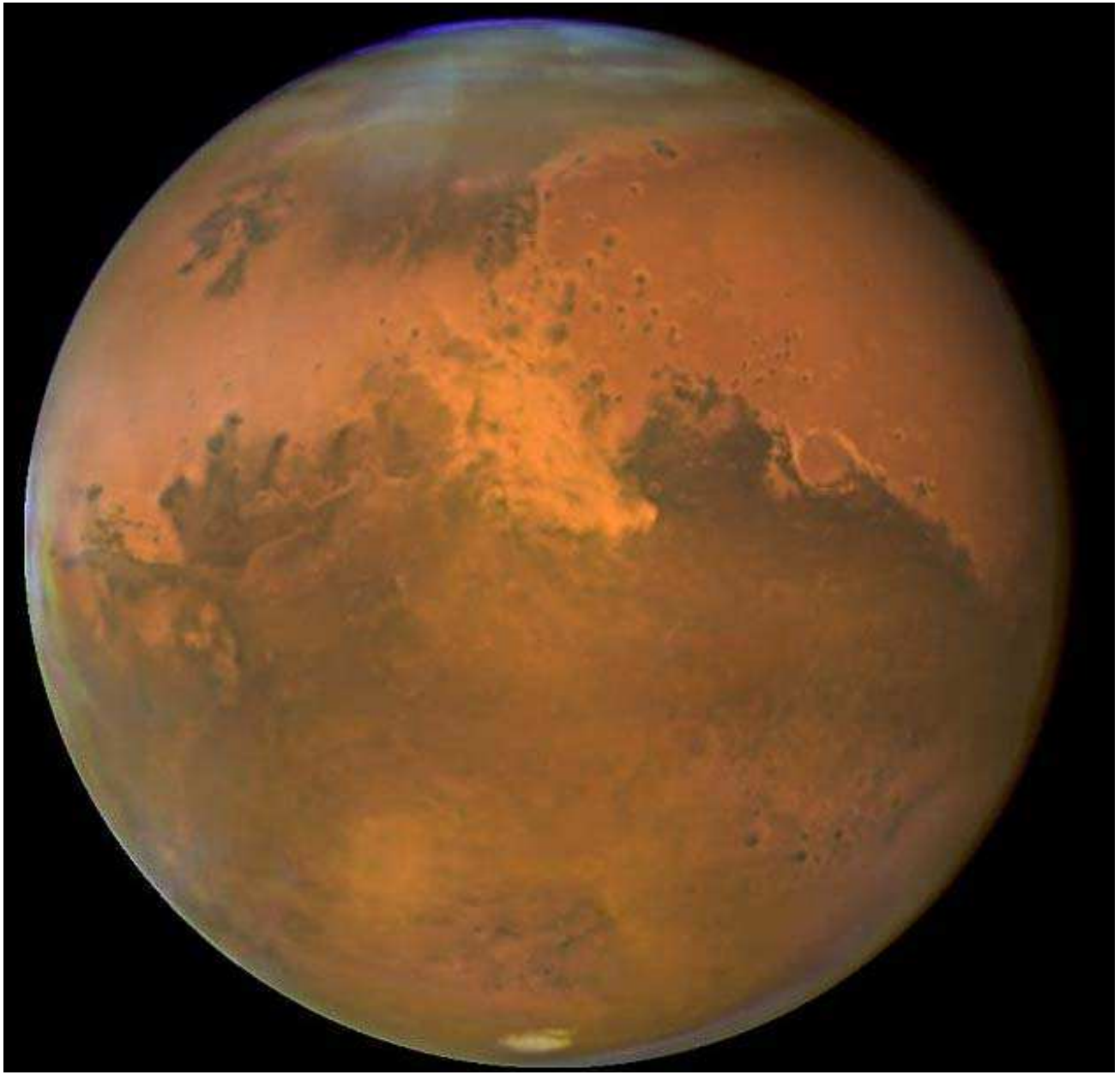


# Mars, Our Future Campsite?

# What We Will Learn Today

- How did Mars develop geologically?
- What are the geological features of Mars?
- How did Mars' atmosphere develop?
- Why does Mars occupy such a big mindshare with humans?

