



# Deep Atmosphere of Venus Investigation Of Noble Gases, Chemistry & Imaging Plus

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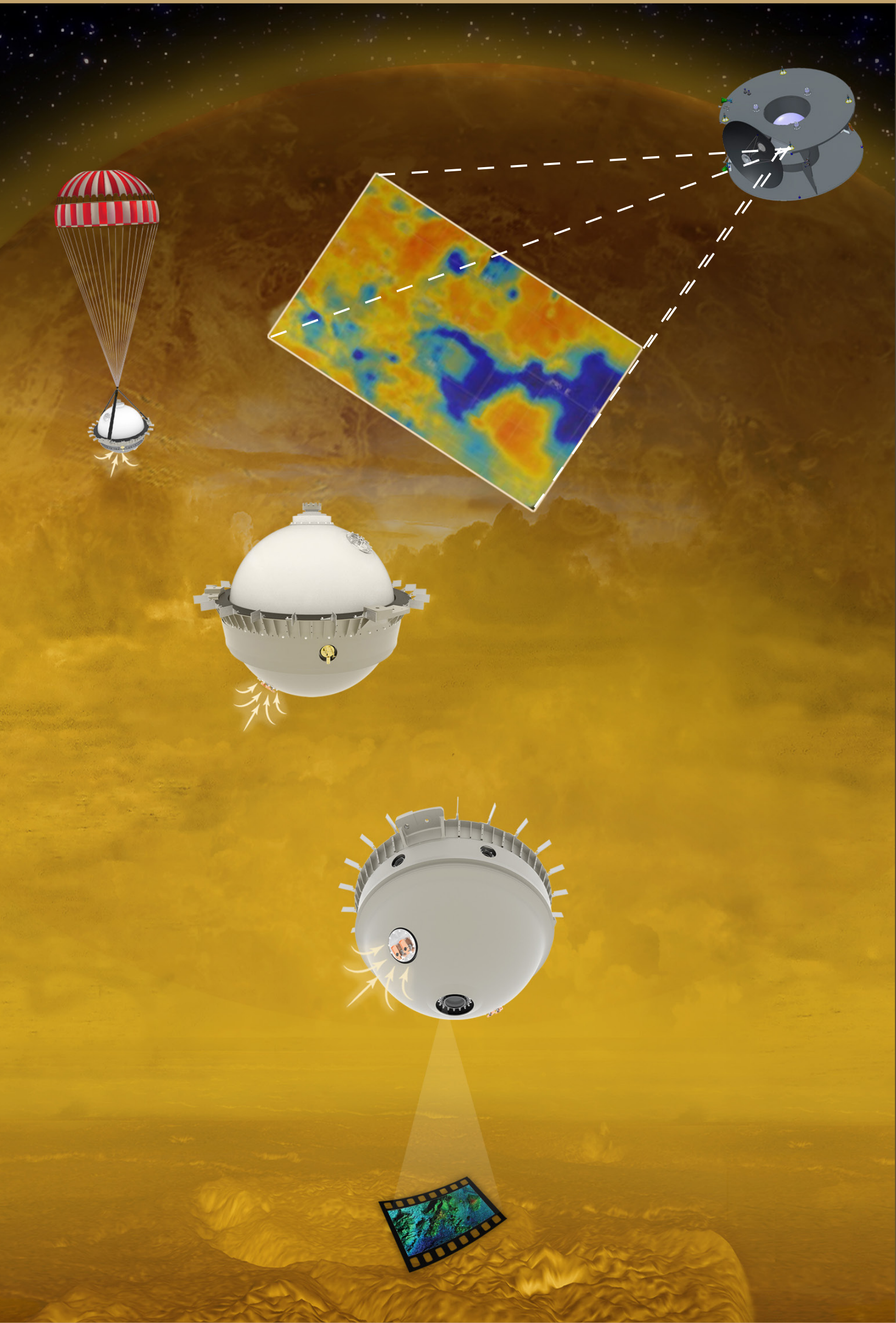
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## Introduction

DAVINCI+ IS INTENDED TO BE HUMANITY’S RETURN TO THE MASSIVE AND MYSTERIOUS ATMOSPHERE OF VENUS using the very best instruments developed over the past 20 years for planetary exploration. The DAVINCI+ mission concept incorporates multiple Venus flybys and an orbital remote sensing phase together with an hour-long probe-based transect of the entire Venus atmosphere to the surface, all within the resource envelopes of NASA’s Discovery program. This enhanced 2019 version of the previously developed DAVINCI mission concept has now been formally selected for Phase A study through the 2019 DISCOVERY mission competition. Here we describe its science motivation and connectivity to long-standing planetary science goals, questions of habitability within our own solar system, as well as those relevant to the astrophysical exploration of exoplanets.

