

Clouds of Venus

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Venus is totally covered by thick clouds, which are practically featureless in visible spectral range. The main cloud deck is in the range 48-70 km altitude. It is separated in three layers with different properties: upper (roughly 60-70 km), middle (50-60 km) and low (48-50 km). The total optical depth of the clouds changes in the range 20 – 40. The main compounds of the clouds is sulfuric acid with concentration 75 - 85 % at all latitudes: the sulfuric acid absorption bands are observed in the thermal emission spectra, which originate from upper and middle clouds. According to MW and radio occultation measurements the abundance of the H₂SO₄ vapor is in saturation at 50 km at low and high latitudes indicating to sulfuric acid condensation in low clouds. However, the other compounds were found by the Venera and VEGA descent probes X-ray analysis in the low clouds : S, Cl, P and Fe, they may be included in aerosol. The upper clouds are situated in mesosphere in the stable area. The sulfuric acid is produced by photochemical way from H₂O and SO₂ near the cloud top. The middle clouds are in convective area. Three modes of particle sizes distribution are found in the clouds (Pioneer Venus, VEGA): mode 1 is submicron sized particles, mode 2 is those with $r_{\text{eff}} = 1-2 \mu\text{m}$, and mode 3 – with r_{eff} of $3.5 \mu\text{m}$. Mode 3 particles may have different, not sulfuric acid composition and non-spherical shape. However, spherical, sulfuric acid mode 3 particles were observed in the middle clouds at high latitudes (FS Venera-15, Galileo-NIMS). One of the mysteries of Venus is ‘unknown’ UV absorber in the upper clouds (in the 0.32 – 0.45 μm spectral range, at $\lambda < 0.32 \mu\text{m}$ the UV absorption are explained by SO₂ and SO). The UV contrasts, provided by UV-absorber, reaches 30% and observed from early 70th. Between reasonable proposed candidates, fitted the spectral shape in UV, sulfur and its compounds and solution of 1% FeCl₃ in sulfuric acid are considered. The last one may explain also disappearance of the UV absorption below 58 km. The UV-absorber is very important for energy balance and dynamics. Altitude of the upper boundary of the clouds varies in the solar related way and variation exceeds 2 km (Venera-15). Latitude variation of the upper boundary of the clouds exceeds 5 km (Venera-15 and VIRTIS –North and South hemispheres respectively). The submicron haze was observed from 30 km below the clouds: *in situ* measurements by Venera, Pioneer Venus, Vega and observations in the windows on the night side by VIRTIS VEX. Above the clouds the haze was observed up to 95 km (VIRTIS and SPICAV VEX, Pioneer Venus). The images by VIRTIS on the night side allow observation of the structure and dynamics of the middle and low clouds, polar dipole and cold collar and etc. VEX started investigation of Venus at new level after more than a decade break, obtained exiting results and put new questions, answer for which will be obtained by future missions.