

NEWS IN FOCUS

POLICY Canada's popular leader faces slew of thorny science issues **p.436**

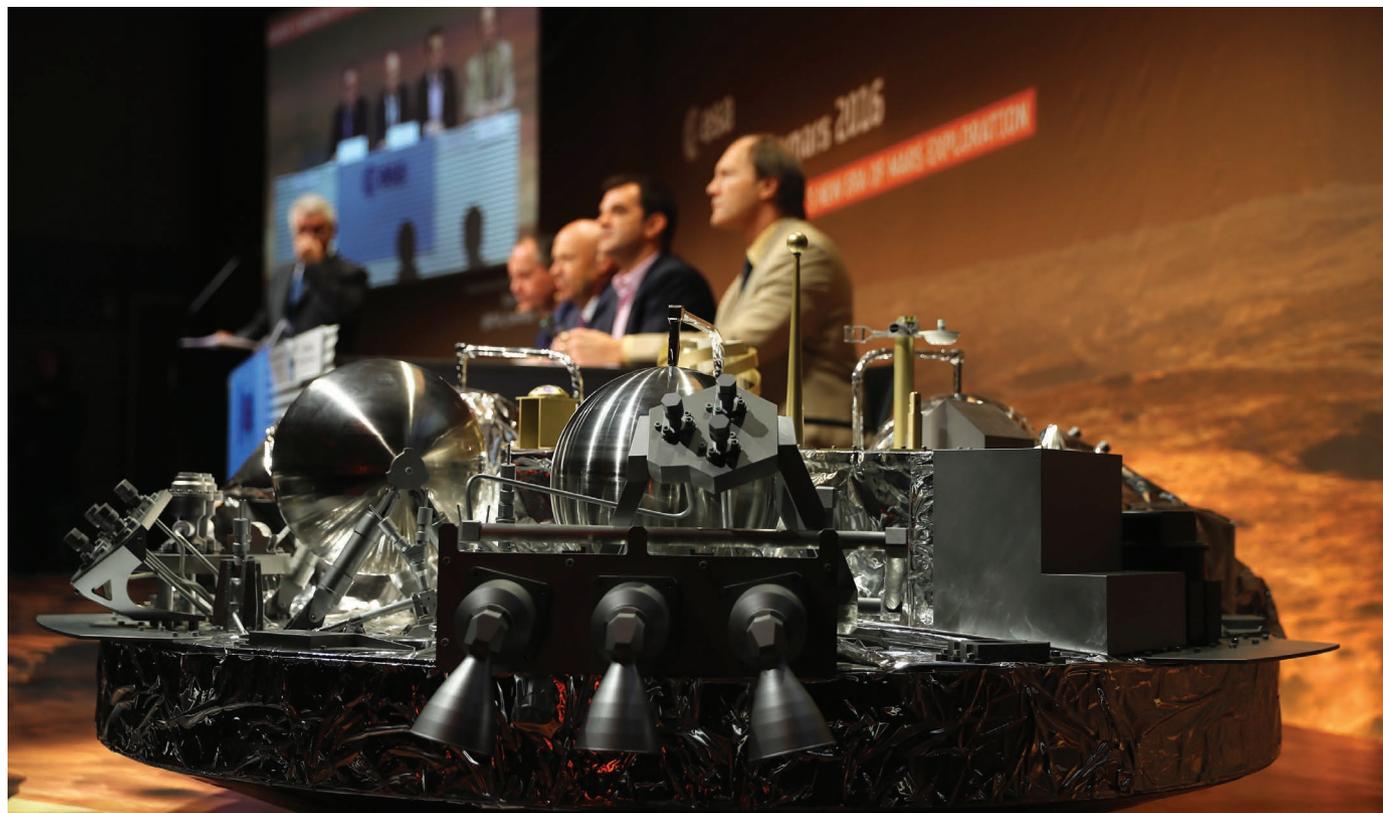
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SPACE Frozen 'heart' has outsized influence on Pluto's geology **p.439**



CAREERS A special issue reveals the pressures felt by early-career researchers **p.543**

KAI PFAFFENBACH/REUTERS



European Space Agency scientists discuss Schiaparelli's failed landing on Mars, alongside a model of the spacecraft.

PLANETARY RESEARCH

Race to unravel Mars crash

Explaining why lander failed is key to avoiding mistakes in 2020 mission.

BY ELIZABETH GIBNEY

Photos of a huge circle of churned-up Martian soil leave few doubts: a European Space Agency (ESA) probe that was supposed to test landing technology on Mars crashed into the red planet instead, and may have exploded on impact.

The events of 19 October may be painful for ESA scientists to recall, but they will now have to relive them many times over in computer simulations. The lander, called Schiaparelli, was part of ESA's ExoMars mission, conducted jointly with the Russian Space Agency Roscosmos. It was a prelude to a planned 2020 mission, when

researchers aim to land a much larger scientific station and rover on Mars. The rover will drill up to 2 metres down to look for signs of ancient life in the planet's soil. Working out Schiaparelli's faults and rectifying them is a priority, says Jorge Vago, project scientist for ExoMars. "That's super important. I think it's on everybody's mind."

Unlike the British-led and ESA-operated Beagle 2 mission, which disappeared during its landing on Mars on Christmas Day 2003, Schiaparelli sent data to its mother ship during its descent. Preliminary analysis suggests that the lander began flawlessly, braking against the planet's atmosphere and deploying its parachute. But 4 minutes and 41 seconds into an

almost 6-minute fall, something went wrong. The lander's heat shield and parachute ejected ahead of time, says Vago. Then thrusters, designed to decelerate the craft for 30 seconds until it was metres off the ground, engaged for only around 3 seconds before they were commanded to turn off because the lander's computer thought it was on the ground. The lander even switched on its suite of instruments, ready to record Mars's weather and electrical field, although they did not collect data. "My guess is that at that point we were still too high. And the most likely scenario is that, from then, we just dropped to the surface," says Vago.