## Mission Design

THE MISSION INCLUDES a spacecraft that carries a meter-diameter “chemistry/imaging probe” which will transit the entire atmosphere from top to bottom in about an hour, producing a first-ever dataset of chemistry measurements of a quality previously not possible in planetary sciences together with over one hundred descent images of the highlands of Venus some of which will be at scales as small as basketballs. The ensemble of measurements from the probe together with flyby and orbital remote sensing of the atmosphere and surface will allow the Science Community to connect Venus to other worlds in our solar system, as well as those that are being discovered around nearby stars.



## DAVINCI+ Mission Science Goals

DAVINCI+ addresses high level questions that are traceable to VEXAG and Planetary Decadal Study priorities

Atmospheric Origin & Evolution	What is the origin of the Venus atmosphere and how has it evolved?
	How and why is Venus different or similar to Earth, Mars, and analog exoplanets?
Atmospheric Composition & Surface Interaction	Was there an early ocean on Venus? If so, when and where did it go?
	What is the rate of volcanic activity on Venus?
Surface Properties	What exactly are the tesserae highlands, including origin and history?
	How do they compare with major highlands, such as Ishtar Terra?

PRIMARY SCIENCE GOALS and OBJECTIVES are intended to provide definitive boundary conditions for models that explain the Venus water inventory over time, volcanic activity, and the potential for past habitability, as well as how to evaluate Earth-sized exoplanets with atmospheres that could be observed with JWST and future exoplanet observatories.

2027 – Flyby Phase

2028 – Probe Descent

2029... – Orbital Phase



Carrier with Probe

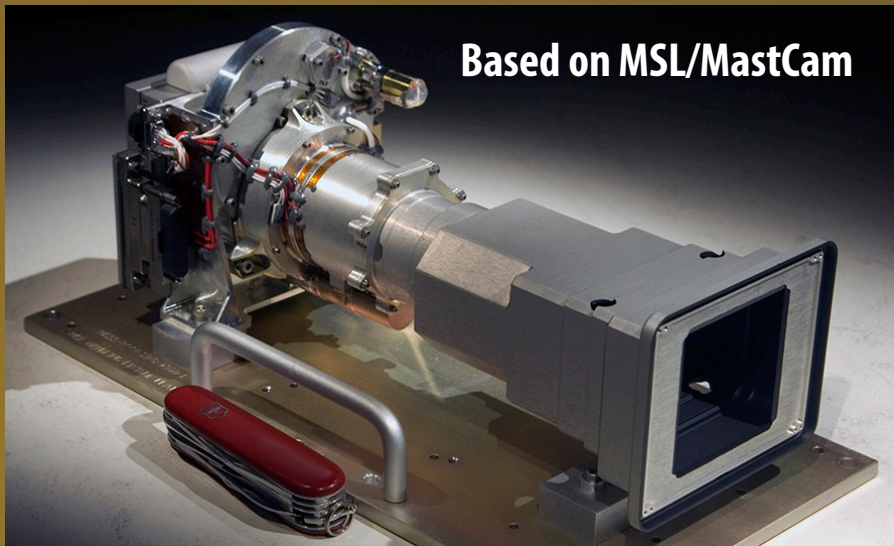


Orbit

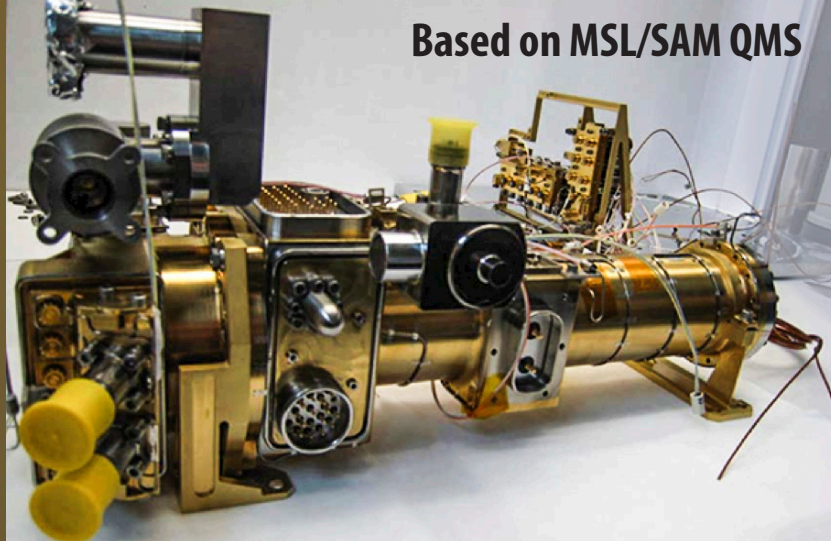
VASI (Venus Atmospheric Structure Investigation)



