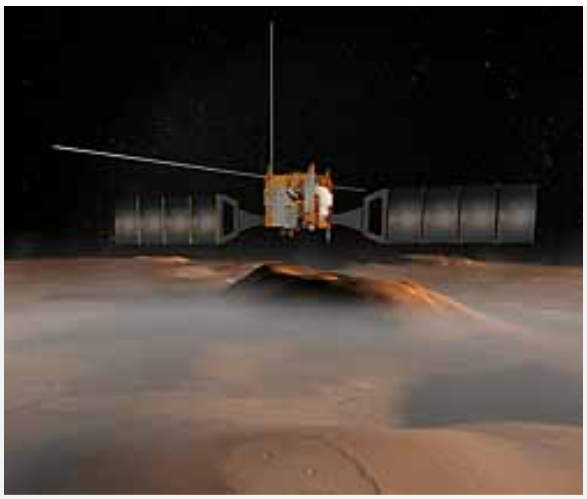
News Archive 2008

Five years of Mars Express – a European success story

29 May 2008

DLR chief Wörner: "New perspectives for planetary research"

Through the Hebes Chasma valley: Flight over the Martian surface

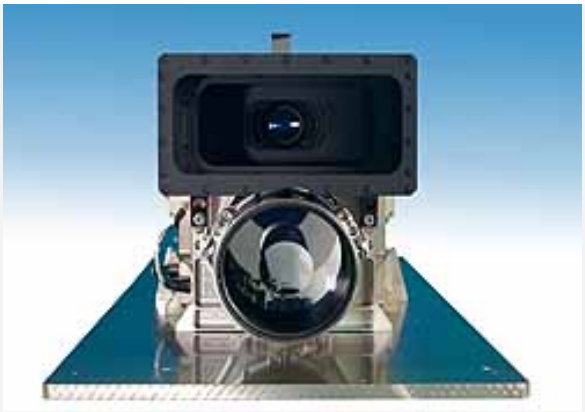


ESA's Mars Express probe over the Tharsis volcano

Now more than ever, Mars is the focus of planetary research. A week after the resoundingly successful landing manoeuvre of NASA's Phoenix probe, scientists and engineers are celebrating the five-year anniversary of the launch of Mars Express, the first ever European planetary mission. The mission has already been extended a second time. "Mars Express has shown that Europe can assume a very important role in researching our solar system", says Professor Johann-Dietrich Wörner, Chairman of the Executive Board of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) while commenting on the Mars probe's success. "Thanks to the German stereo camera on board the Mars Express, we can now observe our neighbouring planet through more realistic 3-D images than ever before. The 3-D images have opened up 'new perspectives' in the true sense of the word, not just for Mars, but for planetary research overall", says DLR chief Wörner.

On the evening of 2 June 2003, a launch vehicle of the tried and tested Soyuz type took off from the Russian Baikonur Cosmodrome in Kazakhstan and first brought the European Space Agency (ESA)'s planetary probe into an orbit around Earth, and a few hours later boosted it with a Fregat upper stage to send it on its six-month journey towards Mars. Ever since its arrival on Christmas 2003, the images and measurements made by the European Mars probe have been able to significantly advance research into the red planet. Using the special HRSC camera (High Resolution Stereo Camera), DLR and the Freie Universität (FU) Berlin are mapping Mars completely, in high resolution, in colour, and in "3-D" - it is the most comprehensive German experiment in planetary research so far. The HRSC stereo camera was developed by scientists and engineers at DLR, under the direction of Professor Gerhard Neukum (presently of FU Berlin) and with the support of the DLR's Space Agency (Raumfahrt-Agentur), and it was built in cooperation with German industrial partners. On the basis of its financial contribution, Germany is the country with the largest stake in Mars Express.

