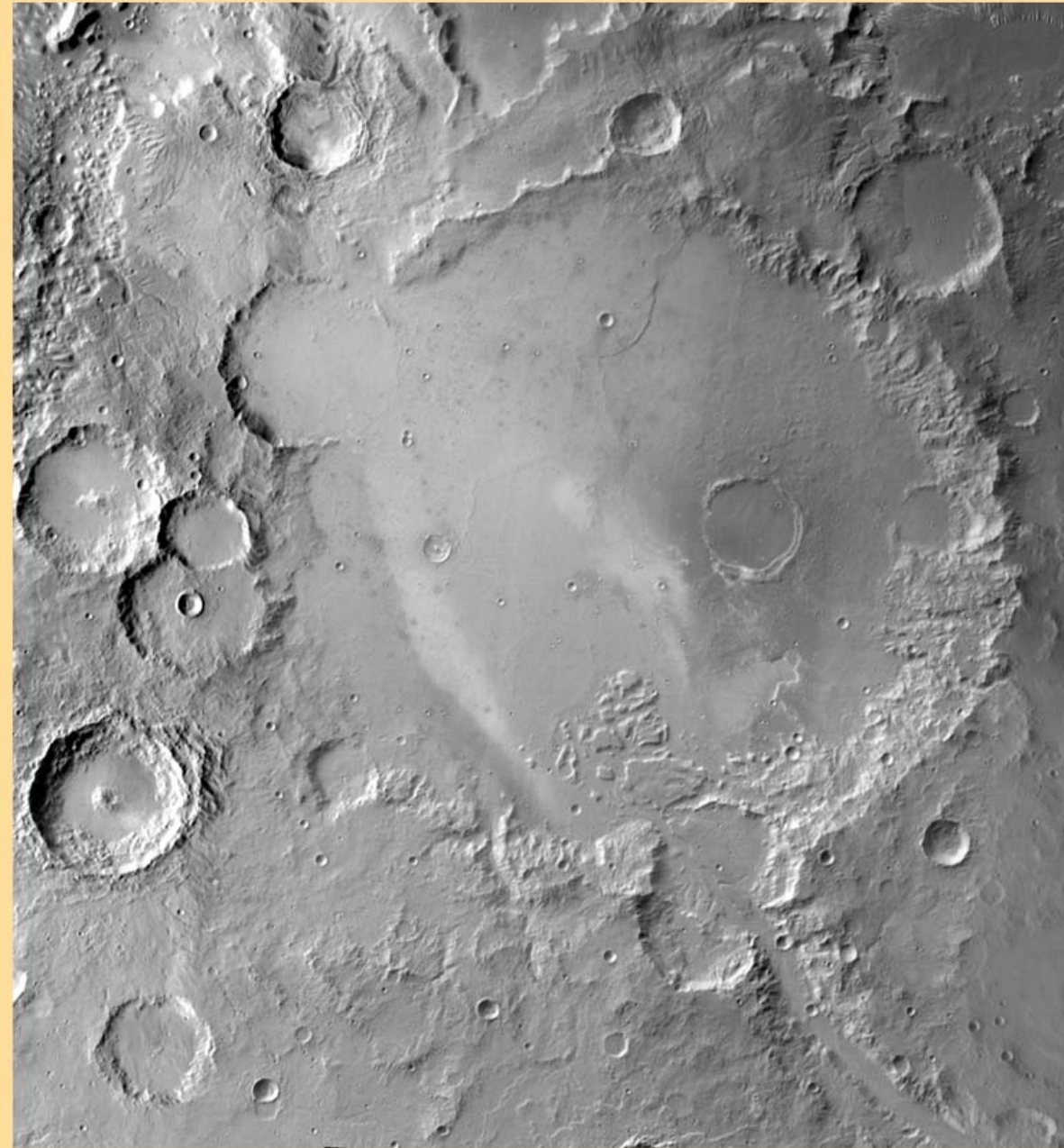
Chlorine in the soil would be damaging to living things.



The rocket thrusters blew soil away, exposing ice under the lander.

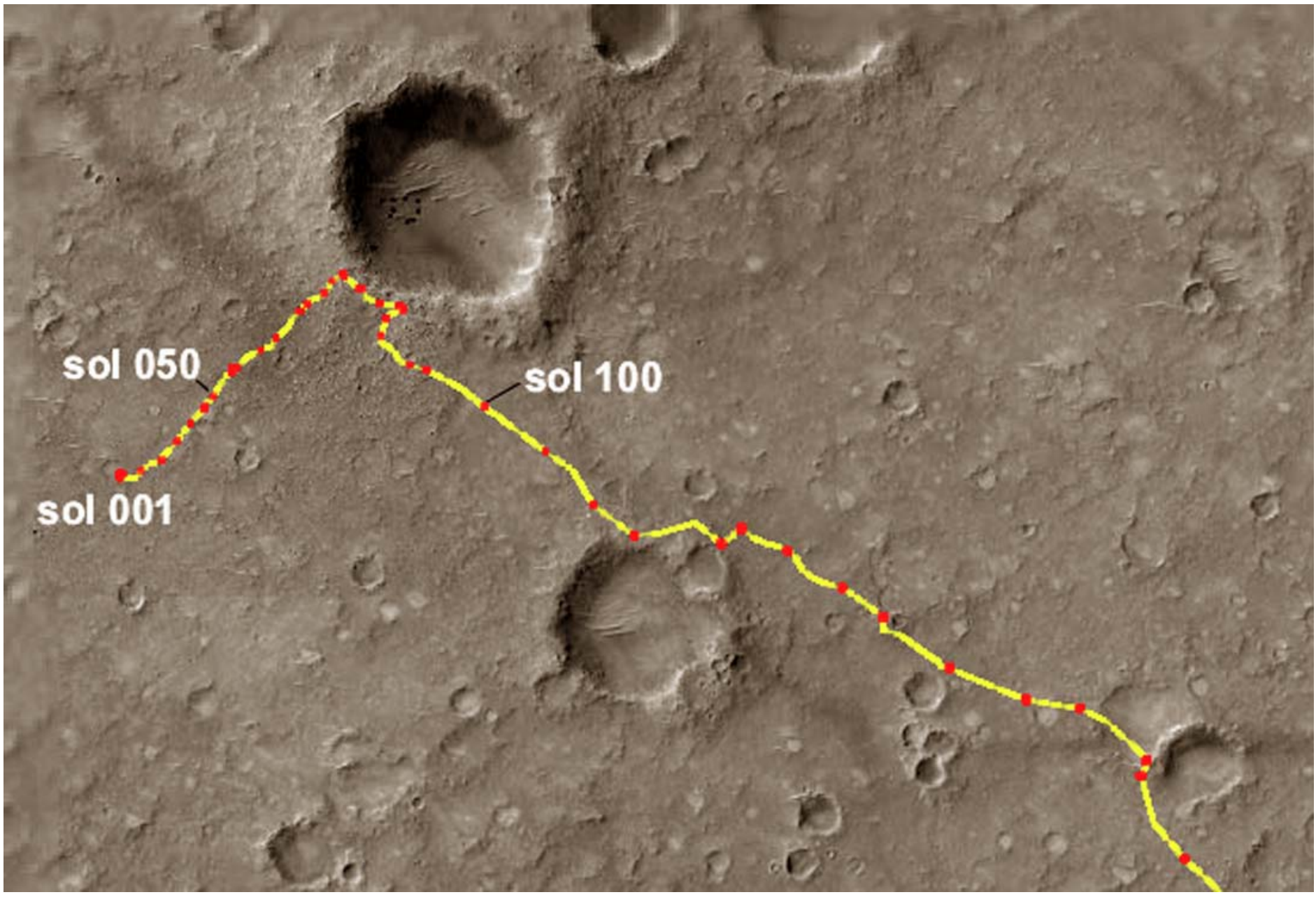


2004: Spirit
lands in what
is supposed to
be a dry lake
bed.



The rocks are not lake sediments but lava flows.

Did the nearby crater dig through lava to older rocks?