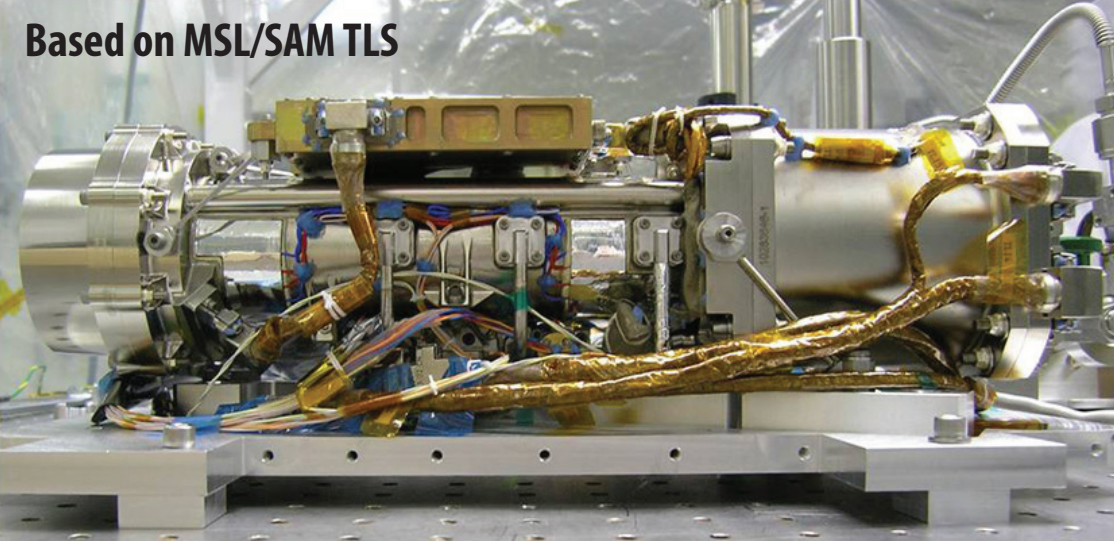
VenDi (Venus Descent Imager)



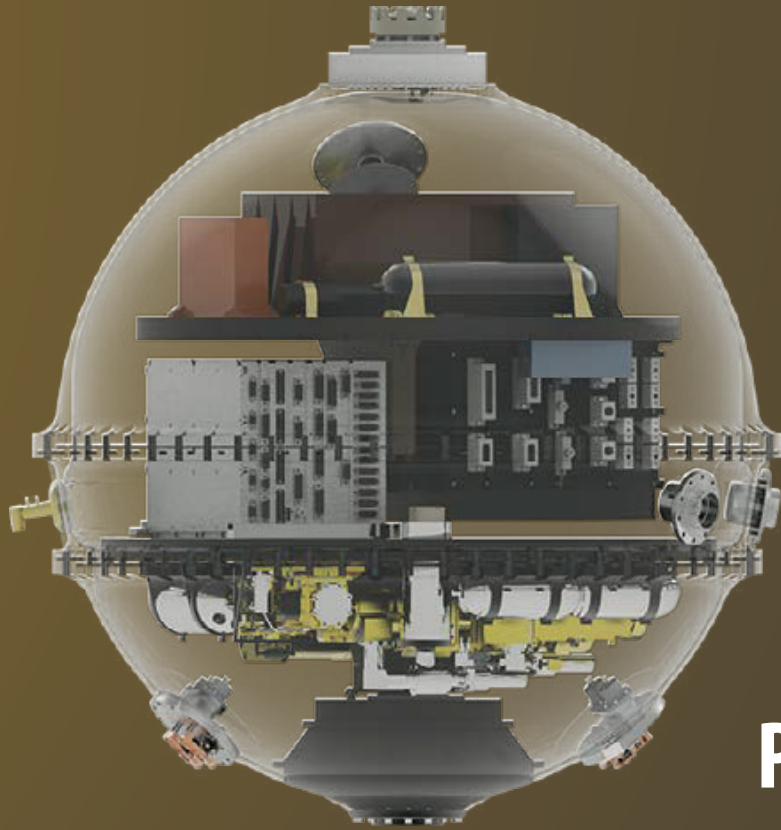
VMS (Venus Mass Spectrometer)



VTLS (Venus Tunable Laser Spectrometer)



