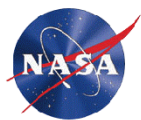


Venus Lander Mission Concepts

By
IPPW 6 Short Course
Venus Lander Team
Georgia Tech Conference Center
June 22, 2008



Venera 9 Surface Image

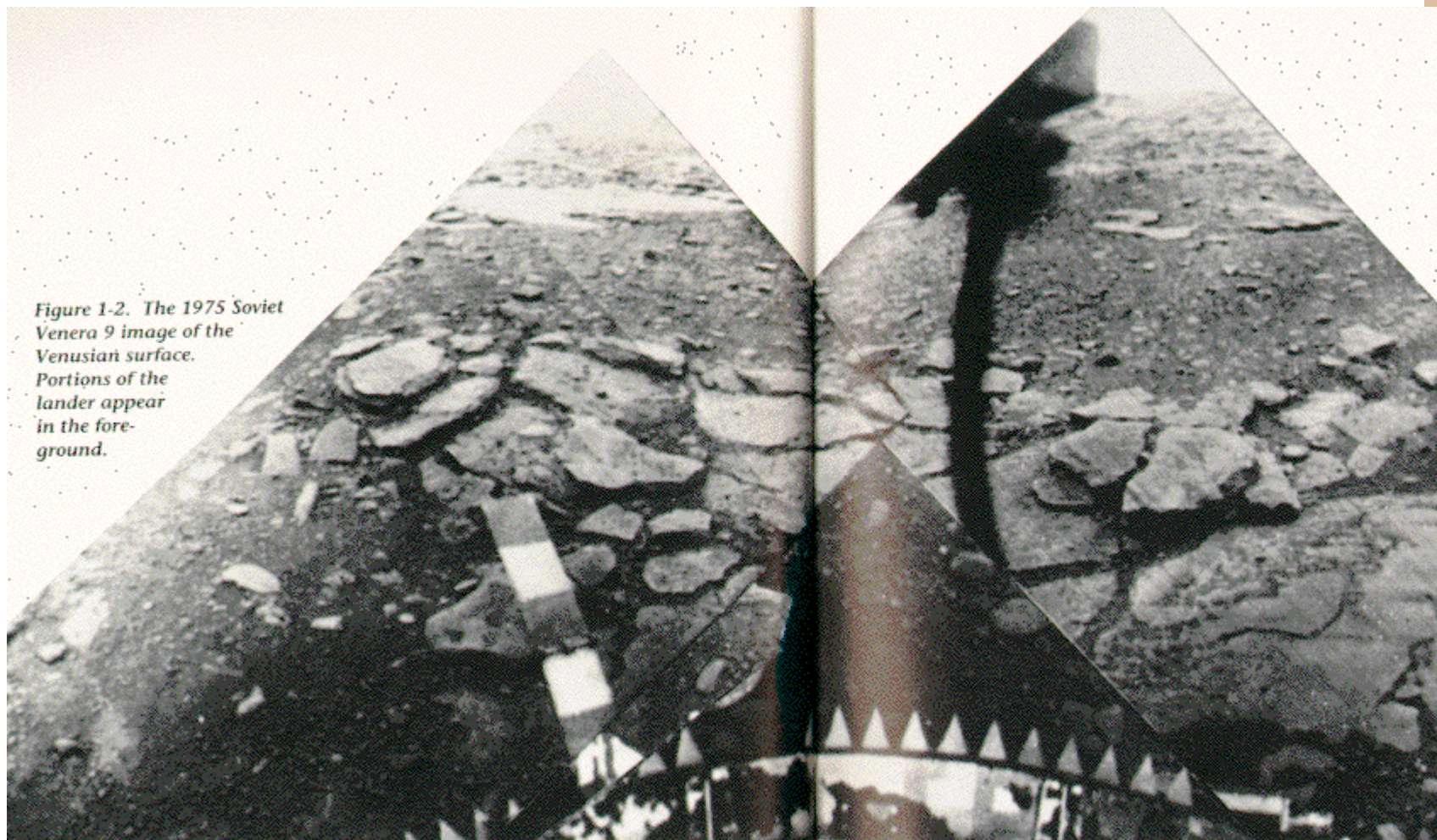
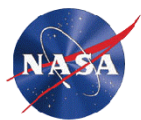
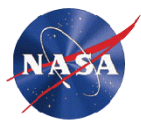


Figure 1-2. The 1975 Soviet Venera 9 image of the Venusian surface. Portions of the lander appear in the foreground.