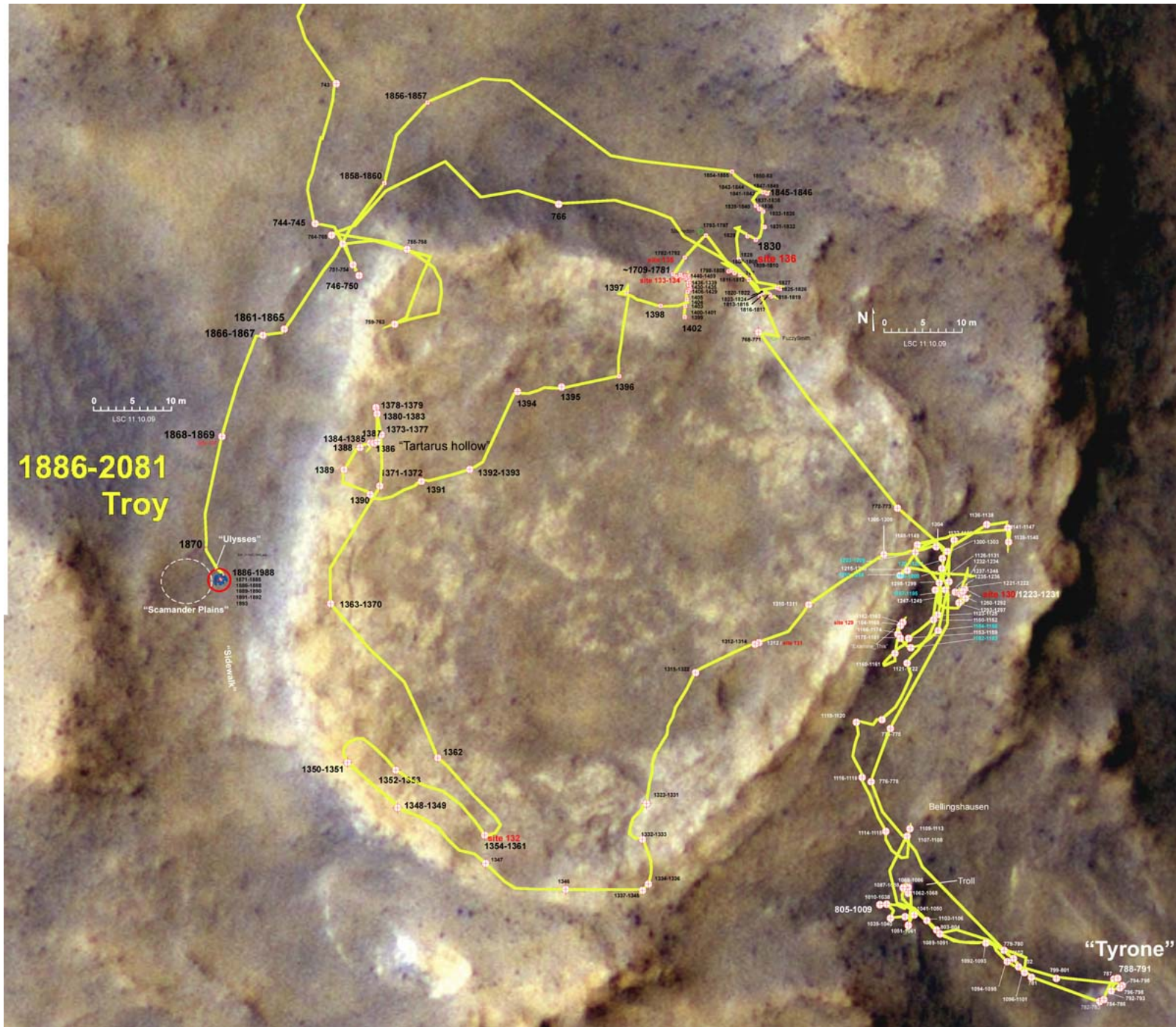


No! Only lava
on the crater
rim. But do
those hills
3000 m away
contain older
rocks?



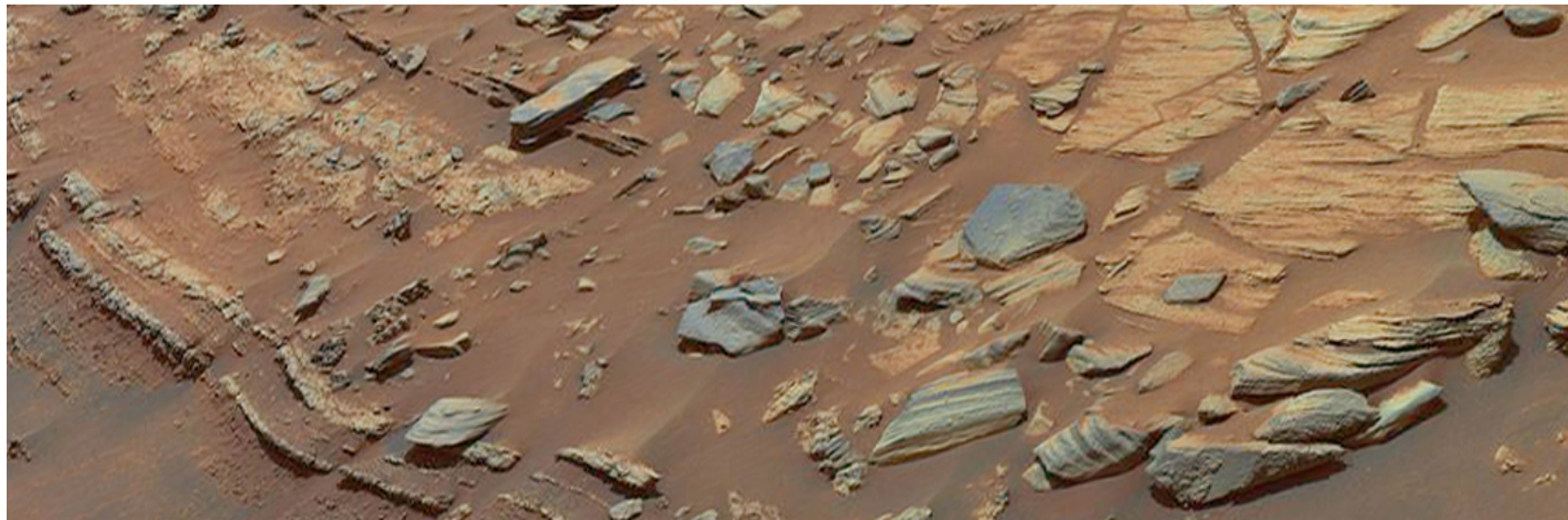
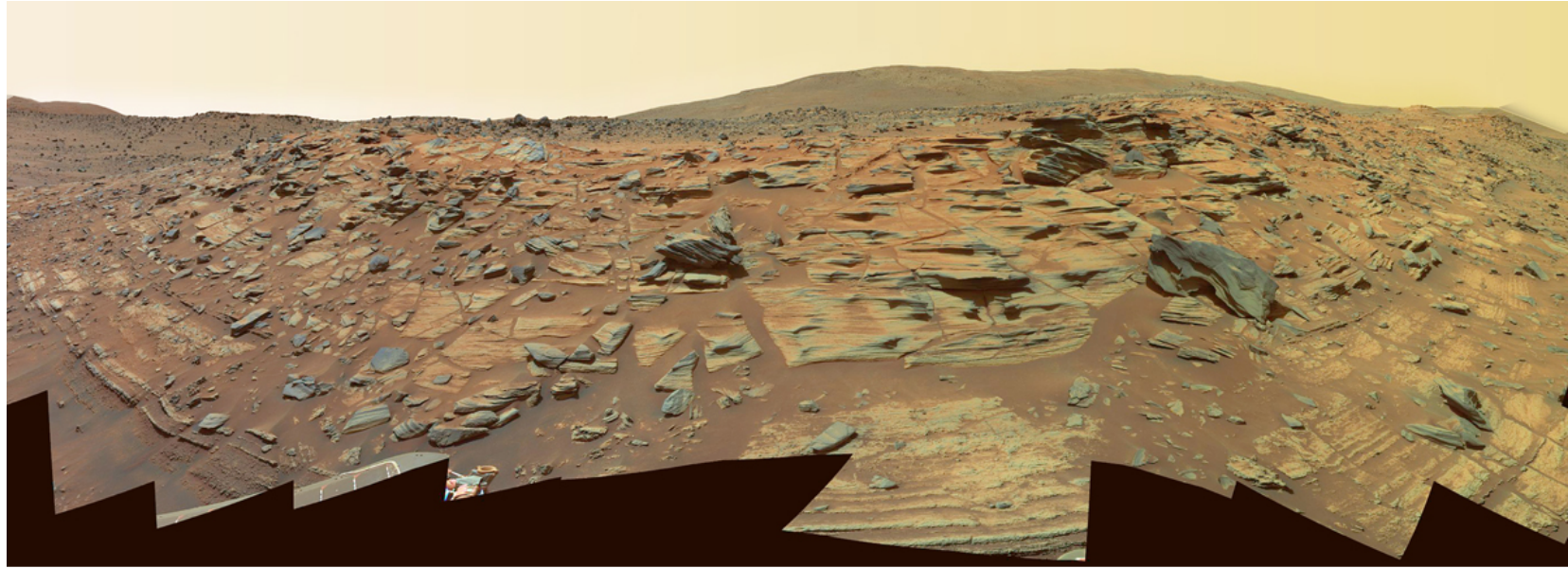
Spirit climbed the hills. They are not lake sediments but might have been wet in the past.

