

# Venus – Earth’s “Twin”

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Venus (Earthbased telescopes)  
Our view is limited due to clouds....



# Venus – Basic Properties

- Apparent brightness as seen from Earth – 3<sup>rd</sup> (behind Sun & Moon) because:
  - Close ( $a = 0.72$  AU from Sun)
  - Cloud shrouded → very reflective !!
- Thick cloud shrouded atmosphere
- Slow retrograde rotation
  - P(revolution) ~ 224 days
  - P(rotation ~ 243 days (RETROGRADE !!!))
- Radius ~ 0.95 Earth's    Mass ~ 0.82 Earth's
  - Average Density ~ 5200 kg / cubic meter
- Differentiated Interior (similar to Earth but proportionally smaller core)
- No significant global planetary magnetic field

# Effects of Slow Rotation

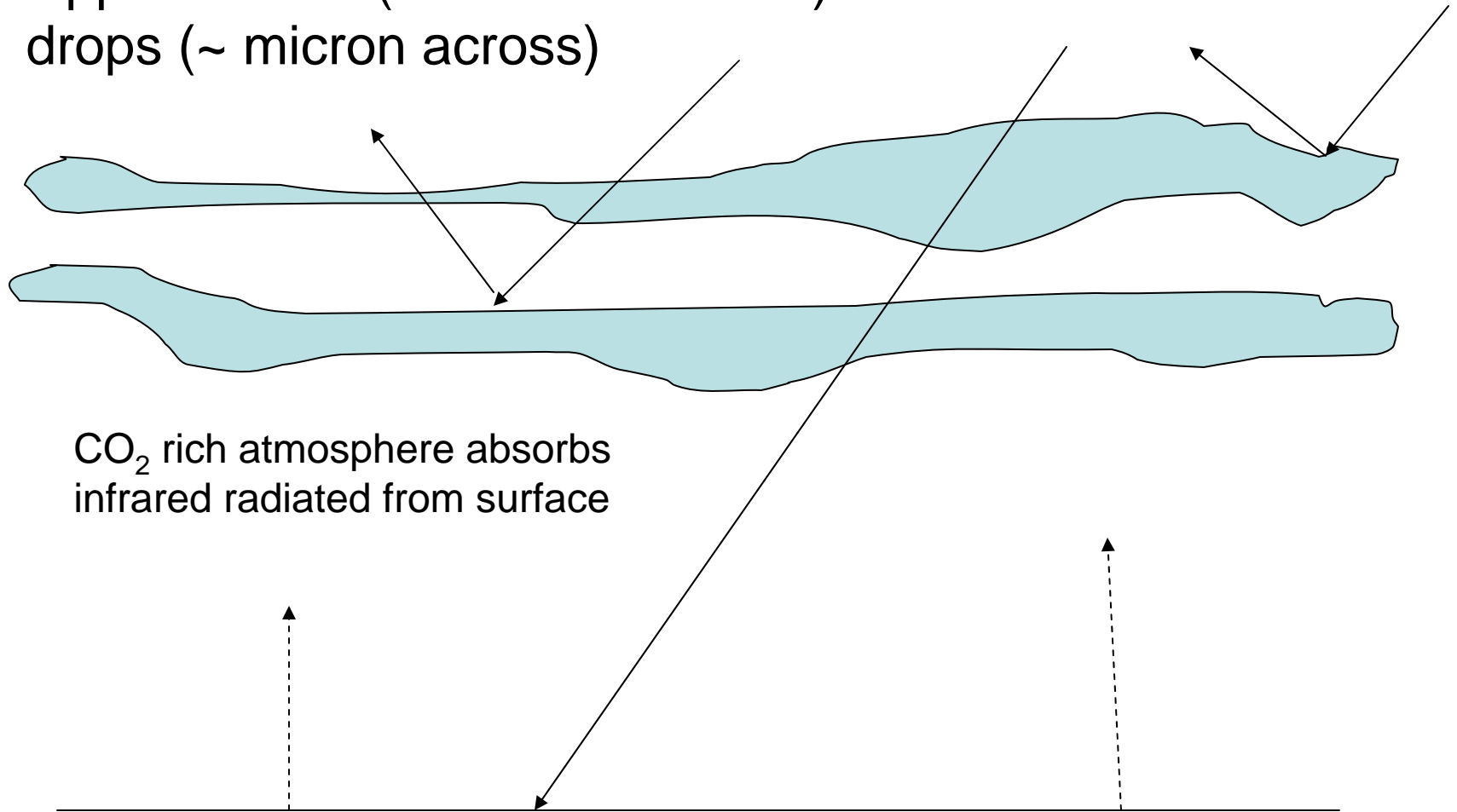
- Differential Heating – day versus night sides → high velocity winds
- Small core plus slow rotation → no significant overall planetary magnetic field
- Solar Wind thus interacts directly with Venus' ionosphere ripping pieces of it off into “streamers & clouds” past the planet into space

