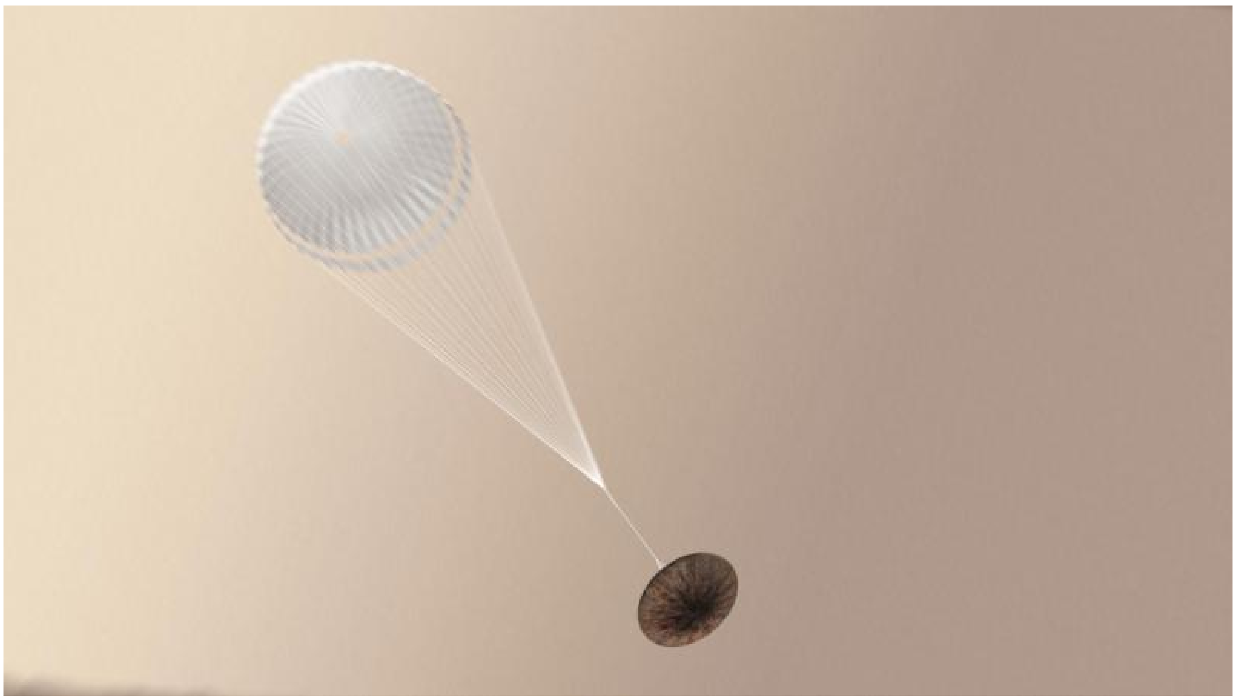
Schiaparelli landing investigation completed

May 25 2017



Artist impression of the Schiaparelli module with parachute deployed. Credit: ESA/ATG medialab

The inquiry into the crash-landing of the ExoMars Schiaparelli module has concluded that conflicting information in the onboard computer caused the descent sequence to end prematurely.

The Schiaparelli entry, descent and landing demonstrator module separated from its mothership, the Trace Gas Orbiter, as planned on 16