On the other side of the hill Spirit found an old volcanic vent.

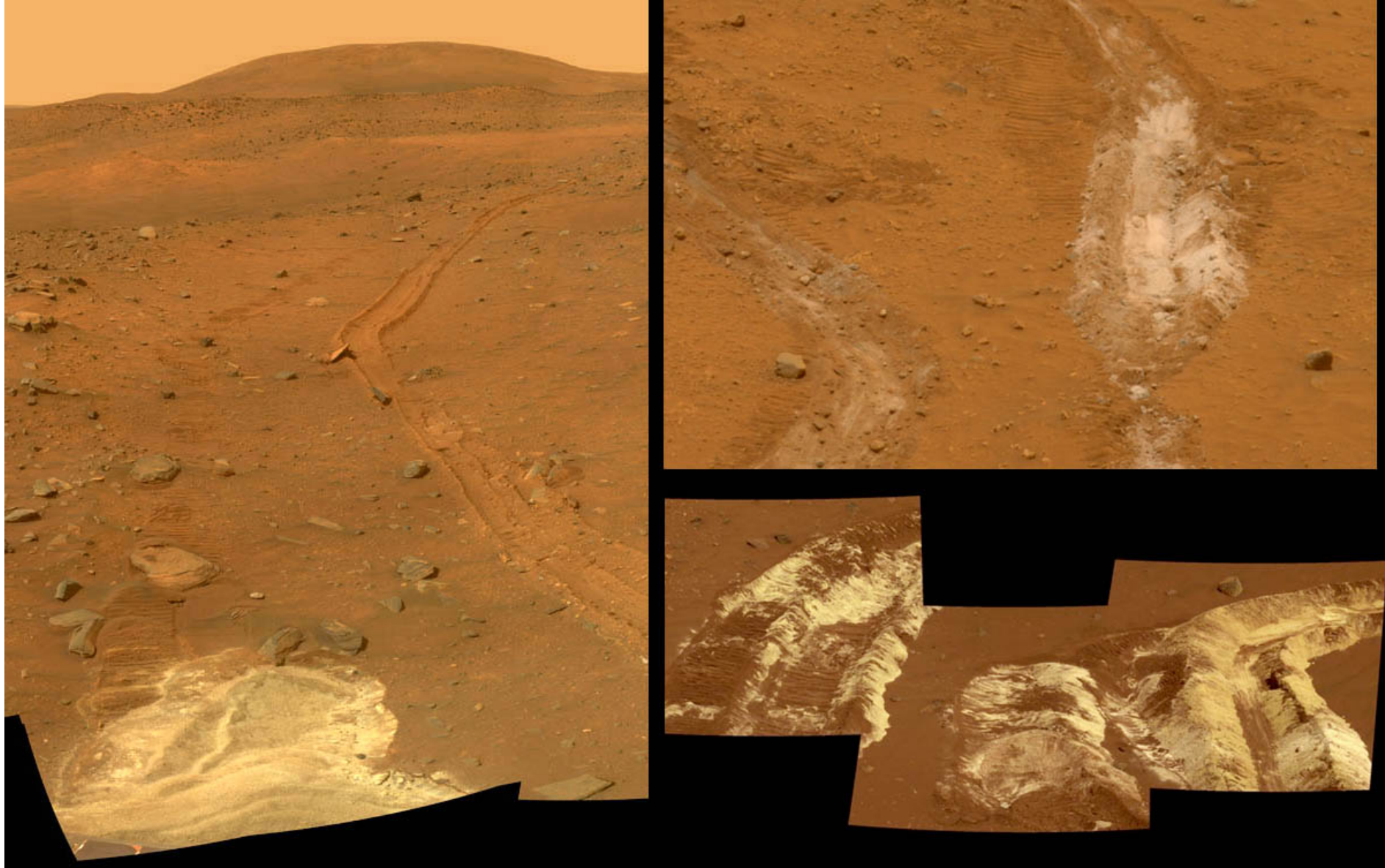


These rocks showed signs of being volcanic ash deposited in water.

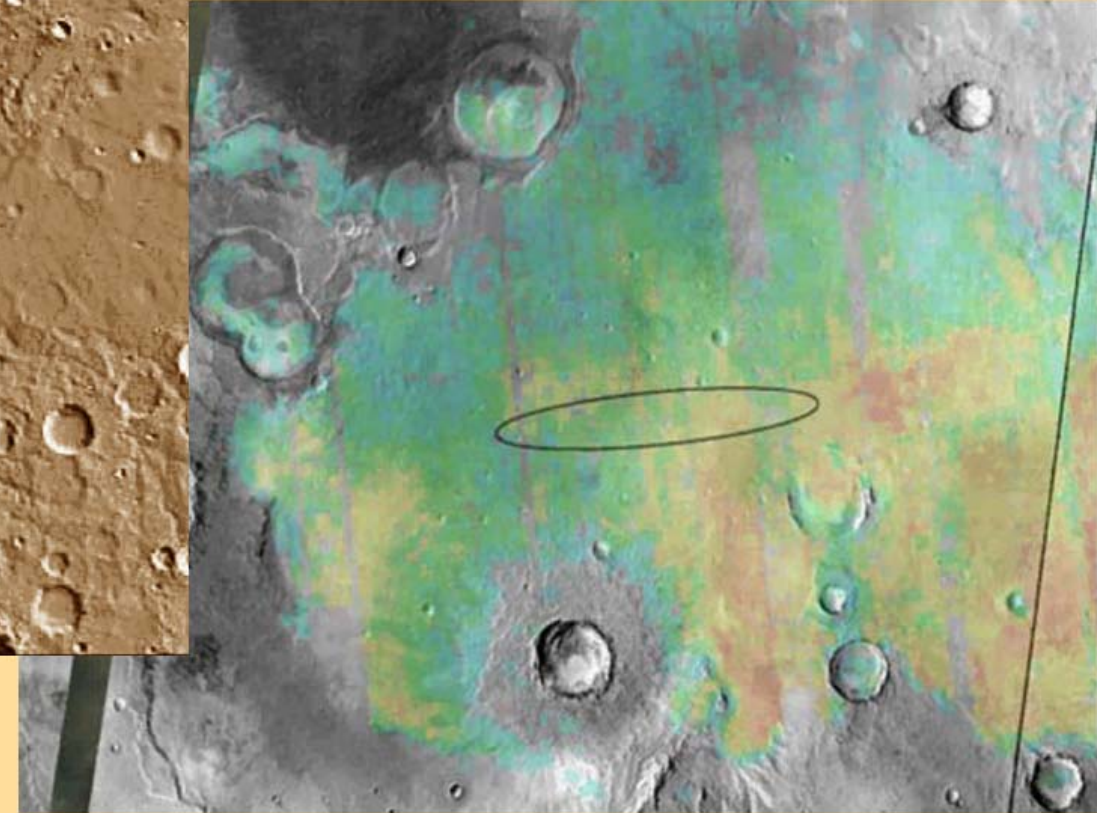
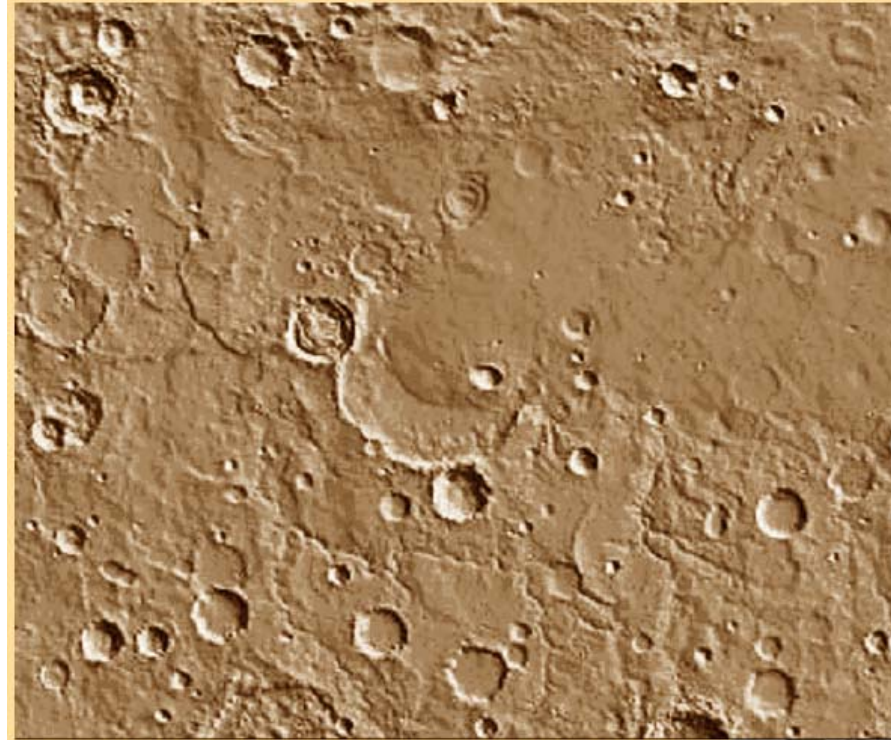
Spirit stopped working here in 2010.



