# *Craters, Volcanoes, and Tectonics in the Solar System*

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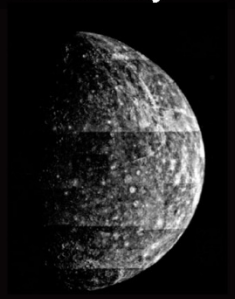
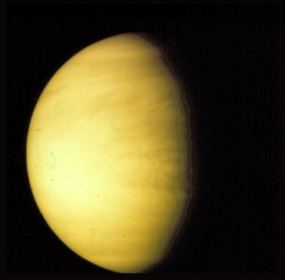
*Northwestern University*

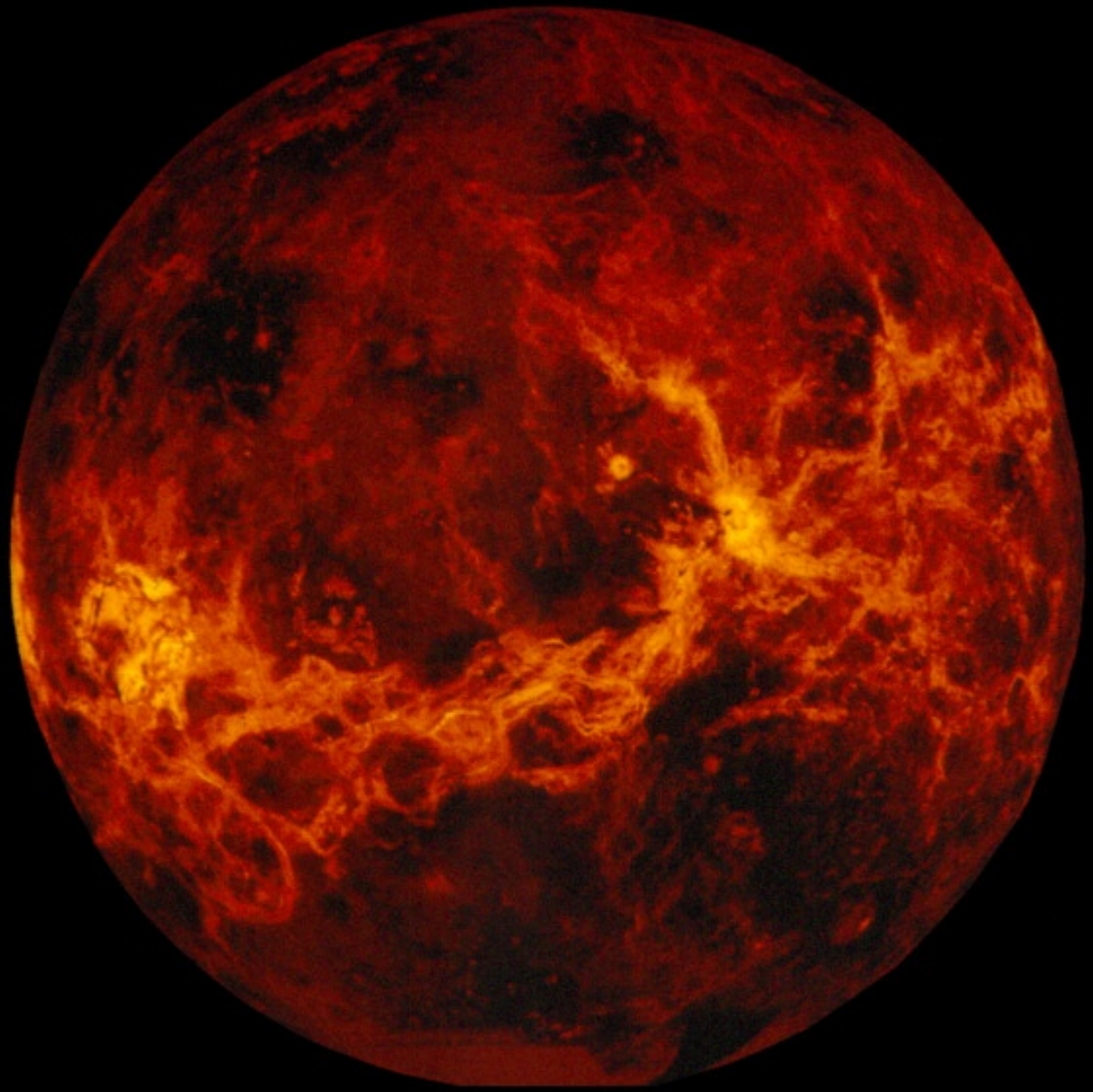
# Early View of Venus

| | Mercury | Venus | Earth | Moon | Mars |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Radius (km) | 2439 | 6052 | 6378 | 1738 | 3398 |
| Mass (kg) | $3.30 \times 10^{23}$ | $4.87 \times 10^{24}$ | $5.98 \times 10^{24}$ | $7.35 \times 10^{22}$ | $6.42 \times 10^{23}$ |
| Density ($kg/m^3$) | 5420 | 5250 | 5520 | 3340 | 3940 |
| Distance from the Sun (A.U) | 0.387 | 0.723 | 1.000 | --- | 1.524 |
| Mean Surface Pressure (bars) | --- | 92 | 1 | --- | 0.006 |
| Mean Surface Temp (K) | 452 | 726 | 281 | 250 | 230 |
| Atmosphere | --- | $CO_2$ | $N_2$, $O_2$ | --- | $CO_2$ |

