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Window for life on Venus narrows to first billion years after it formed

Jason Arunn Murugesu

VENUS may have been habitable for close to a billion years – far less time than previously thought, but still long enough for life to evolve.

The planet's atmosphere is mainly made up of carbon dioxide and its surface is too hot for liquid water. Dennis Höning at VU Amsterdam in the Netherlands and his colleagues modelled how Venus may have developed its atmosphere.

Previous research has indicated that it could have been habitable for 2 to 3 billion years, but didn't account for the planet's lack of plate tectonics. "We've never seen evidence of plate tectonics on Venus," says Höning. The new calculations including this detail suggest this viable period was during Venus's first 900 million years. That is still long enough for life to evolve – though it probably isn't sufficient time for complex life to develop in the way it did on Earth, says Höning.

Key to this model is that when Venus was born 4.5 billion years ago, the sun would have been a lot dimmer. As such, it would have been easier to maintain

liquid water on the planet's surface, says Höning.

Using their model, he and his team found that any such water would have reacted with the CO₂ released into the atmosphere by volcanic eruptions. This would have produced carbonic acid, which would have dissolved silicate rock, helping to capture CO₂ in rocks as carbonates. Unlike on Earth, which has plate tectonics,

Venus has no signs of plate tectonics beneath its thick atmosphere

these carbonates wouldn't have been recycled back into the planet's mantle and would have instead continued to build up.

The hotter these carbonates got as they were buried deeper by successive volcanic flows, the more unstable they would have become, releasing CO₂ through the cracks in the surface. This would have set off a strong greenhouse effect, leading even more of Venus's rocks to release CO₂ and resulting in the environment we see on Venus today (arxiv.org/abs/2109.08756).

"Nine hundred million years is less than a third of some of the more optimistic estimates for how long Venus may have been habitable," says Richard Ghail at Royal Holloway, University of London. He says this is important because there are three missions to Venus in the works that will map the planet's surface and analyse its atmosphere to determine whether Venus really did once have water. "The longer it was [habitable], the better the chances that these missions will find evidence of those past wet environments."

But Helmut Lammer at the Austrian Academy of Sciences in Graz says he is still sceptical that Venus was ever habitable. "The atmosphere on Earth for the first billion years wasn't stable due to extreme UV radiation from the sun," he says. He argues that shortly after it formed, Venus would have received more than double the UV radiation that Earth did, forcing the atmosphere to expand and eventually dissipate, making it less likely that the team's model is accurate. ■



NASA/JPL-CALTECH

Neuroscience

Books in childhood home provide brain boost in later life

CHILDREN who grow up in homes filled with books tend to have less cognitive decline when they reach old age, even when taking factors such as wealth into account. The finding suggests that early cognitive enrichment has long-lasting protective effects on the brain.

Ella Cohn-Schwartz at Ben-Gurion University of the Negev in Israel and her colleagues analysed data from more than 8000 men

and women aged 65 and older without Alzheimer's disease in 16 European countries, who had taken memory tests in 2011 and 2013 as part of the Survey of Health, Ageing and Retirement in Europe.

Participants were asked to recall roughly how many books their family homes contained when they were children: none, a shelf (about 25 books), one bookcase (about 100 books), two bookcases or more.

Those who grew up with larger book collections performed better in the tests. They also showed slower cognitive decline, with a smaller dip in their test scores between 2011

and 2013 (*Dementia and Geriatric Cognitive Disorders*, doi.org/gxfp).

This may be because their early book exposure encouraged them to read more, which in turn boosted their "cognitive reserve", says Cohn-Schwartz. Intellectually stimulating activities like reading are known to create extra connections in the brain that buffer it against degenerative processes like those seen in Alzheimer's disease.

"Intellectually stimulating activities like reading are known to create extra connections in the brain"

"It's highly likely they built that buffer in the early stages of their childhood that has lasted them the distance," says Ralph Martins at Edith Cowan University in Perth, Australia.

The findings persisted when the team used statistical techniques to adjust for the participants' wealth, education, physical health and other factors. This suggests that large home libraries aren't just a marker of having more money, which could protect the brain in a variety of ways, such as through better nutrition, says Cohn-Schwartz. ■

Alice Klein