[1] Lee et al, (2001) Meteoritics and Planetary Science 36(9), A111; [2] Beard et al, (1998), Geochim Cosmochim Acta, 62, 525-524; [3] Scherer et al, (2001), Science, 293, 683-687.

P11A-0355 0830h POSTER

Origin of the Moon Unveiled by its Heavy Iron Isotope Composition

Franck Poitrasson[1] (Franck.Poitrasson@cict.fr)

Alex N Halliday[1]

Der-Chuen Lee[1]

Sylvain Levasseur[1]

Nadya Teutsch[1]

[1]Franck Poitrasson, Institute fur Isotopengeologie, ETH Zentrum, Sonneggstrasse 5, Zurich 8092, Switzerland

The origin of the Moon has long been of interest and although the Giant Impact theory is currently the preferred explanation, unequivocal supporting evidence has been lacking. We have measured the iron isotope compositions of Shergotty-Nakhla-Chassigny meteorites and eucrites thought to come from Mars and Vesta, as well as samples from the Moon and the mafic Earth using high precision plasma source mass spectrometry. The mean iron isotope composition of the lunar samples, expressed in the conventional delta notation (d57Fe/54Fe) with respect to the IRMM-14 isotopic standard, is heavier (0.221 per mil (0.041: one standard deviation, 10 samples)) than those of the Earth (0.119 per mil (0.044, 7 samples)), which themselves are heavier than Martian meteorites (0.009 per mil (0.024, 6 samples)) and the eucrites measured (0.033 per mil (0.038, 7 samples)). Student's t-test calculations show that the Moon and Earth means are different from each other and from those of the other planetary bodies at >99% level of significance. The iron isotope compositions show no simple relationship with planetary heliocentric position, mantle oxygen fugacity, volatile content, or planet size. Similarly, these results do not support an origin of the Moon through co-accretion with the Earth, or as a fragment ejected from the Earth's mantle, or as another planet captured by the early Earth. In contrast, these data can be explained if the Earth, and especially the Moon, went through partial vaporisation and condensation leading to kinetic iron isotopic fractionation. Our data are also consistent with the suggested levels of enrichment of refractory elements for the bulk Earth and Moon. These new iron isotope results thus provide strong support for the origin of the Moon through a giant impact between the proto-Earth and another planet. Raleigh kinetic fractionation calculations indicate that only 1% loss of the current Fe budget of the Moon is required to explain its heavier isotopic composition. This is consistent with the small total losses computed in dynamic simulations of the Giant Impact.

P11A-0356 0830h POSTER

Future Instrumentation for Planetary Gamma-Ray Spectroscopy

Kunihiko Nishiizumi[1] (kuni@ssl.berkeley.edu); David M Smith[1] (510-643-1585; dsmith@ssl.berkeley.edu); Claude D'Uston[4]; Mark Amman[3]; Paul Luke[3]; Lorenzo Fabris[3]; Robert P Lin[1,2]; Steven Boggs[1,2]; Wayne Coburn[1]

[1]Space Sciences Laboratory , University of California, Berkeley, Berkeley, CA 94720-7450, United States

[2]Department of Physics, University of California, Berkeley, Berkeley, CA 94720, United States

[3]Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, United States

[4]CESR, 9 ave Colonel Roche, Toulouse 31028, France

At the Space Sciences Laboratory, U. C. Berkeley, we are beginning a study of advanced instrument designs for planetary gamma-ray spectroscopy. This includes coincidence-mode spectrometers and neutron-activation spectrometers for landers, and a Compton telescope for detecting composition from high orbits or during flybys, where a simple spectrometer would be too insensitive. Detector technologies to be evaluated include germanium strip detectors, mercuric iodide detectors, and coplanar-grid CdZnTe detectors.