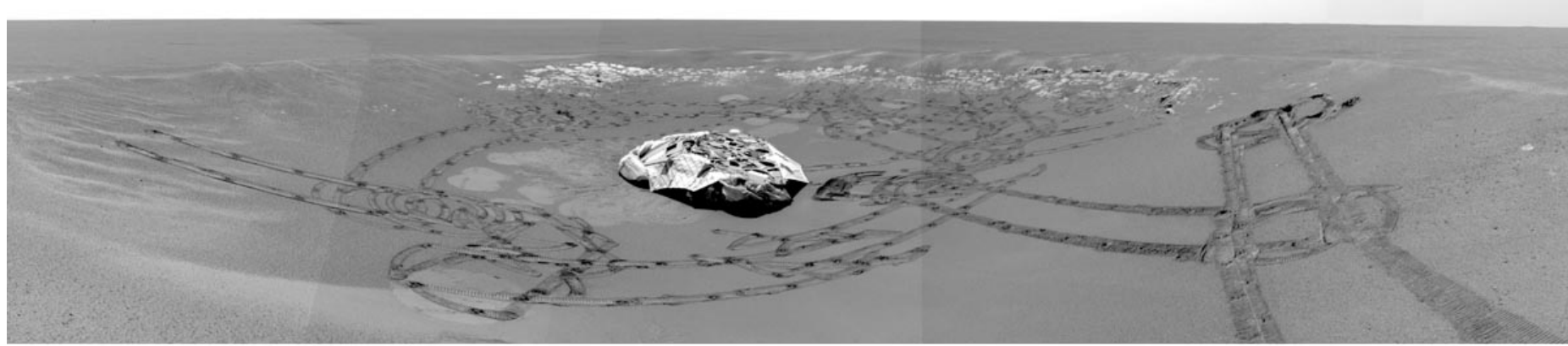
Soils in the hills and here often contained salts (silica, gypsum, iron sulphate), possibly deposited by melting snow.



2004:
Opportunity
was sent to
study a deposit
of hematite
(iron oxide)
deposited by
water.

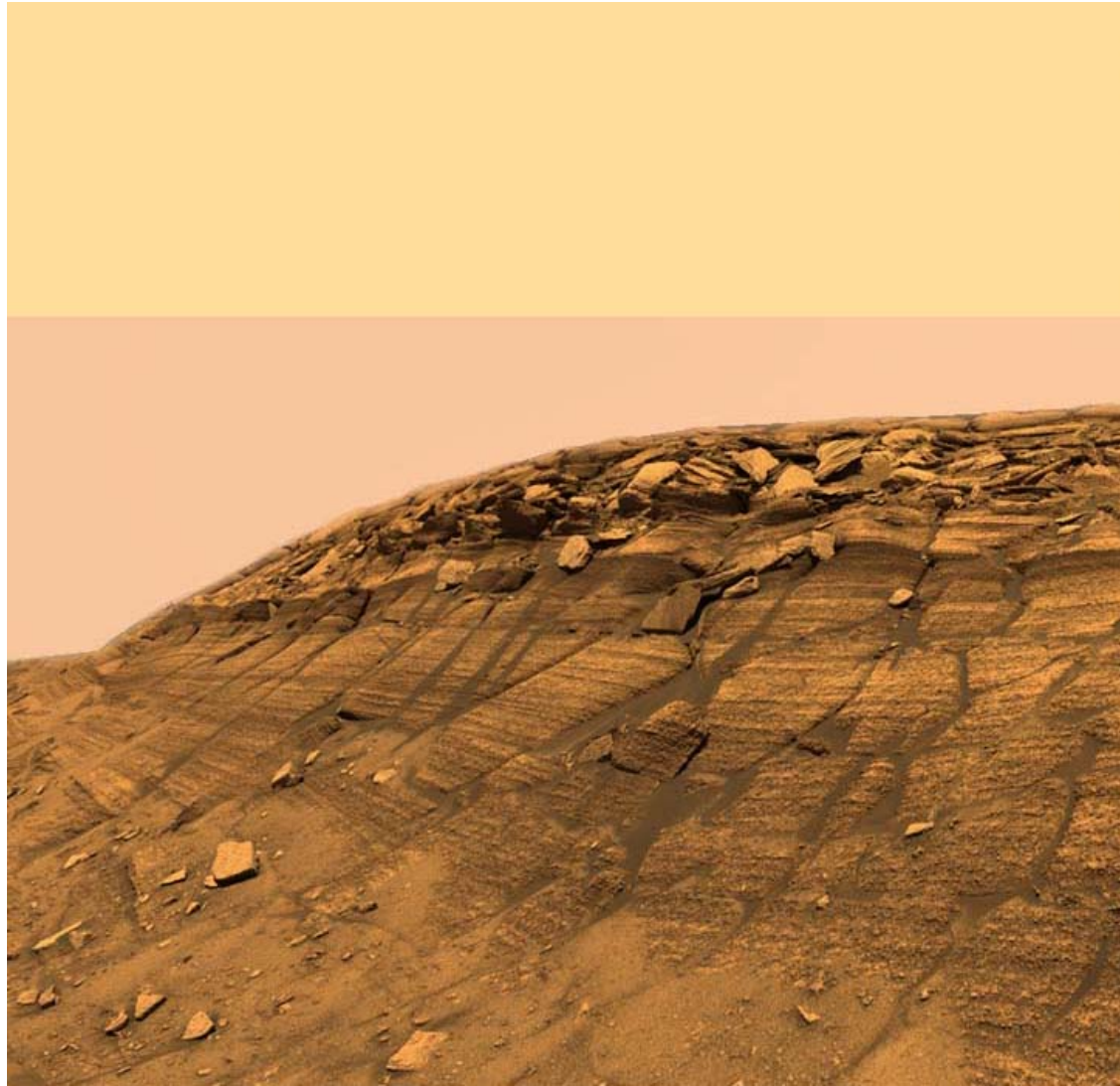


Hematite found
in the first few
days, in little
round grains
deposited long
ago by water
soaked in the
ground.

