Synthesis of Venera Lander Results and Future Problems

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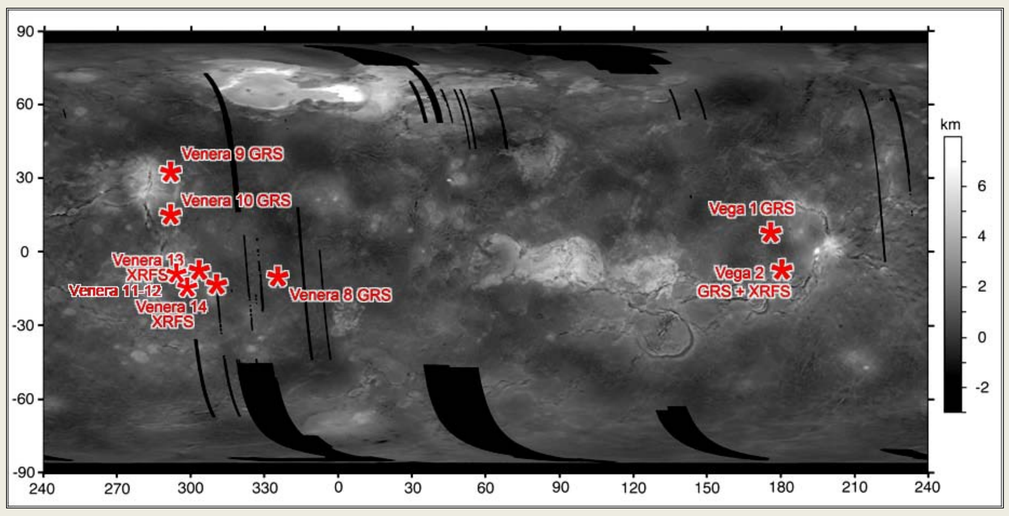
Introduction: There were 9 essentially successful landing missions on Venus which showed close up images of the surface, measured its chemical composition and provided information on the near -surface environment.

Venera 13 site landscape; mosaicing and art by Don Mitchell (http://mentallandscape.com/). Dark surface and bright orange sky are appropriate for Venus daylight landscapes.



Venera – Vega landing sites on the background of Magellan SAR mosaic of Venus.

Mockup of Venera 13 lander in the Museum of Lavochkin association

Mission description:

Venera 8 was a Venus atmospheric probe and lander that landed on July 22, 1972 at 10.70°S 335.25°E. Its instrumentation Included temperature and pressure sensors, accelerometer, photometers, ammonia analyser, gamma ray spectrometer, and a radar altimeter.

Venera 9 - a Venus atmosphere probe/lander and orbiter that landed on October 22, 1975 at 31.01°N 291.64°E, The lander instrumentation included: temperature and pressure sensors, accelerometer, Visible/IR photometer, nephelometers, mass spectrometer, panoramic telephoto meters, anemometer, gamma ray spectrometer, gamma ray densitometer

Venera 10 - a Venus atmosphere probe/lander and orbiter – twin mission to Venera 9, landed on October 25, 1975 at 15.42°N 291.51°E.

Venera 11 was a Venus atmospheric probe and Lander, landed on December 25 at 14°S 299°E. The lander instrumentation included: backscatter nephelometer, mass spectrometer, gas chromatograph, X-ray fluorospectrometer, 360° scanning photometer, spectrometer (430–1170 nm), microphone/anemometer, 4 thermometers, 3 barometers, accelerometer, penetrometer, soil analysis device, and 2 color cameras on which the windows did not open.

Venera 12 was a Venus atmospheric probe and lander – twin mission to Venera 11 that landed on December 25 at 7°S 294°E.