P11B MCC: 131 Monday 0830h

New Results From Mars Odyssey I

(joint with C, G)

Presiding: **J J Plaut,** Jet Propulsion Laboratory**; R S Saunders,** Jet Propulsion Laboratory

P11B-01 0830h INVITED

2001 Mars Odyssey: Science Mission Overview

Jeffrey J Plaut[1] ((818)393-3799; plaut@jpl.nasa.gov)

. Mars Odyssey Team

[1]Jet Propulsion Laboratory California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109

The 2001 Mars Odyssey orbital science mission officially began February 19, 2002. The spacecraft carries three science instrument packages: the Gamma Ray Spectrometer suite (GRS), the Thermal Emission Imaging System (THEMIS), and the Martian Radiation Environment Experiment (MARIE). The GRS suite of three instruments includes the Gamma Sensor Head (GSH), the Neutron Spectrometer (NS) and the High Energy Neutron Detector (HEND). THEMIS consists of two cameras sharing a single set of telescopic optics: a 5-band visible imager and a 10-band thermal infrared imager. Spacecraft and instrument performance have been nominal to this point in the science mission. Gamma and neutron observations of the high latitudes have been used to identify water-ice-rich soil to 1 m depth at latitudes poleward of 60 degrees north and south. A focus of THEMIS infrared and visible data acquisition has been the candidate landing sites for the MER 2003 landers. Daytime and nighttime infrared imaging shows a remarkable diversity of temperature signatures of surface materials, suggesting that THEMIS will truly provide a new view of Mars. MARIE began operating on March 13, 2002 following recovery from an instrument operation anomaly. The instrument has detected radiation signatures from the high solar activity during the first 5 months of operations. Odysseys nominal science mission will extend for 917 days, until August 24 2004. Extended mission operations appear to be feasible, given the current inventory of propellant. In early 2004, the orbiter will serve as a relay platform for the MER landers, and possibly for the Mars Express Beagle2 landers.

URL: http://mars.jpl.nasa.gov/odyssey/

P11B-02 0845h INVITED

Subsurface Ice Content in the Polar Region of Mars: Comparison Between North and South

William Boynton[1] (wboynton@gamma1.LPL.Arizona.EDU)

William Feldman[2] (wfeldman@lanl.gov)

Thomas Prettyman[2] (thp@lanl.gov)

David Hamara[1] (daveh@lpl.arizona.edu)

. GRS Team (wboynton@gamma1.LPL.Arizona.EDU)

[1]University of Arizona, Deparment of Planetary Sciences, Tucson, AZ 85721, United States

[2]Los Alamos National Laboratory, Space and Atmospheric Sciences, Los Alamos, NM 87545, United States

Recently we published results concerning the subsurface ice content in the south polar region of Mars (Boynton et al. 2002, Science 297:81-85) showing that from latitudes south of about -45 degrees, the regolith consists of two layers: a hydrogen-poor layer overlaying a hydrogen-rich layer. The upper, hydrogen-poor layer has a hydrogen content equivalent to about 1% water, similar to that seen elsewhere on Mars. The lower layer has the equivalent water content of 35% +/- 15% by weight. The upper layer decreases in thickness going poleward from -45 degrees to -77 degrees. We concluded that the hydrogen in the lower layer was in the form of ice, based both on the large hydrogen concentration and the fact that it was only found in regions where ice is predicted to be stable.

The northern polar region was covered with its seasonal carbon dioxide cap at the time we published our earlier work, but it is now receding. At the time of this writing we can see as far north as 65 degrees latitude, and the hydrogen content appears to be nearly identical to that in the south at the equivalent latitude. As the cap recedes we expect to be able to collect sufficient data that we can perform a quantitative analysis of the hydrogen content similar to that done in our earlier work. We shall report the results at the meeting and compare the results to our earlier results from the south.

URL: http://grs.lpl.arizona.edu/

P11B-03 0900h INVITED

Time Variation of the North Polar Seasonal Frost Cap of Mars

William C Feldman[1] (505-667-7372; wfeldman@lanl.gov)

William V Boynton[2]

Thomas H Prettyman[1]

Steven W Squyres[3]

Robert L Tokar[1]

[1]Los Alamos National Laboratory, Mail Stop D466 , Los Alamos, NM 87545, United States

[2]University of Arizona, Lunar Planetary Laboratory, Tucson, AZ 87521, United States

[3]Cornell University, Center for Radiophysics Space Research, Ithaca, NY 14853, United States