# Venus, as seen by Veneras 9 and 10

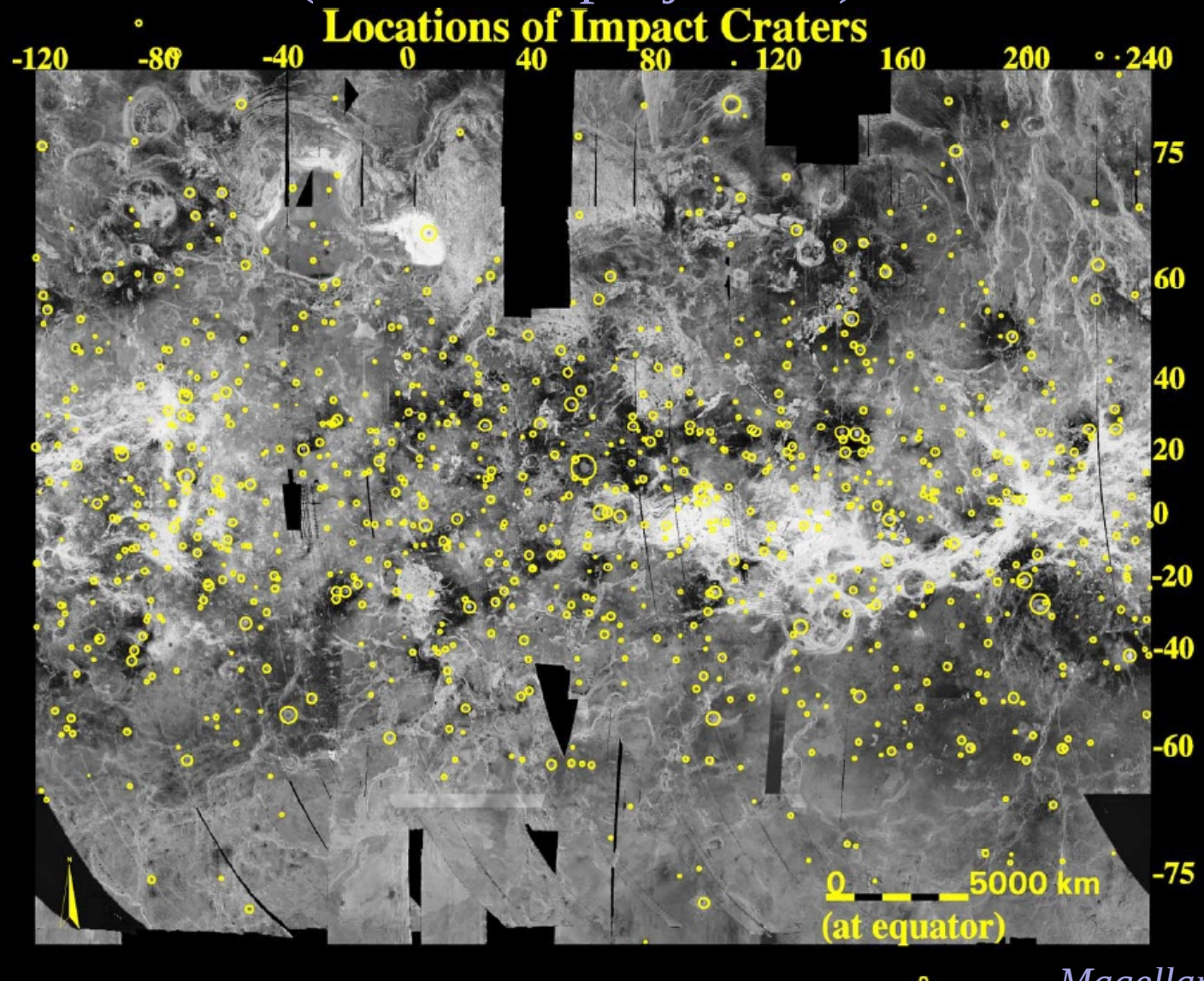
# Magellan Deployment


*Space Shuttle*



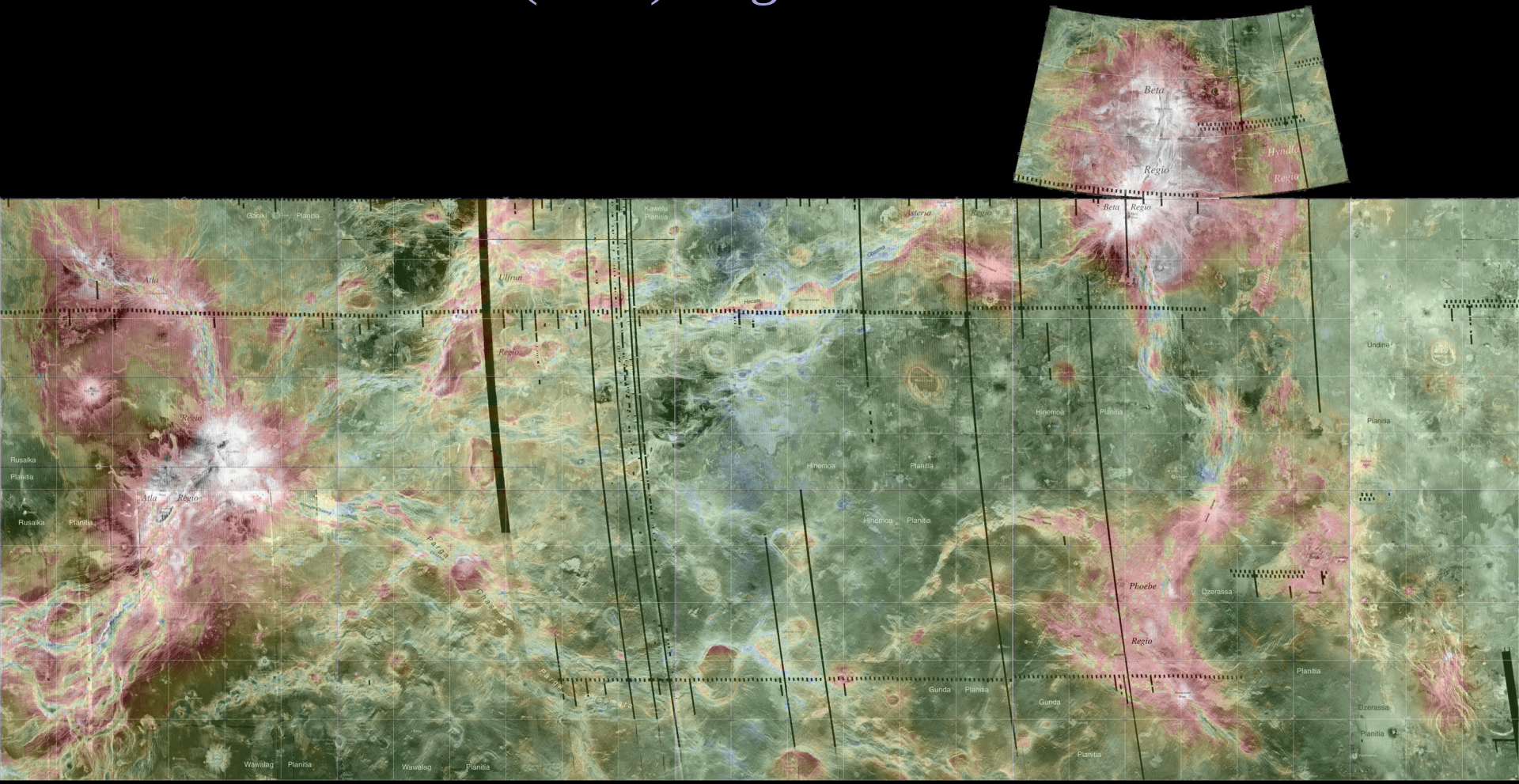
Magellan Radar
Image of Venus

# Venus Chasmata, Coronae, Craters, and Geoid (Eckert IV projection)



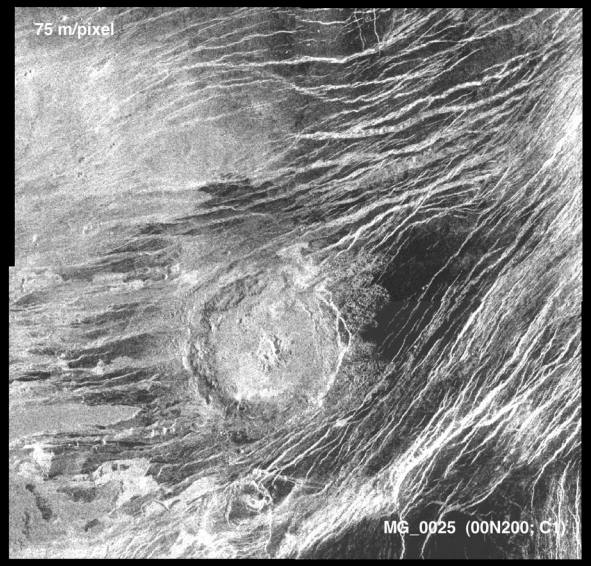

*Magellan, Radar*

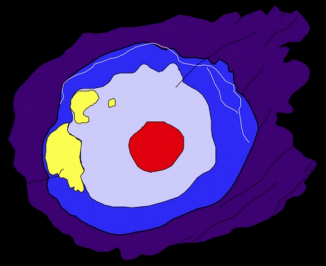
# Beta-Atla-Themis (BAT) Region

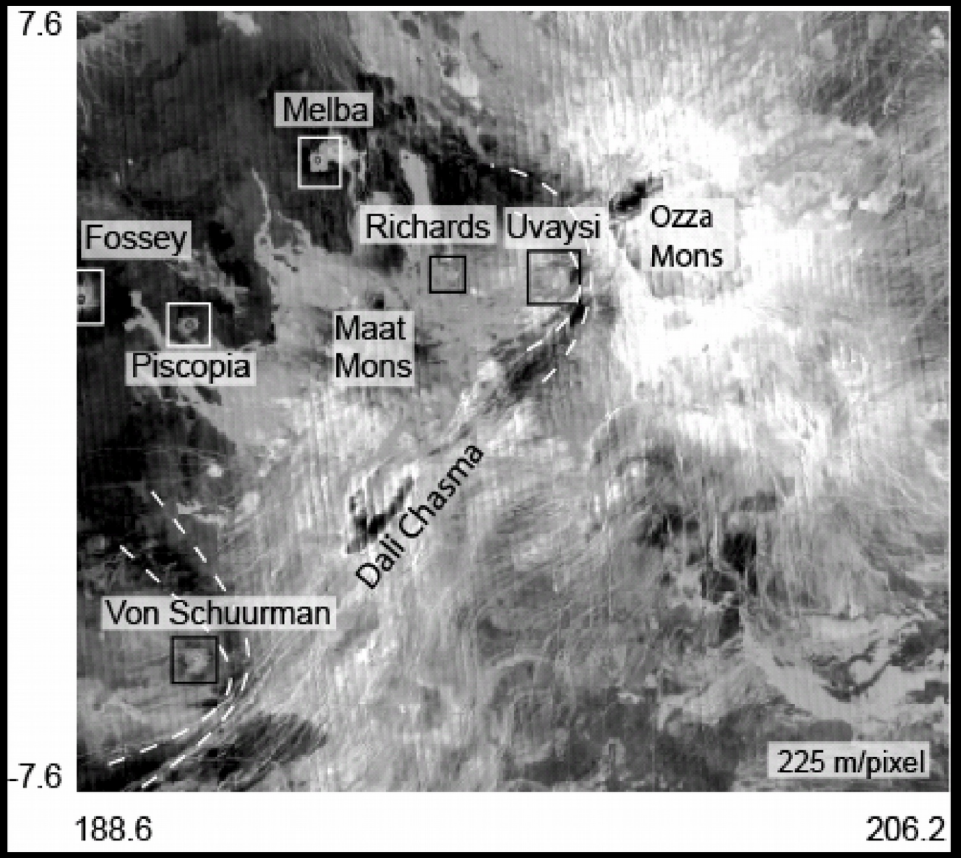



*Magellan, Magellan, Radar*

# Uvaysi Crater



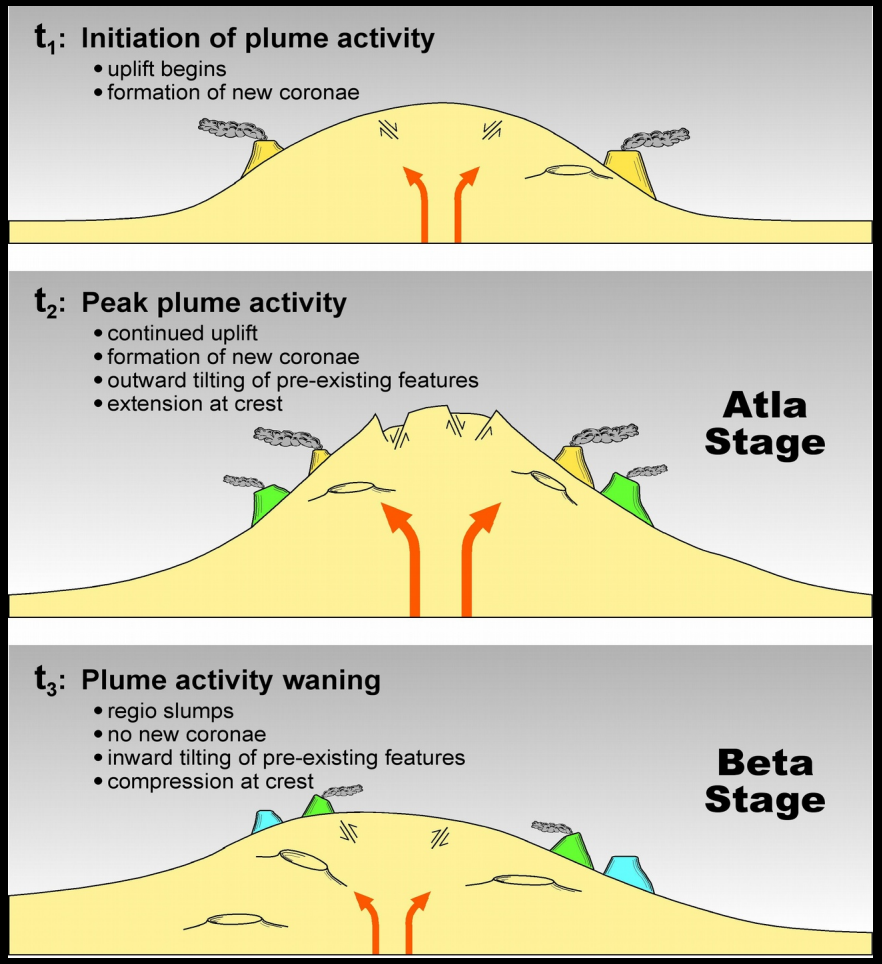






2.3 N, 198.2 E
38.0 km

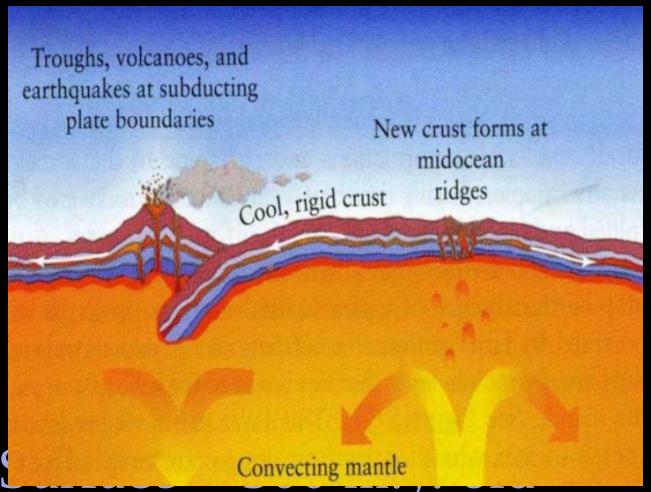
*Magellan, Radar*

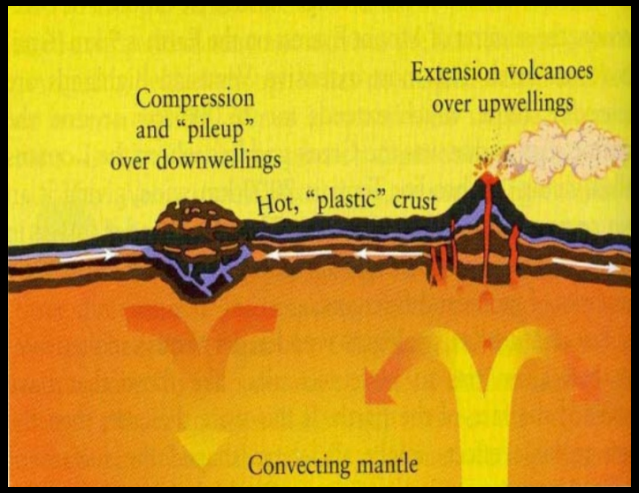
# Regio Stages



# Summary: Venus

- Elevation, unimodal= -3.9 to 12 km
- Mostly flat plains with some topographic swells, volcanoes, dune fields, rift valleys, ~ 1000 impact craters
- No Plate Tectonics

