



The earthquake that devastated San Francisco, California, in 1906 arose from the San Andreas fault.

## TWO BIG QUAKE FAULTS MIGHT BE LINKED

Analysis suggests that quakes on the Cascadia fault off California can trigger shaking on the San Andreas.

By Alexandra Witze

**T**wo of North America's most fearsome earthquake zones could be linked.

A controversial study argues that at least 8 times in the past 3,000 years, quakes made a one-two punch off the west coast of the United States. A quake hit the Cascadia fault off the coast of northern California, triggering a second quake on the San Andreas fault just to the south. In some cases, the delay between the quakes might have been decades long.

The study suggests that Cascadia, which scientists think is capable of unleashing a

magnitude-9 earthquake at any time, could set off quakes on the northern San Andreas, which runs under the San Francisco Bay Area. Several earthquake scientists told *Nature* that more work is needed to confirm the provocative idea. Researchers have long considered the two faults seismically separate.

Chris Goldfinger, a geologist and palaeoseismologist at Oregon State University in Corvallis, will present the findings on 13 December at a meeting of the American Geophysical Union in San Francisco. "This is mostly a circumstantial case," he says. "I don't have a smoking gun."

Goldfinger and his colleagues first suggested in 2008 that earthquakes in the

southern part of Cascadia could trigger quakes on the northern San Andreas (C. Goldfinger *et al. Bull. Seismol. Soc. Am.* **98**, 861–889; 2008). The scientists reported finding layers of churned-up, sandy sediment in sea-floor cores drilled offshore. These layers, called turbidites, usually form when earthquakes cause underwater landslides. The researchers found turbidites in Cascadia that seemed to form just before similar turbidites near the San Andreas – perhaps as a Cascadia quake triggered a San Andreas one.

But it was hard to pinpoint exactly when the turbidites had formed, and Goldfinger knew he needed more evidence. Now he has data from seven cores drilled offshore in southern Cascadia and seven cores drilled near the northern San Andreas. The two sites are around 100 kilometres apart – close enough to feel shaking from both faults.

At eight places in both sets of cores, Goldfinger spotted unusual, two-layered turbidites and realized that they were telling him something new. The two-layered turbidite "has to be two quakes recorded together", he says. As Goldfinger sees it, a Cascadia quake shook the coastline first, causing landslides that show up

## News in focus

in both sets of cores as the first layer of turbidites. Then, at some later point, the northern San Andreas also shook, causing the second turbidite layer to form.

“This story is pretty convincing,” says Jason Patton, an engineering geologist with the California Geological Survey in Sacramento who was a co-author on the 2008 paper. “Cascadia turbidites are covered by San Andreas turbidites, so the Cascadia turbidites were deposited first.”

Others are reserving judgement. Turbidites show that the ground shook at some point in the past, but it’s difficult to tell exactly when or where those quakes happened, says Joan Gomberg, a seismologist at the US

Geological Survey in Seattle, Washington. “All this uncertainty leaves multiple, equally plausible interpretations on the table – most of which are not sensational,” she says.

Ross Stein, a seismologist with the earthquake-preparedness firm Temblor in Redwood City, California, wants to see detailed modelling of how stress from the Cascadia fault might be transferred to the northern San Andreas. Scientists generally agree that a large earthquake can sometimes trigger another on a nearby fault. But it’s not clear whether that might happen between southern Cascadia and the northern San Andreas, Stein says.

This week at the conference, Goldfinger says, “I’m just going to lay out the case.”

detentions and other human-rights violations in the province. The Chinese government says it is conducting a re-education campaign to quell what it calls a terrorist movement.

“We are very concerned about research which involves consent from vulnerable populations,” says a spokesperson from Springer Nature (*Nature’s* news team is editorially independent of its publisher).

The publishers’ announcements, which *The New York Times* reported on 4 December, follow rising concerns about the publication of such work. Last week, Yves Moreau, a computational biologist at the Catholic University of Leuven in Belgium, wrote an opinion article in *Nature* warning of the dangers that accompany the proliferation of DNA profiling and calling for all unethical work in biometric research to be retracted.

Springer Nature said that it would add notes of concern about consent to two papers<sup>1,2</sup> that reported studies using DNA from hundreds of Uyghurs to predict height or facial shape. One, published in *Human Genetics*<sup>2</sup>, was highlighted in a separate *New York Times* article that described worries that the participants hadn’t given informed consent.

Both papers state that volunteers gave consent, and that the studies were approved by an ethics committee from the Institute of Forensic Science, which is affiliated with China’s police and security authority.

“We are ordinary forensic scientists who carry out forensic research following the scientific research ethics norms,” said Caixia Li of the Institute of Forensic Science in Beijing, a co-author of both papers<sup>2,3</sup>, in an e-mail to *Nature’s* news team. He said that “all individuals provided written informed consent”.

Moreau says that it’s hard to see how Uyghur peoples could give free, informed consent to DNA or facial-recognition work – given that so many people in that ethnic group have been sent to internment camps (which China calls education facilities).

Springer Nature has identified a number of other ‘papers of concern’ published by its journals, the spokesperson adds, which are being investigated. And it has updated its guidance about the need to gain explicit and informed consent in studies that involve clinical, biomedical or biometric data from people.

Moreau says: “Expressions of concerns are a welcome first step, but this is only meaningful if it is the start of a large-scale ethical review of all forensic population-genetic research on Chinese populations and of all biometric research.”

Wiley, meanwhile, said it was opening a formal investigation into an article that described an analysis of a database of photos of Uyghur, Tibetan and Korean people using various facial-recognition algorithms<sup>4</sup>. In September, four researchers, including Moreau and Jack Poulson of the advocacy group Tech Inquiry

# PUBLISHERS REVIEW RESEARCH ON CHINESE MINORITY GROUPS

## Springer Nature and Wiley have concerns about the ethics of papers on genetics and facial recognition.

By Richard Van Noorden & Davide Castelvecchi

**T**wo science publishers are reviewing the ethics of research papers in which scientists backed by China’s government used DNA or facial-recognition technology to study minority groups in the country, such as the predominantly

Muslim Uyghur population.

Springer Nature (which publishes *Nature*) and Wiley want to check that the study participants gave informed consent, after researchers and journalists raised concerns that the papers were connected to China’s heavy surveillance operations in the northwestern province of Xinjiang. China has attracted international condemnation – and US sanctions – for mass



Officers patrol in China’s Xinjiang region, where there have been mass detentions.