Water and magnetic properties of dust on Mars
- Results from the Mars Exploration Rovers

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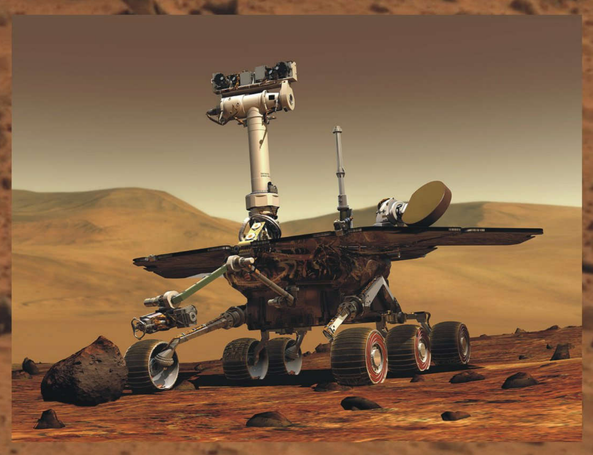
Since the NASA robot rovers Spirit and Opportunity landed on Mars in January 2004, there has been a constant stream of new scienctific discoveries. The rover Opportunity has found compelling evidence for the existence of liquid water in the Martian past. These conclusions are based on many individual observations - in particular from the Microscopic Imager and the Mössbauer backscattering spectrometer, which gives us the first Mössbauer spectra from another planet.

Furthermore we present results from "The magnetic properties experiments" onboard the rovers which is designed by the Mars Group at NBIfAPG. Each rover carries seven magnets, each with a specific purpose, for investigating the magnetic properties of the airborne dust and rocks on Mars.



Height: 1.5 m
"Wingspan": 2.3 m
Length: 1.6 m
Mass: 174 kg
Primary mission: 90 days
Extended mision: 180 days
Energy: Solar panels, 140 w (Initally)
Prize: 820 mill. $ (=Half the cost of the movie Troy)

About MER

On january 4th and 25th *Spirit* and *Opportunity*, two twin rovers, landed on each site of Mars, close to equator. The two rovers are known as Mars Exploration Rovers (MER) and is a NASA driven mission which most important science objectives are:

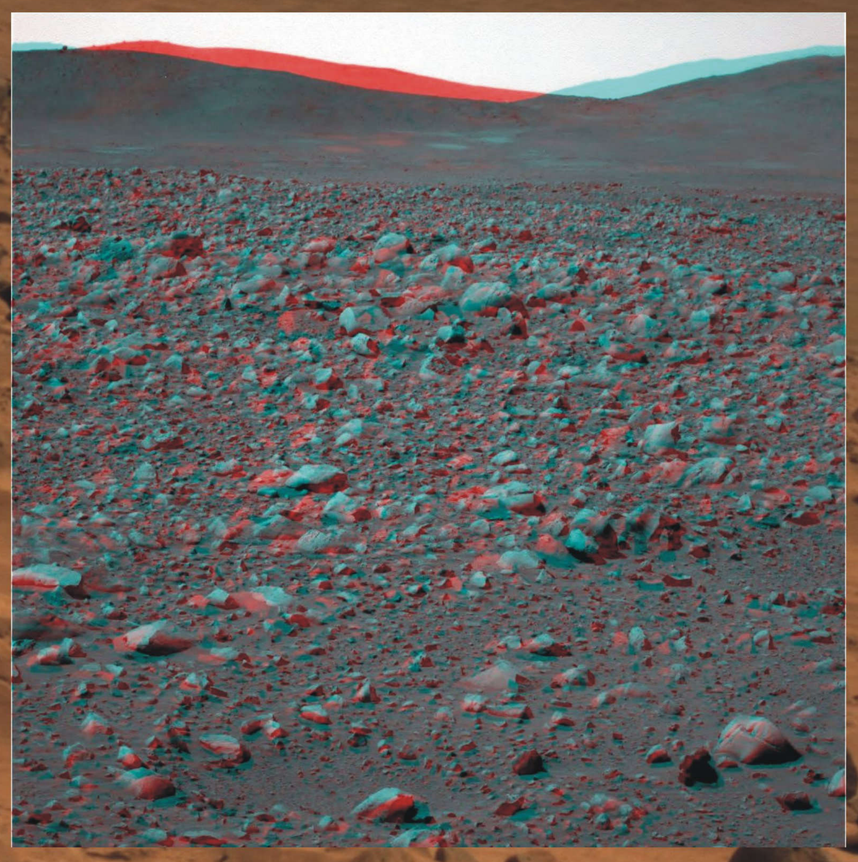
- Search for and characterize a diversity of rocks and soils that hold clues to past water activity.
- Investigate landing sites, selected on the basis of orbtial remote sensing, that have a high probability of containing physical and/or chemical evidence of the action of water.
- Determine the nature of local surface geologic processes from the surface morphology and chemistry.
- For iron-containing minerals, identify and quantify relative amounts of specific mineral types that contain water or hydroxyls, or are indicators of formation by aqueous process, such as iron-bearing carbonates.
- Extract clues from the geologic investigations, related to the environmental conditions when liquid water was present and assess whether those environments were conducive for life.

