Assessing the evidence for active volcanism on Venus: current limitations and prospects for future investigations

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Short summary (650 characters or less)

Venus, often called Earth's sister planet, is expected to be volcanically active due to its similar size and density. Confirming current volcanic activity has been challenging due to thick clouds and corrosive surface conditions. Recent hints suggest active volcanism, especially at Idunn Mons, Maat Mons, and Aramaiti Corona. New missions, combined with previous data, aim to provide better monitoring. Collaboration is essential to collect high-resolution imaging and topographical data to understand Venus's geological activity.

Abstract

Venus is often considered Earth's sister planet due to its similar size and density, and therefore, it is expected to be volcanically active. However, confirming current volcanic activity and its rate has remained elusive despite being a top scientific priority. Recent investigations have provided tantalizing hints of currently active or very recent volcanism. Confirmation of the level of activity is hindered by the thick, omnipresent, optically opaque clouds that obstruct traditional observations of the lower atmosphere and surface. Additionally, corrosive surface conditions pose challenges to long-term landed missions that aim to probe the interior or directly monitor volcanic activity. Despite these challenges, we are entering a new decade of Venus exploration with multiple orbital and probe missions. Here, we review what is known about active volcanism, identify gaps in knowledge to be addressed, and highlight techniques and approaches that need to be developed for this new decade of Venus exploration.

The best evidence for active volcanism comes from combining multiple data sets and approaches, rather than relying on a single study or data set. Venus is likely volcanically active today, with the strongest evidence for activity at Idunn Mons, Maat Mons, and Aramaiti Corona. Without global coverage and regular monitoring, the rate of volcanic activity remains unconstrained. The fleet of new missions, in combination with previous mission data, can be used to provide time-sequence data for monitoring. Our study shows that there are important caveats to combining and comparing data from different instruments. Specifically, differences in look angles and illumination conditions must be accounted for when comparing different datasets.

As we enter the decade of Venus exploration, these new missions must collaborate to collect repeat observations of high-resolution imaging, radar polarimetry, and high-resolution topographical data for any potentially active volcano. The ability to integrate these data is required for understanding Venus's geological activity, particularly in regions where volcanic processes are suspected to be ongoing.