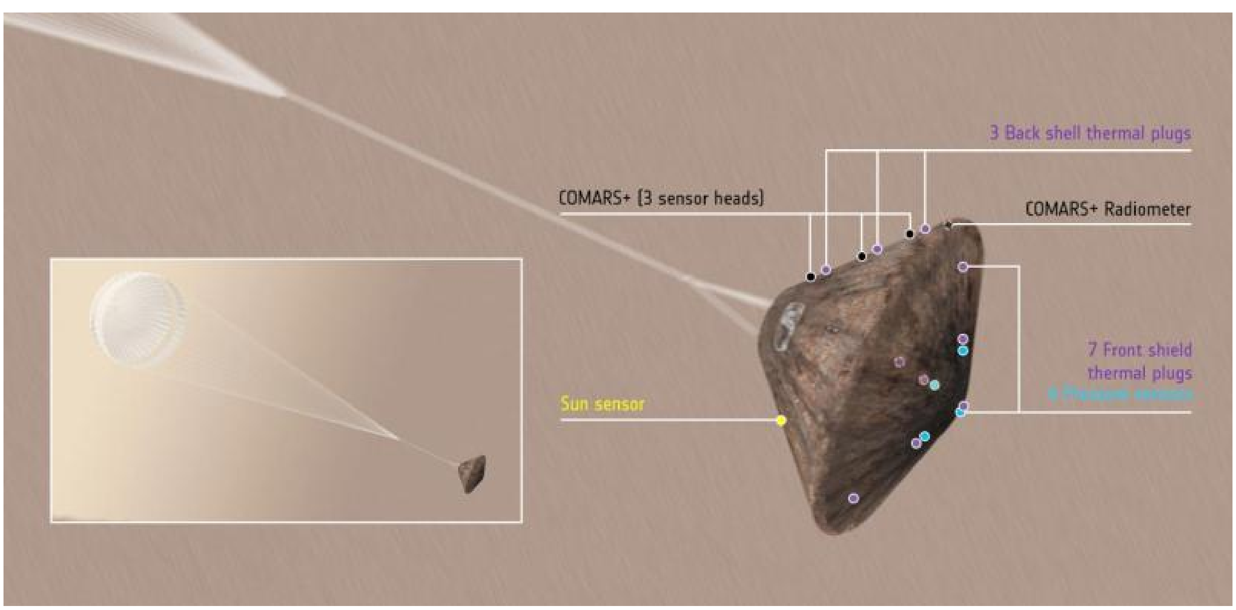
October last year, and coasted towards Mars for three days.

Much of the six-minute descent on 19 October went as expected: the module entered the atmosphere correctly, with the heatshield protecting it at supersonic speeds. Sensors on the front and back shields collected useful scientific and engineering data on the atmosphere and heatshield.

Telemetry from Schiaparelli was relayed to the main craft, which was entering orbit around the Red Planet at the same time – the first time this had been achieved in Mars exploration. This realtime transmission proved invaluable in reconstructing the unfolding chain of events.

At the same time as the orbiter recorded Schiaparelli's transmissions, ESA's Mars Express orbiter also monitored the lander's carrier signal, as did the Giant Metrewave Radio Telescope in India.

In the days and weeks afterwards, NASA's Mars Reconnaissance Orbiter took a number of images identifying the module, the front shield, and the parachute still connected with the backshield, on Mars, very close to the targeted landing site.



Schiaparelli’s heatshield was equipped with a variety of sensors designed to take measurements as the module entered the atmosphere. Credit: ESA/ATG medialab

The images suggested that these pieces of hardware had separated from the module as expected, although the arrival of Schiaparelli had clearly been at a high speed, with debris strewn around the impact site.

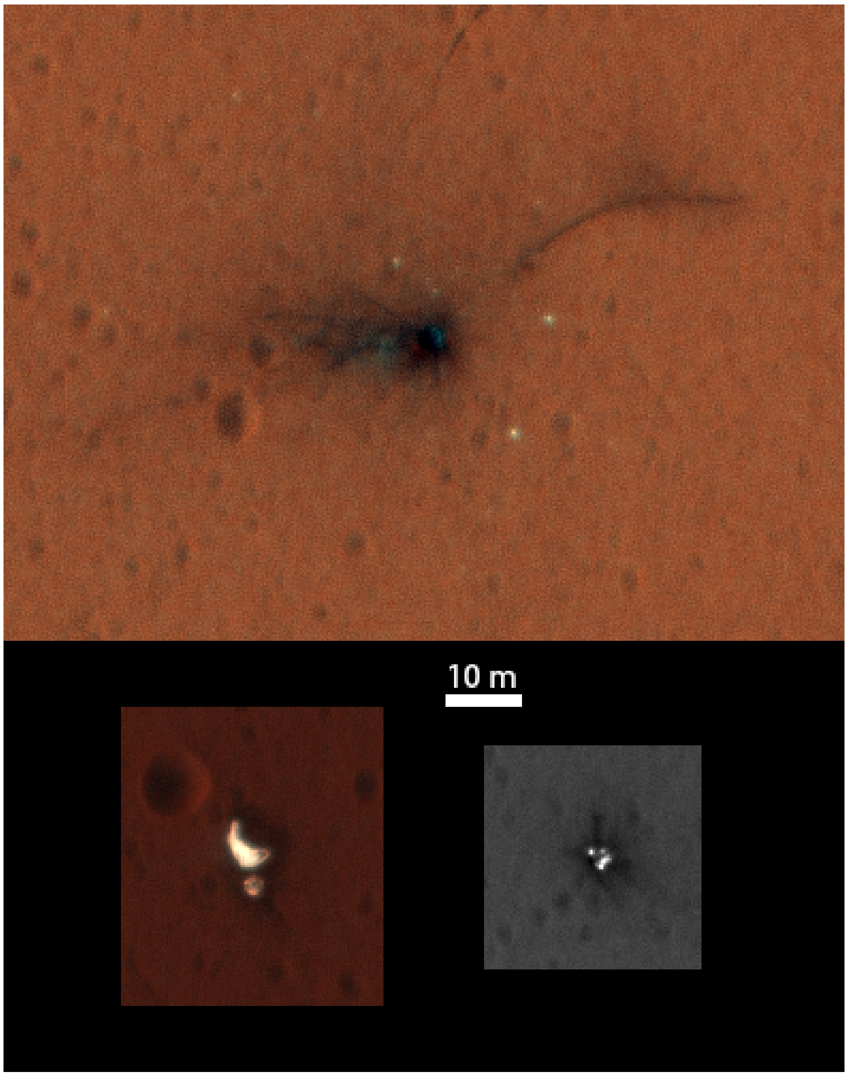
The independent external inquiry, chaired by ESA's Inspector General, has now been completed.