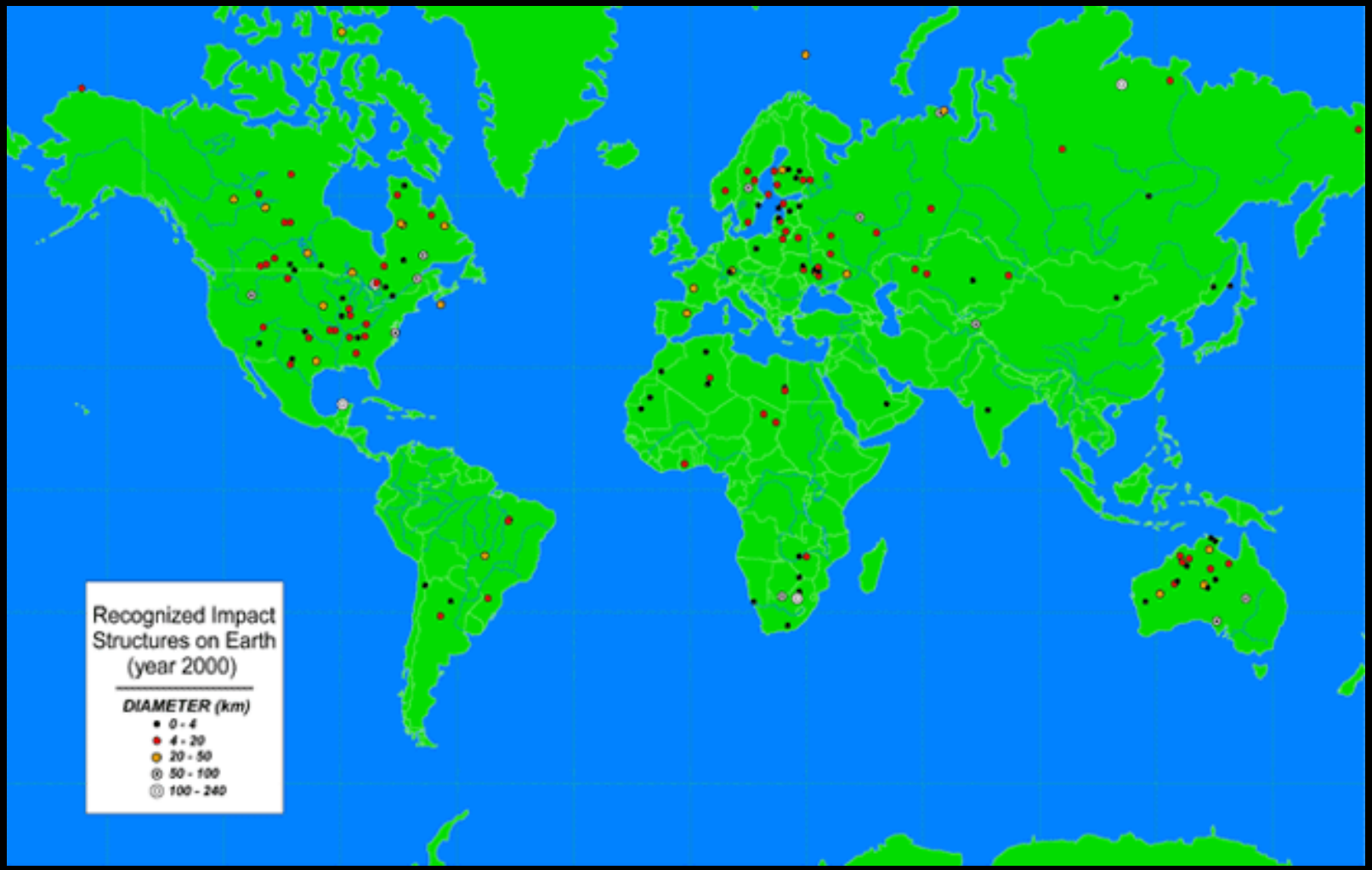



*Freedman & Kaufmann 2002*

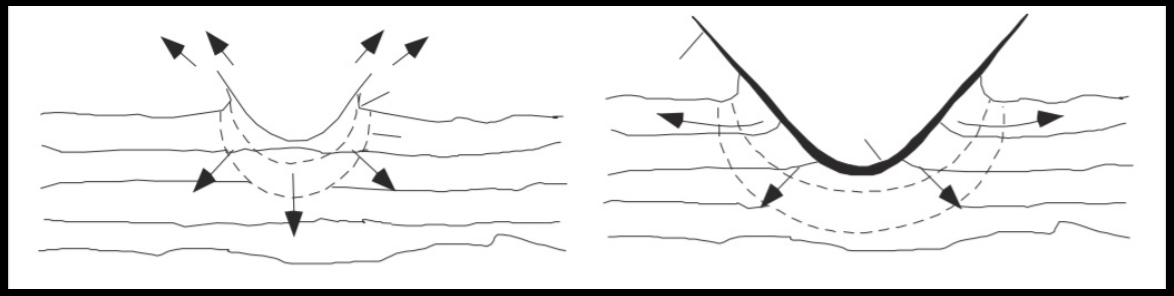
- Surface = Geologically Old
  - Equilibrium Resurfacing Hypothesis
  - Global Catastrophe Hypothesis