# Venusian Atmosphere

- High altitude clouds – opaque & global
- Surface (based upon US & Soviet landers) is too hot – atmosphere is transparent
- Illumination at surface is comparable to a VERY cloudy Earth day . . .
- Atmospheric Composition
  - 96% CO<sub>2</sub> 3% N<sub>2</sub> < 0.4% H<sub>2</sub>O
  - Trace (< 0.1% O<sub>2</sub>, Ar, SO<sub>2</sub>, He, CO, HCl)
- Surface: 730K, 95 atm (GREENHOUSE EFFECT !!!!!)

# Greenhouse Effect

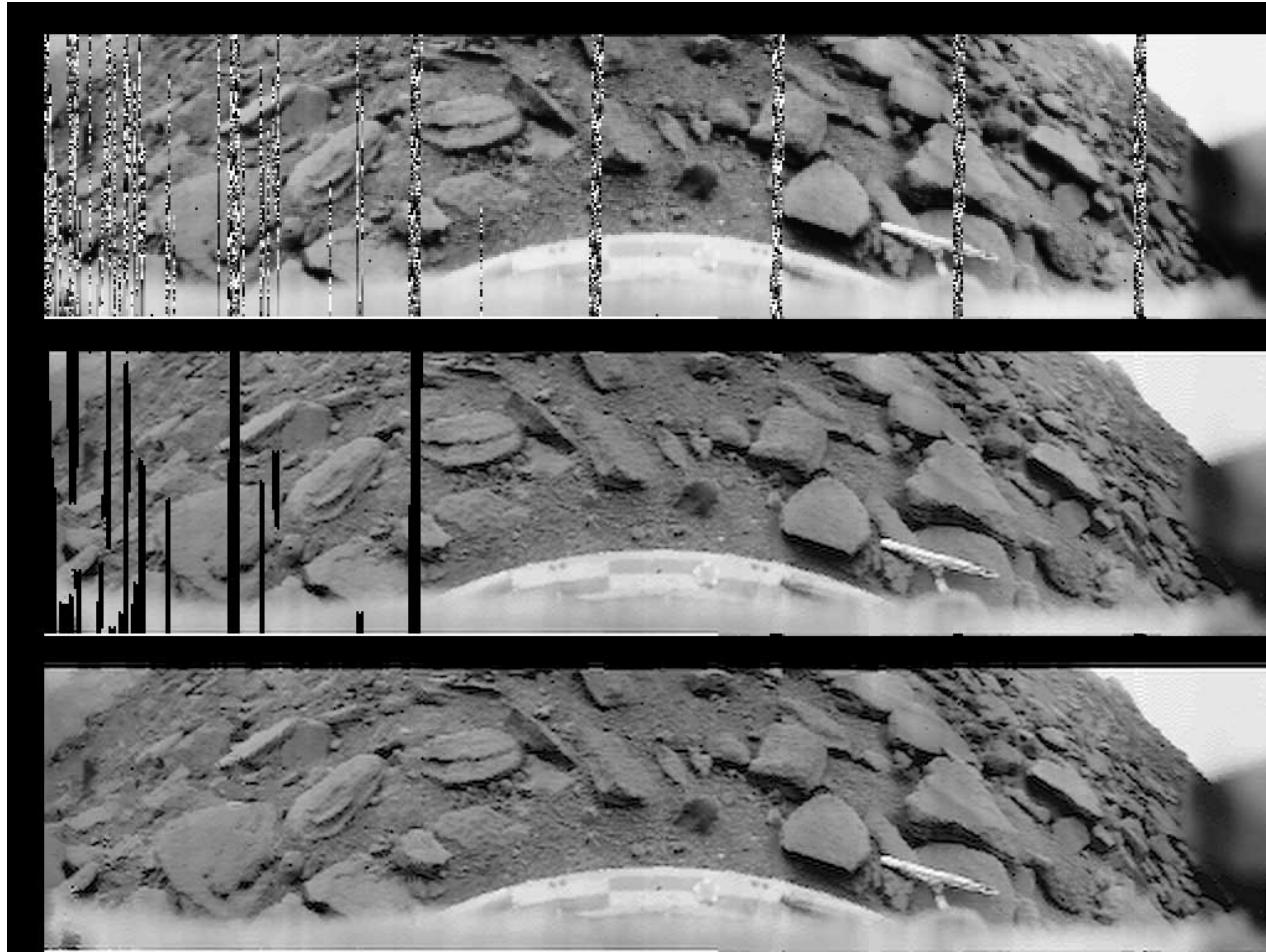
- Upper Clouds (45-60 km altitude) – sulfuric acid & water drops (~ micron across)