Maps of thermal, epithermal, and fast neutrons covering latitudes northward of +45 degrees were studied to determine the time variation of CO2 frost at northern latitudes during late winter and early spring. Data measured between 18 Feb. and 31 Aug. 2002, were broken into eleven, roughly 7.5 degree intervals of areocentric longitudes, Ls, spanning 321 to 55 degrees. The edge of the CO2 frost cap is seen in thermal neutrons to steadily recede during this interval, revealing subsurface deposits of water-rich soil. Simultaneously, the intensity of thermal neutrons near the pole first increases and then decreases. The thermal flux measured near the pole relative to that measured at the Viking 1 landing site is too low, and those for the epithermal and fast neutrons are too high, to be consistent with fluxes simulated using MCNPX for a roughly meter-thick CO2 layer overlying water-ice rich soil. Agreement of measurements with simulations seems to require a strong neutron absorber in either the overlying atmosphere (such as nitrogen) or the CO2 frost cap (such as dust). Our preferred interpretation is in terms of a nitrogen-rich residual atmosphere that forms in consequence of the freeze-out of CO2 gas from the pre-winter polar atmosphere.

P11B-04 0915h INVITED

Mapping of High Energy Neutrons from Mars: Results from Odyssey

Igor Mitrofanov[1] (7 095 333 34 89; imitrofa@space.ru); Alexandr Kozyrev[1] (7 095 333 4123; kozyrev@mx.iki.rssi.ru); Maxim Litvak[1] (7 095 333 4123; max@cgrsmx.iki.rssi.ru); Anton Sanin[1] (sanin@mx.iki.rssi.ru); William Boynton[2] (wboynton@gamma1.LPL.Arizona.EDU); Chris Shinohara[2] (chriss@lpl.arizona.edu); David Hamara[2] (daveh@lpl.arizona.edu); Stephen Saunders[3] (saunders@jpl.nasa.gov)

[1]Institute for Space Research, Profsojuznaja 84/32, Moscow 117997, Russian Federation

[2]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, United States

[3]Jet Propultion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

The first 290 days of Martian mapping in high energy neutrons by High Energy Neutron Detector (HEND) on board of NASA 2001 Mars Odyssey spacecraft manifest very strong variation of flux of neutrons at different points above the surface of the planet. The largest areas with deficits of high energy neutrons are observed at regions with high latitudes around both south and north pPoles of Mars. The interpretation of the signature of neutrons depression is presented, as the evidence for large provinces on Mars with water ice bearing layers in the upper sub-surface. The evidence for seasonal variations of neutron flux from Mars is also presented and discussed.

P11B-05 0930h

Analysis of Mars Odyssey Fast Neutron Data to Constrain the Hydrogen Abundance and Stratigraphy Near the South Pole

Thomas H Prettyman[1] (505-667-6449; tprettyman@lanl.gov)

William C Feldman[1]

William V Boynton[2]

Gregg W McKinney[1]

[1]Los Alamos National Laboratory, Mail Stop D466, Los Alamos, NM 87545, United States

[2]University of Arizona, Lunar Planetary Laboratory, Tucson, AZ 87521, United States

We have analyzed fast neutron data measured by the Neutron Spectrometer subsystem of the Mars Odyssey Gamma Ray Spectrometer for 11 Ls intervals (each approximately 7.5 degrees) from February 18 to August 31, 2002. The fast neutron count rate depends on the abundance of hydrogen and stratigraphy, and is relatively insensitive to the type of material in which the hydrogen is mixed (for example, andesite vs. basalt). The fast neutron output also depends on atmospheric mass, more so at equatorial latitudes than do the thermal and epithermal energy bands. Consequently, the combination of fast- and epithermal-neutron fluxes, along with thermal neutrons and/or the flux of hydrogen neutron-capture gamma rays, can be used to simultaneously determine near-surface hydrogen abundance, its stratigraphy, and the atmospheric mass. In this study, maps of fast neutron count rates are combined with maps of the thermal- and epithermal neutrons and the hydrogen capture gamma ray intensity to study the polar terrain south of -60 degrees latitude as a function of time.

