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FUTURE REQUIREMENTS AND SCIENCE HERITAGE OF VENUS ATMOSPHERIC COMPOSITION DATA

Abstract

From the sulfuric acid cloud layer and high altitude winds to the 470C surface ambient temperature and 92 atmospheres pressure, the Venus environment is characterized by extreme conditions and presents a major challenge to any mission to the planet. Orbiter and lander missions have helped uncover unanswered scientific questions and raised new ones with revelations such as significant changes in mesospheric sulphur dioxide indicators, dark lava surrounding volcanoes, and surface temperature variations suggesting volcanic activity. Indeed, in recent Venus exploration, significant new challenges have been raised, one of the most intriguing being the possibility of recent volcanism.

The atmospheric composition of Venus has been a major subject of interest in missions to the planet and is still considered one of the most engaging fields of study within the Venus scientific community. This paper presents an extensive compilation of the available data on the composition of the atmosphere of Venus and the instruments and mission requirements to continue this work.

The existing data is considerably limited by different parameters such as resolution, error margins, and even absence of existing measurements. This paper includes direct, remote and in situ data but also extrapolated and modelled data as reference for the lower atmosphere. The composition figures can be divided in four main categories: noble gases, reactive gases, noble and non-noble isotopes. They are presented with the respective measurements, error margins, techniques, altitudes, instruments, mission and references. This compilation brings to light the importance of obtaining in situ atmospheric data, such as proposed in the Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging (DAVINCI) mission proposal. While providing a comprehensive heritage of all available measurements to date, we present the needs of future missions to the planet. New missions are essential to pursue these findings and research to outline the state of geological activity on Venus and its relation to the atmosphere and, ultimately, uncover the reasons for the radically different evolution of Venus and Earth with higher resolution data.

In this paper, we will review all collected data on the atmospheric composition of Venus, the screening of new sources and data, as well as the discussion and analysis of the available measurements and the requirements for future missions.