

LUNAR SCIENCE

China reveals the foreign scientists who will share its rare lunar samples

Seven research teams in six nations get Moon rocks and soil brought to Earth by the Chang'e-5 mission

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ive years after its Chang'e-5 mission returned the first samples of soil and rocks from the Moon in nearly 50 years, China has begun to share the precious specimens with select groups of researchers outside the country. Seven institutions in six countries will gain access to tiny shares of the lunar material, the China National Space Administration (CNSA) revealed at a 24 April ceremony in Shanghai. Notably, two institutions in the United States-Stony Brook and Brown universities-are getting samples, even though Chinese researchers have not been able to access NASA's Moon samples because of restrictions imposed by the U.S. Congress.

Those picked to get Chang'e-5's samples feel privileged. "It's honestly a huge honor. Being selected ... is both exciting and humbling—especially knowing how competitive the selection process was," says Frédéric Moynier, a cosmochemist at the Paris Institute of Planetary Physics. When the Chang'e-5 return module landed in the remote grasslands of Inner Mongolia on 17 December 2020, it was carrying 1731 grams of material scooped from the surface and from a 1-meter-deep core drilling. They were the first Moon rocks brought to Earth since the last Soviet Luna mission of 1976. Chinese researchers, often with foreign cooperation, soon began to analyze the trove. In 2023, CNSA also invited proposals from foreign teams, drawing 24 submissions; it quietly informed the winners earlier this year.

Researchers have already published dozens of scientific papers on the samples, which were retrieved from Mons Rümker, an inactive volcano within the Oceanus Procellarum, a vast mare of hardened lava. One surprise is that the material is just 2 billion years old, or about 1 billion years younger than samples retrieved by the U.S. Apollo and Soviet Luna missions. This suggests lunar volcanoes were active more recently than previously thought. And further analyses by Chinese teams have raised the question of what was driving the volcanism in the absence of water and hot radioactive elements to produce subsurface magma.

The foreign scientists now getting samples hope their own unique analytical equipment and expertise will help them answer such questions. Mahesh Anand, a geochemist at the Open University, plans to use a customized instrument to measure isotopes of oxygen that provide hints of where in the Solar System the lunar material originated. "It will help us evaluate the giant impact hypothesis for the origin of the Moon," which proposes that the Moon formed from a collision between early Earth and a Mars-size protoplanet, Anand says.

Moynier says his team is particularly fortunate, getting access to both a sample directly from CNSA and two additional samples that Chinese President Xi Jinping gave to French President Emmanuel Macron in 2023. The CNSA sample is a fragment of basalt, which he says is a rarity in the loose rock that makes up the bulk of the Chang'e-5 samples. Studying the basalt promises a better understanding of the volcanic history of the Moon. And comparing the abundance and composition of volatile elements in this sample and those from Apollo will shed light on the Moon's formation and evolution, Moynier says.

Carsten Münker, a cosmochemist at the University of Cologne who attended the Shanghai ceremony, believes applying his team's analytiPHOTO: TOPPHOTO VIA AP IMAGES

cal expertise to Chang'e-5 samples will provide hints as to how the lunar magma ocean, a layer of molten rock believed to have covered the Moon's surface shortly after its formation, crystalized into the lunar mantle.

Sharing the samples takes China's embrace of international cooperation in space science to a new level. Many Chang'e-5 papers published so far include international co-authors who helped interpret analytical data produced in Chinese labs. Earlier and later lunar missions, Chang'e-4 and Chang'e-6, each carried four international payloads. Chang'e-6, for example, released a Pakistani CubeSat into lunar orbit that is imaging the Moon's surface. Its lander, the first spacecraft to land on the far side of the Moon, carried a French instrument to study volatile compounds. Chang'e-7, set to launch next year, will have six international payloads.

"I wish that every country would follow in the footsteps of the U.S. and now China" in sharing samples widely, Anand says. With its open, competitive process for access to samples (below), "China is setting a very positive example for scientific cooperation," Moynier adds.



Chang'e-5's samples are providing new insights into the Moon's volcanism and evolution.

