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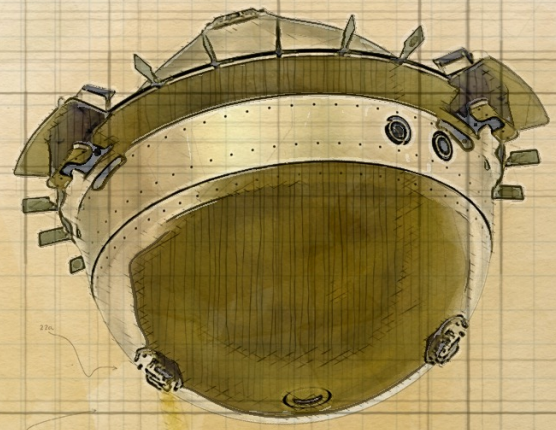
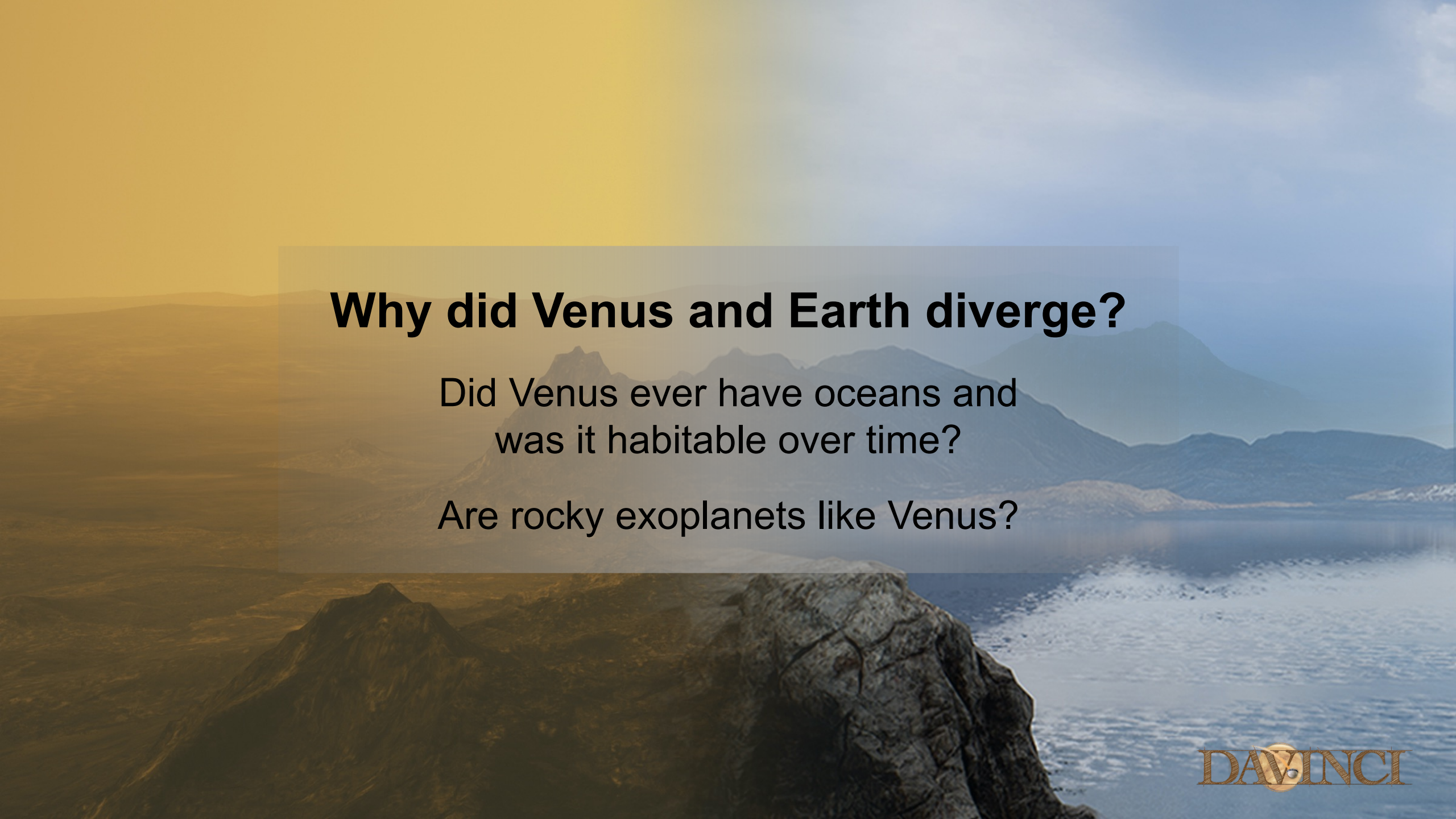
Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging



Giada Arney – DAVINCI Co-DPI
NASA GSFC

Venera-D Habitability Workshop
November, 30, 2021


Why did Venus and Earth diverge?
Did Venus ever have oceans and
was it habitable over time?
Are rocky exoplanets like Venus?
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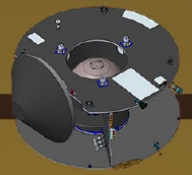
Integrated measurements address key Venus priorities

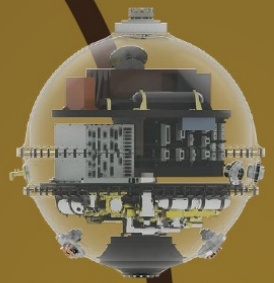
Spacecraft with Probe

Descent



Carrier, Relay, Imaging Spacecraft

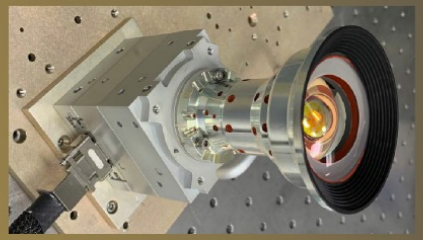
Probe Flight System



Descent Sphere

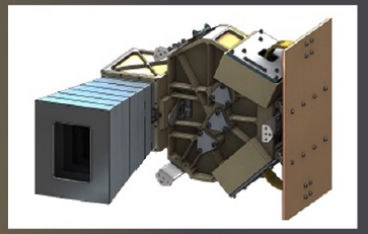
Carrier Flyby Instruments

VISOR (Venus Imaging System for Observational Reconnaissance)



Based on OSIRIS-REx/ECAM

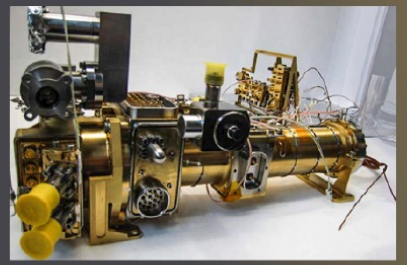
CUVIS (Compact Ultraviolet to Visible Imaging Spectrometer)



Hyperspectral UV Imaging Spectrometer

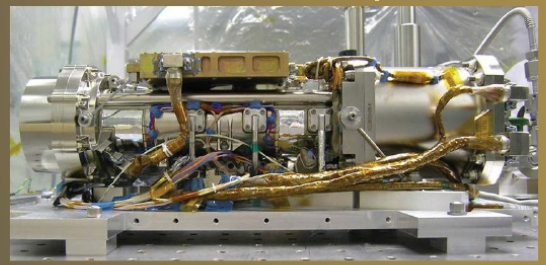
Probe Instruments

VMS (Venus Mass Spectrometer)



Based on MSL/SAM QMS

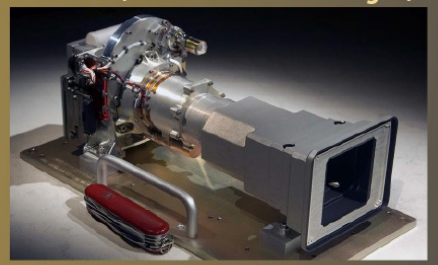
VTLS (Venus Tunable Laser Spectrometer)



Based on MSL/SAM TLS

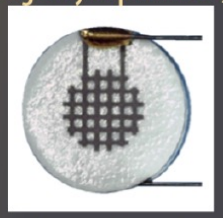
VASI (Venus Atmospheric Structure Investigation)

VenDI (Venus Descent Imager)



