Opportunity rover completes 15 years of Martian exploration

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The Mars exploration rover Opportunity is the most successful robotic explorer humanity has ever placed on the surface of another world. For more than 5,000 days, it has collected and transmitted outstanding scientific data about Mars' history, atmosphere, chemistry and geology, including the first definitive evidence that liquid water once existed on the Martian surface. For the past 15 years, Opportunity has been the eyes for tens of millions of people as they viewed landscapes, dunes, storms, craters and sunrises on another world. On June 10, 2018, radio contact with the rover was lost, and on February 13, 2019, after more than eight hundred failed attempts to reestablish communications, Opportunity's mission was declared complete.

The mission's success is owed to the hundreds of researchers, scientists and engineers who spent years designing, fabricating and assembling the rover and another decade and a half directing its actions from across the interplanetary void. They had to plot paths for the 174-kilogram Martian explorer that took it around, and at times over, rocks and boulders. The rover climbed gravel-covered slopes as steep as 32 degrees, reached the summit of hills, probed valleys and traversed ancient riverbeds. Its final resting place is the western limb of a landscape feature named Perseverance Valley.

The rover's longevity, however, is also owed to the millions of people around the world who were fascinated by the vistas that have been sent back since the mid-2000s of an alien world so unlike and yet so similar to our own. This is embodied by Nick Rossomando, one of the rover's engineers, who was first introduced to Opportunity (and its twin rover, Spirit) as a child. "Like many others, this was the first time I had really been interested in a robotic space mission. Thirteen years later, just a year into my career, I interviewed to work on that very same mission. … I was only on the team for a short time overall, but it will be very, very difficult to top that year and a half."

Opportunity was only planned to last for 90 Martian days, but the design and engineering of the rover proved so successful that it continued operating successfully, year after year, with an immense haul of data. There is little doubt that its funding would have been zeroed out years ago by the retrogressive minds of the US ruling elite had they not been wary of the international public outcry that would have followed. Its total operating costs for a decade and a half of scientific discovery, after all, could have been spent on several hundred Tomahawk cruise missiles.

NASA closed this chapter of Martian science after eight months of blackout of the rover caused by a global dust storm that covered the Red Planet last June, which forced the solar-powered Opportunity into hibernation. It was not the first time the rover put itself into emergency power mode because of Martian weather and its controllers prepared months' worth of strategies to revive the planetary pioneer once the storm subsided. In the past, Opportunity continued to perform groundbreaking research after several other incidents which threatened to end the mission: getting stuck in a sand dune, having a broken battery heater, failed actuators, losing its flash memory and being forced to drive in reverse only after steering was lost in both its front wheels.

These previous challenges were solved through weeks of research by Opportunity's controllers on Earth, who ran simulations and made physical mockups to determine the best way to recover the rover. The most scientifically interesting success was to drag the

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broken wheels as the rover drove along, digging a trench in the Martian soil which the rover could then analyze. Thanks to these efforts, Opportunity survived on the surface of Mars for 5,498 days, nearly 60 times its original specifications.

Through all of this, Opportunity returned more than 217,000 images from the surface of Mars, including 15 360-degree panoramas. It directly sampled 52 rocks and used its spectrometer and microscope to inspect a further 72. It traveled more than 45 kilometers, breaking the off-Earth driving record set by the Soviet lunar rover Lunokhod 2 in 1973. In the end, it took Mars' worst to finally silence the intrepid machine.

Spirit and Opportunity landed in January 2004 on almost exactly opposite sides of the Martian equator, after a seven-month journey from Earth. They were the successors to the two Viking landings in 1976 and the Mars Pathfinder probe in 1997 and were sent to study the Red Planet's geological record in search of any indication that liquid water once flowed on its surface.

Opportunity provided this evidence almost immediately. Its landing site, dubbed Eagle Crater, was characterized by large numbers of small spherical structures found loose on the surface and embedded in a nearby outcropping that were tagged "blueberries." Their smoothness suggested that they were formed in some sort of liquid. Chemical and microscopic analysis performed by the rover revealed high concentrations of the minerals hematite and jarosite, further confirming that the area was once an aqueous environment that had since evaporated.

Once it finished exploring Eagle Crater and its surroundings, Opportunity was directed to drive to Endeavour, an impact crater about 22 kilometers in diameter located in the Meridiani Planum. Orbital data indicated the presence of basalt, hematite and sulfate, as well as active erosion. The minerals are evidence that Endeavour once held water while the erosion could have been caused by wind or even water bubbling up from underneath the surface. Opportunity began its trek toward the crater in August 2008 and arrived after traveling for three years across Martian plains.

One of its first discoveries at this new location was a mineral vein that consisted of calcium, sulfur and water. The closest match to the data is gypsum, and it could have been produced under conditions that were not as harshly acidic as other places where water likely was. Subsequent research indicates that Endeavour Crater once held a body of water that was more hospitable to Earth-like life. These and numerous other discoveries have left an indelible mark on Martian and planetary exploration.

Spirit and Opportunity also paved the way for subsequent Mars rovers and landers, including Phoenix, Curiosity and InSight, as well as NASA's planned Mars 2020 rover and the European Space Agency's ExoMars rover, which are both slated to launch in July 2020. Mars is the only planet besides Earth to have a constant retinue of ground- and space-based instruments that are regularly developed and deployed. The closest parallel in the history of human spaceflight are the Soviet Venera orbiters and landers which studied Venus for 22 years, which included the only probes to transmit data from the surface of that world's hellish landscape.

The resources and technical expertise exist to massively expand these efforts in humanity's persistent quest to expand its knowledge about the natural world. We have proven our capacity to reach our immediate neighbors and there could be dozens of spacecraft, rovers and landers studying the numerous frontiers of the Solar System.

Tragically, there are not. Space exploration for the purposes of discovery and expanding knowledge is being reversed, and the technology perverted into tools for mass annihilation. If the historical development of mankind's increasingly social and collective effort to master nature and explore the universe is to be continued, it can only be realized through the struggle for international socialism.

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