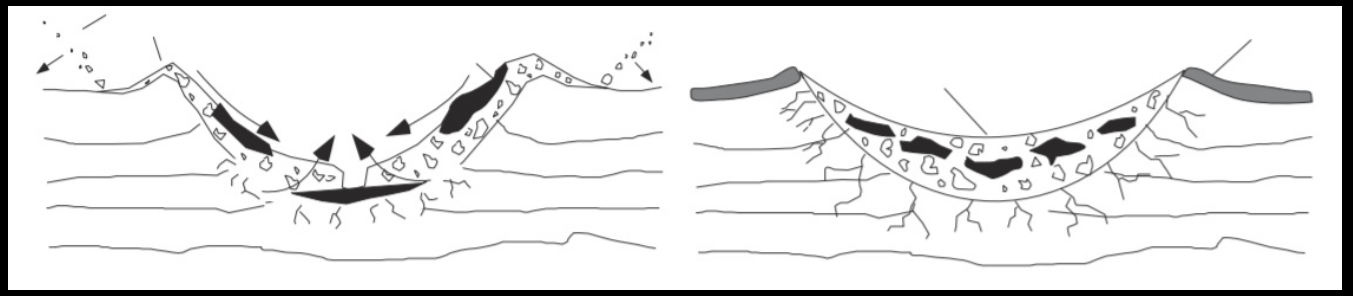
# Impact Structures on Earth

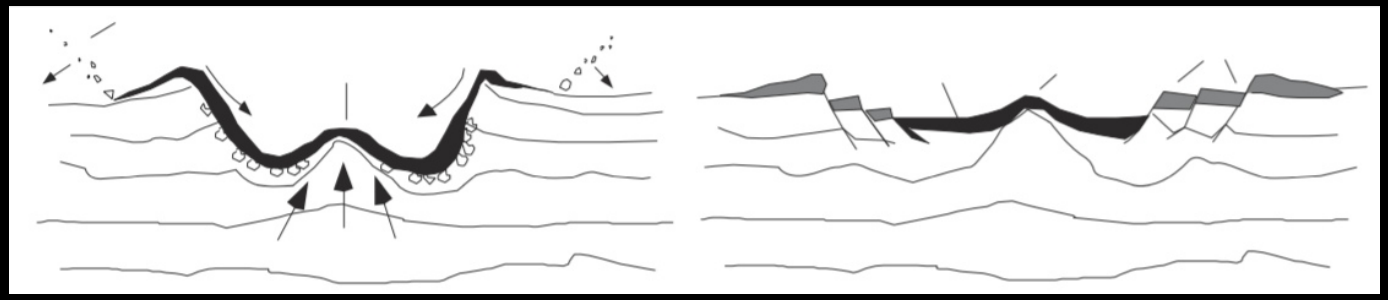



*LPI Craters*

# Impact Cratering as a Geologic Mechanism

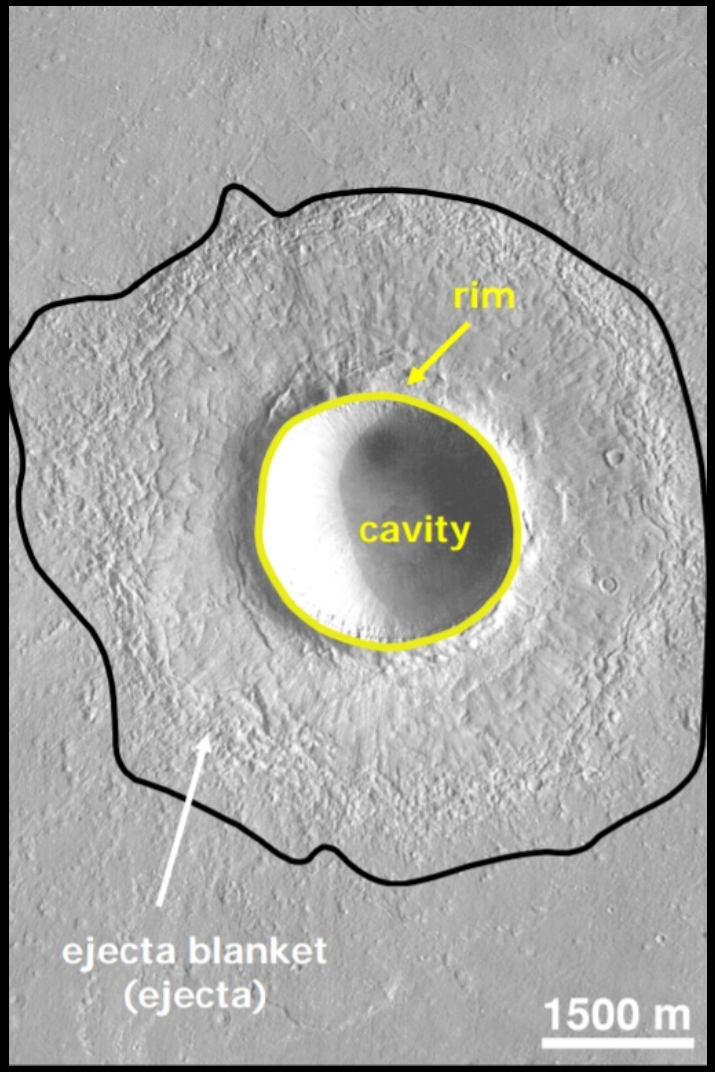






*Melosh, 1989*

# Impact Crater Morphology

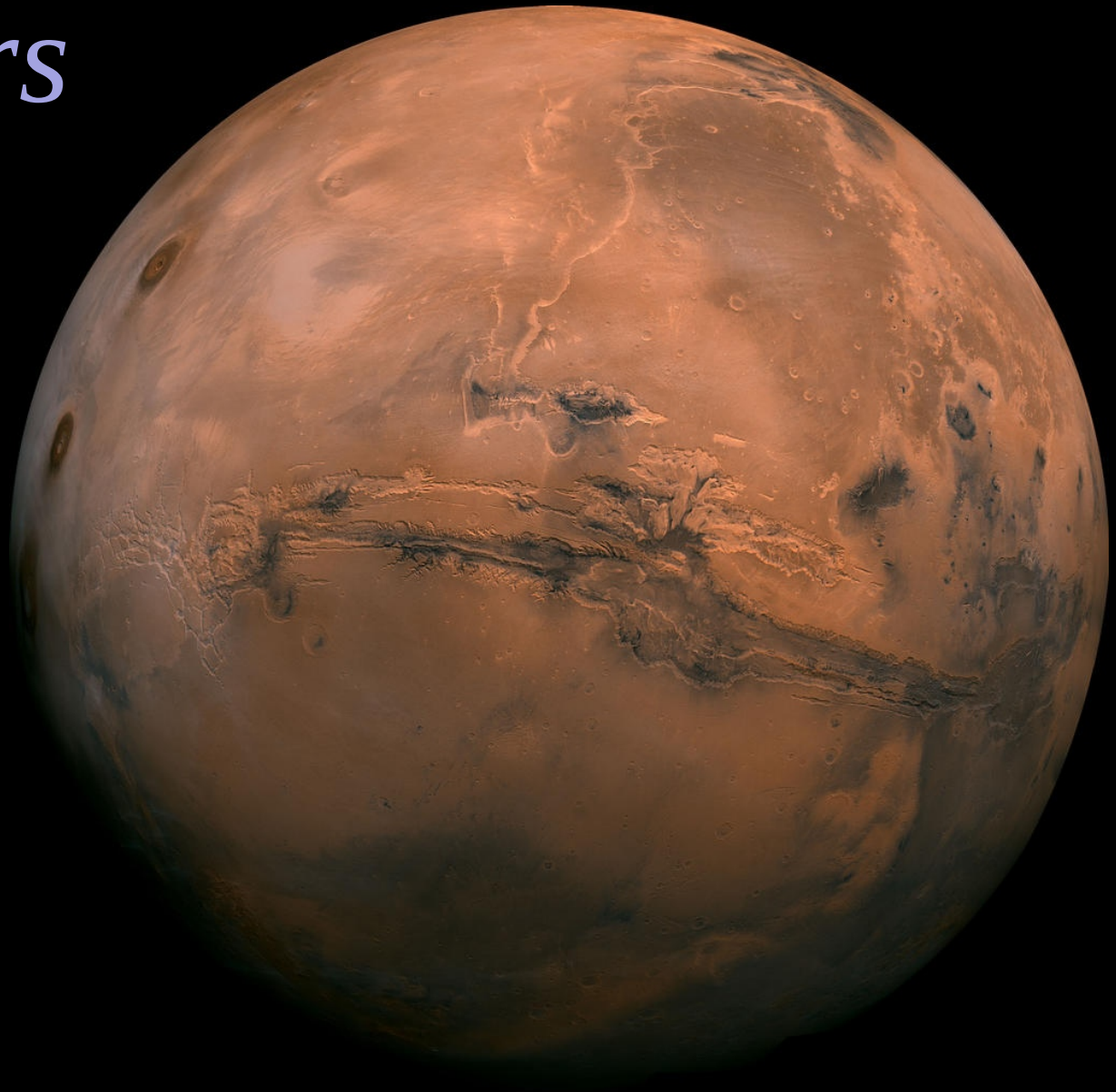



*MGS MOC*

Meteor Crater, Arizona
Diameter: 1.2 km
Age: 49,000 +/- 3,000 years

Vredefort, South Africa
Diameter: ~ 300 km
Age: 2,023 +/- 4 million years

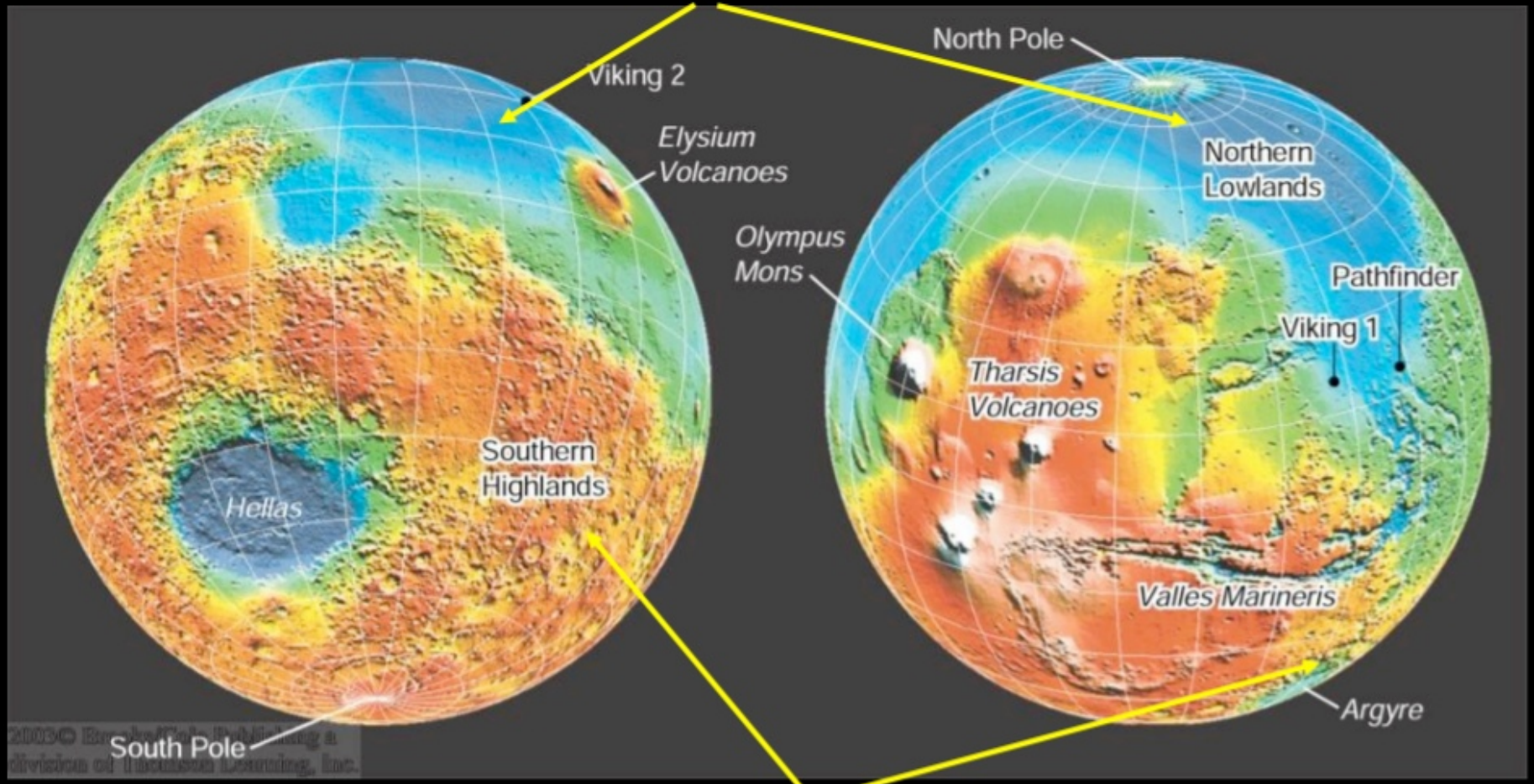
# *Mars*



*Viking, Composite*

Northern Lowlands: Free of craters; probably re-surfaced a few billion years ago.

