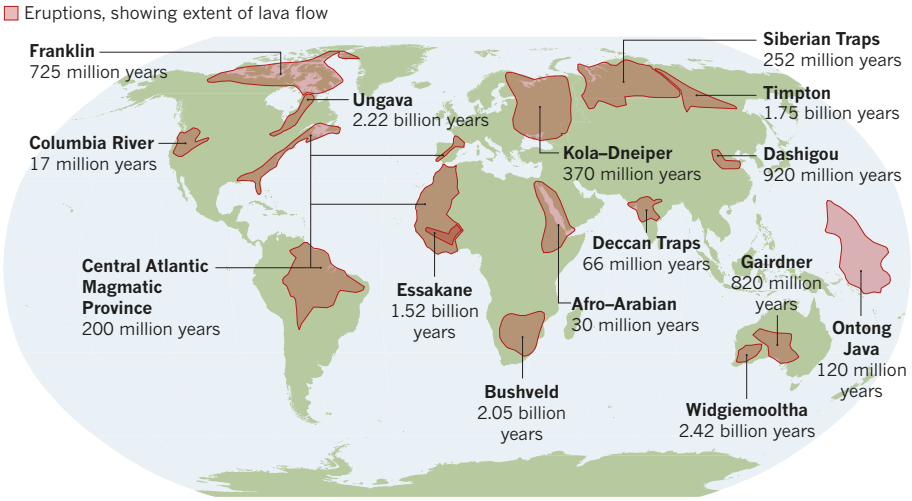
EARTH'S BIGGEST ERUPTIONS

Scientists have extended the geological record of massive volcanic eruptions, uncovering evidence for world-changing events that occurred more than 2 billion years ago.



SOURCE: RICHARD ERNST

from a single huge eruption. During their survey, they found evidence of many of these major volcanic events.

Each of those newly identified eruptions goes into Ernst's database. "We've got about 10 or 15 so far that are probably comparable to the Siberian event," Ernst says, "that we either didn't know about or had a little taste, but no idea of their true extent."

They include a 1.32-billion-year-old eruption in Australia that connects to one in northern China. By linking dyke swarms across continents, scientists can better understand how Earth's crust has shuffled around over time, says Nasrrddine Youbi, a geologist at Cadi Ayyad University in Marrakesh.

Technically, the eruptions are known as 'large igneous provinces' (LIPs). They can spew more than one million cubic kilometres of rock in a few million years. By comparison, the 1980 eruption of Mount St Helens in Washington state put out just 10 cubic kilometres.

These large events also emit gases that can change atmospheric temperature and ocean chemistry in a geological blink of an eye. A modelling study published last month suggests that global temperatures could have soared by as much as 7 °C at the height of the Siberian eruptions (F. Stordal *et al. Palaeogeogr. Palaeoclimatol. Palaeoecol.* **471,** 96–107; 2017). Sulfur particles from the eruptions would have soon led to global cooling and acid rain; more than 96% of marine species went extinct.

But the picture of how LIPs affected the global environment gets murkier the further back in time you get, says Morgan Jones, a volcanologist at the University of Oslo. Uncertainties in dating grow, and it becomes hard to correlate individual eruptions with specific environmental impacts. "It's at the limit of our understanding," he says.

On average, LIPs occur every 20 million years or so. The most recent one was the Columbia River eruption 17 million years ago, in what is now the northwestern United States.

Discovering more LIPs on Earth helps to put the geological history of neighbouring planets in perspective, says Tracy Gregg, a volcanologist at the University at Buffalo in New York. She and Ernst will lead a meeting on LIPs across the Solar System at a planetary-science meeting in Texas next week.

Venus, Mars, Mercury and the Moon all show signs of enormous eruptions, Gregg notes. On the Moon, LIP-style volcanism started as early as 3.8 billion years ago; on Mars, possibly 3.5 billion years ago. But without plate tectonics to keep the surface active, those eruptions eventually ceased.

"Other planetary bodies retain information about the earliest parts of planetary evolution, information that we've lost on Earth," Gregg says. "They can give us a window into the early history of our own planet." ■

INTELLECTUAL PROPERTY

Ugly fights over mutant-mouse patents rise from the dead

University sues US National Institutes of Health over animals used in Alzheimer's research.

