Express mission to Mars

Mars Express is the European Space Agency's first mission to Mars. Its role is to survey the planet from the topmost layer of the atmosphere down to beneath the surface. Since its arrival at Mars, the mission has proved a great success and has given us many new insights into the Martian environment.

Moon watch

Mars has two small, irregularly-shaped moons called Phobos and Deimos. Mars Express has provided the most complete detailed picture of Phobos to date. The OMEGA instrument has mapped the chemical composition of the moons' surfaces and minerals that have been exposed at the bottom of impact craters.

Phobos
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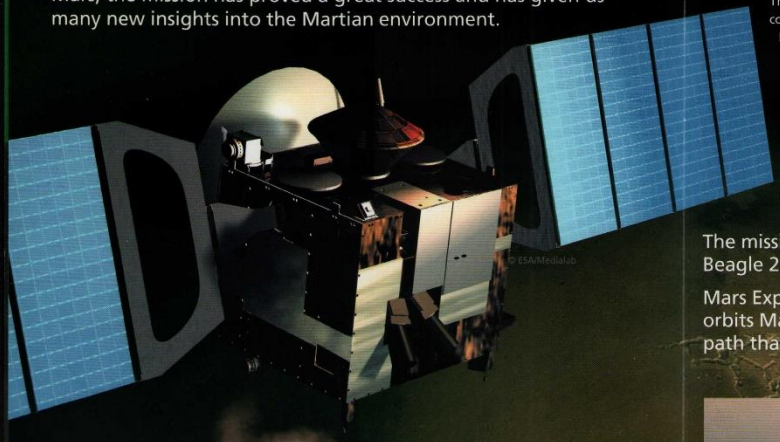

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Highlights include the detection of methane in the Martian atmosphere, the discovery of water ice reserves buried under the planet's surface and the discovery that aurora occur in the upper Martian atmosphere.

The mission consisted of the Mars Express orbiter and the Beagle 2 lander.

Mars Express, which will operate until at least November 2007, orbits Mars in 6 hours and 43 minutes and follows an elliptical path that gives it close up and global views of the planet.

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Mars Express was launched in June 2003, taking advantage of a close alignment of Mars and the Earth to reach the Red Planet in just six months.

Beagle 2, which was named after Charles Darwin's ship The Beagle, was built to search for chemical markers that would show if life once existed on Mars. Unfortunately, it was lost on landing but the miniaturisation technology developed for its instruments will be used on future missions.

Further Information

If you would like to know more about the Mars Express mission, try the following resources:

World Wide Web sites

http://sci.esa.int/marsexpress

www.esa.int/SPECIALS/Mars_Express/

www.dlr.de/pf/en/desktopdefault.aspx/

www.esa.int

www.ex.ac.uk/Mirrors/nineplanets/mars.html

www.uk2planets.org.uk

Books

Patrick Moore
Patrick Moore on Mars
Cassel, 2006

Steve Squyres
Roving Mars: Spirit, Opportunity and the Exploration of the Red Planet
Hyperion, 2005

Michael Hanlon
The Real Mars
Constable and Robinson 2004

Joseph M Boyce
The Smithsonian Book of Mars
Smithsonian Institution, 2003

Heather Couper & Nigel Henbest
Mars *Headline, 2001*

Fredric W. Taylor
The Cambridge Photographic Guide to the Planets
Cambridge University Press, 2001

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- Free **Publications and resource guides** suitable for teaching ages 10-18. Go to www.scitech.ac.uk - Public and Schools - Schools and Education - Resources
- **Funding** schemes for projects and school visits. Go to www.scitech.ac.uk - Public and Schools - Funding
- A **Moon rock and meteorite loan scheme**. Go to www.scitech.ac.uk - Public and Schools - Schools and Education - Loan Scheme
- **Visits** to STFC's UK laboratories in Cheshire, Oxfordshire and Edinburgh plus CERN in Geneva. Go to www.scitech.ac.uk - Public and Schools - Visits and Events
- **Researchers in Residence**. Teachers are placed in partnership with young scientists who have been trained to support the teacher, act as role models and introduce their research. Go to www.researchersinresidence.ac.uk.

