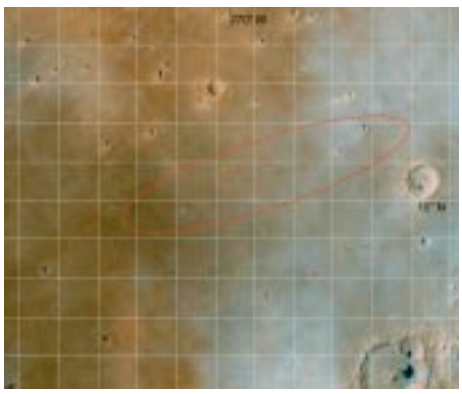
Mars Express –

Europe's contribution to learn more about Mars.

As a part of the Cosmic Vision 2020 Mars Express is the first of the missions that will bring about more knowledge about our neighbours in space. Later, missions such as Venus Express to Venus, and BepiColombo to Mercury, will provide Europe with greater knowledge about the inner planets, missions that can place Europe in the forefront of planet investigation.

Mars Express will be launched in the first half of June this year and together with no less than six international spacecrafts; it will use the launch window that will open in the spring/summer this year, a window it takes thirty-six months until it reopens again. The idea for a European mission to earth is not new, several other ideas have been studied in recent years, but Mars Express is chosen, mainly for economical reasons. This mission is relatively low-priced, mainly because a great deal of the instruments were developed to be used on the Russian Mars '96, a mission that did not reach its goal.

Like all forms of research, the programmes give some answers, but also raise a range of new questions. This also goes for the investigation of Mars. In spite of four hundred years of visual and mathematical investigations and more recently, four decades of investigation with satellites and landers of different types, the scientists have only scratched the surface of the many mysteries such a celestial body hides.



The Beagle landing site. Photo ESA.

Mars Express is therefore only one of the missions that will visit the Red Planet the next decades, but it will provide several new pieces of the puzzle, thus getting a complete picture of the planet. Some of the questions that have been raised are: What forces have created the spectacular features in the Martian landscape? When did they cease? Or do some still act today? Was early Mars really warm and wet? If so, where did the water and atmosphere go? Did life evolve there? And is primitive life still thriving, perhaps associated with underground aquifers?

The Mars Express mission will possibly help to answer these and many other questions by mapping the Martian sub-surface, the surface, atmosphere and ionosphere from orbit and by conducting observations and experiments on the surface.

Mars Express consists of the orbiter which will orbit the planet for several months and Beagle 2, that will land on the surface and send back information from the surface.

The Orbiter will:

- Image the entire surface at high resolution (10m/pixel) and selected areas at super resolution (2m/pixel)
- Produce a map of the mineral composition of the surface at 100 m resolution.
- Map the composition of the atmosphere and determine its global circulation.
- Determine the structure of the sub-surface to a depth of a few kilometres.
- Determine the effect of the atmosphere on the surface.
- Determine the interaction of the atmosphere with the solar wind.

The Beagle 2 lander will:

- Determine the geology and the mineral and chemical composition of the landing site.
- Search for life signatures (exobiology)
- Study the weather and climate.

The mission

Mars Express will leave earth for Mars in late May or early June this year when the positions of the two planets make for the shortest possible route. The satellite will be launched with a Soyus/Fregate launcher from Baikonur in Kazakstan.

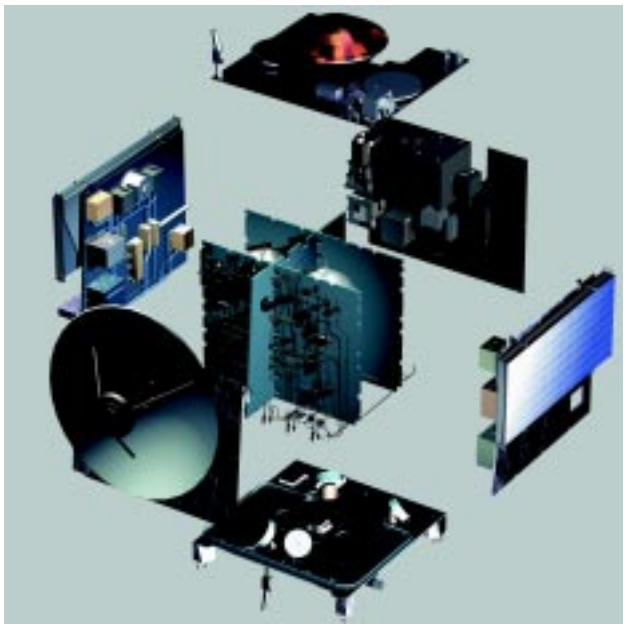
Once Mars Express has escaped the earth and is on course for the Red Planet, it will begin the six