BY HEIDI LEDFORD

Like a zombie that keeps on kicking, legal battles over mutant mice used for Alzheimer's research are haunting the field once again — four years after the last round of lawsuits. In the latest case, the University of South Florida (USF) in Tampa has sued the US National Institutes of Health (NIH) for authorizing the distribution of a particular type of mouse used in the field. The first pre-trial hearing in the case is set to begin in a federal court on 21 March.

The university holds a patent on the mouse, but the NIH has contracted the Jackson Laboratory, a non-profit organization in Bar Harbor, Maine, to supply the animals to researchers. The USF is now claiming that it deserves some of the money that went to the contractor.

If the suit, filed in December 2015, is successful, it could set a precedent for other universities, cautions Robert Cook-Deegan, an intellectual-property scholar at the Washington DC centre of Arizona State University in Tempe. And that would threaten the affordability of and access to lab animals used to investigate Alzheimer's disease more broadly.

"It feels greedy to me," Cook-Deegan says. "If other universities start doing this, all it does is push up the cost of research tools."

The mice, on which the USF filed a patent in 1997, express mutated forms of two genes[1]. These modifications help researchers to study how amyloid plaques develop in the brain, and enable them to investigate behavioural changes that manifest before those plaques appear.

The current suit has dredged up uncomfortable memories of a similar case that centred on other types of mutant mice used in Alzheimer's-disease research. In 2010, the Alzheimer's Institute of America (AIA), based in St Louis, Missouri, sued the Jackson Laboratory directly. But the NIH eventually stepped in because it had contracted the Jackson Lab to distribute

the mice. That move shifted the lawsuit to the federal government — a more costly and formidable defendant to take on in court.

The AIA dropped its case in 2011, and lawsuits that it had filed against other biomedical companies were eventually tossed out as well.

But these cases exacted a toll: all together, they amounted to some 18.7 cumulative court years in 6 jurisdictions, involved at least 98 lawyers and produced 1,143 court filings[2]. The lawsuits also raised concerns that the AIA would sue researchers who had used the mice in question. This was a fear that, the Jackson Lab argued, hindered researchers from sending mouse strains to facilities such as theirs for maintenance and distribution.

COURTING COMPLICATIONS

Nevertheless, the USF decided to pick up where the AIA left off, by suing both the NIH and the Jackson Lab in 2015 over its double-mutant mice. If the university is successful, it could entice others to follow suit, says Tania Bubela, a legal scholar at the University of Alberta in Edmonton, Canada.

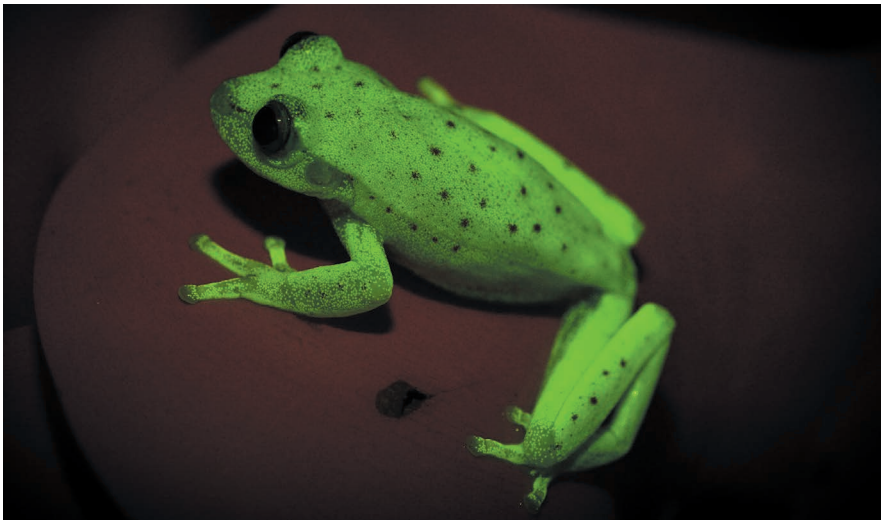
But such lawsuits could risk damaging an academic institution's reputation, Bubela adds. "Whether other universities are crazy enough to follow the lead of the University of South Florida is another question," she says. "I can't imagine more research-intensive universities engaging in this kind of behaviour."