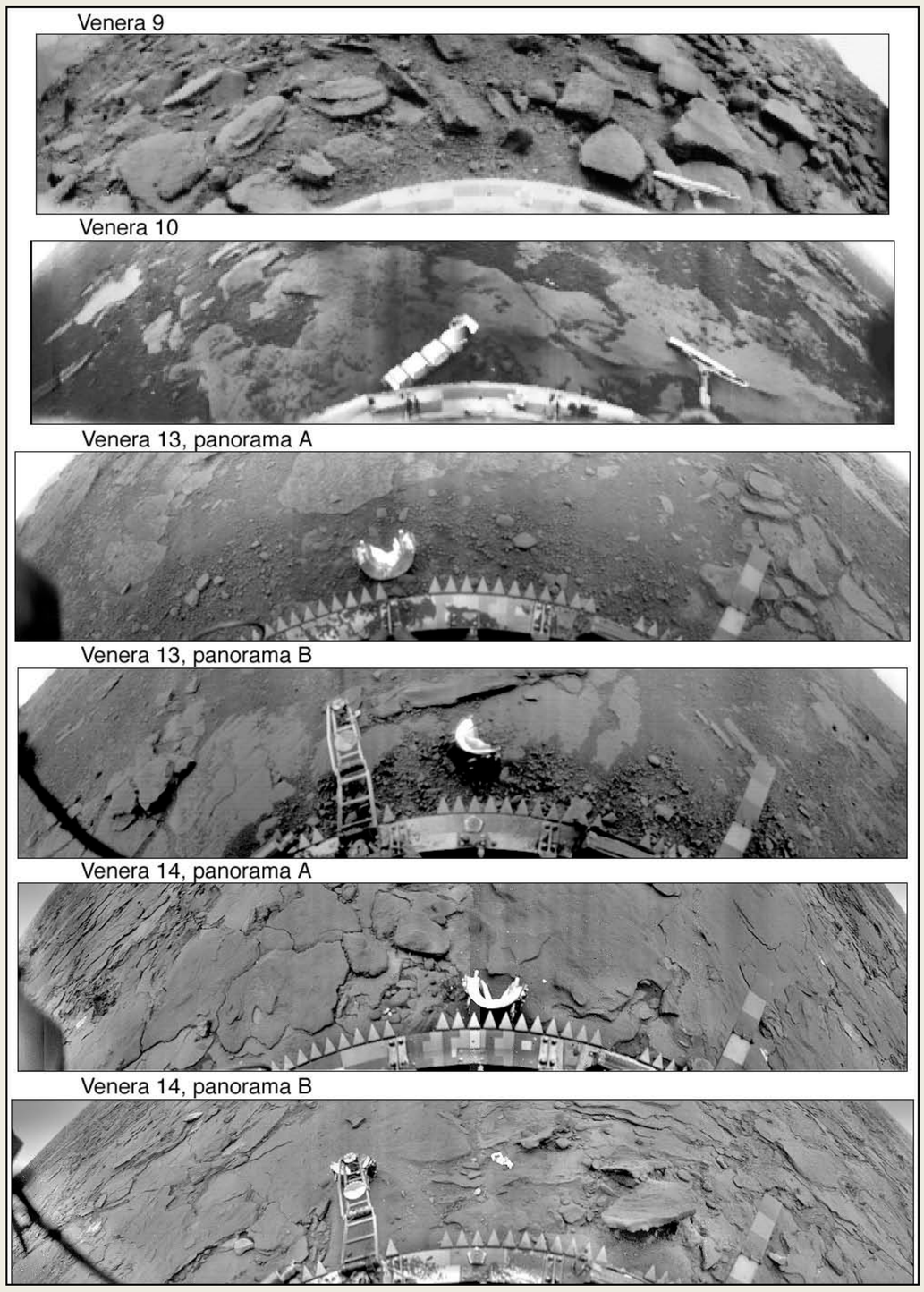
Venera 13 was a Venus atmospheric probe and lander, landed on March 1, 1982, at 7.5°S 303°E. The lander instrumentation included: accelerometer - impact analysis, thermometers, barometers, spectrometer/directional photometer, ultraviolet photometer, mass spectrometer, penetrometer / soil ohmmeter, chemical redox indicator, 2 color telephotometer cameras, gas chromatograph, radio/seismometer, nephelometer, hydrometer, X-ray fluorescence spectrometer (aerosol), X-ray fluorescence spectrometer (soil), soil drilling apparatus.

Venera 14 was a Venus atmospheric probe and lander – twin mission to Venera 13 that landed on March 5, 1982, at 13.25°S 310°E.

