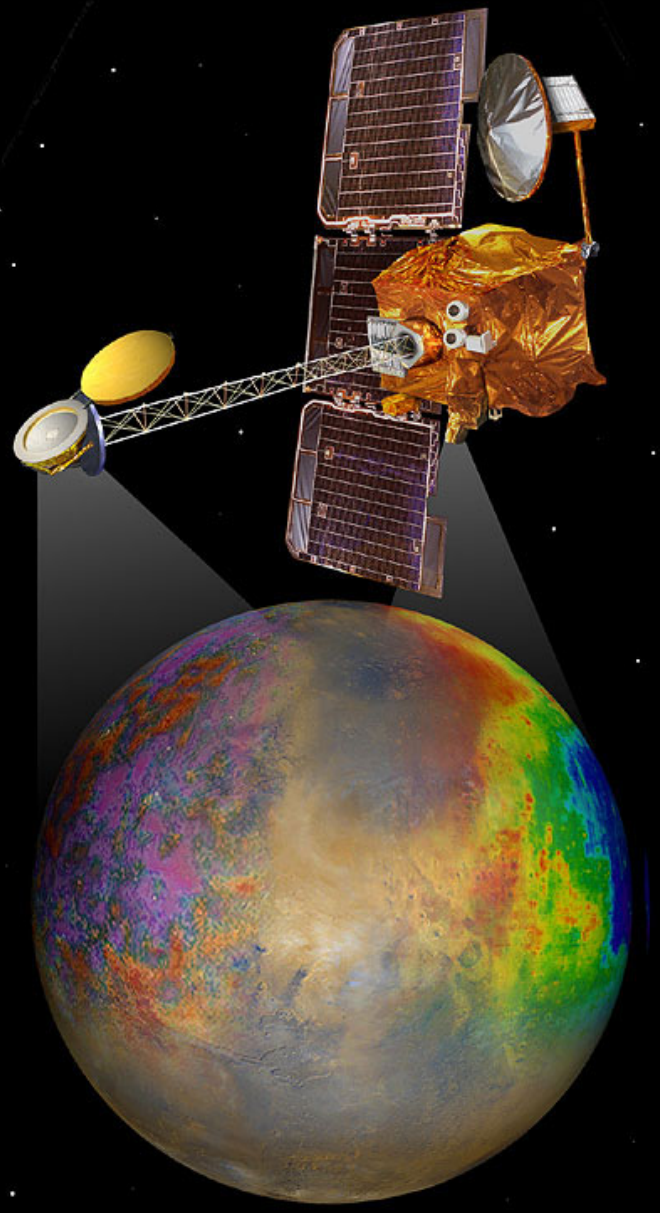


Results from the Mars Odyssey Science Mission

Jeffrey Plaut
Jet Propulsion Laboratory
California Institute of Technology

2001 Mars Odyssey Science Objectives

- Globally map the elemental composition of the surface
- Determine the abundance of hydrogen in the shallow subsurface
- Acquire high spatial and spectral resolution images of the surface mineralogy
- Provide information on the morphology of the Martian surface
- Characterize the Martian near-space radiation environment as related to radiation-induced risk to human explorers

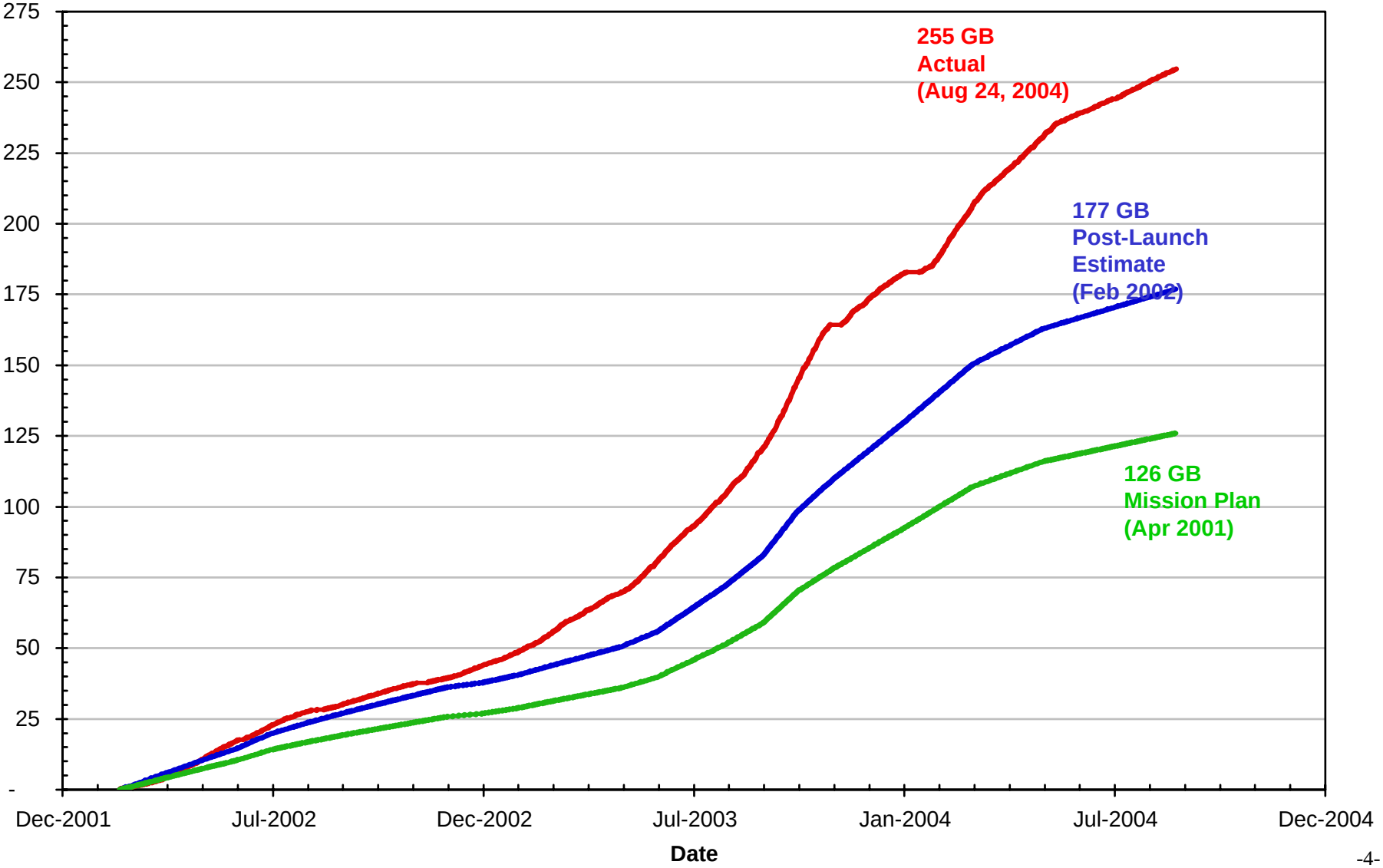
2001 Mars Odyssey Science Instruments

- **GRS - Gamma Ray Spectrometer suite**
  - Gamma Sensor Head (elemental abundance)
  - Neutron Spectrometer (hydrogen/water/CO_2 mapping)
  - High Energy Neutron Detector (hydrogen/water/CO_2 mapping)

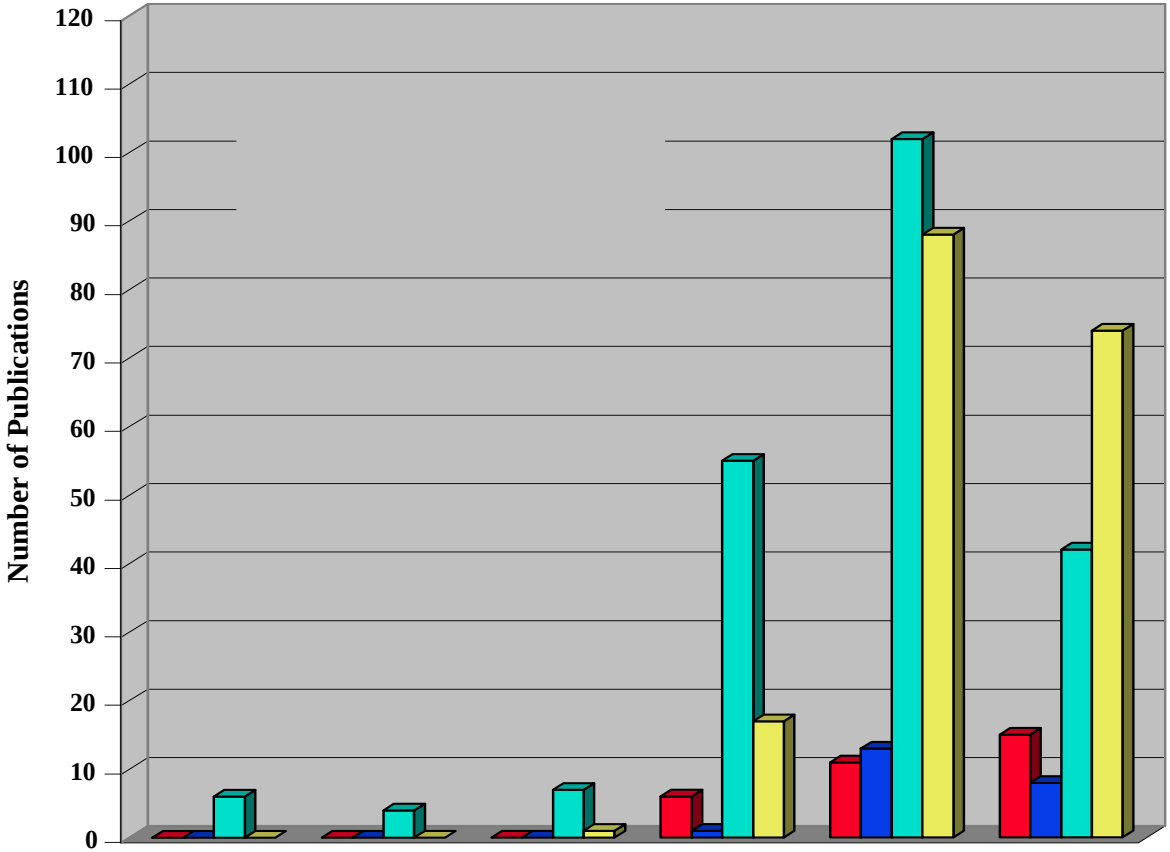
- **THEMIS - Thermal Emission Imaging System**
  - Thermal Infrared Camera - 9 bands, 100 m/pixel
  - Visible Camera - 5 bands, 18 m/pixel (summed to 36 m/pixel)