P11B-06 0945h INVITED

First Results From the Martian Radiation Environment Experiment MARIE

Cary Zeitlin[1] (510-486-5518); Timothy F. Cleghorn[2] (timothy.f.cleghorn1@jsc.nasa.gov); Francis A. Cucinotta[2] (francis.a.cucinotta1@jsc.nasa.gov); Premkumar Saganti[2] (premkumar.saganti1@jsc.nasa.gov); Lawrence S. Pinsky[3] (pinsky@uh.edu); Victor Andersen[3] (andersen@shasta.phys.uh.edu); Kerry T. Lee[3] (kerry.t.lee1@jsc.nasa.gov); Ron Turner[4] (ron.turner@anser.org); William Atwell[5] (william.atwell@boeing.com)

[1]National Space Biomedical Research Institute, One Baylor Plaza NA-425, Houston, TX 77030, United States

[2]NASA Johnson Space Center, 2101 NASA Road 1, Houston, TX 77058, United States

[3]University of Houston, Department of Physics 4800 Calhoun Rd., Houston, TX 77204, United States

[4]ANSER, 2900 South Quincy St. Suite 800, Alexandria, VA 22206, United States

[5]Boeing Company, 13100 Space Center Blvd. Mail Code: HS2-10, Houston, TX 77059, United States

The Martian Radiation Environment Experiment (MARIE), aboard the 2001 Mars Odyssey spacecraft, is returning the first detailed radiation data from Mars orbit. Characterization of the Martian radiation environment is a necessary precursor to eventual human exploration of Mars. MARIE, which consists primarily of an 8-element silicon detector telescope, is providing high-quality measurements of Solar Energetic Particles (SEP) from a unique vantage point, and is also able to measure a significant portion of the spectrum of Galactic Cosmic Rays (GCR).

The GCR are composed of atomic nuclei with kinetic energies ranging from tens of MeV per nucleon to hundreds of GeV per nucleon and higher. Energy distributions typically peak in the region of several hundred MeV per nucleon. These highly charged and energetic particles can penetrate tens of centimeters of matter, including tissue and practical depths of spacecraft shielding. The combination of high energy and high ionization associated with heavy nuclei in the GCR make these particles much more effective in causing biological damage than a comparable dose of sparsely-ionizing radiation such as muons or X-rays. These particles therefore present a potentially serious long-term health risk to astronauts, particularly on missions outside the protection of the geomagnetosphere. At Mars, the GCR spectrum is expected to be substantially the same as seen at Earth, modulated slightly by variations in the solar magnetic field.

The spectrum of SEP tends to be dominated by low-energy protons; though less exotic than heavy ions in the GCR, these particles, produced in Coronal Mass Ejections, pose the risk of acute radiation exposure, owing to the high fluxes that are often generated. SEP spectra for a given CME may be entirely different at Earth and Mars, for a variety of reasons.

MARIE has been operational in Mars orbit since March 2002. Several solar events have been observed, in addition to GCR ions. We will present dosimetric results as well as preliminary particle spectra from SEP and GCR.

P11B-07 1020h INVITED

The Martian Surface As Seen by the 2001 Mars Odyssey Thermal Emission Imaging System Experiment

Philip R. christensen[1] (phil.christensen@asu.edu); Bruce Jakosky[2]; Hugh Kieffer[3]; Michael Malin[4]; Hap McSween[6]; Ken Nealson[5]; James Bell[7]; Anton Ivanov[8]; Melissa Lane[9]; Alfred McEwen[10]; Jeff Moersch[11]; Mark Richardson[12]; Mike Smith[13]

[1]Arizona State University, Department of Geological Sciences, tempe, az 85287

[2]University of Colorado, LASP, Boulder, CO 80309

[3]U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, az 86001

[4]Malin Space Science Systems, 35335 General Atomics Ct, La Jolla, CA 92121

[5]University of Southern California, x, Los Angeles, CA 99999

[6]University of Tennessee, Department of Geological Sciences, knoxville, TN 37996