Ground Rules

- Flagship class mission
- Two concepts:
 - Near term baseline (largely existing technology)
 - 2nd Decade (new technology) – not addressed
- 2000 kg total entry mass
- 25% EDL system mass (including TPS, backshell, parachute)
- 1500 kg landed mass



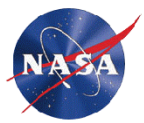
Lander Objectives

- Programmatic
 - Cost (~\$2B)
 - Risk
 - TRL
 - Schedule
 - Tech demo on early mission?
- Science
 - Descent
 - TPS instrumentation (upper atmosphere): heat flux
 - Meteorology: Temperature, pressure, wind
 - Composition: GC/MS
 - Landed (surface science)
 - Seismometer (requires long-term presence)
 - Imager (site panorama)
 - Vis
 - IR
 - Spectrophotometry (multi-spectral imaging?)
 - Microscopic Imager
 - Fines, petrology, mineralogy



Lander Objectives

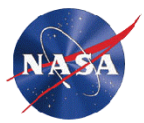
- Landed Science (cont'd)
 - Surface chemistry and interior (implies drill and/or RAT) composition (mineralogy)
 - Contact
 - » APXS
 - » Raman
 - » X-Ray Diffraction
 - » Mossbauer
 - Remote In Situ
 - » LIBS
 - Processed Sample
 - » Mass Spectrometry
 - Radio Geodesy (USO)
 - Meteorology
 - Temperature, Pressure, Wind speed and direction



