Astronomy 405
Solar System and ISM

Lecture 6
Venus

January 28, 2013

Venus Transits the Sun

June 8, 2004

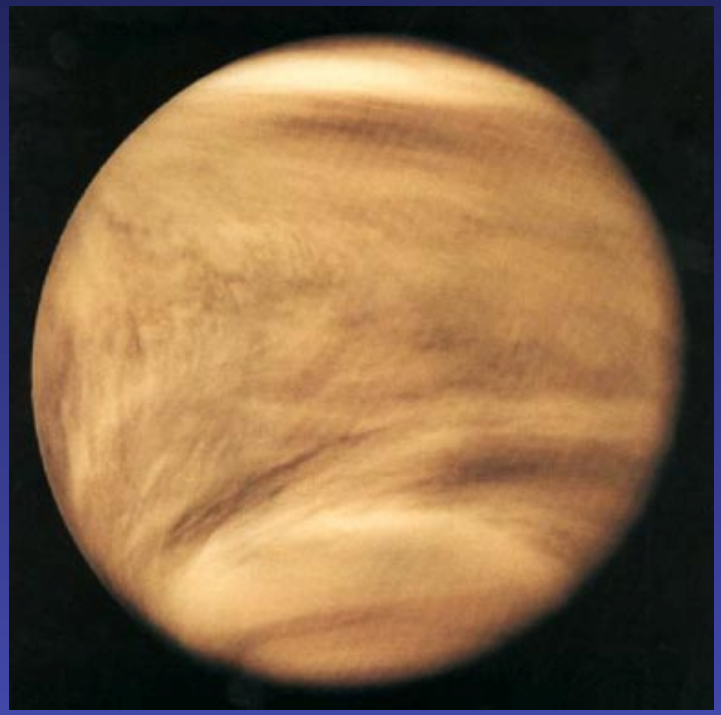
Pictures taken from Dwingeloo

Venus is similar to the Earth in mass and size:

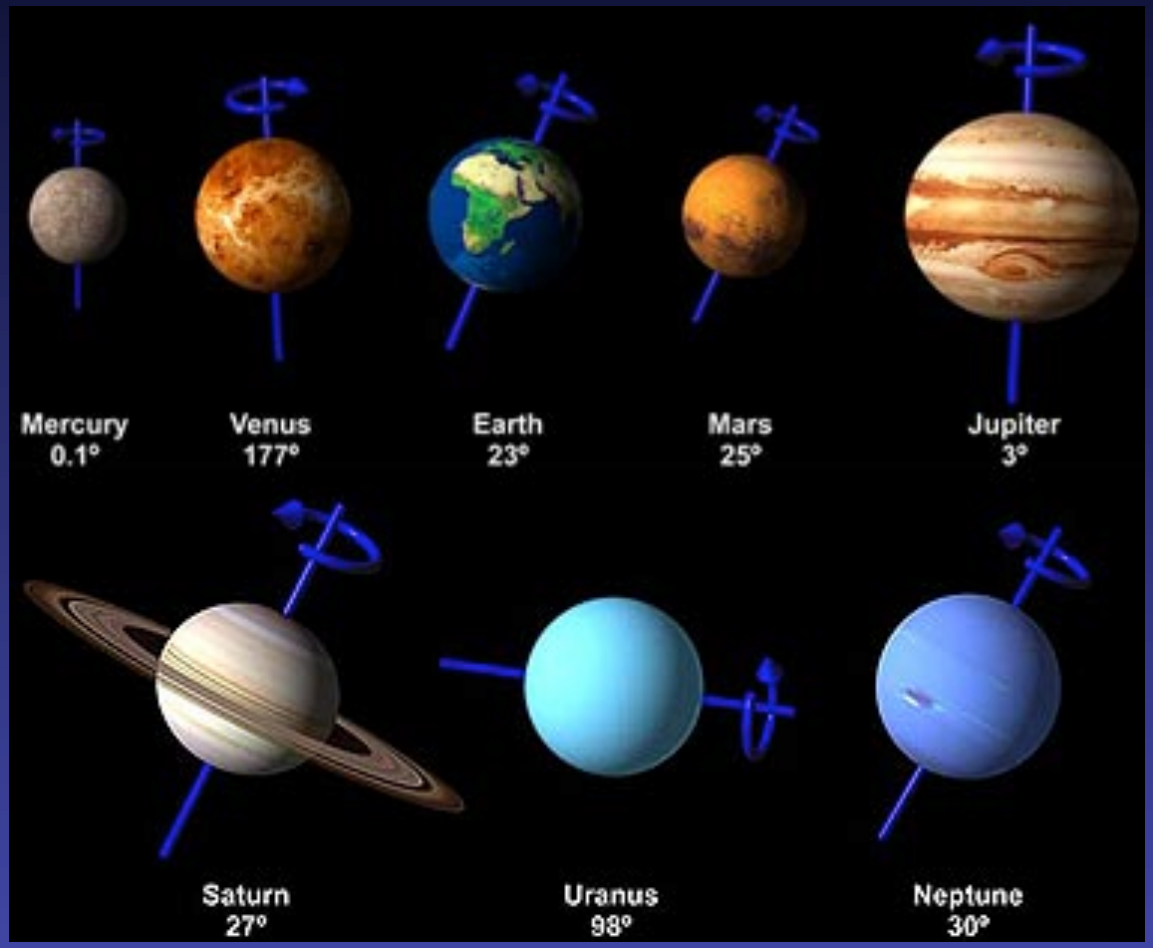
$R = 0.815\ R_{\oplus}$ $M = 0.9488\ M_{\oplus}$