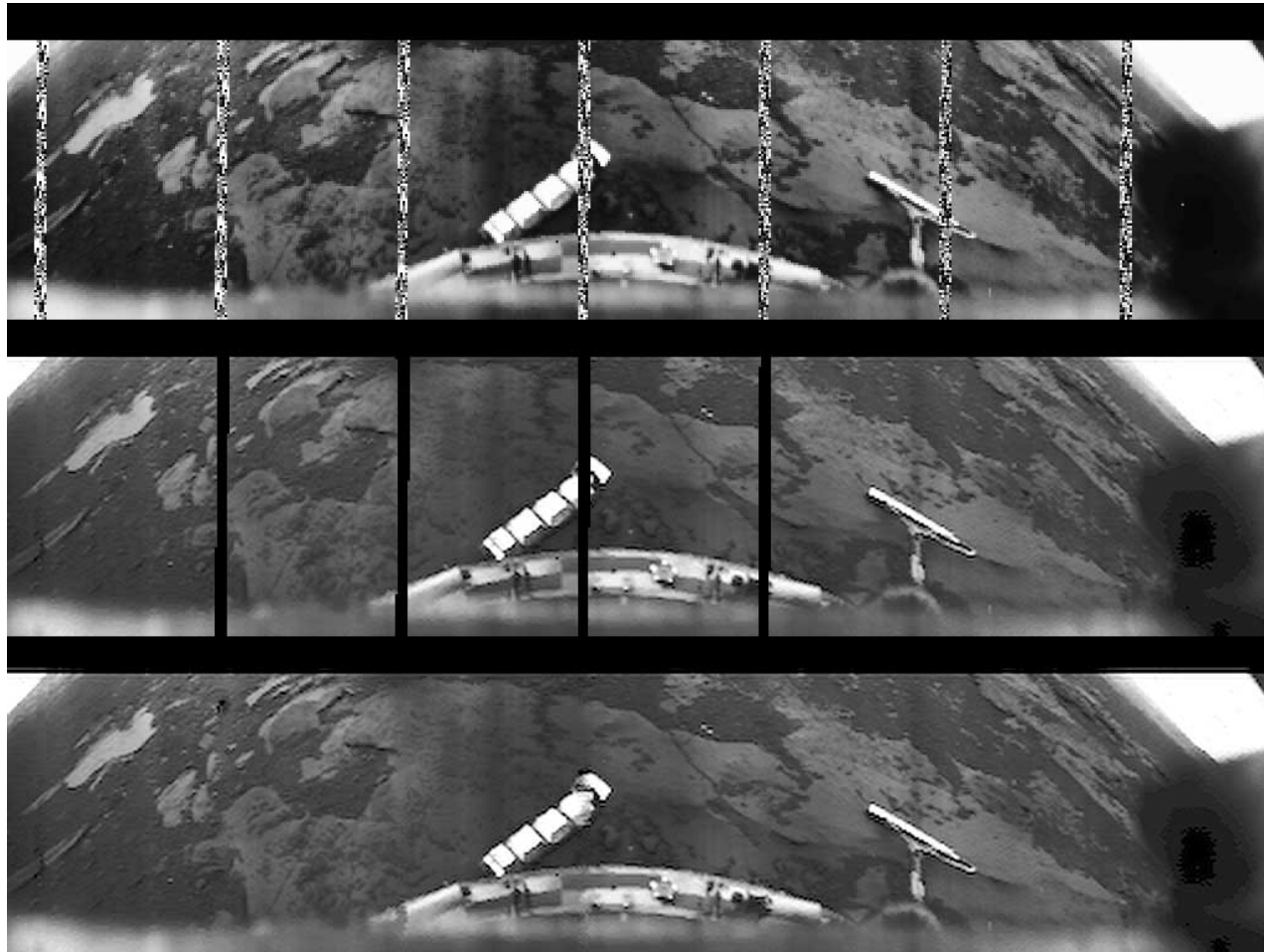
# Surface Properties & Terrain

- Presence of cloudy atmosphere → only two ways to study surface:
  - landers versus radar mapping
