cnes

Space for Earth

# DESTINATION MARS

## IN 7 QUESTIONS

## 1 Why does Mars have such a special place in our imagination?

The Red Planet, named after the Roman god of war, is clearly visible to the naked eye and has fascinated mankind from earliest times. In the popular imagination, while the Moon is associated with dreaming, Mars seems the most likely place in the Universe for life to be possible, with the result that another common expression for extraterrestrials is “Martians”.

Ever since H. G. Wells’s War of the Worlds, there have been endless books and films inspired by this idea, reinforcing the legends about Mars. But as observations and explorations have revealed more about the planet, scientists have also become fascinated with Mars, the most likely of the other planets in the Solar System to have all the necessary conditions for life to appear.

## 2 What are the key dates in the conquest of Mars?

Almost 40 missions have attempted to reach Mars since the 1960s, including the US Mariner probes. The Russians got there first in 1971 with Mars 2, which crashed on the surface, and then with Mars 3, which landed successfully but ceased transmitting after 20 seconds.

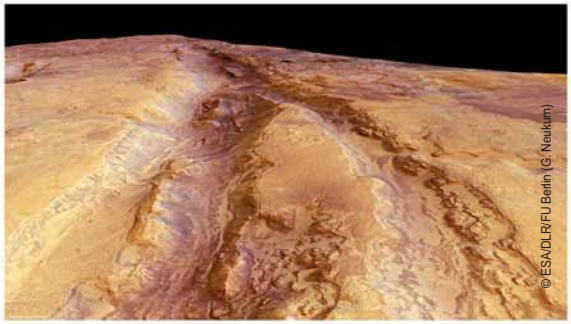
The Americans had the first real successes with the Viking missions, in 1976. Samples were taken and analysed for the first time. In 1997, Sojourner opened the era of exploration with rover vehicles, robots fitted with mobile laboratories. Finally, in 2004, Spirit and Opportunity enabled scientists to study the surface of Mars in much greater detail.

Europe has also contributed to the conquest of Mars: since 2003, the Mars Express orbiting probe has been sending back precious data, particularly concerning the presence of water in liquid form on the planet’s surface.

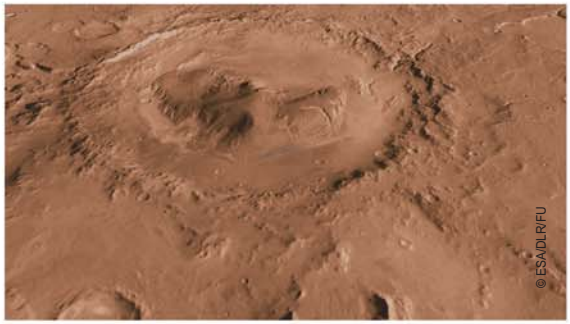
# 3

## Why look for traces of life on Mars?

Wrapped in a residual atmosphere that is 95% carbon dioxide ($CO_2$), swept by violent sand storms, subject to temperature swings from 0° to -130°C and battered by meteorite showers, Mars does not seem like a particularly hospitable planet. But we really are looking for signs of life. Partly because its distance from the Sun, neither too near nor too far, means that it is in the habitable part of the Solar System. But especially because traces of flows (dried-up rivers and outflow channels) suggest that, in the past, water was abundant there, while the atmosphere was very different. Just the conditions necessary for life to appear.

