SPACE

Mars launch puts Russia–Europe team to the test

Joint ExoMars mission launches lander and orbiter, with a rover planned for 2018.

BY ELIZABETH GIBNEY

Neither Europe nor Russia has ever successfully operated a mission on Mars's surface. Now the European Space Agency (ESA) and its Russian counterpart Roscosmos hope to mark a first for both organizations with the joint ExoMars 2016 mission, which launched from the Baikonur Cosmodrome in Kazakhstan on 14 March.

ExoMars 2016 consists of a lander that will study the planet's dust storms and an orbiter that will analyse its atmosphere, including looking for methane. The orbiter will also act as a relay for a Mars rover, due to be launched in 2018. Each phase will test the growing collaboration between the two agencies, which have hinted at further joint missions, including uncrewed and crewed Moon trips.

A Russian Proton rocket launches ExoMars 2016 from Kazakhstan.

STEPHANE CORVAJA/ESA

ESA designed the orbiter and lander projects, but a Russian Proton rocket launched them, and they carry Russian instruments. "The launch is crucial because it's symbolic," says Oleg Korablev of the Space Research Institute, Moscow, who is principal investigator for the Atmospheric Chemistry Suite on the orbiter. "It's psychologically very important."

ESA project scientist Jorge Vago adds: "Hopefully this will cement a way of doing things that becomes the modus operandi for when we do missions together." Based at the European Space Research and Technology Centre in Noordwijk, the Netherlands, Vago also works on the ExoMars 2018 mission.

ESA approved the ExoMars concept in 2005; a subsequent merry-go-round of collaborators eventually resulted in the Europe–Russia collaboration and ExoMars's unusual two-stage format (see 'Mission merry-go-round').

The ExoMars 2016 craft — the heaviest Mars mission ever launched, at 4,332 kilograms — is now bound for the red planet. A favourable alignment of Earth and Mars means that the craft should reach orbit in 7 months; the orbiter and landing module, Schiaparelli, will separate before reaching the Martian atmosphere.

The landing won't involve anything as complex as NASA's sky crane, which delivered the Curiosity rover to Mars in 2012. But it is ambitious, says Vago, and designed to show that Europe can make a controlled landing on Mars. Heeding lessons from Beagle 2 (Britain's failed 2003 Mars lander that was operated by ESA), the module will use drag from the Martian atmosphere to brake, then open a parachute and finally fire its thrusters. During the last 2 metres, Schiaparelli will deploy a honeycomb-like crash pad.

The first lander to set down during dust-storm season, Schiaparelli will monitor pressure and temperature and image the approaching landing site as it descends. On the ground, the conical lander has just 2–4 days of battery power to perform experiments.

Its tiny meteorological station DREAMS (Dust Characterisation, Risk Assessment, and Environment Analyser on the Martian Surface) will measure pressure, humidity, temperature, wind speed and direction. This represents a unique chance to study dust circulation and hopefully unravel the mystery of why some storms on Mars go planet-wide, says Francesca Esposito at the INAF Astronomical Observatory of Capdiomonte in Naples, Italy, and the principal investigator for DREAMS. The lander will also be the first to examine the planet's electric field. Those data will feed into Martian climate models and could allow scientists to better predict future disturbances to communications on the planet, she says.

BIOLOGICAL STUDIES

The higher-profile science — including investigating hints of Martian biology — will take place in the sky on board ExoMars' Trace Gas Orbiter (TGO). That phase will begin at the end of 2017, once the craft has manoeuvred into a circular, 400-kilometre-high orbit.

While studying Mars's atmosphere, the TGO's major task will be to follow up on evidence that the red planet contains methane, which has been associated with active geological processes, as well as biological ones. "Is there a seasonality to the methane, or are the concentrations associated with particular types of terrain, for instance?" asks John Bridges, a planetary scientist at the University of Leicester, UK, who works on the TGO's stereo camera. The camera will use 3D images to chart geological features; a hydrogen detector will map the planet's subsurface water.

The orbiter will also serve as a communications platform, including for the ExoMars rover, which will break new ground — literally. The rover will drill up to 2 metres into the surface, where organic matter, which can be destroyed by surface radiation, may lie preserved.