# Planet Mars Details

| Property | Value |
|---|---|
| Semi-major axis | 1.52 AU |
| Size (radius) | 0.53 $R_{Earth}$ |
| Mass | 0.11 $M_{Earth}$ |
| Average density | 3.93 g/cc |
| Composition | Rocks, metals |
| Average surface temperature | 220 K |
| Moons | 2 tiny ones |
| Orbital period | 1.88 years |
| Rotation period (sidereal) | 24.6 hours |
| Axis tilt | 25.2$^{o}$ |
| Orbital inclination | 1.85$^{o}$ |
| Orbital eccentricity | 0.093 |

Similar land area as Earth

Similar to Earth

Similar to Earth

# Geology of Mars

- Less active than Earth & Venus
- More active than Mercury & Moon
- Explained by
  - Size
  - Distance from Sun
- Mars had all four geological processes
  - Impacts
  - Volcanism
  - Tectonics
  - Erosion

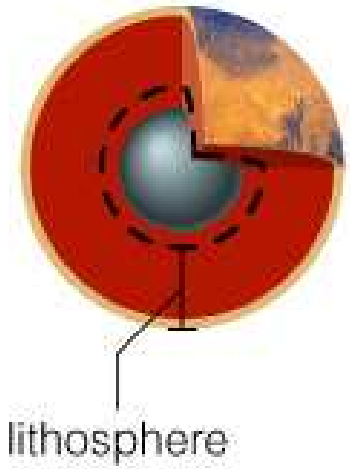



Fig 9.19

# Martian Landscape

- Southern highlands
  - Older, higher, more cratered
- Northern plains
  - Lower, few craters
- Polar ice caps
- Olympus Mons (shield volcano)
  - Tallest known peak in the solar system
  - 600 km across, 26 km high (3 x Mt. Everest)
- Valles Marineris
  - As long as the width of the US
  - 4 times deeper than Grand Canyon
  - Probably created by tectonic stresses and surface upwelling

