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March 4-10, 2006

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Pulse reveals beating heart of a supervolcano

"I DON'T think visitors appreciate that they're standing directly on top of the largest, most dynamic magmatic system on the planet," says geologist Daniel Dzurisin. While the supervolcano that is Yellowstone National Park won't be erupting any time soon, he and his colleagues have uncovered a surprising source of volcanic activity beneath tourists' feet, which was probably the reason trails had to be closed in 2003.

The Yellowstone caldera formed 640,000 years ago in an explosion of magma more than 1000 times greater than the Mount St Helens eruption in 1980. While it is common knowledge that the caldera floor rises and falls, the source of the motion remains uncertain. According to a previous popular theory, the accumulation and release of fluid not far beneath the surface is driving the cycles, but Dzurisin, of the David A. Johnston Cascades Volcano Observatory in Vancouver, Washington, and his colleagues say a deeper source best explains their latest findings.

Led by Charles Wicks of the US Geological Survey in Menlo Park, California, the team used satellite data to determine the changes in elevation – up to 120 millimetres – over a seven-year period.

Although the floor of the caldera began subsiding in 1997, the researchers uncovered a new region of activity beneath the north rim of the caldera that continued to swell from 1995 until 2002. Models incorporating the measurements indicate that the source of the upward push was 10 to 16 kilometres beneath the surface in the basaltic magma layer, well below the level of the fluid suggested as the source of the motion (*Nature*, vol 440, p 72).

The picture is one of magma flow driving the undulation of the surface, flowing upward from beneath the caldera floor towards the northern rim and then down and out from beneath the rim. Seismic activity near the exit acts as a valve, suggests Wicks, blocking or releasing the magma outflow. This explains why the rim and floor can swell and sink at different times.

The idea also explains the rise in thermal activity in the rim area in 2003, Wicks says, when some trails had to be closed because of increased steam releases and a rise in surface temperatures. The swelling magma could have cracked the crust, creating new avenues for steam to escape to the surface, he says. **Jessica Marshall** ●

STUART FRANKLIN/MAGNUM

Red-hot rock below Yellowstone

Global warming bubbles up from the ocean

Around 15 per cent of today's global warming is down to methane, but where does all this gas come from? Some at least could be bubbling up from an unlikely source – deep-sea volcanoes.

Until now, such volcanoes were thought to be a negligible source of atmospheric methane because everyone assumed the gas would oxidise long before it reached the surface. However, research on Håkon Mosby, a mud volcano 1250 metres down in the Norwegian Sea, has overturned this assumption.

Eberhard Sauter of the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany, and his colleagues found a huge column of gas bubbles rising to the surface from Håkon Mosby. They used an echo sounder to get acoustic images of the plume. Meanwhile, a remote-controlled robot dived down and videotaped the bubbles while a probe sampled the water and took temperature and depth readings.

The gas inside the bubbles turned out to be methane, which was protected from oxidation by a tough skin around the bubbles. "We found that a gas hydrate membrane enabled them to rise for around 800 metres," says Sauter. The bubbles eventually dissolved in surface waters, much of it probably ending up in the atmosphere (*Earth and Planetary Science Letters*, DOI: 10.1016/j.epsl.2006.01.041).

"We estimate that several hundred tonnes of methane are being released from this location every year," says Sauter. The atmospheric methane budget is around 600 gigatonnes per year, so this won't make a huge difference. However, if every deep-sea volcano turned out to release a similar amount, it would be a different matter.

No one really knows how many of these volcanoes there are. Estimates vary from thousands to tens of thousands, and it is unlikely that they are all active at the same time. "I'm not sure if it's time to say that deep sea methane is a significant source of atmospheric methane," says Alexei Milkov, a petroleum systems analyst for BP America in Houston, Texas. "The jury is still out." Kate Ravilious ●