- **MARIE - Martian Radiation Environment Experiment**
  - Multiple detectors for human hazards of space radiation

Science Data Return



Publications Generated Using ODY Data



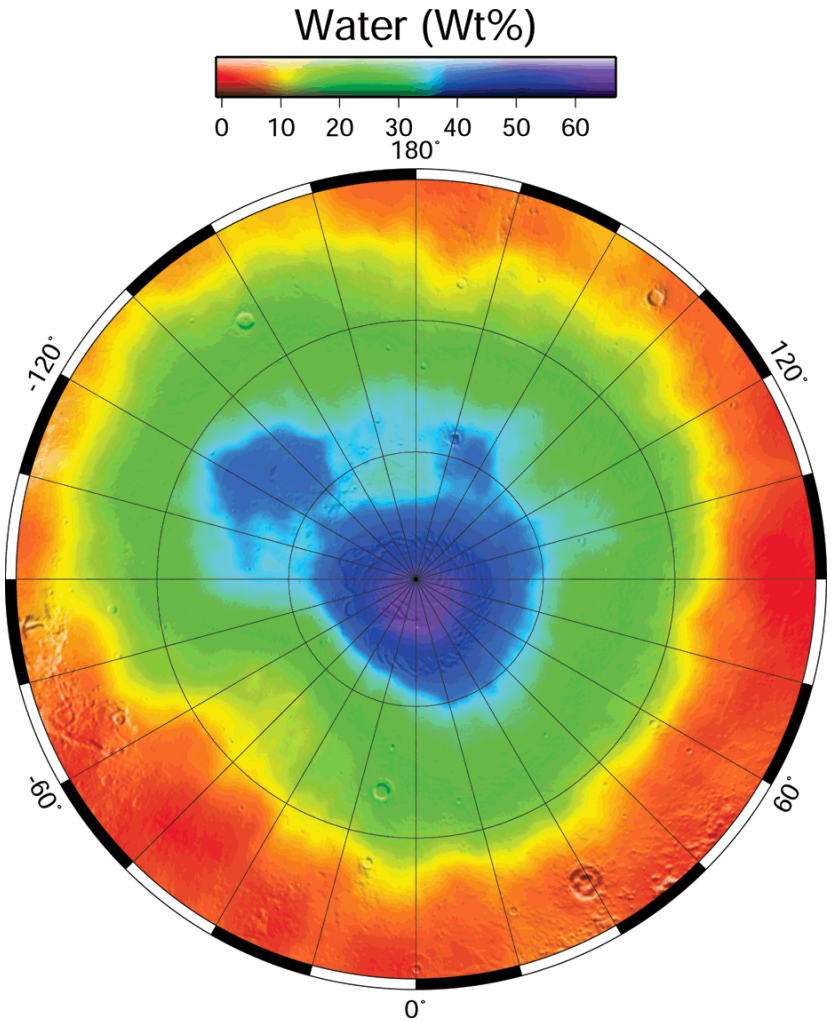
- Peer reviewed journal articles submitted by the Mars Odyssey Team
- Abstracts to professional conferences: AGU, DPS, LPSC, 6th Mars Conference & 3rd Mars Polar Conference, COSPAR, EGU
- Data tracks publications by Odyssey team and overall science community
- Current year data up through August 2004

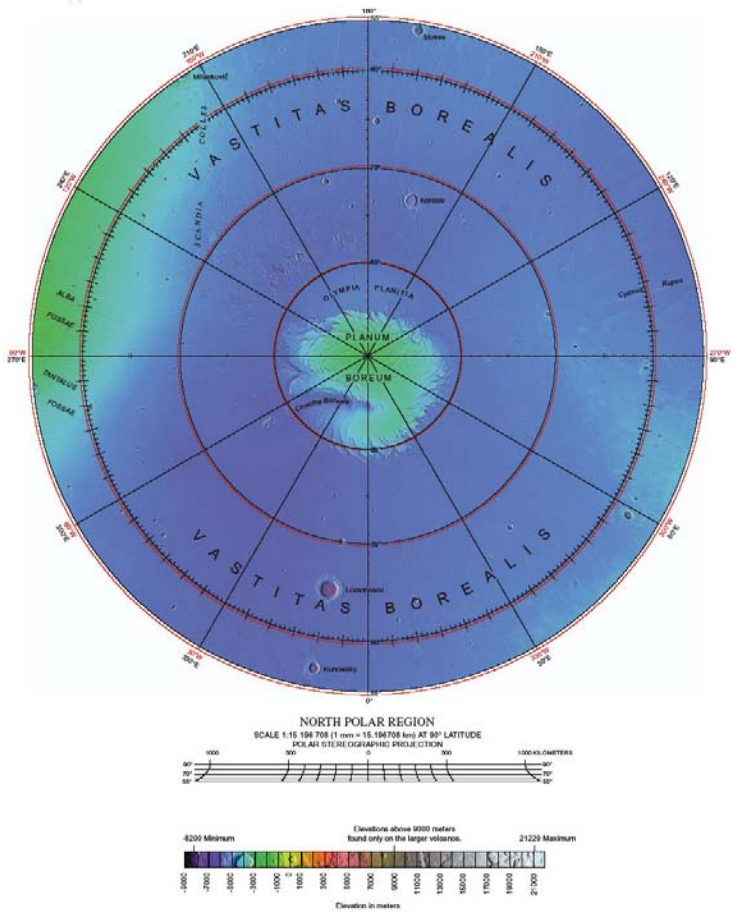
GRS Suite

Mars Odyssey
GRS Performance

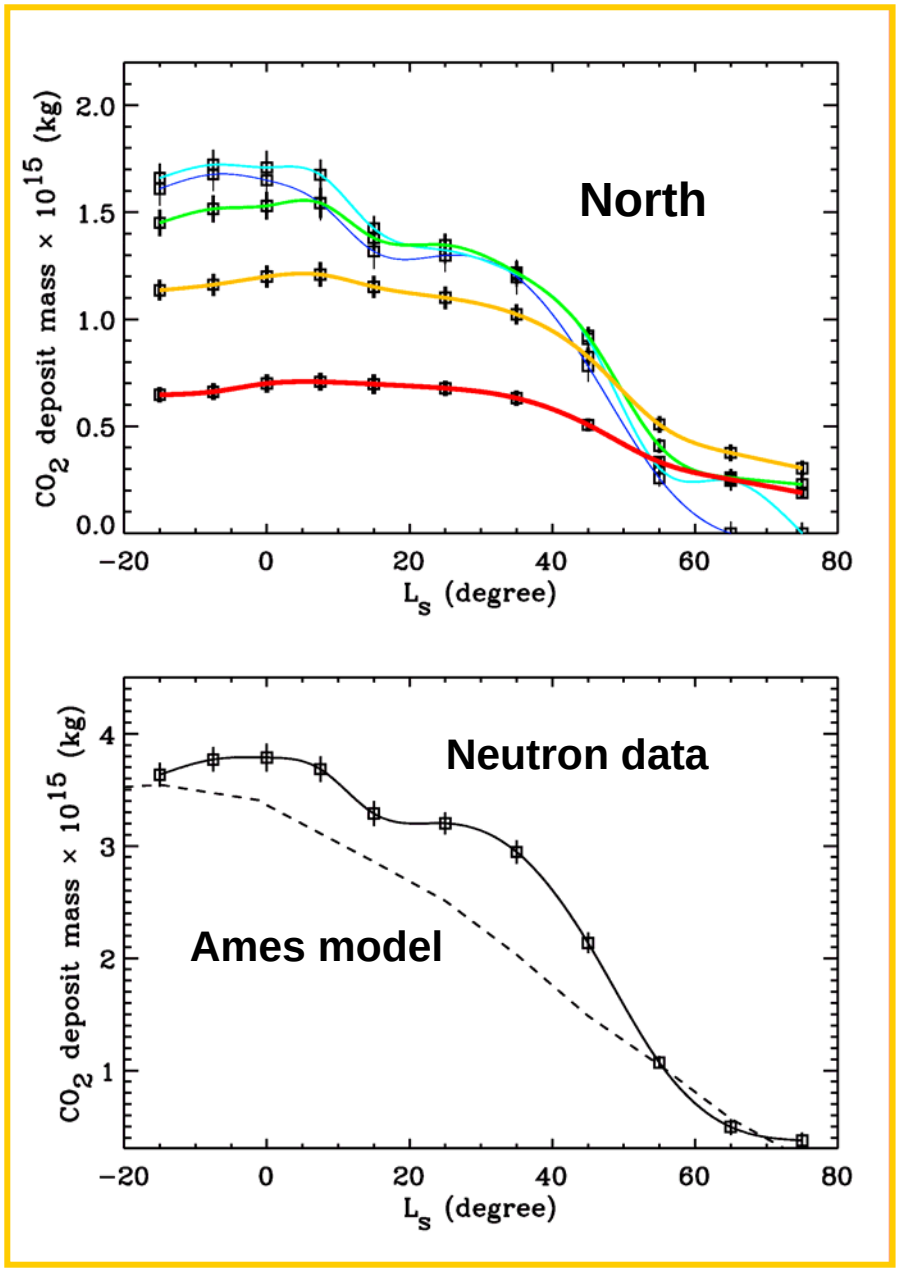
Total duration of GRS operations since Boom Deploy (6/4/2002 - 8/24/2004)	812	118% of one Mars-year
Non-mapping days due to cool down, SPEs and Safing	81	
Total days of science collection	731	106% of one Mars-year

