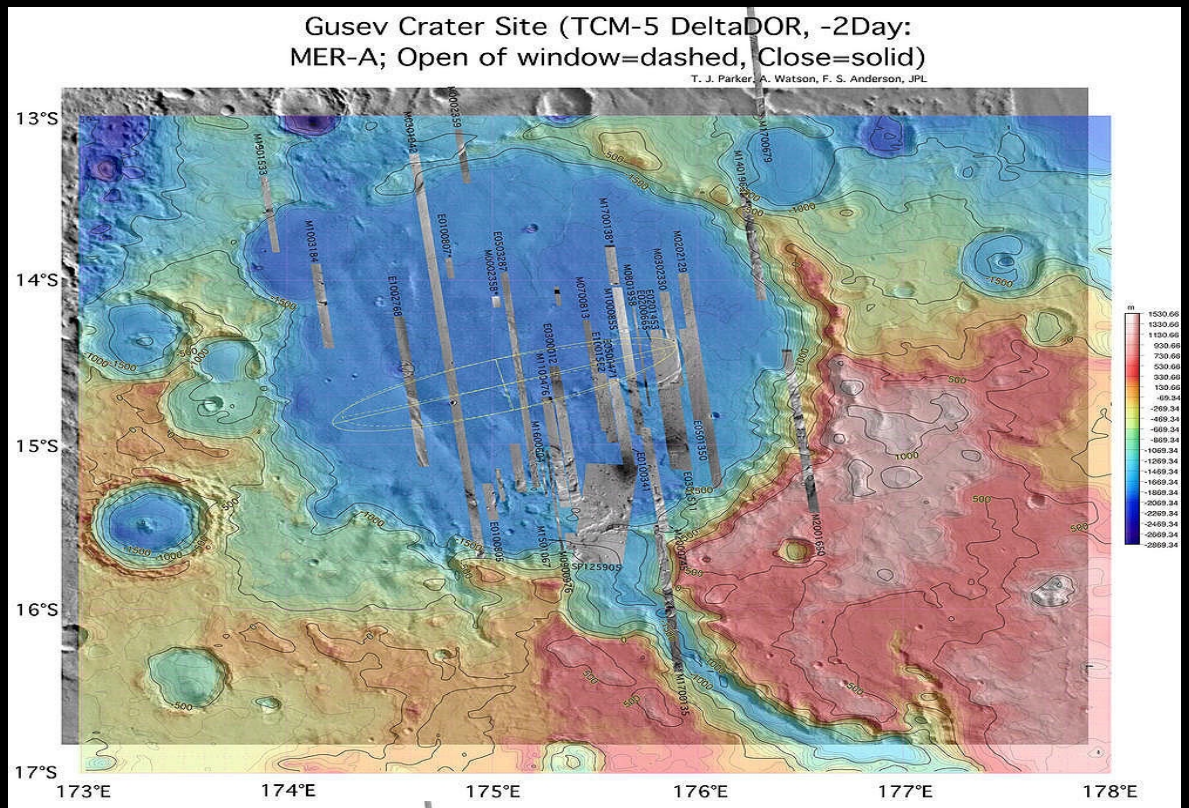
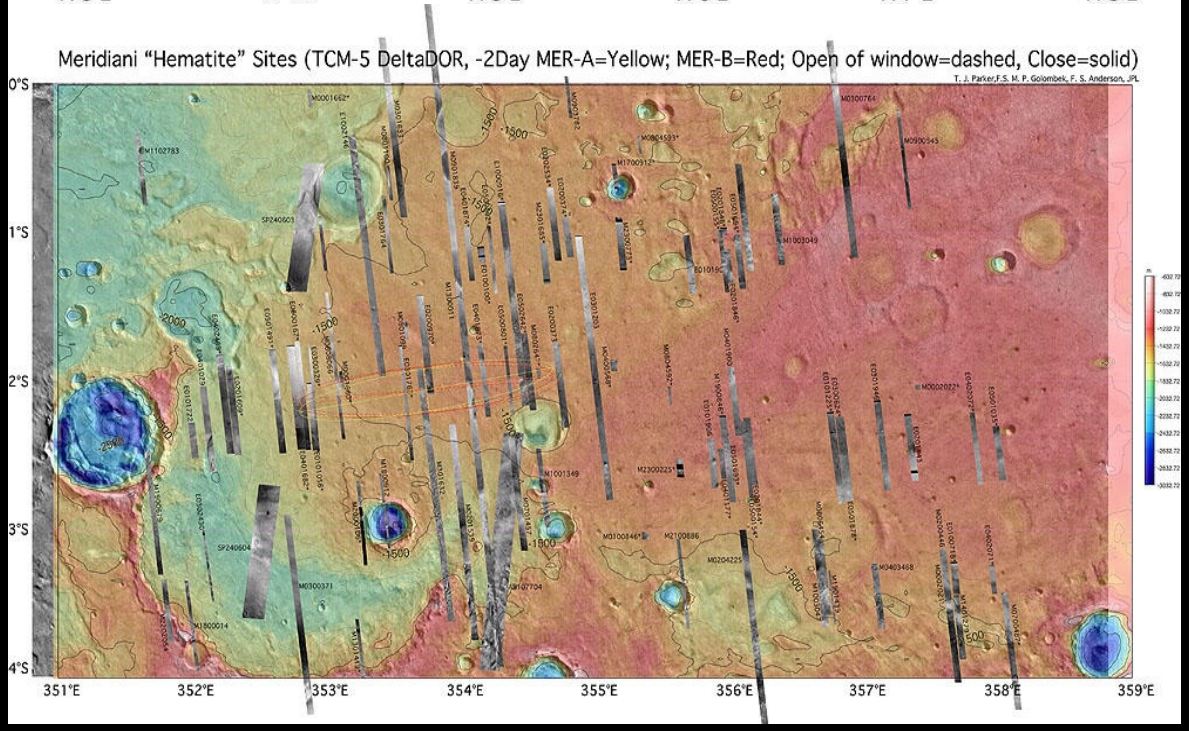
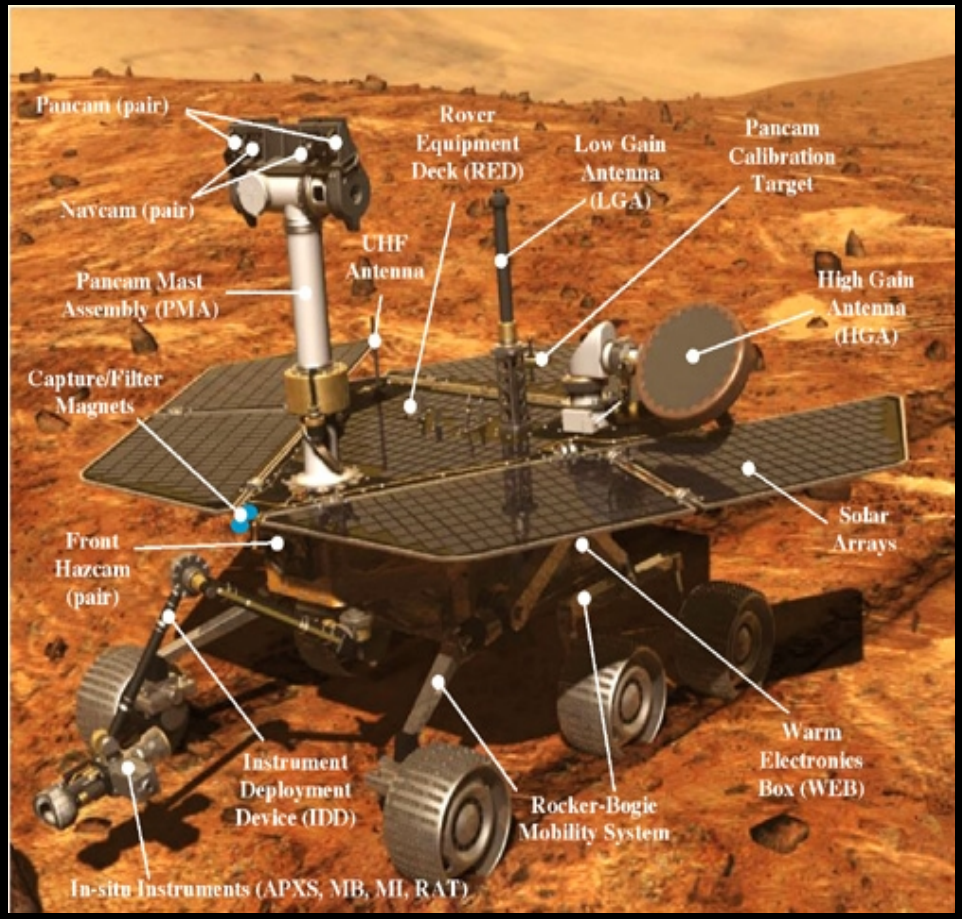
1000 sols with Spirit