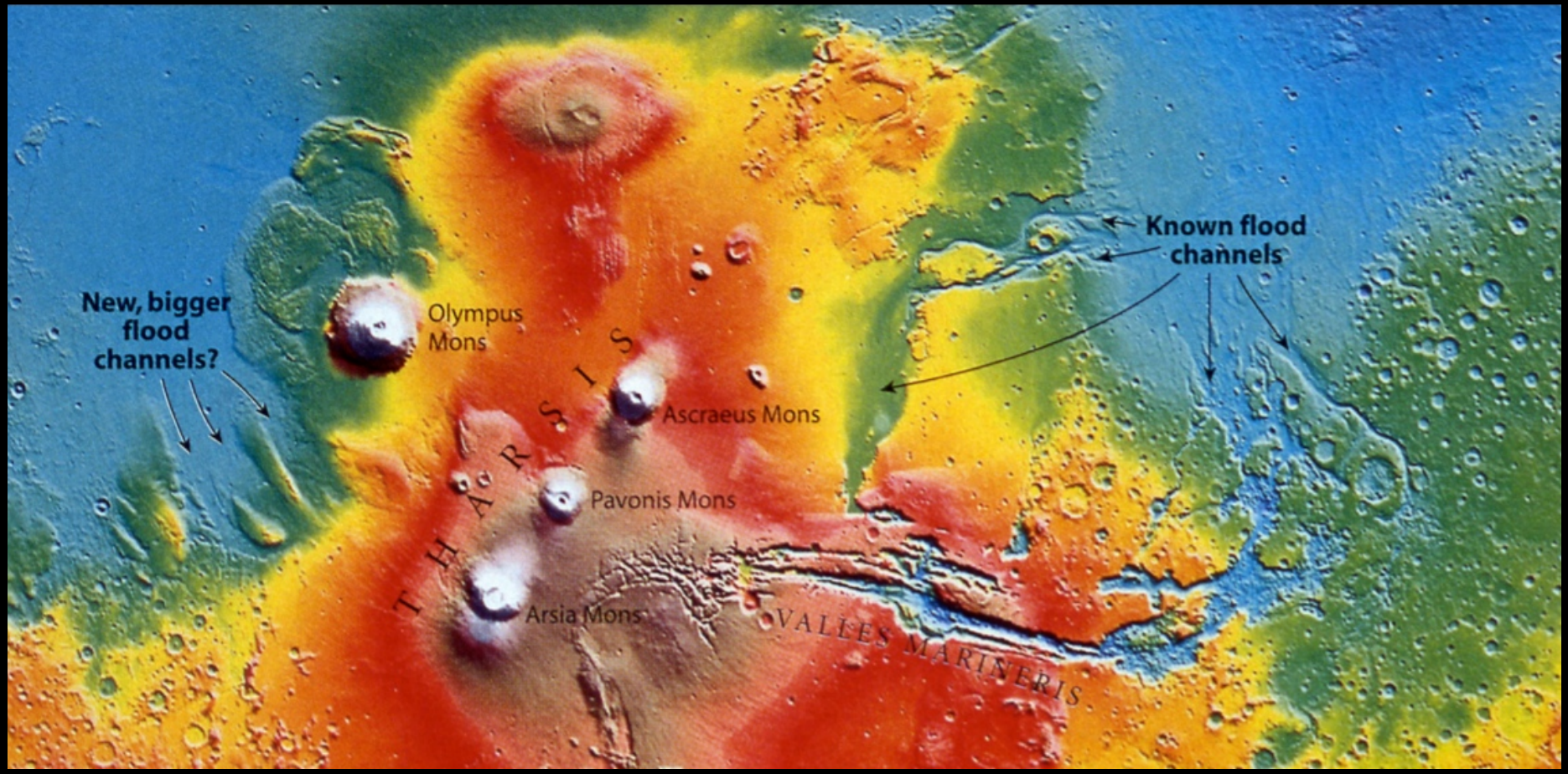
Possibly once filled with water.




Southern Highlands: Heavily cratered; probably 2 – 3 billion years old.

