Ancient eruption tapped the Earth's depths

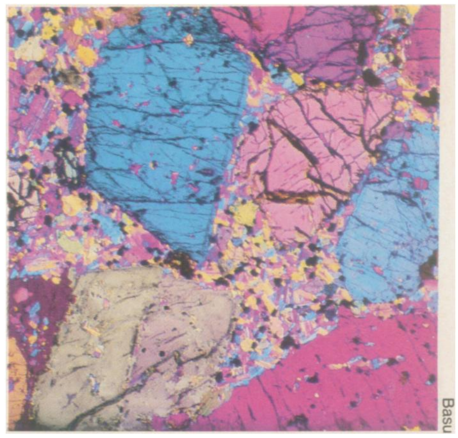
Lofting its mushroom cloud of ash high into the atmosphere, the catastrophic blast at Mount Pinatubo in 1991 may seem the stereotypical volcanic eruption. But the largest lava outpourings in Earth's history actually resemble floods more than nuclear explosions. Research on the remains of one such lava deluge in western India pinpoints for the first time the origin of the rock that erupts in these so-called flood basalts.

Asish R. Basu of the University of Rochester (N.Y.) and colleagues made this discovery while studying the Deccan Traps, stair-like layers of basalt formed during a series of eruptions 65 million years ago. An estimated 1.5 million cubic kilometers of lava spewed over several million years. If spread evenly, that amount of rock would envelop the entire world in a layer more than 3 meters thick.

Geoscientists believe the Deccan Traps and other flood basalts form when narrow plumes of hot rock rise through the mantle and burn through the crust. Most researchers think the plumes come from the base of the mantle near the top of Earth's core, but others suggest the plumes start much closer to the surface.

Basu and his co-workers traced the origin of the Deccan Trap rocks by measuring the ratio of two helium isotopes preserved within bubbles in the basalt. These rocks contain an abundance of light helium, a geochemical signature of the deep mantle, the researchers report in the Aug. 13 SCIENCE.

Geochemists have seen similar helium ratios in young lavas from Hawaii and other sites where deep mantle plumes reach the surface. But the known flood basalts on Earth are all geologically old, and researchers had assumed such rocks could not preserve helium for tens of millions of years.



Basu

Gas bubbles within these crystals reveal deep origin of the Indian eruptions.

Basu and his co-workers found the gas by looking at basaltic rocks that formed at the very start of the Deccan event, when magma from the plume first started rising through the crust. Unlike the bulk of the Deccan basalts, these rocks north of the main lava flows did not erupt at the surface, but cooled underground and trapped the helium instead of releasing it into the atmosphere.

According to Basu, these findings "open up a new avenue of research where people will be able to look at older rocks and look for helium."

The bulk of the Deccan eruptions occurred at roughly the same time as a mass extinction that wiped out the last remaining dinosaurs and a large fraction of other life forms at the end of the Cretaceous period. To better bracket the timing of the eruptions, the researchers dated basalt formations from the beginning and end of the Deccan sequence by measuring a particular argon isotope created by the decay of radioactive potassium.

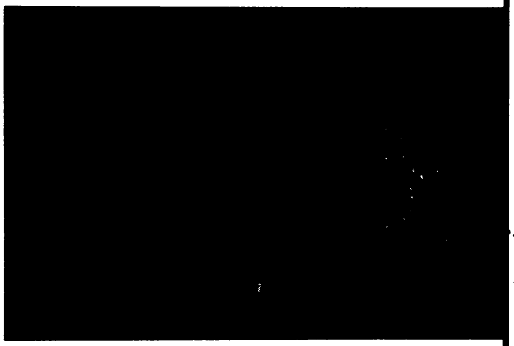
The dating shows the early eruptions began 68.5 million years ago, long before most of the outpourings. The last eruptions ended about 65 million years ago, plus or minus 110,000 years. Within the errors of the dating technique, that age coincides with the crash of a major meteorite that left a 180-kilometer-wide crater in the Yucatán Peninsula.

While speculations about the cause of the extinctions have centered on the meteorite, some researchers think the timing of the Deccan eruptions suggests they too played a role. The eruptions would have emitted vast amounts of heat-trapping carbon dioxide and poisonous sulfur gases, says Robert A. Duncan of Oregon State University in Corvallis. "The coincidence of two rare events, namely flood basalt activity and the meteorite impact, are probably the explanation for the mass extinctions," he says.

– R. Monastersky

Sick plant? Take two aspirin and . . .

Thanks to the immune system, diseases such as measles make people sick just once, and then the body develops a lifelong resistance to the infection. Plants, too, possess similar defenses. Something called "systemic acquired resistance" allows plants to fight off subsequent attacks not only by the original pathogen but by other infections as well.



Gaffney et al./SCIENCE

Increasing spot sizes (left to right) indicate that plants with decreasing amounts of salicylic acid are less and less able to fight off infection.

For years scientists have suspected that salicylic acid, a chemical similar to aspirin's active ingredient, helped plants develop this resistance. New research has confirmed that hunch and shown that the amount of this chemical in a plant determines the degree to which it fights off current and future infections. Thomas Gaffney and his colleagues at Ciba-Geigy in Research Triangle Park, N.C., and Basel, Switzerland, report their findings in the Aug. 6 SCIENCE.

To assess the importance of salicylic acid, the researchers created "transgenic" tobacco plants. The plants contain a bacterial gene, which codes for a protein that breaks down salicylic acid. The researchers infected three lower leaves of these plants with a tobacco virus. A week later, they observed brown spots at the site of infection and measured the amount of the bacterial gene, its protein, and salicylic acid.

At the same time, the investigators infected plants that lacked the gene. Leaves from those plants increased their salicylic acid production 185-fold.

In contrast, infected leaves from plants with a lot of this protein had just two to three times more salicylic acid, the group reports. Moderate amounts of the bacterial protein led to moderate increases in salicylic acid.

Next, the researchers put virus on the upper leaves of these plants and, six days later, measured the size of the brown spots that developed. They observed that the less salicylic acid the plant possessed, the larger the spots.

"It was nice that everything correlated so well," says Leslie Friedrich, a geneticist at Ciba-Geigy. Also, plants with a lot of the bacterial protein developed larger brown spots at the site of the first infection than did the unmodified plants. This indicates that salicylic acid plays a role in neutralizing the initial viral attack, she and her colleagues suggest.

Ultimately, the researchers would like to understand enough about how systemic acquired resistance develops to create a "vaccine" that would mobilize this defense system prior to any infection, she adds. *– E. Pennisi*

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