[7]Cornell University, x, Ithaca, NY 99999

[8]Jet Propulsion Lab, x, Pasadena, CA 91009

[9]Planetary Science Inc., x, Tucson, az 99999

[10]University of Arizona, x, Tucson, az 99999

[11]University of Tennessee, x, Knoxville, TN 37996

[12]California Institute of Technology, x, Pasadena, CA 91125

[13]Goddard Space Flight Center, x, Greenbelt, MD 20771

The Thermal Infrared Imaging System (THEMIS) instrument has observed the surface mineralogy, physical properties, and atmosphere of Mars using multispectral thermal-infrared and visible images in 14 spectral bands from 0.45 to 15.5 m during the first six months of the Mars Odyssey mapping mission. The THEMIS objectives are to map mineral units, map the thermophysical properties of the entire planet, search for thermal anomalies associated with active subsurface hydrothermal systems, investigate the properties of the poles, and study atmospheric temperature, aerosols, and condensates at high (100-m) spatial resolution. The THEMIS multi-spectral images have provided new information on the physical and compositional properties of the martian surface. Initial results include: (1) The individual units within layered deposits, for example the terrains of Terra Meridiani, have significantly different physical properties, indicating either different lithification/cementation processes or different initial depositional conditions or environments. (2) Local exposures of surfaces with thermal inertias approaching bedrock have been observed, indicating that the rock production rate exceeds the rate of burial or erosion and that bedrock is exposed in active environments. (3) Crater ejecta show differing degrees of rock preservation, providing an additional tool for determining surface modification rates and assessing crater ages. (4) Compositional differences are apparent in multi-spectral thermal IR images at spatial scales of 100s of meters. (5) Regional 100-m mapping has revealed the presence of channel systems in ancient crater terrains not detected by Viking and not mapped by the high-resolution camera on Mars Global Surveyor. (6) IR imagery has provided quantitative physical properties of aeolian surfaces, including dunes, wind streaks, inter-dune surfaces, lags, and mega-ripples, allowing assessment of the processes that form these features.

P11B-08 1035h

THEMIS Observations of Fluvial Landforms on Mars

James W. Rice[1] (jrice@asu.edu)

Philip R. Christensen[1]

Michael C. Malin[2]

Alfred S. McEwen[3]

[1]Department of Geological Sciences, Arizona State University, PO Box 876305, Tempe, AZ 85287-6305, United States

[2]Malin Space Science Systems, PO Box 910148, San Diego, CA 92191-0148, United States

[3]Lunar and Planetary Laboratory, University of Arizona, PO Box 210092, Tucson, AZ 85721-0092, United States

The THEMIS (Thermal Emission Imaging System) instrument onboard Mars Odyssey is providing both visible and infra-red imaging observations of the martian surface at two scales (18 m/p and 100 m/p respectively). IR observations are being conducted during both day and night. IR imagery records temperature variations which are primarily due to differences in abundances of rocks, indurated materials, sand, and dust on the surface. All of the major outflow channels, valley networks and fossae related channel systems have been imaged thus far in the mission. Outflow Channels: the source regions contain large blocks of chaotic terrain with very coarse (rocky) slopes and talus aprons while the tops of these blocks appear smooth and mantled with finer grained materials (dust). A similar relationship is also seen on the large mesas and buttes near the mouths of several outflow channels (Kasei and MaAdim Valles). Channel floor regions located near the mouths of some outflow channels (Ares, Maja, and Kasei Valles) appear to be very rocky. This is most likely the result of deep erosion and stripping of the bedrock by plucking and scouring from high velocity flows. However, Tiu Vallis doesnt show this type of stripping. This may be due to waning stage deposition of fines, and or lower flow velocities and shallower channel incision, which failed to reach the bedrock material. Some streamlined islands (Ares, Athabasca and Mangala Valles) have coarse (rocky) prows, flanks and tails. These may be deposits of coarse bedload (boulders) or erosion and exposure of the rocky material which makes up the islands. Preliminary observations of some islands suggest that these are depositional rather than erosional bedforms. Valley Networks: layers are commonly seen in the upper regions of the walls of these systems. Narrow, incised, discontinuous inner channels with finer grained materials are also seen on the floors of some valley networks (Bahram and Nanedi Valles). Maumee Vallis appears to have pendant shaped features (bars?) near the mouth. Samara Vallis and an unnamed channel have terminal deposits located at their mouths (fans?). Valley network dissection also appears much more prevalent in some regions (Libya Montes) than has ever been seen before. Fossae related channel systems, such as Athabasca, Granicus, Hebrus, and Hrad Valles; and Olympica and Hephaestus Fossae, located near the Tharsis and Elysium volcanic provinces have also been studied. These channels systems are most likely the result of volcano ground ice/water interactions. This makes these systems high priority geologic and astrobiologic targets for future landed missions. Preliminary observations and geologic interpretations of martian fluvial landforms will be presented; early results indicate that Mars has had a very rich and complex fluvial history.