Venus's atmosphere circulation was found to be retrograde (opposite direction to the orbital motion) with a speed near 100 m/s at the cloud top close to the equator.

Radar Doppler measurements of the surface show retrograde rotation 60 times slower. Rotation period = 243 days, longer than the orbital period 224.7 days.

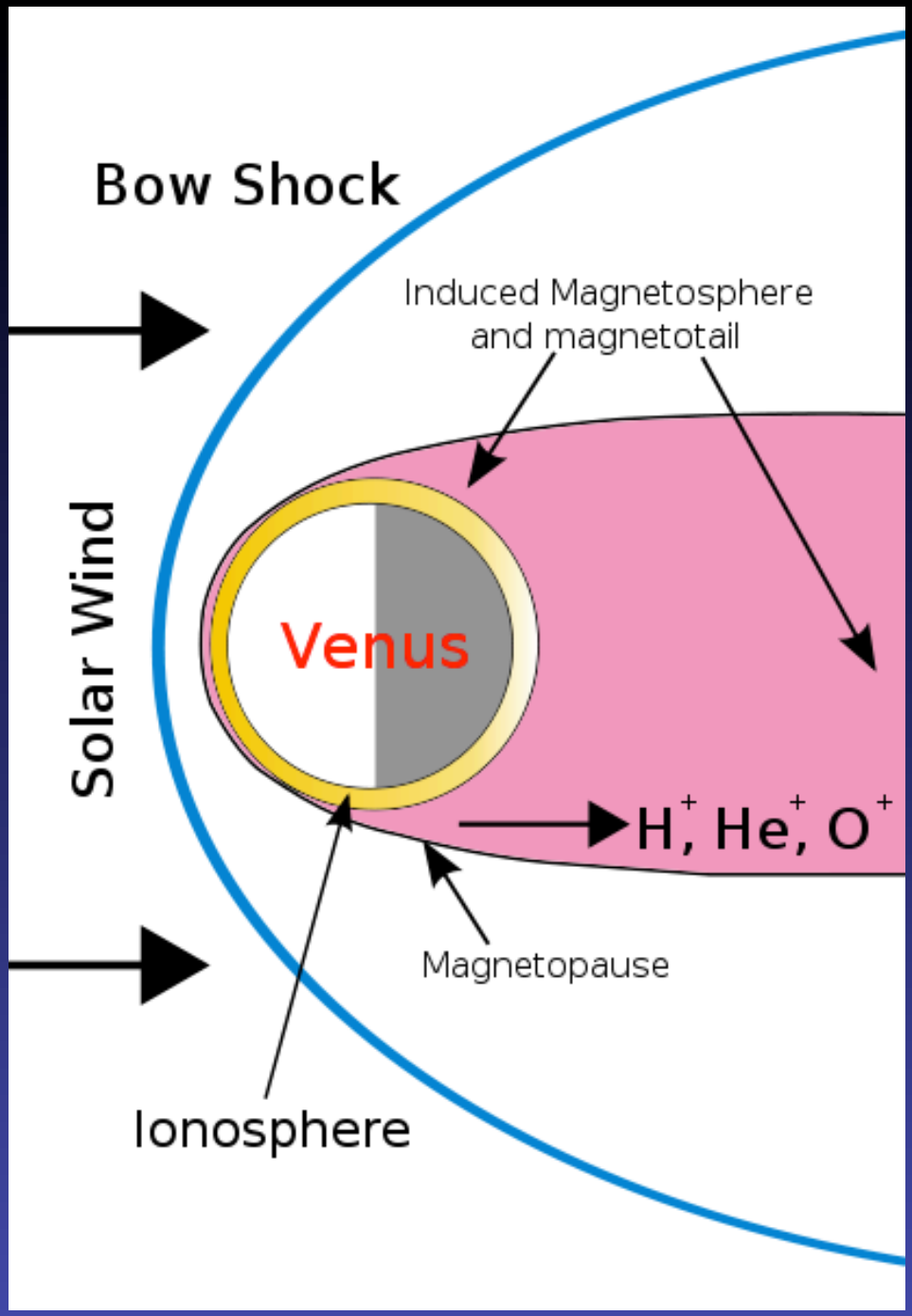


The origin of the retrograde rotation was suggested to be caused by collision, but recent simulations suggest That gravitational perturbations from other bodies can cause Venus's rotation axis to flip.



The thick atmosphere can be significantly affected by tidal forces and slow down the planet's rotation.

It is not known how The armosphere Acquired such high Rotational speed.



Venus

Slow rotation =>
Weak magnetic field

Solar wind directly strikes the upper atmosphere, causing collisional ionization and a bow shock.

