

Today in 2003: Opportunity blasts off to Mars

NASA's Opportunity rover spent some 15 years exploring Mars. It surpassed all expectations for its endurance and longevity, to become one of the most successful planetary missions. Then it went silent.

July 7, 2003. On this date, NASA's Mars rover Opportunity blasted off on a journey to Mars.

After travelling for some seven months through space, Opportunity landed on Mars' Meridiani Planum on January 25, 2004, three weeks after its twin rover Spirit touched down on the other side of the planet. Spirit stopped moving across Mars' surface in 2009, and it stopped sending back signals to Earth in 2010. Meanwhile,

Opportunity – designed to last just 90 Martian days and travel 1,000 metres across Mars' surface – vastly surpassed all expectations in its endurance, scientific value and longevity. It became one of the most successful feats of interplanetary exploration, effectively ending in 2018 (and officially ending in 2019) after some 15 years exploring the surface of Mars.

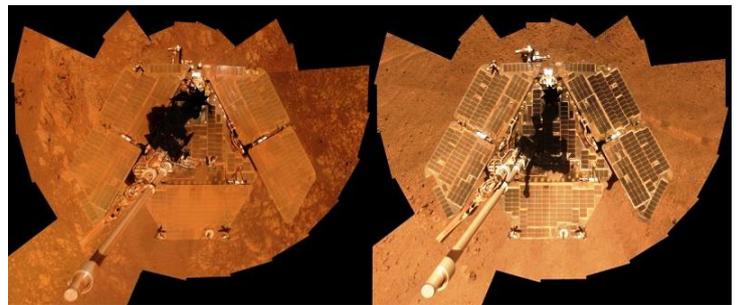
In addition to exceeding its life expectancy by 60 times, the rover travelled more than 45 km by the time it reached its most appropriate final resting spot in Mars' Perseverance Valley. The Opportunity rover stopped communicating with Earth when a severe Mars-wide dust storm blanketed its location in June 2018. Presumably, the storm affected the rover's solar panels. Opportunity's final communication was received June 10, 2018.

But NASA didn't know that yet. Throughout the late summer and fall of 2018, engineers in the Space Flight Operations Facility at NASA's Jet Propulsion Laboratory (JPL) conducted a multifaceted, eight-month recovery strategy in an attempt to compel the rover to communicate. They sent more than a thousand commands to the rover ... but there was no response. In what became a months-long outpouring of emotion, space fans on Twitter and other social media platforms began using the hashtags #ThankYouOppy and #GoodnightOppy.

Space engineers made their last attempt to revive Opportunity on February 12, 2019, starting with a "wake-up song" played in the control room at JPL. The mission's principal investigator, **Steve Squyres**, had chosen I'll Be Seeing You, as performed by **Billie Holiday**.

As was expected by that time, those final efforts at communication were to no avail. Opportunity remained silent on the surface of Mars. Project manager **John Callas** told the crowd of NASA employees gathered for the farewell transmission:

This is a hard day. Even though it's a machine and we're saying goodbye, it's still very hard and very poignant, but we had to do that. We came to that point.



A layer of dust covers Opportunity's solar arrays following a dust storm in January 2014, left, but by March 2014 much of the dust had blown away.



The dramatic image of NASA's Mars Exploration Rover Opportunity's shadow was taken on sol 180 (July 26, 2004) by the rover's front hazard-avoidance camera as the rover moved farther into Endurance Crater in the Meridiani Planum region of Mars.

From the day Opportunity landed, a team of mission engineers, rover drivers and scientists on Earth collaborated to overcome challenges and get the rover from one geologic site on Mars to the next. They plotted workable avenues over rugged terrain so that the 174-kilogram Martian explorer could manoeuvre around and, at times, over rocks and boulders, climb gravel-strewn slopes as steep as 32 degrees (an off-Earth record), probe crater floors, summit hills and traverse possible dry riverbeds. Its final venture brought it to the western limb of Perseverance Valley. Opportunity's achievements include:

- 1 – Setting a one-day Mars driving record March 20, 2005, when it travelled 220 metres.
- 2 – Returning more than 217,000 images, including 15 x 360-degree colour panoramas.
- 3 – Exposing the surfaces of 52 rocks to reveal fresh mineral surfaces for analysis and cleared 72 additional targets with a brush to prepare them for inspection with spectrometers and a microscopic imager.
- 4 – Finding hematite, a mineral that forms in water, at its landing site.
- 5 – Discovering strong indications at Endeavour Crater of the action of ancient water similar to the drinkable water of a pond or lake on Earth.

