Why the success of China’s sample return lunar mission matters

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An image of China's Chang'e 6 lander on the moon's far side, snapped by the mission's minirover. (Credit: CNSA)

China's Chang'e-6 on Tuesday became the first spacecraft to bring back samples from the far side of the Moon — the part that the Earth never gets to see.

The lander descended on the Moon's surface on June 1, and spent two days collecting rocks and soil from one of the oldest and largest of lunar craters — the 2,500 km-wide South Pole-Aitken (SPA) basin — using a robotic arm and drill.

The lander then launched an ascent module that transferred the samples to the Chang'e-6 orbiter that was orbiting the Moon. On June 21, the orbiter released a service module that **brought back the samples to Earth**.

Is this the first time a spacecraft has brought lunar samples to Earth?

No. Back in July 1969, the US Apollo 11 mission brought 22 kg of lunar surface material, including 50 rocks, to Earth. In September 1970, the Soviet Luna 16 mission — the first robotic sample return mission — too, brought pieces of the Moon to Earth. In recent years, Chang'e-5, the predecessor of Chang'e-6, brought back 2 kg of lunar soil in December 2020.

Read | China's Chang'e-6 brings back samples from far side of Moon: What was the mission?

All these samples, however, came from the near side of the Moon. Difficult terrain, giant craters, and the difficulty in communicating with ground control made it technically challenging to land a spacecraft on the side that never faces the Earth. The Moon is tidally locked with Earth; thus we see only one side of our nearest space neighbour.

Chang'e-4 overcame these difficulties in 2019, putting the Yutu-2 rover on the far lunar surface. Now, Chang'e-6 has not only landed on the far side, but also returned with samples from there.

"This is a great achievement by China… Recovering any samples from the Moon is difficult, but doing so from the far side, where communications are particularly difficult, is a step taken by no other agency. A real technological feat," Martin Barstow, a professor of astrophysics and space science at the University of Leicester, told The Guardian.

But why are sample return missions significant in the first place?

A **sample return mission** such as Chang'e-6 aims to collect and return samples from an extraterrestrial location like the Moon or Mars to Earth for analysis. The sample can be rocks or soil — or even some molecules.

In situ robotic explorations — in which landers, orbiters, and rovers carry out experiments in space or on heavenly bodies — can carry only miniature instruments that are not very sophisticated or accurate, and answer only certain types of questions. For instance, they can't determine the origin or age of a rock.

If the samples can be brought to Earth, on the other hand, scientists can examine them using extremely sensitive laboratory instruments. They can study the "chemical, isotopic, mineralogical, structural, and physical properties of extraterrestrial samples from the macroscopic level down to the atomic scale, frequently all on the very same sample," Lori S Glaze, director of NASA's planetary science division, wrote in January 2020.

Also, returned samples can be preserved for decades, and can be examined by future generations using ever more advanced technology. The samples brought back by the Apollo missions in the 1960s and 1970s are still being studied by scientists, who are extracting information on the history of the Moon, Earth, and the inner solar system.

India's Chandrayaan-4 mission, which is currently under development by the Indian Space Research Organisation (ISRO), will also be a sample return mission. Chandrayaan-3 landed about 600 km from the South Pole of the Moon last year.

What can the lunar samples brought by Chang’e-6 reveal?

The lunar far side is geologically different from the near side. It has a thicker crust, more craters, and fewer plains where lava once flowed. But scientists do not know why the two sides are so different — and an examination of the Chang’e-6 samples could throw up some answers. Samples collected from the SPA basin can also reveal the timeframe for lunar cratering. The collision that created the basin may have excavated enough material from the Moon’s lower crust and upper mantle, which could give insights into the Moon’s history and, possibly, its origins. The samples can also suggest ways to use lunar resources for future lunar and space exploration. For instance, lunar soil could be used to produce bricks to build future lunar research bases through 3D printing. Scientists are also interested in the potential presence of ice at the Moon’s poles. Ice can be harvested for water, oxygen and hydrogen — and the latter two can be used in a rocket propellant.

Why is there a new ‘race’ to the Moon?

In 2023, India, China, Japan, the US, and Russia launched lunar missions. By 2030, more than 100 Moon missions by both governments and private companies are expected, according to the European Space Agency.

Countries such as China and the US also want to put astronauts on the Moon by 2030. The success of Chang’e-6 is seen as an important step towards achieving this goal by China.