Cloud layer habitability of Venus. There may be life on it. A.T Pelawatta. Rajarata University of Sri Lanka, (pelewattaanuhansi99@gmail.com).

Introduction: Venus is the twin sister of earth that remind the name of the love goddess of the ancient Greek civilization. It is one of the terrestrial (rocky) planets and situated as the second planet from the distance of sun. There are some similarities between Earth and Venus. Both of them are more or less similar in their size, density and chemical components etc. Venus has a harsh geological background with 475 degrees of Celsius average surface temperature and thousands of volcanos. Some volcanos are still in active stage [5][6].

Venusian atmosphere is thick and toxic one that filled with carbon dioxide gas and yellowish sulfuric acid cloud layers [6]. It’s atmosphere continuously covered with this cloud layers and because of this reason, the surface gets fever solar rays. This atmosphere divided for five layers. They are, lower haze layer, lower cloud layer, middle cloud layer, upper cloud layer and upper haze layer.

![Image of Venus atmosphere](https://www.researchgate.net/figure/Venus-atmosphere-showing-the-increase-of-temperature-as-altitude-decreases-with-the_fig1_269127628)

Figure 1. The atmosphere of Venus. It shows the lower haze layer, three cloud layers (lower, middle and upper) and upper haze layer. From: https://www.researchgate.net/figure/Venus-atmosphere-showing-the-increase-of-temperature-as-altitude-decreases-with-the_fig1_269127628

Venus is one of the important astrobiological targets because of its ability to give some answers for the unsolved problems regard the origin of life and the evolution of the life on earth. Study of Venus is important because we can get a proper idea about the inner habitable zone region of solar system. Also, there are some unsolved questions such as why the Earth and Venus are so different? What are the interactions between atmosphere and the surface of the Venus and is it affect on the life of the Venus and if there is a life, how those interactions affect for this life? etc. [1].

When scientists observe the Venusian atmosphere, they discovered that at the top of the Venusian clouds has some unnatural dark streaks. Those dark streaks show an odd habit to absorbed ultraviolet radiations. Scientists suggested two possible suggestions for describe this observation:[6]

1. They may be ice crystals or some inorganic compounds such as iron chloride.[6]
2. These fine particles should be microbial life that survived on Venusian clouds [6].

Also, astrobiologists have noted that some ring-shaped aggregations between Sulphur atoms and those structures are able to provide microbes with some kind of shield.

Before billion years ago, Venus might have been an ocean world with surface water [6][1]. But present day it is a dry planet with huge active volcanos and didn’t discover surface water yet. Surface water of the Venus has turned into vapor and leaked to the space because of the greenhouse effect or some unknown reason. However, if there was enough surface water, there might be a probability of the existence of the life on Venus.[1]

Only the surface water is not enough for the origin of life on a planet. It needs some requirements such as necessity elements, energy source and fluctuation. Venus contain with sufficient elements like C, H, O, N and as an energy source and fluctuation there are active volcanos.[1]

So, the life on Venus might have originated in the presence of surface liquid water and probably it should be a microbial life. when the liquid water turns to vapor, that microbial life may be migrated to some suitable place where they can survive. Most of the time, it should be the Venusian atmosphere and sometimes this life may be extant or still alive with long time hibernation or active stage.

Lower cloud layer of Venusian atmosphere is one major target for studying the life, because of its favorable conditions for some kind of microbial life. the moderate temperature (∼ 60 degrees of Celsius), pressure (∼1 atm), very low pH (pH < 0.5) and microne size of aerosols gives a sign of the microbial life on Venusian cloud system.[3][1]
If there are any microbial life on Venusian cloud system, they should be depending on the available water, carbon and sufficient elements. Because of the anerobic atmosphere, those life probably would be an anaerobic life. Phototrophic reduction of the atmospheric carbon dioxide gas would be the major source of the acquire of carbon and the ultraviolet radiation provides the driving energy source for the life.[3]

According to the reports of VeGa 1 and 2 missions, both phosphorous and Sulphur have been detected [3]. Partially hydrated phosphoric anhydrate may be the most abundance phosphorous compound of the Venusian lower cloud system. Aerosol aqueous sulfuric acid (75% to 98% and pH =0.5 to 1.5) also can be observed between 48 km to 60 km of the atmosphere.[3]

Several types of terrestrial microbes on earth can survive in very marginal environments that similar to the Venus’s atmosphere with high sulfuric acid concentration, anaerobic and with ferrous ions. On Earth, some microbes can survive in the high altitudes of the atmosphere. (15 km to 42 km).[3]

As an example, we can consider the Acidithiobacillus ferroxidans. It is a chemolithoautotrophic and acidophilic γ protobacterium. It can survive on extremely low pH range (pH = 1-2) and capable of survive in high temperature (50-60 degrees of Celsius). Also, A. ferroxidans is capable to produce sulfuric acid.[2]

So, according to the information that scientists has discovered, Venusian cloud system show habitability for a microbial life and there may be a possibility of microbial life on Venusian cloud layers.

https://solarsystem.nasa.gov/planets/venus/overview/
[6] In depth of Venus. NASA solar system exploration (update;3rd August 2021)
https://solarsystem.nasa.gov/planets/venus/in-depth/