P11B-09 1050h

Athabasca Valles Region: New Insights From THEMIS

Alfred McEwen[1] (520-621-4573; mcewen@lpl.arizona.edu); Laszlo Keszthelyi[1] (lpk@pirl.lpl.arizona.edu); Moses Milazzo[1] (milazzo@pirl.lpl.arizona.edu); Devon Burr[1] (dburr@pirl.lpl.arizona.edu); Phil Christensen[2] (phil.christensen@asu.edu); James Rice[2] (jrice@asu.edu); Michael Malin[3] (malin@msss.com); . THEMIS Team[2,3] (phil.christensen@asu.edu)

[1]LPL, University of Arizona, Tucson, AZ 85721

[2]ASU, Moeur Building, Tempe, AZ 85287

[3]MSSS, PO Box 910148, San Diego, CA 92191

Remarkably well-preserved lava flows and flood channels emanate from the Cerberus Fossae, a set of en echelon fissures trending E-SE from Elysium Mons. Crater counts and models suggest that the most recent volcanic activity (over a broad region) and fluvial activity at Athabasca Valles occurred within 10Ma. However, controversy persists over whether or not this region was recently exhumed from beneath a cover of low-density sediments, and could be older than it appears. We hope to better understand relations between the volcanic and fluvial activity, with implications for the source of water and potential geothermal activity. Was the volcanism and water release driven by the same basic magmatic/tectonic event, or were they separate events that exploited the same fissure system? High-resolution MOC images have been crucial to initial interpretations, but they are widely spaced and cover only a small percentage of the region, except over an area that was under consideration as a landing site for MER. THEMIS provides the missing links: regional morphologic coverage and thermophysical mapping at intermediate resolutions (18 m/pixel visible and 100 m/pixel IR). Temperature variations may directly map bedrock units in this region, which has a thin dust cover that is penetrated by the diurnal thermal cycle. Most of the temperature units closely correspond to morphologic units seen in MOC images, enabling extrapolation of unit maps over the entire region. Ratios of band 4 to band 9 (8.56/12.57 microns) nighttime images have not revealed anomalies suggestive of current geothermal anomalies. Except for dark steep slopes the albedos do not vary strongly, so the nighttime temperature differences must be controlled primarily by variations in thermal inertia; this is consistent with TES results. Relatively high nighttime temperatures correspond to dark rock outcrops in the steep slopes of fossae and craters and to very flat plains with well-expressed patterned ground. Relatively low temperatures correspond to bright dunes and bright-rayed craters; although not

resolved by TES they are only slightly brighter than the surroundings so they probably have low thermal inertias. Clusters of bright-rayed craters have a peculiar distribution, concentrated in an E-SE trend parallel to but S of Cerberus Fossae. Recent lava flows have high temperature contrasts due to a low-inertia cover over relatively high-standing plates separated by high-inertia patterned ground, and the trapping of low-inertia eolian materials along flow margins. Channel floors have intermediate thermal inertias, but with streamlined patterns. A morphologic/thermophysical unit map and geologic interpretations will be presented; preliminary results show close spatial relations between source regions and extents of lava flows and flood channels.

P11B-10 1105h

THEMIS Multi-spectral Views of Compositional Heterogeneity in Nili Patera Caldera

Steven W. Ruff[1] (480-965-6089; ruff@tes.asu.edu)

Philip R. Christensen[1]

[1]Arizona State University, Department of Geological Sciences, Moeur Building, Room 131, Tempe, AZ 85287-6305, United States

THEMIS infrared data provide remarkable multispectral views of the compositional variations in and around Nili Patera, the caldera at the summit of the Syrtis Major shield volcano. It was with TES spectra that these compositional variations were first observed and now THEMIS images show their distribution in great detail . Two spectral units dominate the scene. One also is a thermal inertia anomaly that was detected using TES data but is dramatically displayed in nighttime THEMIS images. It likely results from the presence of exposed bedrock. TES spectra of this surface resemble the Syrtis-type spectrum of Bandfield et al. [2000] but with notably enhanced spectral contrast. This is consistent with the effect of viewing bedrock rather than a particulate surface like that which presumably makes up the majority of Syrtis Major. The second spectral unit occurs in two very distinct settings. The first is associated with a small (∼5 km diameter) knob on the floor of the caldera that appears to be a breached volcanic cone. The spectral unit fans out from the cone in a manner similar to a lava flow and cross-cuts the contact with the Syrtis-type spectral unit. The second occurrence of this spectral unit is ∼50 km to the south of the caldera. In this location the unit clearly is structurally controlled, bounded on two sides of its roughly rectangular shape by wrinkle-ridge-like scarps. TES spectra of this unit display features similar to those of the Acidalia-type spectrum of Bandfield et al. [2000], indicative of a more glassy, silica-rich composition than the plagioclase-pyroxene Syrtis-type basalt. The cross-cutting relationship observed to the north suggests a more recent eruption of this unit than that of the Syrtis-type. The apparently more silica-rich composition may be indicative of late stage differentiation. The adjacency of these two compositional units and their apparent age relationship tend to support the idea that Acidalia-type spectral character is attributable to primary volcanic mineralogy rather than secondary alteration products, at least in this location.