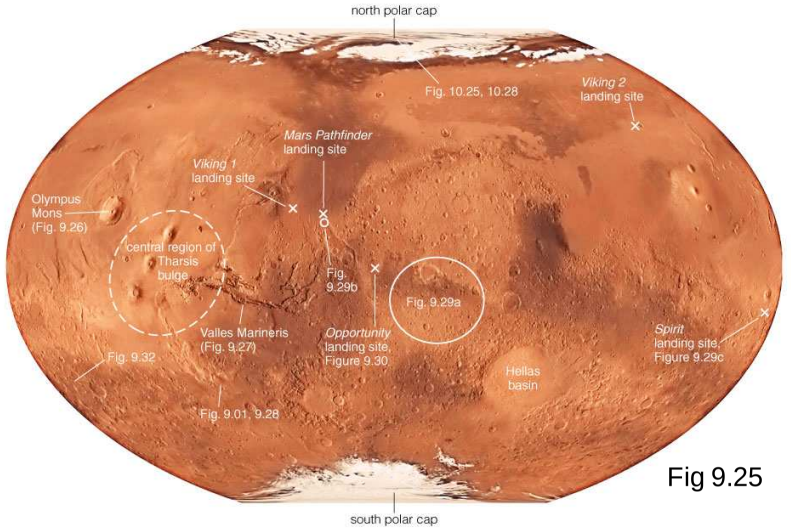


Fig 9.25

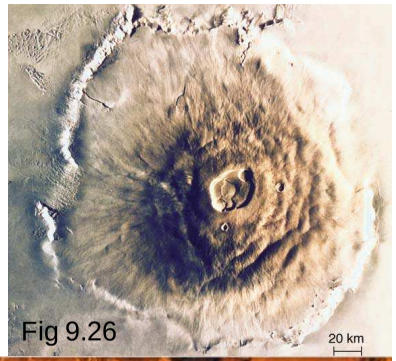


Fig 9.26

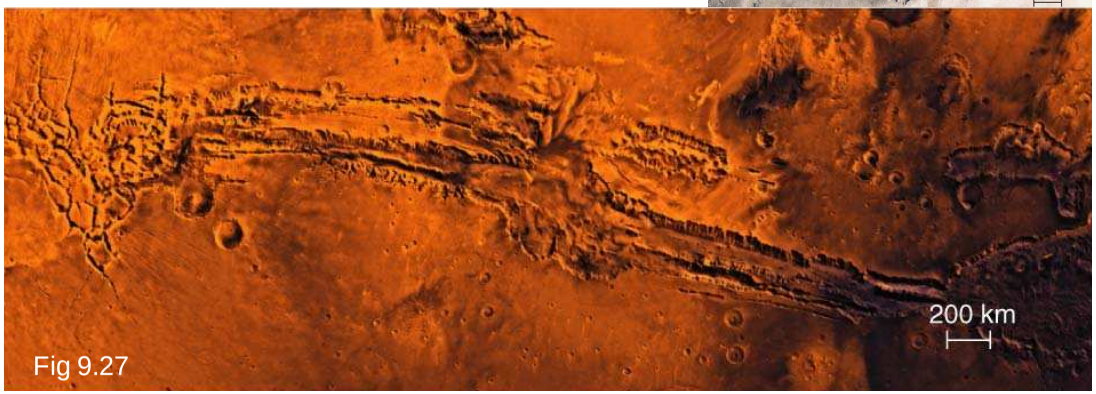
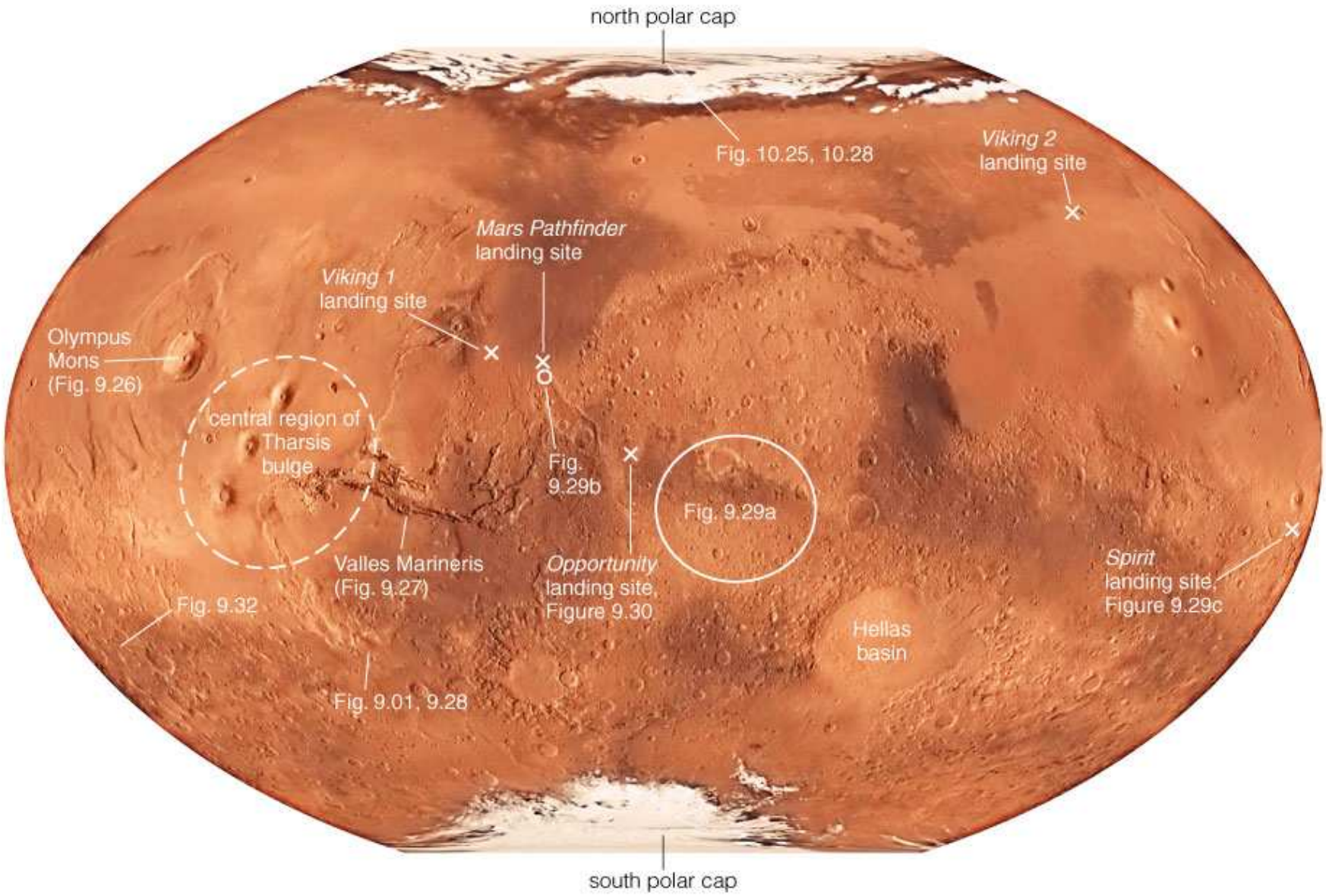


