Introductory Astronomy

Week 3: Solar System(s)

Clip 8: Terrestrial Planets

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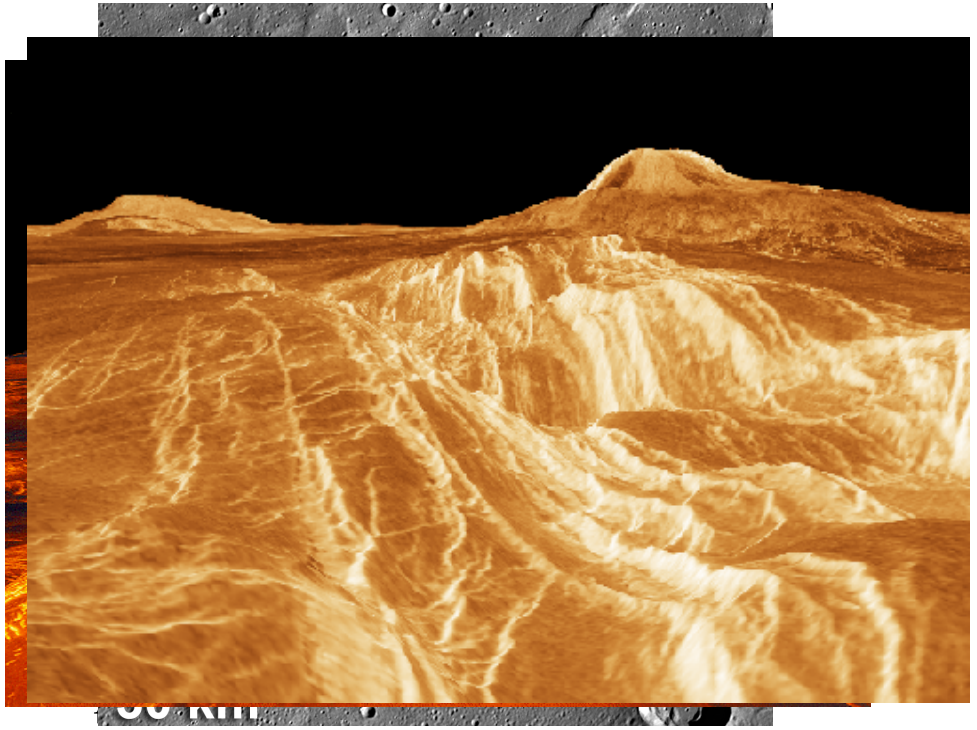
Spin and Orbit

- Mercury: close to Sun and eccentric: 2:3 tidal locking to 88d orbit tilted 7°
- Venus: 224d orbit tilted 3.4°; 243d retrograde spin tilted 177.3°
- Mars: 687d orbit tilted 1.9°; 24.6h spin tilted 25°

On the Surface

Tectonic Activity:

- Mercury: Features reflect cooling compression and extension
- Venus: Strong flaky crust and viscous mantle. Tesserae, chasmate. Global Resurfacing 400Mya
- Mars: Two Plates?
- Evidence of volcanic activity on Mars extinct



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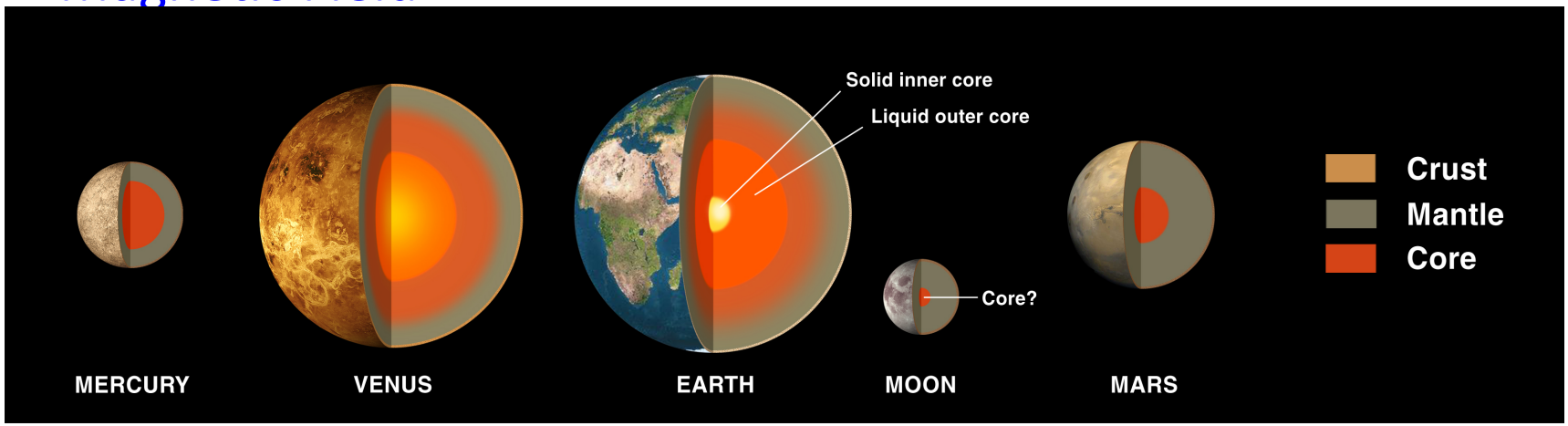
Inside