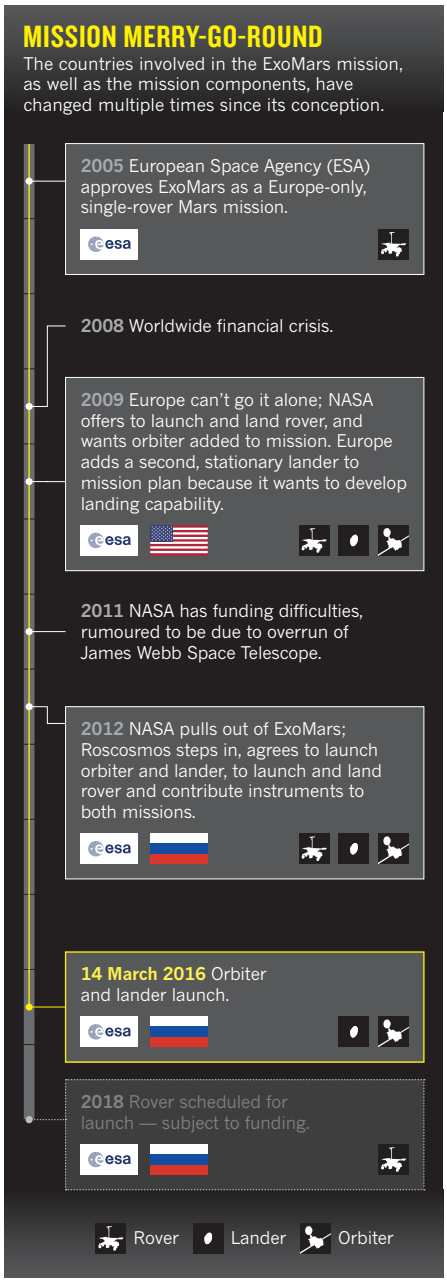
The rover project will require the Russian and European teams to work together to an extent unprecedented for ESA, says Vago. In the 2016 mission, their responsibilities are relatively separate, but in the 2018 mission, he says, "there is no clean line", and each design tweak ripples through the work of both teams. It is a new experience for Russia too, says Korablev, even though the country has long contributed scientific instruments to foreign space missions. "There are many problems, but there are always problems on national projects too," he says.

This complexity, coupled with late-running instruments, delays in testing and a lack of cash, means that the 2018 rover mission could be delayed until 2020, says Vago. ESA's

director-general, Johann-Dietrich Wörner, said in January that the 2018 mission needed more funding to meet its launch target, and the agency is expected to ask member states for the missing few hundred million euros at a meeting in December. Success with ExoMars 2016 could help to persuade European leaders to contribute. Bridges says that most scientists will accept a delay as long as it means that all the instruments are on the craft and working.

Korablev's involvement with Mars missions has been an emotional roller coaster. He spent 10 years working on Russia's Mars 96 orbiter, which failed to leave near-Earth orbit. He was also involved in a sample-return mission to the Martian moon Phobos, which ran into problems, eventually crashing in the Pacific Ocean in 2012. "We put a great effort into ExoMars," he says. "I almost don't dare to say any words." ■

PAUL JACKMAN/NATURE



PLANETARY SCIENCE

NASA Mars woes could delay missions

Decision to defer InSight launch will cost US$150 million.

BY DEVIN POWELL

Cracks in an instrument designed to detect earthquakes on Mars will add roughly US$150 million to the price tag of InSight, NASA's next mission to the red planet. But the agency said on 9 March that it still intends to fly the spacecraft, raising questions about how the unexpected expense will affect other planetary missions in development.

Although InSight's launch — originally scheduled for this month — is now slated for May 2018, it is not clear whether the spacecraft's faulty seismometer will be ready in time. InSight seeks to investigate Mars's interior by measuring seismic activity, as well as the heat that is escaping from the planet and the movement of its surface.

"We're really grateful that NASA has recognized the value of science we're going to do and agreed to give us a chance to try it again," says InSight's principal investigator, Bruce Banerdt, who works at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California.

The spacecraft was developed as part of NASA's Discovery Program, which funds small, quick-turnaround missions whose costs are capped at $450 million. Five proposed missions are currently vying for a chance to launch in the early 2020s. These include a trip to Jupiter's Trojan asteroids, two missions to Venus and a camera that would detect near-Earth objects.

"NASA has been trying to choose two missions out of this round instead of one, and the community's concern is that the likelihood of that happening might be falling," says Linda Elkins-Tanton, a planetary scientist at Arizona State University in Tempe and principal investigator of a proposed mission to the asteroid Psyche.

Jim Green, director of NASA's planetary-science division in Washington DC, says that budget details and consequences to other planetary missions will be worked out by August. "Our ability to select at least one Discovery mission in December is expected to be unaffected," he says.

Then there is the matter of whether InSight's troubled seismometer, which was developed by a global collaboration led by the Paris Institute of Earth Physics, can be repaired.

Banerdt says that Sodern, the French company subcontracted to build a vacuum container to enclose the seismometer's sensors, did not detect any problems with connectors that are supposed to seal wires leading out of the vacuum housing. Only when the instrument was tested in frigid, Mars-like temperatures in December did cracks in those seals become apparent. The project team tried to patch the problem, but persistent leaks remained.

"It's very frustrating," says Banerdt. "I've been working on getting this kind of mission for more than 25 years, and everything else on the project was going really well."

FUTURE FIX

NASA has asked the JPL to craft a new, hardier vacuum chamber. The agency's French collaborators will test the chamber at their own expense. "Personally, I am relieved to know that JPL will be taking responsibility for the vacuum chamber," says Lisa Pratt, a biogeochemist at Indiana University Bloomington.

The Mars InSight team is now re-running landing simulations and recalculating orbits to account for the updated launch date.

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Some wonder whether the mistake could cause NASA to tighten the reins on future projects. The most recent call for Discovery mission proposals — made before the problem with InSight occurred — mandated that no more than one-third of instrument costs be spent on foreign sources.

"The word on the street is that NASA's a little more wary of collaborating with groups that they don't know so well or don't control directly," says Elkins-Tanton.

But Green argues that any nation trying to build a new instrument could have made this mistake. "This is the first time this type of instrument has been built to withstand harsh environmental conditions on another planet," he says. ■