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Venera-D: expanding our horizon of terrestrial planet climate and geology through the comprehensive exploration of Venus

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Abstract

A joint NASA-IKI/Roscosmos Joint Science Definition Team (JSDT) was established in 2015. Within the overarching goal of understanding why Venus and Earth formed in the inner solar system from the same proto-planetary material took divergent evolutionary paths. The JSDT has the task of defining the science and architecture of a comprehensive Venera-D (Venera-Dolgozhivuschaya (long-lasting)) mission, aimed to study the atmosphere, surface, interior structure and solar wind interaction that would further our understanding of Venus as a system [1].

1. Venera-D science goals and mission concept

Venera-D investigations would address the dynamics of the atmosphere with emphasis on atmospheric superrotation, the origin and evolution of the atmosphere, and the geological processes that have formed and modified the surface with emphasis on the mineralogical and elemental composition of surface materials, and the chemical processes related to the interaction of the surface and the atmosphere and the solar wind interaction.
The JSDT recommends, as a baseline elements of mission, an orbiter and a VEGA-type lander with an attached 1- 2 long-lived small stations (Long-Lived In-Situ Solar System Explorer, or LLISSE) [2]. While the lander will survive for 2-3 hours, LLISSE is predicted to survive 2-3 months on the Venus surface. Additional breakthrough science could be achieved by augmenting with additional potential contributed elements: two more complex long duration (>120 days on the surface) seismic stations SAEVe (Venus Seismic and Atmospheric Exploration of Venus) [3]; a vertically maneuverable aerial platform/balloon (several weeks life time) and one or two sub-orbiters in the Lagrangian points L1 and L2 (from day side and night side respectively) or more LLISSEs.

2. Venera-D mission architecture

JSDT members from Lavochkin Association are leading the mission architecture development [4]. This assessment includes: (1) Development of the general configuration for both the orbiter and the lander; (2) Accommodation of systems and subsystems within the orbiter and lander; (3) Assessment of orbit options along with the strategy for descent and landing and long term observation of LLISSE; (4) Evaluation of telecommunication options from the spacecraft to Earth and from the lander and LLISSE to the orbiter; (5) Accommodation of the contributed elements in their own delivery systems. Resourses for launch dates between 2028 and 2031 have been evaluated.

3. Ongoing activities of the Venera-D JSDT

Phase II final report was published in January 2019 on sites NASA and IKI [5,6].The next phase (*Phase 3*) of development would focus on a deeper examination of the science and instruments of the baseline and augmented elements along with a more complete definition of the spacecraft requirements, assessment of data communications capability.The current JSDT extension to include pre-project engineers with expertise in telecom engineering, structural and thermal engineering, system engineering, and so on, is required.

Engagement of the broader science community is also required. Thus, Venera-D Joint Science Definition Team Workshop on potential landing sites and habitability in cloud layer is being planned for early October, 2019, in IKI, Moscow. Two workshops on Venus modeling were held in 2017: one at the NASA Glenn Research Center, and another at IKI in Moscow. Proceedings ("Venera-D Venus Modeling Workshop") are published in IKI (2018) and can be found online [7].

References

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