In July, Zhurong photographed the parachute that had brought it to the surface.

CHINA'S MARS ROVER HAS AMASSED REAMS OF GEOLOGICAL DATA

The Tianwen-1 orbiter and Zhurong rover are offering new insights on Mars.

By Smriti Mallapaty

More than 30 scientists across the Chinese mainland, Hong Kong and Macau are rushing to process data collected by China's Mars rover, Zhurong, and by the nation's Tianwen-1 spacecraft, which is in orbit around the planet. Several studies have trickled out, but researchers say that more are coming in the next weeks and months, offering insights into the climate, geology and history of Mars's northern hemisphere.

Since September, the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), which has been receiving the data from space, has released nearly 200 gigabytes of information that was collected from eight instruments on the rover and orbiter between February and June. These instruments include cameras, a radar system, climate sensors and a laser spectrometer.

Some surface features, such as possible sedimentary material and mud volcanoes, hint at the past flow of water, so scientists are looking for clues that there was once water or ice below the surface. This is "of great scientific interest" because it might provide evidence of an ancient ocean, says Bo Wu, a planetary scientist at the Hong Kong Polytechnic University.

Tianwen-1 arrived at Mars in February. In May, it dropped a lander containing Zhurong onto a basin known as Utopia Planitia. The rover's initial mission was intended to be three months long, but it has exceeded expectations. Over four months, it travelled more than 1,000 metres, visiting features of interest and even investigating part of the capsule that brought it to the surface, along with the remains of the descent parachute.

Pause in communications

In September, Zhurong was put into hibernation by the China National Space Administration (CNSA) because Mars passed behind the Sun, relative to Earth, and communication was lost. It was powered up again in October, and has since traversed another 200 metres.

The month-long break offered mission scientists at research institutes across China a chance to start analysing data. Some researchers had already received images of Mars from the orbiter's cameras in March, and the CNSA had previously publicly shared images and videos taken by the rover during its descent and from the surface. But now researchers are studying the much larger volume of data released in September.

This data set includes images from Zhurong's navigation camera; climatic data on temperature, pressure and wind speed; information on the chemical composition of rocks, soil and sand dunes from a laser spectrometer; and clues from below the surface, from its ground-penetrating radar.

Apart from the handful of images and videos released by the CNSA, few scientific insights about the mission have been released or published until now. Researchers say this is because it has taken time to process and clean up the data.

Doing this ensures that the data are reliable and removes noise produced by the instruments, says Lu Pan, a planetary scientist at the University of Copenhagen. The fact that this mission is China's first to the surface of another planet might also have slowed things down compared with NASA's recent Mars missions. "If this is the first time you do it, there's a learning process," she says.

Speeding up the analysis

Two publications have already emerged. One study, posted as a preprint in late September, analysed images and information on friction that were gleaned from the movement of Zhurong's wheels (L. Ding *et al.* Preprint at Research Square https://doi.org/g74h; 2021). The results show that regions of Mars that the rover trundled over have properties similar to those of compact, sandy soil on Earth.

The study "provides useful data about surface soil properties", says Xiao Long, a planetary geologist at the China University of Geosciences in Wuhan. This might be helpful for understanding how soil and dust on the surface formed, says Long, who is also conducting his own analysis.

A second study, published in August, used high-resolution images from the orbiter to pinpoint the rover's coordinates on Mars (W. Wan *et al. Remote Sens.* **13**, 3439; 2021). But researchers say that many studies are expected soon, including some on topography.

So far, the data have been shared only with researchers directly involved in the mission, but Wu says that the NAOC will at some point release them to the public and the international community.

That could help to speed up analysis. Scientists with experience of Mars might be able to recognize features and their significance more quickly, says David Flannery, an astrobiologist at Queensland University of Technology in Brisbane, Australia. "Mars is peculiar in some ways, and geologists are only as good as the rocks they have seen in the past," he adds.

Zhurong will now continue to explore, potentially for years, as some of NASA's rovers have. Bo says that he and his team are providing "suggestions for future data collection" that take in surface features of particular scientific interest.