

Titan, The Moon With an Atmosphere

Third (Final) Bonus Assignment

Solar System Exploration!

Due: November 9, 2007

- Imagine that you are visiting one of the planets or moons we have talked about and write about the activities of a day at that place
- For up to **30 bonus points**, turn in (2 pages max)
 - A fun & creative journal log, story, poem, or limerick
 - Draw a picture to go with your log
 - Be sure to cover specific aspects of the place such as:
 - Weather (Wind, Temperature, Atmosphere), Gravity
 - Season, Length of the day, view of the sky
 - Features/places you explored (e.g. craters, mountains, volcanoes)
 - How you are dressed and/or otherwise prepared for this environment
 - Etc.

What We Will Learn Today

- What is Titan so interesting?
- How have we explored Titan?
- Which of Saturn's other moons are particularly noteworthy?
- What causes geological on these small, cold worlds?

Titan's Atmosphere

- Titan has the most significant atmosphere of all Solar System Moons
 - 1.5 times Earth's pressure at sea level
- 90% of the atmosphere is N₂
 - Similar to Earth's 77%
- Rest of it is Argon, Methane, Ethane, other Hydrogen compounds
 - Earth's remaining atmosphere is mostly Oxygen
- Very unique atmosphere

Origin of Titan's Atmosphere

- Ammonia and Methane sublimate from the surface
- Sun's UV light breaks up Ammonia (NH_3)
- Hydrogen escapes Titan forever
 - Why?
- Nitrogen left behind forms the N_2 molecules
- Some of the methane reacts to form ethane (C_2H_6)
- Methane and ethane foster a greenhouse environment
 - Still, the temperature is 93 K (-180 °C)
 - How much sunlight does Titan receive, compared to the Earth?

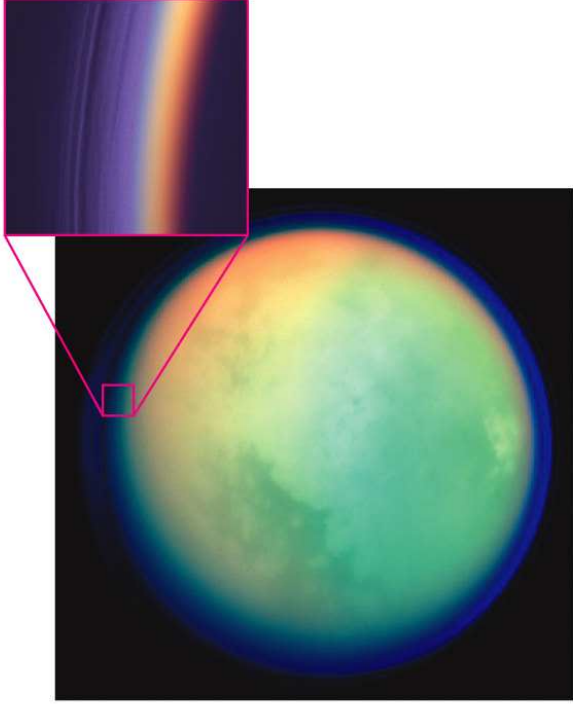


Fig 11.25

Titan's Exploration

- The Cassini-Huygens Mission
 - NASA / ESA collaboration
 - Cassini spacecraft studying Saturn & its moons
 - Huygens probe landed on Titan
 - Finally penetrated Titan's thick clouds
 - Huygens landed on Titan on January 14, 2005
 - Very interesting results!



Titan Might Have Rain & Lakes

- Water is frozen solid on Titan
 - Like rock on Earth
- Rain and lakes are liquid methane
- “Dust” is smog particles raining from the sky
- “Molten lava” is water and ice slush

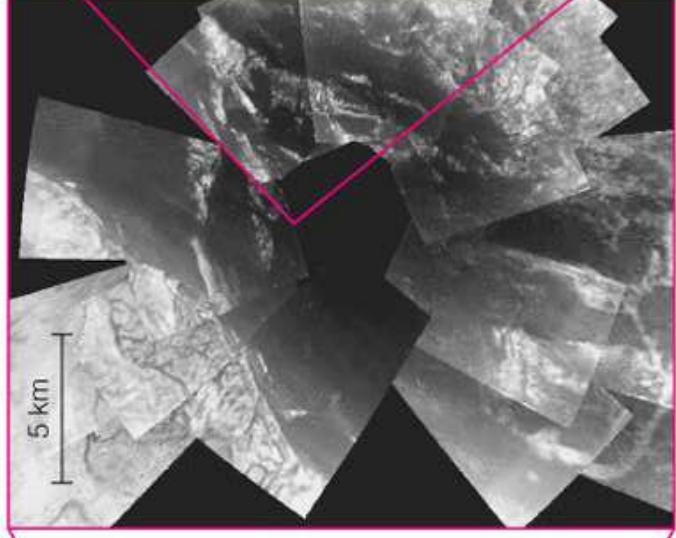
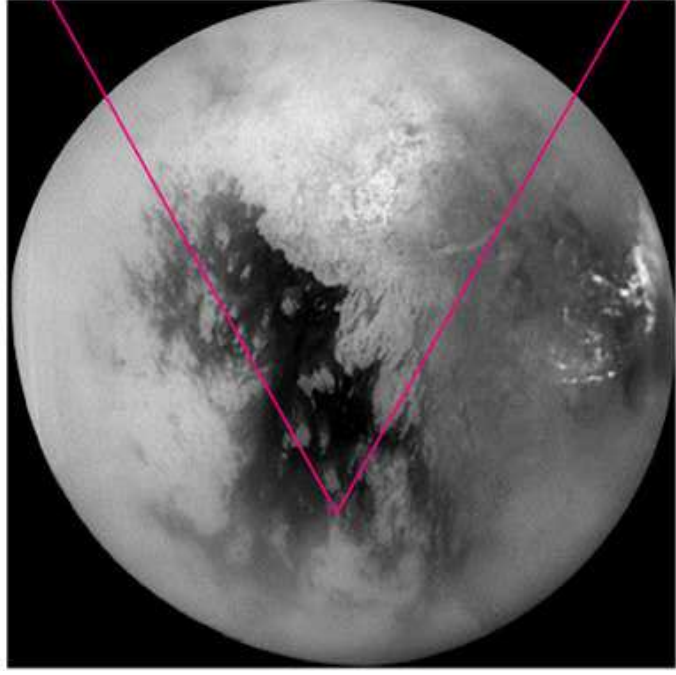