For scientists

- **Communication and media training** courses; **funding** schemes and **Fellowships** for public engagement. Go to www.scitech.ac.uk - Public and Schools - Fellowships and Communications Training

For further information telephone 01793 442175 or email gareth.james@stfc.ac.uk

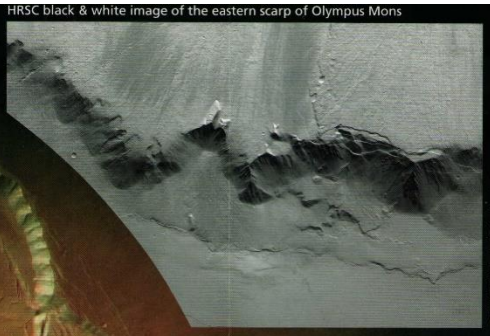
esa

UK GOES TO THE PLANETS

Mars Express

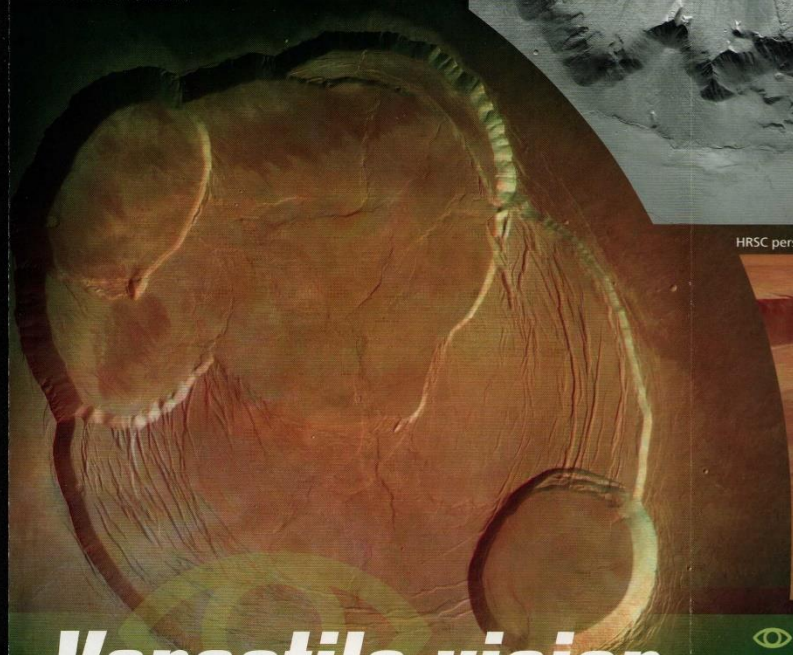
Science & Technology Facilities Council

HRSC black & white image of the eastern scarp of Olympus Mons

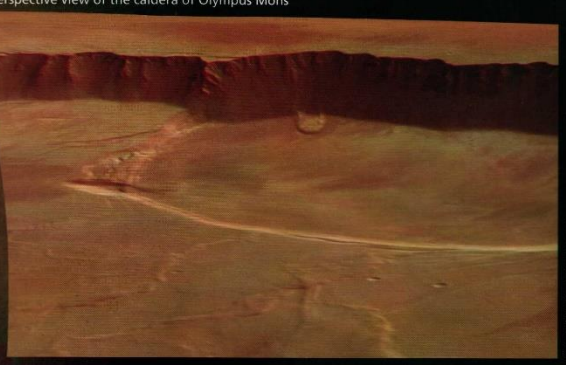


HRSC 3-D image of the caldera of Olympus Mons

HRSC colour image of the caldera of Olympus Mons



HRSC perspective view of the caldera of Olympus Mons



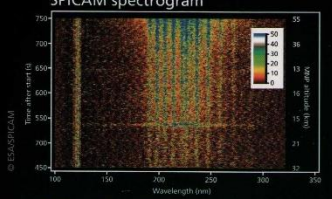
Versatile vision

the many eyes of Mars Express

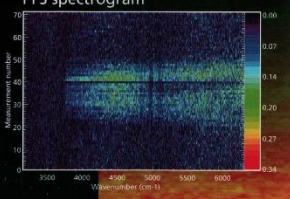
HRSC The High Resolution Stereo Camera is a sophisticated system that produces black and white, colour, infrared and 3-D images of the surface of Mars. The images can be processed to produce perspective views of features. When Mars Express is closest to the surface (258 km altitude), HRSC images have a resolution of 10 metres, which means objects about the size of a house can be distinguished. In addition, the camera has a Super Resolution Channel, which can zoom in on an area and take images with a resolution of 2.3 metres (about the size of a small car).

The Mars Express orbiter carries seven instruments that are tailor-made to monitor different aspects of the Martian environment. HRSC, OMEGA and MARSIS study the planet's surface or subsurface, and PFS, SPICAM and ASPERA monitor the Martian atmosphere and its interaction with the solar wind. The Mars Radio Signal experiment uses radio transmissions between the spacecraft and the Earth to deduce information about the planet's surface and interior. UK scientists are involved in the ASPERA, MARSIS and HRSC instruments.

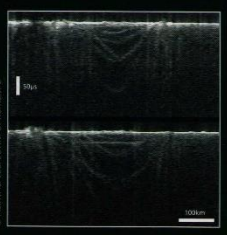
SPICAM spectrogram



PFS spectrogram



PFS and **SPICAM** instruments analyse infrared and ultraviolet radiation to determine the composition of the Martian atmosphere. Peaks in the spectrum indicate the concentrations of gases present.