Based on MSL/MastCam, MARDI, MAHLI

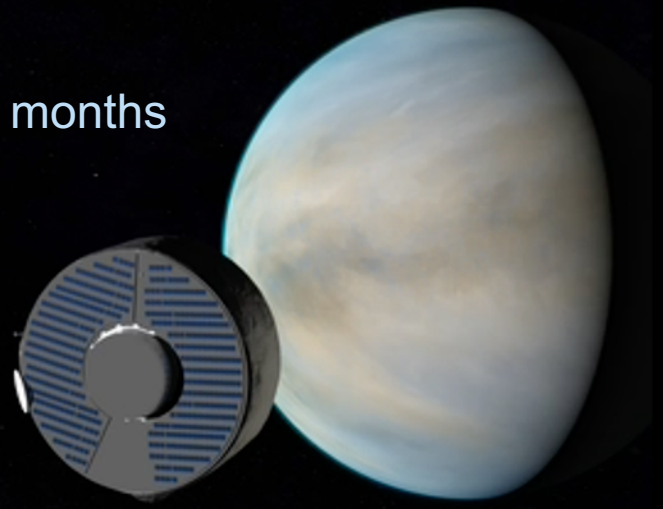
VfOx (Venus Oxygen Fugacity Experiment)



Deep Atmosphere Oxygen

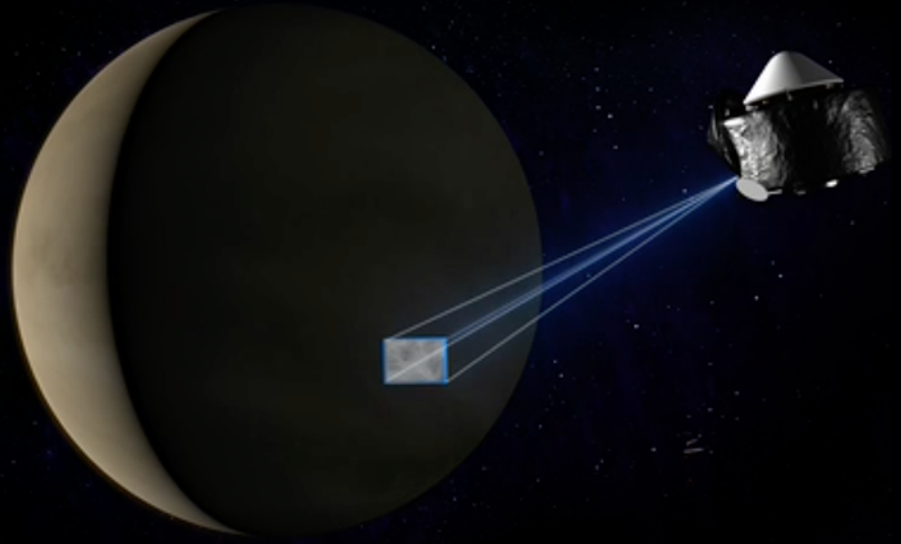
Flyby 1

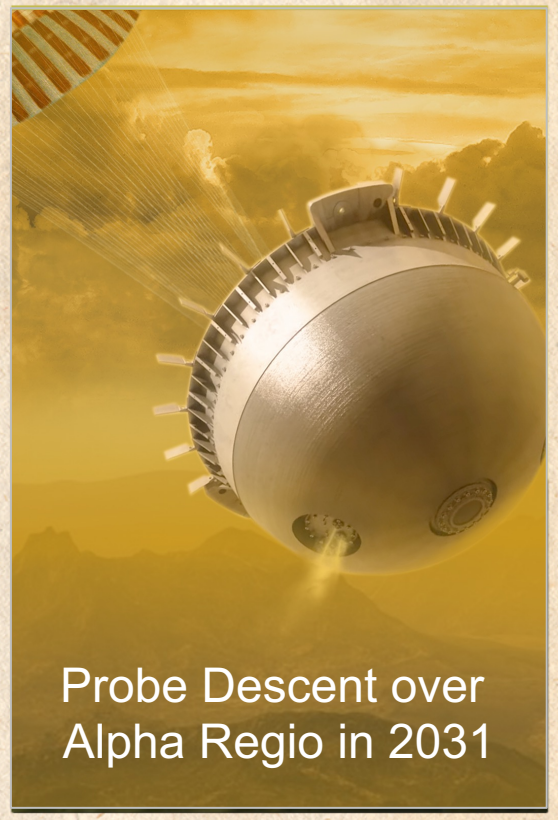
First flyby occurs six months after launch in 2029



Flyby 2

9 months after flyby #1

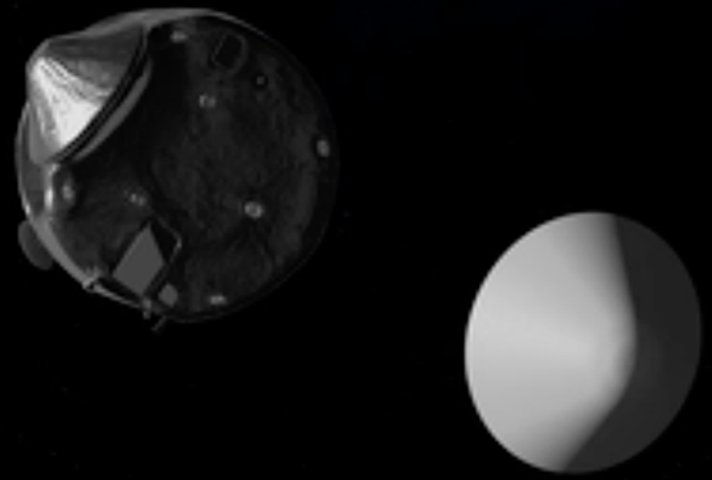




Probe Descent over Alpha Regio in 2031

Probe Entry and Descent with Science

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



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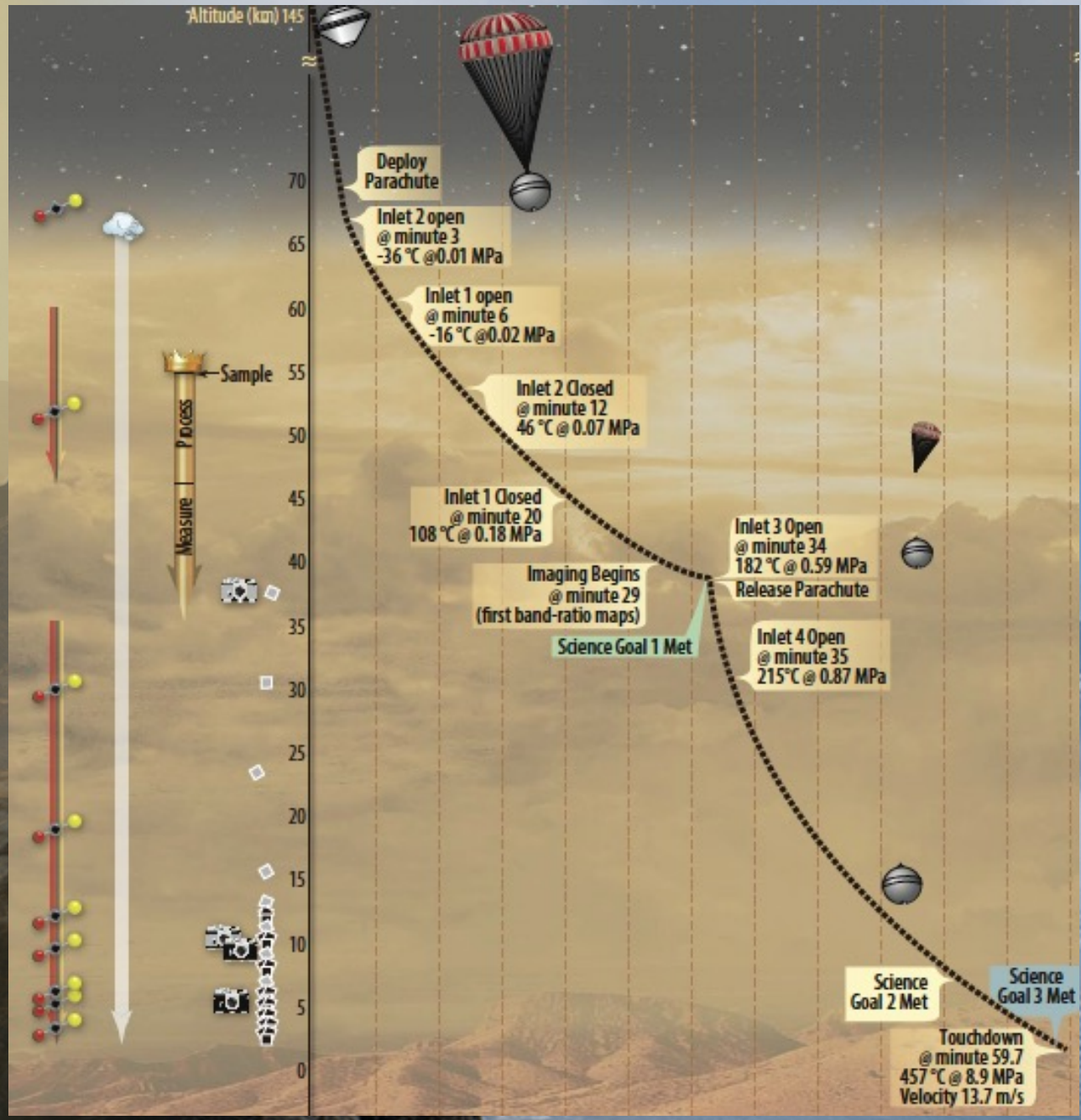
Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging

Mission Phases

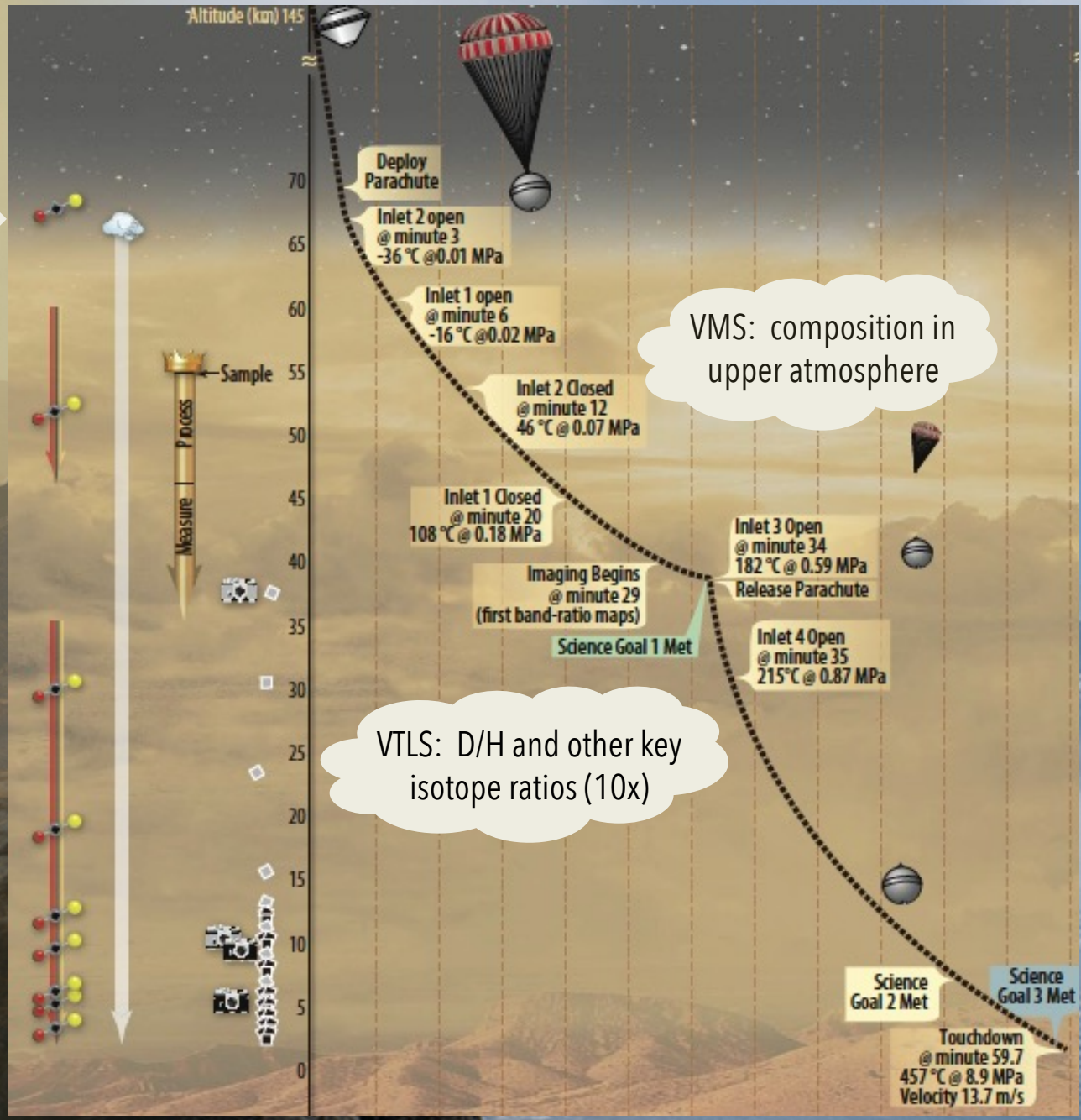
SCIENCE EVERY STEP

An hour of measurements will rewrite the textbooks on Venus



An hour of measurements will rewrite the textbooks on Venus

Upper cloud-deck: inputs to chemical cycles involving C, H, N, O, P, S, D/H versus altitude



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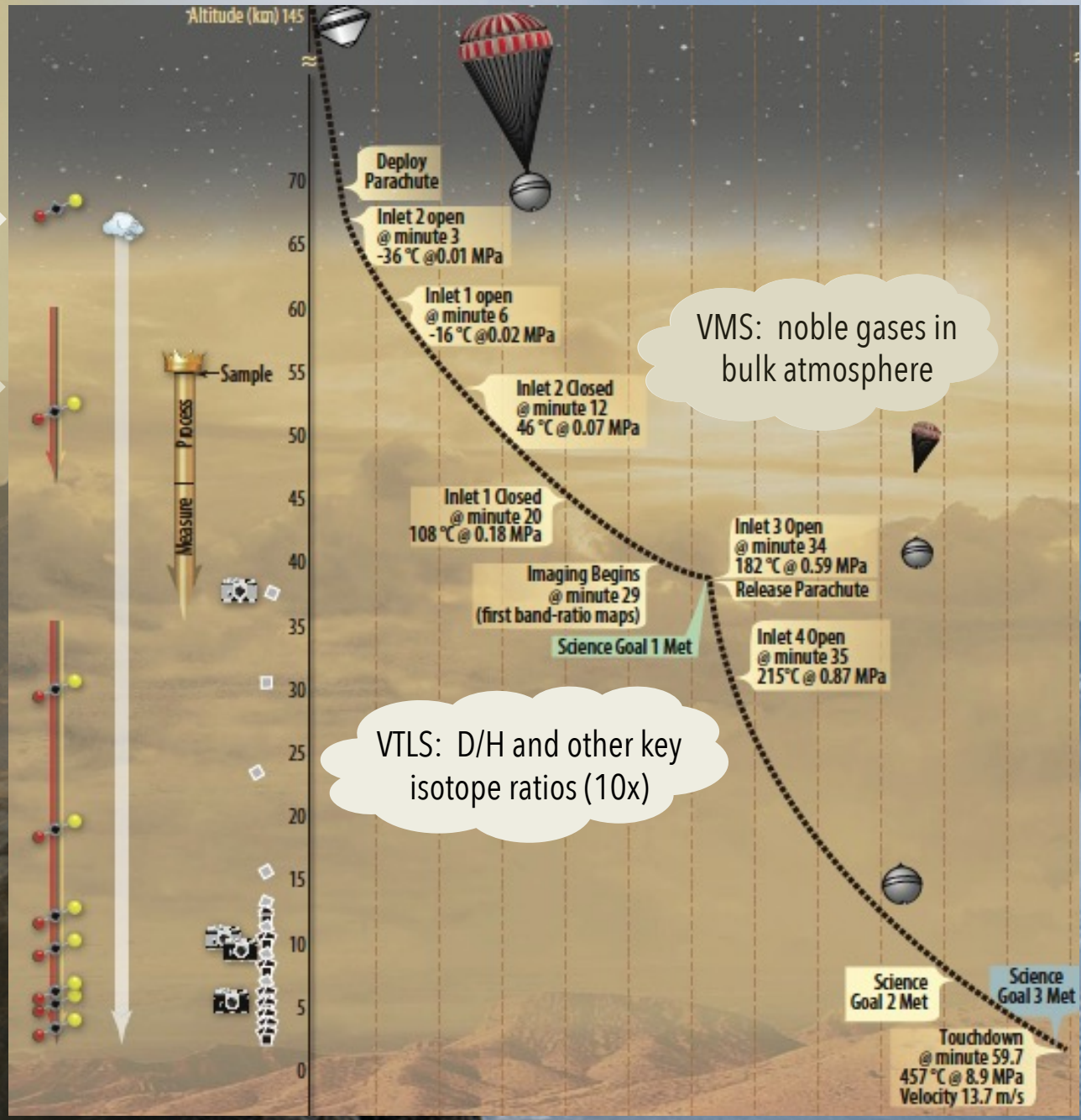