Fig 9.27

# Martian Landscape



# Erosion on Mars

- Mars likely had liquid water on its surface once

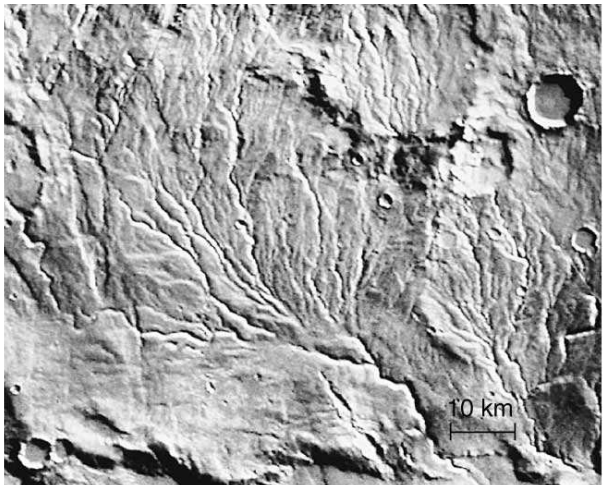
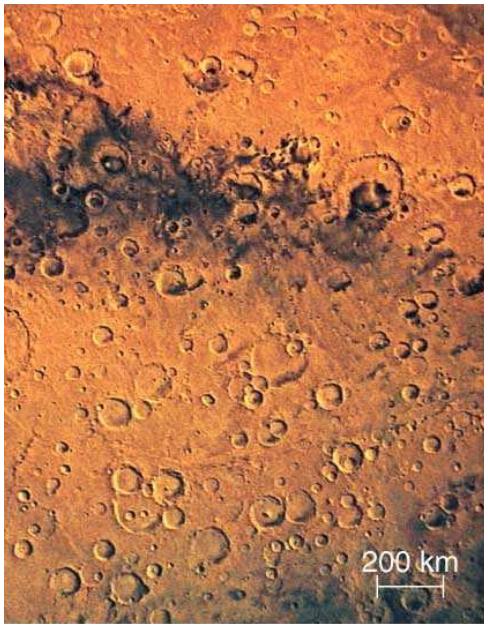



