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New theory explains Mercury's mysterious cliffs

Hot mantle rock popped out the planet's characteristic ridges

By **Dave Mosher**



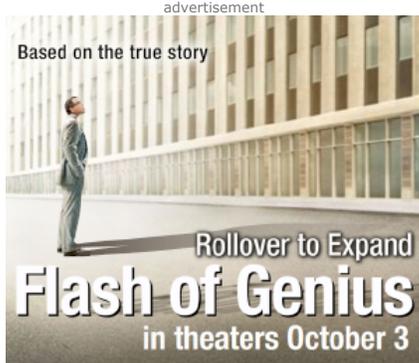
updated 1:38 p.m. ET, Tues., March. 25, 2008

Mercury's surface is not only peppered with impact craters, but also wrinkled with mysterious chains of cliffs.

Scientists think the "lobate scarp" cliffs — some 2 miles high and hundreds of miles long — were created as **Mercury's crust** bunched up around its shrinking interior, something like a dried-out piece of fruit. A new theory, however, suggests that rising sheets of hot mantle rock popped out the planet's characteristic ridges, helping to create the cliffs.

"There's a preferred north-south alignment to these scarps," Scott King, a planetary geophysicist at Virginia Tech University, told SPACE.com. "If you just have a shrinking sphere, there's no reason they should be aligned. It should be fairly random."

[Story continues below ↓](#)



Instead of just a shrinking crust, King thinks linear sheets of rock heaved on the planet's crust from below, pushing up the cliff-like features. He detailed his computer-modeled hypothesis in the March 16 online edition of the journal *Nature Geoscience*.

"It's a very plausible idea," said Sean Solomon, principal investigator for NASA's **Messenger spacecraft** at the Carnegie Institution of Washington, who was not involved in the study. "It gives a nice set of predictions about what we might see, so it's highly testable."

New views

Prior to Messenger's **January 2008 flyby** of Mercury, Mariner 10 was the planet's most recent visitor — but that was 33 years ago.

Mariner 10 captured only half the surface of the solar system's innermost planet, King said, preventing a final verdict on whether or not the cliffs have an orientation across the planet. That scenario

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improved dramatically with new Messenger data.

"We saw a third of the part we had never seen after this recent flyby," King said, noting that the **new views** also had different sun angles to highlight new cliff regions. "It still looks like the idea of an orientation is going to hold up."

King said that after the Messenger (which stands for MErcury Surface, Space ENvironment, GEochemistry and Ranging) spacecraft reaches stationary orbit around the planet in March 2011, scientists will know for certain if the scarps are aligned planet-wide.

"Until then, we won't have 100 percent coverage," King said. For now, the craft is zooming near Venus's orbit and is closing in on Mercury for a second pass in October 2008 and a third in September 2009.

Mantle push-ups

Assuming the scarps are indeed lined up, King thinks a thin yet active mantle layer beneath Mercury's crust may be to blame for the cliff-like features.

"It has a very large iron core compared to Earth, Venus and Mars," King said of Mercury's metallic heart. "The rock above it is confined to a real thin shell."

Because there's hardly any room for hot mantle rock to snake toward the **planet's surface**, King's models suggest that the material is forced into a rolling pattern of linear or sheet-like plumes. On Earth — where mantle space abounds beneath the crust — rising rock is mostly squeezed into cylindrical plumes.

"The dynamics are much different for Mercury. I've done a number of models, and this roll pattern almost always shows up," King said. "The stresses created by that on the crust can be enormous."

Still active?

Although both King and Solomon agree that Mercury's cliffs probably stopped forming a few billion years ago, King's models suggest that convection activity might still be roiling beneath the planet's surface.

"You bottle up a lot of energy when you create a planet, and it takes a long time for that heat to get out of the system," King said. "It's **still debatable** whether or not that convection continues on today."

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Solomon said instruments on Messenger that can monitor changes in mass should be able to tell if hot rock is still moving beneath Mercury's cold, hardened shell.

"If new images show an orientation to the lobate scarps, Scott (King) may have described convection of Mercury's mantle in the past," Solomon said. "If that convection is still going on today, we should be able to use Messenger to detect that activity in the planet's gravity field and topography."

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