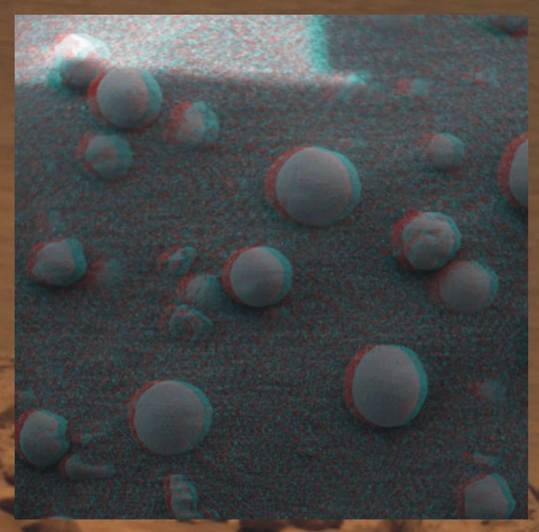
Each rover carries a large package of science instruments to achive these goals, the most importants are:

- ·Panoramic Camera will view the surface using two high-resolution stereo cameras.
- ·The Mini-TES is an instrument that sees infrared radiation.
- ·Magnets (see box)

On the robotic arm:

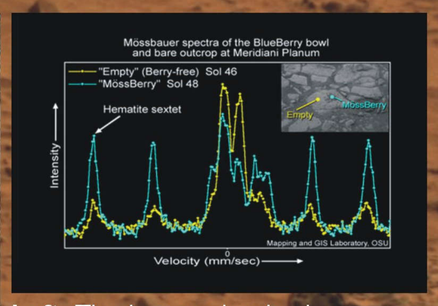
- ·Microscopic Imager is a combination of a microscop and a camera.. Produces extreme close-up view-
- ·Mössbauer spectrometer determines the composition and abundance of iron-bearing minerals
- ·The Alph Particle X-Ray Spectrometer determins the elements that makes up rocks and soil.
- ·Rock Abrasion tool is an instrument that uses a grinding wheel to remove dust and weathered rock, exposing fresh rock underneath. The tool grinds to 5 mm depth.





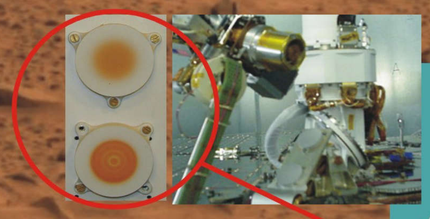
3D images

The images show 3D of a landscape (left) and of the "blueberries" (right). 3D glasses must be used to see the 3D effects.



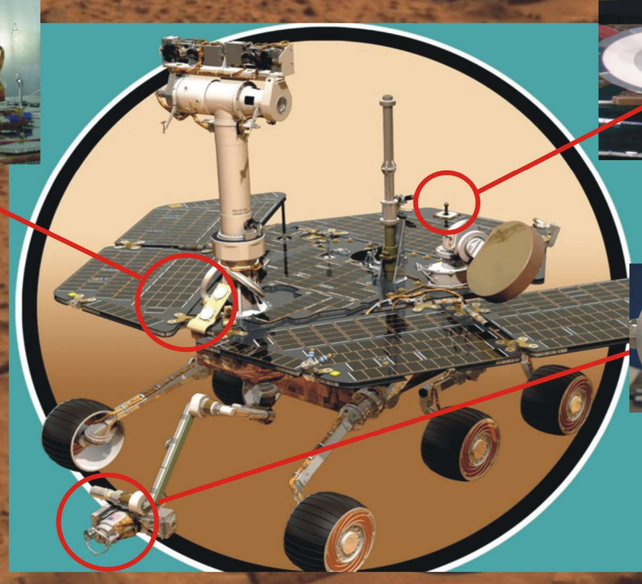
Left: The image clearly shows sedimentary rocks which have been formed in liquid water.

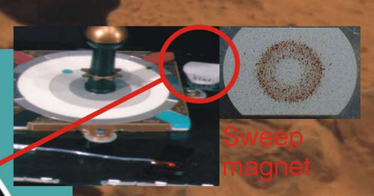
Right: The image shows Mössbauer spectra of a rock with and without "blueberries". The spectra indicate that the "blueberries" are composed at least partly of hematite.