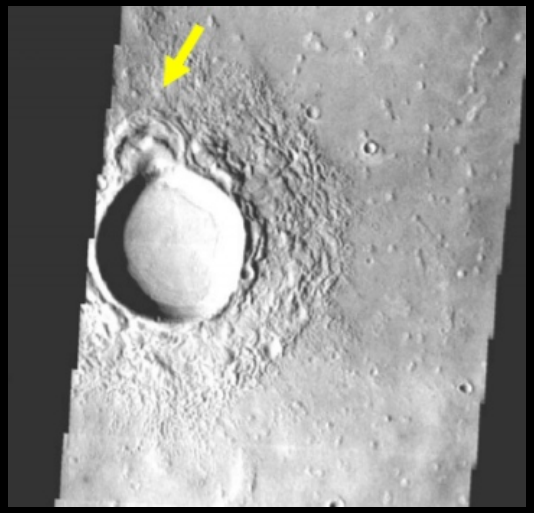
MGS MOLA

# Tharsis Region Topography

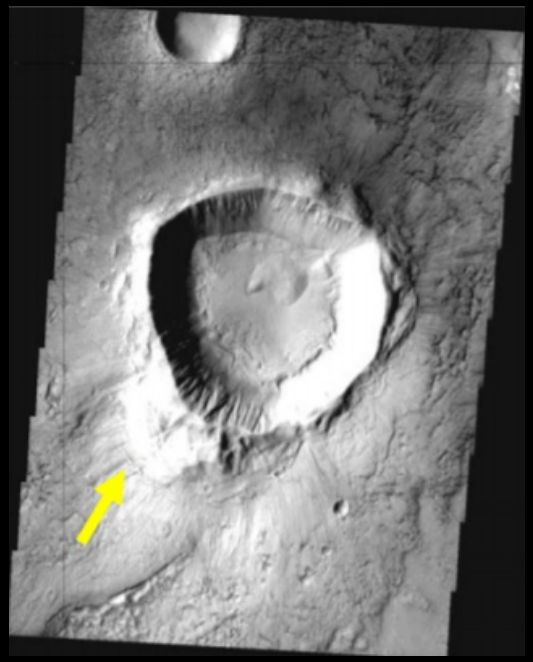



*MGS MOLA*

28.3 N, 116.7 E
14.9 km



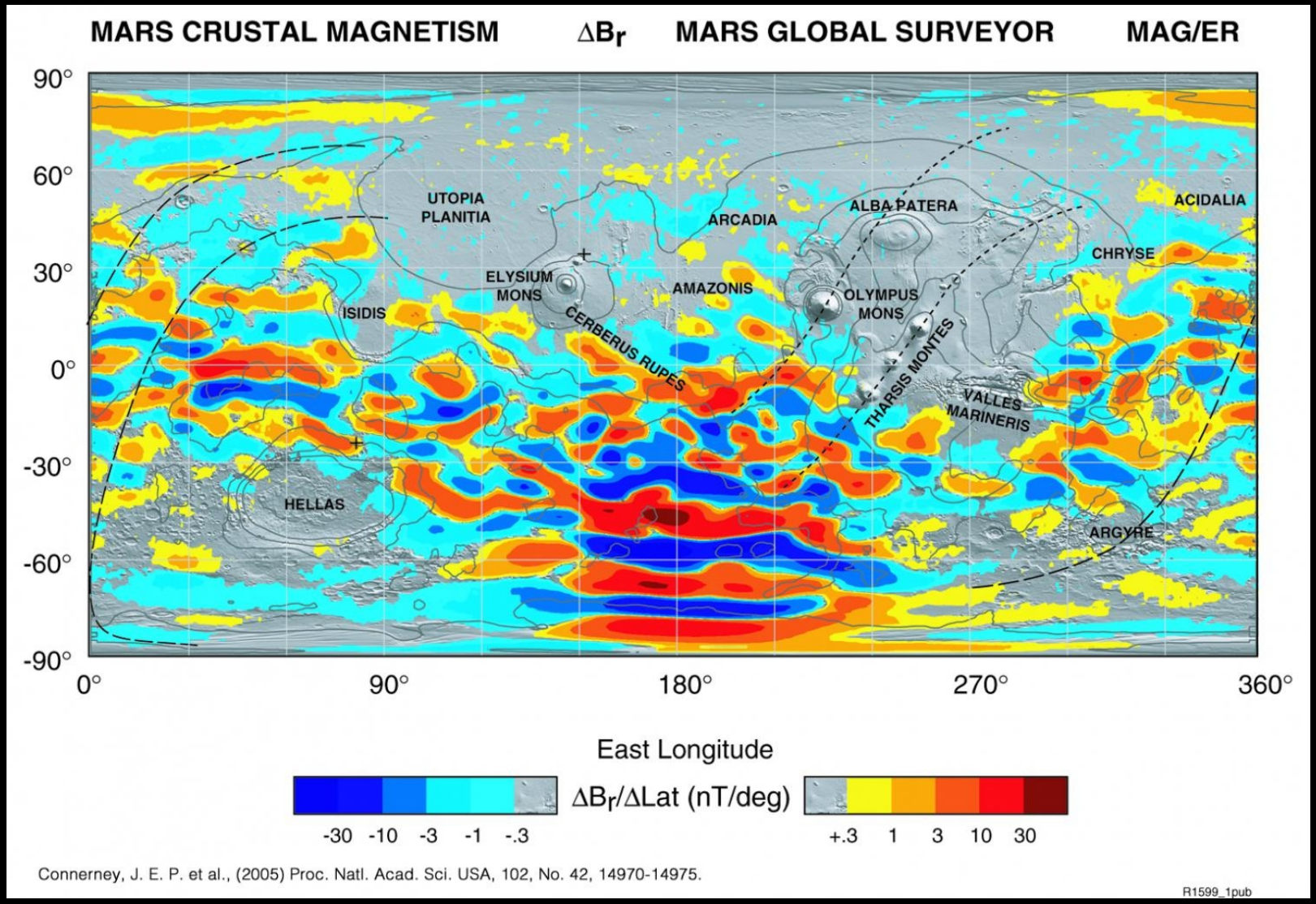
31.2 N, 88.7 E
7.3 km



38.0 N, 338.8 E
11.6 km

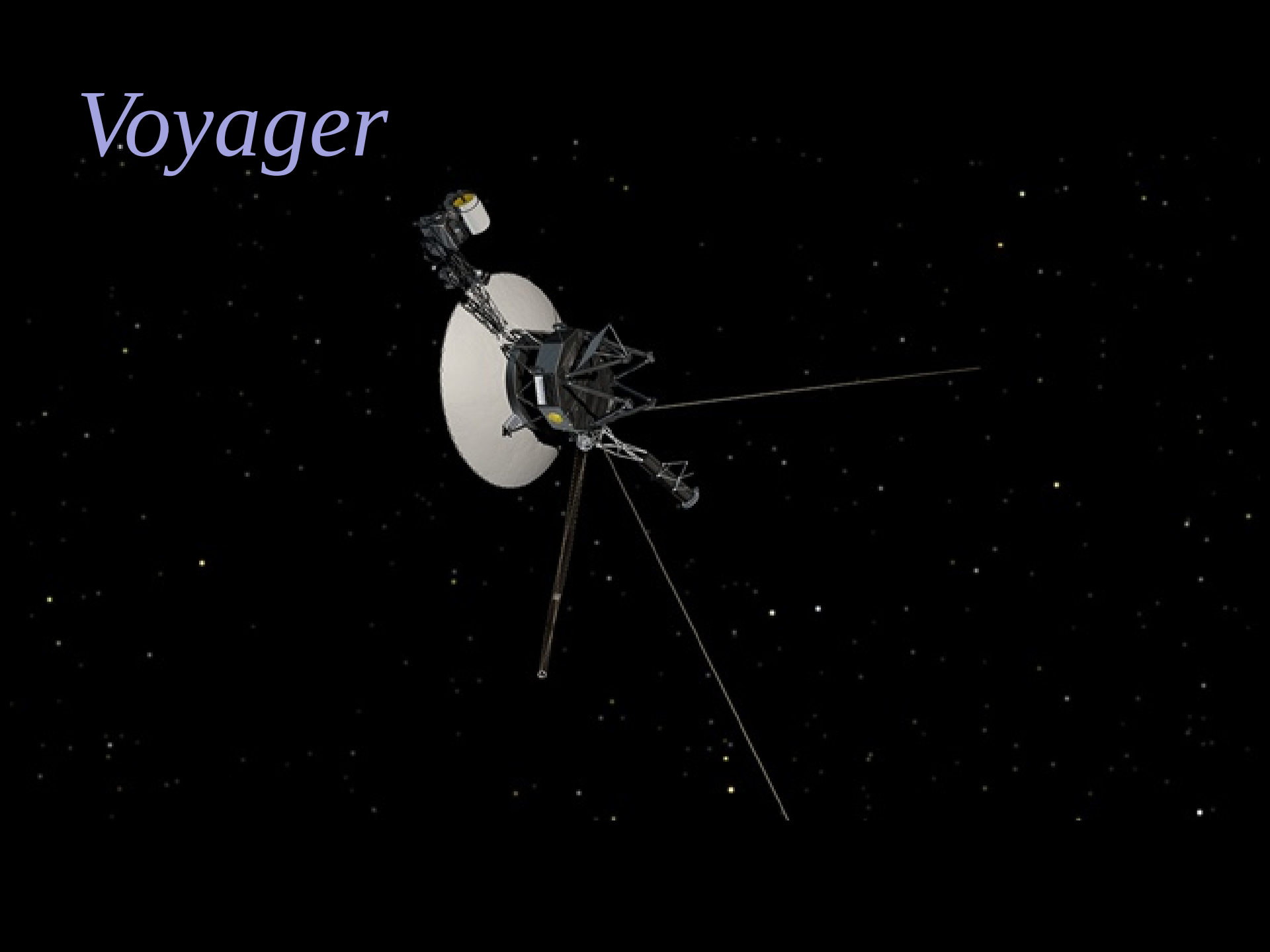
*MGS MOC*

# Martian Magnetics

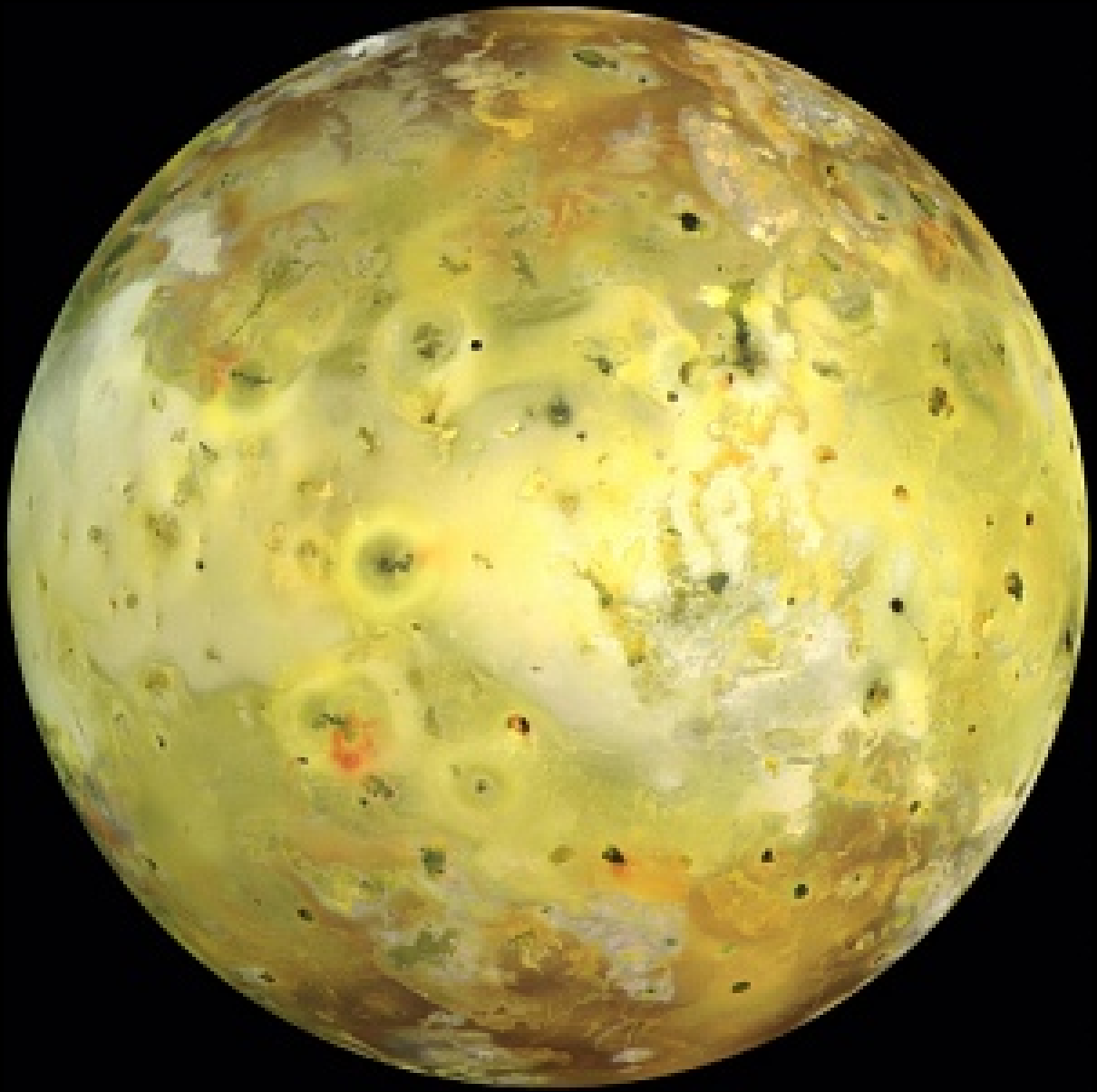



*MGS MAG/ER*

# *Voyager*

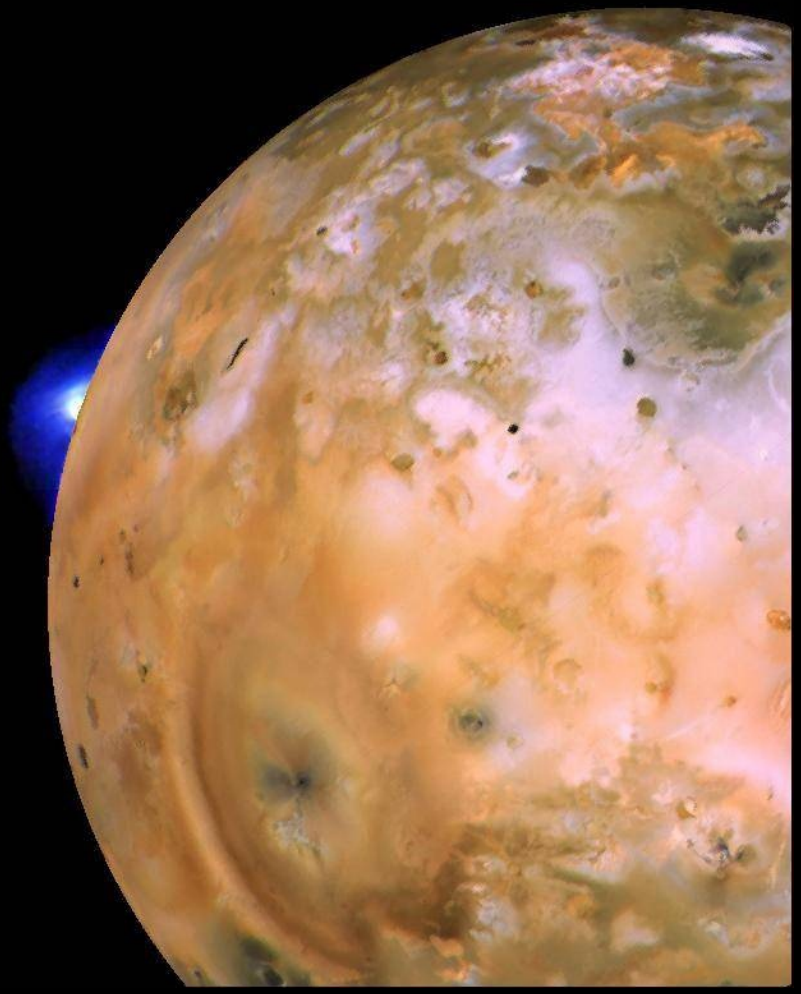


