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Space exploration

Up close with other worlds

Samples from the moon and the asteroid Ryugu are returning to Earth

Leah Crane

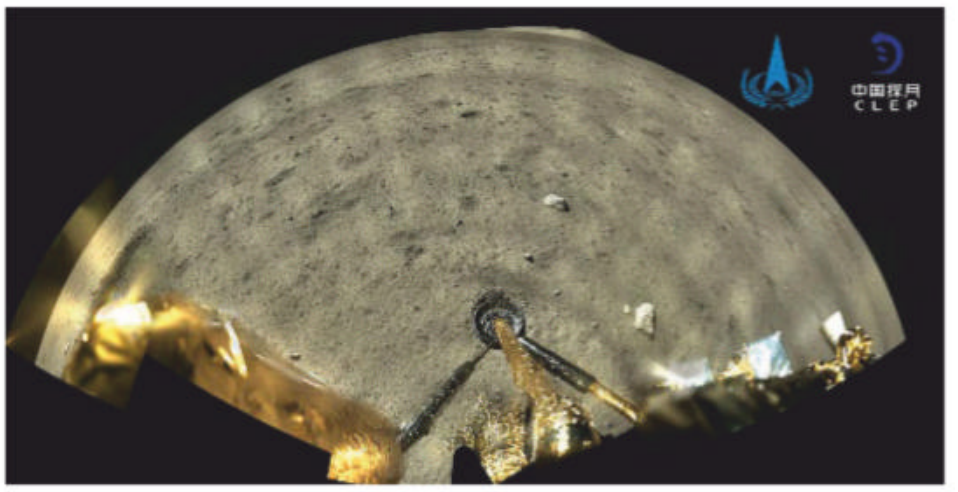
CHANG'E 5 is on the last leg of its lunar mission. After a visit to the lunar surface lasting less than 48 hours, it returned to orbit around the moon to get ready to bring its samples back to Earth.

It isn't the only spacecraft returning far-flung samples in December. Japan's Hayabusa 2 has this week returned debris from an asteroid, landing in Australia (see "Rocks from Ryugu", below).

"Two sample return missions returning within 10 days of each other is pretty incredible," says Jessica Barnes at the University of Arizona.

Chang'e 5 launched on 23 November aboard a Long March 5 rocket and consists of an orbiter, re-entry capsule, a lander and ascent stage. The latter two sections landed on the moon on 1 December. Chang'e 5 is China's first sample return mission, making the nation only the third – after the US and the Soviet Union – to bring back rocks and dust from the moon. The most recent mission to bring back lunar samples was the Soviet Luna 24 probe in 1976.

It landed in an unexplored area of the moon called Oceanus Procellarum, or the Ocean of Storms. "It's a region where there are these really volcanically young landforms, and we currently don't have samples in the Apollo samples or the Russian samples that have anything like that, so these samples will really enable some new science," says Kerri Donaldson Hanna at the University of Central Florida.



CHINA NATIONAL SPACE ADMINISTRATION/AFP VIA GETTY IMAGES

The leg of the Chang'e 5 lander on the moon (above), and the lander's robotic scoop that collected surface soil (left)

Most of the areas that have been sampled on the moon are about 3 billion years old or older. Scientists estimate that the rocks in Chang'e 5's landing area are less than 2 billion years old based on the layering of craters in the area.

Once we get the samples back to Earth, we will have a better idea of how old these volcanic rocks are.

That's crucial because on other worlds, the only way we can tell the age of an area on the surface is by analysing the craters – there is no direct way to confirm those ages. By comparing the age directly measured from the samples with the age inferred from craters on the moon, we can create a link between those methods of analysis that will also be useful on other crater-pocked worlds.

After Chang'e 5 landed, it almost immediately began digging into the lunar surface. It has two ways to get samples, both from the surface and underground: a robotic arm with a scoop to collect surface soil, and a drill to collect a core about 2 metres deep.

The sampling had to be done quickly. The spacecraft is solar powered and doesn't have the heaters it would have needed to survive the frigid lunar night, so it had to be finished within a single lunar day at most – about 14 Earth days. After the drilling was done, the samples were loaded into the ascent stage which launched back off the moon to reunite with the orbiter and re-entry capsule.

It is expected to land in Inner Mongolia in mid-December. If all goes well, that will be when the work of analysing the new stash of moon rocks begins. Part of the haul will also be stored at Hunan University in Changsha, China, for future analysis.

Chang'e 5 is part of a series of missions that began with an orbiter that circled the moon from 2007 to 2009. "The Chinese lunar exploration programme has been building up the capability to do science from orbit, and then from the surface, then collect samples and bring them back – that's a logical progression," says Barnes.

Rocks from Ryugu

Japan's Hayabusa 2 spacecraft has returned two samples of rocks and dust from the surface of the asteroid Ryugu to Earth.

The spacecraft skimmed past Earth and dropped its sample capsule on a trajectory that sent it through our atmosphere to land in South Australia early on 6 December local time. The capsule had no thrusters, so accuracy was key. It was recovered undamaged.

Hayabusa 2 launched in 2014. At Ryugu it took images and dropped three rovers onto the surface, but its main mission was to collect samples. The first was taken by firing a small bullet into the surface and collecting the particles that puffed up.

For the second, the spacecraft essentially bombed the asteroid, blasting a piece of copper towards the surface with an explosive charge to excavate a crater about 10 metres across. This allowed access to pristine material from beneath the surface. Comparing the two will give us a sense of how space changes rocks over time, says Kerri Donaldson Hanna at the University of Central Florida.

After the sample capsule drop, Hayabusa 2 fired its engines to continue on in space. It still has plenty of fuel, so it is heading for an asteroid called 1998 KY26, which it should reach in 2031.