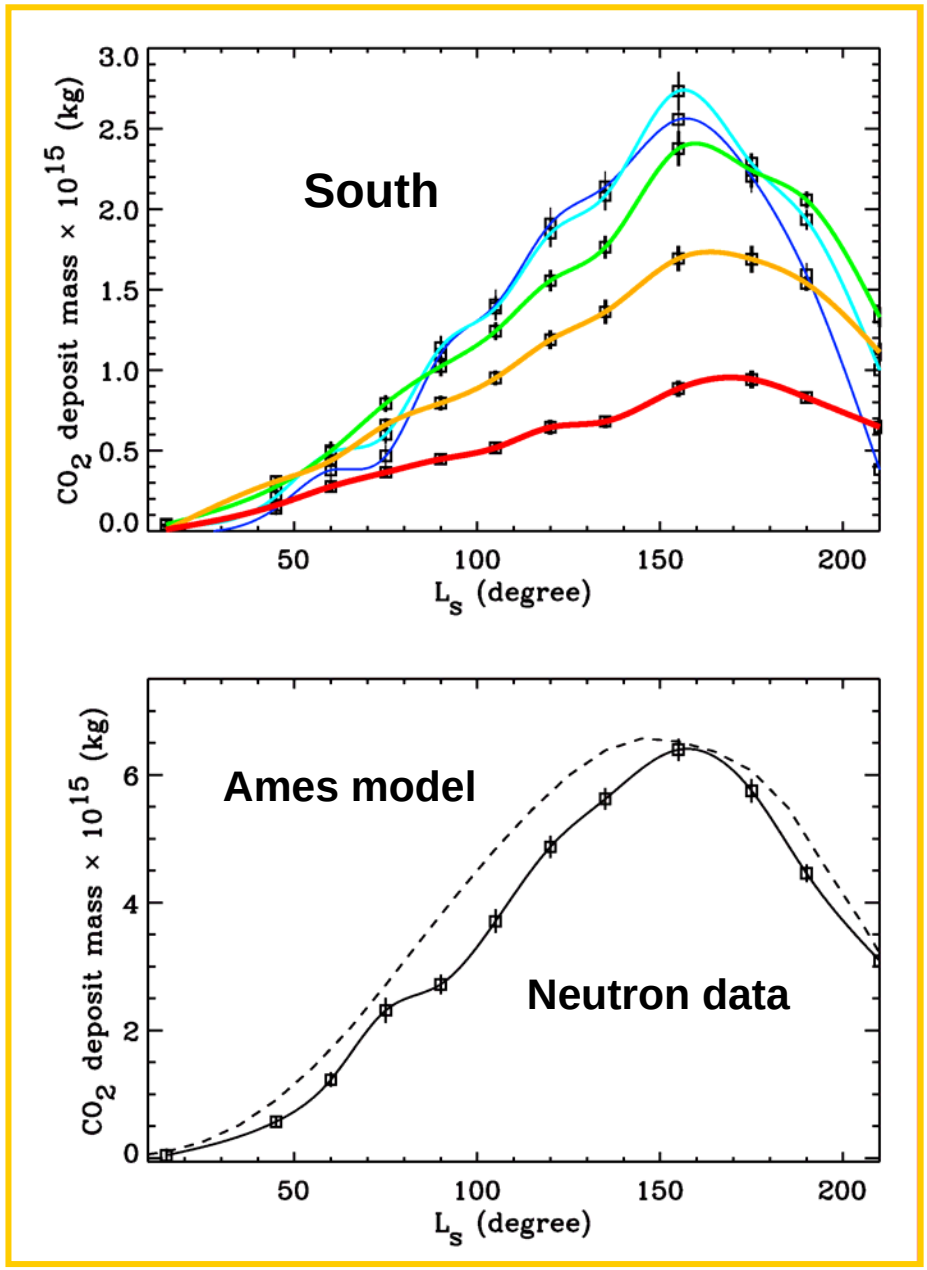
H_2O Abundance in North Polar Region From Gamma Ray Spectrometer