Capture magnet and Filter magnet

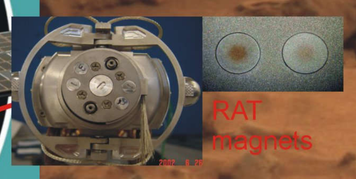
The strong Capture Magnet attracts all magnetic dust particles, while the weaker Filter Magnet preferably attracts the strongly magnetic dust particles. The dust is analyzed with multispectral optical cameras, Mössbauer spectroscopy and X-ray spectroscopy.





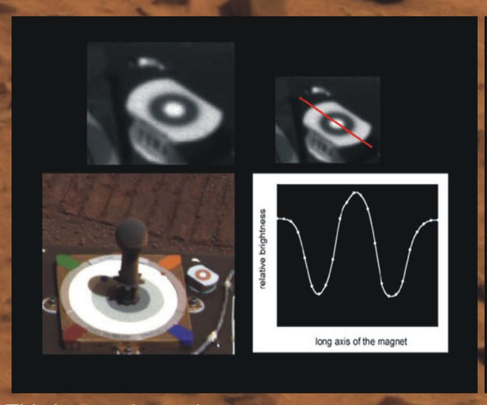
Sweep magnet

Detects 'non-magnetic' particles in the center.

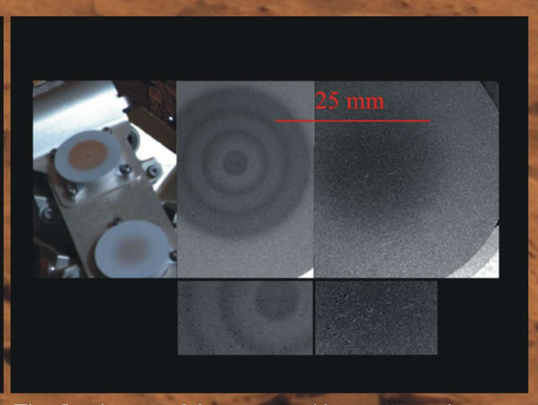


RAT magnets

Detects magnetic dust particles that are produced during rock abrasion.
Clues to mineralogy of Martian rocks and magnetic anomalies



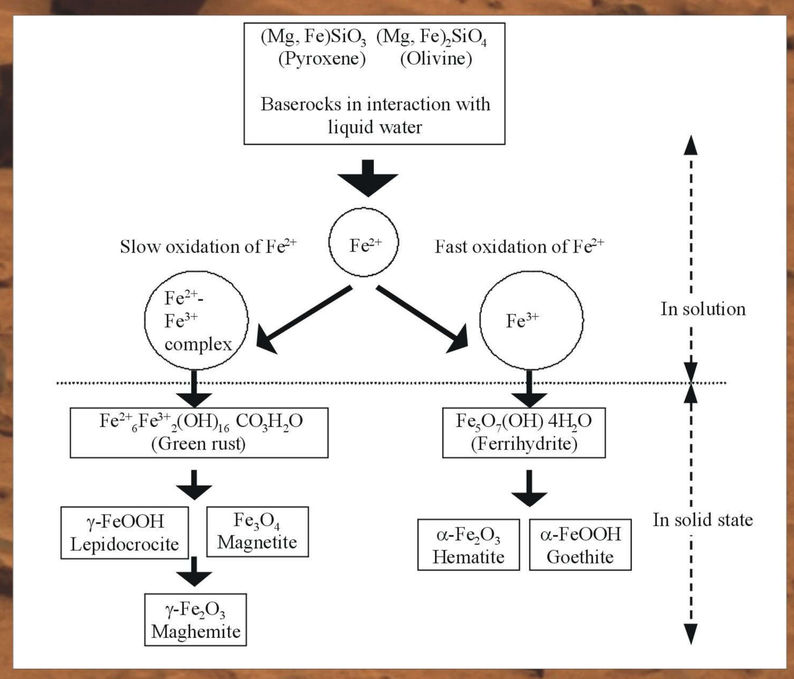
This image shows the sweep magnet on Opportunity (may 10th), which clearly has very little and probably no dust in the sweep area. This shows that all the dust on Mars carries a magnetic moment, and therefore contains a least one ferri/ferromagnetic phase.



The first image of the capture (ring patterned magnet) and the filter magnet.

The APEX spectra of the capture and filter magnets show little difference between the composition of the dust attracted by the magnets.

This image shows the LEGO man on the landing module. The LEGO man has a dust attarcting magnet in his belly.



This figure shows the formation of iron oxids in slow and fast oxidating enviroments. Fast oxidation is common on Earth, where lots of water is presents. It is not known if the dust on Mars formed through slow or fast oxidation.

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