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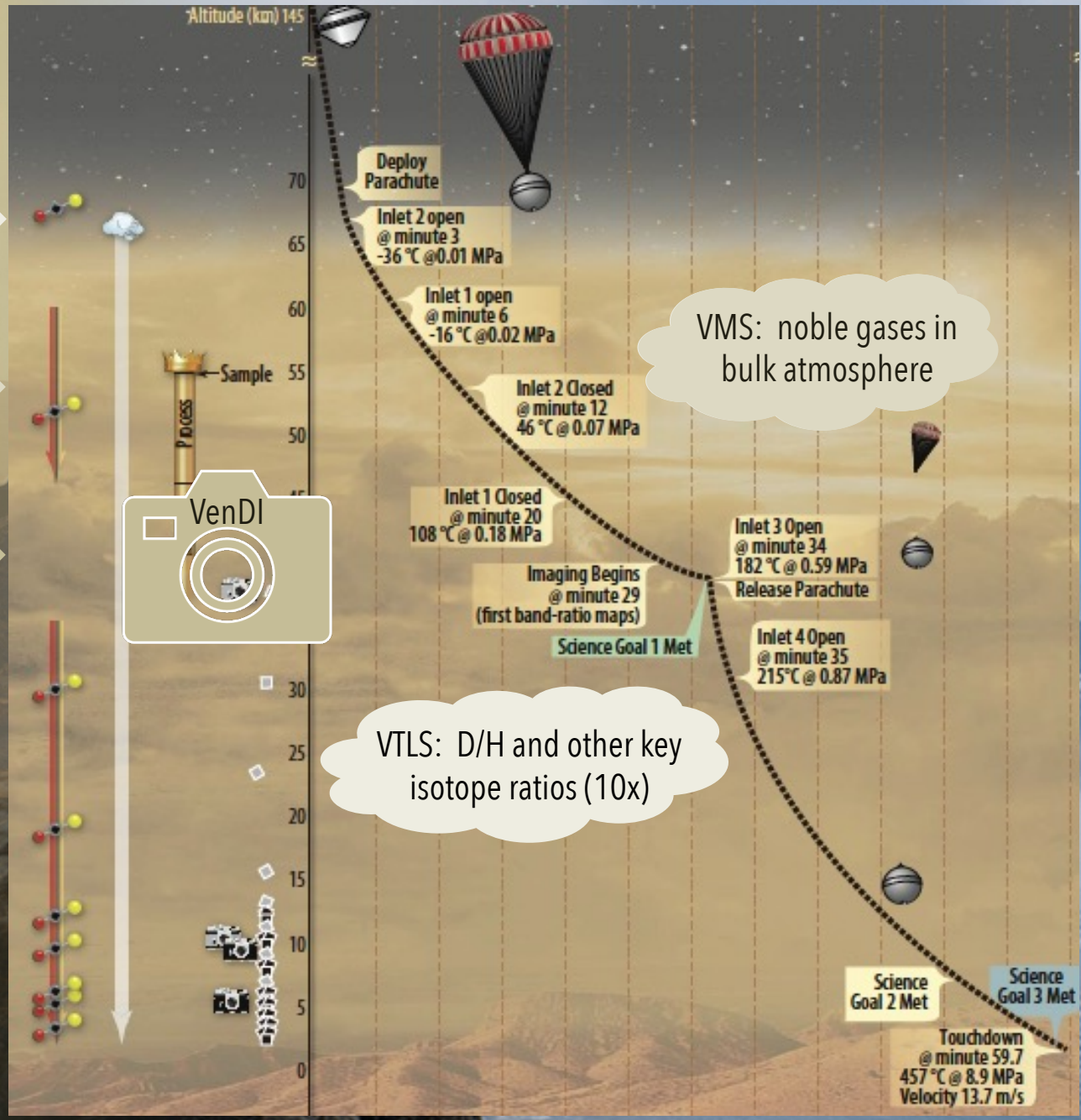
Emerging from clouds: imaging in narrowband, broadband NIR for regional evidence of role of water in rock formation



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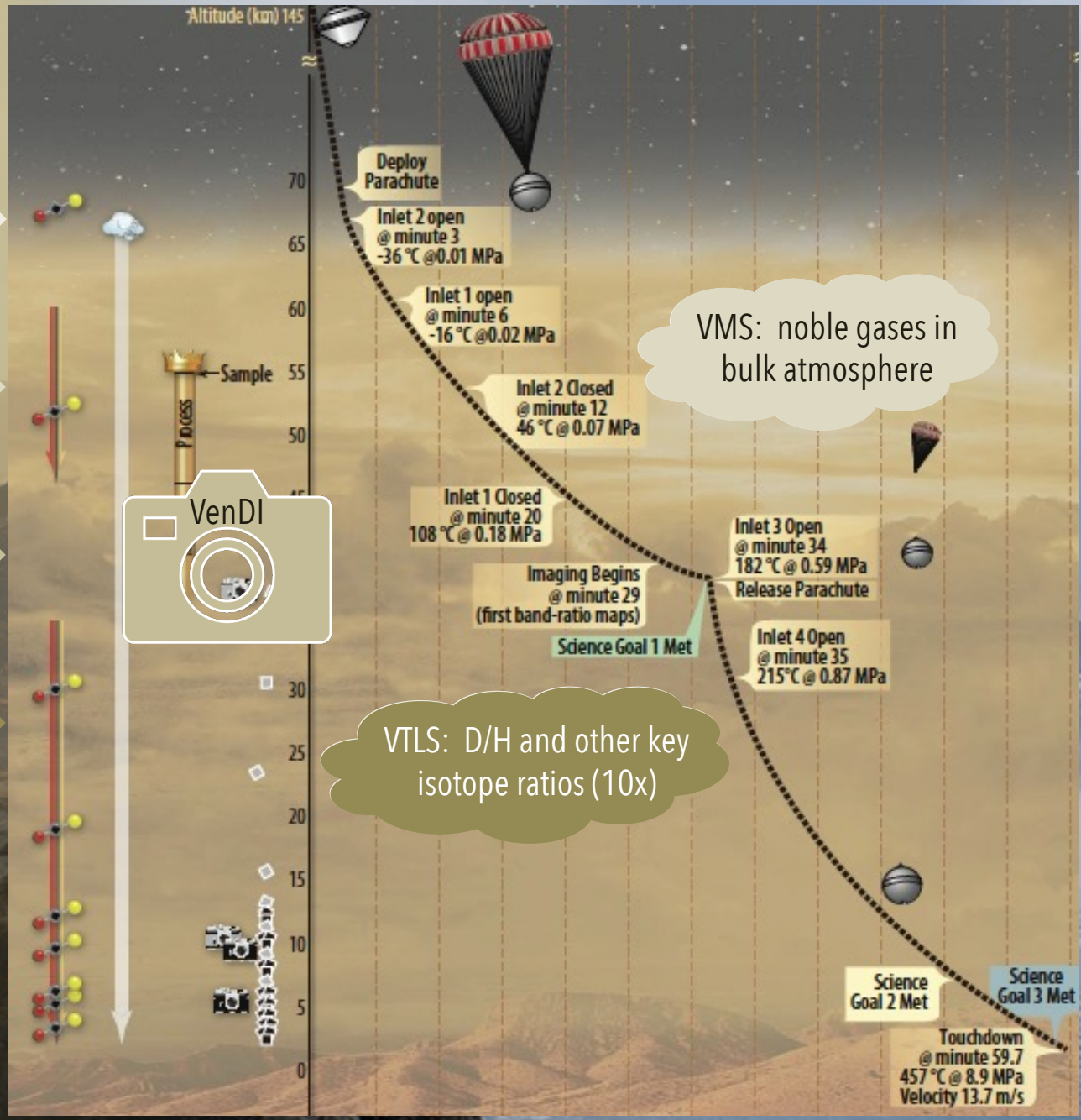
Below clouds: regular cadence inputs into chemical cycles involving C, H, N, O, P, S, D/H versus altitude



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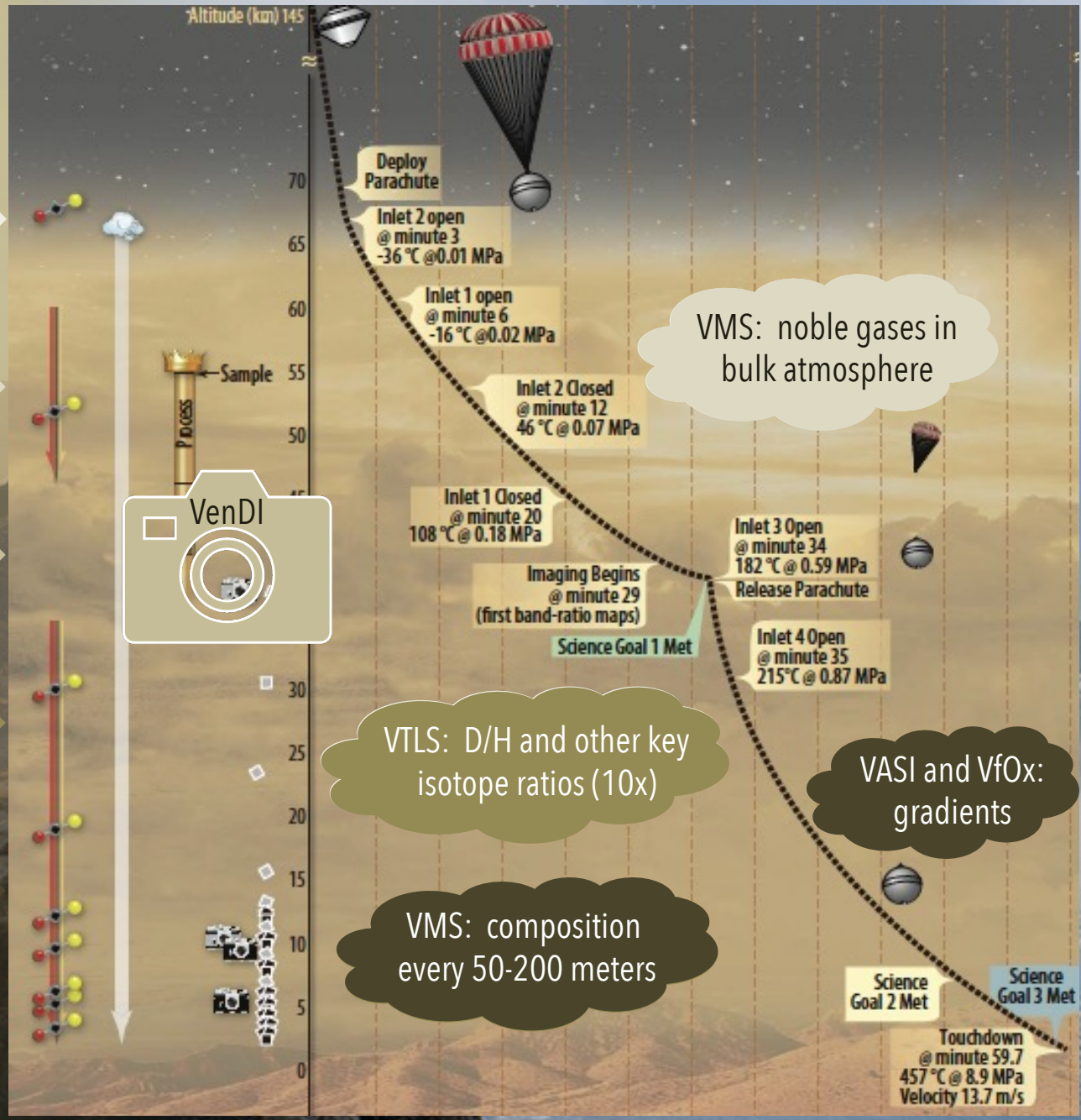
Deep atmosphere: focused search for gradients, surface-atm exchange to resolve questions of composition and stratification