All those accomplishments were not without the occasional extraterrestrial impediment. In 2005 alone, Opportunity lost steering to one of its front wheels, a stuck heater threatened to severely limit the rover's available power, and a Martian sand ripple almost trapped it for good. Two years later, a two-month dust storm imperiled the rover before relenting. In 2015, Opportunity lost use of its 256-megabyte flash memory and, in 2017, it lost steering to its other front wheel. Each time the rover faced an obstacle, Opportunity's team on Earth found and implemented a solution that enabled the rover to bounce back. However, the massive dust storm that took shape in the summer of 2018 proved too much for history's most senior Mars explorer.

NASA's Opportunity rover launched to Mars on July 7, 2003 officially ended its mission on February 13, 2019. The Opportunity rover featured an array of scientific tools. One of its main objectives was the search for signs of water on the red planet, since, as far as we know, water is necessary for life

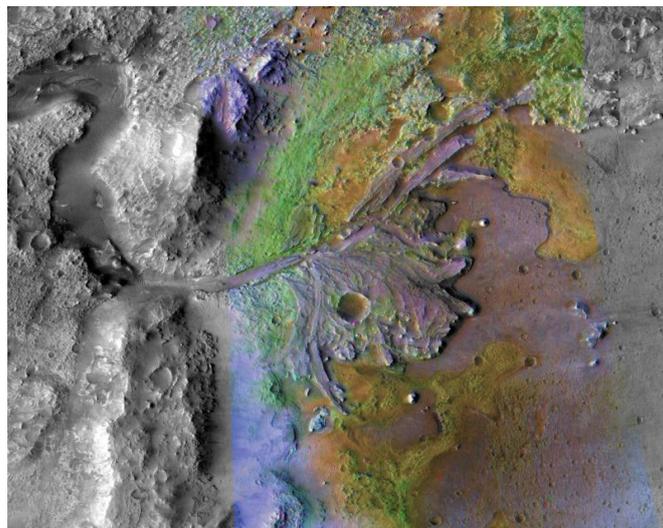
But Mars exploration continues. NASA's InSight lander, which touched down on November 26, 2018, is just beginning its scientific investigations. The Curiosity rover has been exploring Gale Crater for more than six years. And, NASA's Mars 2020 rover and the European Space Agency's ExoMars rover both will launch in July 2020, becoming the first rover missions designed to seek signs of past microbial life on the red planet.

The Mars 2020 mission is timed for a launch opportunity in July/August 2020 when Earth and Mars are in good positions relative to each other for landing on Mars. That's because it takes less power to travel to Mars at this time, compared to other times when Earth and Mars are in different orbit positions.



Mars is the fourth planet from the Sun and the second-smallest planet in the Solar System after Mercury. In English, Mars carries a name of the Roman god of war, and is often referred to as the "Red Planet" because the iron oxide prevalent on its surface gives it a reddish appearance that is distinctive among the astronomical bodies visible to the naked eye. Mars is a terrestrial planet with a thin atmosphere, having surface features reminiscent both of the impact craters of the Moon and the valleys, deserts, and polar ice caps of Earth.

AK, with EarthSky and Wikipedia Notes



This is Jezero crater on Mars, the planned landing site for NASA's Mars 2020 rover mission. The image was taken by instruments on NASA's Mars Reconnaissance Orbiter, which regularly takes images of potential landing sites for future missions. Here's how NASA described the area:

On ancient Mars, water carved channels and transported sediments to form fans and deltas within lake basins. Examination of spectral data acquired from orbit show that some of these sediments have minerals that indicate chemical alteration by water. Here in Jezero Crater delta, sediments contain clays and carbonates.