What makes a rocky planet habitable?
Like Earth, Venus started with all the building blocks of a habitable world.
How was habitability lost?

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?

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

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
Discovering the Secrets of a Lost Habitable World

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 volanically 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
DAVINCI 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

Way et al. (2016) GRL
Kepler-69c

Lockheed Martin SPACENET
PROBE
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)

Flyby 2
IR observations during both flybys (VISOR) constrains surface composition in key regions

Probe Descent
VASI, VMS, VTLS, and VfOx make detailed measurements of the atmosphere, including noble gases.
VenDI measures surface topography & composition

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.

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?

Altitude-resolved atmospheric measurements will reveal origin, composition, and cycles.

Local composition and topography inform how highland landforms have evolved in the distant and recent past.

Launch 2029

Descent 2031

VMS (Venus Mass Spectrometer)

Based on MSL/SAM QMS

VTLS (Venus Tunable Laser Spectrometer)

Based on MSL/SAM TLS

VASI (Venus Atmospheric Structure Investigation)

VenDI (Venus Descent Imager)

VfOx (Venus Oxygen Fugacity Experiment)
Questions?