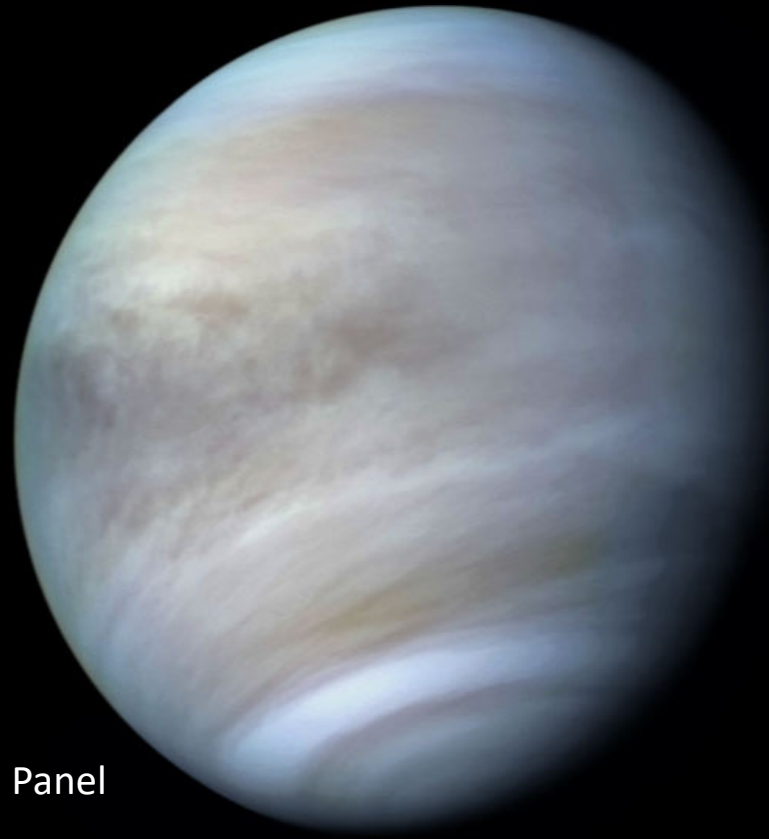


NASA Venus Missions



James L. Green
October 20, 2021

COSPAR Planetary Protection Panel

VERITAS

Venus Emissivity, Radio Science, InSAR,
Topography, & Spectroscopy

Science Goals

1 Rocky planet evolution

- 1a igneous rock type, surface-atmosphere interaction
- 1b ancient geologic processes
- 1c volcanic history
- 1d subduction, origins of plate tectonics

2 Active processes

Active and recent volcanism, tectonics?

3 Past and present water

- 3a continents from a wetter past?
- 3b current volcanic outgassing of water?

Mission Overview

Launch Date: 2028

Venus Orbit Insertion: TBD

3 years of science operations from orbit

>40 Tb of science data returned

PI: Sue Smrekar, JPL; Managed by JPL

What makes a rocky planet habitable?

*Like Earth, Venus started with all the
building blocks of a habitable world.*

How was habitability lost?

High-Resolution Global Reconnaissance

1. VISAR (Venus Interferometric Synthetic Aperture Radar)

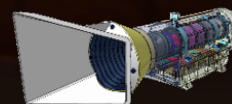
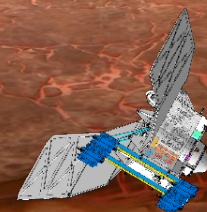
- Highest resolution global topography for terrestrial planets
- 1st planetary active deformation map
- Global data sets:
 - Topography: 250 m horiz, 5 m vertical
 - SAR imaging: 30 m
- Targeted data sets:
 - SAR imaging: 15 m
 - Surface deformation: 1.5 cm vertical

2. VEM (Venus Emissivity Mapper)

- 1st near-global map of igneous rock type, weathering
- 6 NIR surface bands with robust SNR
- 8 atmospheric bands for calibration / water vapor

