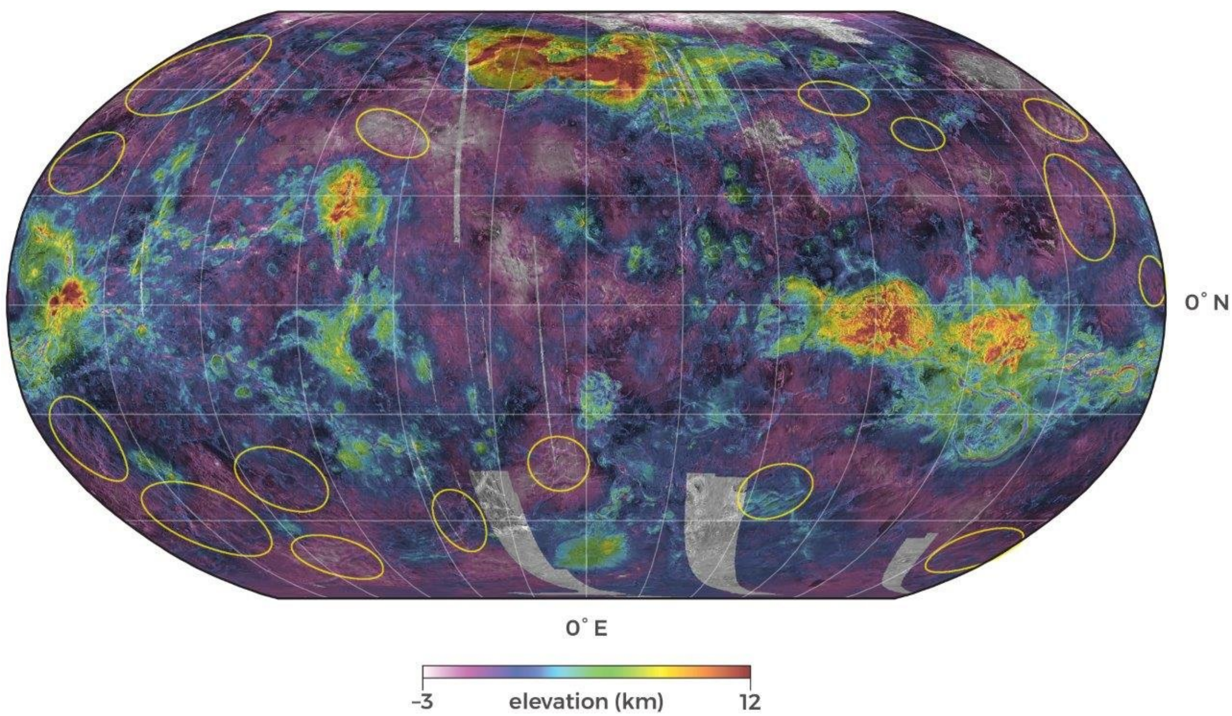
Lava-filled blocks on Venus may indicate geological activity

December 18 2017, by Jeremy Rehm



Global elevational view of Venus with locations of tectonic blocks circled around the poles. The global regularity and distribution of these blocks possibly indicate the presence of a global systematic geologic process. Credit: Paul Byrne

For planetary scientists, Venus's geologic heartbeat flat-lined around 700 million years ago.