- Soviet & US landers – Venera & Pioneer
- Mapping – Venera & Pioneer & Magellan

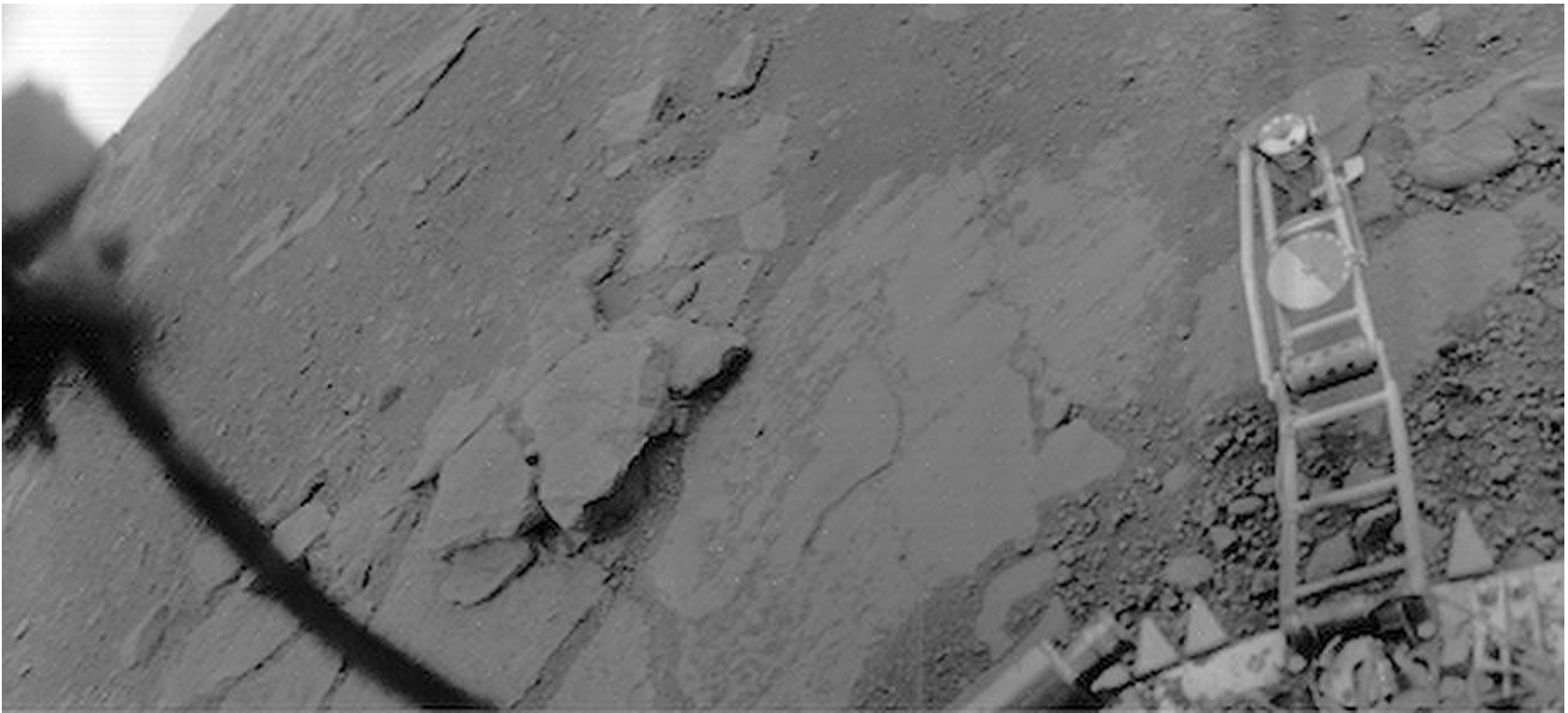
# Venera 9 – 1975 (panorama)