Fig 9.28: Viking orbiter picture; dried river beds 2 – 3 billion years old



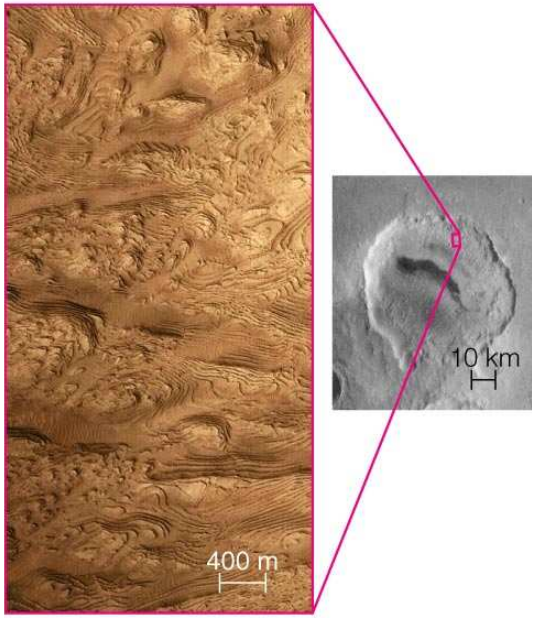




Fig 9.29: Evidence if erosion by rainfall

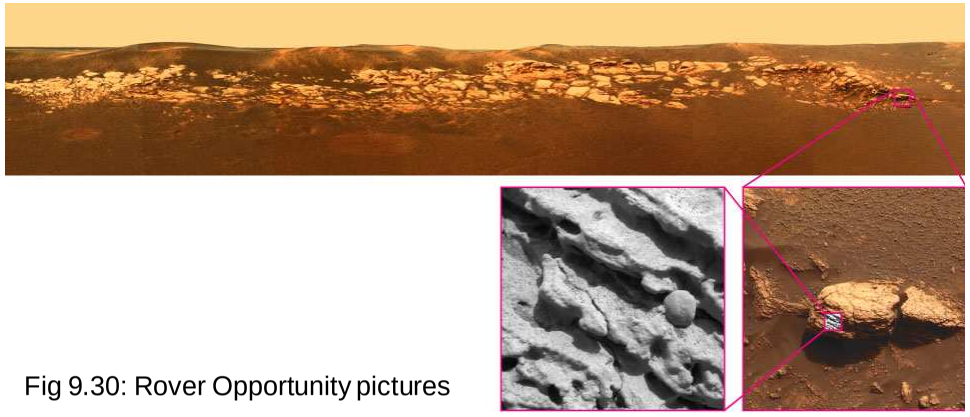
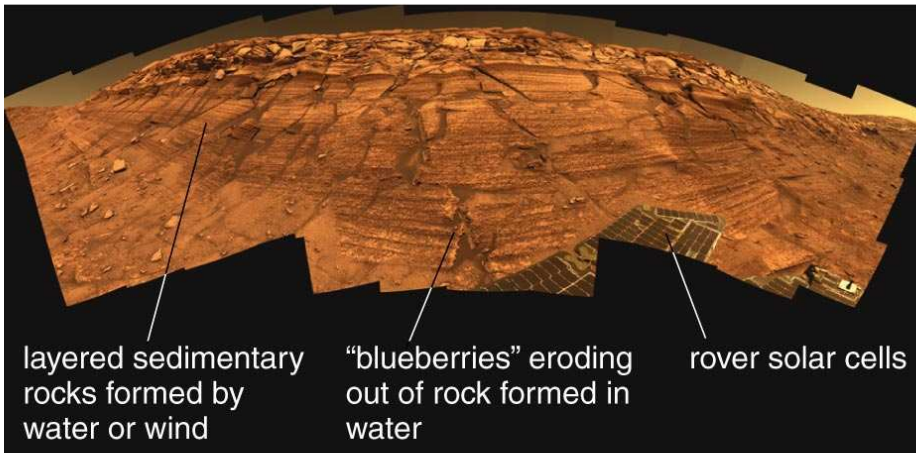
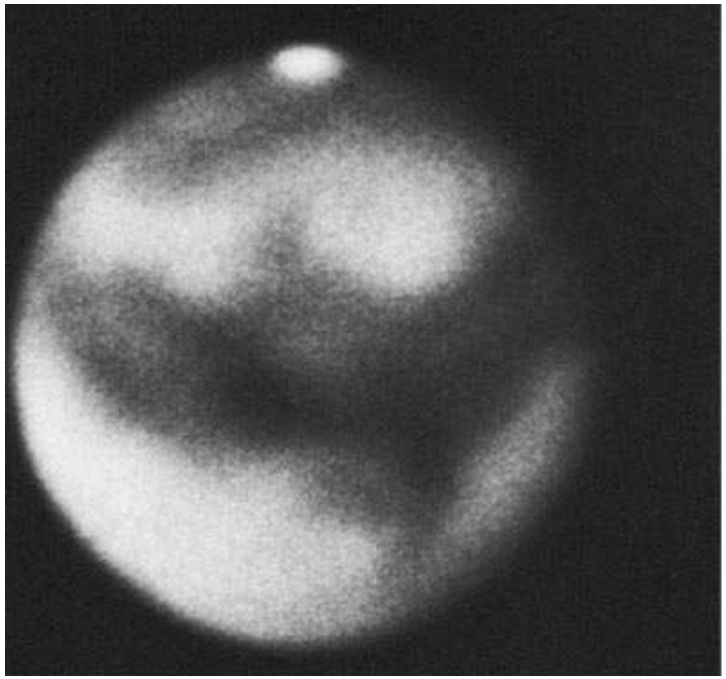


Fig 9.30: Rover Opportunity pictures



# Martian Canals

- William Herschel's speculation
- Percival Lovell's passion



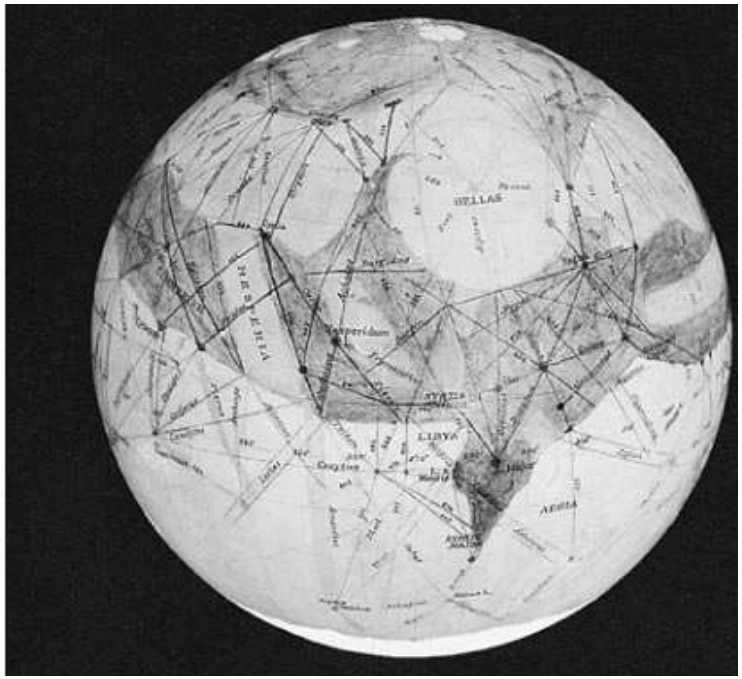



Fig 9.24

# Martian Seasons

- Like Earth, but different
  - Similar day/night
  - Similar axial tilt
    - But wanders more
    - Jupiter's effect and no stabilizing moon
  - Twice as long
  - Larger eccentricity
  - More extreme in Southern Hemisphere