Vega 1 was a Venus atmospheric probe/lander and balloon; the flyby part travelled to Halley's comet. The lander instrumentation included: accelerometer, temperature and pressure measuring sensors, UV spectrometer, hygrometer, aerosol analyzer, spectrometer/nephelometer, gas-phase chromatograph, X-ray spectrometer, mass spectrograph, drilling device, gamma ray spectrometer and X-ray fluorescence spectrometer. Vega 1 landed on June 11, 1985, at 7.2°N 177.8°E.

Vega 2 was a Venus atmospheric probe and lander – twin mission to Vega 1 that landed on June 15, 1985, at 7.14°S 177.67°E.

TV panoramas taken at the Venera 9, 10, 13 and 14 landing sites.



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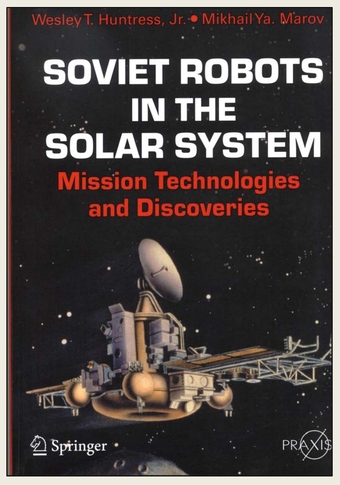
Surface analysis results:

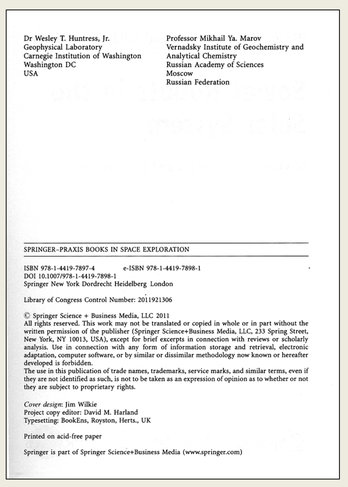
Based on measurements of the instruments mentioned above a lot of key information on the surface and atmosphere characteristics of Venus was acquired. The GRS and XRFS measurements show-ed that surface material at the Venera-9, 10, 13, 14 and Vega 1,2 sites is of basaltic composition [1]. At the Venera 11/12 sites analyses of this sort were not done. The measured basaltic surface composition agrees well with the results of photogeological analysis of the Magellan images of the planet [2-4]. Only areas of tessera terrain [3,4] and some steep-sided domes probably are not basaltic but rather felsic [5-8]. Centimeter-scale platy surface seen at the Venera-9, 10, 13, 14 panoramas is probably composed of air-fall deposits resulted from fine ejecta of impact craters located upwind [9]. Normally the near-surface winds are slow but the high density of the atmosphere makes sculpturing of the surface possible [10]. At zero altitude level, the surface temperature on Venus is 470C and the atmospheric pressure is 93 bar [11]. The major constituents of the Venus atmosphere are CO_2 (96.5 mol %) and N_2 (3.5%) [12]. The geochemically important H_2O vapor content is ~45 ppm, and the SO_2 content normally is ~100 ppm [12]. But in 1980 the SO_2 content was as high as ~400 ppm and then for several years gradually decreased [13]. This peak content could be a result of massive volcanic eruption but purely meteorological causes are also not excluded. The D/H ratio of the Venus atmosphere is more than factor 100 higher than that in the Earth's ocean, suggesting that in its early history Venus could have had an ocean [14]. Recent observations of the surface "hot spots" in the Ganiki rift zone suggest that this planet is still volcanically active [15], but this conclusion needs to be confirmed in other areas of the planet.

Key problems to be addressed in future studies:

- What was happening on Venus between its accretion and the formation of tessera terrain?
- Did Venus once have an ocean?
- Did plate tectonics ever occur on Venus?
- Is tessera terrain composed of thickened basaltic crust or of a different low-density material?
- What is the chemical/mineralogical composition of key stratigraphic units?
- What is the temperature / compositional profile of the lower (<10 km) atmosphere?
- How did the folded mountain ranges surrounding Lakshmi Planum form?
- Is Venus still volcanically / tectonically active?
- Are coronae manifestations of mantle plumes or negative diapirs? Are some of them still active?
- What is the nature of the layered rocks seen in the Venera panoramas?

Additional information can be found in:

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