The eventful climatological history of the Red Planet: rivers, lakes and volcanoes

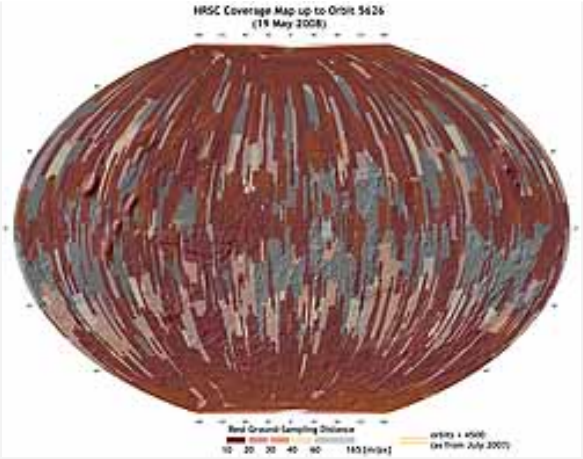


Front view of the High Resolution Stereo Camera on Mars Express

The HRSC images not least allow planetary researchers to show that Mars has had a distinctly eventful climatological history. Three to four billion years ago, rivers have dug deep valleys into the highlands of Mars, now a dry and cold desert planet. There is much to be said for the view that for some time it was warmer on the Earth's outer neighbouring planet than it is now, and that it had a water cycle with precipitation and standing bodies of water. There are many indications that the sometimes gigantic volcanoes on Mars could still retain traces of activity.

Mars Express will be operated by ESA at least until May 2009; the orbiter has circled the planet over 5 600 times so far. The space probe is controlled and monitored by ESA's European Space Operations Centre in Darmstadt. On average once in every three orbits, the stereo camera records images of a band of Mars's surface, many hundreds of kilometres long and about 50 to100 kilometres wide. In this way, the HRSC has by now captured over two thirds of the planet's surface, which is 145 million square kilometres in size and thus almost as large as the Earth's continental area. Almost half of this image data is available with a resolution of ten to twenty metres per picture element (pixel).

Instruments and space probe are still in excellent condition



The HRSC's four and a half years mapping Mars

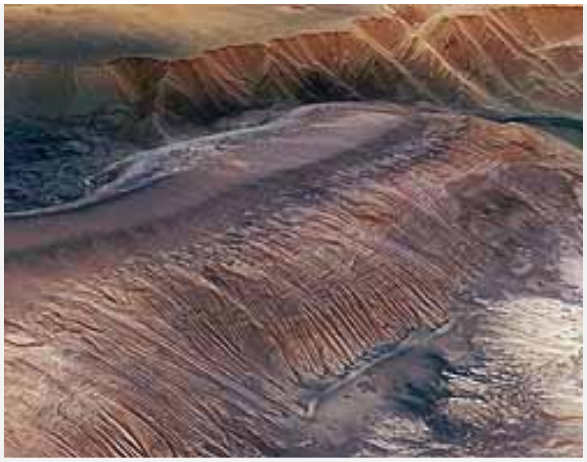
"Apart from scientific analysis of the images our main priority is to provide the global research community at regular intervals with so-called digital terrain models and topographic image maps of Mars's surface", explains Professor Ralf Jaumann of the DLR Institute of Planetary Research (DLR-Institut für Planetenforschung) in Berlin, who manages the camera experiment. "Like the other six experiments and the space probe itself, the HRSC is still in excellent condition", adds Professor Neukum, the "Principal Investigator" (PI) for the camera experiment. "We are therefore optimistic that sometime this year ESA will approve a request by the project scientists to extend the mission into the next decade." Apart from the HRSC, Germany is also represented on Mars Express with the Mars Radio Science Experiment (MaRS). Under the direction of Dr Martin Pätzold (Universität zu Köln), scientists are studying the structure of Mars's atmosphere and gravitational field. The Planetary Fourier Spectrometer (PFS), which analyses the composition of the atmosphere, was partially developed at DLR as well.