# *Io*



*Galileo*

# Sulphur and Silica-based Volcanism

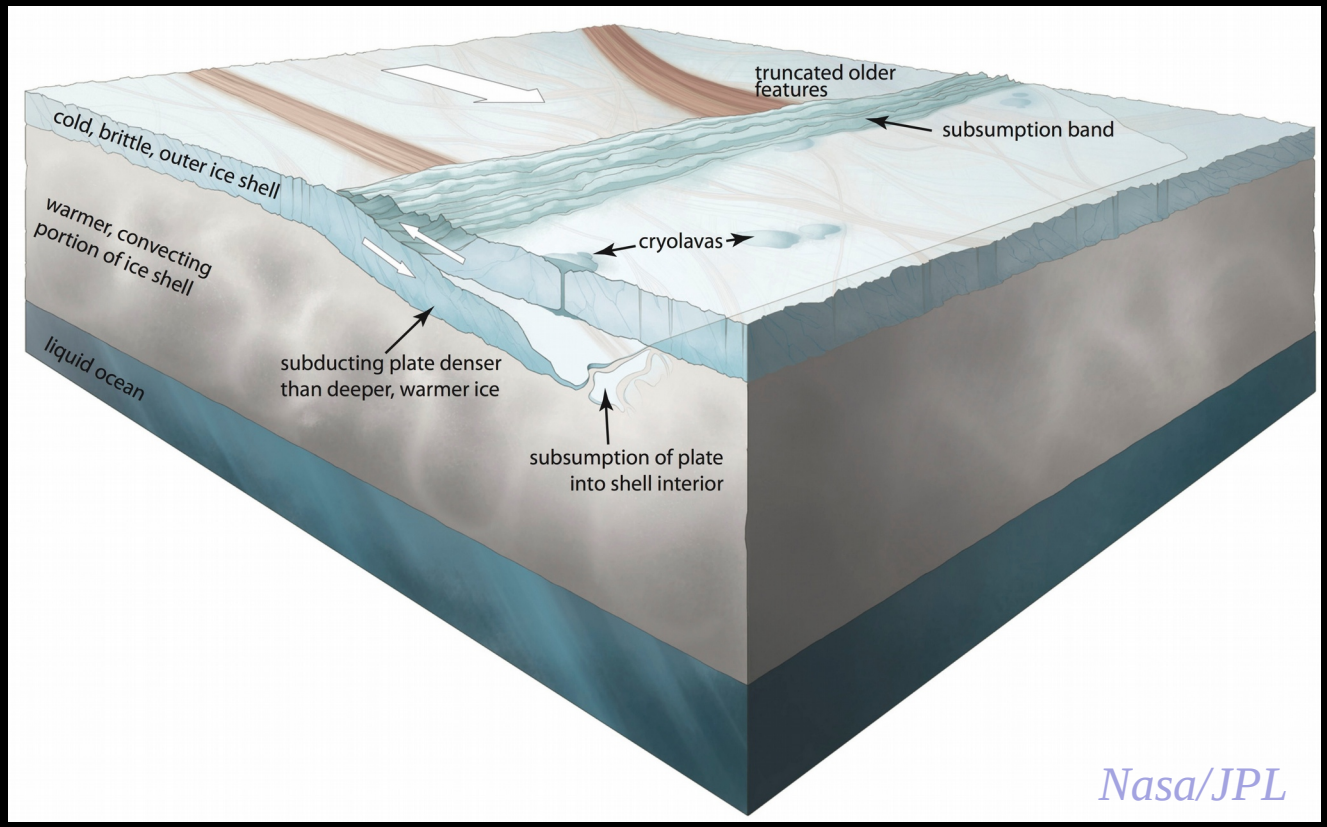


*Voyager 1*

# *Europa*

*Galileo*

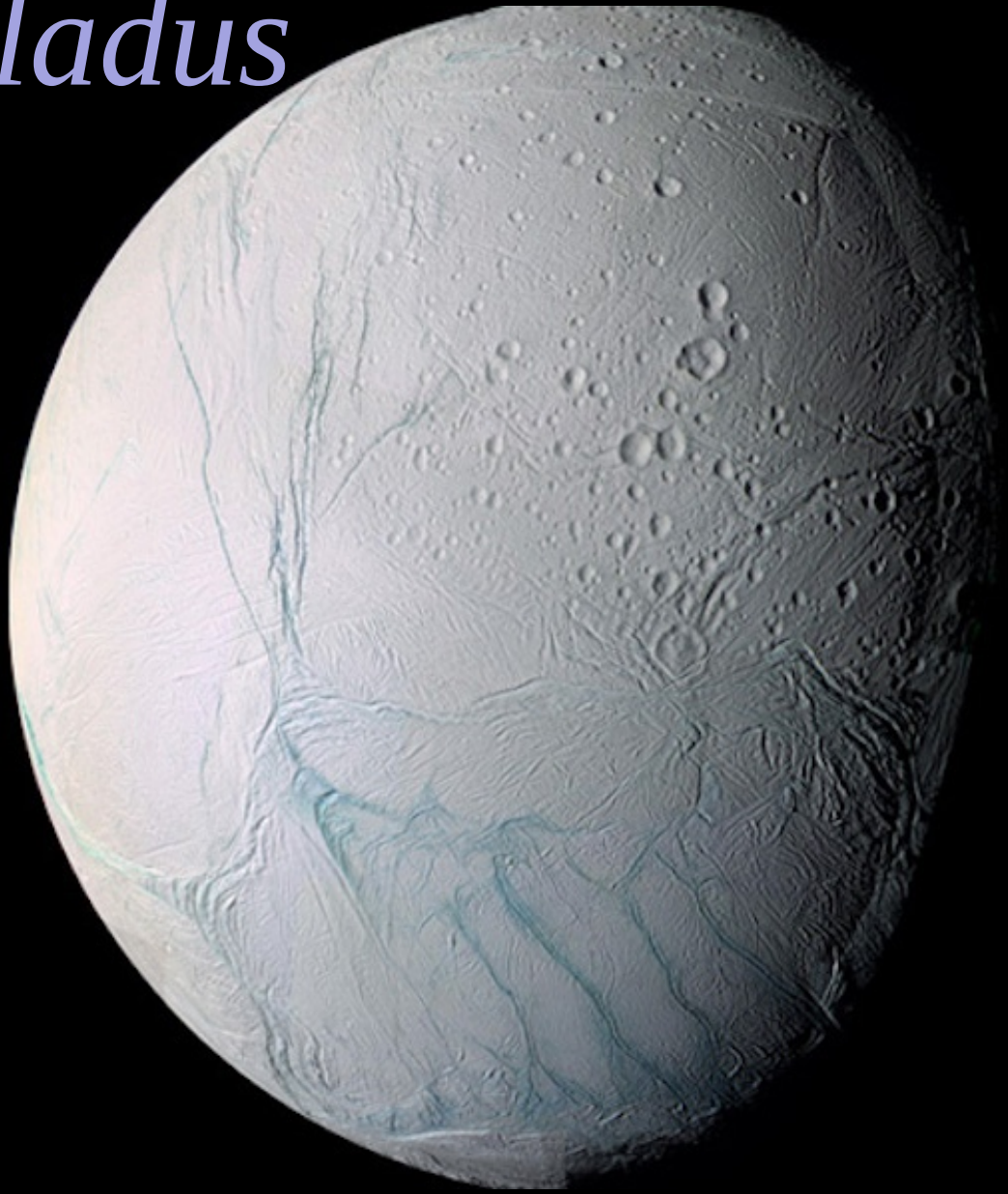
# Ice Tectonics



# *Callisto*

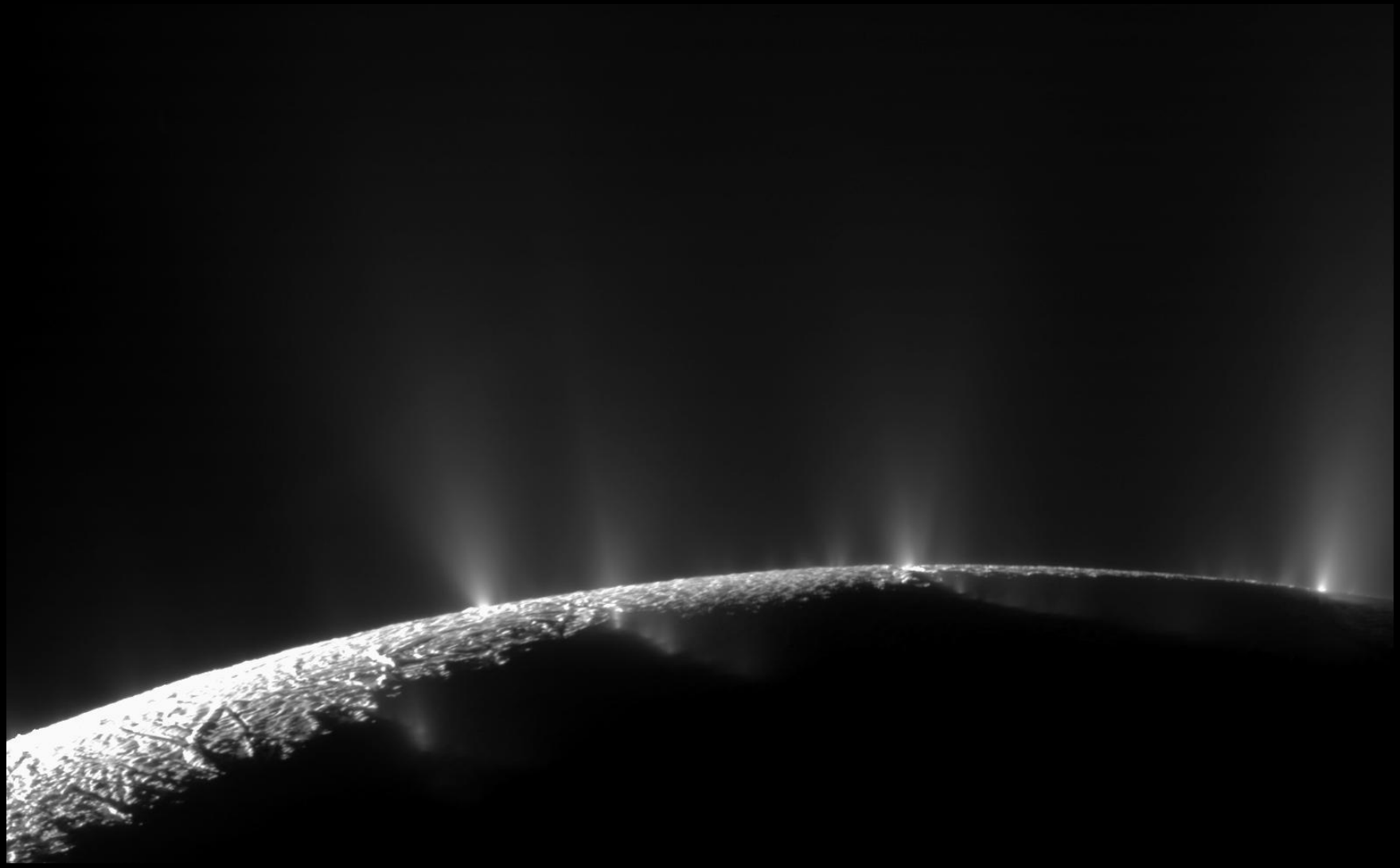
*Galileo*

# *Enceladus*



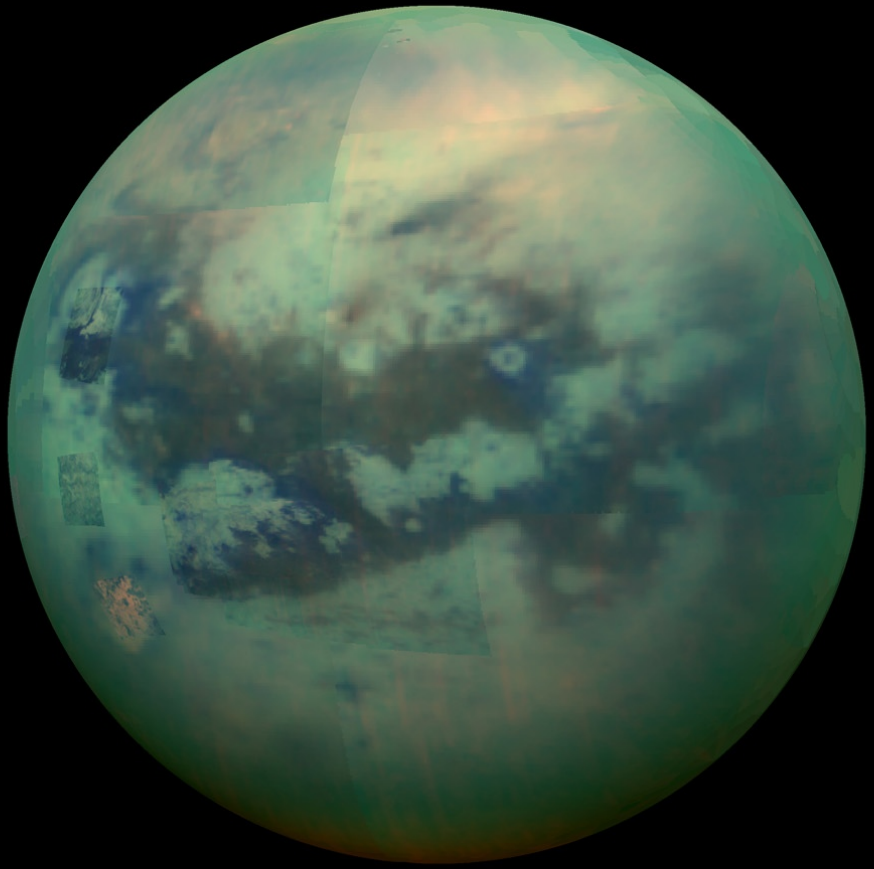
*Cassini*

# Active Geysers



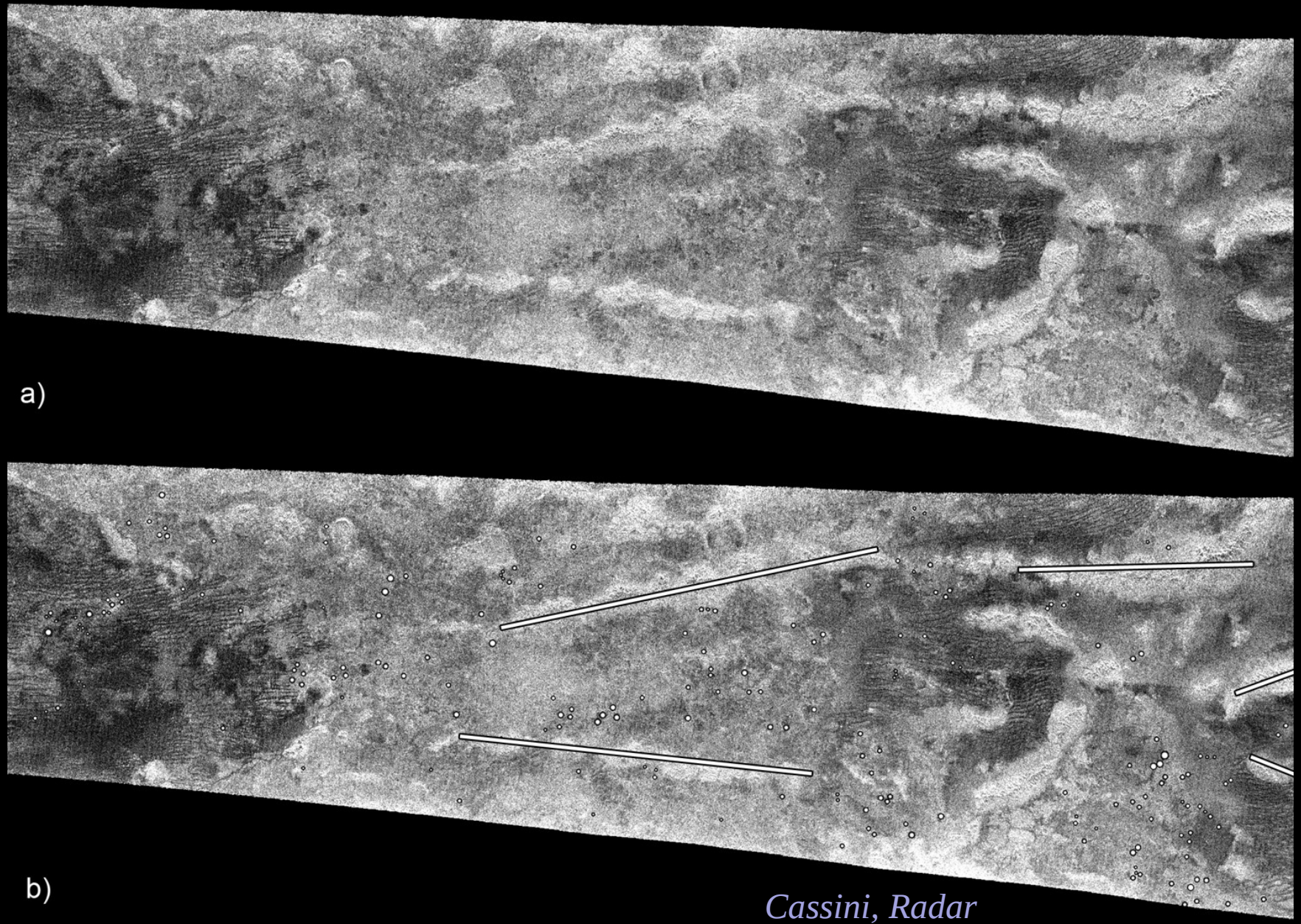
*Cassini*

# *Titan*



*Cassini, Composite VIMS*