Moynier received his samples last week as he could not attend the signing ceremony. Stony Brook and Brown are still working on final approval of loan agreements, says Stony Brook planetary scientist Tim Glotch. He says they hope to pick up their samples and get to work later this year. (In accordance with a longstanding U.S. congressional ban on using NASA funding for bilateral cooperation with China, the research is being funded by their respective institutions, Glotch says.) The remaining four groups received their samples last week in Beijing.

More samples are on the way. Last year, Chang'e-6 returned nearly 2000 grams of lunar soil, which CNSA says it will also share with foreign teams. Scientists are eager to see what the soil can reveal about the Moon's history. □

U.S. SCIENCE POLICY

NSF director resigns amid cuts to grants and staff reductions

Sethuraman Panchanathan stepped down soon after Trump team started to terminate agency awards **JEFFREY MERVIS**

he scientist President Donald Trump chose during his first term to lead the National Science Foundation (NSF) resigned last week after apparently being unable to stomach the massive changes Trump has imposed on the agency during the first 100 days of his second administration.

"I believe that I have done all I can to advance the mission of the agency and feel that it is time to pass the baton to new leadership," Sethuraman "Panch" Panchanathan wrote in a 24 April letter to the staff. Panchanathan, a computer scientist whom the Senate confirmed to lead NSF in August 2020, leaves 16 months short of the end of the 6-year term.

"I cannot imagine how difficult it must have been trying to protect the NSF, its programs and staff, and the U.S. research community from White House directives and actions that are in conflict with NSF's mission, decades of congressional appropriations, and the law," says Rice University physicist Neal Lane, who led NSF under former President Bill Clinton.

Panchanathan didn't give a reason for his sudden departure, but he could not have been happy with orders from the White House to accept what could be a 55% cut to the agency's \$9 billion budget next year and to draw up plans to halve its 1700-person staff. But his resignation letter was the first public indication of his unhappiness. "While NSF has always been an efficient agency," he wrote, "we still took [on] the challenge of identifying other possible efficiencies and reducing our commitments to serve the scientific community even better."

The last straw may have been a decision in mid-April by billionaire Elon Musk's Department of Government Efficiency (DOGE) to terminate up to \$2 billion in existing NSF grants. The list appears to have been drawn from a report last fall by Senator Ted Cruz (R-TX) identifying what he said were 3483 "woke science" grants NSF had made to increase diversity in science, foster environmental justice, and study the spread of misinformation on social media. As *Science* went to press, researchers had reported the termination of some 550 awards since the agency's 18 April announcement it would begin to cancel grants.

Before leading NSF, Panchanathan had spent 20 years as a faculty member and then senior research administrator at Arizona State University. When nominated he was also serving on the National Science Board, NSF's presidentially appointed oversight body. His achievements included creating NSF's first new directorate in 30 years, for technology, innovation, and partnerships, and launching 10 regional "engines" that seek to spur economic development.

During his 5-year tenure, Panchanathan worked to build bipartisan ties to congressional leaders, who reciprocated in statements reacting to his resignation. "I thank Dr. Panchanathan for his vision, integrity, and unwavering commitment to U.S. scientific innovation," said Representative Brian Babin (R-TX), who leads the science panel in the House of Representatives.

The top Democrat on the Senate panel that Cruz chairs praised Panchanathan but also pointed a partisan finger at the Trump administration. Its proposal to cut NSF's budget represents "a deliberate dismemberment of America's innovation engine by DOGE" and the head of the White House budget office, Russell Vought, said Senator Maria Cantwell (WA). "Don't blame Panch for stepping down."

Brian Stone, who joined NSF in 2000 as a facilities manager and has spent the past decade as chief of staff to the director, is now acting director. The science board traditionally gives the president a list of potential nominees for director. But the board's leadership is in limbo. Its former chair, computer scientist Dario Gil, left on 21 April because he has been nominated as undersecretary for science at the Department of Energy. The acting chair is chemist Victor McCrary, vice president for research at the University of the District of Columbia.

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