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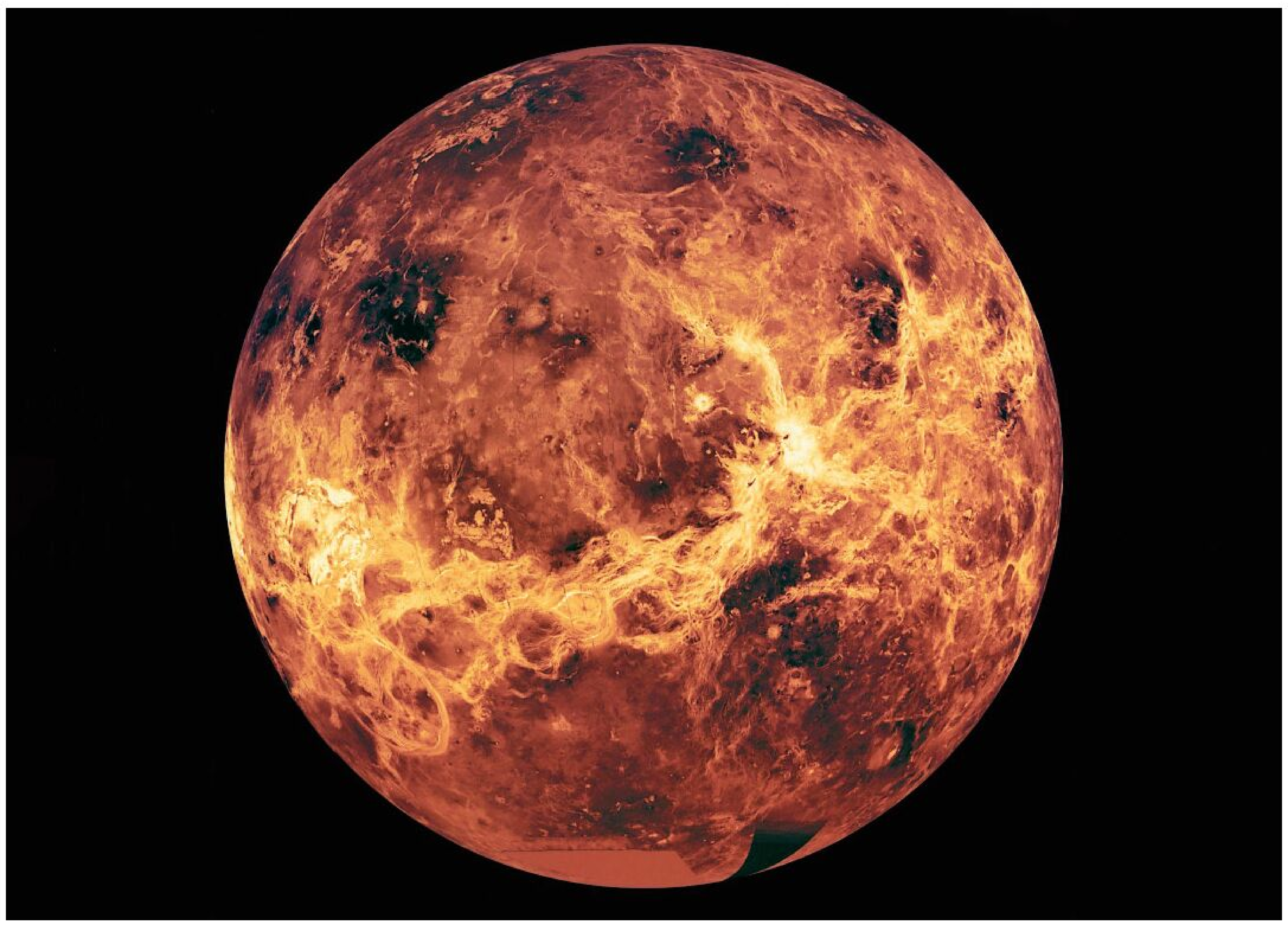
Solar system

Venus has lava tubes, and they're a bit weird

Alex Wilkins



JSC/NASA

A computer-simulated global map shows volcanic activity on Venus's surface

WE NOW know that massive underground tunnels, carved by lava, exist on Venus – and they are surprisingly wide and different from those on any other planet.