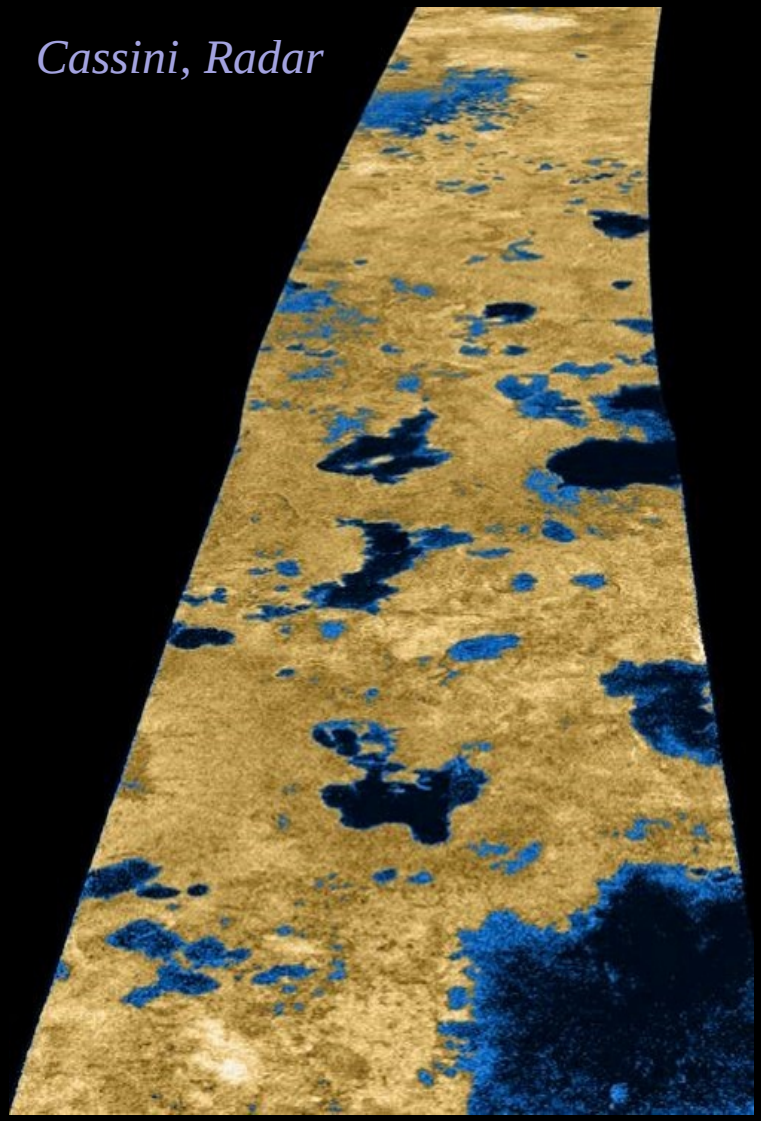
# Pits



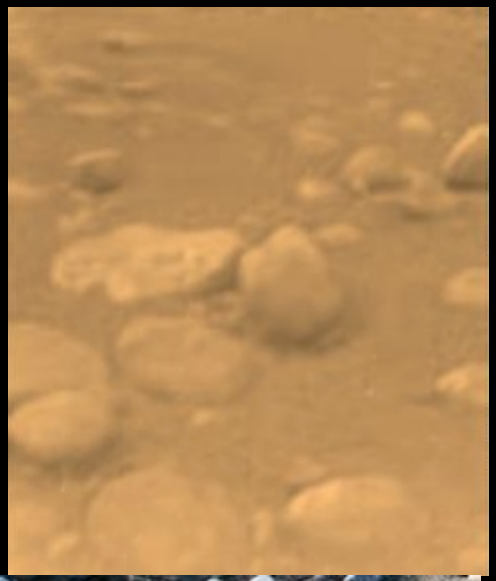

*Cassini, Radar*

# Methane lakes and rivers

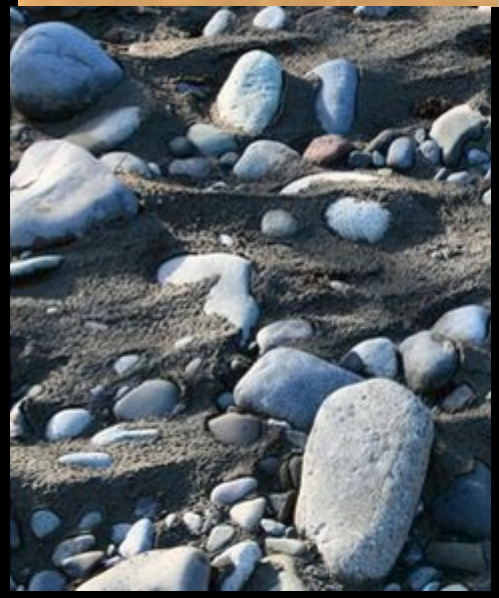
*Cassini, Radar*



*Cassini-Huygens image of surface rocks*



*Terrestrial River Rocks*



# Habitability

- Requirements:

  -Solid Surface

  -Atmosphere

  -liquid on surface

  (does not have to be water)
- Titan at the Triple Point of Methane
- Planetary Habitability index: