volcanism on the surface of Venus suffers from a lack of data."

A hellish planet

Gathering evidence that the planet is volcanically active wasn't easy. Venus's thick atmosphere — 100 times the mass of Earth's — and high temperatures of 450 °C make it difficult for rovers and other probes to explore the surface. So far, the most reliable data scientists have collected have come from the Magellan spacecraft.

Robert Herrick, a geophysicist at the University of Alaska Fairbanks, and Scott Hensley, a radar scientist at JPL who is also part of the VERITAS team, analysed full-resolution radar images captured by Magellan of areas with suspected volcanic activity.

The challenge was that Magellan imaged the planet in three cycles over the 24-month period analysed by the scientists. During each cycle, the spacecraft pointed its radar to Venus's surface at a different angle. For the scientists to look for changes on the surface over time, they had to superimpose the images at various angles and find overlaps in the terrain to line them up.

Herrick compares the problem to flying from multiple directions through the Grand Canyon in Arizona and then trying to map its surface while looking at opposite canyon walls. "Trying to find the same things in those images gets a little more challenging," he says.

The low resolution of the Magellan images added another layer of complexity. "You're looking at the surface, where a football field is a single pixel," he adds.

This worries Scott King, a geophysicist at Virginia Tech in Blacksburg who studies Venus. He questions whether the images are strong enough evidence to convince sceptics that Venus is volcanically active.

Herrick and Hensley acknowledge this limitation in their data. But they also say they are not aware of any equivalent events on Earth that could cause the observed changes without volcanic activity, although they cannot rule out the possibility that something else might have been responsible.

King doesn't find it hard to believe that the planet has volcanic activity. He hopes, however, that upcoming missions to Venus, including VERITAS, will provide the data needed to convince everyone.

VERITAS has been delayed, however — so King might be waiting longer than originally thought. NASA had planned to launch the mission in 2028, but the agency had to reallocate JPL's funding to address the delay of Psyche, a mission that will study a metal-rich asteroid orbiting the Sun between Mars and Jupiter. NASA does not currently have funds planned for VERITAS, and even if it restores funding, the mission would launch no earlier than 2031.

Launching VERITAS after 2030 could cause problems, Dyar says. Ideally, the topographic data collected by VERITAS would have provided NASA's DAVINCI and the European Space Agency's EnVision missions with information to help them target the areas they're planning to explore. DAVINCI, set to launch in 2029, aims to drop a probe into Venus's atmosphere, and EnVision, set to launch in the early 2030s, is meant to take high-resolution radar images of the planet's surface.

Studying Venus could not only allow researchers to understand more about how Earth works, but also help them learn more about exoplanets beyond the Solar System. "We're discovering hundreds, thousands of exoplanets," Dyar says. And many of those seem to be Venus-like, she adds.

Numerous space missions have been targeting Mars recently, even though Venus is much more Earth-like than the red planet is overall. Herrick hopes that the latest findings will motivate people to turn their eyes towards Venus and prompt NASA to launch VERITAS on time. "Venus is truly Earth's sibling," he says.

EMBRYO STUDIES SUGGEST CRISPR BABIES ARE STILL TOO RISKY

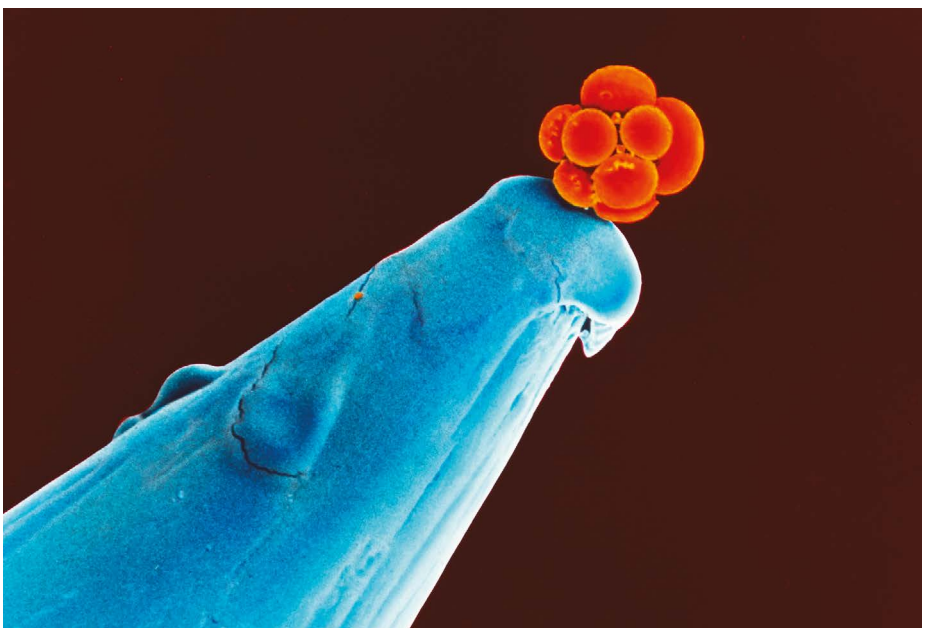
Even as society grapples with the ethics of heritable genome editing, technical obstacles abound.

By Heidi Ledford

More than four years after the first children with edited genomes were born, genome-editing techniques are still not safe enough to be used in human embryos destined for reproduction, announced the organizers of the Third International Summit on Human Genome Editing.

"Heritable human genome editing remains unacceptable at this time," they said in a statement issued on 8 March. "Preclinical evidence for the safety and efficacy of heritable human genome editing has not been established, nor has societal discussion and policy debate been concluded."

The statement concluded a day of discussion at the meeting in London about the potential of altering the genomes of either embryos or reproductive cells, called gametes, in ways that would affect future generations. Many of the talks at the meeting focused on technical and scientific challenges, such as the uncertain consequences of breaking both strands of the DNA double helix — a necessary step in some



YORGOS NIKAS/SPL

Genome-editing techniques are still not safe enough to be used in embryos for reproduction.

forms of genome editing — in embryos.

In addition to those challenges, society must grapple with questions about whether the technology should be used, organizers said: "Governance frameworks and ethical principles for the responsible use of heritable human genome editing are not in place."

Effects of editing

Some researchers have argued that heritable genome editing could help people who carry genetic diseases to avoid passing those conditions on to their children. However, in many cases, this can already be done by combining *in vitro* fertilization with testing of the resulting embryos for a given genetic disorder.

As well as addressing broader concerns about ethics and social justice, editing embryos would require a safe and effective genome-editing platform to minimize the chances of harm to the embryo, the resulting child and any descendants. Most research on genome editing in embryos, however, has been done using animal models, which might not accurately reflect what happens in human embryos. And, although potential genome-editing therapies have been widely studied in adult human cells, embryos might respond differently than adult cells to the DNA damage caused by some of the tools.

Only a handful of laboratories have tried to edit the genomes of human embryos directly using the popular CRISPR–Cas9 editing system, and several of these presented concerning results at the summit.

The Cas9 enzyme works by breaking both strands of DNA at a site designated by a guiding piece of RNA. The cell then repairs the break, either by using an error-prone mechanism that stitches the two ends together but sometimes deletes or inserts a few DNA letters in the process, or by replacing the missing DNA with a sequence copied from a template provided by the researcher. DNA breaks created by Cas9 in embryos are usually repaired using the error-prone pathway, said Dietrich Egli, a stem-cell biologist at Columbia University in New York City, at the conference.

Egli and other researchers also reported on the consequences of the double-strand breaks made by Cas9. Developmental biologist Kathy Niakan, now at the University of Cambridge, UK, recounted that her lab found[1] that some human embryos lost large regions of chromosomes when they were edited using CRISPR–Cas9. And Shoukhrat Mitalipov, a reproductive biologist at Oregon Health & Science University in Portland, said that his team had found large DNA deletions at the editing site in human embryos[2].

"Can human embryos at this stage really tolerate this kind of intervention?" asked Dagan Wells, a reproductive geneticist at the University of Oxford, UK, who also reported concerning responses to DNA breaks in human embryos. About 40% of the embryos in one of his genome-editing studies failed to repair broken DNA. More than one-third of those embryos continued to develop, he said, resulting in the loss or gain of pieces of chromosomes in some cells. That could harm the health of the child if such embryos were allowed to develop further. "These results are really a warning," he said.

Better techniques

There are newer variations of CRISPR–Cas9 editing that do not break both strands of the DNA helix. Base editing, for example, can convert a single DNA letter into another, and a technique called prime editing allows researchers to insert DNA sequences more predictably than when using CRISPR–Cas9. Neither of these methods causes double-strand breaks, but they have not been as thoroughly studied and optimized as have CRISPR–Cas9 tools. At the summit, developmental biologist Yuyu Niu at the Kunming University of Science and Technology in China reported that one kind of base editor did not cause off-target DNA mutations in rhesus macaque (*Macaca mulatta*) embryos, but did cause unwanted RNA mutations[3].

An alternative to editing embryos would be to instead edit eggs, sperm or the stem cells that give rise to them. This would also sidestep concerns that efforts to edit embryos might not succeed in all cells of the embryo, resulting in a mixture of edited and unedited cells. Several researchers at the summit reported progress towards generating edited gametes in the lab, but doing this with human cells destined for reproduction still poses challenges.

The summit organizers urged researchers to continue exploring each of these options, even as policymakers and the public grapple with what restrictions should be placed on heritable genome editing. "We are still keen that the research goes ahead," said developmental biologist Robin Lovell-Badge at the Francis Crick Institute in London, who chaired the organizing committee. "In parallel, there has to be more debate about whether the technique is ever used."

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HOW SILICON VALLEY BANK COLLAPSE COULD HIT SCIENCE START-UPS

Bailouts mean deposits are safe, but failure raises fears over future investment in small tech companies.

By Katharine Sanderson

The collapse of Silicon Valley Bank (SVB) late on 10 March sent science and technology start-up companies into chaos, and has left many questioning where investment will come from in future.

Regulators closed the bank after several days of turmoil after an announcement that it needed to raise US$2 billion to cover debts owing to rising interest rates. This led to a run on the bank as several large venture-capital firms advised their clients to withdraw funds.

SVB was known for funding technology start-ups. Its location in Silicon Valley, a region in the San Francisco Bay Area of northern California, meant that many of these were green-energy or biotech companies.

The situation after the collapse was "absolutely terrifying", says Ethan Cohen-Cole, chief executive of Capture6, a clean-technology start-up in Berkeley, California, that is developing ways of capturing carbon dioxide directly from the air. "Your first thought is: 'This is the end of your company.'"

But on 12 March, the US government announced that it would guarantee deposits with the bank. Although relieved, Cohen-Cole doesn't think this was necessarily the right thing to do to ensure long-term investment in companies such as his. "They're perpetuating the problem," he says. The rescue plan covers immediate cash-flow problems such as paying employees, but the next step remains unclear, he says, adding that he would like to have seen the government bolstering existing lending programmes for small businesses. Cohen-Cole predicts that investors will back away from investing in small companies, and this will inevitably affect small start-ups working on climate solutions.

HSBC buyout

In the United Kingdom, events have played out slightly differently. On 10 March, the Bank of England announced that SVB's UK arm would