Fig 11.26

What Makes Titan Interesting

- Chemical reaction in the atmosphere could produce organic compounds
 - Such that those which form the basis of life on Earth
- Perhaps similar to the atmosphere on Earth a few billion years ago
- Could have methane and ethane rain, lakes and oceans



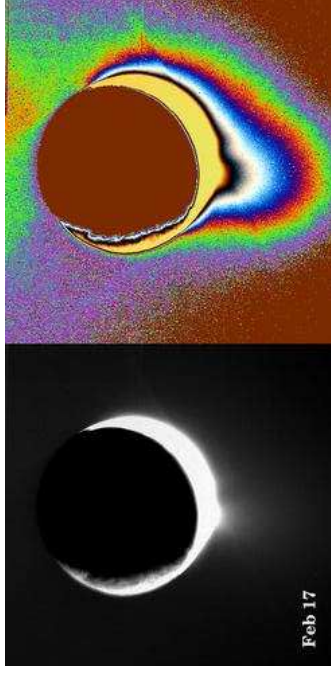
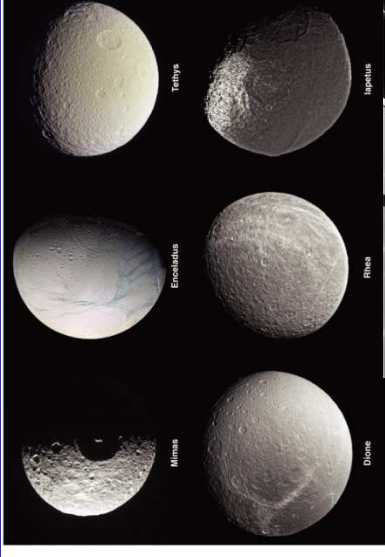
Saturn's Medium-Sized Moons



Fig 11.27

Saturn's Medium-Sized Moons

- Mimas
 - 2:1 orbital resonance causes the Cassini Gap
 - No evidence of past volcanism
- Enceladus
 - Water geysers
- Iapetus
 - Ridge along equator, distinct light and dark regions
 - Tectonic activity suspected



Geologically Active Small Moons?

- What makes these moons active?
 - Too small for residual heat from contraction
 - Should be geologically dead like the Moon
- Energy comes from tidal heating
- Not much energy to melt rock, but enough to melt ices
- So, their composition (ice) is responsible for their geological activity

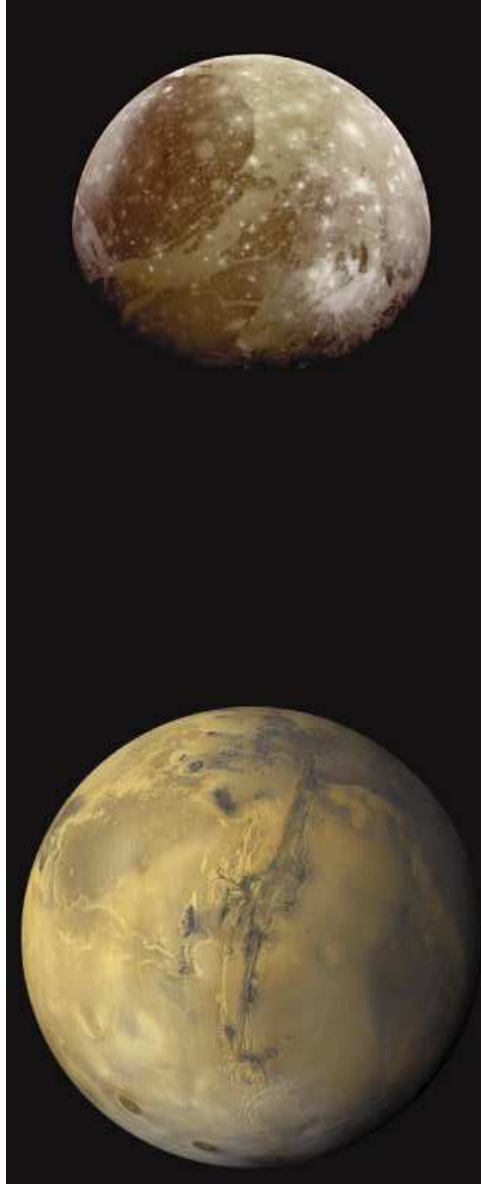


Fig11.30

Unique Features of Saturn's Moons

- Titan
 - Has the densest atmosphere of all SS moons
 - Is the farthest place where a human-made object has landed
 - The place with an atmosphere most similar to the ancient Earth's
- Enceladus
 - Water geysers
- Iapetus
 - Equatorial ridge and distinct colors