Mercury: Relatively huge core: uncompressed density $5300\,\mathrm{kg/m^3}$, at least partially liquid. Dipolar Magnetic Field



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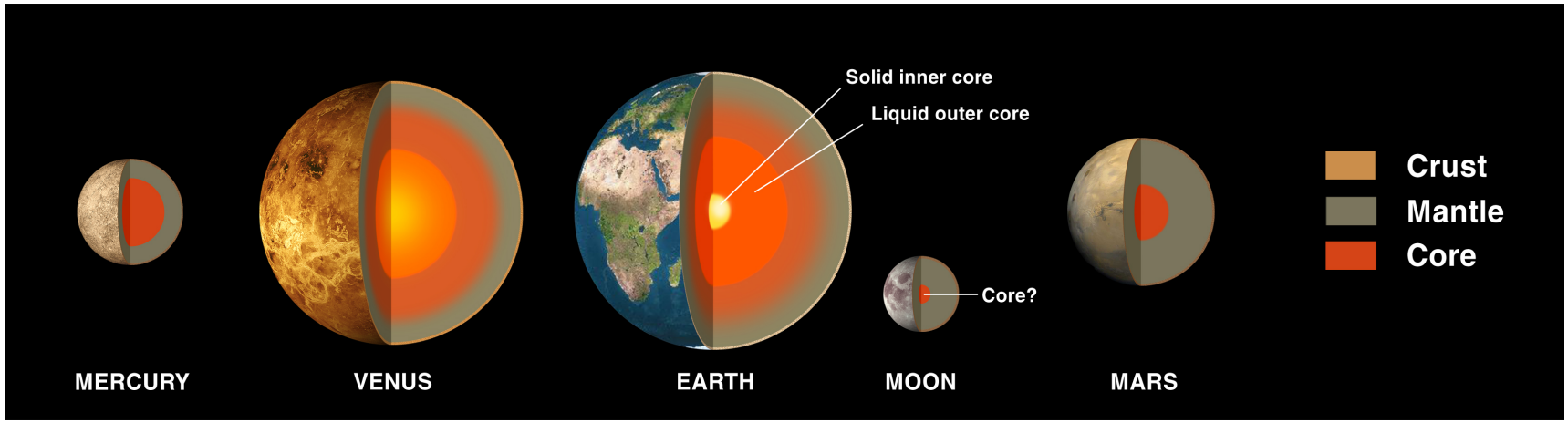
Inside

Venus: Presumed similar to Earth, density $5243\,\mathrm{kg/m^3}$

No geodynamic Magnetic Field



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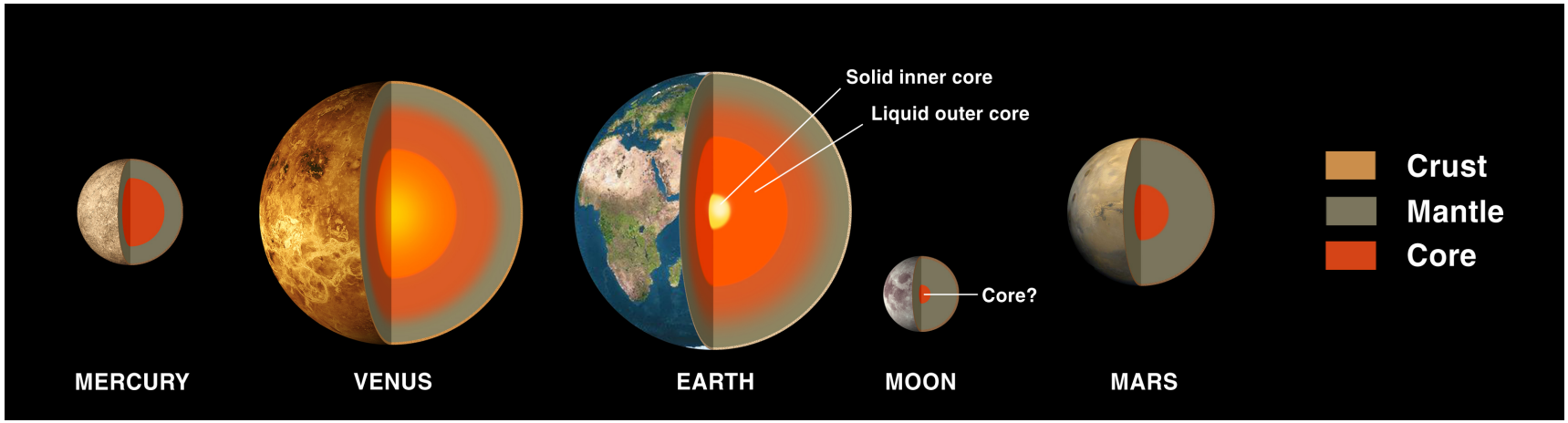
Inside