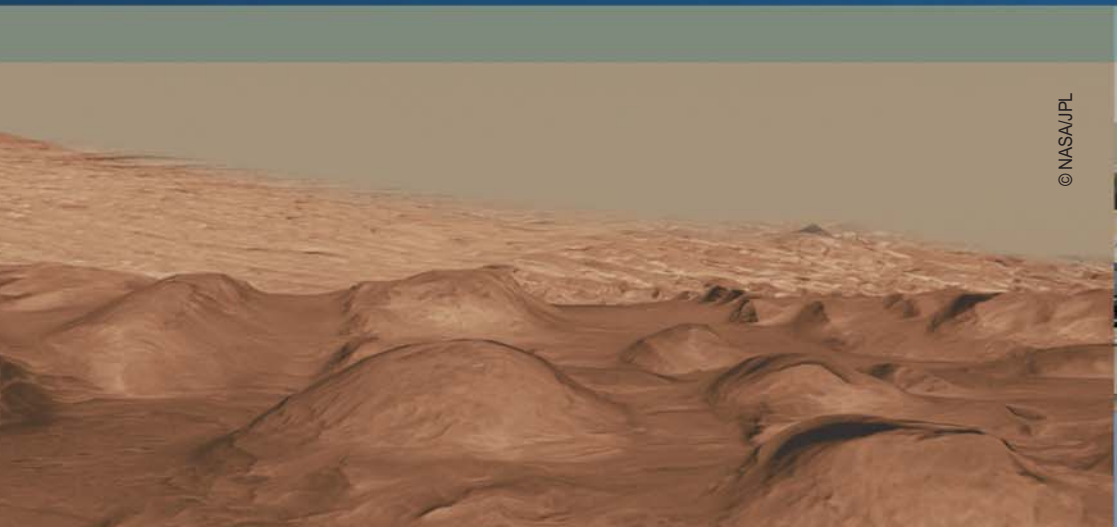



Channels carved into the crust of Mars, to depths of as much as 500 m, observed during the Mars Express mission




Gale Crater, landing site for the Curiosity rover.

Martian landscape




The Curiosity rover

# 4

## The saga continues: what will the Curiosity rover discover during the Mars Science Laboratory mission?

So far, we only have clues as to the presence of water on Mars; we now need to find proof. After being launched by an Ariane V rocket for a nine-month journey through space, the MSL mission will aim to land the Curiosity rover in the Gale Crater. This site was chosen for its geological characteristics and also because it contains clay, proving that there was liquid water there in the distant past. For a Martian year (the equivalent of two Earth years) this extremely sophisticated mobile laboratory will move about and analyse the surface of Mars. During this period, it will try and determine whether the planet really did meet all the conditions necessary for life to develop. It will learn more about the climate and the planet's geology via precise chemical analyses. A longer term objective is to prepare the way for future human exploration.

The ChemCam instrument will pulverise rock from the surface of Mars, to help unlock the secrets of the Red Planet's geological past.



5

## In what way is this expedition more ambitious than previous ones?

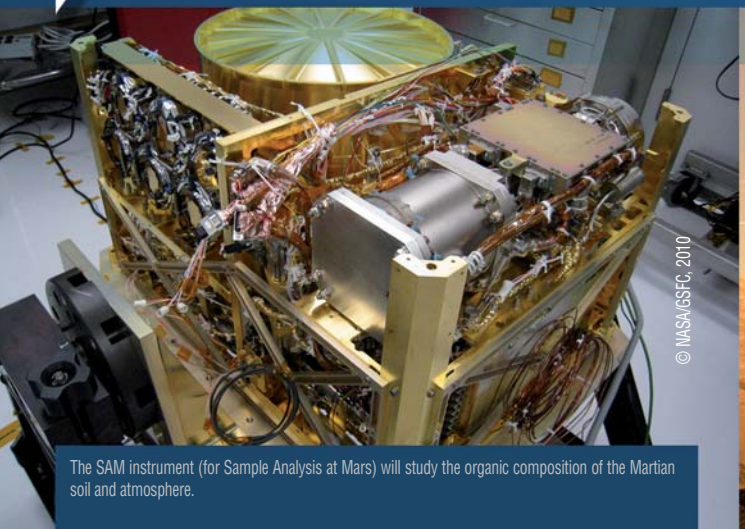
MSL marks the start of a new era in Martian exploration. First, by the size of the rover, which meant new techniques had to be developed to land it safely. Curiosity will be carrying 10 scientific instruments, a 70-kilo payload ten times heavier than its predecessors. The rover will communicate with Earth via a relay satellite in orbit round Mars. There will also be a backup link directly to Earth in case of need. The new rover will have considerable operating autonomy and, with its six powered wheels, will cover about 20 kilometres during the mission. Unlike the previous rovers, which were fitted with solar panels, Curiosity will be powered by a nuclear battery, allowing it to continue its experiences whether in daylight or the Martian night.