3. Gravity Science Investigation

- 1st global maps of derived elastic thickness & core size

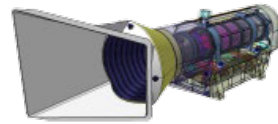
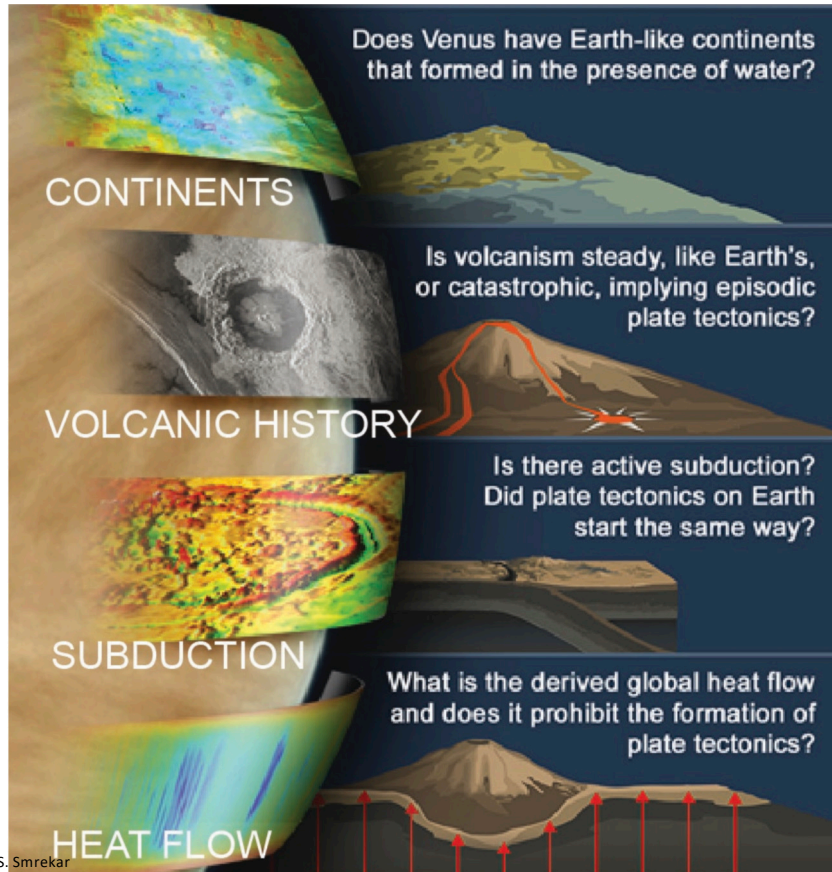




VERITAS

Venus Emissivity Radio science, InSAR, Topography And Spectroscopy

Payload



- **Venus Emissivity Mapper (VEM): DLR**
 - NIR multispectral imager for surface rock type, active and recent volcanism, and volcanically outgassed water



- **Venus Interferometric Synthetic Aperture Radar (VISAR): JPL/ASI**
 - Radar for geologic evolution, volcanism, tectonism, and active deformation

- **Gravity Science Investigation**
 - Uses two-way Ka-band telecom (ASI) to obtain elastic thickness and density variations, core size and state



Measurement Objectives

VISAR

Science Measurements:

Global DEM

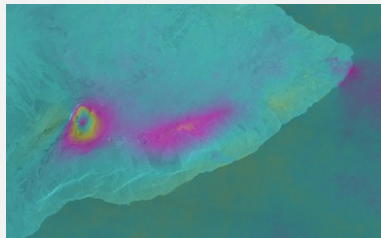
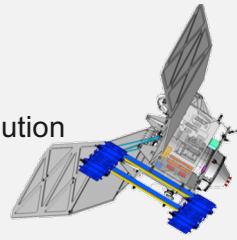
- 250 m horz, 5 m vert resolution

