

29:52 Exploration of the Solar System
Class Notes for March 14, 2008
Exploring Venus by Radar

Let's see what we have learned about the surface of Venus from radar observations. Most of the surface of Venus is a low, rolling plain, similar to the ocean bottoms on Earth. There are two large continent areas, named Ishtar and Aphrodite. You should look at figures 10.20 and 10.21 to see those.

The *Magellan* spacecraft, which is responsible for most of our information about the surface of Venus, had two instruments. One was an altimeter, which measured the height of the landscape, and the other measured the radar reflectivity, which is how "shiny" the surface is to radio waves. A map of the radar reflectivity is given in Figures 10.22 and 10.23. These maps give another insight into the surface, such as what kinds of minerals are there.

The radar maps of the surface of Venus show very few impact craters. The density of craters is consistent with about 500 million years "exposure time", so we believe that Venus was "resurfaced" by planet-wide magma flows about that time. This event may be similar to an event which occurred on Earth at the end of Permian age, 250 million years ago. The extremely high surface temperatures on Venus, and the resultant inhospitable nature of the planet is due to the dense carbon dioxide atmosphere. Carbon dioxide absorbs radiation at infrared wavelengths. Planets like Venus and Earth cool off by radiating electromagnetic radiation in the infrared part of the spectrum, so an absorbing molecule like CO₂ impedes the ability of the planet to cool off. An extremely interesting fact is that the Earth has an amount of carbon dioxide on its surface which is similar to that in the atmosphere of Venus. On Earth, it is tied up in carbonate rocks. On Venus, the CO₂ is in the atmosphere.

On Earth, the presence of the oceans has been responsible for removing CO₂ from the atmosphere. Dissolved CO₂ in the ocean waters reacts chemically with dissolved minerals to form minerals such as limestone, which then precipitate on the ocean floor. If there are bodies of water, CO₂ can be removed from the atmosphere and "locked up" in carbonate rocks.

At the present, we don't know if Venus has always been the way it is now. It is possible that the temperature has always been too high for oceans, and that there was no water to remove the CO₂. On the other hand, some scientists speculate that Venus may have had a time early in the history of the solar system, when it would have been cool enough for oceans to exist and moderate the CO₂ level. This early, cool stage would have been assisted by the fainter Sun early in the history of the solar system.

These latter scientists speculate that as the Sun gained in brightness, the tem-

perature on Venus increased, evaporating the oceans, and removing the mechanism for moderating the CO₂ in the atmosphere, and thus the planetary temperature.