Mission and Lander Design

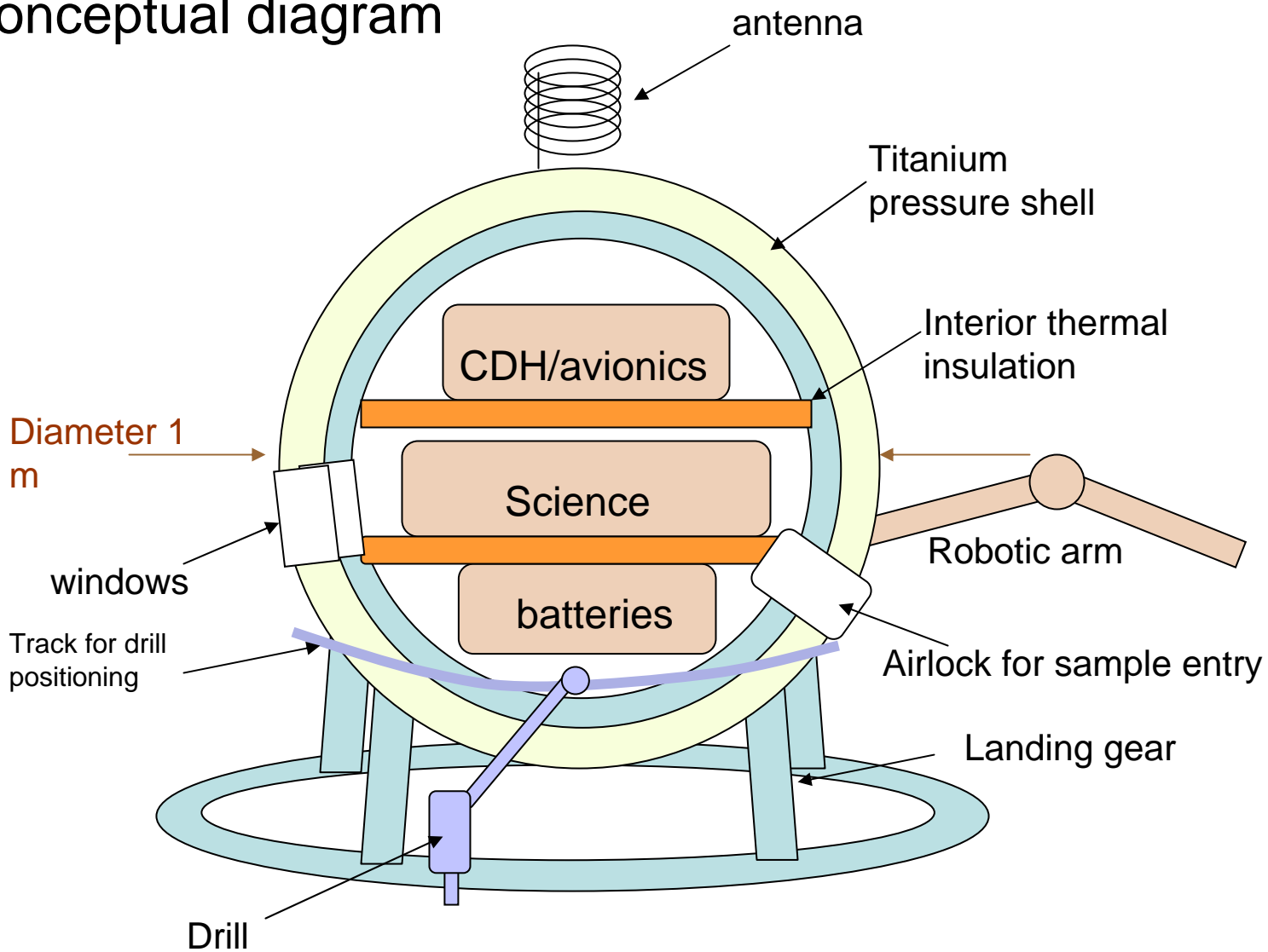
- Mission Duration: a few hours (2 to 12)
 - Graceful degradation with CDH and telecom lasting up to 125 C internal temperature
 - Other subsystems (e.g., instruments) will fail as temperature limits are reached
 - Use contact instruments to characterize sample site prior to drilling
- HT Mechanisms
 - Sample Acquisition and Handling
 - Robotic arm, Drill/scoop, grinder?
 - Mobility (not in near-term baseline)
- Single Compartment 1 meter diam. Pressure Vessel
 - Titanium with Beryllium shelf
 - Feedthroughs
 - Optical windows (4) for imagers
 - Sample[s]
 - Power and data for arm, drill, grinder, meteorology instruments
- Passive Thermal Control
 - Insulation inside
 - Phase change material
- Power: Batteries (Li-Ion)
- Telecom: S-Band Omni to Orbiter

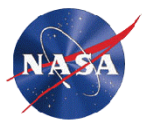




Venus Lander

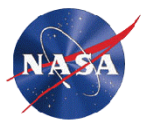
Conceptual diagram





Surface Operations Scenario

- Antenna Deploy & Systems Check
- Continuous telecom to orbiter
 - Orbiter in highly elliptic orbit (with apoapse over lander to provide 12 hour minimum coverage)
- Science Operations
 - Continuous
 - Meteorology
 - Periodic
 - Imaging
 - Sample acquisition/Sample analysis
 - Repeat until out of power or thermal death



Lander Subsystems

Subsystem	Mass (kg)	Power (w)
EDL: TPS, backshell, parachute, crushable landing pad	500 kg	NA (for surface ops)
Instruments	40	111
Sample airlock	25	30
Power (batteries and PMAD)	150	120
Thermal Control	725	NA
CDH	10	10
Telecom	50	100
Mechanisms (arm, drill, grinder)	50	130
Structure (pressure vessel, shelf, etc.)	300	NA
Cabling	150	NA
TOTAL	2000	500