Chapter 10. Venus: A Cloud-Covered Inferno

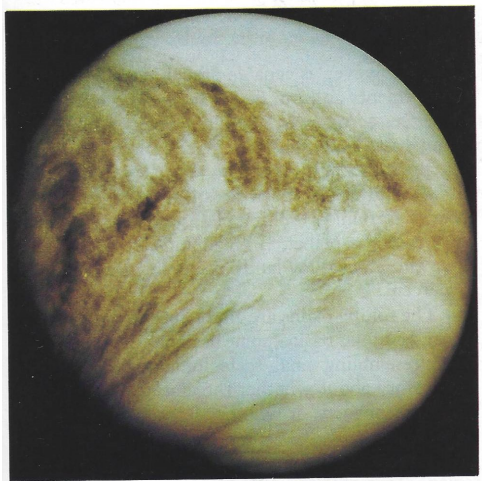

Figure 10.5. An ultraviolet image of Venus from Pioneer Venus.

Note. In this section we survey physical properties of Venus.

Note. Venus is commonly known as the evening and morning star. Its albedo is 76% due to the presence of high, bright clouds. The surface is not visible due to the clouds.

Note. The atmosphere consists of 96% CO_2 (carbon dioxide). Recall that CO_2 reflects infrared radiation producing a *greenhouse effect*. The surface temperature is 750° K (900° F).

Note. The planet was found to have *retrograde rotation*; it rotates backward from what the other planets do. The sidereal period of rotation is 243 (Earth) days, The solar day is 116.8 (Earth) days.

Note. Planetary Encounters generally follow three phases: (1) fly-by, (2) orbiters, and (3) landers. For Venus, the fly-bys were Mariner 2 (1962), Mariner 5 (1967), and Mariner 10 (1974). The orbiters were Venera 1 (USSR, 1975), Venera 10 (USSR, 1975), and Pioneer Venus 1 (1978). The landers were Venera 4 (1967, USSR, hard landing), Venera 9 (1975, USSR, soft landing), Venera 10 (1975, USSR, soft landing), and Pioneer Venus 2 (1978, hard landing). Mariner 10 (a productive project) studied clouds and found no magnetic field. The upper clouds move at a rate of 360 km/hour circling the planet in 4 days.

Note. The pressure at the bottom of the atmosphere is 90 times that of the Earth's. The uppermost layer is 60 km above the surface; this is the layer that we see. The clouds (which form at three different altitudes; see Figure 10.4) are condensed H_2SO_4 (sulfuric acid).

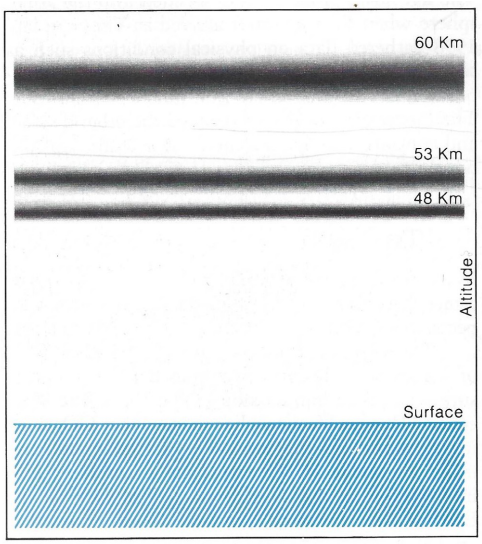

Figure 10.4. The clouds of Venus.

The clouds also contain sulfuric dioxide (SO_2) which absorbs ultraviolet light, explaining the appearance of the ultraviolet photos. Due to the slow rotation, there

is a warm point (the *subsolar point*) where warm air rises and spreads out across the planet. See Figure 10.7.