6

## What roles are played by France and CNES?

The MSL mission is part of NASA's Mars exploration programme. It is overseen by the Jet Propulsion Laboratory (JPL), a NASA centre in Pasadena, USA. Several countries are participating (Canada, Spain, France and Russia). France is contributing to two of the ten scientific instruments carried by the Curiosity rover, ChemCam and SAM, created by joint CNRS/University laboratories (IRAP in Toulouse and LATMOS in Paris), with CNES as contracting authority. At NASA's request, France will be involved in operating these instruments, once on Mars, from the FIMOC mission centre, set up at the Toulouse Space Centre.

The Curiosity rover will try to find traces of life-forms on Mars. France is heavily involved in two of the rover's instruments: ChemCam and SAM.





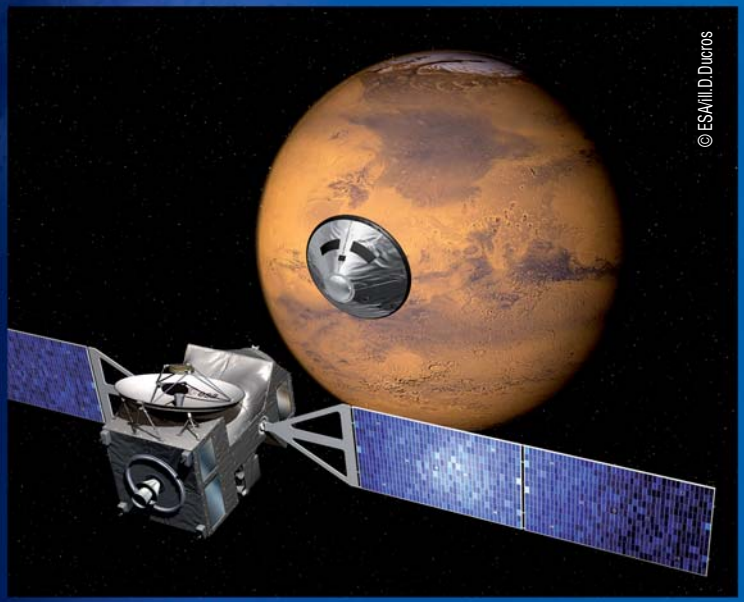
The SAM instrument (for Sample Analysis at Mars) will study the organic composition of the Martian soil and atmosphere.

7

## What will ChemCam and SAM, the two instruments in which France is participating, be looking for?

ChemCam (Chemistry Camera) will make selective analyses of the composition of soil and rocks from 1 to 9 metres around the rover, without physical contact. It will do this by analysing the light spectrum emitted by matter when electrons within it are excited by a laser beam fired at it. France is providing the laser unit located on the rover's mast. SAM (Sample Analysis at Mars) will analyse Mars's soil and near subsoil in situ and also its atmosphere. It will look for chemical compounds related to carbon, including methane, which are associated with life, so that scientists can learn more about the way they were created and destroyed in the Martian ecosphere.

France is also providing the gas chromatography (GC) device, one of the three instruments making up SAM.




## Find out more

**The planet Mars**

**Mars is the fourth planet in the Solar System, at a mean distance of 1.52 astronomical units from the Sun (about 227 million kilometres). Its orbital period, the Martian year, is 687 days. With a diameter of 6805 kilometres, about half that of the Earth's, it is the second smallest planet after Mercury. Like Mercury, Venus and Earth, it is a terrestrial planet, meaning that it consists of rocks and metals. Its reddish tinge comes from the abundance of iron oxide on its surface. Lastly, Mars is not completely alone in the heavens: just as Earth has our Moon, Mars has two small natural satellites orbiting it, Phobos and Deimos. The Russian Phobos-Grunt mission, in which France is participating, will study Phobos in situ, by bringing samples of this moon back to Earth for the very first time.**

**Find out more about Mars and the MSL mission:**
**http://smsc.cnes.fr/MSL/Fr/**
**Find out more about the Phobos-Grunt mission:**
**http://smsc.cnes.fr/PHOBOS/Fr/**


2, place Maurice Quentin - 75039 Paris cedex 01 - France
www.cnes.fr
Published by the External Communication, Education and Public Relations Directorate, 2011


cnes