10 Years Mars Express with HRSC
PLANET MARS IN 3-D

On June 2, 2003, the first European mission to another planet took off from the Baikonur cosmodrome in Kazakhstan: Mars Express. Since December 2003, this probe of the European Space Agency (ESA) has been orbiting Mars at a distance of 30,000 kilometers above the planet’s surface. The mission is scheduled to last until the end of 2004.

All seven scientific experiments on board are designed to help observe and explore the red planet in a way that is comparable to the high-resolution stereo camera (HRSC) that was developed and built in Germany. It is the first camera system on an interplanetary mission to systematically deliver high-definition stereo images of the Martian surface.

The ultimate objective of the HRSC experiment is to generate a global topographic map of Mars, with a resolution down to about 40 meters per pixel, with major parts of the planet being mapped at 150 meters and even 15 meters per pixel. By the end of the mission, a topographical model of the surface of Mars should be available. This global image could be used to then reconstruct the geological development of the planet in the course of its history of four-and-a-half billion years.

Three-dimensional images showing the terrain on the Martian surface are of great benefit to science. The elevation data contained in the high-resolution imagery will significantly improve our theories concerning the geological evolution of the planet in the course of its history of four-and-a-half billion years.

This highly precise 3-D mapping process became possible thanks to an imaging technique used for the first time in planetary science: the HRSC employs what are called line sensor arrays arranged across track to scan the landscape as it passes. About twice the size of a human hand, these image sensors are equipped with different color filters, thereby giving the ground the opportunity to look at the interior and the dynamics of Mars. To be sure, Mars has no particular colors of its own, since the planet’s surface is dark, brown, and yellowish in color. But since the atmosphere of Mars is cool enough to permit large-scale, dense formations, high-altitude atmospheric layers that are colored in blue, red, green, and orange, and other colors. In particular, the weather is colored in white, including snow on the surface and the atmosphere. The weather on Mars is therefore quite dynamic.

It is the weather that causes the surface of Mars to change slowly but surely. One characteristic weather event is the formation of tiny, dust-covered ice particles, which pick up dust and tiny grains of sand from the ground, carry them around the planet, and deposit them elsewhere. One of the results of these processes is the existence of a planet that, in the words of a German proverb, “is being built by the wind.” In order to form these phenomena, however, the Martian atmosphere is very much below that of Earth, due to the fact that the pressure on Mars is only about 1% of Earth’s atmospheric pressure. The Martian atmosphere is a crosswind of carbon dioxide, nitrogen, oxygen, argon, and trace gases.

These trace gases have an effect on the climate and the atmosphere, mainly due to the fact that Mars has no liquids in its surface. In contrast, liquid water is present on Earth, which means that Earth is the only planet suitable for life as we know it today. Mars, however, is not suitable for life as we know it today, due to the lack of liquid water.

Search for Life

Martian moons

Phobos and Deimos, the two moons of Mars, were discovered in 1877. Phobos means “fear” and “terror,” their names were taken from the Greek gods of war. Astronomers have observed the moons from Earth, and they have been observed from space, as they orbit Mars at a distance of about 20,000 kilometers, taking 1.26 terrestrial days to complete one orbit. The orbit of both moons is retrograde, meaning that they move in the opposite direction to the rotation of Mars, which results in the moons taking the same time to orbit Mars. Consequently, they always move in the same direction towards Mars.

The moons are not suitable for life as we know it on Earth. Their surface is darker than that of Mars, meaning the amount of energy received on the moons is less than on Mars itself. However, if life were to exist on Mars, it might exist on the moons.

10 YEARS HIGH RESOLUTION STereo Camera on MARS EXPRESS

Tectonics

Disturbances on the surface of Mars indicate that there are processes occurring on the planet that can be observed by exactly the same processes that occur on Earth. They might, for example, be caused by the movement of viscous masses of rock within the mantle of Mars, when hot material slowly rises from the surface. This process is called convection. The Martian crust is thinnest in the polar regions, where it is about 50 kilometers thick, and thickest in the equatorial regions, where it is about 150 kilometers thick. The crust is made up of large, dark-colored plains, and the thickest parts of the crust are found on the eastern sides of the planet’s two largest impact basins, Arabia and Amazonis Planitia.

Atmosphere and Wind

Like Earth, a gas-covered planet, Mars is affected by atmospheric phenomena. However, the Martian atmosphere is much thinner than that of Earth, due to the fact that the pressure on Mars is only about 1% of Earth’s atmospheric pressure. The Martian atmosphere is a crosswind of carbon dioxide, nitrogen, oxygen, argon, and trace gases. The atmosphere of Mars is cool enough to permit large-scale, dense formations, high-altitude atmospheric layers that are colored in blue, red, green, and orange, and other colors. In particular, the weather is colored in white, including snow on the surface and the atmosphere. The weather on Mars is therefore quite dynamic.

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