MARSIS (the Mars Advanced Radar for Subsurface and Ionosphere Sounding) probes up to 5 kilometres below the Martian surface by bouncing radio signals off layers in the rock and analysing the echo. The "radargrams" above appear to show a buried impact crater filled with a material rich in water-ice.

ASPERA-3 consists of 4 sensors that monitor the interaction of the Martian atmosphere with the solar wind.

OMEGA analyses the light reflected from the surface of Mars to create a map of rock-types on the surface and areas covered by frost or ice. Different chemicals absorb light strongly at characteristic wavelengths. These three images of the Martian south pole show (from left to right) areas covered by carbon dioxide ice, water ice and south pole in visible wavelengths.

There's more to Mars than Red Dust!

The main aim for Mars Express is to investigate the history of water on Mars. Previous missions have gathered evidence that large quantities of liquid water once flowed across the Martian surface. Since its arrival in December 2003, Mars Express' instruments have been mapping and analysing the Martian environment to find out what happened to that water.

The ASPERA instrument has shown that water vapour in the Martian atmosphere has been stripped away into space by the solar wind and the MARSIS radar has also found large quantities of ice buried beneath the planet's surface. However, water still exists on the Martian surface as ice-caps at the poles. In addition, HRSC images have revealed a lake of water-ice sheltered from the Sun's rays by craters near the Martian poles (image 1). Images of plains near the equator show a landscape that resembles the ice rafts that lie off Antarctica (image 2). This may be the remains of an ancient frozen sea that has since evaporated or it may be evidence that the ice is still there, protected by a layer of volcanic dust. At the poles, frost and volcanic dust are clearly visible on the surface (image 3).

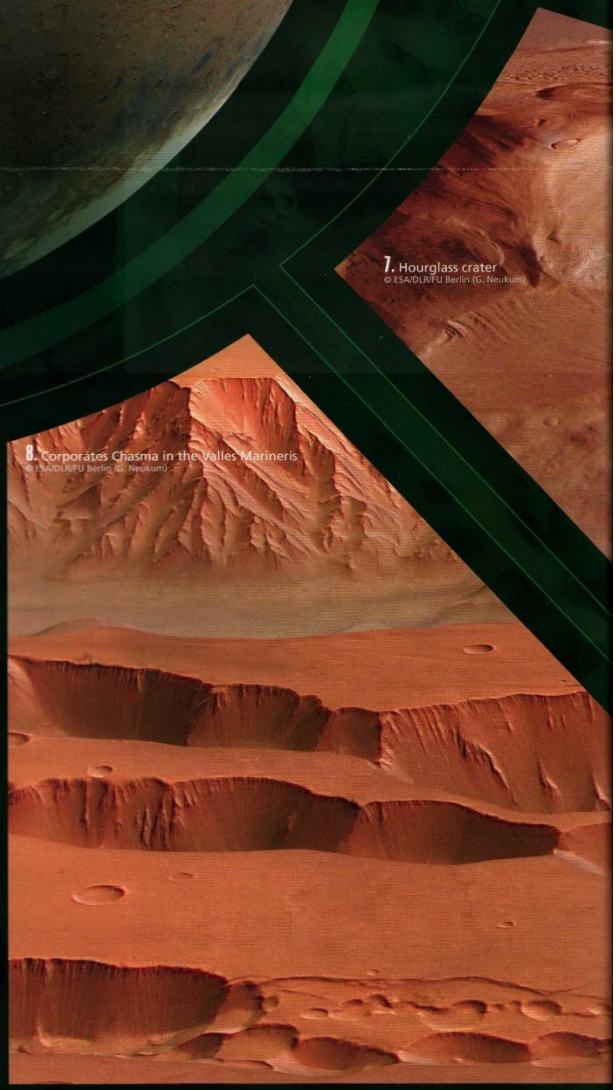
Mars is home to the largest volcano in the Solar System, Olympus Mons, but its surface is covered with other signs of geological activity. The depressions seen on the flanks of Pavonis Mons (image 4) were formed when tubes that had contained flowing lava beneath a solidified crust collapsed.

Mars Express data has shown that Martian rocks formed in three distinct eras: a period where hydrated, clay-rich minerals dominated, a volcanic era where sulphur mixed with water to create sulphates, like those seen in the mountain (image 5) in Juventae Chasma, and a period that continues to the present day where minerals are formed without the presence of water.

Mars is famously dusty and the planet's surface is sometimes obscured by enormous dust storms. Whirling dust devils (image 6) may also generate hydrogen peroxide, a chemical that could play a role in breaking down the methane that is seen in variable concentrations in the Martian atmosphere. The presence of methane suggests that Mars may still be geologically active or may even indicate life.

Evidence for glacial activity in the last few million years, such as the features found at the Hourglass crater (image 7) suggest that a drastic change to the Martian climate happened relatively recently.