It identifies the circumstances and the root causes, and makes general recommendations to avoid such defects and weaknesses in the future. The report summary can be downloaded here.

Around three minutes after atmospheric entry the parachute deployed, but the module experienced unexpected high rotation rates. This resulted in a brief 'saturation' – where the expected measurement range is exceeded – of the Inertial Measurement Unit, which measures the lander's rotation rate.

The saturation resulted in a large attitude estimation error by the guidance, navigation and control system software. The incorrect attitude estimate, when combined with the later radar measurements, resulted in the computer calculating that it was below ground level.

This resulted in the early release of the parachute and back-shell, a brief firing of the thrusters for only 3 sec instead of 30 sec, and the activation of the on-ground system as if Schiaparelli had landed. The surface science package returned one housekeeping data packet before the signal was lost.



Schiaparelli in colour. Credit: NASA/JPL-Caltech/University of Arizona

In reality, the module was in free-fall from an altitude of about 3.7 km, resulting in an estimated impact speed of 540 km/h.

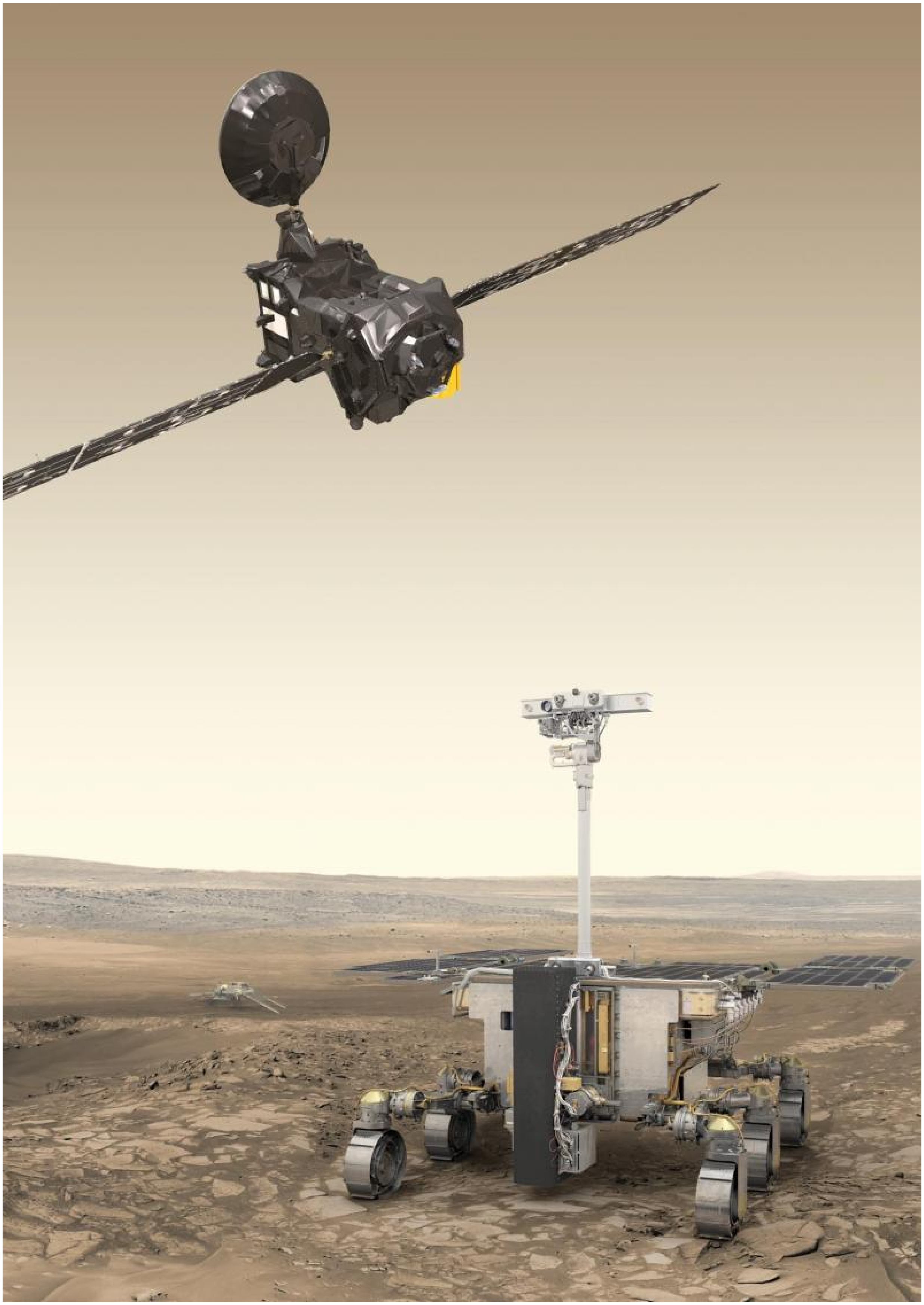
The Schiaparelli Inquiry Board report noted that the module was very close to landing successfully at the planned location and that a very important part of the demonstration objectives were achieved. The flight results revealed required software upgrades, and will help improve computer models of parachute behaviour.

"The realtime relay of data during the descent was crucial to provide this in-depth analysis of Schiaparelli's fate," says David Parker, ESA's Director of Human Spaceflight and Robotic Exploration.

"We are extremely grateful to the teams of hard-working scientists and engineers who provided the scientific instruments and prepared the investigations on Schiaparelli, and deeply regret that the results were curtailed by the untimely end of the mission.

