

Conversion of living matter to inanimate material as the method of detection of life signs: application to Venera-D mission.

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The currently available data on the physicochemical parameters in the cloud layer of Venus allow the existence of extremophilic microbial forms of the terrestrial type in this system. Despite the fact that there are indirect methods for detecting biomarkers such as identifying chemical components of presumably biological origin, only direct methods detecting the living activity in the samples can provide a reliable answer the question if life exist in there. In order to obtain evidence of the presence of the earth-type life in a sample, we propose to use a method based on the fact that biocidal processing of the samples under study, resulting in the destruction of living organisms, leads, at the same time, to reliable detection of their presence. As a result of biocidal treatment, cell membranes are destroyed and components of the cytoplasm of living organisms, such as proteins, protein-nucleic acid complexes, lipid complexes, vacuoles and other intracellular structures are released. Their release significantly shifts the ratio of fractions of various components in the test sample: after biocidal exposure, a significant amount of much smaller components appears. This difference in fractions of components of different weights is easily and reliably fixed using gravimetry and indicates the presence of whole cells in the original sample (Scheme).

With regard to Venus, the most important problem in detecting microbial forms that may inhabit its cloudy layer is the very low pH, at which many standard methods for determining biological activity require significant modification. Under such conditions, the use of simple and reliable gravimetric methods for the detection of solid components in the liquid phase of the test samples seems to be the most effective for the qualitative determination of biomarkers. The reliability of the gravimetric method for the determination of components has long been confirmed in numerous studies.

Based on our preliminary experiments, we propose the following bactericidal treatment methods for samples of the water phase of Venus clouds:

- destruction of cell walls by ultrasonic processing of aliquots;
- a sharp change in the level of acidity of the medium;
- decrease of the content of dissolved substances in the medium by dilution with sterile water;
- a sharp temperature shift. Any of these methods, when used in terrestrial conditions, leads to the destruction of membranes and microbial cell walls.

We propose the concept of an instrument set for detecting cellular forms in the clouds of Venus (installed on a research probe). Such detection complex should include a sampler, a biocidal action system and a gravimetric detector, as well as a system for preserving samples that have shown a positive result for further studies. To create an appropriate detecting device for astrobiology experiments, it is necessary to develop its version that successfully operates in a wide range of temperatures and at low pH values as well as to carry out a series of tests in various extreme terrestrial ecosystems.