Global SAR Imaging

- 30 m resolution

Targeted imaging (27% of planet)

- 15 m resolution

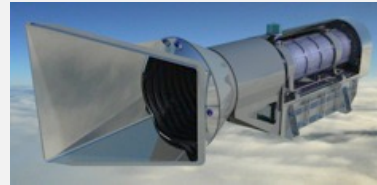


1st Interferometric Deformation Maps



Searching for Surface Change

VEM



Science Measurements:

- 6 surface bands, SNR > 150
- 8 atmos. bands & calibration



Global Rock Type



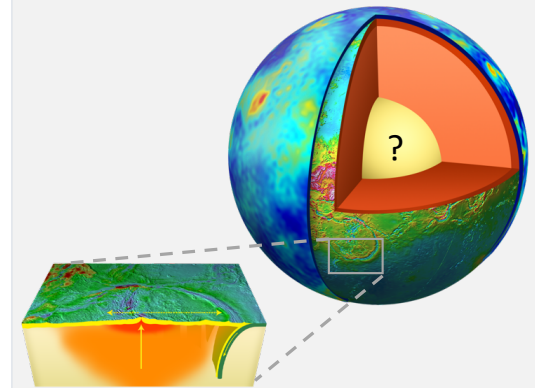
Search For Volcanic Activity

Gravity



Science Measurements:

- Gravity field (155 km) , 3 mgal
- MOIF to ± 0.005 , k2 to ± 0.01



Interior Structure
Core Size and State



will explore past and present Venus

Deep Atmosphere Venus Investigation of Noble Gases, Chemistry, and Imaging

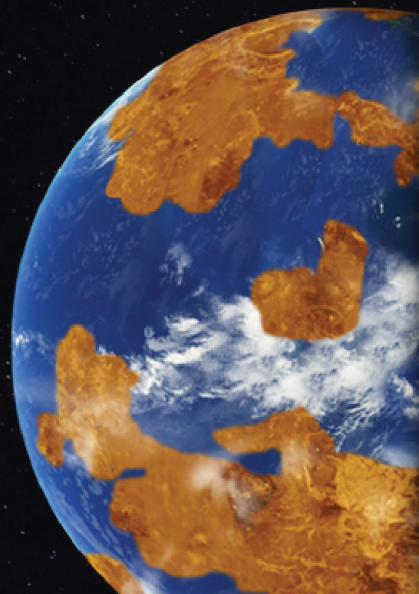
*Establishing Venus' place
in our Solar System*

*Enabling exploration of Venus-like
exoplanets and Earths*

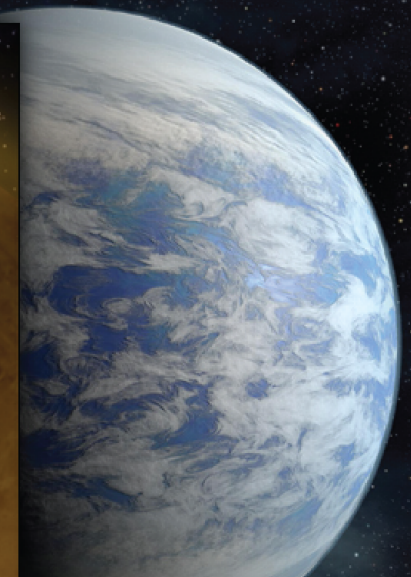
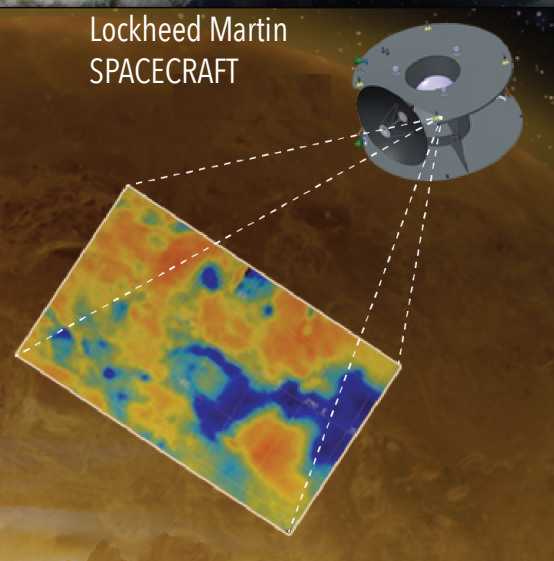
Ancient Oceans on Venus?