The Hot, Thick Atmosphere of Venus

- composition: 96.5% CO_2, 3.5 N_2
  traces of Ar, SO_2, CO, H_2O
- thick clouds of concentrated sulfuric acid (H_2SO_4) !!!
- at the base of the atmosphere, 740 K, 90 atm
- optical depth of the atmosphere $\tau = 70$
  severe Greenhouse effect
- atmosphere has been altered by outgas from volcanoes
- The Sun was 30% less luminous at birth, Venus was closer to the Sun, so had hot water ocean. As the Sun heated up, water evaporated and caused a runaway Greenhouse effect. H_2O floated to the top and CO_2 sank to the bottom.
  $H_2O + \gamma \Rightarrow H + HO$, escaped from exosphere…
  D/H = 0.016 on Venus; 1.57×10^{-4} on Earth

Surface of Venus imaged by Soviet Union's Venera 13 March 1982

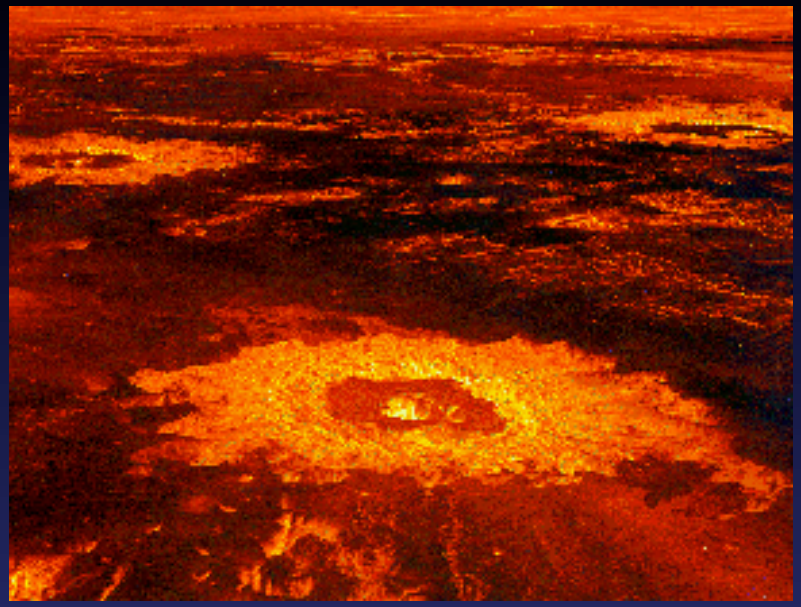
Imaged the surface and measured compositions of atmosphere and rocks - sulfur in the air, volcanic rocks

