
# The Climate Evolution of Venus

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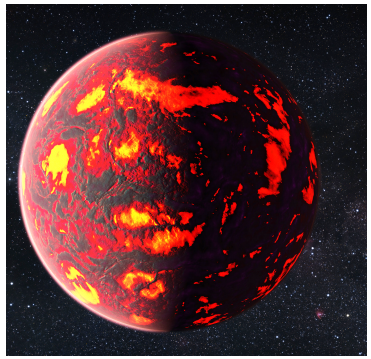
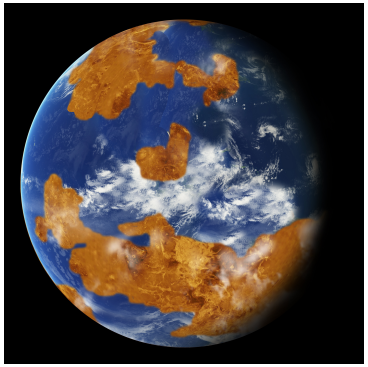
NAS Decadal Survey: The Origin and Evolution of Venus

# Two views

Venus
4.5 Ga





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- Magma Ocean 100Myr
- Primordial water lost
- Bone dry for 4+ Gyr
- PV D/H from this epoch

Ingersoll 1969 -> Hamano 2013
& fellow travelers

- Magma Ocean 1-5Myr
- Water condenses on surface
- ~1–3Gyr 'habitable phase'
- PV D/H from this epoch
- Sun's luminosity increases: Runaway?

or

- Great Climate Transition Event?

Pollack 1971 -> Grinspoon 2003
-> Way+ 2016, Way & Del Genio 2020

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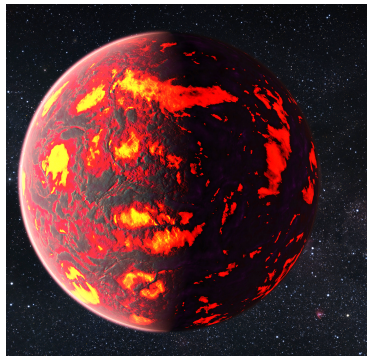

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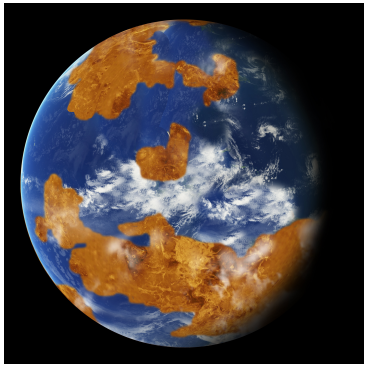
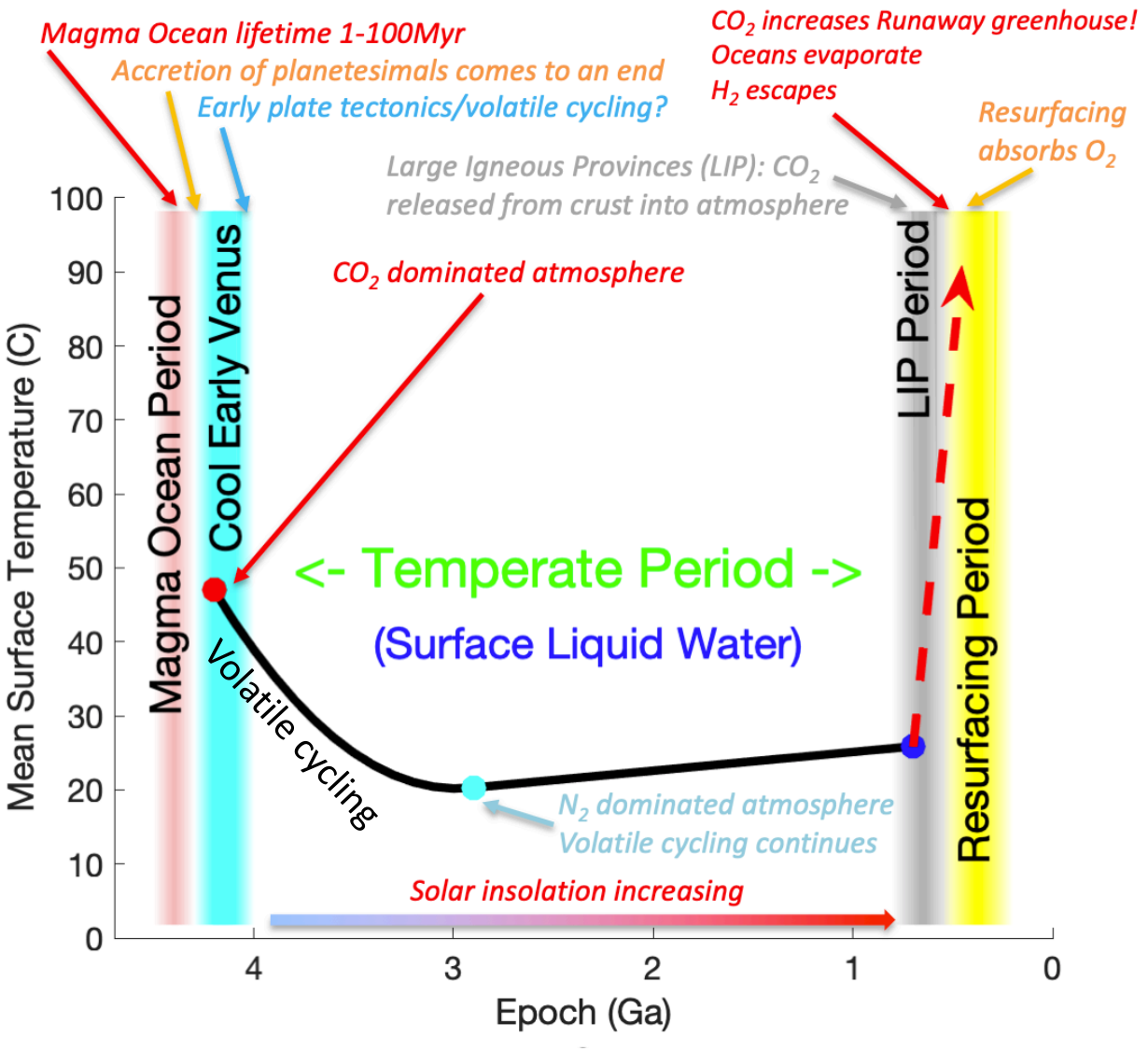


- **Easily explains present day state**
- H2 -> escapes to space
- O2 absorbed in magma ocean
- Never had plate tectonics
- Why still thick atmosphere!?

- **Can we explain present day state?**
- Where is the Oxygen?!
- What is the evidence?

Annotated from:
Way & Del Genio 2020
JGR Planets, 125,
e2019JE006276.
https://doi.org/10.1029/2019JE006276



# Wish List to quantify our picture

- Venus in-situ missions:
  - Cloud layers: for extended periods of time – with a mass spec
  - Surface: to examine the chemical composition of the rocks
  - Atmospheric column: updated high resolution version of PV LNMS

→ Allow us to quantify abundance and escape properties of Nobel Gases and other critical atmospheric components.

- Venus orbital mission to:
  - Make high resolution radar mapping of the Tesserae terraines

→ Allow us to put Surface landers on the oldest and most interesting Tesserae to quantify their properties.