A pile of dust? Local winds may have built the central mound of Gale crater from passing dust.

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No Lake Mud for Curiosity Rover to Investigate?

To Mars scientists, Gale crater's central mound seemed an irresistible twofer: an environmental record from when the once–water-rich planet slid into hyperaridity, plus the prospect of analyzing sediments that might have been laid down in an ancient lake. That would be the ideal place to find remains of any early martian life.

But at the meeting, a pair of researchers probing the internal structure of the mound for clues to its formation put a damper on these hopes. "We see nothing in the geometry of the mound that would suggest [lake sediments] in it," says planetary scientist Kevin Lewis of Princeton University.

Lewis and planetary scientist Edwin Kite of the California Institute of Technology in Pasadena and colleagues used images from the Mars Reconnaissance Orbiter (MRO) with a resolution of 1 meter per pixel. That's the highest resolution yet available, high enough to make out the thin layers of sediment exposed around the 5-kilometer-tall mound. They also determined the mound's topography using stereo MRO images made by combining pairs of images taken from slightly different points in orbit. Taken together, the images allowed the researchers to measure the inclination of the sediment layers in the mound.

What Lewis and Kite found bears little resemblance to a deposit formed at the bottom of a lake. Lake sediments are deposited as flat-lying beds. But the mound's sediment layers are consistently inclined by 2° to 4°, they reported. At the seven outcrops examined around the mound, the beds slope away from the center of the mound, echoing the mound's present-day shape, not the shape of a lake bottom. And when partially eroded beds exposed around the mound are extended radially outward, none reaches the crater wall. All of this seriously challenges the leading explanation for the mound: that Gale crater was once filled to the brim with sediment that has largely blown away to leave the mound.

Searching for another way that Gale's mound could have formed, Kite and Lewis conclude that the wind did it. In their scenario, the mound "rose from nothing on the crater floor," Lewis says. Gale lies in an especially dusty region of the dustiest planet known. Once the huge impact billions of years ago raised the Gale crater rim, solar heating of the crater floor would drive winds up over the rim during the day, and later cooling would drive winds down from the rim at night. These topographic winds would clear dust from the outer parts of the crater floor, but a stagnant region in the center—where the winds mainly blow up or down—would trap any dust delivered by inward winds.

If that's the way it worked, Gale mound would be a very high pile of dust. "There must have been more going on," Lewis says; perhaps ground water altered and welded together minerals near the bottom of the mound. "But it's a great base hypothesis to explain most of the deposit," he says.

No one has been entirely happy with the filling and partial removal idea, so the topographic wind hypothesis "is intriguing," says planetary scientist James Bell of Arizona State University, Tempe. Even so, he adds, "I don't think it's a slam dunk. It looks like a variety of processes were at work there." The mound's origins may prove complicated, but planetary geologist James Head of Brown University thinks Curiosity has the required tools: "It's going to be exciting moving up and down those slopes and sorting this out."

Tying Megaeruptions To a Mass Extinction Long After the Fact

To incriminate a global catastrophe in the extinction of a wide swath of the biosphere, you need precise dates for two events: the catastrophe—say, an asteroid impact or volcanic eruption—and the mass extinction. At the meeting, geochronologists who measure the passage of time in the steady ticking of radioactive decay presented convincing evidence that massive eruptions at the opening of the Atlantic Ocean 201 million years ago drove the mass extinction that cleared the way for the rise of the dinosaurs.

The dating—by Terrence Blackburn of the Carnegie Institution for Science in Washington, D.C., and colleagues—was impressively precise. For minerals from the end of the Triassic period, 201 million years ago, the researchers reported ages to three decimal places with a 1-sigma error of about 30,000 years, just 0.015% of the ages. That kind of precision takes careful measurements of the amounts of the radioactive element of interest and the product of its decay. That's quite a feat in mineral grains that have been ravaged for hundreds of millions of years by both the environment and their own radioactivity.

Radiometric dating has been in use for half a century, but in recent years a National Science Foundation program called EARTHTIME has prodded some improvements. New laboratory procedures and data analysis software developed through EARTHTIME-sponsored interlaboratory collaborations have helped reduce uncertainties in uranium-lead radiometric dating. And uranium-lead labs have adopted a sample pretreatment that effectively dissolves away parts of the mineral that has lost some of its lead because of radiation damage, leaving only mineral that has locked in all the lead it was endowed with.

Near the end of the Triassic period, millions of cubic kilometers of magma spewed from the crack that split the supercontinent Pangaea in two and started the opening of the Atlantic Ocean. Debris from the eruptions might have chilled the climate or poisoned the environment, triggering the extinction. But previous dating had had the extinction coming before the first volcanic outburst, not at the same time.

So Blackburn and his colleagues used the latest uranium-lead techniques to date volca-