Evolution of Habitability

Venus-like Exoplanets



Lockheed Martin
SPACECRAFT

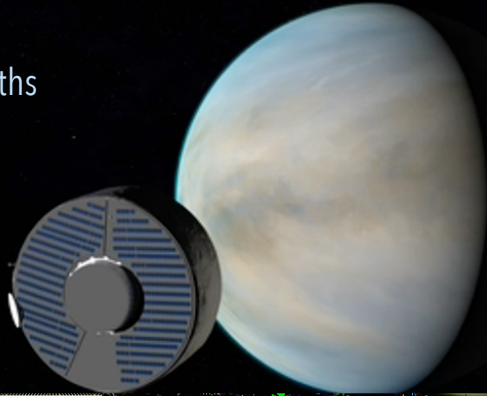


Way et al. (2016) GRI

Kepler-6

Flyby 1

First flyby occurs six months after launch



UV observations during both flybys track cloud motions (VISOR) and characterize the unknown UV absorber (CUVIS)

Probe Entry and Descent with Science

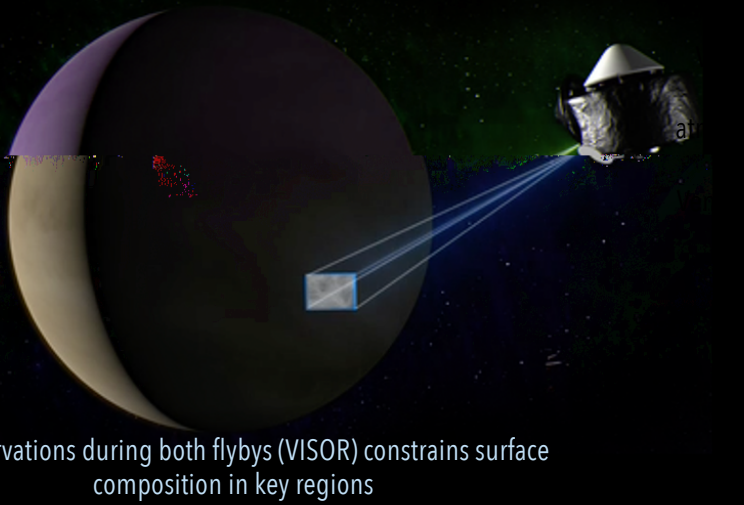
In 2031, the probe will carry a suite of instruments into the Venus atmosphere



These instruments will work together to characterize the atmosphere and surface, seeking evidence of ancient water.

Flyby 2

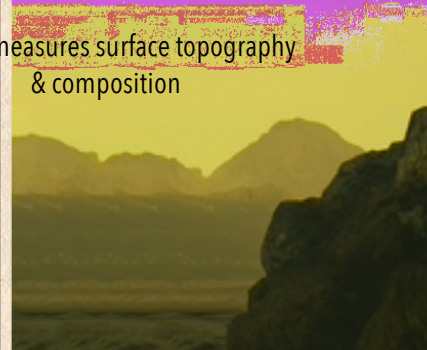
Probe Descent



IR observations during both flybys (VISOR) constrains surface composition in key regions

VIMS, VTLS, and Vfox make detailed measurements of the atmosphere, including noble gases.