# Venera 10 – 1975 (panorama)



# Venera 13 – 1982



# Venera 14 – 1982 (camera 1)



# Landers' Key Results

- Transparent atmosphere near surface
- Basalts & igneous rocks
- Angular rock shapes – lack of weathering compared to terrestrial rocks (no water erosion for instance)

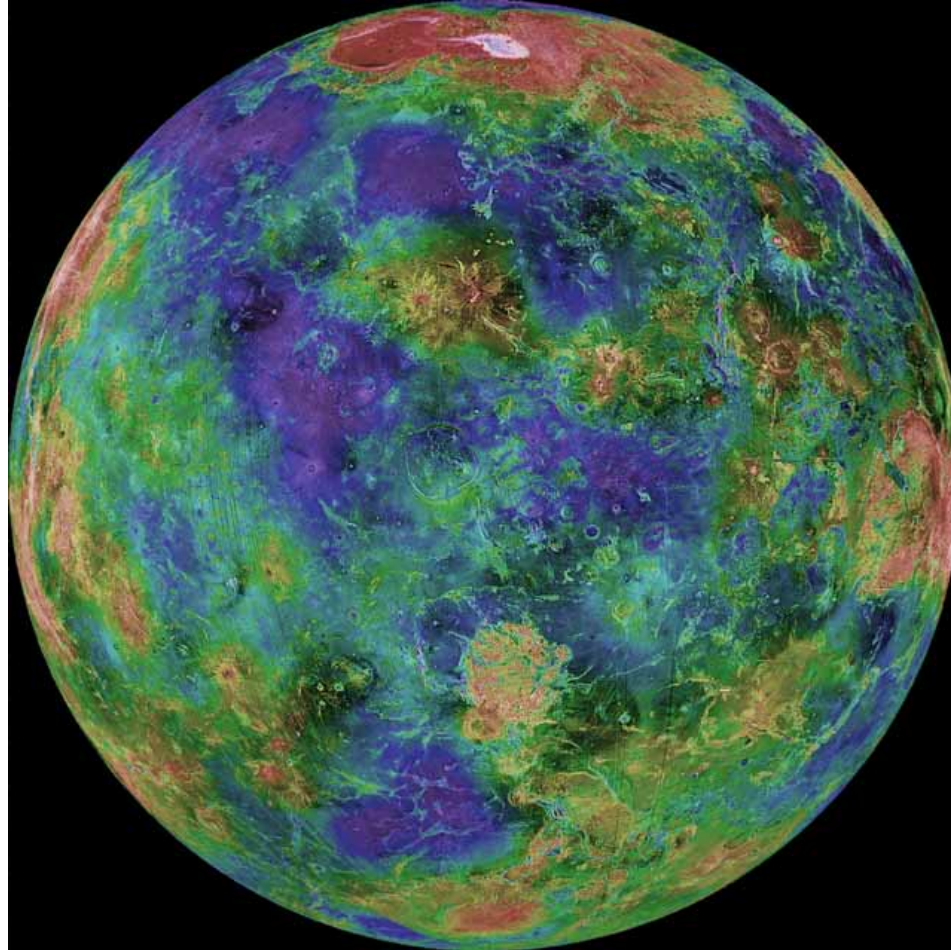
# Radar Mapping

- Use radar unit mounted on orbiting spacecraft to bounce radar beams off planet and study return echo
- Echo indicates altitude of terrain plus roughness / smoothness of terrain (dependent upon radar's resolution . . .)
- US & Soviets both did radar maps