Fig 10.24

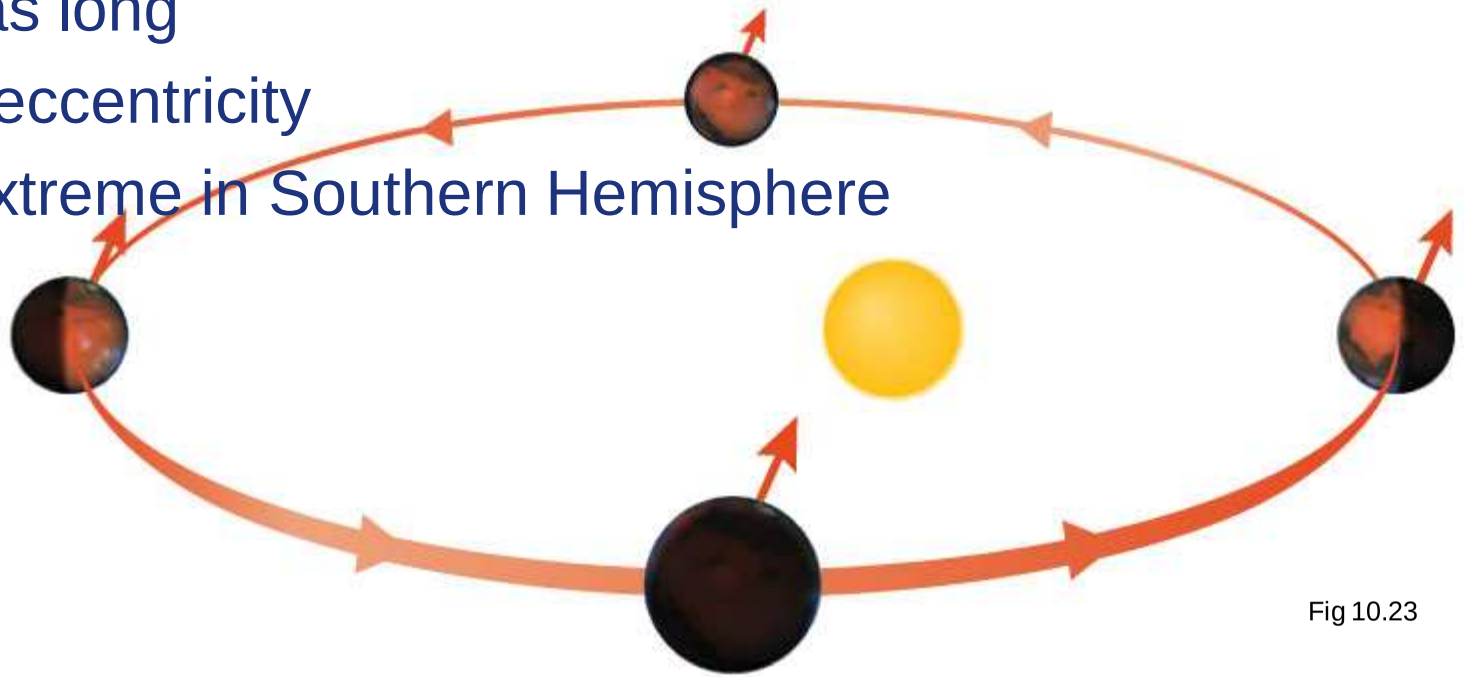


Fig 10.23

# Mars is a Windy, Dusty Place

- Atmospheric pressure 1% of Earth's
- $CO_2$ sublimation in the Summer pole causes high pressure and strong winds to winter pole
- Many dust devils created along the way