P11B-11 1120h

Morphological analysis of the Mars polar terrains based on the THEMIS data

Anton B Ivanov[1] (818-3549478; anton.ivanov@Jpl.nasa.gov); Hugh Kieffer[2] (hkieffer@usgs.gov); Tim N Titus[2] (ttitus@usgs.gov); Jeff J Plaut[1] (Jeffrey.J.Plaut@jpl.nasa.gov); Mark Richardson[3] (mir@gps.caltech.edu); Shane Byrne[3] (shane@gps.caltech.edu); Phil Christensen[4] (phil.christensen@asu.edu); Greg Mehall[4] (mehall@asu.edu); . THEMIS Science Team

[1]Jet Propulsion Laboratory, 4800 Oak Grove Dr, Pasadena, CA 91109

[2]U. S. Geological Survey, 2255 North Gemini Drive, Flagstaff, AZ 86001

[3]California Institute of Technology, 150-21 Caltech 1205 E. Calfornia blvd, Pasadena, CA 91125

[4]Arizona State University, Department of Geological Sciences Campus Box 871404, Tempe, AZ 85287

We present the latest results from our analysis of the Mars polar regions based on the data from the THermal EMission Imaging System (THEMIS) on board the Mars Odyssey spacecraft. THEMIS obtains data in the infrared (IR, 10 spectral filters between 6.6 and 15.0 micrometers) and visible (VIS, 5 spectral filters between 420 and 870 nanometers) wavelengths. The resolution of the THEMIS IR images is 100m/pixel and the resolution of THEMIS VIS images is 18m/pixel. Visible images will provide a link between THEMIS IR and Mars Optical Camera (MOC) narrow angle images. THEMIS started acquiring data from Ls=329. High quality thermal and IR images of the south residual ice cap were obtained during late southern fall period. THEMIS will allow an extensive coverage of both polar regions by the end of the prime mission.

In this presentation we discuss the following topics:

1. Sensitivity of THEMIS instrument in the IR wavelengths for low temperature environments in the polar regions of Mars.

2. Initial results from morphological analysis of the THEMIS IR and VIS data from the polar regions and especially polar layered terrains. We are interested in observations of the layers and troughs and correlations with the MOC narrow angle images for the same region and season.

3. Mars Orbiter Laser Altimeter (MOLA) topography will be used to analyze THEMIS IR data on the slopes of the residual ice caps and inside troughs. High-precision registration of THEMIS IR images to MOLA DEMs will allow us to analyze temperature dependencies of ice on the slopes.

P11B-12 1135h

Initial Atmospheric Observation Results From Mars Odyssey THEMIS

Michael D. Smith[1] (301-286-7495; Michael.D.Smith.1@gsfc.nasa.gov)

Joshua L. Bandfield[2] (480-965-0601; joshband@asu.edu)

Mark I. Richardson[3] (mir@gps.caltech.edu)

Philip R. Christensen[2] (Phil.Christensen@asu.edu)

[1]NASA Goddard Space Flight Center, Code 693.0, Greenbelt, MD 20771, United States

[2]Arizona State University, Mars Space Flight Facility, Tempe, AZ 85287-6305, United States

[3]California Institute of Technology, Department of Geological and Planetary Sciences, Pasadena, CA 91125, United States