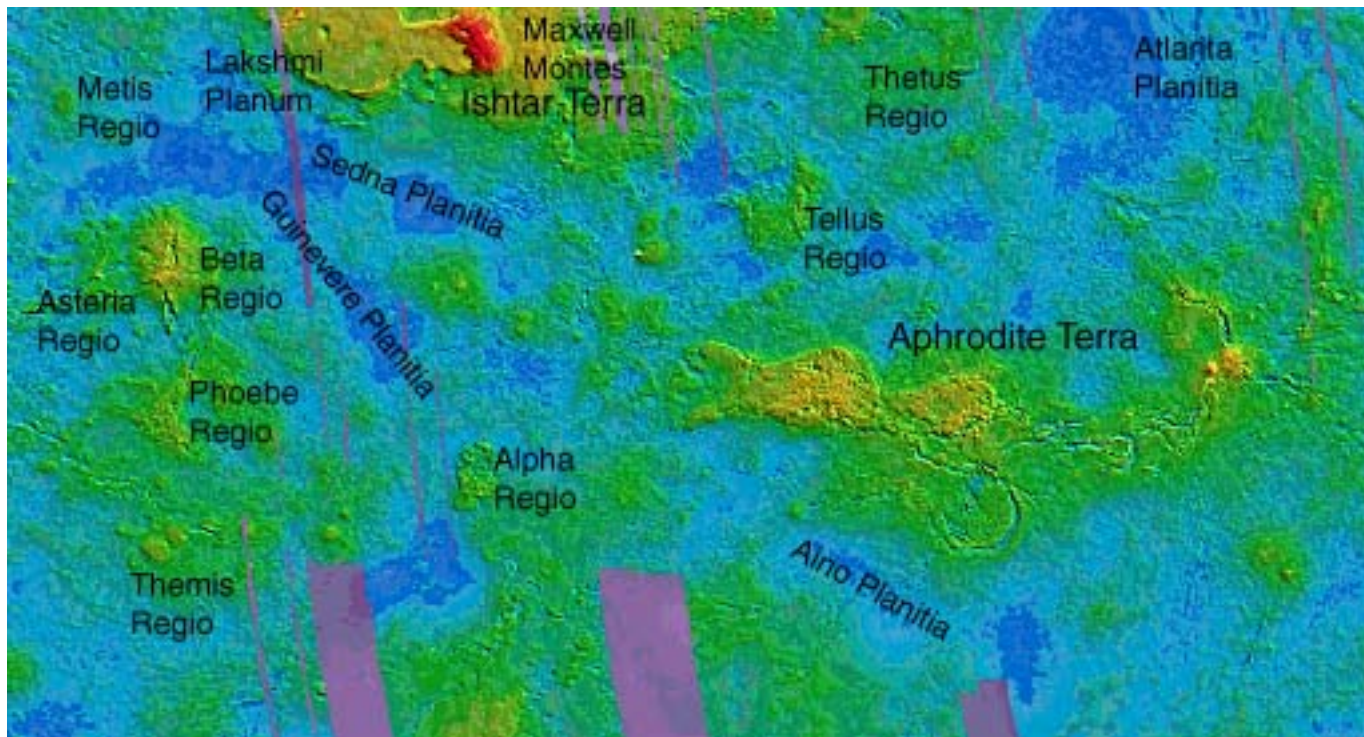
# RADAR MAPPING RESULTS

- Overall:
  - 3 highlands (uplands) -- closest things to “continents”
    - Ishtar Terra (including 12 km high Maxwell Montes on east) – in Northern hemisphere, ~ size of Australia
    - Aphrodite Terra (near equator, ~ size of Earth’s Africa)
    - Beta Regio (rifting and volcanism)
  - Widespread evidence of volcanoes & volcanism across the planet
  - Presence of canyons / rift valleys
  - Presence of impact craters
  - General “rolling terrain” showing lava flows
  - No strong evidence for any plate tectonics (unlike Earth !)
- Northern Hemisphere – upland plateaus
- Southern Hemisphere – cratered plains
- Possible widespread resurfacing in last billion years . . .