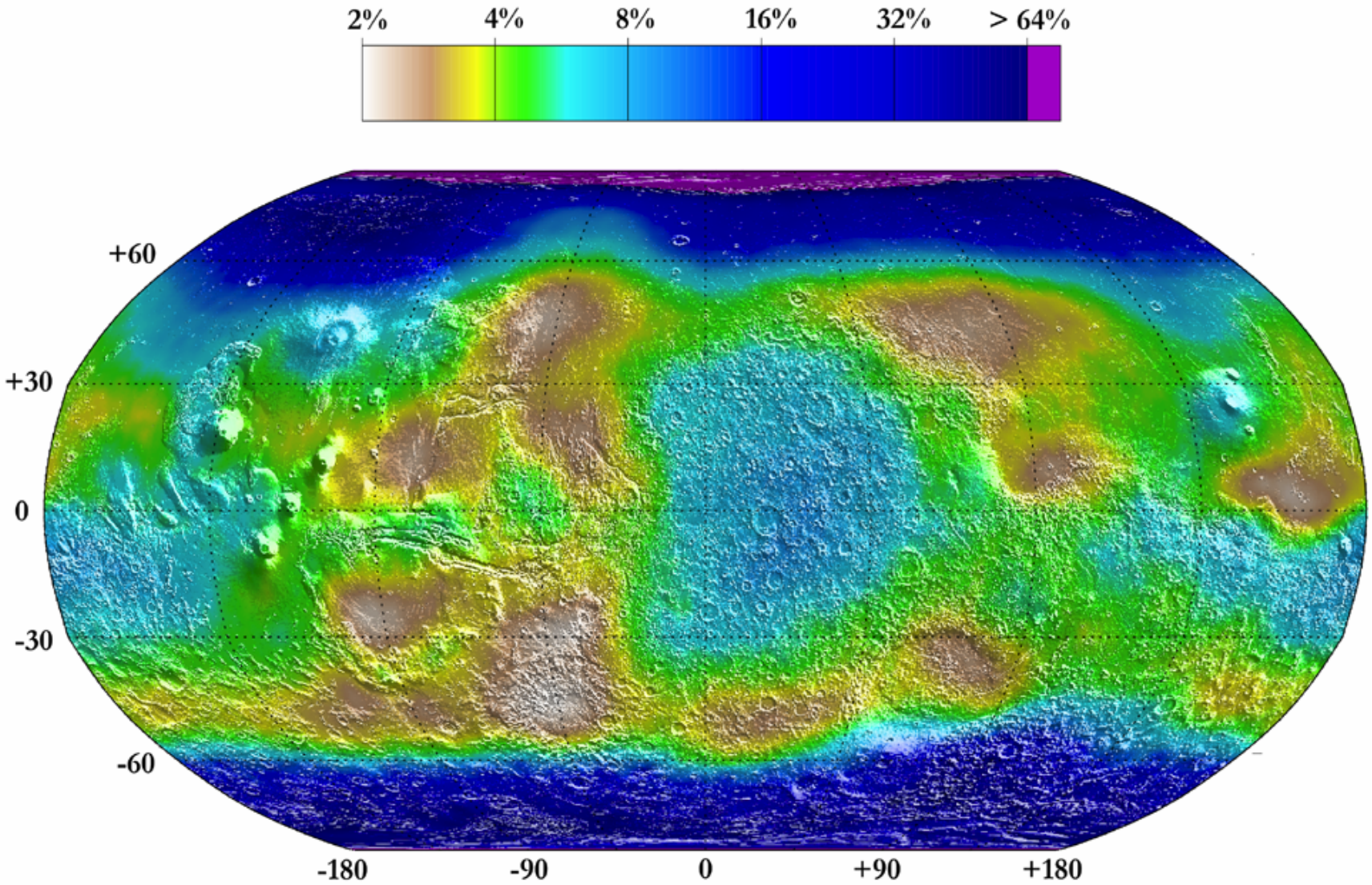


Mass of Seasonal CO_2 Frost Deposits from HEND

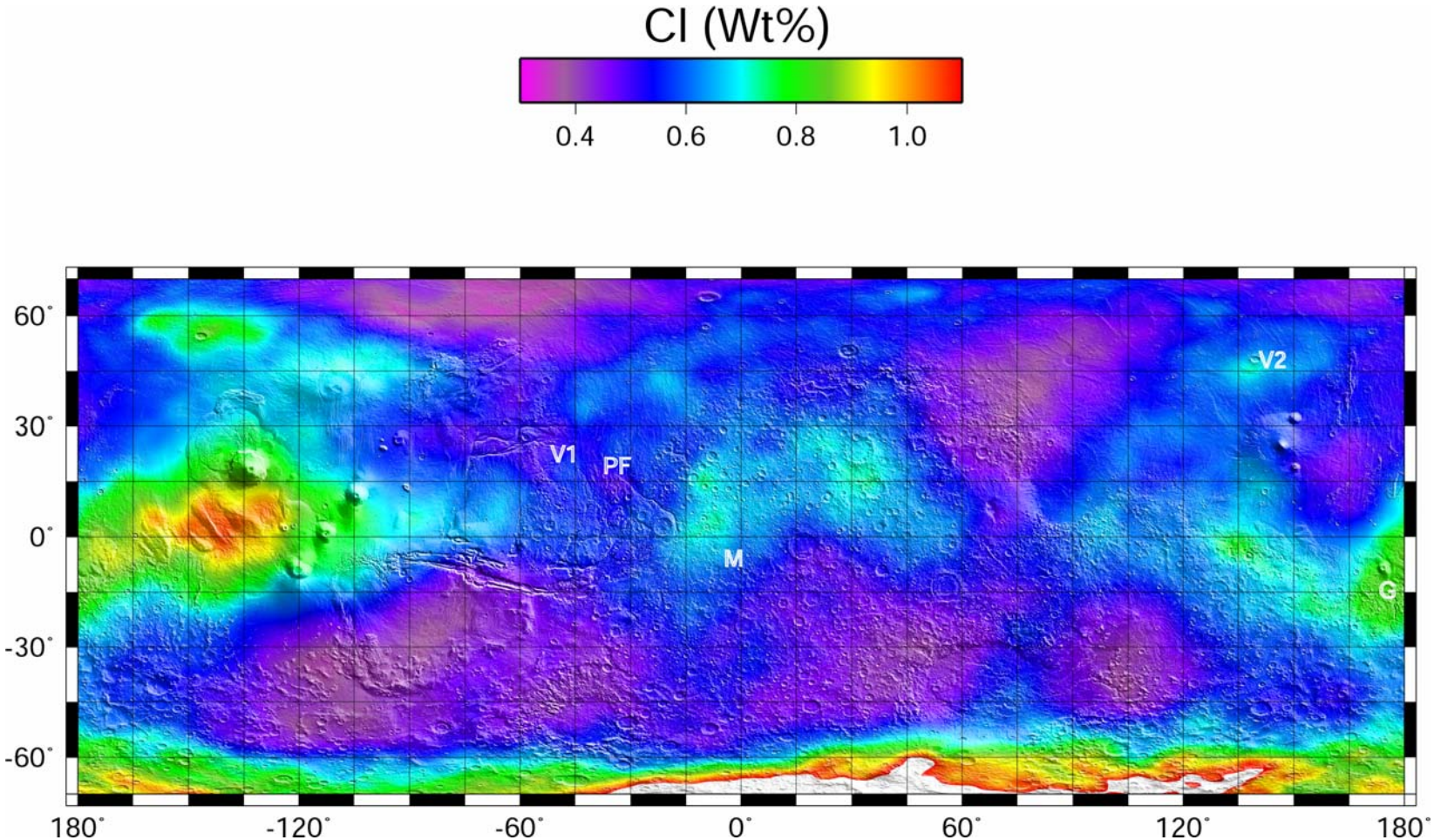




Lower-Limit H_2O Mass Fraction on Mars From Neutron Spectrometer



GRS Gamma Ray Element Mapping - Chlorine



Possible chlorine sources:

Deposition of chlorine-rich dust by the wind

Acid-fog reactions from volcanic eruptions in the area

Alteration in hydrothermal systems

Evaporite deposition

THEMIS

Mars Odyssey
THEMIS Performance

Jet Propulsion Laboratory
California Institute of Technology

Targeted/Received Observations as of Sept 1, 2004:

Infrared Spectrum

- 36,265 IR images (422.2 GB) — 99.8% of planet's surface mapped
  - Daytime IR — 89.6%
  - Nighttime IR — 99.2%

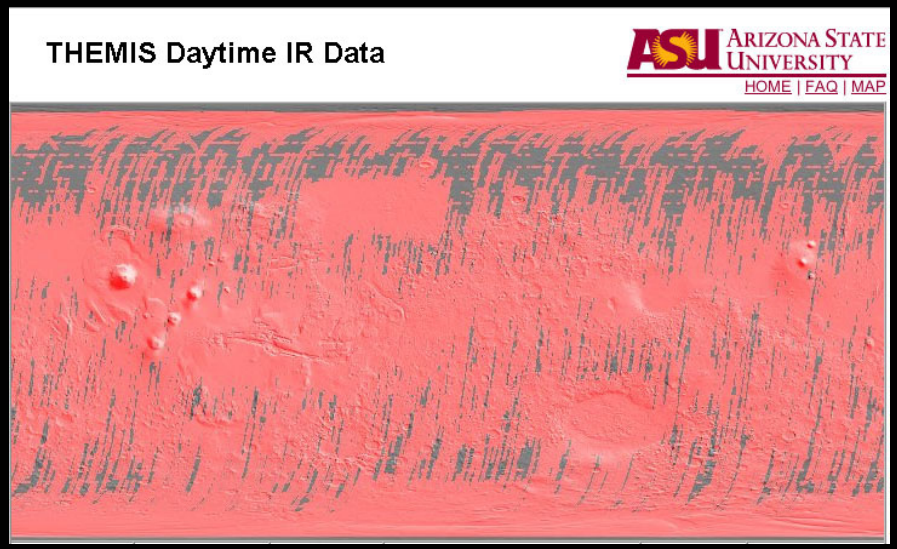
Visible Spectrum

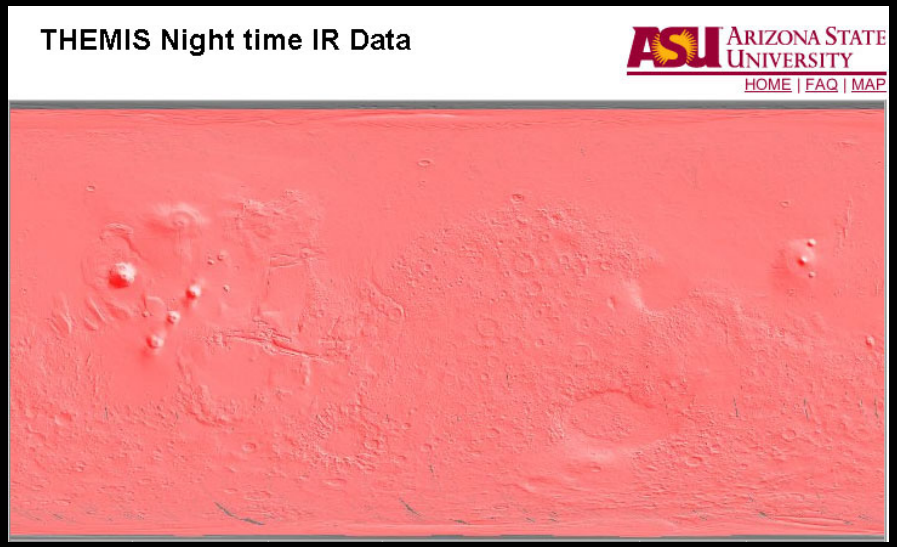
- 28,085 VIS images (99.8 GB) — 25.1% of planet's surface mapped