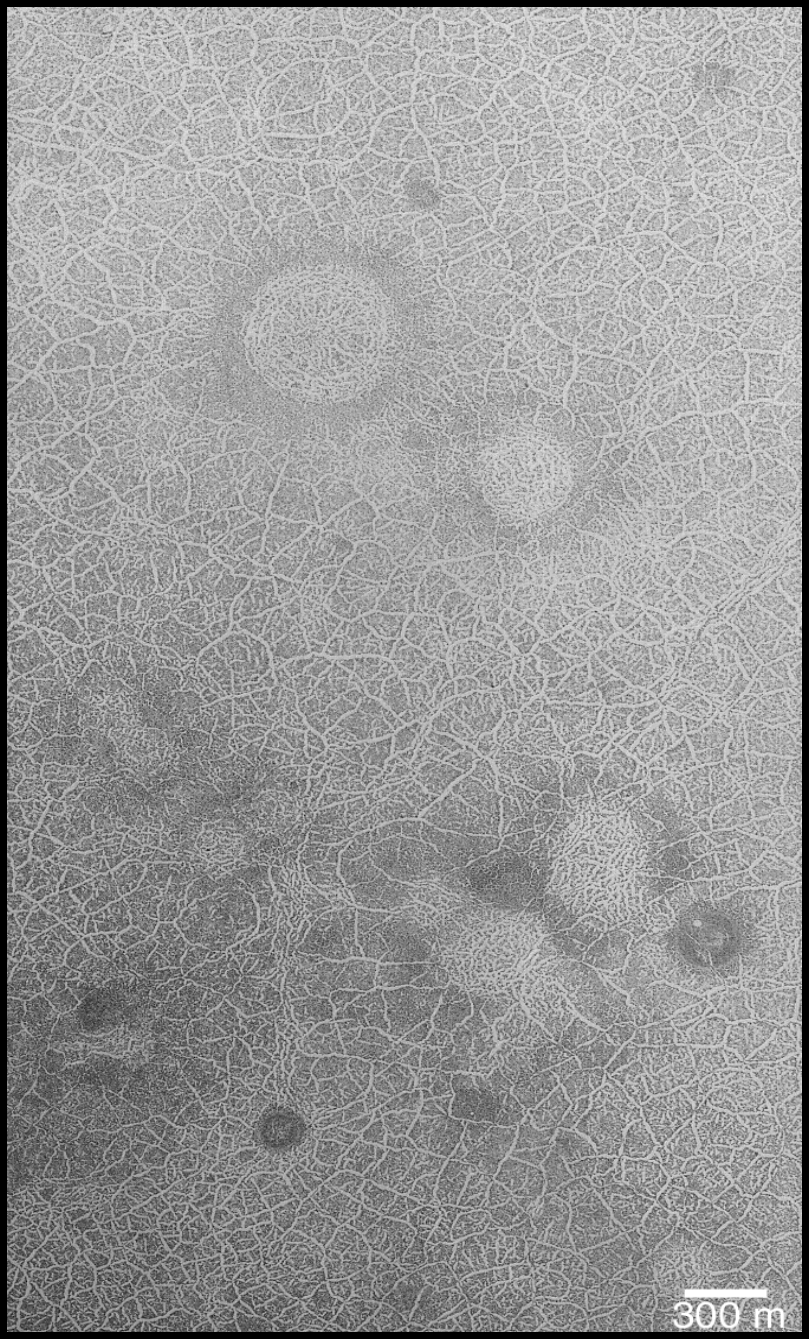
- The NASA's twin robot geologists, Mars Exploration Rovers, Spirit and Opportunity, were launched toward Mars on June 10 and July 7, 2003, in search of answers about the history of water on Mars.
- They landed on Mars January 4 and January 25 UTC
- They were designed to work for 90 days on the martian surface.
- Their primary scientific goals were to search for and characterize a wide range of rocks and soils that hold clues to past water activity on Mars.
- Rovers were targeted to sites on opposite sides of Mars that appear to have been affected by liquid water in the past: Gusev Crater, a possible former lake in a giant impact crater, and Meridiani Planum where mineral deposits (hematite) suggest Mars had a wet past.