month' cruise at a velocity of 10 800 km/h relative to earth. Five days before arrival in December 2003, Mars Express will eject the Beagle 2 lander, which will make its own way to the correct landing site on the surface. The orbiter will then manoeuvre into a highly elliptical capture orbit, from which it can move into its operational near-polar orbit.

Mars Express will remain in orbit around Mars for at least a Martian year, 687 earthly days, which is the nominal mission lifetime. During this time, the point of the orbit closest to Mars will move around to give the scientific instruments coverage of the entire Martian surface at all kinds of angles.

Beagle 2 will descend to the surface, entering the atmosphere at more than 20 000 km/h. A heat-resistant front shield will protect it as friction with the upper atmosphere slows it down. When its speed has fallen to about 1600 km/h, parachutes will deploy to slow it further. Finally, large gas-filled bags will inflate to protect it as it bounces to a halt on the chosen landing site. The landing site is Isidis Planitia (10.6oN, 270 oW), a large flat sedimentary basin straddling the relatively young northern plains and ancient southern highlands.

As soon as it has come to a halt, the gas-filled bags will be released and ejected away from the lander, its clam-like outer casing will spring open, its solar panels will unfurl and its cameras will start to take in the view. Beagle 2 must accomplish its mission in just 180 Martian days, close to the same length as 180 days on earth. The first few days will be spent running pre-programmed sequences, imaging the site and running the environmental sensors, preparing for when the lander will start doing very detailed rock and soil analyses.



The bus dimensions for Mars Expess are 1.5 x 1.8x 1.4 m and for power supply, two solar arrays with a collected area at 11.42 m2. At that figure folded at the left and right side. At the top, the Beagle 2 lander.
Figure: ESA

Developing and building – a new approach.

Mars Express is a pioneer – and not just because it is Europe's first mission to the Red Planet. It is also pioneering in more economical ways of building space science missions at ESA. These new working methods have already proved effective and will be applied to future science missions in the agency's long-term scientific programme.

ESA is spending just 150 million Euros in 1996 prices, on Mars Express, which is about one third of the cost of previous, similar missions. This sum will pay for the spacecraft, the launch and the operations. Orbiter instruments and the beagle 2 lander are provided separately. Also, the mission is being built unusually quickly to meet a narrow launch window in May/June 2003.

Savings are being made by reusing existing hardware, adopting new project management practices, shortening the time from original concept to launch, and procuring the most cost effective launcher available. What ESA is doing with Mars Express will affect flexible missions at the agency, which may, in future, be linked more closely to major missions. ESA is making savings, but is not taking big risks.

Mars Express is making a maximum use of existing technology that is either "off-the-self" or has already been developed for Rosetta. Items that are not at least partly in common with Rosetta constitute only about 35% of the spacecraft.

ESA is delegating tasks to Astrium, France, the spacecraft prime contractor that previously would have been done by the project team at ESTEC. In particular, Astrium is managing the technical interfaces between the spacecraft and science payload, and between the spacecraft and launcher. This shift in responsibility is allowing industry to streamline procedures and ESA to reduce the size of its project team to half that of previous equivalent projects.

The time from concept to awarding the design and development contract was cut from about five years to little more than one year. Astrium won the prime contract in March 1999 in competition with two other consortia. The design and development phase will take less than four years, compared to six years for previous similar missions.