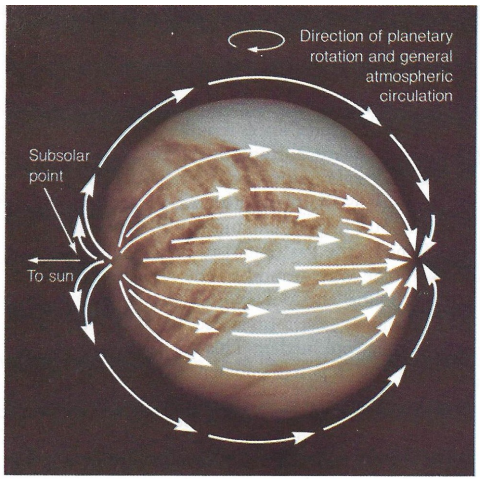

Figure 10.7. High altitude circulation.

Note. Venus does not have as active continental drift as Earth, although there is evidence that highlands were formed through some tectonic activity. There is apparently volcanic activity on Venus, indicating convection currents in mantle and hot spots. So internally, Venus is much like Earth.

Note. Because of clouds, the surface of Venus must be studied by radar. The best images are from Pioneer Venus. The surface has been classified into three types of terrain: (1) rolling plains (65% of the area) with many craters and circular basins; the craters may be volcanic in origin, (2) lowlands (27% of the area), and (3) highlands (8% of the area) with three main regions, Istar Terra, Aphrodite Terra, and Beta Regio (see Figure 10.9).

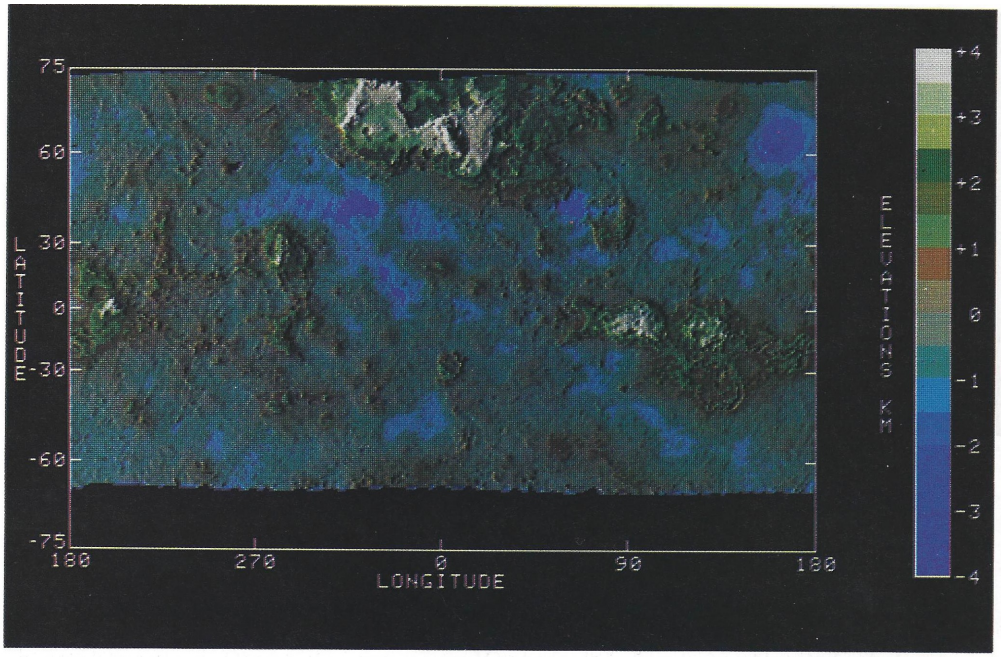

Figure 10.9. A relief map of Venus made from Pioneer Venus data. The large area at top center is Ishtar Terra, right center is Aphrodite Terra, and left center is Beta Regio.

Note. As oxygen and hydrogen bonded in the early atmosphere, H_2O stayed in a vapor form due to the high temperature. This started the greenhouse effect and heating baked CO_2 out of the rocks (it's still in rocks on Earth). CO_2 became the dominant gas in Venus' atmosphere. By contract, life on Earth was a big factor in the chemical composition of Earth's atmosphere.

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