Lava tubes – tunnels carved out by molten rock – exist on Earth, the moon and Mars. Smaller planets with low gravity tend to form more cavernous tubes, in part because the rock walls are less likely to collapse with weaker gravity.

Scientists had seen hints of these lava tubes on Venus, from holes and pits that appear to have formed on its surface, but it was unclear whether these were caused by lava tubes beneath them or by other geological processes, such as from an active fault line.

Now, Barbara De Toffoli at the University of Padova in Italy and her colleagues have found direct evidence of lava tubes on Venus. They also appear to be surprisingly wide and of a comparable volume to those on the moon, despite Venus being more like Earth in terms of its mass and gravity.

"Earth lava tubes have smaller volumes, Mars tubes have slightly bigger volumes, and then the moon's tubes have even bigger volumes – and then there's Venus, completely disrupting this trend, displaying very, very big tube volumes," De Toffoli told the Europlanet Science Congress in Helsinki, Finland, in September. "This is already giving away the fact that there's likely something more on Venus playing a significant role."

Using radar and mapping data from past missions, De Toffoli and her team analysed how these pits lined up and were arranged near large volcanoes. They found four clear examples that didn't have any other geological explanation. The pits also lined up with the steepest part of the volcanoes' slopes, which is the direction the lava would have travelled, and the ratio of their depth and width was consistent with other known lava tubes.

The tubes' unexpected size suggests that the extreme Venusian environment might affect how molten rock moves under its surface, said De Toffoli, and isn't just dependent on gravity like lava tubes on other planets. ▮

Neuroscience

Mapping a brain doesn't reveal all its secrets

Karmela Padavic-Callaghan

IF WE can fully map the structure of our brains, will we be able to understand how they work? That is the goal of researchers attempting to build a wiring diagram, or connectome, of our neural pathways – but now it seems uncovering the secrets of the brain may not be so simple.

You can think of the connectome as a map of all the possible roads along which neural signals can travel. But now Sophie Dvali at Princeton University and her colleagues have discovered that some of these roads are underused.

The researchers looked at the connectome of the nematode worm *Caenorhabditis elegans*, and compared it with a record of the worm's neural signals, which they assembled by stimulating each neuron and tracking how the signal it emitted moved through the connectome. This is possible in the worm because it has only around 300 neurons in its entire nervous system.

By treating the two datasets as mathematical networks, the team could determine whether groups of neurons that are very densely interconnected in the connectome also tend to exchange a large number of signals. They found that this isn't always the case (*PRX Life*, doi.org/p658).

"Neurons are known to communicate in ways beyond the 'wires' that connect them"

Dvali says that there were some examples of overlap for high connection density and signal exchange, such as for groups of neurons responsible for how the worm eats, where the two networks matched really well, or neurons involved in how it moves backwards, an important manoeuvre for a worm escaping danger. In the latter case, the neurons were very connected in both networks though not in an identical way. But, more generally, there were enough discrepancies that the team says the connectome of an organism isn't enough to predict all of its behaviour.

Taking the scenic route

Team member Andrew Leifer, also at Princeton University, says that the difference may be because signals between neurons don't always take the shortest path, and there are also known cases where neurons can communicate in ways beyond the "wires" that connect them. "We're used to using the connectome for guiding our research, and often it's very helpful and informative, but in many cases there's so many connections that we wished we had more information," he says.

"Connectomics data is often criticised as, 'Oh, you get only structure. You don't get behaviour.' And this paper is really probing that question to what degree we can [connect the two]," says Albert-László Barabási at Northeastern University in Massachusetts.

Next, the researchers want to expand their study to account for how signals spread through the connectome when multiple neurons get stimulated simultaneously, and to look at more complex animals like a fruit fly larva, which has the largest whole-brain connectome described to date. "We are under a revolution right now of mapping out the brain," says Barabási. ▮