Rovers' primary science instruments:



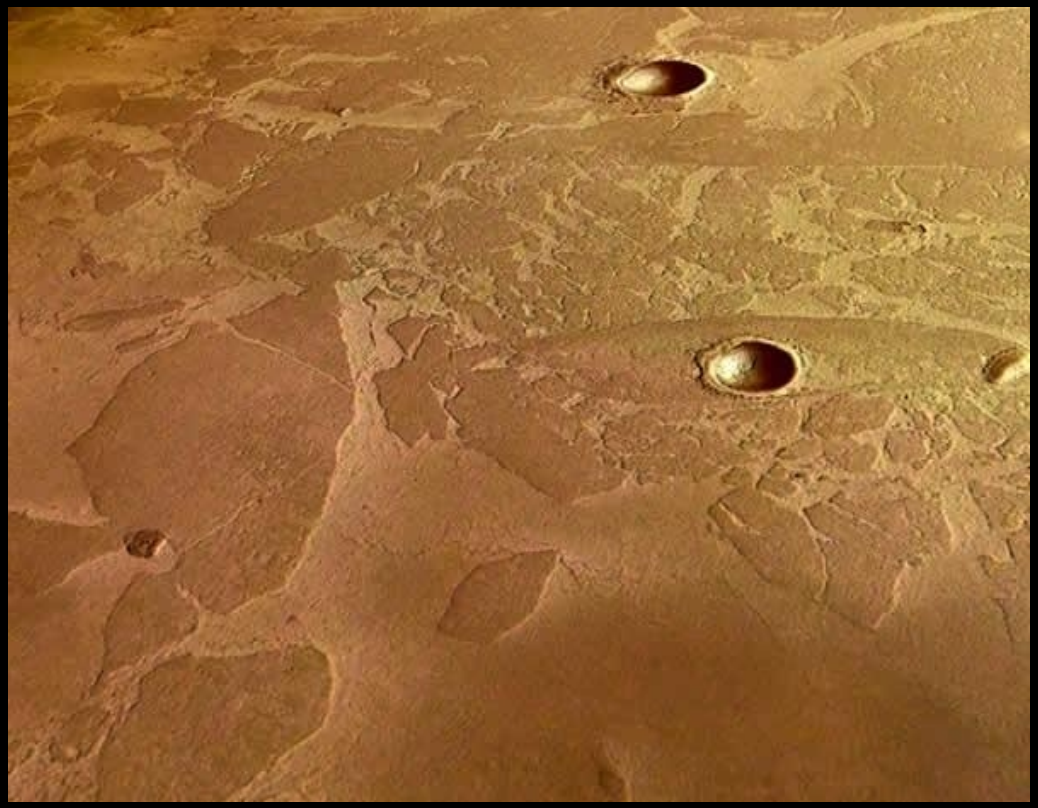
- Panoramic Camera (Pancam) for determining the mineralogy, texture, and structure of the local terrain.
- Miniature Thermal Emission Spectrometer (Mini-TES) for identifying promising rocks and soils for closer examination and for determining the processes that formed Martian rocks.
- Mössbauer Spectrometer (MB) for close-up investigations of the mineralogy of iron-bearing rocks and soils.
- Magnets for collecting magnetic dust particles.
- Microscopic Imager (MI) for obtaining close-up, high-resolution images of rocks and soils.
- Rock Abrasion Tool (RAT) for removing dusty and weathered rock surfaces and exposing fresh material for examination by instruments onboard.

Rovers' discoveries:



- Opportunity, that nearly reached the bottom of the 160-metre-diameter Endurance crater, has found clear signs that the area was drenched twice in the past.
- It has discovered a slab of rock, which is fractured into polygonal shapes.
- On Earth, many polygons in periglacial environments are directly linked to water: they typically form from stresses induced by repeated freezing and thawing of water.
- The shapes suggest that the original sedimentary rock formed in a lake or shallow sea - which then dried and solidified - before undergoing a second wet episode and yet another drying out.
- Spectral data show that the concentration of chlorine, sodium and other soluble elements is far heavier on the surface of the rock than just beneath it, as it would be if the rock had been bathed in water long after it formed, leaching out the salts.

Rovers' discoveries:



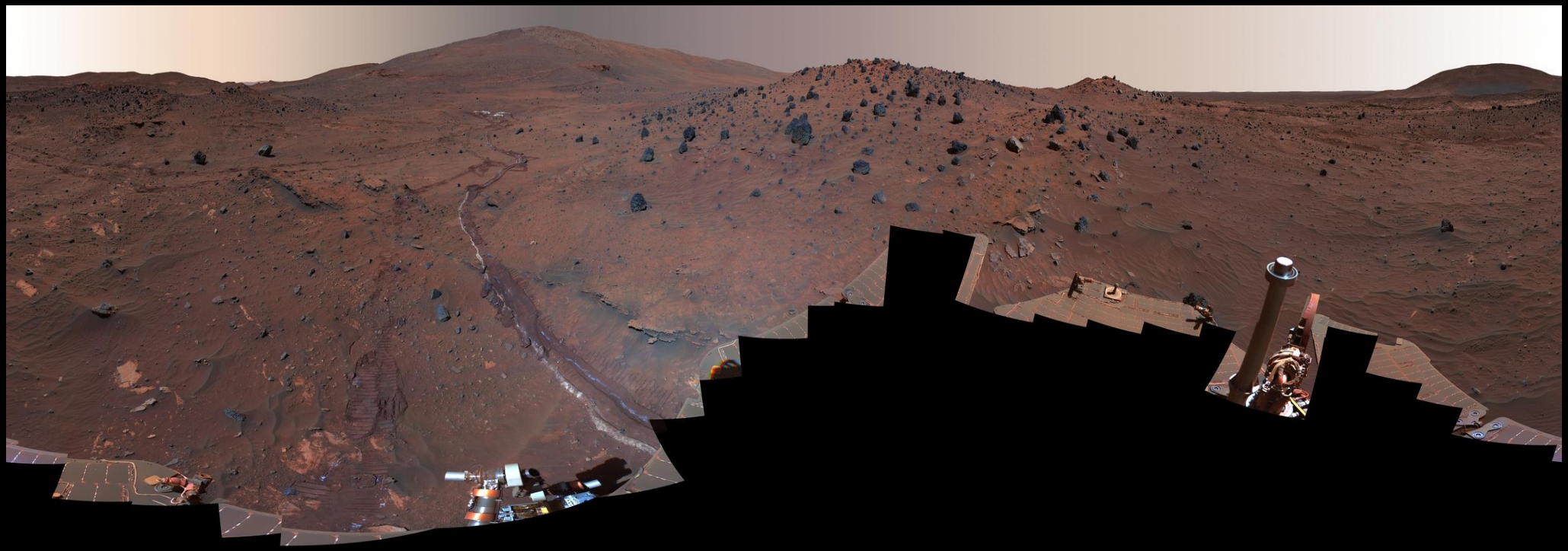
Much of Mars's water may still be present in the form of buried ice - this region near the equator that may consist of jumbled blocks of ice beneath a shroud of dust

- Spirit and Opportunity have discovered Sulphates, which form most readily in liquid water, and phosphates, also linked to water, that are present at both hemispheres.
- The analysis of rover data suggests that the sulphates were once dissolved in a planet-wide ocean. The phosphorus was probably leached from rocks in the form of calcium phosphate. The fact that it appears to have been dissolved and mixed with sulphates in large amounts suggests that the hypothesised ocean must have been very acidic, because calcium phosphate only dissolves well in acidic water.
- A phosphorus-rich ocean is a bad sign for past Mars life. Phosphorus is an important element for life on Earth, and is quickly extracted from the environment by organisms. If life were extensive on Mars, it would not have left so much phosphorus dissolved in the water.
- But similar phosphate-to-sulphate ratio seen on opposite sides of the planet could also arise if wind mixed these materials together after the bodies of water disappeared...