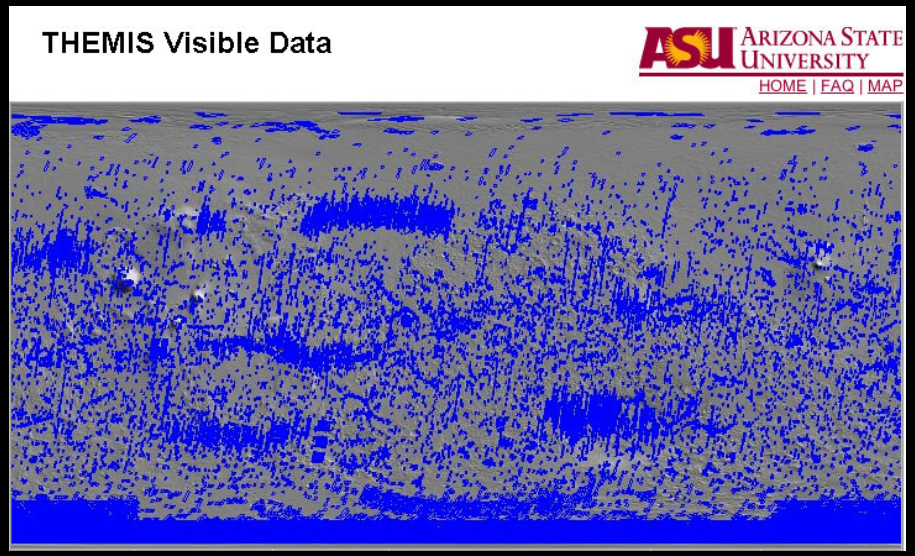
Calibration Data

- 32.0 GB Calibration data

Distribution of Mars Odyssey THEMIS Data

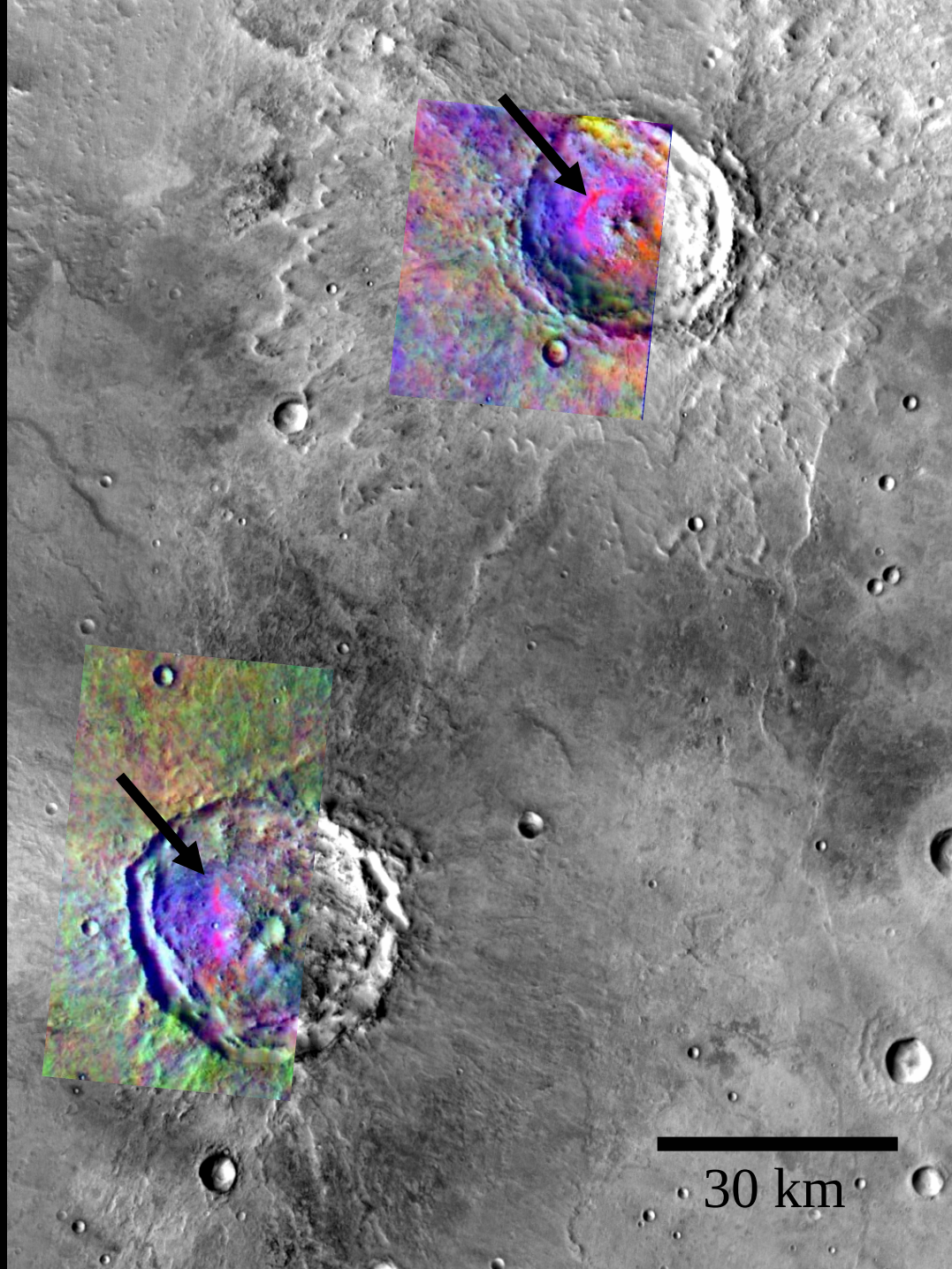






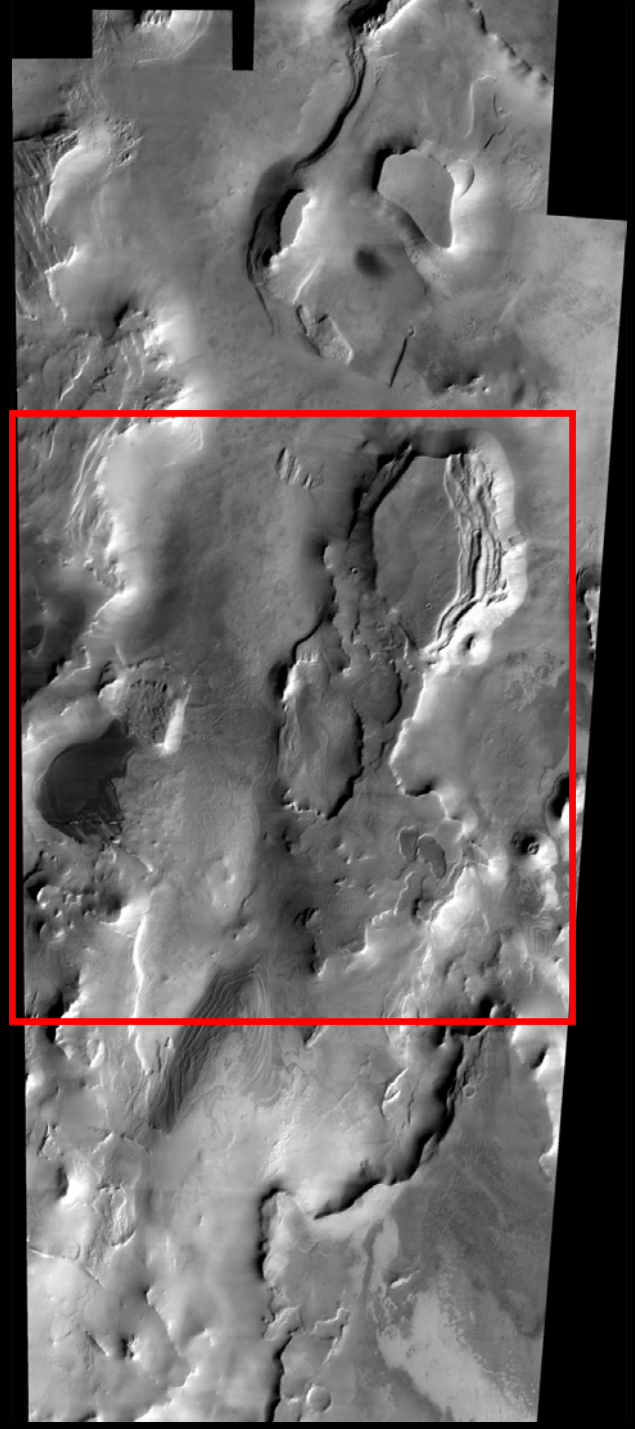
Granitoids on Mars

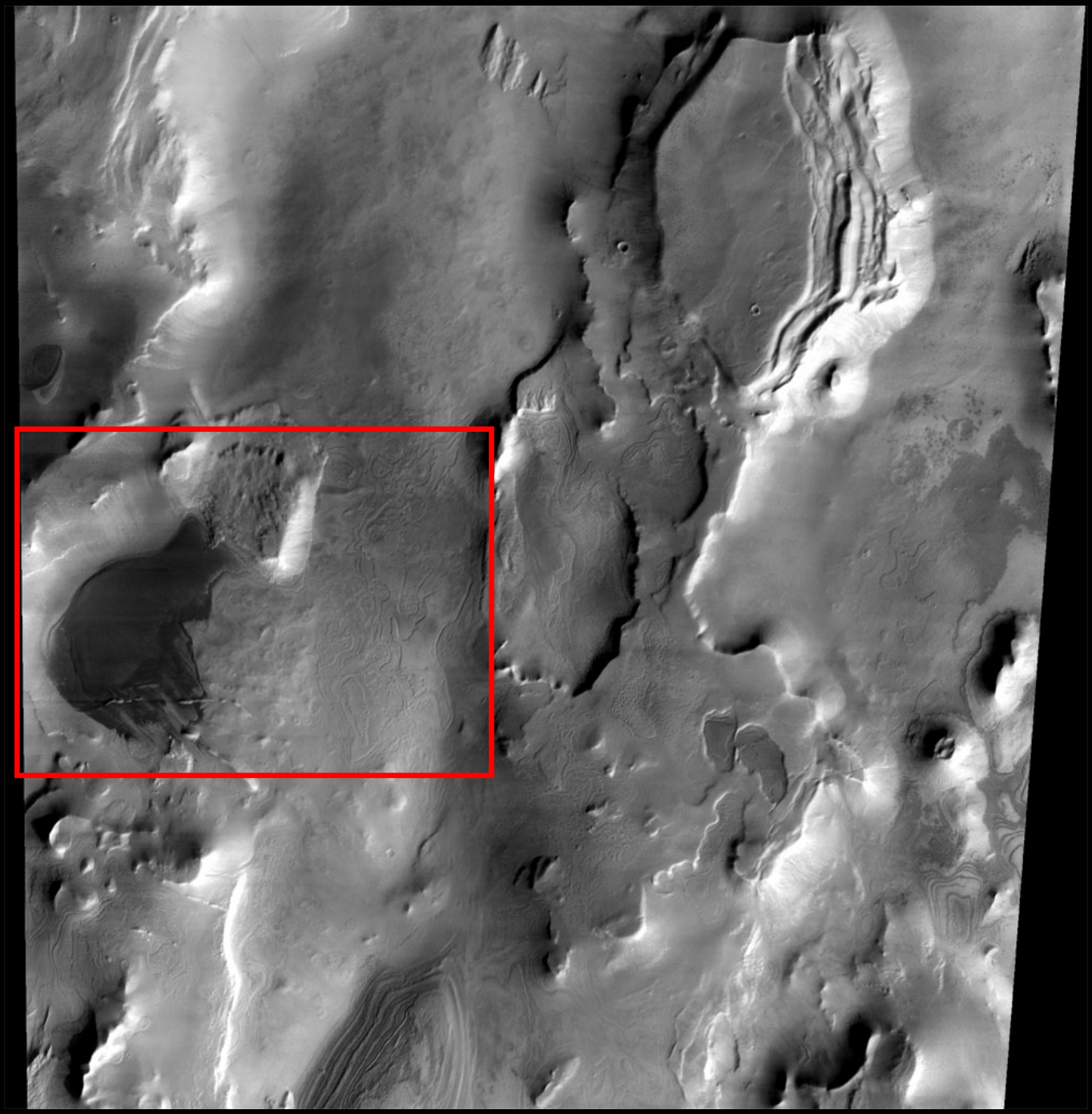
- Quartz and feldspar mineralogy in N. Syrtis Major
- Central peaks uplifted from 3-4 km depth
- Formation could be similar to trondhjemites
  - Partial melting of meta-basalts