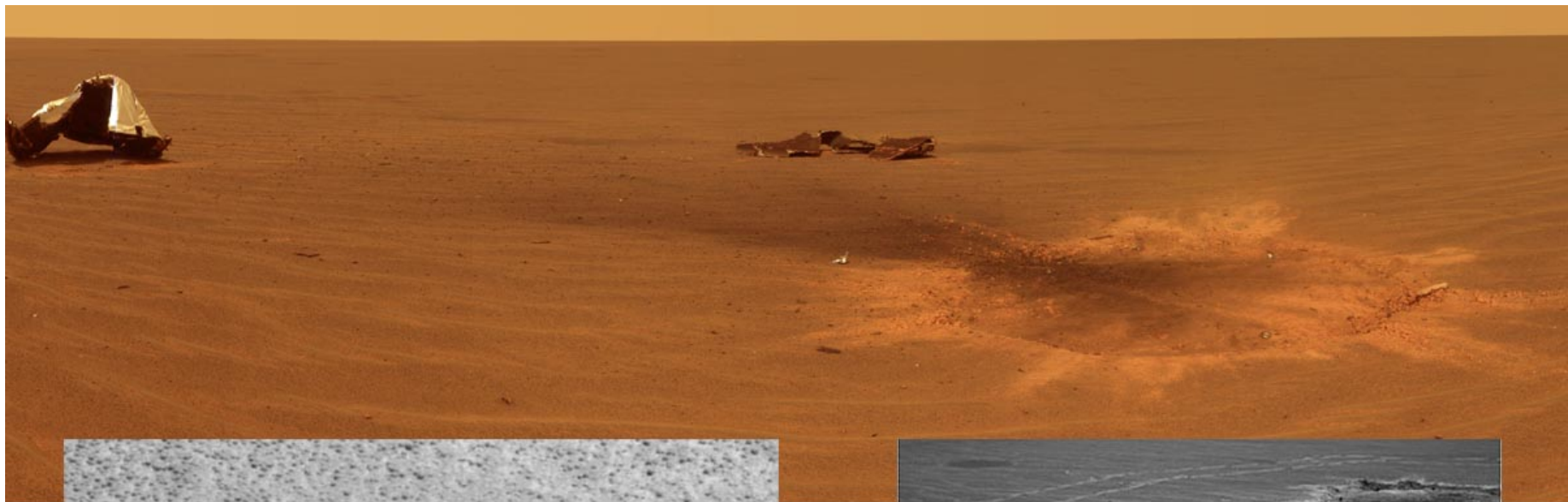


Eagle crater, rock
layers 30 cm
deep

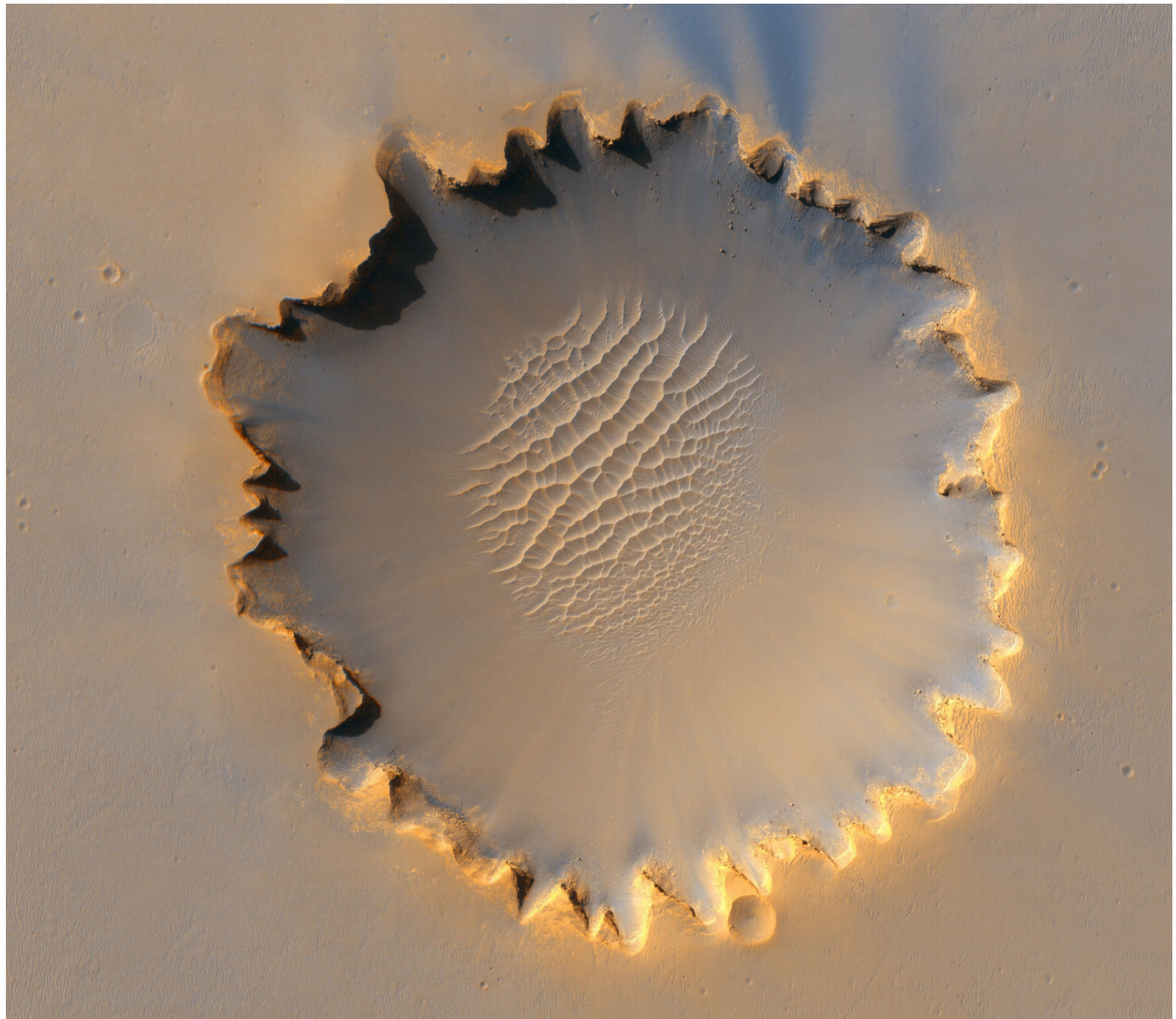
A nearby crater exposes layers of rock a metre deep, also affected by water, but very acidic water, not good for living things.