Two researchers formerly at the USF who are listed as inventors on the university's double-mutant-mouse patent — neuroscientists Karen Duff, now at Columbia University in New York City, and John Hardy, now at University College London — declined to comment specifically on the current lawsuit. A lawyer for the USF also did not comment on the case. But Hardy says: "I do think these things are better sorted out without recourse to lawyers and the courts."

The case is unlikely to set Alzheimer's research back if access to the mice is restricted as a result of the lawsuit, says neuroscientist Sangram Sisodia of the University of Chicago in Illinois. Several alternative models have been developed since the *Nature* publication in 1998 that first described the USF double-mutant mouse[1]. In 2001, for example, a team led by neuroscientist David Borchelt at the University of Florida in Gainsville described a way of introducing the two mutated genes in one step[3]. "It saved a lot of time and money," says Sisodia.

Sisodia's team developed a double-mutant mouse[4] similar to the USF's version before Hardy and Duff described their mutants. Did Sisodia want to patent his mice? "No," he says: "Not interested." ■

1. Holcomb, L. *et al. Nature Med.* **4,** 97–100 (1998).
2. Bubela, T., Vishnubhakat, S. & Cook-Deegan, R. *J. Law Biosci.* **2,** 213–262 (2015).
3. Janowsky, J. *et al. Biomol. Eng.* **17,** 157–165 (2001).
4. Borchelt, D. *et al. Neuron* **5,** 1005–1013 (1996).



JULIÁN FAIVOVICH AND CARLOS TABOADA

Fluorescent molecules in this male polka-dot tree frog turn it into a night light.

BIOLOGY

First fluorescent frog found

Rare discovery in a land animal reveals a new way to glow.

BY ANNA NOWOGRODZKI

Under normal light, the South American polka-dot tree frog (*Hypsiboas punctatus*) sports a muted palette of greens, yellows and reds. But switch on ultraviolet illumination, and this little amphibian gives off a bright green glow.

The ability to absorb light at short wavelengths and re-emit it at longer wavelengths is called fluorescence. The phenomenon is rare in land animals and, until now, was unheard of in amphibians. Researchers also report that the frog uses fluorescent molecules unlike those found in other animals; they published the find on 13 March (C. Taboada *et al. Proc. Natl Acad. Sci. USA* http://doi.org/b364; 2017).

Fluorescence is distinct from bioluminescence, in which organisms give off light generated by chemical reactions. Many ocean creatures fluoresce, including corals, fish and sharks. On land, fluorescence was previously known only in parrots and some scorpions. It is unclear why animals have this ability, although explanations include communication and camouflage.

The researchers first thought that they might find red fluorescence in these frogs, because the creatures contain a pigment called biliverdin. By itself, biliverdin turns the amphibian's tissues and bones green. However, in some insects, proteins that bind to biliverdin emit a faint red fluorescence, says study co-author Carlos Taboada, a herpetologist at the University of Buenos Aires. When researchers used a UV light on polka-dot tree frogs collected near Santa Fe, Argentina, the animals gave off an intense green glow instead.

Three molecules in the animals' lymph tissue, skin and glandular secretions were responsible for the green fluorescence. The molecules contain a ring structure and a chain of hydrocarbons, and are unique among known animal fluorescent molecules. The closest similar molecules are found in plants, says study co-author Norberto Peporine Lopes, a chemist at the University of São Paulo in Brazil.

The fluorescent molecules are bright, providing about 18% as much visible light as a full Moon. The polka-dot tree frog's visual system remains a mystery, so Taboada plans to study it to determine whether the amphibians can see their own fluorescence.

"I think it's exciting," says marine biologist David Gruber of Baruch College, part of the City University of New York, who with his colleague discovered fluorescence in hawksbill sea turtles (*Eretmochelys imbricata*) in 2015 (D. F. Gruber and J. S. Sparks *Am. Mus. Novit.* **3845,** 1–8; 2015). "It opens up many more questions than are answered," he says — including the ecological and behavioural function of fluorescence. ■

CORRECTION

The News story 'Ancient volcanoes exposed' (*Nature* **543,** 295–296; 2017) wrongly said that ancient Siberian volcanic eruptions could have raised global temperatures by 7 °C per year, rather than over 100 years.