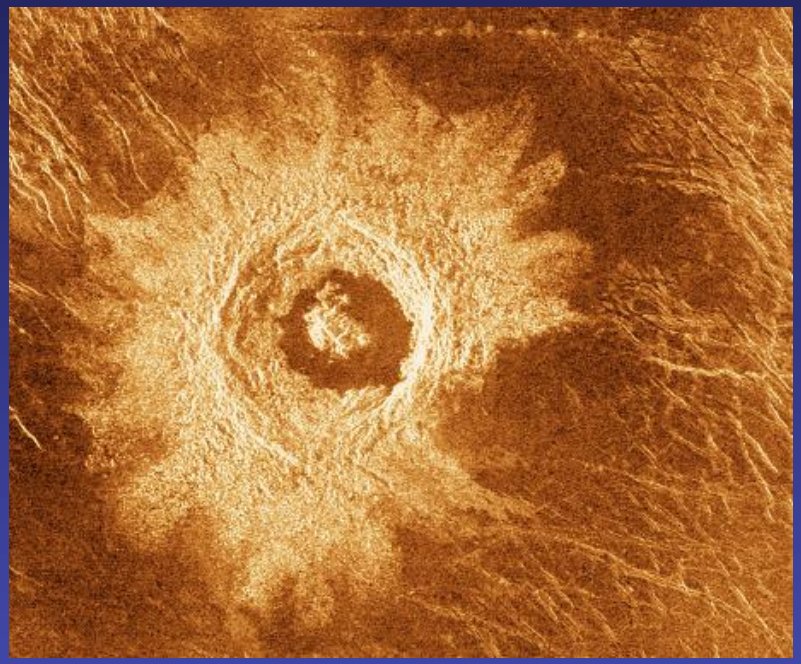
Radar Imaging by Magellan 1989-1994 (launched from Atlantis)

Mapped 98% of the surface of Venus at a resolution of 75 m and 120 m.

Generated a gravity map.

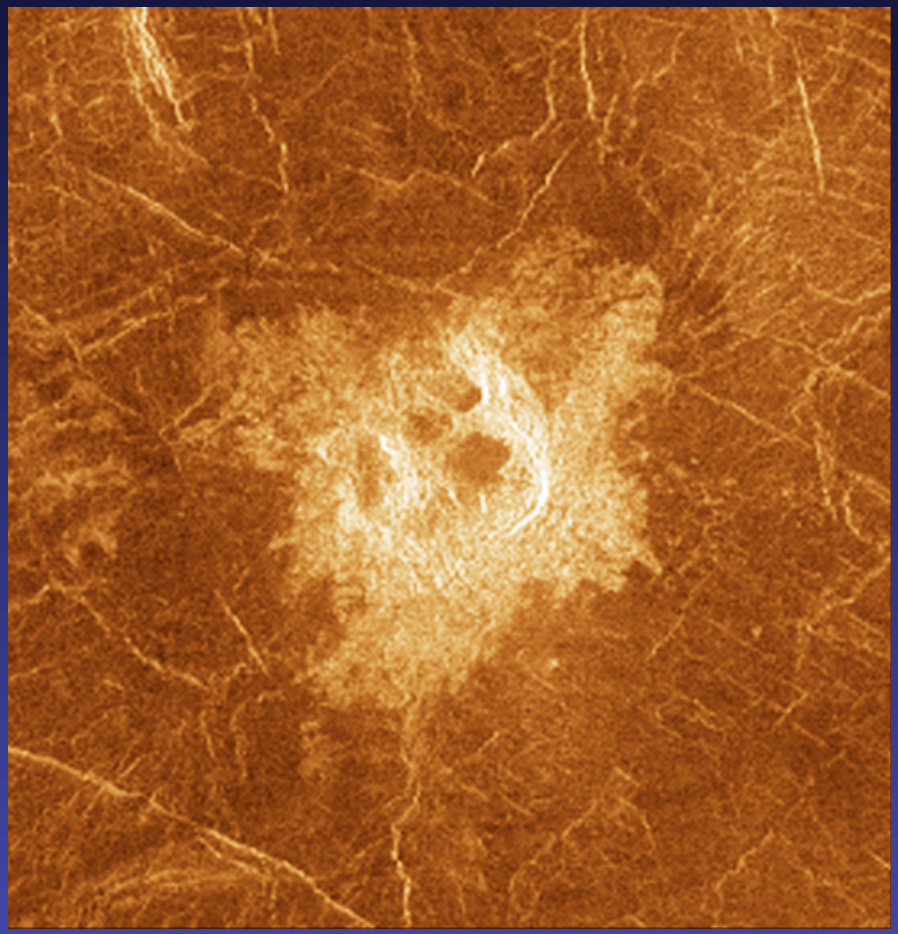
(Vertical relief is × 22.5)