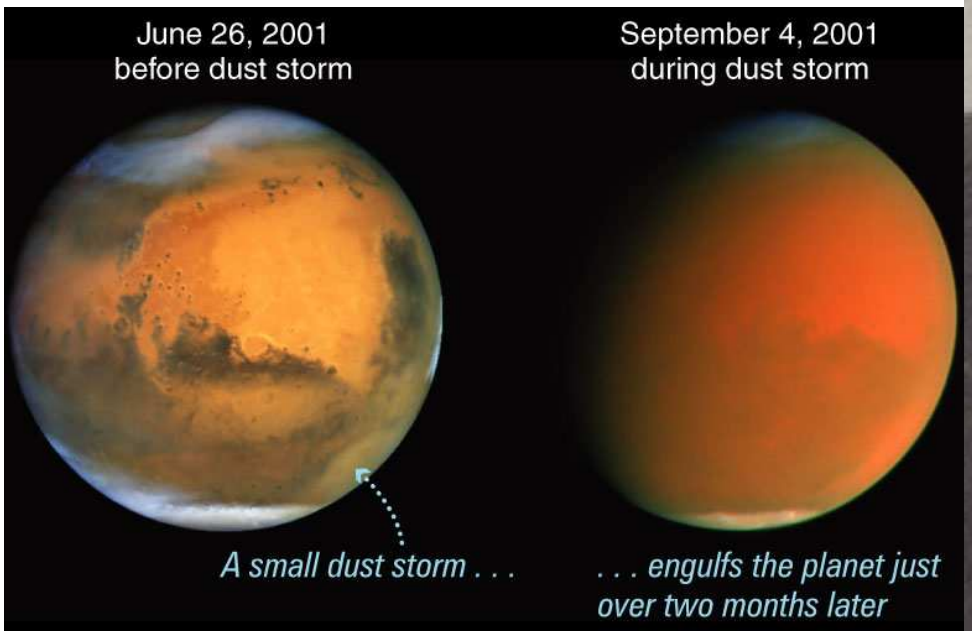



Fig 10.26

Fig 10.27

# Evolution of Martian Atmosphere

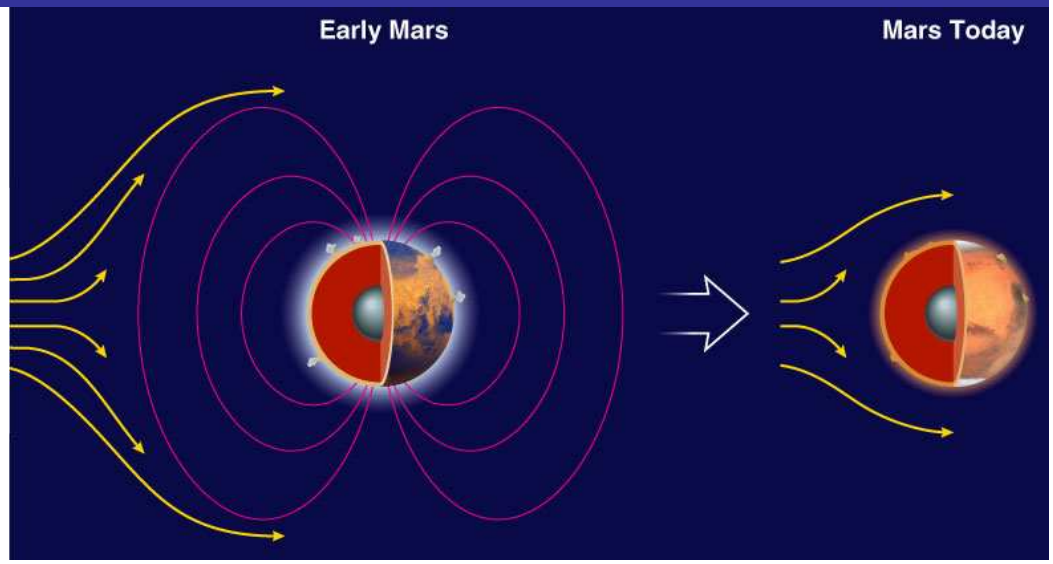
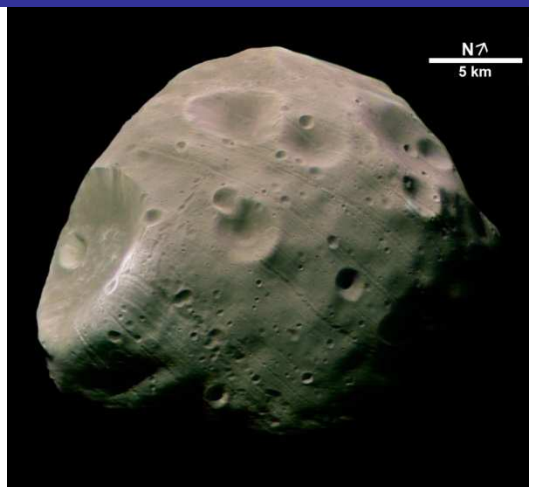



Fig 10.29

- In the past
  - Volcanic activity
  - Magnetosphere
  - Denser atmosphere
  - Temperate climate
  - Liquid water on surface, rains
- But, smaller size sealed its fate
  - Convection slowed down / stopped
    - Volcanic activity stopped, magnetosphere lost
  - $H_2O$ frozen or sublimated
  - Disassociated by UV light from the Sun, H escapes
  - O captured in soil: Mars' soil is rusted