Now, a global view of some well-known deformation features on

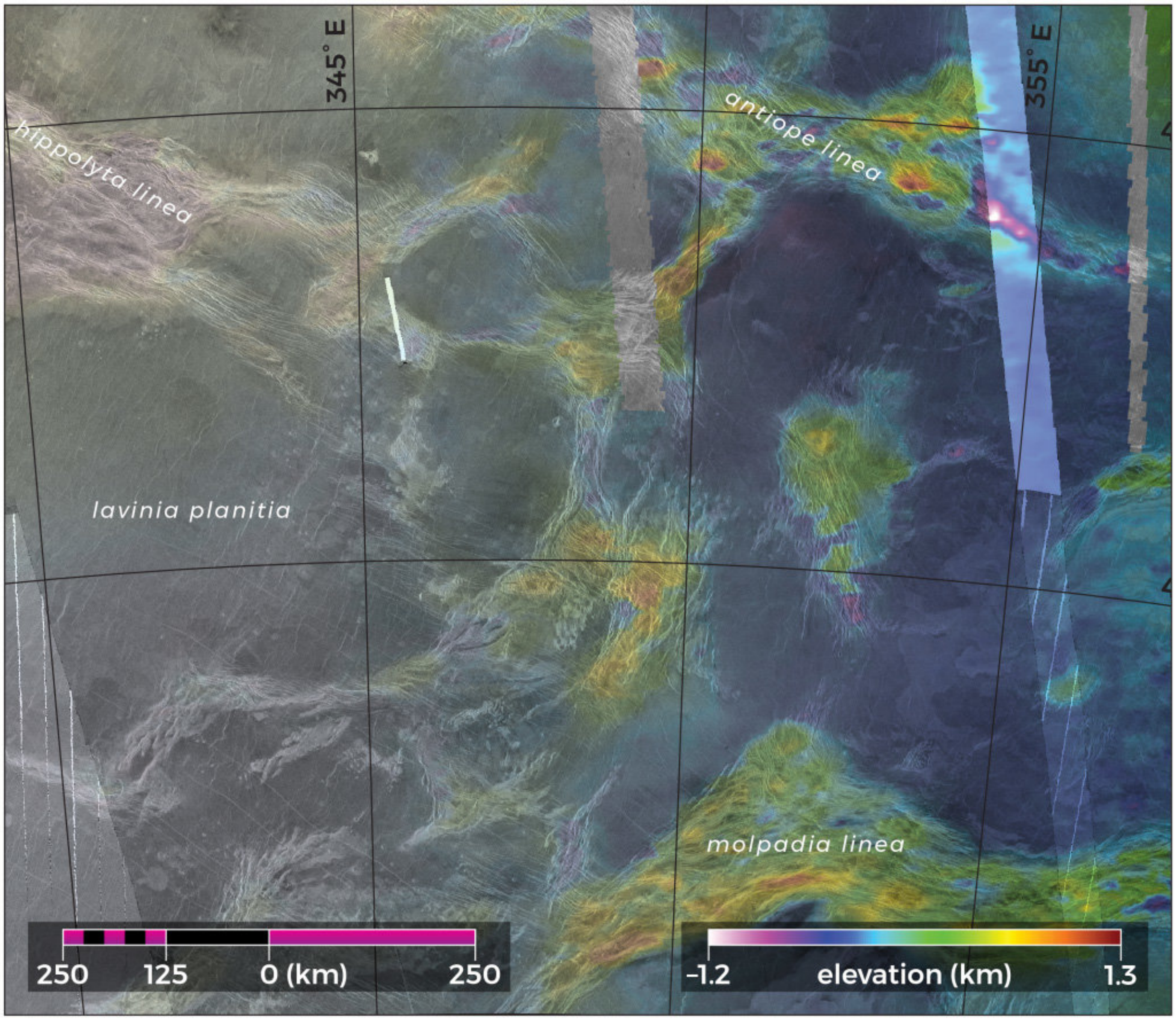
Venus's surface may indicate it's capable of crustal motion, and that motion might even be happening today, scientists reported Monday at the 2017 American Geophysical Union Fall Meeting in New Orleans.

Scattered on Venus's surface are various narrow mountain ridges and surface grooves, or grabens. Scientists have known about these Venusian features for decades, but had only viewed them in isolation from one another.

Paul Byrne, a planetary geologist at North Carolina State University who presented the new research, and his colleagues used radar images of Venus's surface from the Magellan mission between 1990 and 1994 to view these structures from a global perspective. Doing so revealed a new pattern: these mountain ridges and grabens converge to isolate blocks of flat, low-lying plains of cooled lava along the planet's poles, something never noticed before.

"When you zoom out, you see that these features form a connected pattern," Byrne said. "That's when you realize that they seem to be working together."

From this higher vantage point, the structures looked a lot like features seen on Earth, such as the Tarim Basin in northwestern China. Basins like Tarim are large pieces of continental crust that jostle, rotate and crash into surrounding terrain due to forces from the mantle below. Consequently, the basins deform the surrounding terrain into mountain ranges or grabens—features identical to those on Venus.