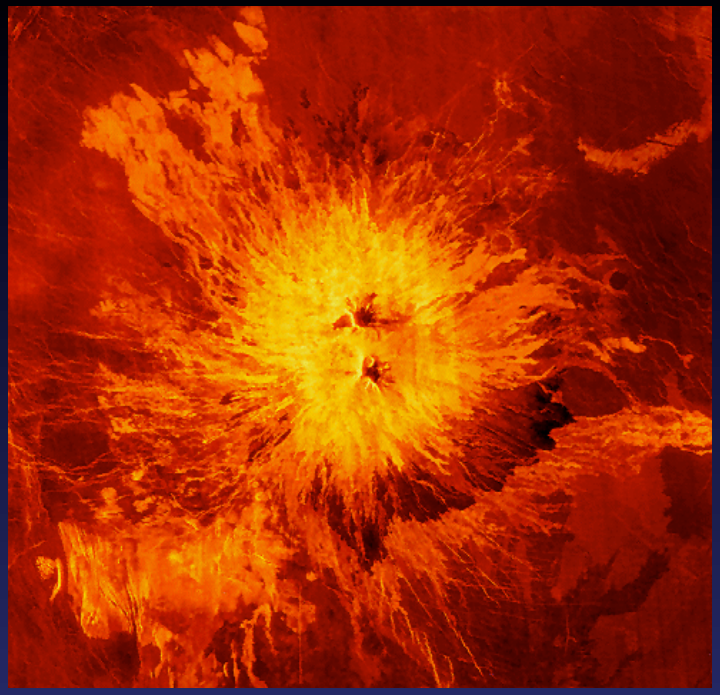




Craters on Venus

- large ejecta blanket
- clustered craters





Volcanoes on Venus

- shield volcanoes
- tick volcano

(Vertical relief is × 22.5)