Mars: Small core, density $3934\ \mathrm{kg/m^3}$ Mantle inactive. No Magnetic Field now but old geodynamo



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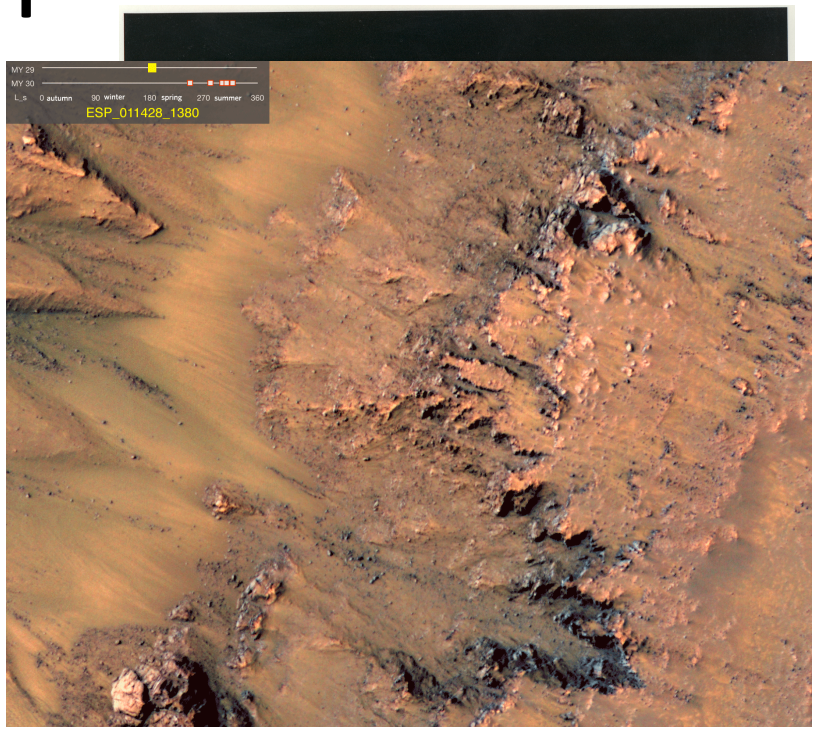
Atmospheres

- Mercury: Not much. Albedo 0.142 T=700K/100K. Ice in shadows?
- Venus: Dense (93x Earth) CO_2. SO_2 clouds Albedo 0.9 T=730K No water.
- Mars: Tenuous (.005x Earth) CO_2. Albedo 0.25 T= 308/130 seasonal. Large polar ice caps. Water?



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Why? A Comparative History

- Venus: Initially similar to Earth. CO_2 outgassed and water
- Evaporating water does not condense - dissociated and H_2 lost
- No oceans or tectonics CO_2 builds up
- Runaway greenhouse

- Mars: Initially similar to Earth. CO_2 outgassed and water
- Evaporating water condenses and rains, removing greenhouse gases
- No tectonics, gas trapped in rocks stays there
- Cooling traps water as permafrost if not lost to dissociation
- Weak magnetic field allows Solar Wind to strip remnant atmosphere
- Runaway Icehouse

Credits

- Mercury Orbit Animation: NASA JHU/APL
  http://sciencenetlinks.com/interactives/messenger/or/OrbitRotation.html
- Mercury Surface: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington
  http://messenger.jhuapl.edu/gallery/sciencePhotos/pics/Watters_Press_photo_1.jpeg
- Venus Surface Image: NASA/JPL http://www2.jpl.nasa.gov/magellan/image13.html
- Mars: NASA http://solarsystem.nasa.gov/multimedia/display.cfm?Category=Planets&IM_ID=2050
- Mars Topography: NASA http://photojournal.jpl.nasa.gov/jpeg/PIA02031.jpg
- Internal Structure: NASA http://solarsystem.nasa.gov/multimedia/display.cfm?IM_ID=168
- HD 17255 Animation: NASA/JPL-Caltech
  http://www.nasa.gov/mission_pages/spitzer/multimedia/spitzer-20090810.html
- Venus Clouds: NASA http://nssdc.gsfc.nasa.gov/image/planetary/venus/pvo_uv_790205.jpg
- Mars Icecap: Philip James (University of Toledo), Steven Lee (University of Colorado),
  NASA http://nssdc.gsfc.nasa.gov/image/planetary/mars/hst_mars060.jpg
- Water on Mars: NASA/JPL-Caltech/Univ. of Arizona
  http://www.nasa.gov/mission_pages/MRO/news/mro20110804.html

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