DISCOVERY VENERA SURFACE - ATMOSPHERE GEOCHEMISTRY EXPERIMENTS MISSION CONCEPT;

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SCIENTIFIC GOALS AND OBJECTIVES - The phenomenal increase in our understanding of Venus provided by the Magellan Mission has raised a series of focused, fundamental scientific questions about the geochemistry of the surface of Venus, the nature of the lower atmosphere, and the relationship of the lower atmosphere and surface. First, surface geochemical measure-ments from the Venera/Vega spacecraft showed that widely spaced regions of the venusian plains are made of basalts; thus basalts are significant and may be the only component of the venusian crust. But we lack information on the composition of several key elements of Venus geology: 1) Tessera terrain (which may be outcrops of continental-like non-basaltic crustal material) and steep-sided domes/festoons are promising candidates for non-basaltic geochemically evolved material. The composition of the lower part of the Venusian crust is unknown: however, ejecta from large venusian craters provides us with the possibility of sampling this material on the surface; 2) Bulk chemistry (structure and dynamics) of the venusian atmosphere are known. The altitude profiles of water vapor content and minor admixtures relevant to redox conditions in the lower atmosphere(< 20 km altitude) remain uncertain. Lack of that knowledge means that we don't understand the fine chemical structure of the main mass of the Venusian atmosphere; 3) Thermodynamic models predict that igneous materials on the surface of Venus should react with gases of the venusian atmosphere. But because the water vapor content and redox conditions in the lower atmosphere are not well known, we don't understand the nature of venusian weathering: oxidation, sulfatization, carbonatization, hydration. The answers to these questions are critical to the understanding of Venus, the most Earth-like of the terrestrial planets.

THE CONCEPT: The primary goal of the Discovery Venera Surface-Atmosphere Geochemistry Experiments (SAGE) Mission is to acquire the data to address these fundamental questions. The concept is to launch a Venera-class lander to a designated target of high scientific interest on the surface of Venus with instruments to measure lower atmosphere constituents and surface geochemistry and mineralogy, as well as to investigate surface geology. The core of this mission would involve the utilization of mature and flight-proven spacecraft hardware and experiment concepts from the Soviet Venera lander program, with some experiments modified to take advantage of recent technological developments. Discovery Venera can be repeated at appropriate intervals to explore a variety of environments on Venus and our analysis of launch opportunities shows that widespread and representative areas of the surface of Venus are accessible. The Discovery cost envelope is met through the availability of low-cost Russian spacecraft hardware and mission design experience.

THE INSTRUMENTS: Scientific goals of the mission will be met by measurements using four instruments:

1. Optical Atmospheric Spectrometer: This will obtain vertically resolved profiles of the key atmospheric gases (H2O, HDO, SO2 H2S, OCS, and CO) in the lower atmosphere. The instrument will be based on flight heritage of the Venera spectrometer. It will implement an F/1.5 dual arm grating approach. The first arm covers 0.8 to 1.20 mm, the second, 2.25 to 2.2 mm; l/Dl=1000. The instrument will collect measurements looking both up and down. Mass: ~ 12 kg, Power: ~12W.

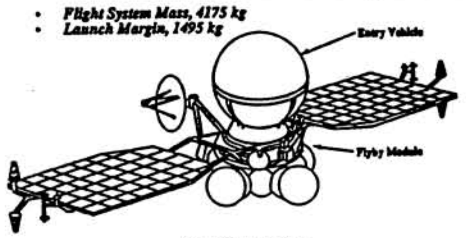
2. Imaging Spectrometer: This will provide a closeup view of the targeted terrain, obtain spectra of soil and rock and provide us with an understanding of what kind of material (soil, rocks) other surface measurements are related to. The instrument utilizes proven Venera F/2 camera optics and scanning system as a telescope for the imaging spectrometer. There is an option to add a beamsplitter and fly both the Russian TV camera and Imaging Spectrometer. Mass: ~11 kg, Power: ~8W.

3. Neutron Probe and Gamma Ray Spectrometer: This will work in two regimes: 1) passive, measuring abundances of K, Th and U from their natural gamma irradiation and 2) active, measuring bulk composition of the surface material from gamma irradiation due to nuclear interaction with free neutrons generated by a Pulsed Neutron Generator. The instrument utilizes commercial petroleum industry technology (Schlumberger GSO/PMT) and Russian Vega CsI/PMT. It utilizes also proven Vega deployment technology. Mass: ~27 kg, Power: 30W average.

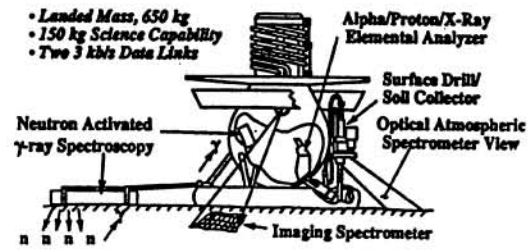
4. Alpha-Proton-X-ray Elemental Analyzer, which will measure elemental composition from C through Ni of a sample taken by the sampling device from a depth of 10 mm. The instrument utilizes Venera/Vega technology for sample acquisition and technological developed for the Phobos and Mars 94 APX instruments. Mass: ~6 kg, Power: ~1W.

EXPECTED SCIENCE RESULTS:

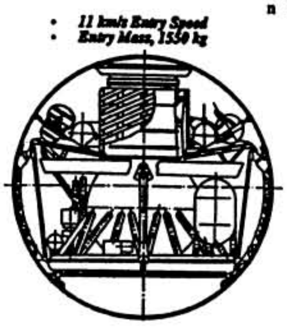
- •Major and trace element geochemistry of the target (e.g., tessera, festoon) material.
  - Determine rock type/implications for igneous petrology.
  - Understand whether Venus crust is composed of basalts only or is compositionally bimodal.
- •Key components of lower atmosphere.
  - Redox conditions and water vapor content in lower atmosphere.
- •IR spectra and chemistry of surface material.
  - Mineralogy of surface material: Surface weathering.
- •Closeup view of the target region (e.g., tessera, festoon) landscape.
  - Character of surface processes in non-plain area.



Modified Phobos
Flyby Module



Venera/Vega Lander



Venera/Vega
Entry System

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