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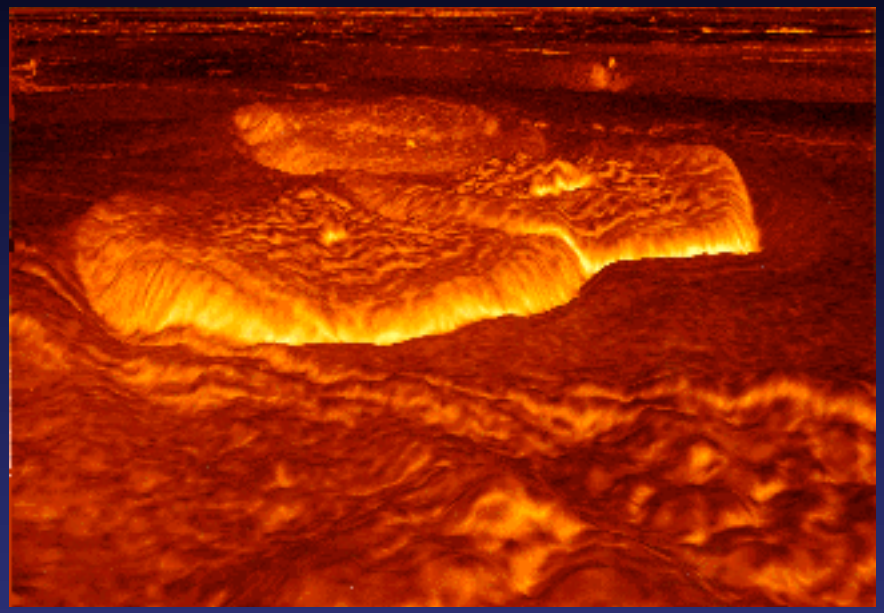
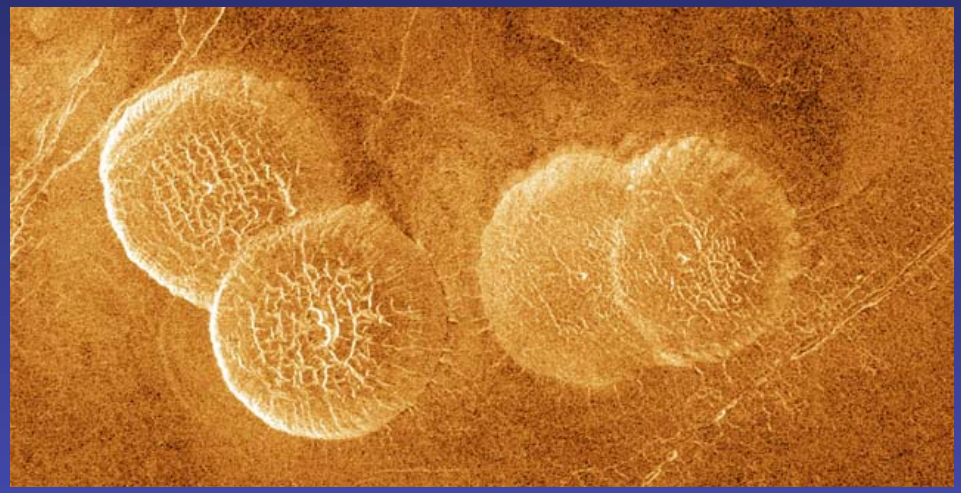
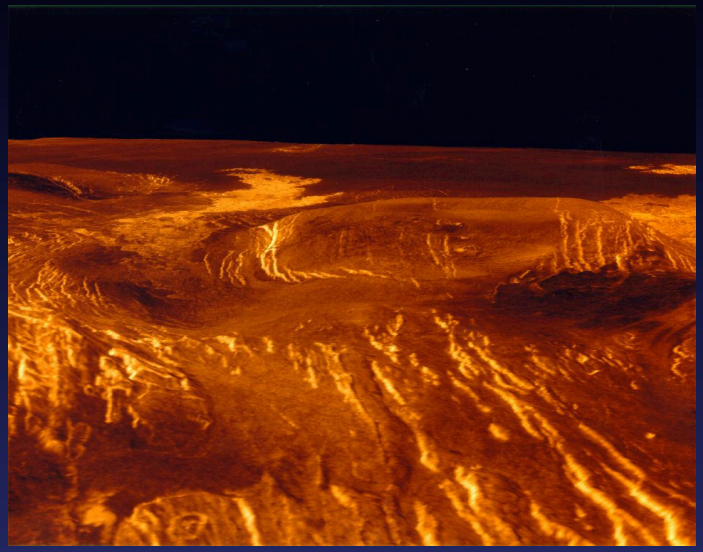
Volcanoes on Venus

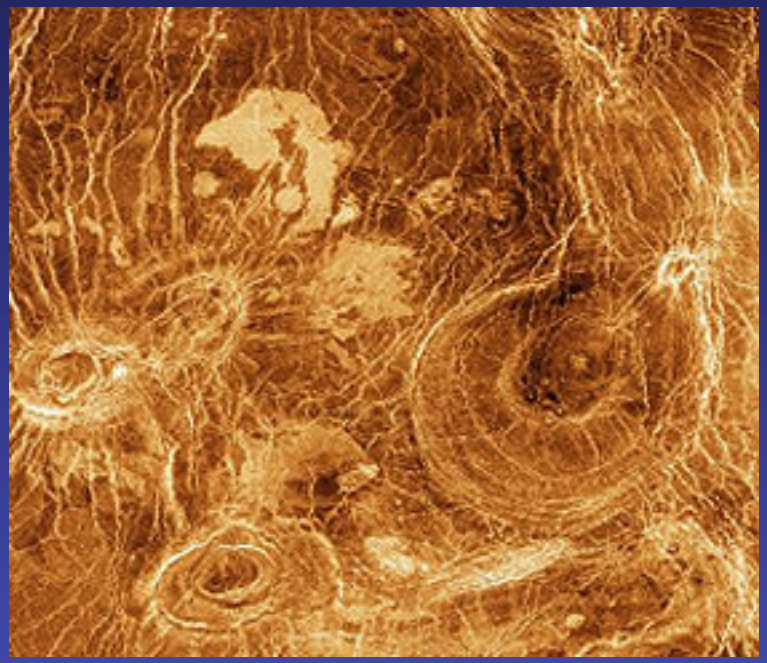
Pancake volcanoes





Circular coronae





Lava Flows on Venus