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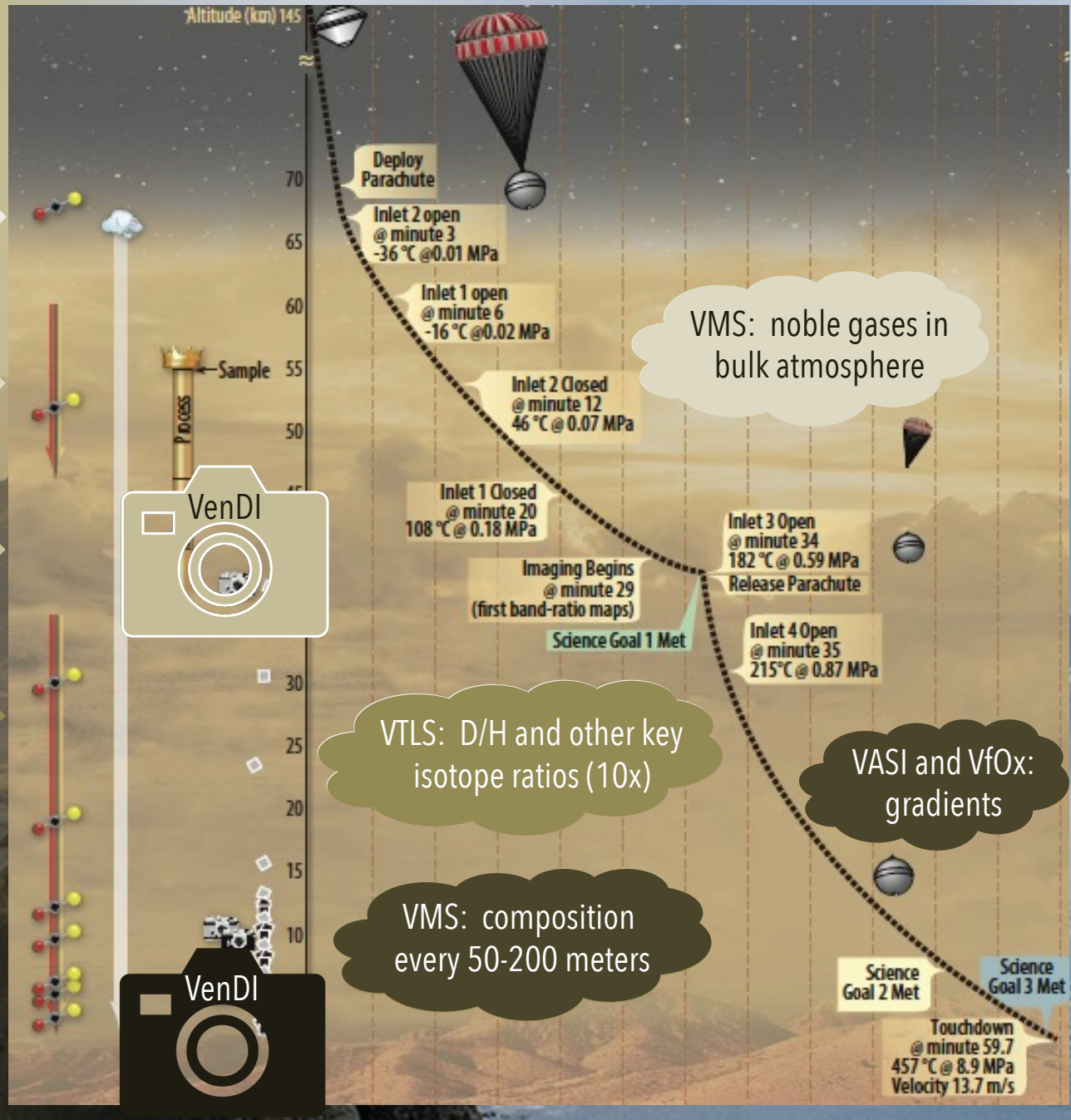
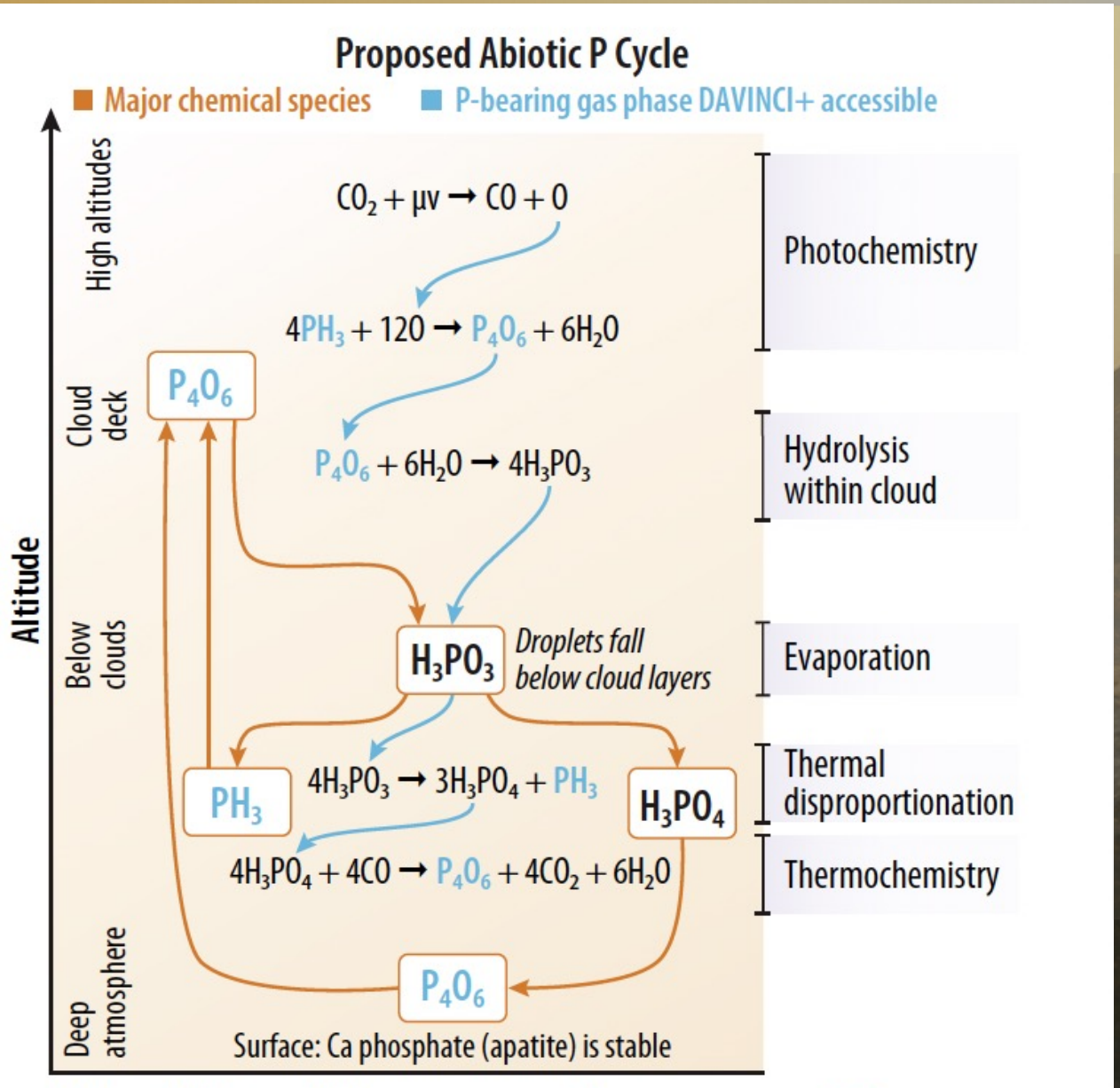
Deep atmosphere: focused search for gradients, surface-atm exchange to resolve questions of composition and stratification

Near surface: paired images in narrowband, broadband NIR for first 3-dimensional views of a tessera (meter scale)



What is the nature of phosphine on Venus?

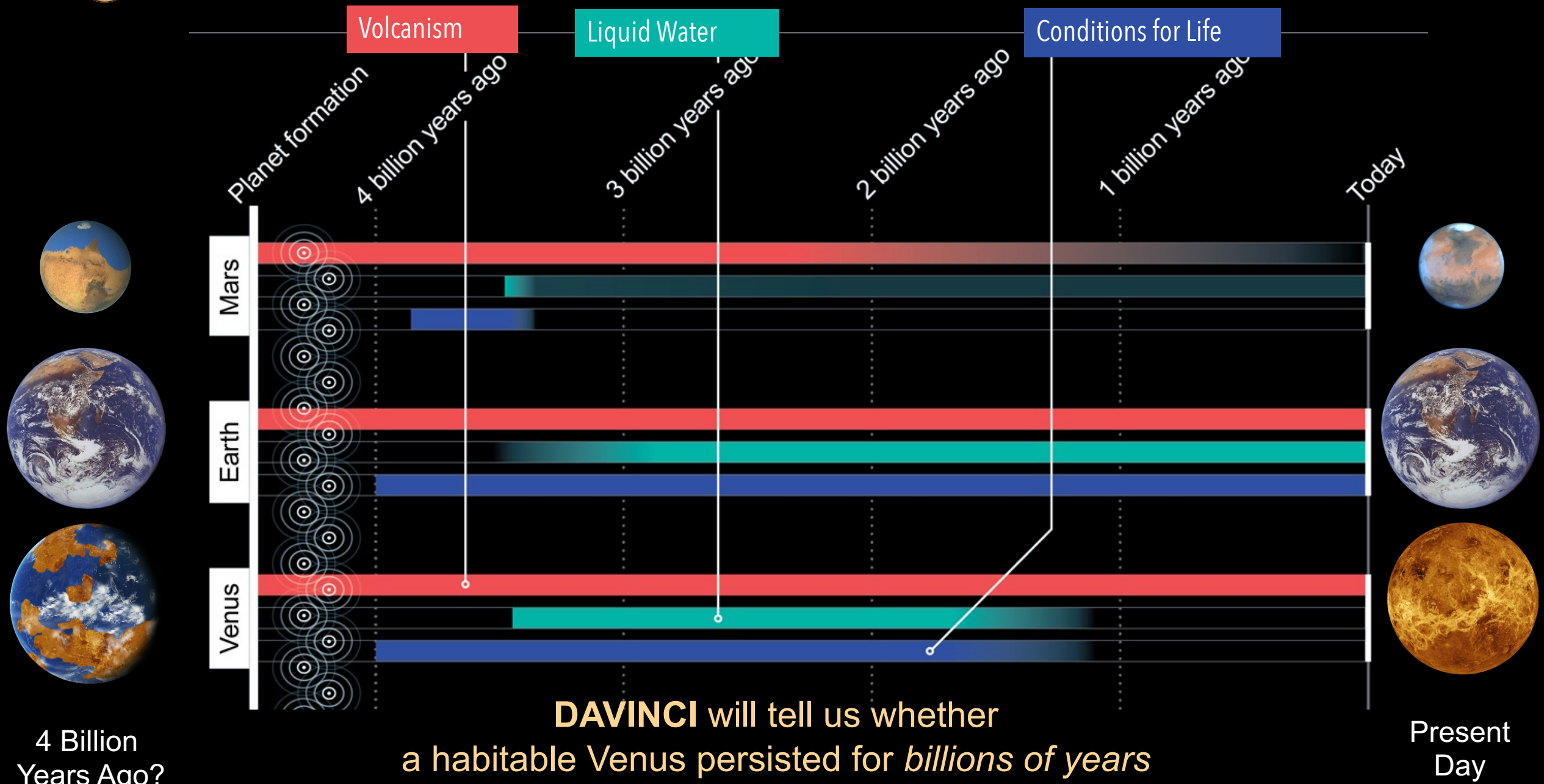


Is there **phosphine** in the Venus atmosphere?

