



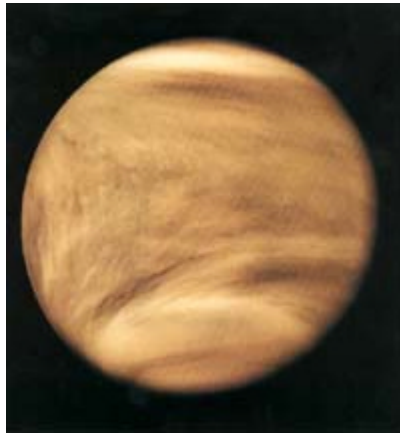
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### The Mysterious Planet Venus

by Melanie Melton

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Recent reports released by scientists remind us that much of our sister planet, [Venus](#), is still a mystery to us.

One report, released by Cassini spacecraft scientists, simply states that their spacecraft did not detect any signs of lightning on Venus during its two gravity-assist flybys of the planet.

Another report announces that tremolite (a mineral formed when magma or lava interact with water) can survive the harsh conditions found on the surface of Venus. Therefore, if scientists can find evidence of tremolite on the Venesian surface, they would have the first hard evidence that water once existed on the surface of Venus.

A third report discusses how scientists used a mathematical model to reveal large hexagonal patterns of cracks on the Venesian surface. These cracks suggest that the surface of Venus has been subjected to large changes in temperature over long periods of time.

Rather vague statements, but interesting nonetheless. While providing tantalizing hints about Venus, they also remind us that, even though we have explored every planet in the solar system (except Pluto), there is still much we don't know about the closest planet to our own.

#### Why don't we know more about Venus?

Conditions on Venus make exploring the planet extremely difficult. Thick white clouds completely block the view of its surface. Corrosive sulfuric acid clouds eat away at any spacecraft that passes through its carbon dioxide atmosphere, and extremely high temperatures (450 degrees Celsius, or 900 degrees Fahrenheit) and an incredibly dense atmosphere greet any visitor to its surface.

The average atmospheric pressure on the surface of Venus is a crushing 2/3 of a ton per square inch. For comparison, the average atmospheric pressure on Earth (calculated at sea level) is equal to 14.7 pounds per square inch.

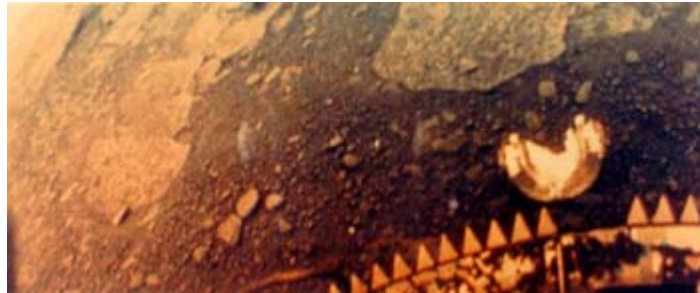
#### Exploring Venus

Despite the challenging conditions on the planet, Venus was the first planet in the solar system to receive earthly visitors. On December 14, 1962, Mariner 2 flew by Venus and confirmed that the intense microwave radiation that scientists had detected from

Earth was indeed coming from the surface of the planet, rather than the thick cloud cover.

A series of Soviet and American spacecraft in the 1970's and 1980's managed to send back information on the thickness, composition, and temperature of the cloud layers. One orbiter recorded something that may have been lightning in the Venusian atmosphere, although this has been the subject of many debates over the years. (More about this later.)

A few of the Soviet Venera spacecraft were landers. Despite the harsh conditions on the surface, some of them actually survived to transmit home. They didn't last for long, though. The first to survive, Venera 7, only transmitted a few seconds worth of data back to controllers on Earth. Venera 13, arriving on March 1, 1982, lasted the longest on the surface, 127 minutes, before succumbing to the heat and pressure.