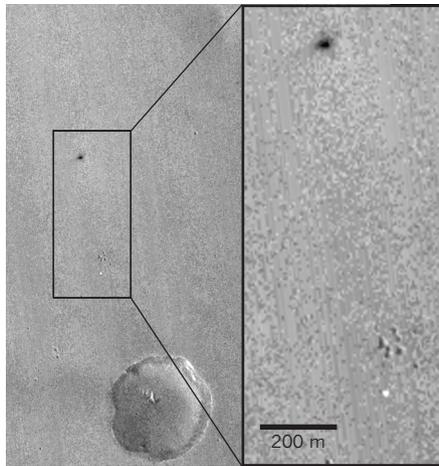
The craft probably fell from a height of ▶

▶ between 2 and 4 kilometres before slamming into the ground at more than 300 kilometres per hour. That's according to estimates based on images (right) of the probe's probable crash site taken by NASA's Mars Reconnaissance Orbiter on 20 October.

The most likely culprit is a flaw in the craft's software or a problem in merging the data coming from different sensors, which may have led the craft to believe it was lower in altitude than it really was, says Andrea Accomazzo, ESA's head of solar and planetary missions. Accomazzo says that this is a hunch; he is reluctant to diagnose the fault before a full post-mortem has been carried out. But if he is right, that is both good and bad news.

European-designed computing, software and sensors are among the elements of the lander that are to be reused on the ExoMars 2020 landing system, which, unlike Schiaparelli, will involve a mixture of European and Russian technology. But software glitches should be easier to fix than a fundamental problem with the landing hardware, which ESA scientists say seems to have functioned well. "If we have a serious technological issue, then it's different, then we have to re-evaluate carefully. But I don't expect it to be the case," says Accomazzo.

The ExoMars team will try to replicate the mistake using a virtual landing system designed



Mars orbiter photos show the probable crash site.

to simulate the lander's hardware and software, says Vago, to make sure that scientists can deal with the issue before redesigning any aspects of ExoMars 2020. That mission has already been delayed by two years, owing to hold-ups on both the Russian and European sides. But Vago believes that design tweaks will not push the mission back. "At this point, no one wants to think about flipping to 2022. It was painful enough to go from 2018 to 2020," he says.

The 2020 mission has a budget shortfall of

around €300 million (US\$326 million), which ESA will request from European Union member states at a meeting of ministers in December. ESA director-general Johann-Dietrich Wörner insists that Schiaparelli's failure will have no impact. "We have the function which we need for the 2020 mission, so we don't have to convince them, we just have to show them," he told reporters at a press conference. But Vago is more pragmatic. "It would have been much nicer to be able to go to the ministers with a mission where both elements had performed flawlessly."

ESA is keen to stress that, overall, the ExoMars mission can be seen as a triumph: Schiaparelli sent back test data from most of its descent, and its sister craft — the Trace Gas Orbiter — successfully manoeuvred into Martian orbit. The orbiter is the more scientifically valuable of the two halves of the mission: from December 2017, it will study Mars's atmosphere, aiming to find evidence for possible biological or geological sources of methane gas. It will also be a communications relay for the 2020 rover.

"As it is, we have one part that works very well and one part that didn't work as we expected," says Vago. "The silver lining is that we think we have in hand the necessary information to fix the problem." ■

See go.nature.com/2ebtqfo for a longer version of this story.

NASA/JPL-CALTECH/MSS

POLICY

Scientific challenges loom for Canada's Trudeau

Prime minister has boosted budgets and unmuzzled researchers — but some forecast tricky times ahead.

BY NICOLA JONES

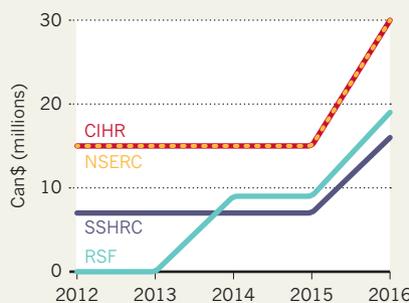
It didn't take long for Canada's Prime Minister Justin Trudeau to send scientists swooning. Within days of taking office on 4 November 2015, the middle-left Liberal relaxed restrictions on government scientists' ability to speak to the press and the public, and reinstated a long-form census prized by social scientists. A year on, Trudeau has boosted science budgets and restored some research jobs cut by his Conservative predecessor, Stephen Harper.

"The sun has peeked through some of the clouds," says Paul Dufour, a science-policy analyst at the University of Ottawa. "The dark prince has left."

Yet many in Canada's science community

BUDGET BOOST

Prime Minister Justin Trudeau's first budget included bigger annual increases for Canada's research councils.



CIHR, Canadian Institutes of Health Research; NSERC, Natural Sciences and Engineering Research Council of Canada; RSF, Research Support Fund; SSHRC, Social Sciences and Humanities Research Council.

say they are reserving judgement, waiting to see whether Trudeau can sustain his string of victories as he tackles some of country's thorniest science-policy issues. Among them are revisions of processes ranging from environmental regulations to Canada's system for doling out research grants.

Kathleen Walsh, executive director of the non-profit science-advocacy group Evidence for Democracy in Ottawa, worries that some of the Trudeau government's environmental policies may favour style over substance. Take the prime minister's decision to put a price on carbon — starting at Can\$10 (US\$7.5) per tonne in 2018 and rising to Can\$50 per tonne in 2022. Environmentalists and economists say that those prices are too low to achieve Canada's goal of reducing

SOURCE: GOVT OF CANADA