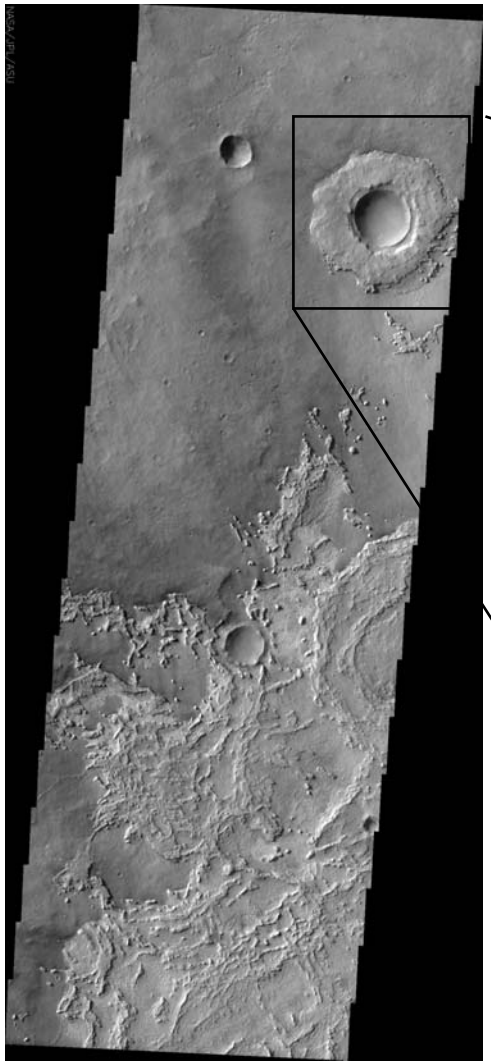


THEMIS Visible Mosaic

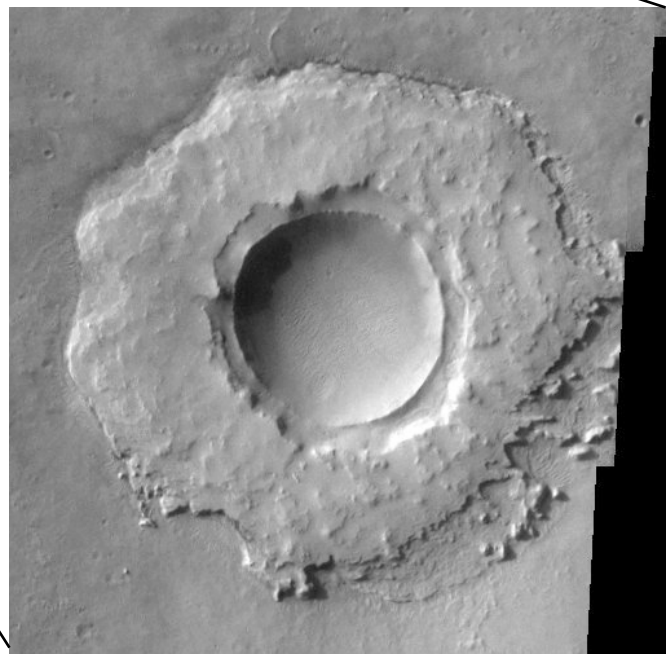
South Polar Region Summer

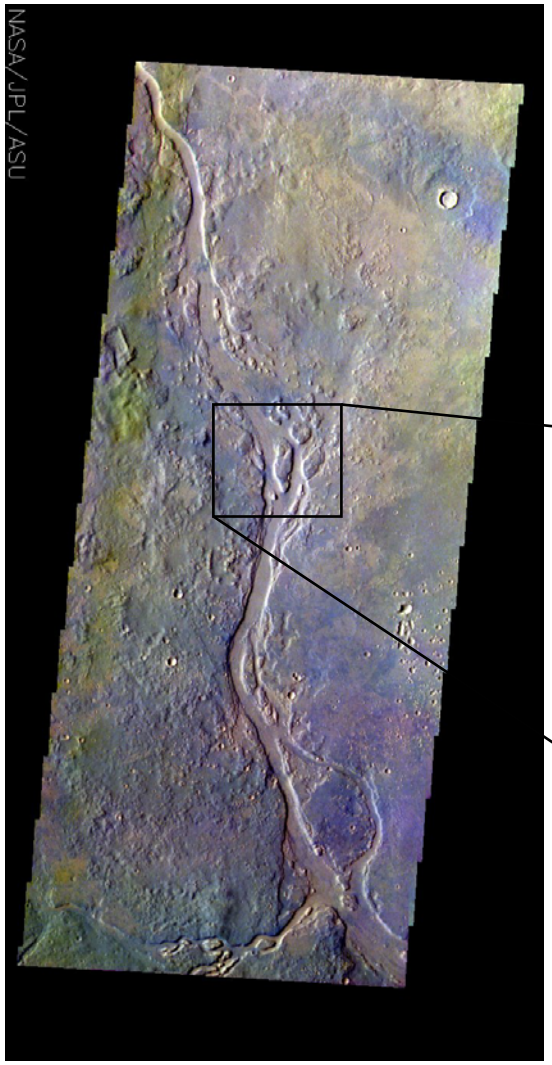






This daytime THEMIS visible image covers an area 58- x 26-km and was collected during the northern summer season. The crater at the upper right was once buried, and has since been exhumed.

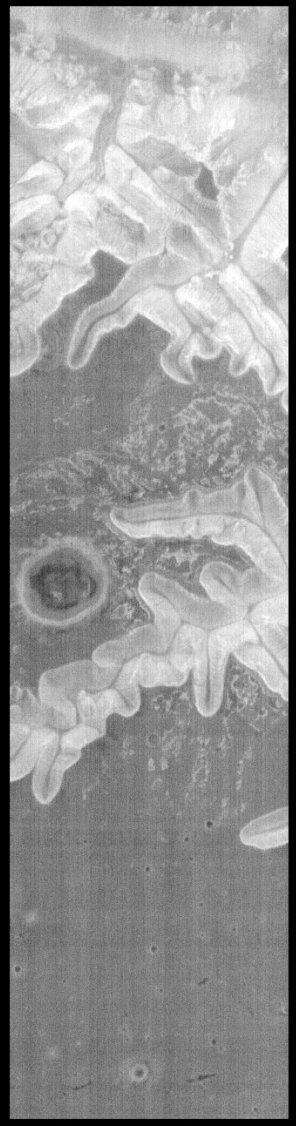




This false color visible image shows subtle compositional variations in part of the Apsus Vallis region covers an area 26- x 13-km. It was collected during northern summer season. The image shows a typical channel with streamlined islands within it.

NASA/JPL/ASU

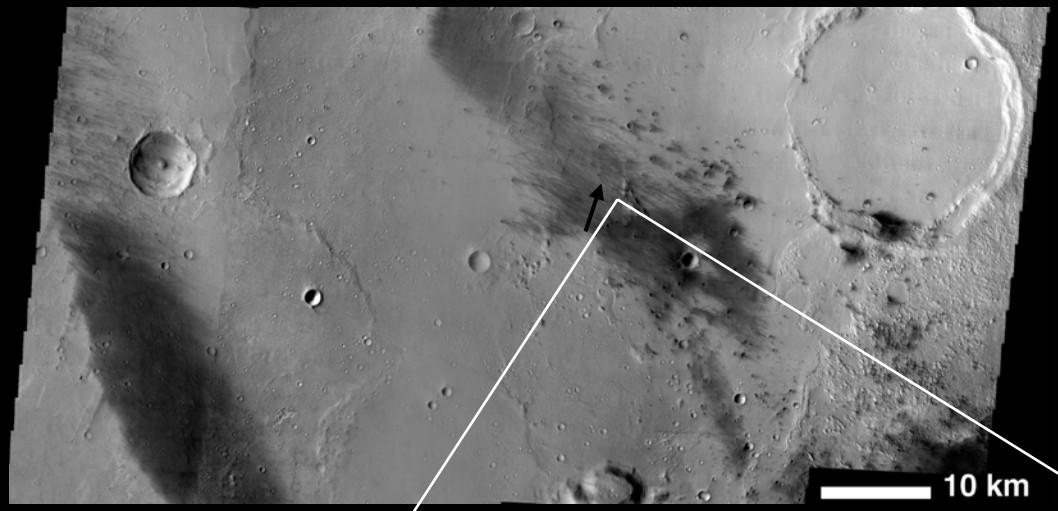
Daytime IR
(I01638003)



Nighttime IR
(I02606002)

