

Understanding Divergent Evolution Among Earth-like Planets, the Case for Venus Exploration

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Venus was once considered to be Earth's twin because of its similar size, mass, and solar distance. Prevailing theories early in the 20th century alternately characterized it as a hot, lifeless desert or a cool, habitable swamp. Venus was therefore the target of intense scrutiny during the first three decades of the space age. Those studies found that although Venus and Earth apparently formed in similar parts of the solar nebula, sharing common inventories of refractory and volatile constituents, these two planets followed dramatically different evolutionary paths. While the Earth evolved into the only known oasis for life, Venus developed an almost unimaginably inhospitable environment for such an Earth-like planet. Some features of Venus can be understood as products of its location in the solar system, but other properties and processes governing the evolution and present state of its interior, surface, and climate remain mysterious or even contradictory. A more comprehensive understanding of these factors is clearly essential as NASA embarks on efforts to detect and then characterize Earth-like planets in other solar systems.

As part of the National Research Council's effort to identify themes and priorities for solar system exploration over the next decade, an open community panel was formed to provide input on future Venus exploration. A comprehensive investigation of the processes driving the divergent evolution of Venus is emerging as the primary focus. In other words, why is Venus a failed Earth? From this theme, we will define specific measurement objectives, instrument requirements, and mission requirements. Priorities will then be based on a number of factors including the needs for simultaneous or correlative measurements, technology readiness, and available opportunities.

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