Plumbing Old Faithful's depths

A cavern the size of a two-car garage has been found under the Old Faithful Geyser in Yellowstone National Park, helping to explain how geysers such as this one erupt.

When Old Faithful was discovered in the 1870s, it spewed sulphurous water and steam about once an hour. Today, it spurts a 30-metre-or-higher jet on average every 90 minutes. Researchers have struggled to work out exactly how and why it erupts when it does.

Part of the problem is that peering into a boiling geyser is tricky. Researchers tried to map Old Faithful in the 1990s using both seismic studies and a camera lowered down its spout. These efforts revealed a cavern about the size of a small car, with a narrow constriction less than 10 cm wide at its top. But the plumbing below 14 metres, where the camera couldn't survive the heat, remained a mystery. Most researchers assumed that the eruptions were caused by a sudden conversion of superheated water into steam inside the geyser's long, vertical pipe.

Jean Vandemeulebrouck and colleagues, of the Université de Savoie, France, have taken a second look at some of the old data. Bubbles popping inside the geyser cause tiny tremors, which were recorded at 96 seismic sensors around the geyser's surface in 1992. They analysed this using an acoustic technique. This

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revealed a larger cavern, of about 60 cubic metres, 15 metres down, off to the geyser's southwest side (*Geophys. Res. Lett.* http://doi.org/k63; 2013). The innovative technique might prove useful in future studies of other eruptive systems, including volcanoes.

Vandemeulebrouck says that Old Faithful's side cavity acts as a reservoir for hot, bubbling water and steam that can compress or expand, allowing the water in the smaller main vent to oscillate up and down like a spring. In the run-up to each eruption, these oscillations repeatedly slop a little water out of the top of the geyser, reducing the pressure on the water inside. This, in turn, helps the water to boil and work up enough heat to result in a full eruption. This 'bubble chamber' model of geyser eruptions is more complex and drawn-out than the previous view of eruptions from a single, vertical pipe.

The new view of Old Faithful's innards fits well with work from Geyser Valley, Kamchatka. Video footage of the plumbing of four geysers in that valley recently revealed contorted conduits that also favour the bubble chamber model (*Geology* http://doi.org/khj; 2013). The authors of this work say that a geological requirement for complex plumbing could explain why geysers are so rare: there are only a few hundred in the entire world, many of which are in Yellowstone.

These studies do not yet explain the frequency of Old Faithful's eruptions, or why the average time between spouts has lengthened over time. It could be that earthquakes changed the size or connections between chambers, affecting the oscillations in the geyser's plumbing. ❐

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The journalist's take

Many science journalists look beyond press releases and trawl through the abstracts of upcoming or recently published papers, looking for fun tidbits hiding in the table of contents of the less prominent journals. The chance of finding something truly important or exciting this way is slim, but the stories are usually exclusive to the journalist who finds them.

I stumbled across this paper by Vandemeulebrouck *et al.* on one such trip through the 'Accepted Articles' web page of *Geophysical Research Letters* (http://go.nature.com/wcuy7V), which lists their accepted manuscripts before they are copyedited or typeset. Another common trawling ground for reporters is *ScienceDirect*, which lists the latest papers in more than 2,500 journals. Although the American Geophysical Union distributes press releases or publishes news stories for some papers, these can go out some time after the accepted paper is published online (in this case, they kindly waited for my news story before putting out a blog post). There are no embargoes on their articles, so reporters can get a head start by looking directly at the 'Accepted Articles' site.

The headline news of finding a previously unknown cavern under a famous geyser makes this paper instantly attractive to a journalist. Beyond that, the details of the work are actually quite technical and the conclusion a little vague. The paper does not actually explain how or why Old Faithful is so 'faithful', although the abstract does hint that it might do so, by stating: "This reservoir […] plays a major role in the oscillatory behavior". Journalists are effectively trained by their job to leap to conclusions and then back-pedal if those conclusions aren't quite right. I originally hoped this phrase meant that the cavity explained the geyser's 90-minute cycle, although a chat with the author of the research cleared that up. Other reporters fell for the best-hoped-for story: *USA Today*, for example, ran with "Mystery solved: Scientists say they've finally figured out why Old Faithful erupts with super-hot water and steam about every 90 minutes" (http://go.nature.com/7Mif7v).

The actual results are a little trickier to explain to a layperson. And they arguably only have direct relevance to researchers keen to know how geysers, and perhaps also volcanoes, work: the paper is not going to revolutionize eruption warnings or change the experience for Yellowstone's tourists. Nevertheless, the story was picked up fairly widely by the popular press. What made it so attractive is the basic fact that it's about Old Faithful, which comes with a host of fun historical facts, some cool basic science and great pictures. Stories such as this allow reporters to air things that experts may have long known, but the average newspaper reader had never imagined — and there's nothing wrong with that.

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