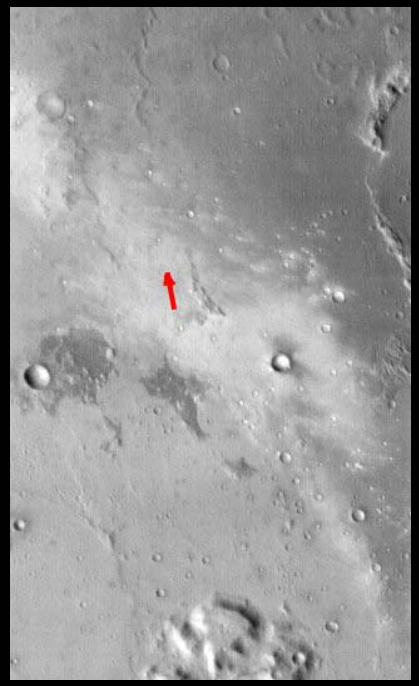
THEMIS IR Images of Ius Chasma

THEMIS Imaging of MER Landing sites

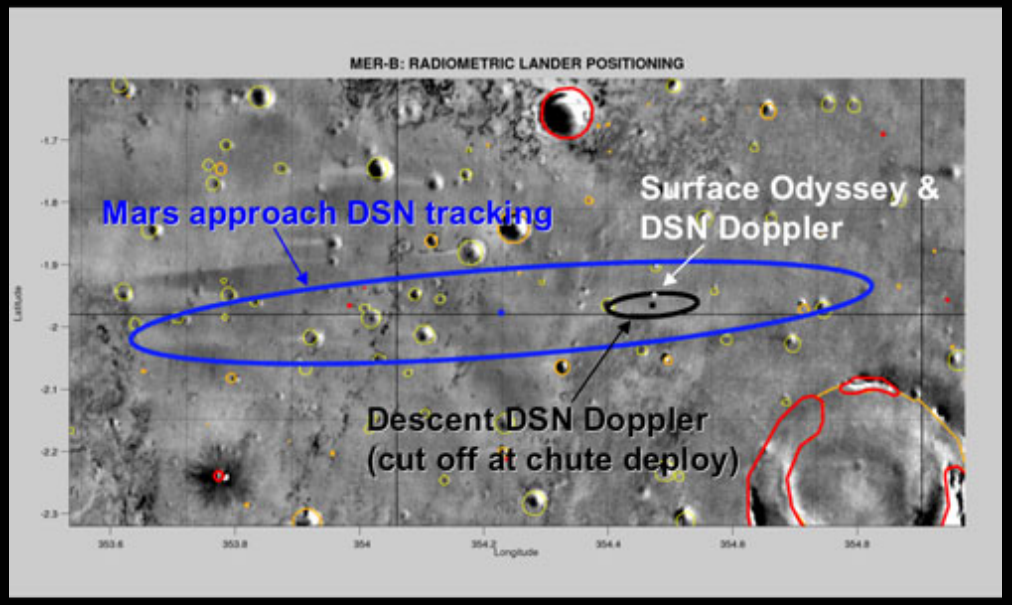


Visible Mosaic of Spirit Landing Site Gusev Crater

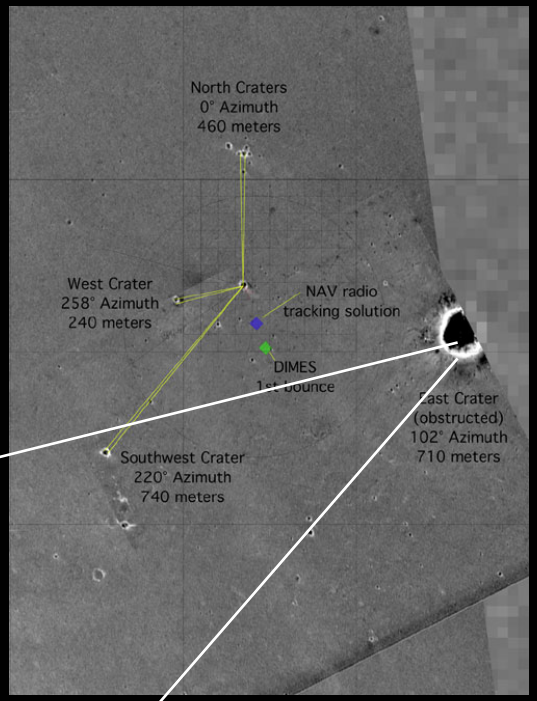
IR image of Spirit Landing Site



Opportunity Landing Site in Meridiani



Odyssey & MGS data of Opportunity Landing Site



NASA/JPL/ASU

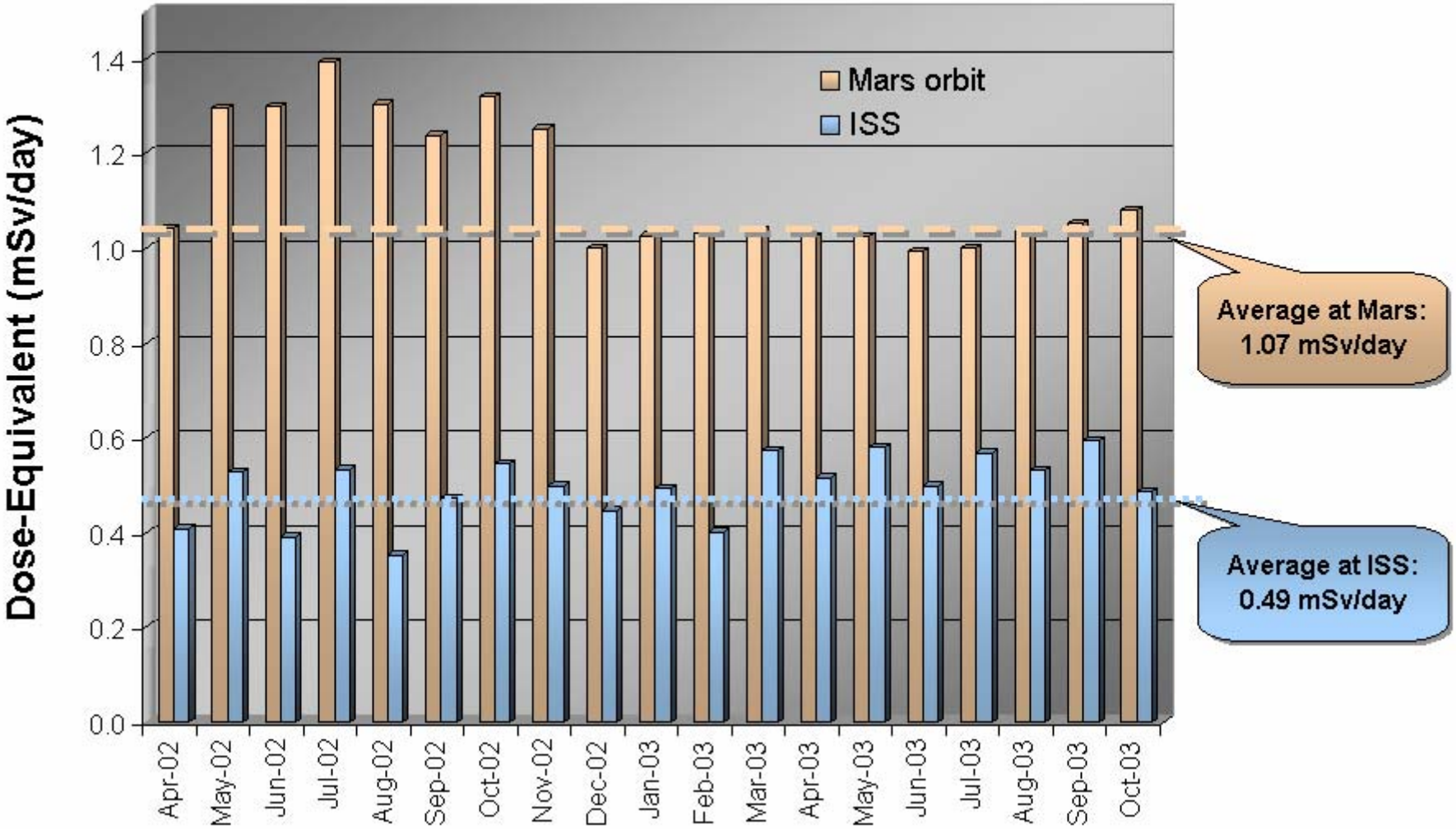
DAYTIME IR
(I03520002)

NIGHTTIME IR
(I02603002)