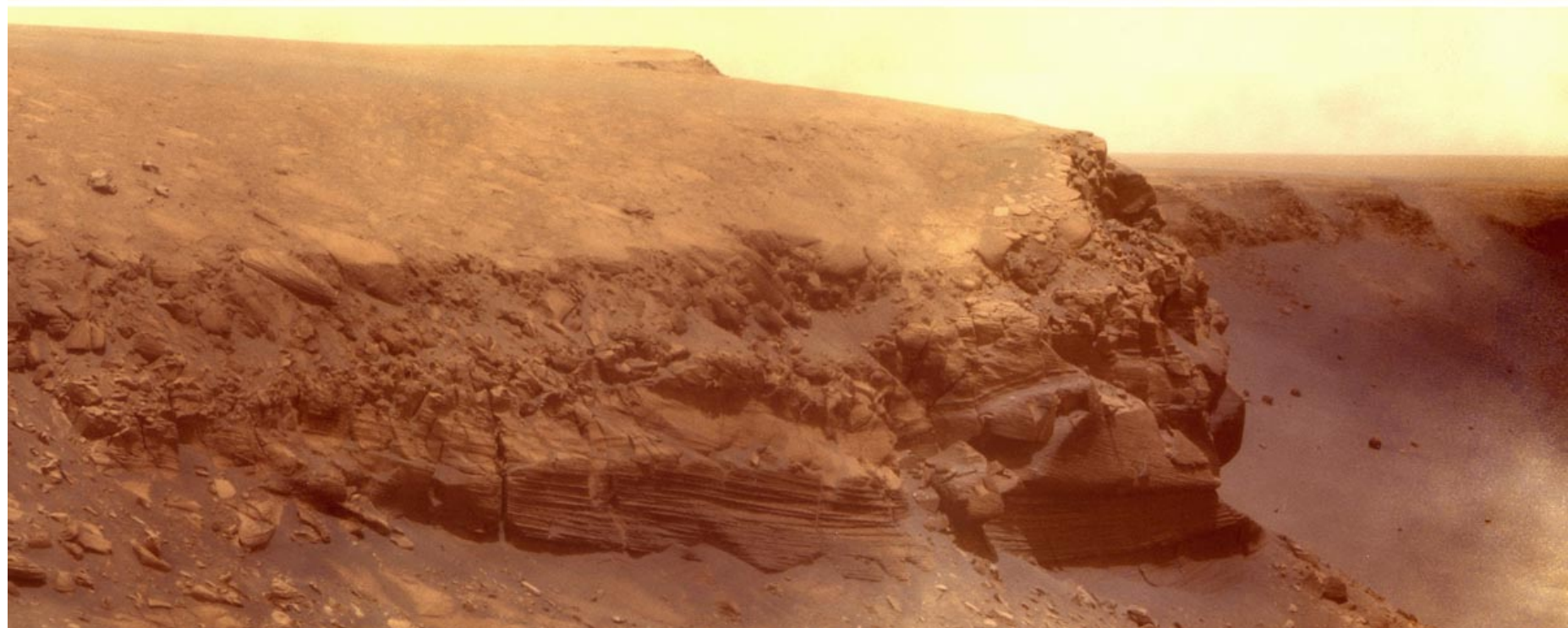
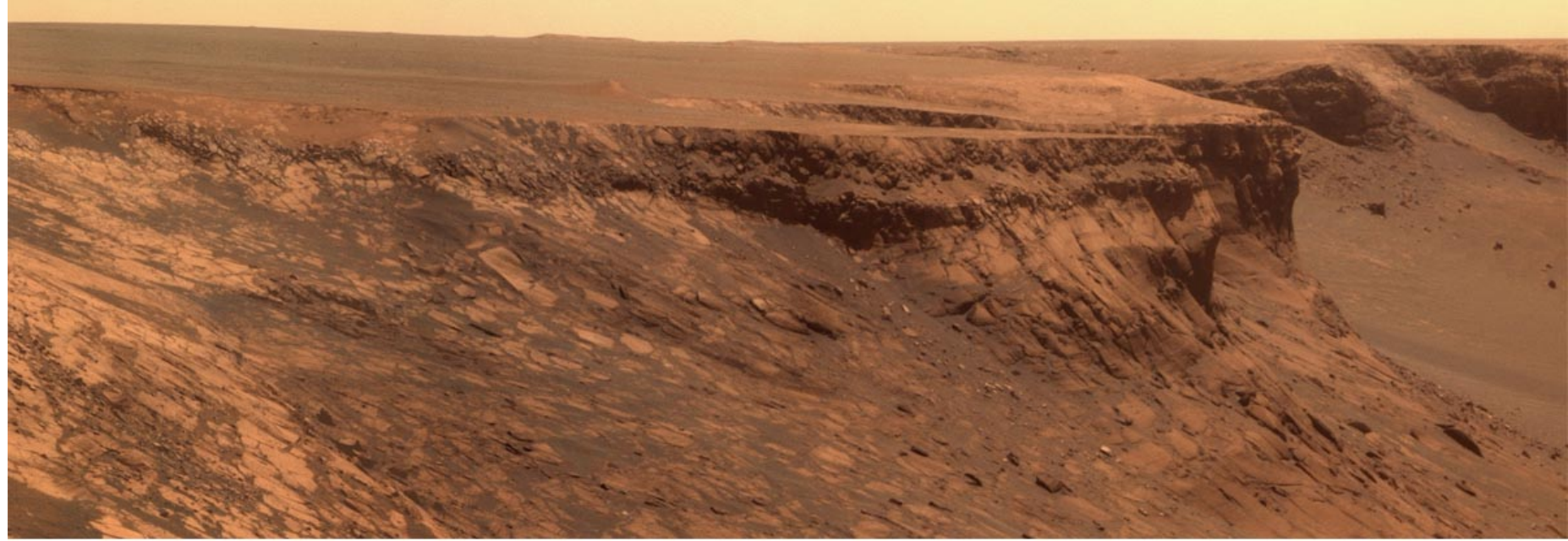
Opportunity sets off to look at a bigger crater, sees its heatshield and an iron meteorite



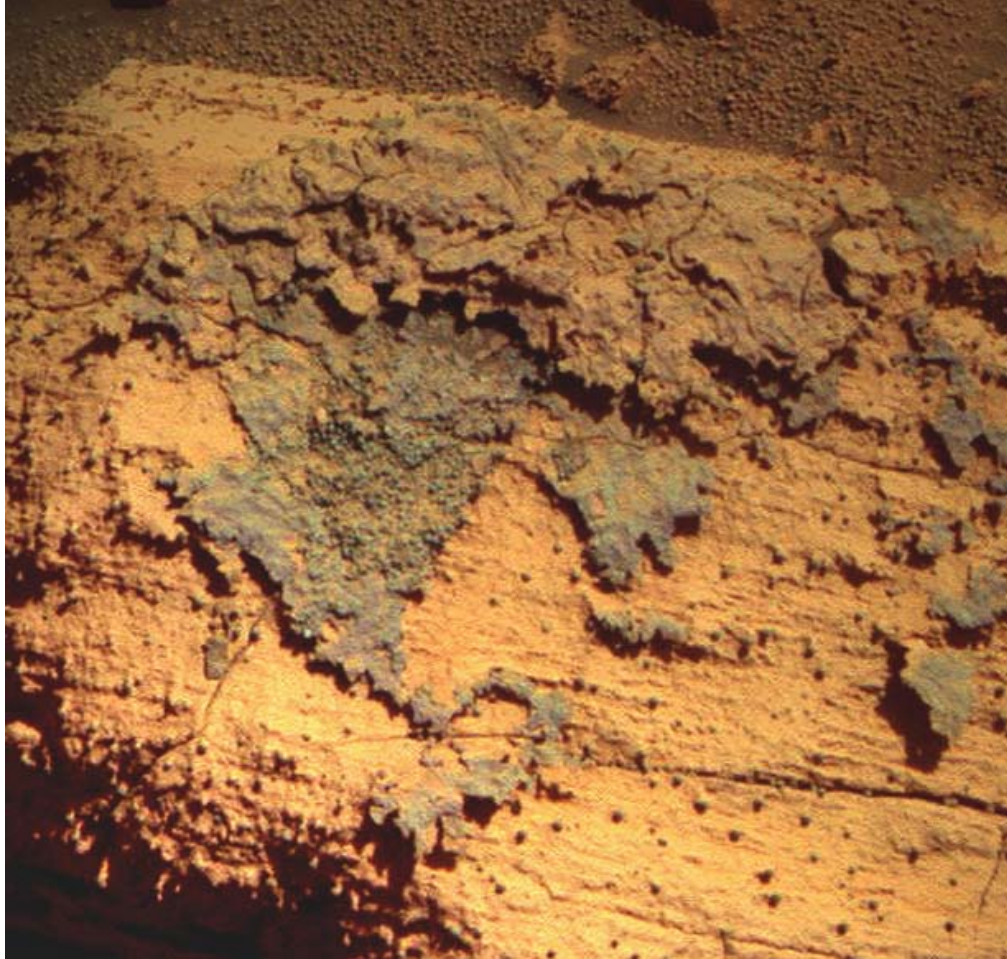
Victoria crater
exposes 10 m
of rocks. Each
crater digs
deeper into
buried layers of
rock.