Seven DLR scientists are working on the HRSC camera experiment; planetary researchers from the following German institutions are also participating in the project, supported by the DLR's Space

Agency: the Freie Universität Berlin, the Universität Münster, the Universität zu Köln, the Technische Universität Dresden, the Leibnitz Universität Hannover, the Technische Universität Clausthal, the Technische Universität Berlin, the Technische Universität München, the Universität der Bundeswehr München, and the Max-Planck-Institut für Sonnensystemforschung in Katlenburg-Lindau. In addition to this, at the DLR Institute of Planetary Research the HRSC recording schedule is coordinated with the PI group of the FU Berlin, the ESA, and the other experiments on board the orbiter, and after the images have been received, the data are processed there almost completely automatically and subsequently prepared for integration into the planetary data archives of ESA and NASA. "These tasks are at least as demanding as the actual research activities", explains Experiment Manager Ralf Jaumann. The DLR Institute of Planetary Research has already processed several terabytes of image data over the past years.

Little flowing water on Mars for 3.5 billion years

Water is a recurring theme in Mars research. Ever since the American twin Viking probes photographed the entire surface of the planet for the first time in the late 1970s, researchers know that large amounts of water must once have flowed on Mars. There is no other explanation for its many wide, winding, and deeply cut valleys. However, the question as to where this water is now remains unanswered. "It appears that about 3.8 billion years ago it may have been a lot warmer on Mars than it is now, and that the climatological conditions may have allowed for the existence of a water cycle", explains planetary researcher Neukum. "This hypothesis is corroborated by determining the age of the now dry river valleys and of the former standing bodies of water, which we can do quite accurately through statistical analysis of impact craters of different sizes in the HRSC images."



False colour image of a mountain in the Hebes Chasma region

The observations of the French OMEGA spectrometer (Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité) on board the Mars Express also confirm the observation that during the first billion years or so of its existence it was more humid and hotter on Mars than in the 3.5 billion years that followed. OMEGA was able to identify so-called phyllosilicates (sheet silicates) - minerals with crystal structures bearing hydroxyl groups. These minerals are only found in very old areas in the Martian highlands. The geological context of the mineral deposits that have been detected by OMEGA can be recognised in the HRSC images.

Mars Express lays the foundations for Mars research in the coming decade

In younger geological formations on the other hand, sulfate minerals such as gypsum or kieserite were discovered, which were formed under the influence of water. "Over the past three billion years, water appears to have flowed over Mars's surface only intermittently and at irregular intervals", explains planetary geologist Jaumann.

"The areas on Mars about which we can say with some certainty that they once held water are particularly interesting as potential landing sites for the ESA ExoMars mission, which in the next decade will search for traces of life that once used to be there, or perhaps even still is", Jaumann adds. HRSC and OMEGA data will play an important role in the selection of the landing site.

Video: DLR planetary geologist Ernst Hauber talks about the Mars Express mission (german)

Due to the low atmospheric pressure on Mars, large amounts of waters may have rapidly evaporated in the atmosphere, and due to the planet's weak gravitational pull have subsequently escaped into space - results from the Swedish ASPERA spectrometer (Analyser of Space Plasmas and Energetic Atoms) on board Mars Express seem to point in that direction. However, a lot of water could also have seeped away into Mars's soil and still be present as ice inside cavities. This definitely applies to the high northern latitudes, where NASA's Phoenix probe has now landed to drill for water and ice in the permafrost soil. "In the HRSC images, we see many areas close to the equator, in which in geologically recent times - just a few million years ago - glaciers existed. And in those areas there could still be ice under the surface", explains DLR researcher Jaumann, "which we also consider to be an indication of fast and frequent climate changes".

Webcast: Mars Express investigates the Red Planet

In this DLR webcast, Ernst Hauber of the Institute of Planetary Research talks about the start of the mission and about the study of our neighbouring planet Mars. The planetary geologist coordinates the recording of images by the high-resolution HRSC stereo camera. This camera records images of Mars in 3-D and colour. During an overflight, the camera records images of an area from multiple visual angles. Ernst Hauber analyses the images. In his conversation with DLR reporter Sven Oswald, Hauber also discusses the most important results of Mars research so far, especially the evidence of water on the planet.

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