Before the big volcano blows

Many volcanoes figuratively clear their throat before erupting, but few do so with as much gusto as the one that obliterated the island of Santorini around 1600 BC.

That colossal eruption scattered up to 60 cubic kilometres of magma into ash and rock across the eastern Mediterranean region. Left behind was a massive caldera now mostly filled by the Aegean Sea, the rim poking above the waves as a pair of crescent-shaped islands that belong to Greece. Although more recent volcanism has added several other new islands, Santorini's Bronze Age eruption is the stuff of legend. Some scholars have linked it circumstantially to the decline of the Minoan civilization, and a few speculate it could be the source of the myth of Atlantis, the island Plato described as sinking beneath the sea.

Now, this storied place has another tale to tell, of magma quickly rising beneath a volcano before it erupts. A team led by Timothy Druitt, at the Blaise Pascal University in Clermont-Ferrand, France, studied silica-rich crystals in pumice created during Santorini's Minoan eruption (*Nature* **482,** 77–80; 2012). The researchers analysed trace elements — such as magnesium, strontium and titanium — in locations ranging from the inner cores of the crystals to the outer rims.

Magnesium in particular diffuses slowly through a crystal, at rates of around 10 micrometres a year at the Santorini magma temperature of about 855 °C. This diffusion would have been halted abruptly when the eruption threw the material out into the cold. Differing amounts of magnesium throughout the crystal thus reveal the time that has elapsed between formation of the crystal within the magma chamber and the eruption.

Based on this and other evidence, Druitt and his colleagues have pieced together a timeline of what transpired before the Minoan eruption. First, within about a century of the eruption, a few cubic kilometres (or more) of silica-rich magma began ascending towards the surface. There it presumably encountered a body of chemically distinct rock and stalled. Then, starting about a decade before the eruption, the two began mixing together, as seen in the rims of the crystals and in the hybrid magma that finally erupted.

Before this awakening, Santorini hadn't had a large eruption for 18,000 years. The speed with which the fresh magma ascended, mixed and reactivated the system is notable, Druitt and his colleagues report. Their fluid dynamics calculations also support the idea that the final magma could have been thoroughly mixed for as long as a decade or as short as a few months.

Studies at other calderas, such as the Long Valley Caldera in California, have shown similar late-stage magma recharge before a big eruption. But the precise timing provided by Druitt and colleagues, along with the historical appeal of the Santorini volcano, makes it a valuable reference point for understanding how quickly super-eruptions can get going — and that is useful information for anyone worried about what might blow next. ❐

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The journalist's take

The story of Santorini was ripe for sensationalism from the start. The media rarely pass up the chance to write about any volcano, much less one responsible for one of the greatest eruptions in history. Even the advance tip sheet that *Nature* provides to journalists tantalizingly headlined the Santorini article "Can supervolcano eruptions be predicted?"

Reporters have to balance this predilection for disaster — doom sells, after all — with responsible information that puts new volcanic discoveries in context. Media coverage of the Druitt paper was complicated by the fact that Santorini is currently experiencing swarms of earthquakes and caldera uplift, unprecedented since its last eruption in 1950 (*Geophys. Res. Lett.* http://dx.doi.org/10.1029/2012GL051286; in the press).

Scientists and Greek officials are now wrestling with the question of whether Santorini is likely to erupt, and how they should convey the risk to local residents. As *Nature Geoscience* went to press, the level of activity was similar to that seen recently at other calderas, such as California's Long Valley, that have not erupted. But no one can rule out the possibility that Santorini's unrest is the beginning of something bigger. The volcano might erupt, or it might not.

Government officials have gathered an international team of experts to assess and present the risks. Looming large in these discussions is the memory of L'Aquila, Italy, where six scientists are on trial for manslaughter for failing to properly warn the community of seismic risk before a deadly earthquake there in April 2009.

It is not only officials and scientists who struggle with communicating risk. Reporters, too, have a responsibility to convey such context. In my *Science News* story about the Druitt paper, I left out any mention of the current unrest at Santorini. This decision went against my sense of news judgment, which holds that new developments about a topic at hand should be included in a story about it.

But given various constraints, I felt it would be misleading to include a throwaway sentence without the space and context to explain the current activity — because if Santorini does erupt soon, it won't be anything close to the Minoan eruption; magma volumes today are much smaller.

At least one local journalist has provided a level-headed account. A story in the Greek newspaper *Ethnos* described the seismic activity but emphasized the scientific monitoring and the need to stay informed and alert but not panicky. With good reporting, good science and good planning, Santorini may yet avoid the communication catastrophe of L'Aquila.