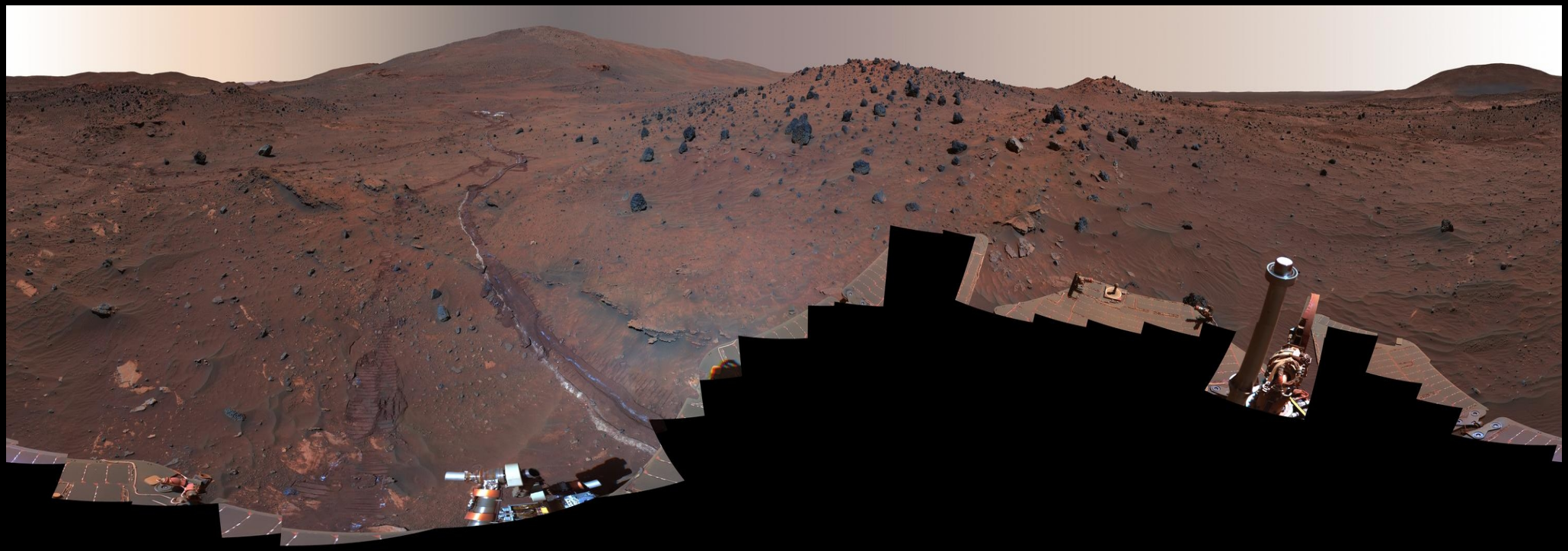
Rovers' discoveries:

This view is a false-color rendering to emphasize differences among rock and soil materials. It combines images taken through the panoramic camera's 753 nm, 535-nm and 432-nm filters.

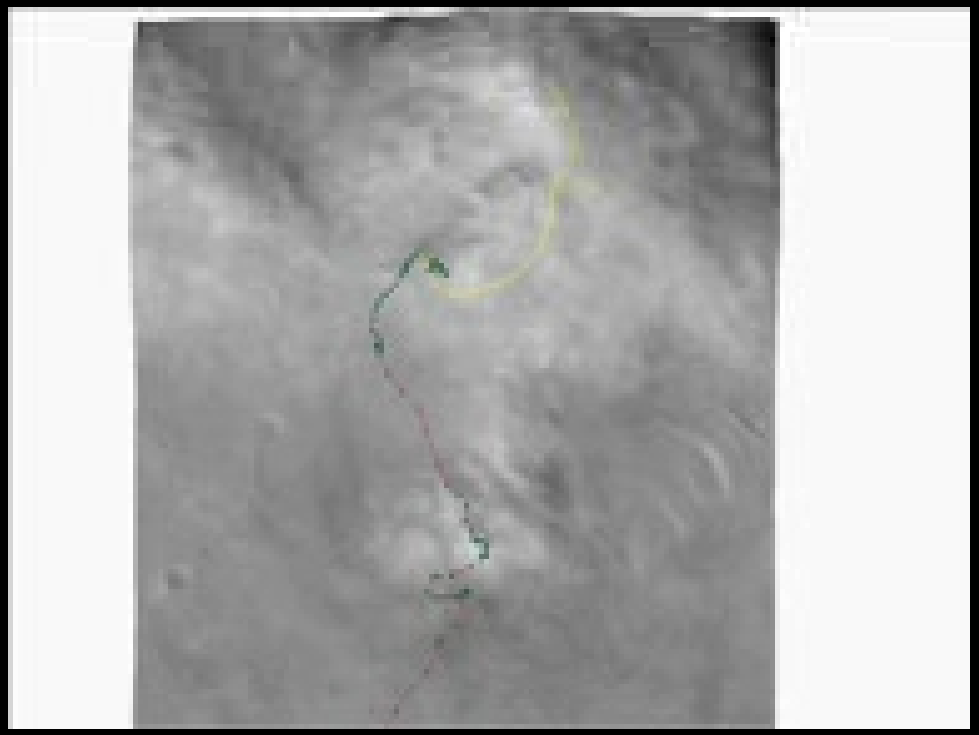
- Spirit, found a possible meteorite in Columbia Hills during its 809th Martian day i.e. April 12, 2006.
- The rock in the center foreground of this picture, informally named "Allan Hills", is suspected of being an iron meteorite.
- “Allan Hills” and “Zhong Shan”, that falls just out of the field of view to the left, are the first likely meteorites found by Spirit.
- If the Zhong Chang and Allan Hills rocks seen by Spirit do turn out to be iron-rich meteorites, they may have originated from an asteroid and landed on Mars.