Descent

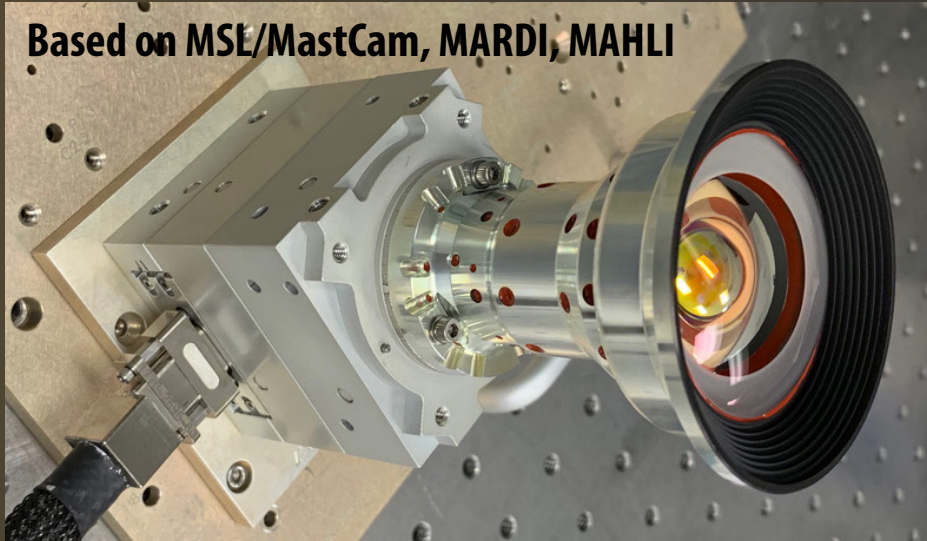


Probe

Orbiter



VISOR (Venus Imaging System from Orbit for Reconnaissance)



Major Partners: Lockheed-Martin • JPL • MSSS • LaRC • ARC • APL • KinetX • University of Michigan

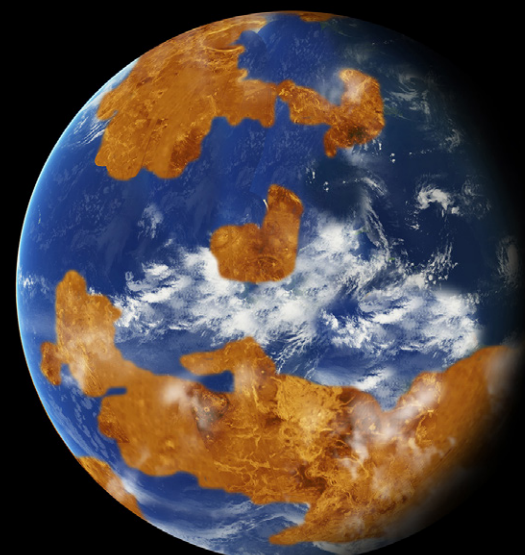
## Conclusions

DAVINCI+ is a first-of-a kind flyby-probe-orbiter mission to Venus

- Definitive noble gas isotopes in bulk atmosphere to fundamentally reveal the origin and evolution of Earth’s sister planet and provide a comparative context with Earth and Mars.
- History of water & how planetary habitability evolves, including for those planets beyond our solar system
- Ground-truth connection to remote observations of stratified and near-surface chemistry
- Insight into the atmospheric composition and evolution of Venus-like exoplanets for future modeling and observations

DAVINCI+ is ready to lead the return to our enigmatic sister planet, poised to emerge as an international, multi-mission human endeavor starting in the 2020s.

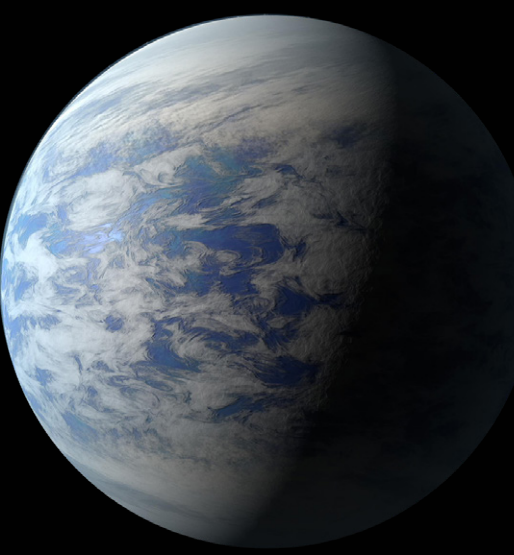
Ancient Oceans on Venus



Evolution of Planetary Habitability



Venus-like Exoplanets



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