measures surface topography & composition



DAVINCI

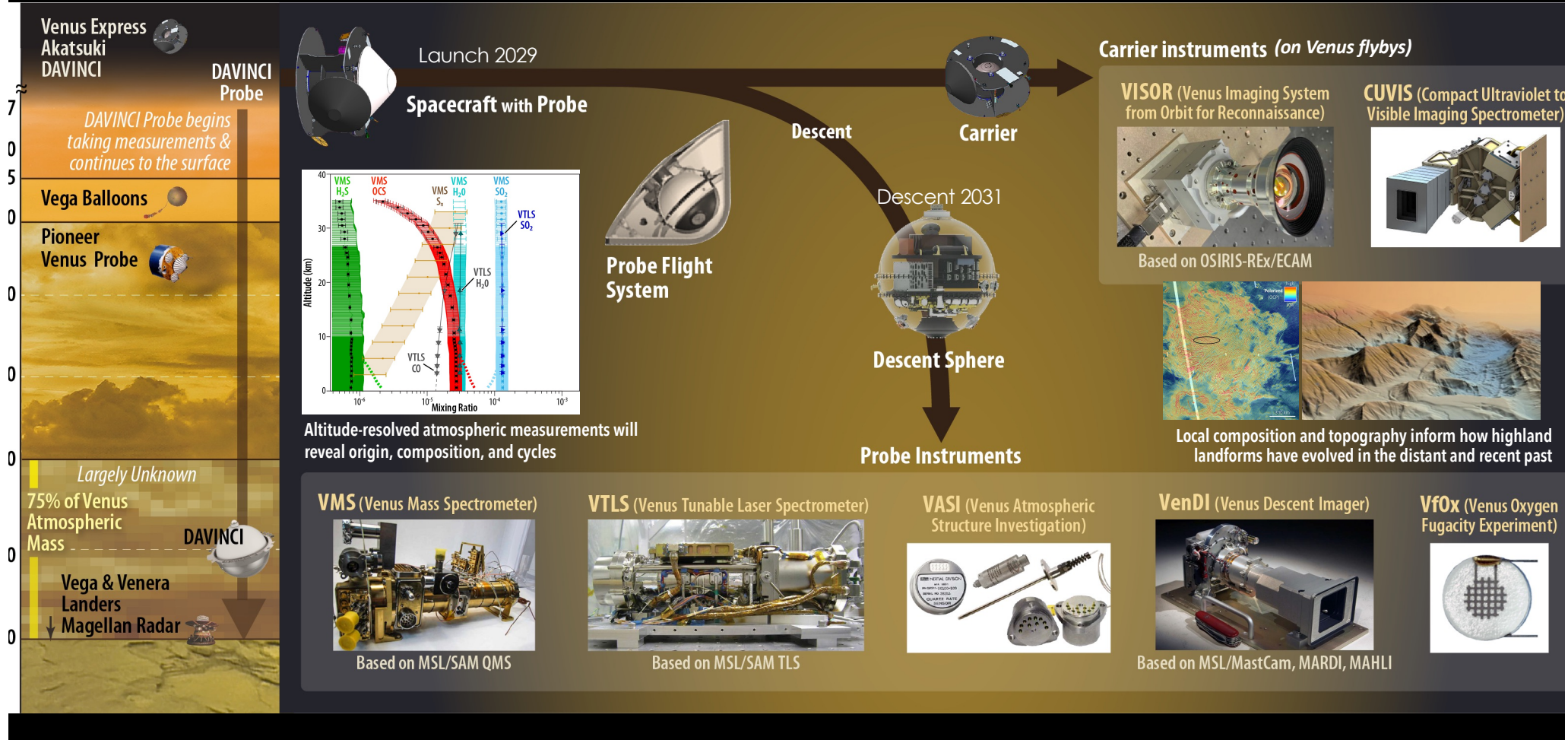
Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging

Mission Phases

SCIENCE EVERY STEP

DAVINCI Flybys and Probe Descent reveal Atmosphere and Oceans

Was Venus habitable in the past?



Questions?