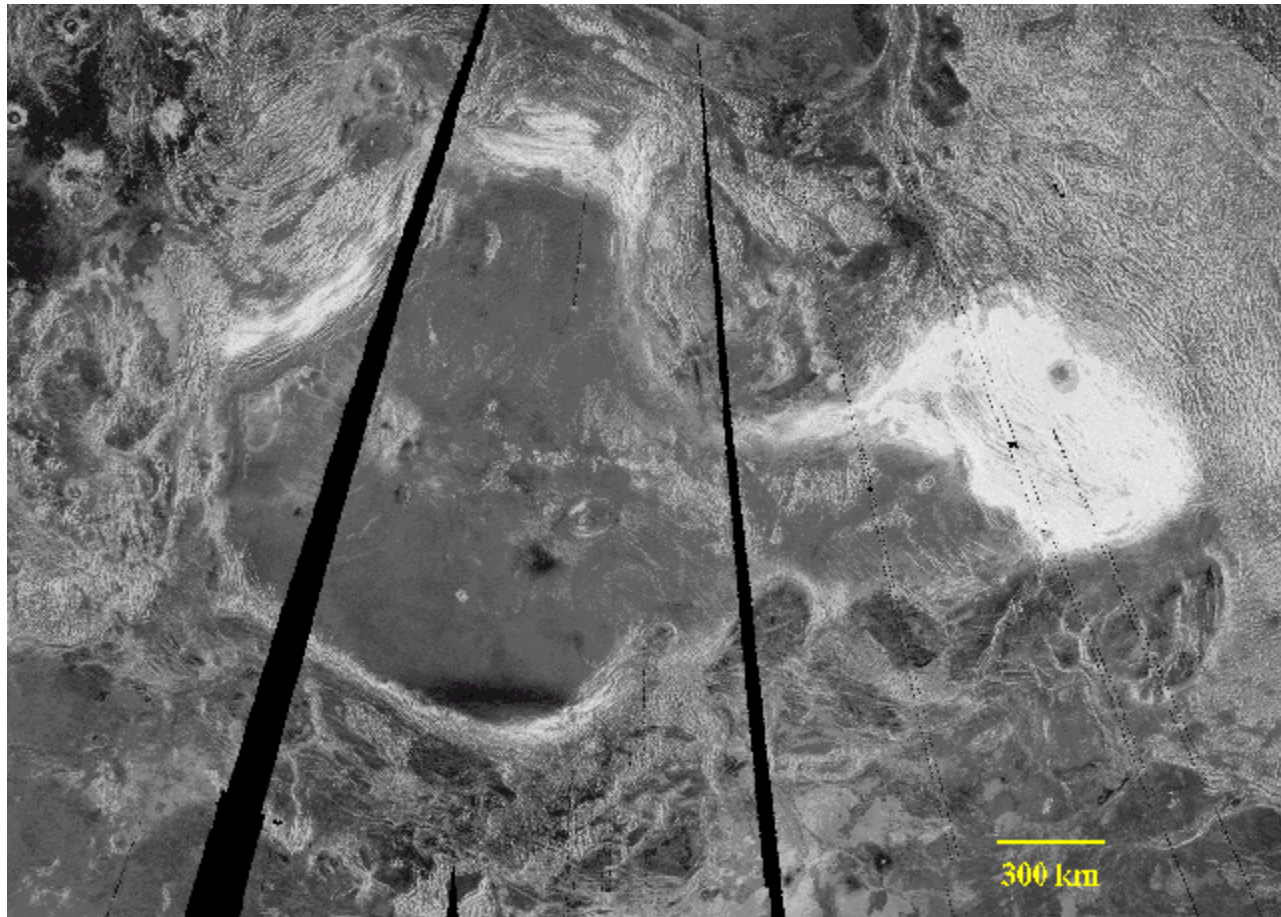
# Venus (Magellan hemispheric radar map – color coded)



