Venus: Earth's "Twin" and the Hothouse Planet

Venus is the second planet from the Sun and is often called Earth's "sister planet" or "twin" due to their similar size, mass, and bulk composition. Both are terrestrial planets. However, beyond these superficial similarities, Venus is a world of extreme and inhospitable conditions, representing a starkly different evolutionary path.

Atmosphere and Runaway Greenhouse Effect

The atmosphere of Venus is the defining feature of its hellish environment. It is incredibly dense—the surface pressure is over 92 times that of Earth, equivalent to the pressure 900 meters (3,000 feet) deep in Earth's oceans.

The atmosphere is composed of over 96% carbon dioxide (CO_2), with most of the rest being nitrogen. This overwhelming concentration of CO_2 has triggered a runaway greenhouse effect. While Venus is not the closest planet to the Sun (Mercury is), this thick blanket of CO_2 traps solar radiation so effectively that Venus has the hottest surface of any planet in the Solar System. The average surface temperature is a uniform 465°C (869°F), which is hot enough to melt lead.

The upper atmosphere contains clouds not of water, but of sulfuric acid (H_2SO_4), and it experiences "super-rotation," with winds in the upper cloud deck circling the planet in just four Earth days.

Surface and Volcanism

Because of its thick, opaque cloud cover, the surface of Venus cannot be seen in visible light. Our knowledge of its surface comes from radar mapping, primarily by NASA's Magellan spacecraft in the early 1990s.

The surface is dominated by vast plains of volcanic rock. Venus shows extensive evidence of widespread volcanism, including thousands of volcanoes. Some, like Maat Mons, are massive shield volcanoes. While it is unknown if any volcanoes are currently active, recent data suggests ongoing volcanic activity is plausible. Unlike Earth, Venus does not appear to have active plate tectonics.

Rotation and Orbit

Venus has the most unusual rotation of any planet. It spins on its axis in the opposite direction to most other planets (a retrograde rotation). Furthermore, it spins incredibly slowly. A single Venusian day (sidereal day) lasts 243 Earth days, which is longer than its year (orbital period) of 225 Earth days.