"There were clearly a number of areas that should have been given more attention in the preparation, validation and verification of the entry, descent and landing system.

"We will take the lessons learned with us as we continue to prepare for the ExoMars 2020 rover and surface platform mission. Landing on Mars is an unforgiving challenge but one that we must meet to achieve our ultimate goals."



Artist’s impression of the ExoMars 2020 rover (foreground), surface science platform (background) and the Trace Gas Orbiter (top). Not to scale. Credit: ESA/ATG medialab

"Interestingly, had the saturation not occurred and the final stages of landing had been successful, we probably would not have identified the other weak spots that contributed to the mishap," notes Jan Woerner, ESA's Director General. "As a direct result of this inquiry we have discovered the areas that require particular attention that will benefit the 2020 mission."

xoMars 2020 has since passed an important review confirming it is on track to meet the launch window. Having been fully briefed on the status of the project, ESA Member States at the Human Spaceflight, Microgravity and Exploration Programme Board reconfirmed their commitment to the mission, which includes the first Mars rover dedicated to drilling below the surface to search for evidence of life on the Red Planet.

Meanwhile the Trace Gas Orbiter has begun its year-long aerobraking in the fringes of the atmosphere that will deliver it to its science orbit in early 2018. The spacecraft has already shown its scientific instruments are ready for work in two observing opportunities in November and March.

In addition to its main goal of analysing the atmosphere for gases that may be related to biological or geological activity, the orbiter will also act as a relay for the 2020 rover and surface platform.

Provided by European Space Agency