that are intended for use in establishing a pregnancy — but it endorsed basic research.

"People are more understanding of this research," says Fan, who points to UK fertility regulators' approval in February of a proposal by developmental biologist Kathy Niakan to edit genes in healthy human embryos, at the Francis Crick Institute in London.

Fan's team began its experiments in early 2014 and originally submitted the paper to *Cell Stem Cell*, Fan says. By the time the manuscript ended up on the desk of David Albertini, editor-in-chief of the *Journal of Assisted Reproduction and Genetics*, a different Guanghzou-based team had become the first to report human-embryo-editing experiments. That paper[1], which tried to correct a mutation that causes a blood disease, fed into a firestorm over the ethics of modifying human reproductive cells (or 'germline' modification). Some researchers called for a moratorium even on proof-of-principle research in non-viable embryos.

Albertini, a reproductive biologist at the University of Kansas Medical Center in Kansas City, felt that it was important to publish Fan's paper to educate scientists and clinicians. He says that the manuscript went through two rounds of review over eight months — twice as long as is normal for the journal — and that he urged the researchers to discuss the ethical issues surrounding germline editing in the paper.

Fan's paper should help to reassure international observers about the legitimacy of human-embryo-editing research in China, says Robin Lovell-Badge, a developmental biologist at the Crick. More such embryo-editing papers are likely to be published, he adds. "I know that there are papers floating around in review," he says. "I'd much rather everything was out in the open." (Fan says that his team is now focusing on improving the efficiency of CRISPR using human stem cells).

Research involving the editing of human embryos will begin soon elsewhere in the world, if it hasn't done so privately already.

"I know that there are papers floating around in review."

In a *Cell* paper[3] published on 7 April, Lanner's team analysed gene expression in 88 early human embryos and is using those data to identify genes to disrupt in embryos using CRISPR–Cas9. Lanner will discuss the work at a meeting on human gene editing organized by the US National Academy of Sciences and National Academy of Medicine this month in Paris. He says that the experiments could begin in the coming months.

Norms for conducting human-embryo editing are still taking shape. Evan Snyder, a stem-cell scientist at the Sanford Burnham Prebys Medical Discovery Institute in La Jolla, California, says that whenever possible, researchers should use alternatives, such as embryos of non-human primates. And when it is not, they should use only surplus embryos that would ordinarily be discarded from *in vitro* fertilization clinics. Both Chinese teams used non-viable embryos, but Lovell-Badge says experiments in normal embryos are also important: to see, for instance, if CRISPR–Cas9 is more or less effective in such cells.

Some scientists contend that gene-editing experiments designed to probe human development, such as those planned by Lanner and Niakan, are more valuable than experiments that are intended to lay the groundwork for creating genetically modified humans. "At the moment, there seems little point in pursuing long-term clinical goals when there's so much not known about the technique with human embryos," says Lovell-Badge.

But Chan thinks there should be ethical latitude for both kinds of research to proceed. "We should give the public the credit for being able to understand the difference between research into genetically modified embryos and genetically modifying human beings," she says. "I think it's a good thing if the hubbub dies down a bit." ■

Additional reporting by **David Cyranoski**.

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SEISMOLOGY

North Korea lets scientists peer inside massive volcano

Seismic images from unprecedented international collaboration hint at future eruption risks.

BY ALEXANDRA WITZE

A rare collaboration between North Korean and Western scientists has probed the ground beneath a dangerous volcano on the Chinese–North Korean border. The work illuminates the geological plumbing that could underlie possible future eruptions.

"This is our first glimpse into what the insides of the volcano look like," says Kayla Iacovino, a volcanologist with the US Geological Survey in Menlo Park, California.

She and her colleagues, led by Ri Kyong-Song of the Earthquake Administration in Pyongyang, North Korea, used seismic data to pinpoint molten rock beneath the mountain. The researchers' paper was published on 15 April in *Science Advances*[1].

Called Mount Paektu on the North Korean side and Changbaishan on the Chinese side, the volcano is considered one of the region's most hazardous. Around AD 946, it let loose one of the most powerful eruptions in recorded history, showering ash as far away as Japan. Today, more than 1.6 million people live within 100 kilometres of Paektu.

"This volcano is quiet at the moment, but it's definitely got potential," says team member James Hammond, a seismologist at Birkbeck, University of London. "We need to keep an eye on it."

Lava could erupt as much as 20 kilometres away from the mountain's summit, says Haiquan Wei, a volcanologist at the China Earthquake Administration in Beijing who has studied the mountain's past activity[2].

Because the volcano straddles the Chinese–North Korean border, scientific studies have been fragmented between the two countries. "People have spent their whole lives studying the volcano and have never seen it from the other side," says Iacovino. The mountain holds a special significance in North Korea as the purported birthplace of both the founder of the first Korean kingdom and the former North Korean leader Kim Jong-Il.