The surface of Venus

NASA's Magellan spacecraft was in orbit around Venus from 1990-1994. Magellan was equipped with a radar mapping system that was able to "see" through the thick clouds. Scientists were able to produce a complete radar map of the surface of Venus from the data Magellan sent back. The spacecraft revealed a relatively flat world with a few large impact craters, cracks, domes, mounds, fractures and other unearthly features. Scientists believe that some, if not most of these features are volcanic in origin. Are there still active volcanoes on Venus? This is another question for debate among scientists.

### The Recent Reports

#### Lightning?

The Cassini spacecraft flew by the planet Venus twice before beginning its long trek towards Saturn. (Set to reach the ringed world in July of 2004, Cassini just flew by Jupiter last December.)

During these gravity-assist flybys of Venus, Cassini's instruments were turned on to search for impulsive high-frequency radio signals - which, on Earth, are indicative of lightning. During the two passes, on April 26, 1998 and June 24, 1999, no radio signals were recorded. In a similar flyby of Earth, Cassini detected almost a steady stream of lightning-related signals.

Does this conclude that Venus does not have any lightning. No. It just means that no Earth-like lightning was detected during these flybys.

"Since the atmosphere of Venus is very different from that of Earth, it is perhaps not surprising that electrical activity on Venus might be very different from lightning in the Earth's atmosphere," says Donald Gurnett of the University of Iowa.

Lightning can usually be divided into two types: cloud-to-ground lightning and cloud-to-

cloud lightning (the weaker of the two).

"Because clouds over Venus are at very high altitudes of 40 kilometers (25 miles) or more, it is likely that lightning at Venus, if it exists, is primarily cloud-to-cloud," says Gurnett. This may mean that the lightning on Venus is fairly weak and more difficult to detect.

So, the lightning debate continues.

### Water long ago?



Radar Image of Venus, from the Magellan spacecraft

Since Magellan showed scientists several images of "volcano-like" features, it is very possible that lava or magma exists - or once existed - on the surface of Venus.

Scientists at Washington University have been studying tremolite, a mineral that is formed when lava or magma interacts with water. One theory suggested that such a mineral is unstable at high temperatures. If any tremolite had formed on Venus - meaning if there had been any water on Venus to interact with the magma, the evidence would have been destroyed long ago.

However, graduate student Natasha Johnson and Professor Bruce Fegley, Jr. have shown that tremolite is stable at high temperatures - like those found on Venus.

Johnson and Fegley, Jr. conducted over 200 experiments, heating samples of tremolite in laboratory furnaces at temperatures of up to 1770 degrees Fahrenheit, for as long as 20 months. Their research shows that tremolite is much more stable than first thought. In fact, tremolite exposed to temperatures like those found on Venus could still exist after 4 billion years.

"We have shown that tremolite can withstand extreme temperatures and remain intact for billions of years," Johnson explained. "If we can go to Venus and find tremolite, or some other hydrous mineral, then we would have proof that Venus had water in its past."

If Venus did have water on its surface, it would prove that it was much more Earthlike in its early years.

### Climate Changes?

Scientists recently analyzing radar images from the Magellan spacecraft believe they have discovered a series of large hexagonal-shaped cracks covering the surface of Venus. These cracks seem to indicate that the surface of Venus has undergone extreme changes in temperature, on the order of 200 degrees Celsius (392 degrees Fahrenheit).

Pierre Moreels, a French intern with the Jet Propulsion Laboratory in Pasadena, California, used a mathematical modeling technique - adapted from a model originally designed to detect individual blood cells - to examine Magellan radar images of the Venusian surface. When applying the mathematical model to the data, Moreels noticed several patterns of hexagonal-shaped cracks on the surface.

One hypothesis suggests that these hexagonal cracks were formed as a result of slow heating and cooling over long periods of time. Were these temperature changes localized or global in nature? Mapping the size and distribution of these cracks may help determine how far-reaching these effects were, giving scientists a better understanding of any climate changes Venus may have experienced in the past.

The harsh conditions of Venus restrict our understanding of Earth's nearest neighbor. However, little by little, scientists are trying to unlock its secrets. Even so, it may be a long time before we really know our closest planetary neighbor. .

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