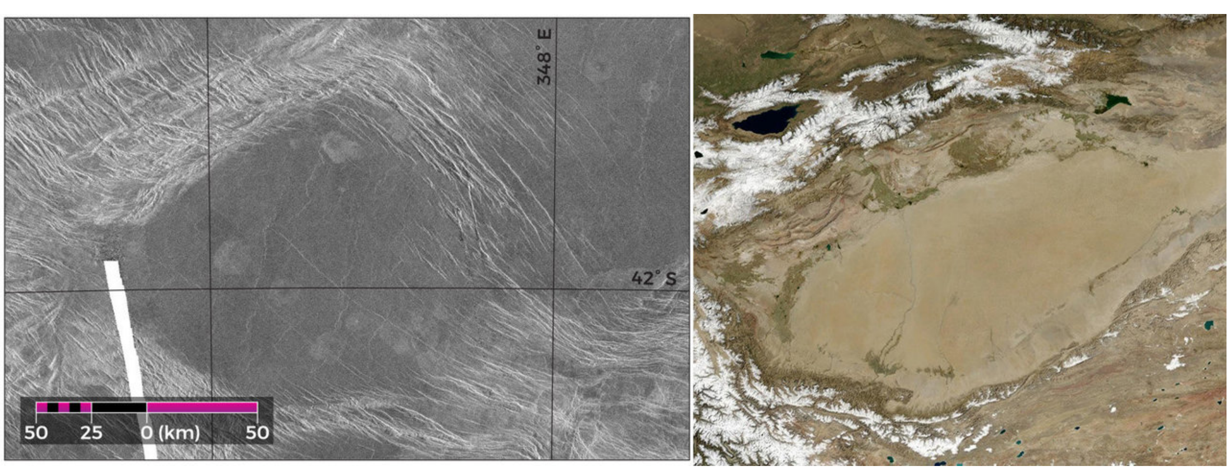
Examples of low-lying tectonic blocks outlined by mountain ridges and/or grabens formed by compression and extension of the planet's surface. Credit: Paul Byrne

That uncanny similarity persuaded the team that a comparable process may be happening on Venus. With the scorching 462-degree Celsius (864-degree Fahrenheit) temperature at Venus's surface, Byrne and his colleagues estimate the crust could heat enough that it will slightly detach from the planet's mantle only 10-15 kilometers (6-9 miles) down, creating thin, "crustal blocks" that could jostle, crash and rotate just like those on Earth.

"It's not plate tectonics," Byrne said, "but it does suggest that the outer, rigid, brittle surface layer of Venus, in some places at least, has broken into these small blocks," many of them only a couple hundred kilometers to as many as 1200 kilometers (745 miles) across.

What excited Byrne the most were signs of deformation within a few of the lava plains. The presence of any deformation atop the young lava—a meager 700 million years old—indicates "at least some of the jostling and moving and rotating could have taken place very recently," he said. For a planet theorized to have had no activity in millions of years, that prospect seemed revolutionary.

Byrne compared this jostling process to the three layers in a Mars Bar: Venus's thin upper crust as the chocolate, its more fluid mantle as the caramel, and its deeper core as the nougat. If you put your Mars Bar into the fridge, pull it out, and try to break it, each layer breaks in its own way. The thin chocolate "crust" breaks into discrete chunks, whereas the caramel goes "all flowy."



Comparison between enclosed lava plains on Venus (left) and the Tarim Basin in China (right). The similarity between the two offers insight about block tectonics on Venus. Credit: NASA

"That's essentially what characterizes the mechanical behavior of this stuff," Byrne said.

But what could cause these tumultuous blocks to jostle in the first place? And why only at the poles?

Byrne could only conjecture, but he suspects one possibility is very slow convective movement in the mantle. With the thin crust at the surface sitting only tens of kilometers above the mantle, convective motion could slowly push or drag surface chunks along. But because an enormous spreading rift also exists around the equator of Venus, it's possible that a global spreading process systematically pushes these blocks, causing them to jostle and deform.

"Again, it's not plate tectonics," Byrne emphasized. "These are little chunks of land that just rotate and move around. But if we were to put seismometers on Venus, maybe you'd hear some of these chunks go off today."

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