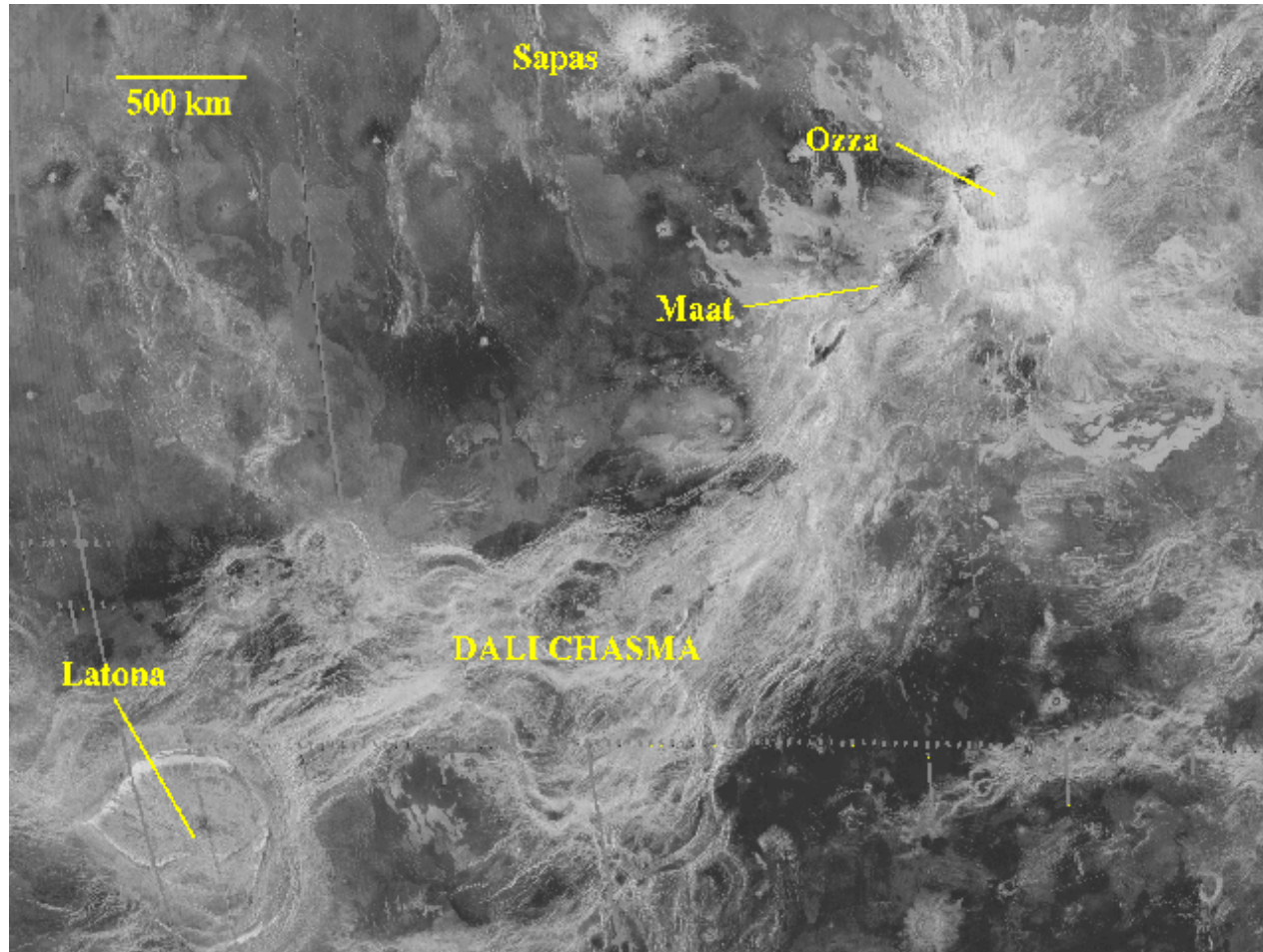
# Venus – Surface Radar Map (Pioneer -- mercator projection)



# Ishtar Terra



# Aphrodite Terra



# Venus (Magellan hemispheric radar map – color coded)