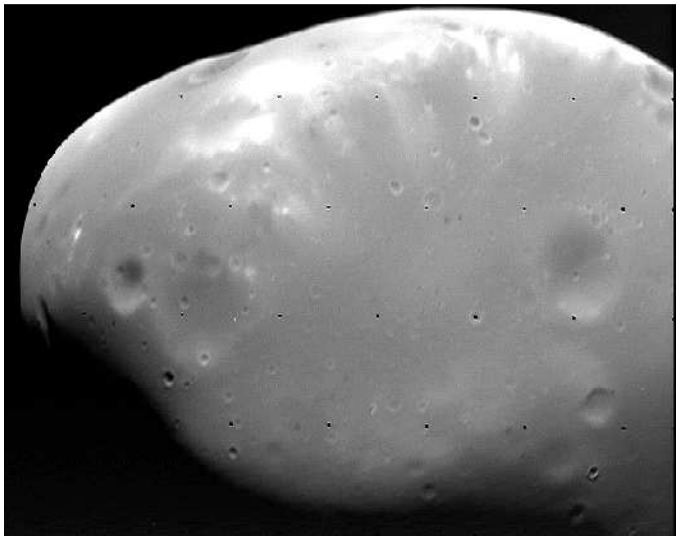
# Martian Moons

- Likely captured asteroids
- Phobos (Greek for fear)
  - Larger of the tiny moons (17 mi long)
  - 5,800 km above Mars' surface
  - 7.6 hour orbit, > 3 orbits per planet day!
  - Rises in the West, sets in East!
  - Will crash into Mars or break up into a ring in ~ 50 million years!
- Deimos (Greek for panic)
  - Smallest SS moon (9 miles across)
  - 30 hour orbit
  - Looks like a bright star from Mars



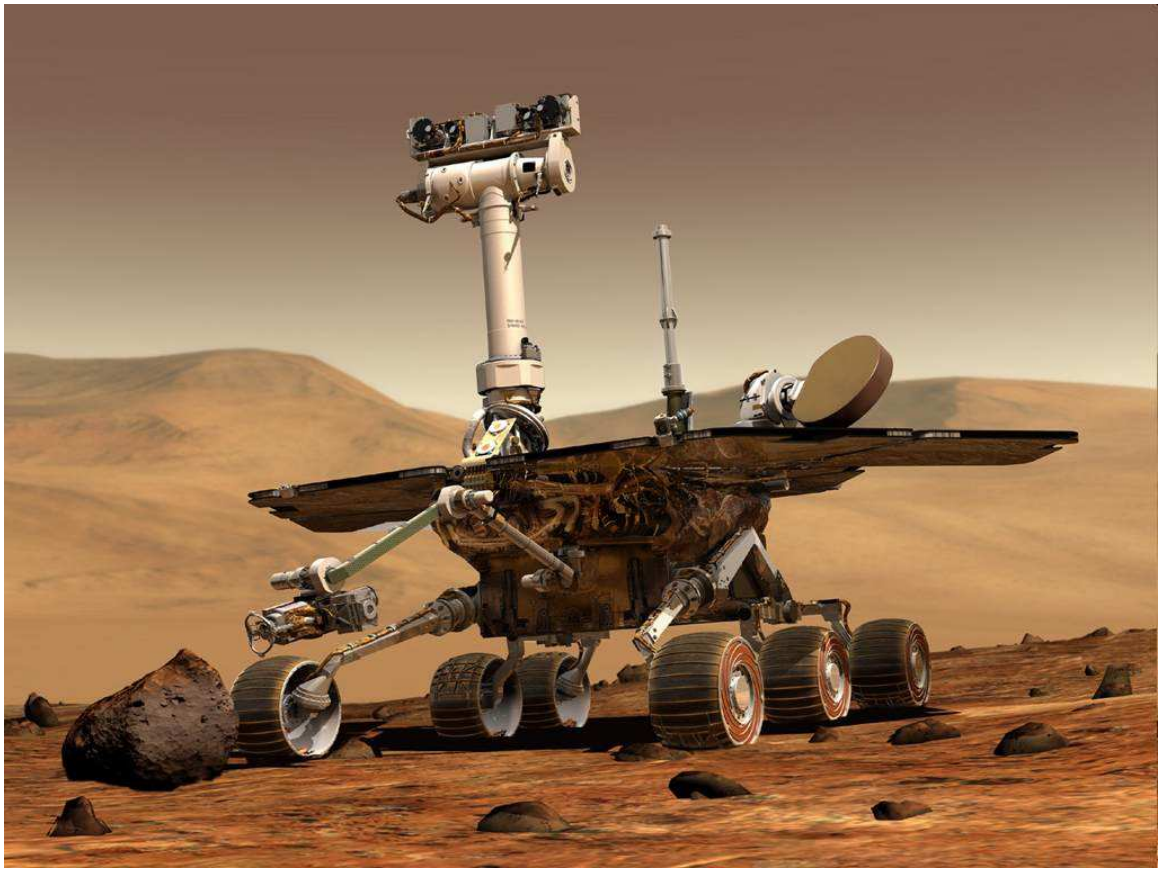
Phobos, Mars Express Image

Deimos: Viking Image



# Mars Exploration

- Mars is the most visited place in the SS
- Window of opportunity about once every two years (Mars at opposition)



# Unique Features of Mars

- Similar seasons as Earth
- Similar day/night as Earth
- Two small moons (captured asteroids)
- Tallest known peak
- Deepest known gorge
- Most visited by alien spacecrafts
- Liquid water on surface in the past
- Possible past/current life?