- **Oct. 26, 2006, marks Spirit's 1,000th sol of what was planned as a 90-sol mission!** (a *sol* is a Martian day, which lasts 24 hours, 39 minutes, 35 seconds)
- To celebrate Rover's 1,000th martian day, NASA posts a detailed panorama produced from the most detailed imaging yet completed by either Spirit or its twin, Opportunity
- This 360-degree view, called the "McMurdo" panorama, comes from the Pancam on Spirit, and shows rugged terrain of the robot's current location amid a range of hills.
- The panorama shows Spirit's view of part of the Columbia Hills region, where it has made many of its most interesting discoveries.

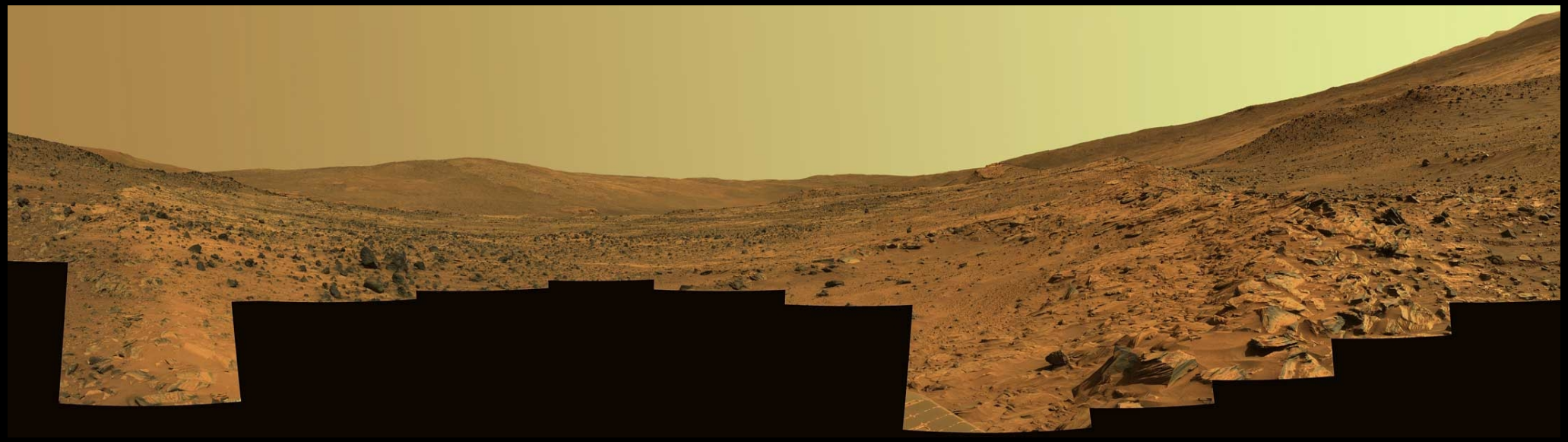


- Pancam began shooting component images of this panorama during Spirit's sol 814 (April 18, 2006) and completed the part shown here on sol 932 (Aug. 17, 2006). The overall panorama consists of 1,449 images and represents a raw data volume of nearly 500 megabytes.
- On the right, "Husband Hill" on the horizon, the rippled "El Dorado" sand dune field near the base of that hill and the lighter-toned "Home Plate" below the dunes provide context for Spirit's travels since mid-2005.
- Left of center, tracks and a trench dug by Spirit's right-front wheel, which no longer rotates, have exposed bright underlying material. This bright material is evidence of sulfur-rich salty minerals in the subsurface, which may provide clues about the watery past of this part of Gusev Crater.

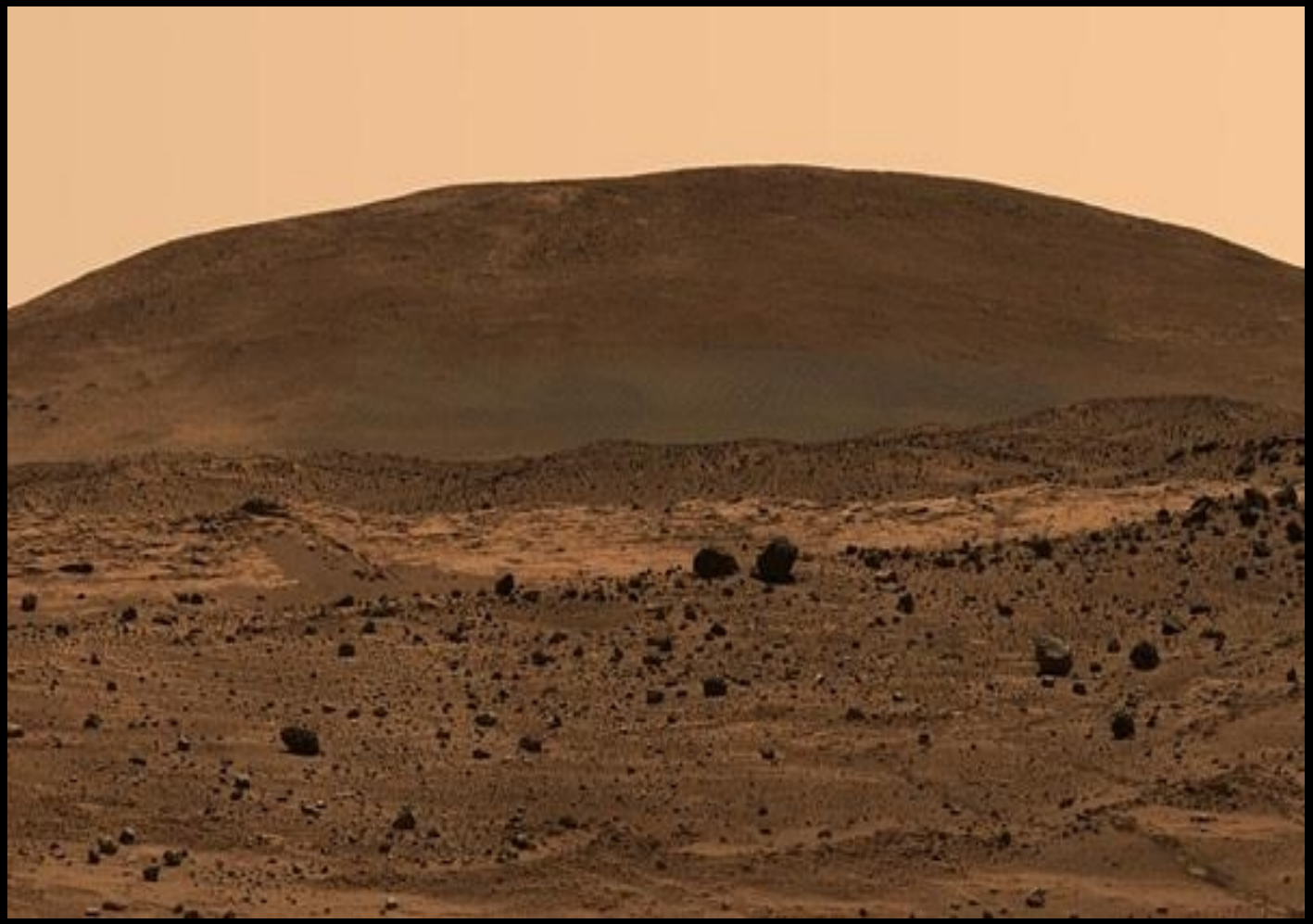


film

- A simulated aerial view of Spirit's journey through the "Columbia Hills" on Mars.
- The three-dimensional digital terrain model was created using images from the Mars Orbital Camera on the Mars Global Surveyor satellite.
- Released June 3, 2005, the route shows the rover's progress from martian day, or sol, 149 (June 3, 2004) through sol 502 (May 31, 2005), at which time the rover had traveled 3.9 kilometers (2.4 miles) since landing on Mars in January, 2004.



- A synthetic image of Spirit on the flank of "Husband Hill" film
- The image was created using a photorealistic model of the rover and a false-color mosaic.
- The size of the rover in the image is approximately correct and was based on the size of the rover tracks in the mosaic.
- The mosaic was assembled from frames taken by the panoramic camera on the rover's 454th Martian day, or sol (April 13, 2005)



Home Plate may be the remains of an explosive volcanic eruption. The explosion may have been triggered by underground water being heated by magma.

- Now, Spirit is parked on a slope called Low Ridge Haven where it waits for the Spring. The relatively small amount of winter sunshine meant the rover did not have enough power to drive anywhere.
- Spring in the southern hemisphere of Mars will begin in early 2007. Before that, the rover team hopes to start driving Spirit again toward scientifically interesting places in the "Inner Basin" and "Columbia Hills" inside Gusev crater.
- About a month from now, Spirit will start a longer drive towards a formation called Home Plate.

Opportunity's adventurs:

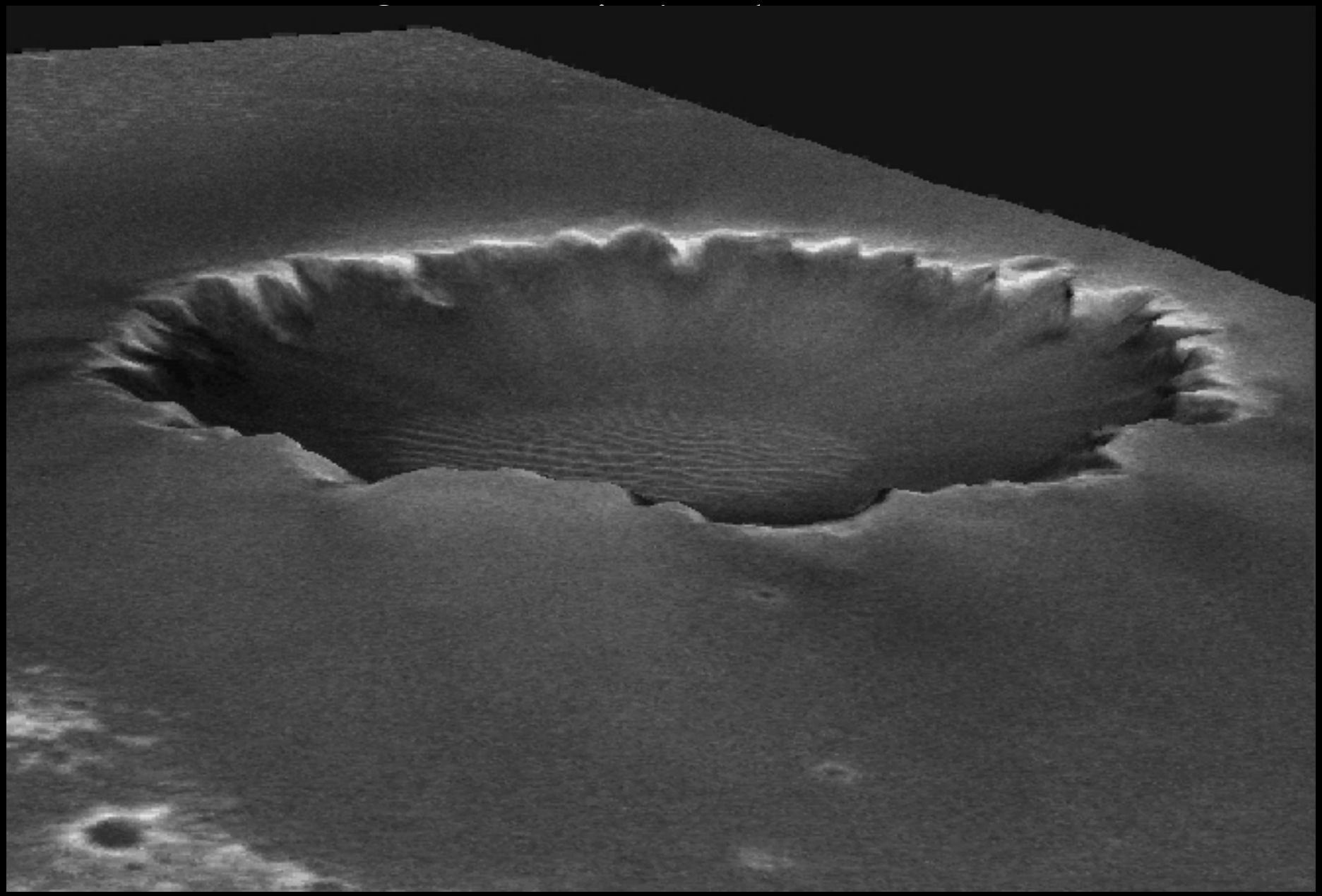
• Trapped in a martian sand dune between May 11 and June 3. Engineers at NASA's Jet Propulsion Laboratory worked for nearly five weeks to get Opportunity free.

• Exploration of sand dunes and outcrop rocks at the "Erebus Rim".

• Stop at the “Victoria Crater” where Opportunity waits for its 1000-sol in late November.

- Victoria is about 70 m deep and about 800 m wide, six times wider than "Endurance Crater," which Opportunity spent six months examining in 2004, and about 35 times wider than "Eagle Crater," where Opportunity first landed.
- Victoria is a scientific treasure trove. The walls of Victoria hold the scientific allure of much taller stacks of geological layers than Opportunity has been able to inspect on the Meridiani plains or at smaller craters

• The animation of Victoria uses a digital elevation model generated from computer analysis of three images taken by the Mars Orbiter Camera aboard NASA's Mars Global Surveyor orbiter.

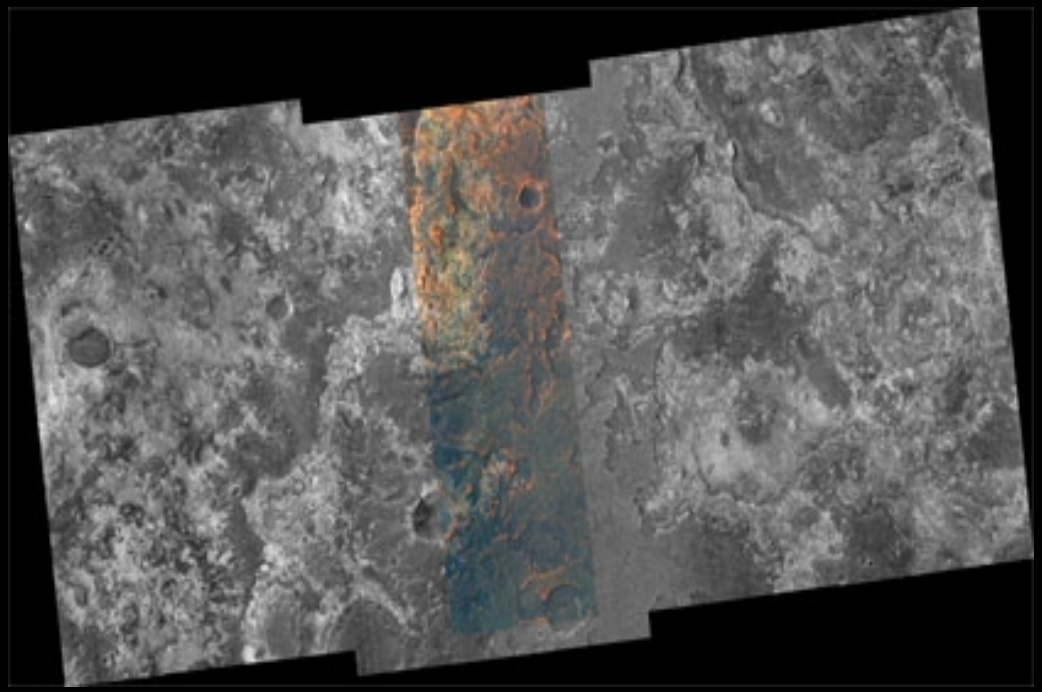

film

News from the Mars Reconnaissance Orbiter:

The Mars Reconnaissance Orbiter provided first observations from the low orbit. Scientists hope it the will answer questions about the history and distribution of Mars' water.

It combines data from the orbiter's high-resolution camera, imaging spectrometer, context camera, ground-penetrating radar, atmospheric sounder, global color camera, radio and accelerometers.

Part of Mawrth Vallis Region:

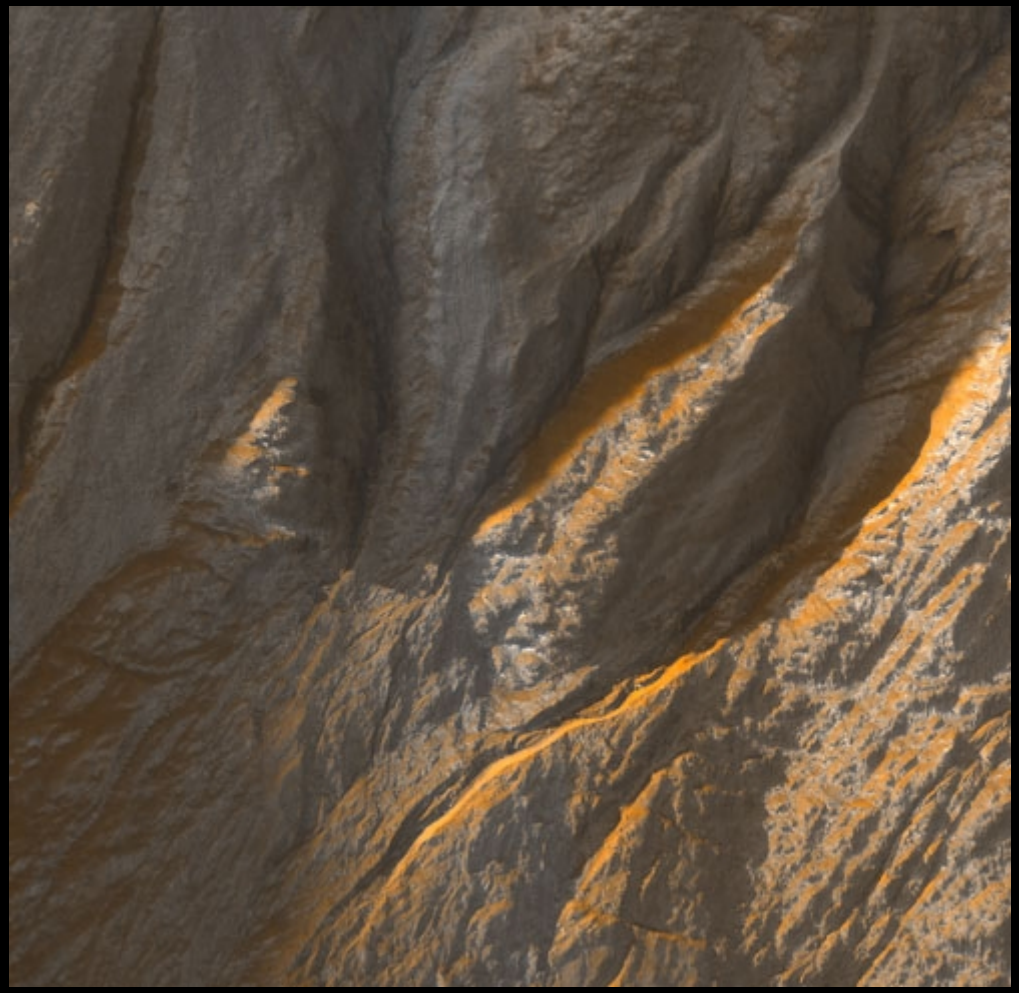


High Resolution Imaging Science Experiment (HiRISE) observations of Mars: Besides acquiring monochromatic images of 6-kilometer (3.7-mile) swath width and variable length, HiRISE can also image the central 20 percent of the swath width in color.

Southern Mars winter.:

- The bluish areas consist of frost. At the latitude of this image, frost is most likely composed of water because the temperature is not low enough for carbon dioxide condensation.
- The reddish regions are locations where frost has been removed, most likely by sublimation.

Gullies in Sirenum Terra:

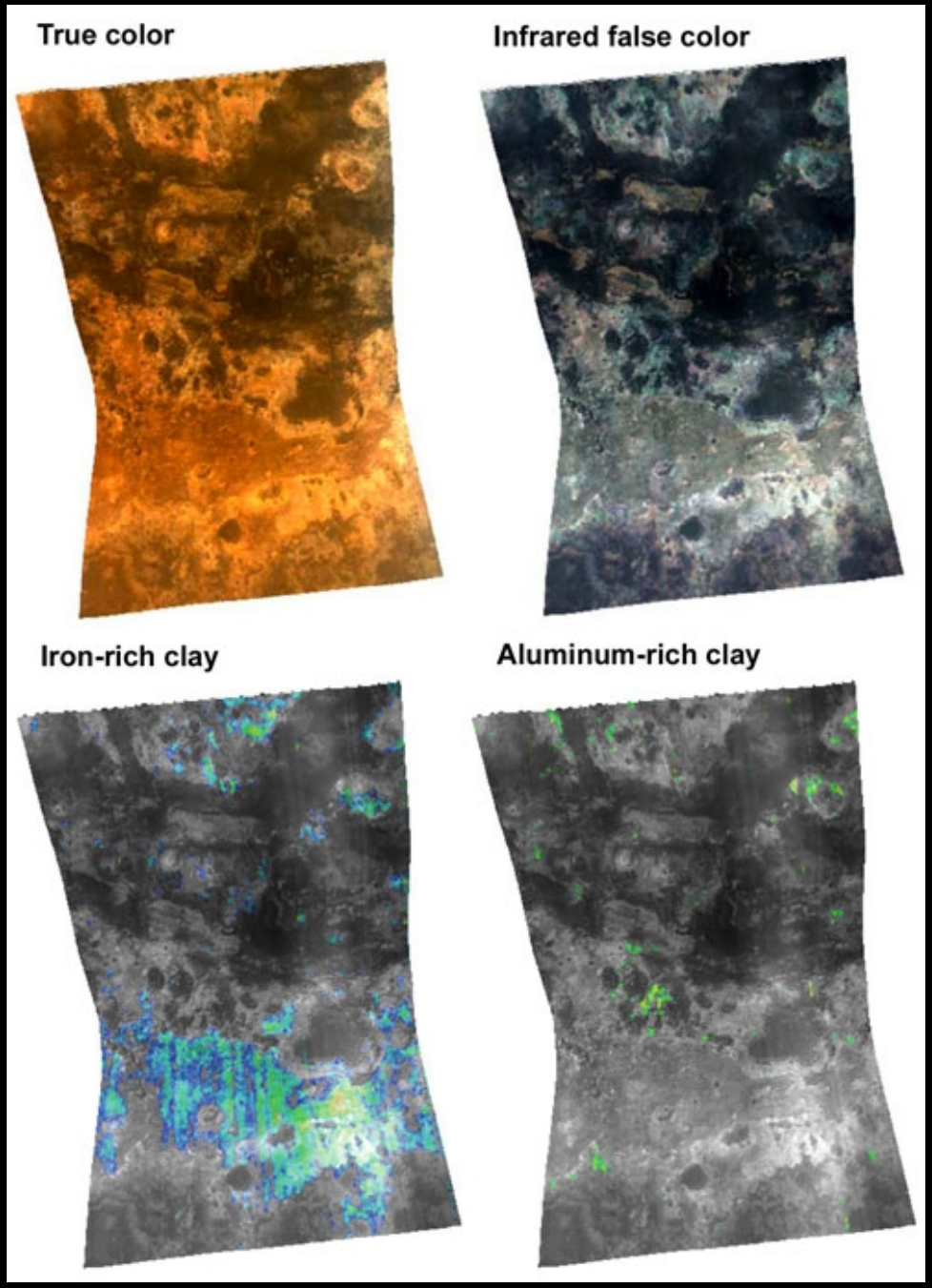


- Gullies in an unnamed crater in the Terra Sirenum region of Mars.
- This scene is about 254 meters wide.
- The upper and left regions of this scene are in shadow, yet color variations are still apparent.
- The high signal to noise ratio of the HiRISE camera allows for colors to be distinguished in shadows.

Diversity in Mawrth Region:

- Diverse materials and morphologies in the region south of Mawrth Vallis on Mars.
- The color is composed of infrared, red, and blue-green color images, and has been enhanced to accentuate the color differences.
- The bright material may be rich in clays and date back to a time when Mars had a wetter environment.

Spectrometer Observations Near Mawrth Vallis:



- A region of heavily altered rock in Mars' ancient cratered highlands. It covers an area about 13 kilometers long and, at the narrowest point, about 9 kilometers wide. At the center of the image, the spatial resolution is as good as 35 meters per pixel.
- Clay minerals are important to understanding the history of water on Mars because their formation requires that rocks were exposed to liquid water for a long time. Environments where they form include soils, cold springs, and hot springs. There are many clay minerals, and which ones form depends on the composition of the rock, and the temperature, acidity, and salt content of the water.
- Both types clays formed early in Mars' history, about 3.8 billion years ago. The difference in clay mineralogy reveals differences in the environment either over time or over a distance of kilometers.
- The aim is to find spectral fingerprints of aqueous and hydrothermal deposits and map the geology, composition and stratigraphy of surface features, watch the seasonal variations in Martian dust and ice aerosols, and water content in surface materials, leading to new understanding of the climate on Mars.

Joanna Molenda-Żakowicz, Journal Club 10 Nov 2006

And now something completely different:

- A new eruption of Etna started 14 July that is about two weeks after my return from the astronomical observatory at Mt. Etna, Fracastoro Mountain station.

film

These is a Charles Riviere movie adopted from http://rivierec.club.fr/films_eruption_2006.htm

And now something completely different:

- On 26 July strong explosions were heard from the rim of the NE crater.
- On 31 August the SE crater produced lapilli and bombs that fell mainly in the crater.
- On 5 Septmber the ejecta filled the crater and lava overflowed the crater.

film

These is a Charles Riviere movie adopted from http://rivierec.club.fr/films_eruption_2006.htm

And now something completely different:

- An excursion watches the eruption and the lava flow.

film

These are Charles Riviere movie adopted from http://rivierec.club.fr/films_eruption_2006.htm

And now something completely different:

film

film

film

These are Charles Riviere movie adopted from http://rivierec.club.fr/films_eruption_2006.htm

The lava moves slowly and can be wached from a close distance.