should push to get as much science as possible out of those missions, for example by insisting that they go to mostly unexplored targets, such as the Moon's far side, David Kring, a planetary scientist at the Lunar and Planetary Institute in Houston, said at the meeting. Other nations are also racing to the Moon; in January, a Chinese probe made a historic touchdown on the Moon's far side, and last month, an Israeli company launched the first private Moon lander.

PLUMBING THE PAST

Moon rocks have helped scientists to pinpoint the dates of key events throughout the 4.5-billion-year history of the Solar System, such as the asteroid bombardment thought to have happened about half a billion years after Earth formed. "The lunar crust is really a museum of planetary science," said Juliane Gross, a planetary scientist at Rutgers University in Piscataway, New Jersey.

Some insights have come from looking at Apollo-era rocks in new ways. Beck Strauss, a planetary geophysicist at the US National Institute of Standards and Technology in Gaithersburg, Maryland, described hunting for faint magnetic fields in 3.1-billion-year-old rocks gathered by Apollo 12 astronauts. Strauss's research confirms earlier hints that the Moon's magnetic field strength peaked between 3.9 billion and 3.6 billion years ago and then dropped — which suggests that something must have changed in the lunar interior, where the ancient magnetic field evolved in unknown ways. "New techniques give us access to things that were not possible during the Apollo era," they said.

Glassy beads in some of the Apollo Moon rocks — which formed during volcanic eruptions — are also yielding discoveries. Megan Guenther, an undergraduate student at the Massachusetts Institute of Technology in Cambridge, has tried to replicate the chemical conditions under which the black glass beads in Apollo 14 rocks probably formed. She found that the beads could have formed at up to 900 kilometres deep, which is much deeper than scientists had suspected.

> ***"One should consider this a new mission to the Moon."***

Green glass beads from Apollo 15 rocks also tell a story about the primordial Moon, said Evelyn Füri, a geochemist at the French national research agency CNRS in Vandœuvre-lès-Nancy, France. Her team has analysed neon and other gases inside 22 of the tiny beads and found that two of the beads are particularly gas-rich (E. Füri *et al. Geochem. Persp. Lett.* **8**, 1–5; 2018). Those gases might be relics from the early days of the Solar System, which would support the idea that the Moon has managed to hang on to some of the volatile materials that many researchers thought it had lost altogether (A. E. Saal *et al. Nature* **454**, 192–195; 2008).

Shearer and his colleagues will look for hints of those volatile compounds when they open the long-sealed Apollo 17 core. Astronauts collected it from rocks piled up by a landslide at the base of a small mountain in the Taurus-Littrow Valley. They pounded the core-collection tube deep enough to penetrate frozen soil, and the rock sample could still contain water or other volatile substances that were once trapped beneath the landslide. If so, researchers will be able to measure the volatile substances much more precisely than they could have 50 years ago, and start to answer lingering questions about how the Taurus-Littrow Valley — which is as deep as the Grand Canyon — formed.

Opening a lunar sample is always a thrill, says Andrea Mosie, a curator at the Houston facility. She still remembers processing her first Apollo sample decades ago, wearing three sets of gloves and working in a nitrogen-filled glove box. "Just to pick it up was really exciting," she says, "because I was picking up a piece of the Moon." ■

GLACIOLOGY

Ancient Antarctic ice holds record of Earth's climate

International team plans to extract column containing 1.5-million-year-old ice.

BY QUIRIN SCHIERMEIER

Geoscientists are getting ready to dig up ice that is older than anything ever excavated before.

After two years of extensive reconnaissance in Antarctica, an international team of researchers is set to drill for a core that is likely to contain ice at least 1.5 million years old, and that should reveal details about the planet's ancient climate.

The Beyond EPICA project, which the European Commission is expected to fund with about €11 million (US$12.5 million) in grants, is set to start formally in June.

Next year, scientists on the team, which includes 12 groups from 10 European countries, plan to set up camp in an area of East Antarctica called little Dome C (see 'Drilling deep'), and start drilling to the bottom of the 2.75-kilometre-thick ice sheet at a site there.