THEMIS IR images of Meridiani Terra

MARIE

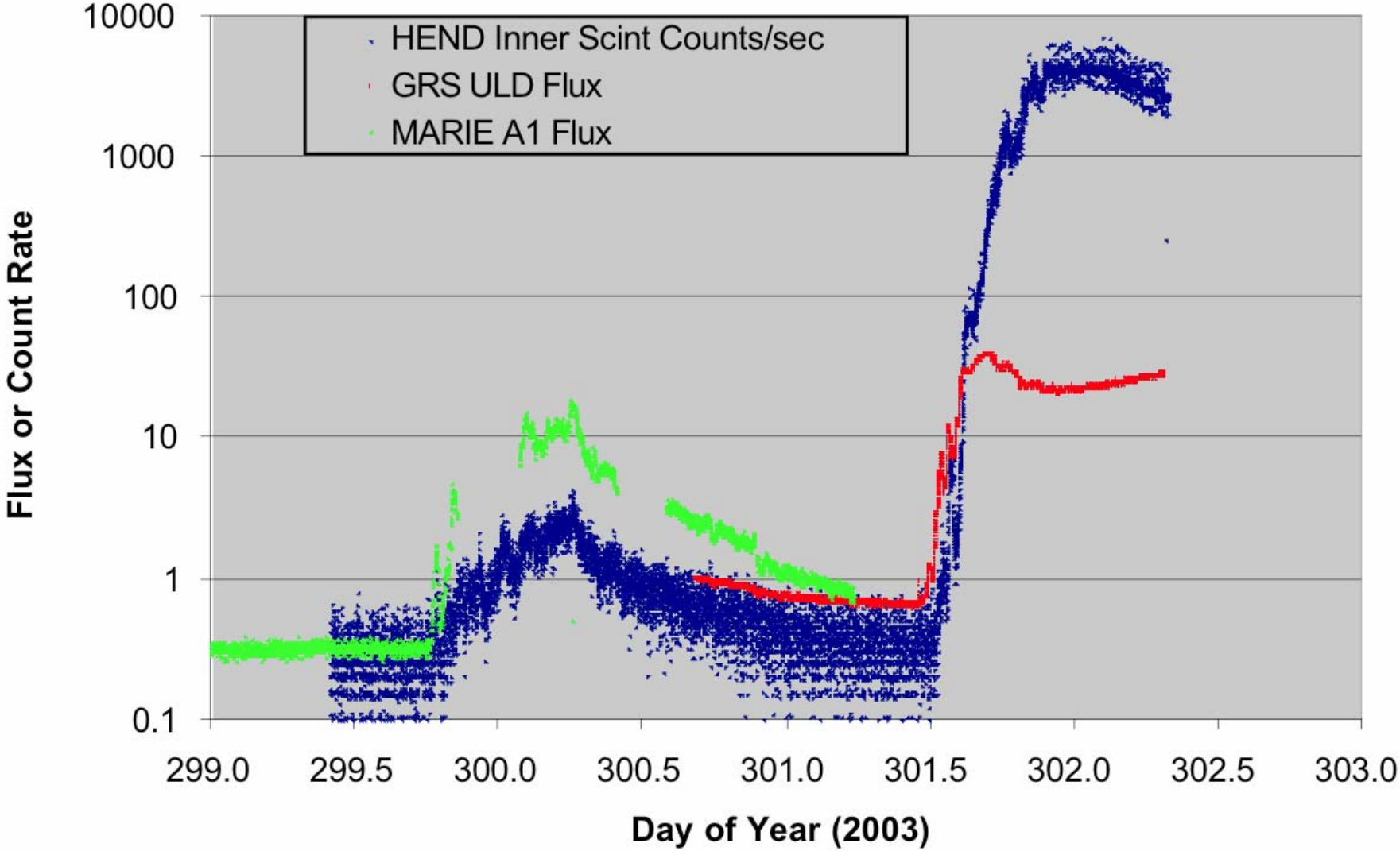
Radiation Dose-Equivalent at Skin Level (mSv/day): ISS Orbit vs. Mars Orbit



MARIE Status

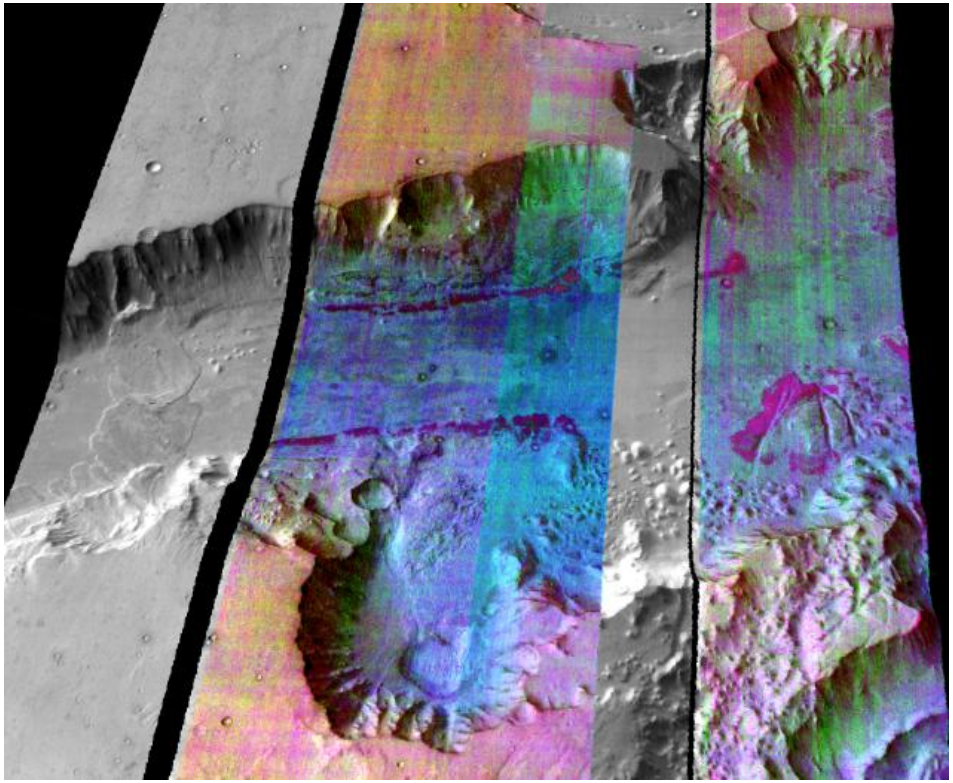
- MARIE stopped working properly during intense solar activity on October 28, 2003
- Current efforts to return MARIE to normal functioning have so far been unsuccessful

MARIE, GRS & HEND – Oct. 2003

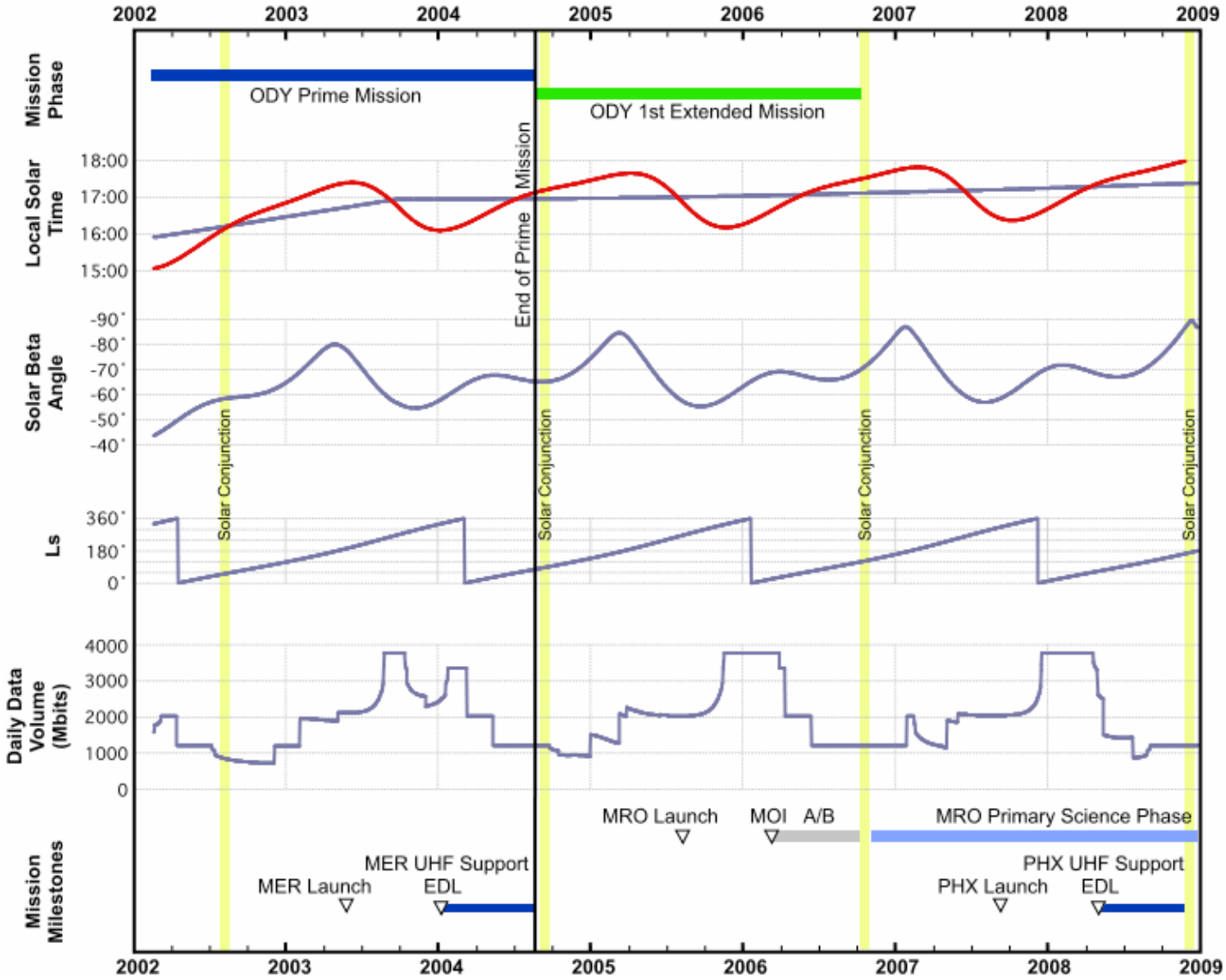


Odyssey Extended Mission

- Significantly enhance the data sets already acquired by extending the spatial and temporal coverage
- Enable new types of observations by operating the instruments and spacecraft in novel ways
- Establish Odyssey's role as a long-term asset in the scientific and operational infrastructure at Mars



Mission Timeline and Geometry



Odyssey Science Still to Come

- Global element maps and associated geochemical interpretations.
- Second Mars year of observations of CO_2 cycle / hydrogen mapping.
- North Polar imaging campaign--currently ongoing
- High resolution mineral mapping.
- Global high resolution thermal inertia map.
- And more…