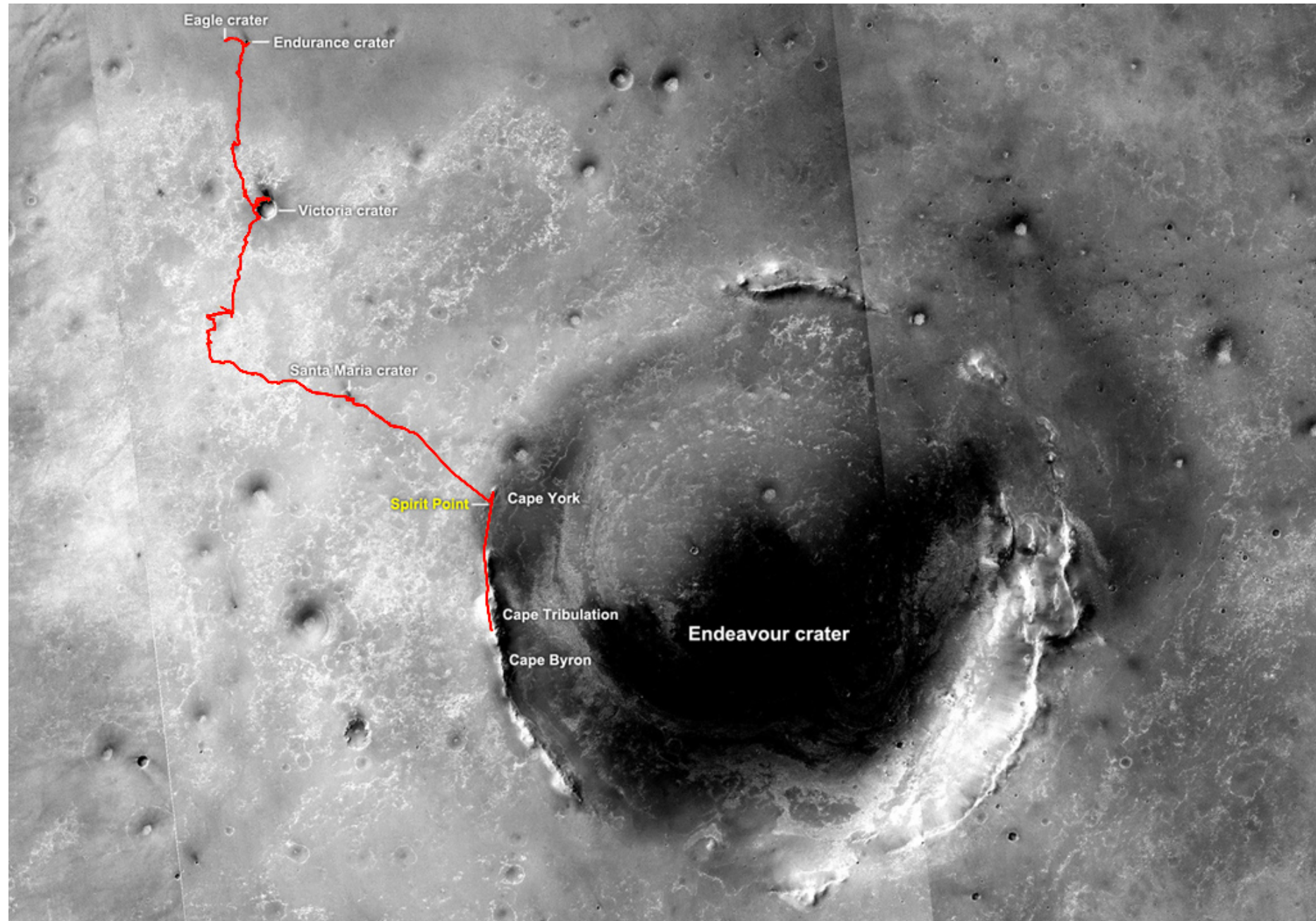
Victoria crater
exposes 10 m
of rocks. Each
crater digs
deeper into
buried layers of
rock.



South from
Victoria,
different kinds
of rocks.
Flaky layers
deposited in
cracks by
water, and
more iron
meteorites

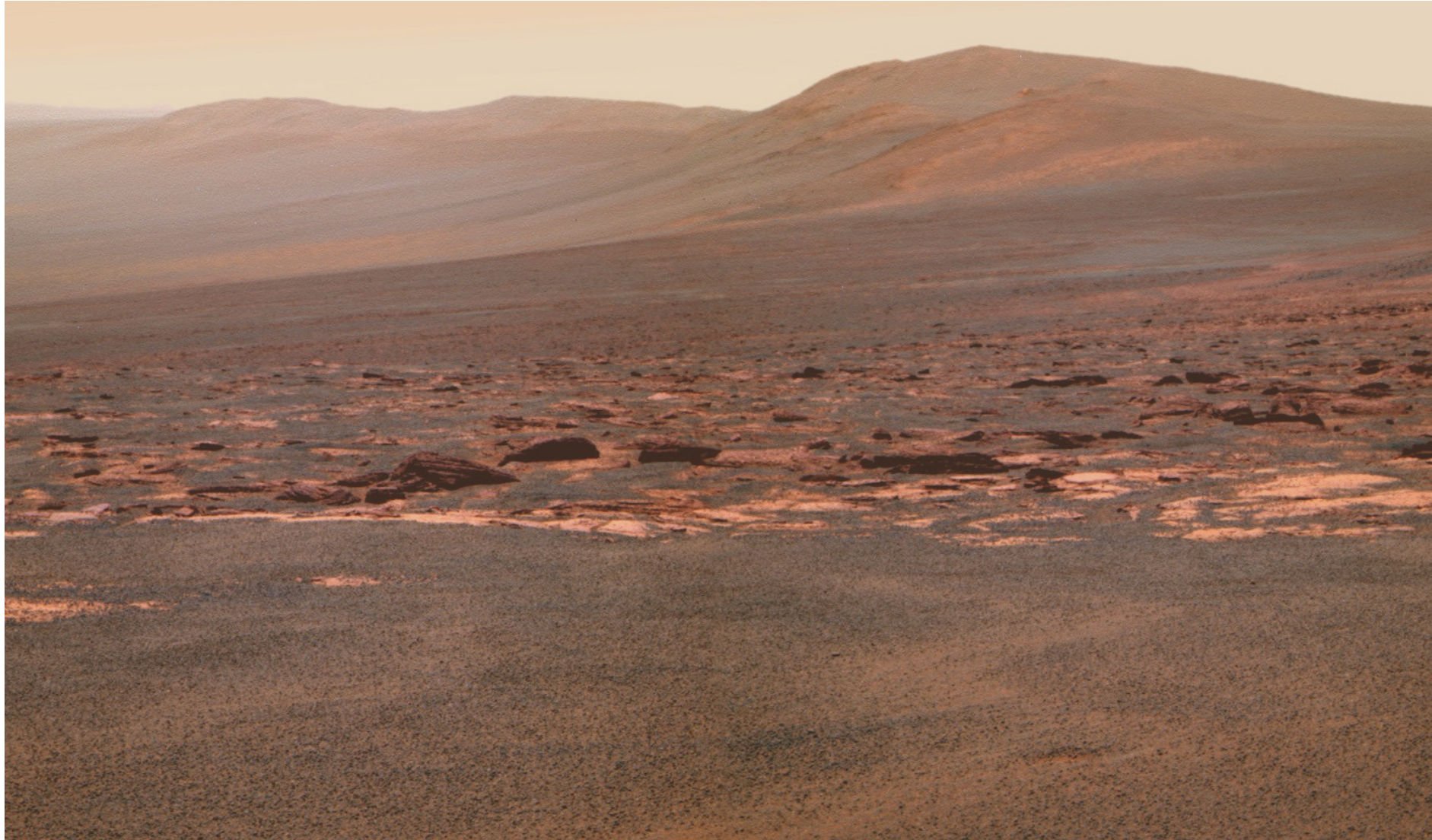


From Eagle to
Endurance,
Victoria – and
now Endeavour,
a 20 km crater
with mountains
of ancient rocks
very different
from the plains.



Mountains
form the rim of
the crater,
sticking up
through the
younger rocks
of the plains.

Old rocks, a
record of long
ago on Mars.