If so, at what **altitudes**?

Are there **other P-bearing species**?

One Hypothesis we test : *Venus had long-lived oceans*



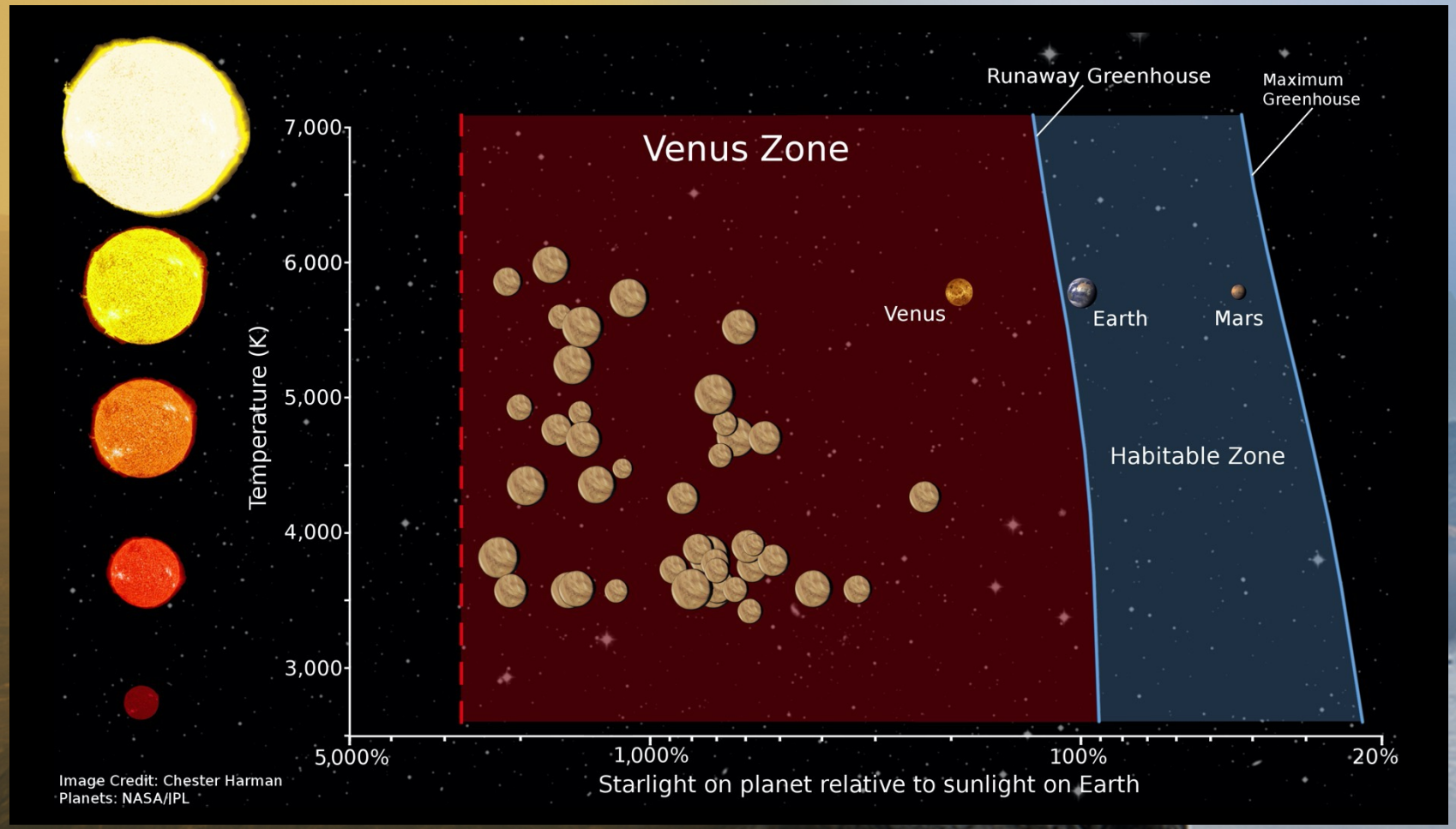
DAVINCI will tell us whether
a habitable Venus persisted for *billions of years*

