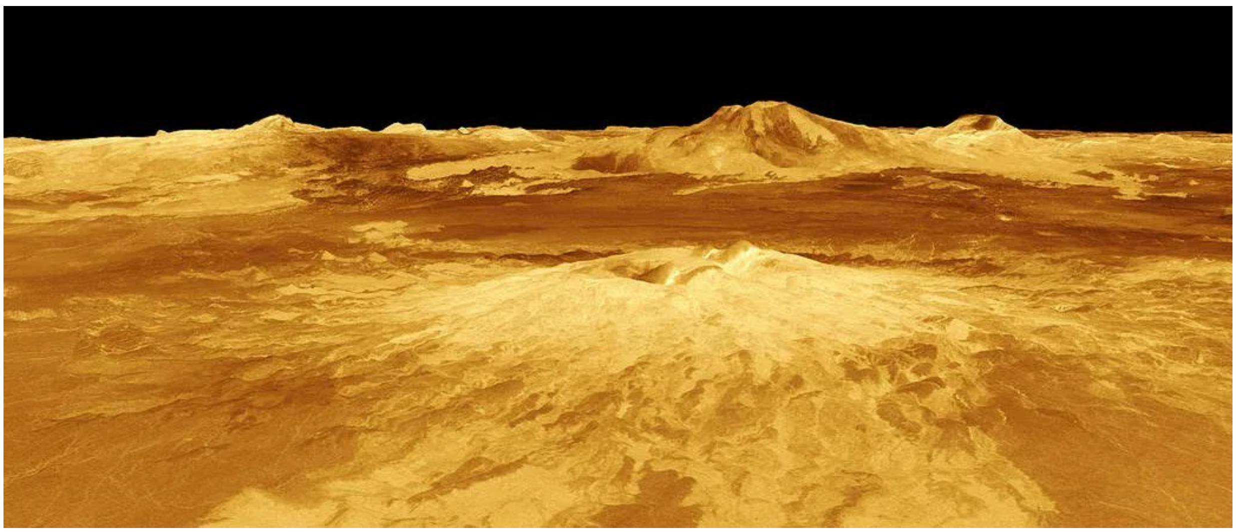
A private mission to scan the cloud tops of Venus for evidence of life

January 26 2022, by Andy Tomaswick



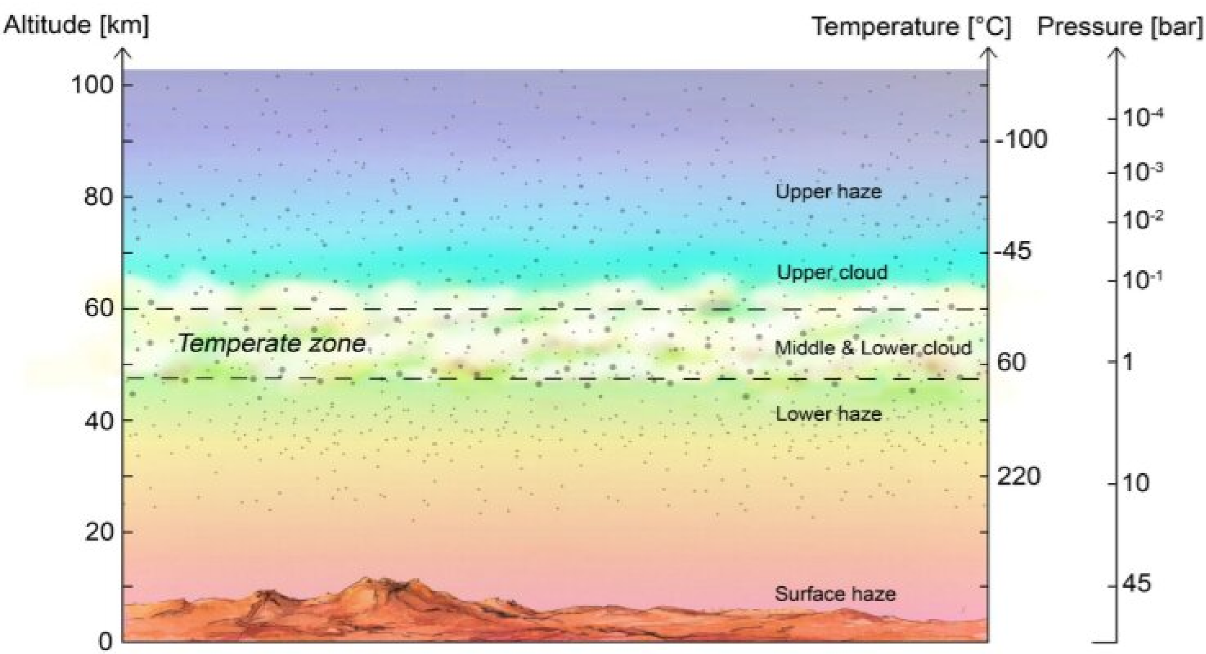
Computer-generated model of Sapas Mons on Venus. Credit: NASA / JPL

