


# Two decades for twin rovers

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**Twenty years ago, the Spirit and Opportunity rovers landed on Mars. Over the next 15 years, they showed us a planet that was warmer and wetter – and capable of sustaining life – that we now take as read.**

**H**appy 20th anniversary to NASA's Mars rovers, Spirit and Opportunity (Oppy). While not the first rovers on Mars – that distinction belongs to Sojourner, part of NASA's Mars Pathfinder mission in 1997 – Spirit and Oppy found geological evidence for a wetter and warmer ancient Mars. Their stereoscopic cameras changed public perception of our neighbouring planet, with images such as the panoramic view of Marathon Valley in the Endeavour Crater (displayed) taken by Oppy.

Spirit landed on 4 January 2004, followed by Opportunity on 25 January on the opposite side of the planet. For a 90-day planned mission, Spirit's 7.73 km journey over 2,210 sols was incredible. Highlights include the discovery of rocks at the Comanche outcrop. Based on data from a suite of instruments on Spirit, scientists determined that the rocks were ten times richer in magnesium-iron carbonate than found in previously studied Martian rocks. Carbonates form in conditions involving persistent liquid water, and dissolve in acid, so their existence points to the presence of a chemically neutral, wet environment (and warmer climes) over a long period of time.

On Sol 778, Spirit's right front wheel stopped working, so the engineers drove the

rover backwards. In a classic case of Glück im Unglück, the dead wheel that was dragging behind scraped beneath the surface and uncovered a bright patch of nearly pure silica. It could have been formed in either a hot-spring-like environment or by the passage of acidic steam rising through a vent (such as those found on Hawaii or Iceland). Such steamy conditions on Earth are teeming with microbial life.

Meanwhile, Oppy landed in Eagle Crater and quickly found small spherules, nicknamed 'blueberries', rich in hematite and suggestive of a bygone watery climate near Fram Crater. Near the rim of Endeavour Crater, it also discovered bright veins of hydrated calcium sulfate, most likely formed when calcium (dissolved from volcanic rock by flowing water) combined with sulfur (from rocks or volcanic gas). The calcium sulfate then settled into an underground fracture before becoming exposed billions of years later. Oppy went on to investigate a clay deposit observed from orbit, montmorillonite, which forms from basalt in wet and mildly acidic conditions. Further north, Oppy detected not only montmorillonite but also iron-bearing smectite. Again, their presence suggests an ancient wet environment. In all, Oppy travelled over 44 km in 14.5 years, last communicating with mission control on 10 June 2018 from Perseverance Valley.

Perseverance happens to be the name of the most recent and currently active NASA Mars 2020 rover. The mission's main goal is to find evidence for microbial life in rocks that were formed under conditions that might have been habitable. What it cannot study

in situ, Perseverance has been collecting and caching materials for future sample return. In addition to seven instruments, nineteen cameras and two microphones, the rover carried the mini helicopter Ingenuity. As a technology demonstration for controlled, powered flight in a thin atmosphere (1% atmospheric volume of Earth's), Ingenuity far surpassed its initial plan for five flights and completed 72 before all four of its blades were damaged upon landing roughly on 25 January 2024. It was a successful scout for the rover, flying ever farther and higher, and will inform future mission design.

Looking ahead, the ExoMars Rosalind Franklin mission to place a rover on the Martian surface to look for past or present signs of life has been resurrected. Its key innovation is a drill for reaching 2 m in depth, and it will analyse the samples on its mobile laboratory. Roscosmos had been responsible for the 2022 launch rocket, lander and additional components, but following Russia's invasion of Ukraine, cooperation between ESA and Roscosmos was terminated, thereby delaying the mission yet again (parachute problems delayed the original 2020 launch). NASA will be taking over the launcher (and other elements), and the new European lander has been scaled back to focus on the safe delivery of the rover to the surface, without having any surface platform functionality as previously planned when Roscosmos was involved.

China also has plans for a sample return mission to Mars, Tianwen-3, around 2030. And further national and private ventures are under development, even to the moons of Mars. Slowly but surely, the conditions on



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# Editorial

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ancient Mars and whether life existed will be puzzled out.

Space missions have shown us that robust and well-designed robotic missions can

well exceed their intended lifetimes (unlike human missions). But more intangibly, Spirit and Opportunity have inspired a generation of humans to look at Mars and see beyond

the dust and rocks – to see the red planet as a world.

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