Mars Express has now mapped almost the entire surface of Mars. As long as it remains operational, it will continue to give us new views and perspectives on some of the Solar System's most spectacular geological features, such as the enormous canyon, the Valles Marineris (image 8).



7. Hourglass crater

8. Corporates Chasma in the Valles Marineris

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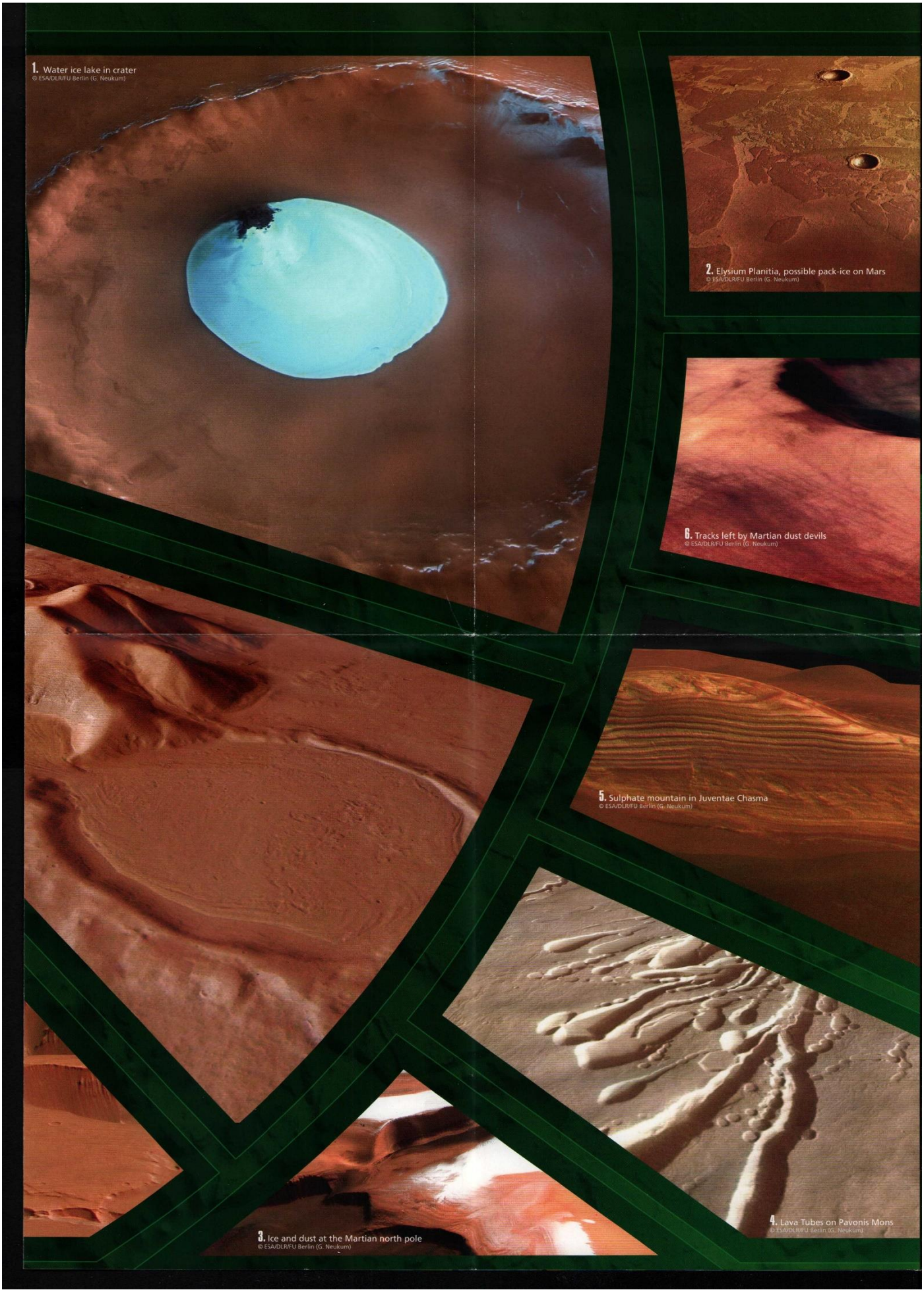
1. Water ice lake in crater
© ESA/DLR/FU Berlin (G. Neukum)
2. Elysium Planitia, possible pack-ice on Mars
© ESA/DLR/FU Berlin (G. Neukum)
6. Tracks left by Martian dust devils
© ESA/DLR/FU Berlin (G. Neukum)
5. Sulphate mountain in Juventae Chasma
© ESA/DLR/FU Berlin (G. Neukum)
4. Lava Tubes on Pavonis Mons
© ESA/DLR/FU Berlin (G. Neukum)
3. Ice and dust at the Martian north pole
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