The search for life on Venus has a fascinating history. Carl Sagan famously and sarcastically said there were obviously dinosaurs there since a thick haze we couldn't see through covered the surface. More recently, evidence has pointed to a more nuanced idea of how life could evolve on our sister planet. A recent announcement of phosphine in the Venusian atmosphere caused quite a stir in the research community and numerous denials from other research groups. But science moves on, and now, some of the researchers involved in the phosphine finding have come up with a series of small missions that will help settle the question more thoroughly—by directly sampling Venus' atmosphere for the first time in almost 40 years.

Several interesting findings and important questions have cropped up in the absence of any current data. Venus is commonly depicted as a hellscape of sulfuric acid where any living thing would be instantly melted, either by the acid itself or by the extremely high temperatures and pressures present on the planet's surface. But parts of its atmosphere have temperatures and pressures similar to Earth.

That is not to say that life as we know it would thrive there. Those atmospheric regions are extraordinarily arid—about 50 times drier than the Atacama desert, the driest place on Earth. And they have an abundance of sulfuric acid, which most life has a hard time dealing with.

Still, there have been intriguing findings from various sources that hint at the many unknowns of the Venusian atmosphere. Both Vega and Venera, two missions that sampled the atmosphere decades ago, found non-volatile chemicals that life needs to exist present in the cloud layer. Also, there is an unknown "UV absorber" in the atmosphere that somehow captures about 50% of the solar energy that is hitting the planet.



Graphic depicting the various zone of Venus' atmosphere. Credit: Seager, et al.

A novel type of particle could explain that UV absorption. Known as "Mode 3" in scientific circles, it was found in the lower reaches of the atmosphere. While not much is known about these particles, they were not spherical and not comprised of any liquid. Certain types of bacteria and organic compounds have the same absorption pattern found in the absorption of UV light. There is still a lot we have to learn about the processes of the Venusian atmosphere—primarily due to a lack of data.

