

**29:52 Exploration of the Solar System**  
**Class Notes for March 31, 2008**  
**The Ancient Climate of Mars**

At the end of this session, we will get in our spaceship and go down to the surface of Mars. However, before doing so, let's talk a bit more about the implications of the water channels. As discussed in class, the existence of water channels on the surface at least *suggests* that the atmosphere of Mars could have been more Earthlike and conducive to the presence of life 3-4 billion years ago.

As we will discuss in another couple of lectures, the physics of atmospheres shows that it is entirely possible for a planet to have a "slow leak" of its atmosphere over a period of hundreds of millions to billions of years.

To understand the possible significance of an ancient atmosphere, look at the powerpoint slides from the lecture, showing a brief graphical representation of the geological history of the Earth and Mars.

- On Earth, the atmosphere was primarily carbon dioxide, like the atmospheres of Venus and Mars, for the first 2 - 2.5 billion years of its history. Geologists believe they see the first evidence of life 3.5 Gyr ago, only a billion years after the planet formed. The first fossils of life are in the form of *stromatolites*, layers of algae, that still exist in some places on Earth. There is possible evidence for life as long ago as 4.1 billion years.
- On Mars, the geological history is less certain. We will learn much more over the next several decades. However, it seems likely that the atmosphere of Mars was of higher pressure and warmer for the entire period in which the valley networks formed, i.e. from 4.5 to at least 3.5 billion years ago. This was enough time for the first life to have formed on Earth. Was it enough time on Mars, too? We don't know. Furthermore, water outflows which formed the outflow channels occurred for at least another billion years. The big question is whether life formed on Mars during this early favorable period. If it did form, we would like to know whether it evolved and adapted to some form that is still there, or if it became extinct when the climate worsened. *The Truth is Out There.*

Recall that the results of the Viking spacecraft tests for microbial life are predominantly, although not unanimously, interpreted as being negative, i.e. no life at the sites where the Viking landers landed.

A mystery about Mars concerns its apparent lack of carbonate rocks. If large parts of the surface of Mars were covered in water at a time when the planet had

a dense atmosphere of carbon dioxide, then a lot of that carbon dioxide should have been locked up in carbonate rocks such as limestone (calcium carbonate), like happens on Earth. However, from orbit there is little indication of limestone. Traditionally, this was viewed as evidence against the “warm, wet Mars” view of its early history. However, nowadays there may be a resolution of this question.

Next time, we will talk about the view from the surface.