DRILLING DEEP

European researchers will next year head to an area of East Antarctica called Dome C to start drilling to the bottom of the 2.75-kilometre-thick ice sheet and extract a core of ancient ice.

"I'm absolutely thrilled," says principal investigator Carlo Barbante, a climate scientist at the Ca' Foscari University of Venice in Italy and at the National Research Council of Italy. "This iconic project will help us better understand climate change in the past and to come."

MILLENNIA OF ICE

Ice that has accumulated undisturbed over millennia preserves samples of the world's ancient atmosphere, creating a continuous climate record with high temporal resolution. Existing records from Greenland and Antarctica shed light on what drives Earth's glacial cycles, and how climate fluctuations correlate with atmospheric levels of greenhouse gases.

Deep cores drilled by the European Project for Ice Coring in Antarctica (EPICA) more than a decade ago cover the climate

CHRIS GILBERT/BRITISH ANTARCTIC SURVEY

Geoscientists will drill for a 2.75-kilometre ice core in East Antarctica.

and greenhouse-gas history of the past 800,000 years. The cores showed that, over this time, there were 8 pronounced glacial cycles that each lasted nearly 100,000 years.

The new core will extend the record to a period when the pattern of climate variability was markedly different.

Marine sediments suggest that, before about one million years ago, the climate oscillated in 40,000-year cycles. Barbante says that a 1.5-million-year-old ice core will provide clues to what caused the transition — a major question in the Earth and climate sciences.

Barbante thinks that it will take four years to complete the mechanical drilling. The team will begin its mission next year, by lowering a tube with a cutting head into a casing inserted in the topmost 100 metres of ice. A drilling liquid will prevent the borehole from closing.

A SECOND OPINION

Proper drilling into the ice sheet will proceed in the 2020–21 Antarctic field season. Ice-deposition models and exploration at the site, including several reconnaissance drills and radar measurements taken from the air, suggest that the oldest ice at the bottom of the sheet is undisturbed by melting or folding.

"We're very confident that the bottom-most 300 metres have the missing climate information that we want to find," says Barbante.

The French–Italian Concordia Station, about 40 kilometres northeast of the drilling site, will provide logistical and medical support throughout the five-year project.

Meanwhile, Australian researchers are looking for an appropriate site at which to drill for a separate deep ice core nearby. A team hopes to establish camp on little Dome C in January 2021. With logistical support from Concordia Station, drilling could start later that year, or in 2022.

"We don't see it as a race or competition," says Tas van Ommen, a glaciologist with the Australian Antarctic Division in Hobart, who leads the Aus$50-million (US$36-million) project. "There's plenty of room for friendly cooperation."

A second core would be extremely desirable for replication purposes, says Barbante. "Two is better than one," he says. "You can never be confident in a single record. And, who knows, just a few kilometres apart might tell a completely different story." ■

FUNDING

Canada budget overlooks research

Basic science gets only small spending bumps, unlike last year.

BY BRIAN OWENS

What a difference a year makes. Canada's 2019 budget, released on 19 March, includes modest increases for Prime Minister Justin Trudeau's government priorities, including neuroscience and genomics research — nothing like the historic five-year, Can$4-billion (US$3-billion) boost for basic science and research unveiled in 2018. The 2019 funding plan also proposes creating an advisory body that would subject future government funding decisions for research to greater scientific scrutiny.

The latest budget does not include new money for basic science projects at Canada's three main research-grant agencies because of the funding boost they received last year. And it contains only modest amounts — Can$459 million over the next five years — for specific scientific organizations and institutions.

This spending plan is the last to be released before the federal election in October. As such, many researchers expected it to include funding for government priorities that would play well in the upcoming campaign, such as cancer research. Many institutions and organizations lobbied for a piece of the budget, breaking the united front that the science community presented last year when it demanded that the government follow the recommendations of the Fundamental Science Review — an independent assessment of Canada's research priorities and funding. The review recommended boosting spending on basic research from Can$3.5 billion ▸