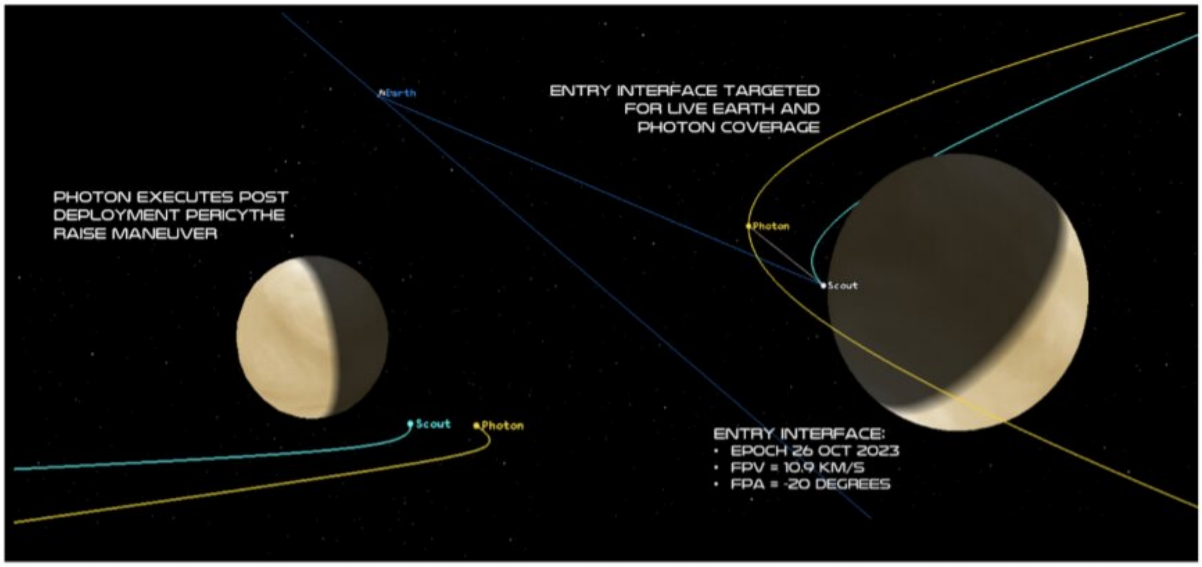
Given the current lack of data, scientists have also turned to models to find if there was some pattern of life that could exist in the Venusian cloud layers. The answer was a resounding yes, with one of three options available for dealing with the incredible amount of sulfuric acid.

A completely novel type of life could use sulfuric acid as a solvent, similar to how Earth-based life uses water. Alternatively, water-based life could protect itself with a protective shell. Some researchers were already able to encourage Earth-based life to develop a protective lipid layer that would insulate it from the sulfuric acid. Finally, life could have evolved to emit a neutralizing compound such as NH_3 to eliminate the local effects of the sulfuric acid around it.

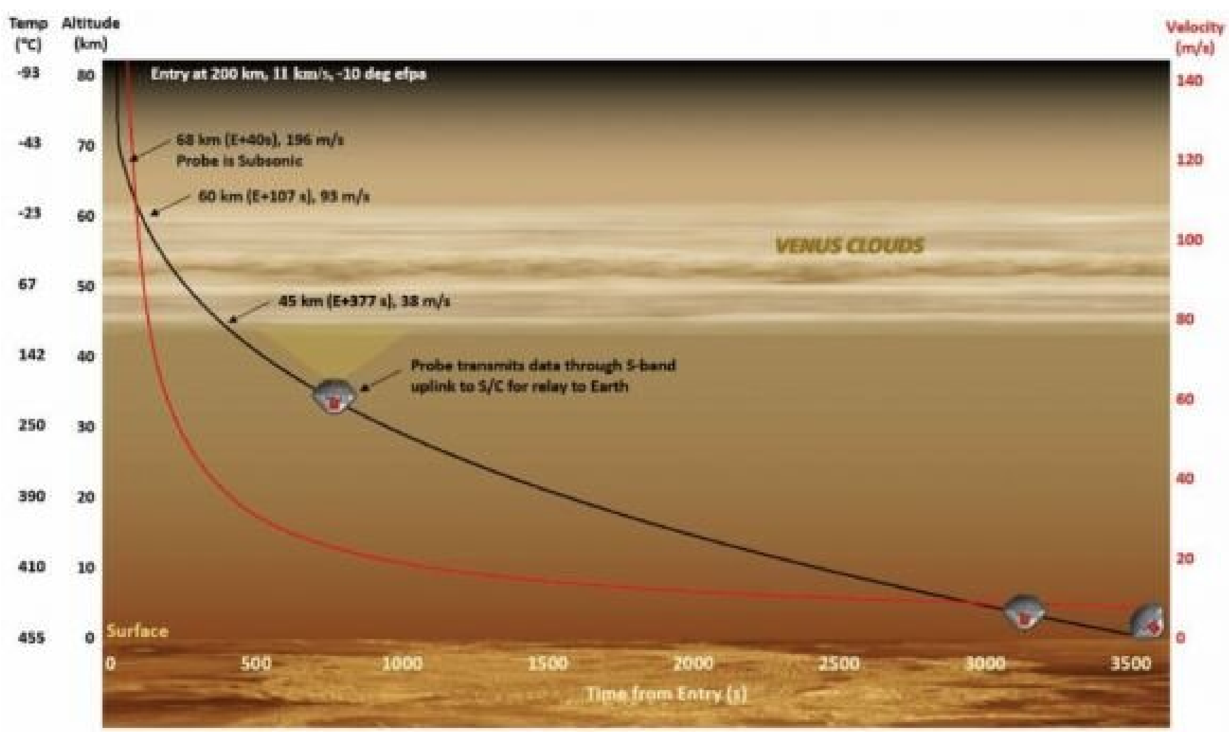
All these theories are fascinating, and all would be disprovable with more data on the atmosphere, which is where the Venus Life Finder (VLF) mission comes in. Rapid advancements in satellite technology have enabled the development of CubeSats—relatively inexpensive, easy to build (and reproduce) incredibly light satellites, and therefore easy to launch into space. Though their payload capacity is limited, they can hold one, or sometimes two, instruments to study a specific phenomenon. Since they are so inexpensive, it is possible to launch multiple missions with different instrumentation and mission objectives.