Paektu last erupted in 1903. In 2002 it began shaking, generating thousands of tiny earthquakes, possibly as molten rock shifted underground. The seismic unrest ended after several years without any lava erupting — but the episode prompted researchers on both sides of the border to reassess what they knew about the volcano and to try to prepare for

DAVID GUTTENFELDER/AP

Mount Paektu (also called Changbaishan), with its crater lake, straddles the China–North Korea border.

what it might unleash in the future.

In 2011, at the invitation of the North Korean government, Hammond went to the country with Clive Oppenheimer, a volcanologist at the University of Cambridge, UK. That meeting spawned an unprecedented collaboration to try to understand Paektu better from the Korean side[3]. With diplomatic support from the American Association for the Advancement of Science in Washington DC and the Royal Society in London, Hammond arranged to bring six state-of-the-art seismometers into North Korea.

It wasn't easy. It took years to sort out the proper import licences, and the team had to ditch plans to measure conductivity beneath the volcano because the required equipment has a second use in submarine detection. But in the end, Hammond and his colleagues deployed the seismometers in a 60-kilometre-long line east from Paektu's summit, deep into the countryside. "Every year, I would visit these families and they would look after our stations for us," says Hammond. "They clearly wanted to understand this volcano."

The seismometers remained in place from August 2013 to August 2015 (which meant that they were not present during any of North Korea's four nuclear-weapons tests). By analysing how seismic waves travelled beneath the volcano, the scientists found that a significant part of the crust must be at least partially molten. "Whether or not that melt is going to turn into an eruption is a bigger question," says Iacovino. "But at least we can now start to draw a picture of what's happening."

Previous studies have hinted at the presence of molten rock beneath the volcano, says Haibo Zou, a geoscientist at Auburn University in Alabama. But "any new serious research", he says, "is of interest".

Chinese and North Korean scientists monitor Paektu using their own seismic networks as well as gas samples collected from hot springs. But until geologists have a better understanding of what the volcano has done in the past, it will be hard to tell emergency officials how they should prepare for future eruptions, says Iacovino.

For instance, she has been mapping the geology of the ash, pumice and other rocks thrown outward in the AD 946 eruption. Enormous clouds of superheated gas and ash swept downhill, followed by destructive mudslides. If Paektu were to erupt again, it might send torrents of water downhill from the summit lake, or clouds of ash skyward, which could interfere with aeroplane flights across Korea and Japan.

"At least we can now start to draw a picture of what's happening."

By studying rocks collected during a 2013 visit, Iacovino has found that the AD 946 eruption probably spewed much more sulfur dioxide into the atmosphere than earlier studies found[4]. That suggests that Paektu has the potential to alter the global climate.

Hammond will be in Pyongyang this week, working on proposals to expand studies of Paektu. "We'd really like to work together with the Chinese and North Koreans to study the volcano as a whole volcano, using instruments on both sides of the border," he says. "Ultimately, it's up to them to work together, and maybe we can be a part of it." ■

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INVESTMENT

EU innovation hub slammed

Audit picks out management and funding issues.

BY QUIRIN SCHIERMEIER

An ambitious initiative to fuel innovation in the European Union has swallowed up a vast amount of money, but has little to show for the investment, auditors say.

Backed with almost €3 billion (US$3.4 billion) in EU cash, the European Institute of Innovation and Technology (EIT) was established in 2008 to stimulate economic growth by transferring research and innovation from academia to commercial applications. But the institute is a long way from achieving its goals, and is beset by management problems, ill-suited short-term grants and potential conflicts of interest, according to an audit report released on 14 April.

"Significant legislative and operational adjustments are required," says Alex Brenninkmeijer, the chair of the European Court of Auditors' team behind the report.

First conceived as a research powerhouse to rival the Massachusetts Institute of Technology (MIT) in Cambridge, the EIT ended up as a distributed network of academic and business partners that has failed to convince many experts. "Stimulating actual innovation by adding more bureaucracy where less is needed just doesn't work," says Helga Nowotny, a science-policy adviser to the Austrian government.

The institute operates through Knowledge Information Communities (KICs): groups of universities, research institutes and businesses working in specific technologies.

The three initial KICs set up in 2010 created 90 start-ups, 400 business ideas and 71 new or improved products, services or processes. And the EIT claims that every euro spent from its budget triggers four extra euros for innovation. But the auditors say that this is "undemonstrated and implausible" and that most of the KICs' claimed activities would have been carried out whether or not the EIT existed.

The failure to deliver has to some extent been the result of "limited leadership abilities" and high staff turnover, including at senior management level, the auditors say.

"We agree with this report's important finding and recommendations," says Martin Kern, the Budapest-based interim director of the EIT. "But we have moved on since, and we have already addressed many concerns." ■ SEE EDITORIAL P.282

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