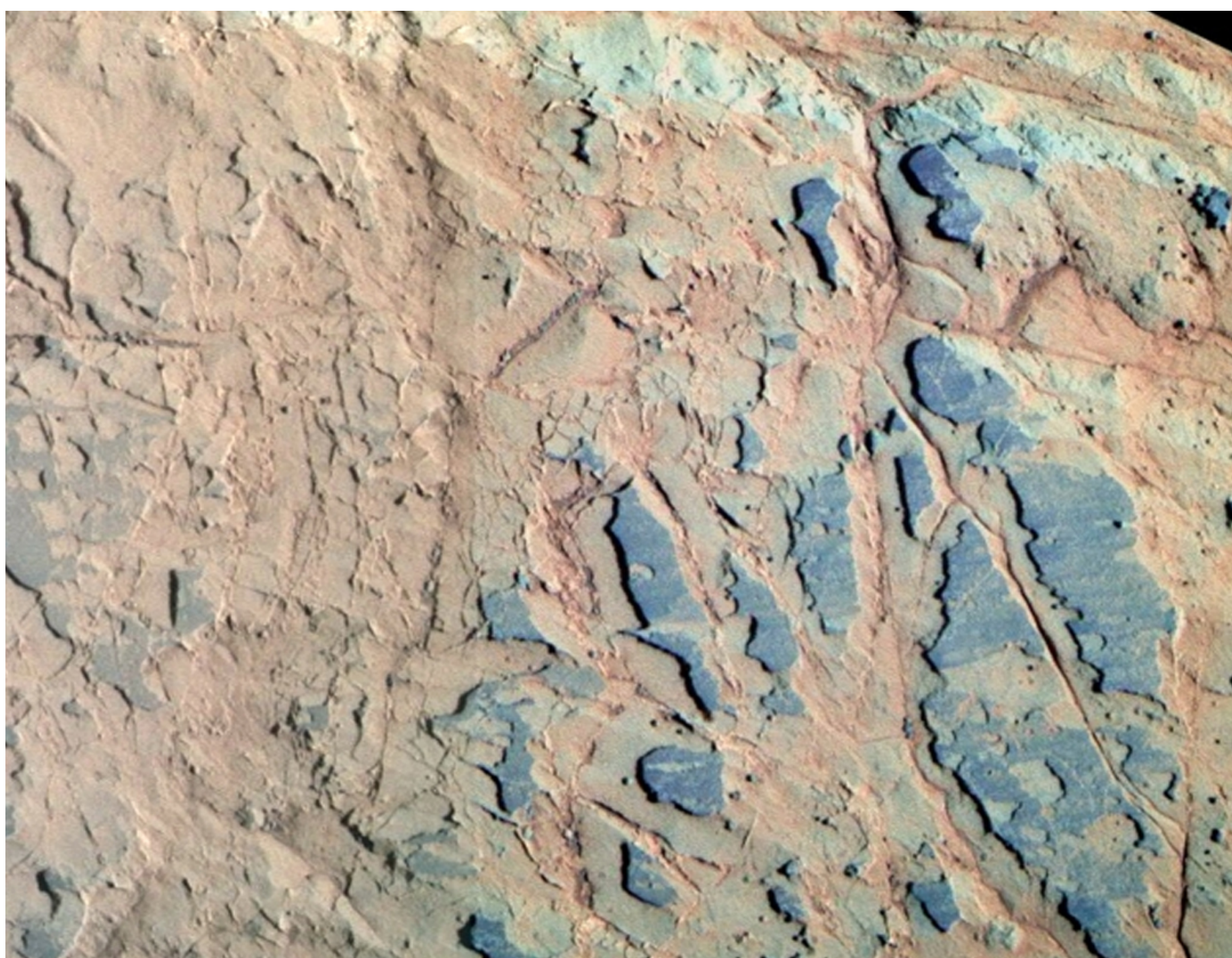
At the first science site, very unusual rocks on Matijevic Hill – veins and coatings on the rock.



This rock has a blue-grey coating, now being eroded away. It seems to contain clay.

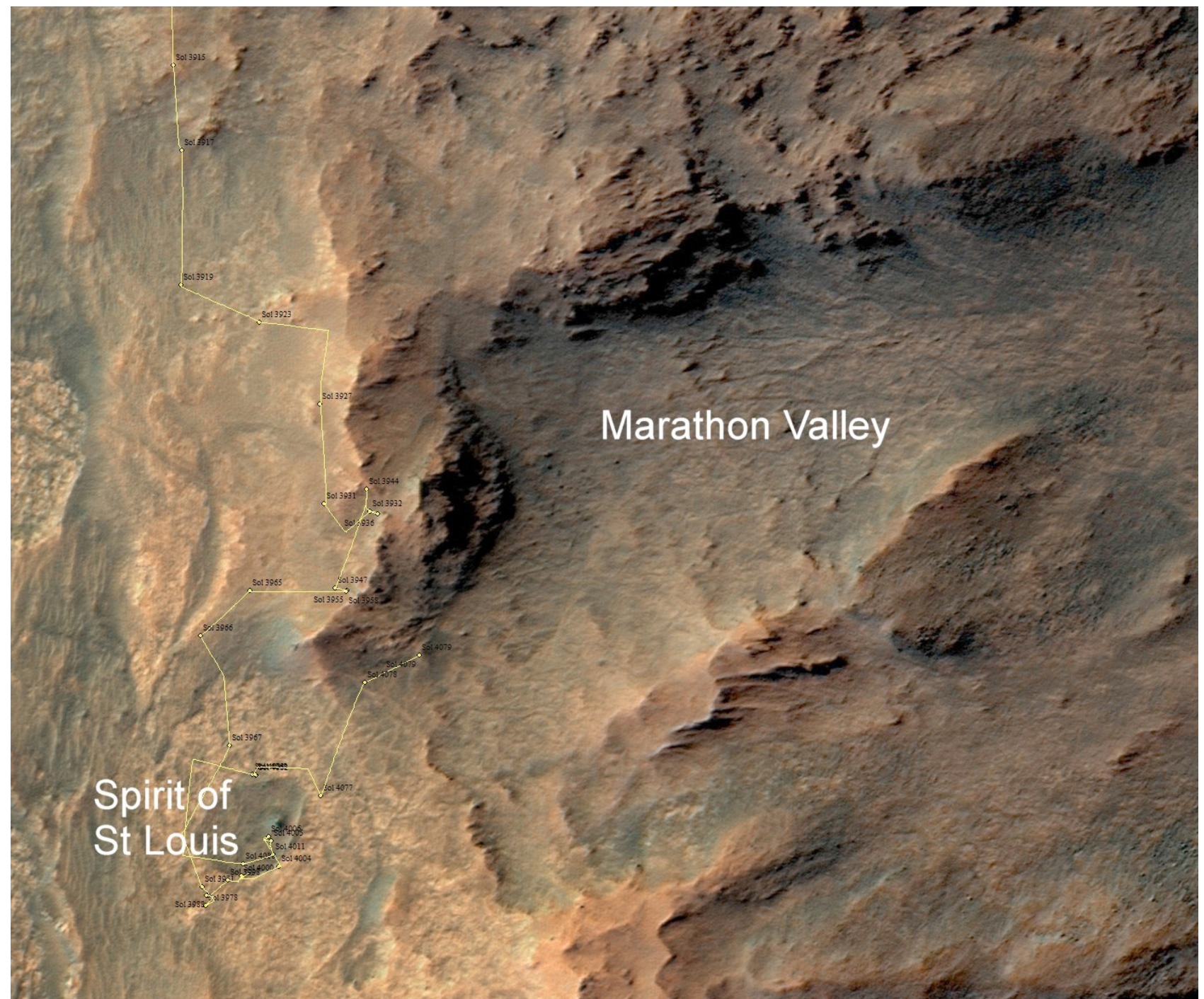


Clay is another sign of water, chemically reacting with older rocks.



Even more clay is detected from orbit in Marathon Valley, Opportunity's current location.

Can the rover find it?



Marathon Valley – where is the clay?



Opportunity
will spend
several months
searching for
clay and other
old rocks in
this valley.