4 Billion Years Ago?

Present Day

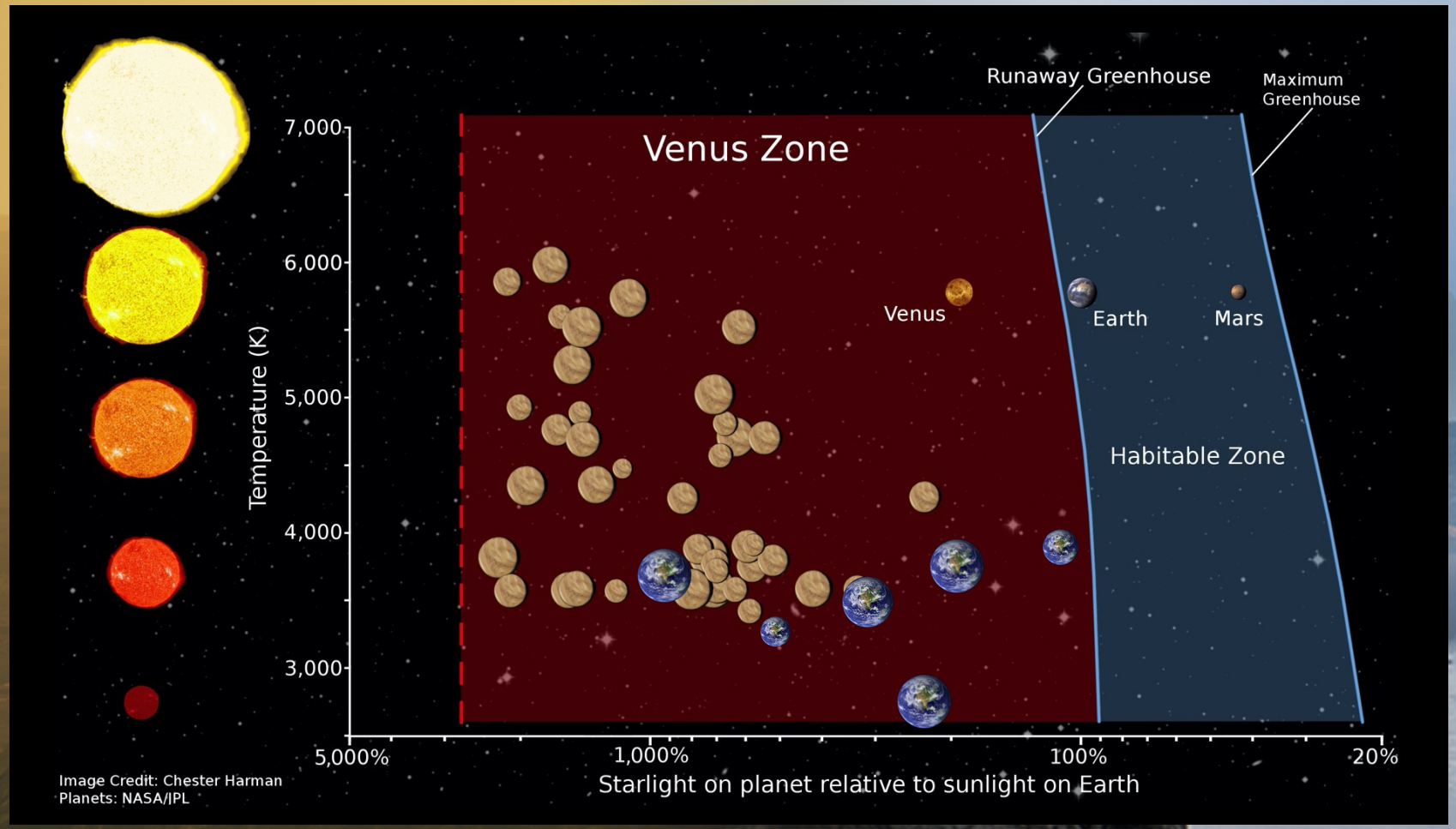
Venus is the exoplanet next door

DAVINCI helps us define the boundaries of habitability



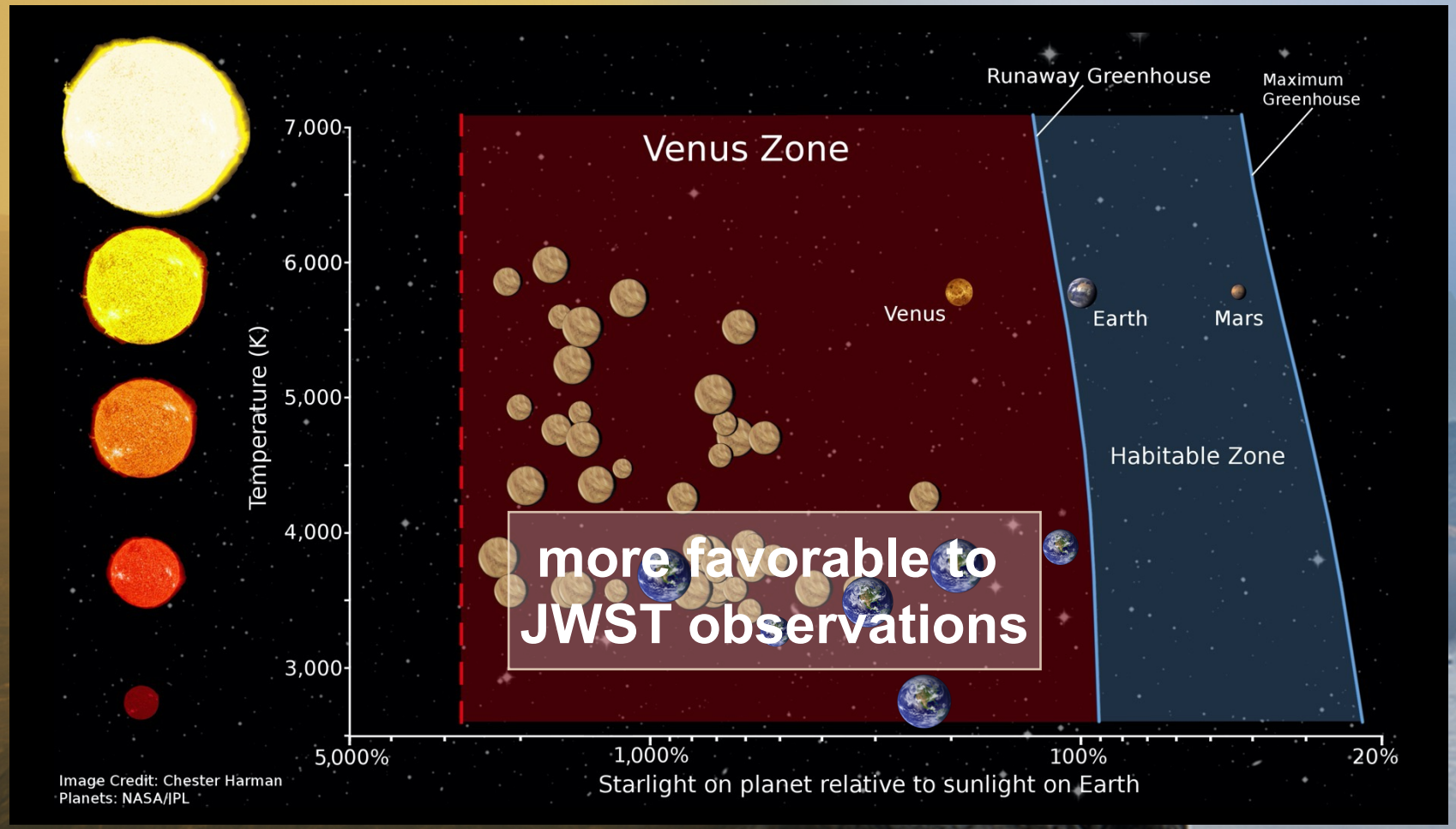
VMS Noble gases + VTLS D/H + VenDI/VISOR granitic rocks

DAVINCI helps us define the boundaries of habitability



VMS Noble gases + VTLS D/H + VenDI/VISOR granitic rocks

DAVINCI helps us define the boundaries of habitability



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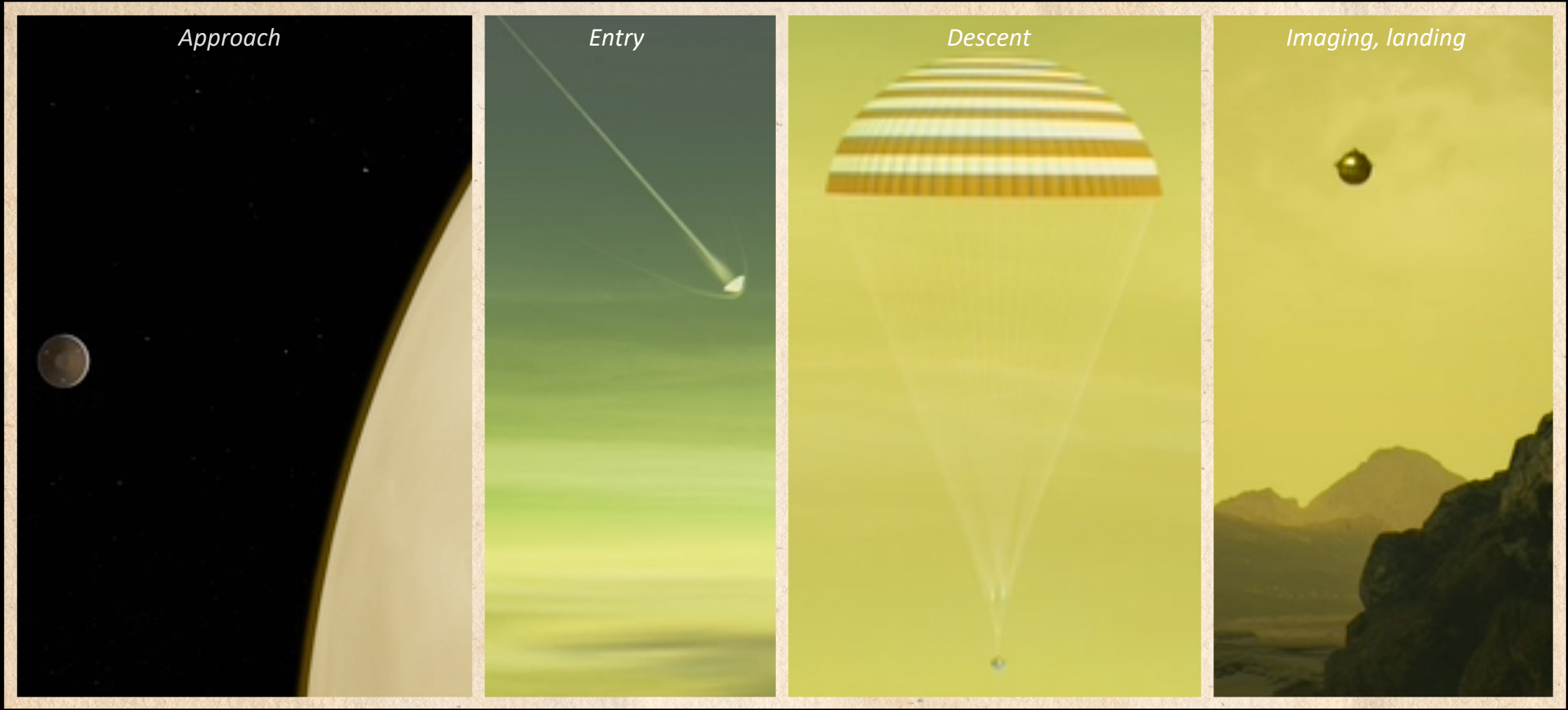
Probe-based Chemistry, Environments, Dynamics, and Descent Imaging of Venus atmosphere



Questions?

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