That is the path this new mission is going. Even more intriguingly, it is not sponsored by any state-funded space agency but by the Breakthrough Initiatives program, a nonprofit research organization founded by billionaire Yuri Milner.

The first of these missions would launch a 50-lb probe with a laser 38 million miles to ride through Venus' atmosphere for three minutes. During those three minutes, it will use an instrument called an autofluorescing nephelometer to detect whether any molecules light up when hit with a laser beam. Many organic molecules do so, so any indication of any fluorescence happening during its trip through the atmosphere would be fascinating, according to project scientist and MIT professor Sara Seager.



Graphic showing the orbit of the orbit and prove for the VLF mission. Credit: Seager et al.



Graphic depicting how the probe entry for the first phase would go. Credit: Seager, et al.

Whatever the result of the first mission might be, it will feed into a second, larger mission that will use a balloon to float through the atmosphere for several weeks and send a series of probes down through the atmosphere at different spots to try to get as many diverse samples as possible. If enough intriguing evidence is found as part of the first two missions, an ambitious, much larger, third mission would sample some of Venus' atmosphere and return it to Earth for further, fuller analysis.

This phased approach, with increasing cost and complexity as more data is collected to answer a specific question, is a potentially game-changing approach to planetary research. Instead of betting hundreds of millions of dollars on a complex system that a single point of failure can completely destroy, take smaller shots to collect increasing amounts of data that can be used to prove or disprove a theory.

Maybe some of the larger space agencies will begin to adopt such an approach. Still, for now, Venus is about to enter a golden age of exploration with three missions from NASA and ESA focused solely on it. While none will directly sample Venus' atmosphere, DAVINCI+, Veritas, and Envision will undoubtedly bring more attention to the planet, increasing interest in private missions life VLF.

Another advantage of smaller satellites is that they can be developed relatively quickly. The planned launch of the mission's first phase is in 2023, with the follow-up balloon mission ready to launch in 2026. None of these plans are finalized yet, but if they are funded for the first time in almost four decades, we will begin to see data on Venus' atmosphere directly—and it might hold some astonishing results.

More information: Sara Seager et al, Venus Life Finder Mission Study. arXiv:2112.05153v1 [astro-ph.IM], arxiv.org/abs/2112.05153

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