The Thermal Emission Imaging System (THEMIS) is continuing the infrared global monitoring of Martian dust and water ice aerosols as well as atmospheric temperatures started by the Mariner 9 Infrared Interferometric Spectrometer (IRIS), Viking Infrared Thermal Mapper (IRTM), and the Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) instruments. Aerosol optical depth is retrieved in a manner similar to retrieval algorithms used with TES data. THEMIS 9 point spectra are converted to the equivalent column integrated optical depth. The relative contributions of dust and water ice to the observed optical depth are then determined using a least squares fit of predetermined water ice and dust opacity spectral shapes to the measured THEMIS optical depth. Several refinements have been made to the aerosol opacity retrieval algorithms for increased accuracy of both aerosol abundances as well as surface temperatures. The opacity retrieval algorithm iteratively solves for a self-consistent solution for surface temperature as well as aerosol abundance. As a result, no atmospheric transparency wavelength needs to be assumed. Surface emissivity maps are also now incorporated into the retrieval algorithm. Results to date are consistent with concurrent TES observations, displaying low dust opacities and the onset of the perihelion water ice cloud belt as Mars progresses towards northern summer. The Mars Odyssey mission plan includes observations that drift from local times of approximately 3-6 PM. These local times combined with concurrent TES observations of a local time of 2 PM will allow for some resolution of diurnal atmospheric variations, such as water ice cloud abundances. The THEMIS investigation will extend the continuous infrared monitoring of the Martian atmosphere, bridging the MGS TES and the 2005 Mars Reconnaissance Orbiter (MRO) Mars Climate Sounder (MCS) investigations. This continuous long-term monitoring is essential for the understanding of the atmospheric processes and cycles present in the Martian atmosphere.

P11B-13 1150h INVITED

Calibration and Initial Analysis of Multispectral Images of Mars from the VIS Subsystem on the Mars Odyssey THEMIS Investigation

J. F. Bell[1] (jfb8@cornell.edu); T. H. McConnochie[1] (mcconnoc@astro.cornell.edu); M. J. Wolff[2] (wolff@colorado.edu); P. R. Christensen[3] (christensen@asu.edu); G. Mehall[3] (mehall@asu.edu); M. Malin[4] (malin@msss.com); M. Caplinger[4] (mc@msss.com); M. Ravine[4] (ravine@msss.com); L. L. Cherednik[3] (laural.cherednik@asu.edu); K. C. Bender[3] (kcbender@asu.edu); K. Murray[3] (kim.murray@asu.edu); . THEMIS Team[3] (themis@asu.edu)

[1]Cornell Univ., Dept. of Astronomy, Ithaca, NY 14853

[2]Space Science Inst., 3100 Marine St., Boulder, CO 80303

[3]Arizona State Univ., Dept. of Geology, Tempe, AZ 85287

[4]Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191

The Visible Imaging Subsystem (VIS) on the Mars Odyssey spacecraft THEMIS instrument is a 5-color, 1024x1024 interline transfer CCD camera that is currently acquiring high spatial resolution multispectral images from Mars orbit. The five VIS filters have central bandpasses of 425, 540, 654, 749, and 860 nm, bandwidths of approximately 50 nm, and are bonded in 1000x200 pixel strips directly onto the VIS CCD. Odyssey is in a near-polar orbit, traveling southward on the dayside of the planet, and VIS acquires multispectral images by using along-track motion to step the ground footprint through each desired filter. Nominal ground surface resolution is approximately 18 meters per pixel, and summing modes are available that can provide 36 m or 72 m resolution for increased surface coverage. As of early September, just over 1.1% of the surface of Mars has been imaged by VIS during daytime (between about 3:00 pm to 4:15 pm local solar time), with about 80% of that coverage at 18 m/pixel and 20% of that coverage at 36 or 72 m/pixel. About 55% of the VIS image sequences are monochrome (650 nm) for geomorphology studies; the rest are multispectral sequences in 2 to 5 colors.

VIS data are calibrated using a combination of preflight radiometric calibration measurements and inflight flatfield and bias data. We have developed a VIS calibration pipeline that performs a bias subtraction, removes CCD frame transfer smear, and applies a flatfield correction for pixel-to-pixel nonuniformities. In addition, raw VIS data contain a substantial stray light component that is modeled and removed as part of our pipeline process using data collected in flight. VIS images corrected for these instrumental effects are then converted to radiances using pre-flight integrating sphere measurements. Division by the solar spectrum at Mars convolved to the VIS bandpasses results in a set of PDS-format image cubes calibrated to radiance factor (I/F).

We validate our derived radiances by comparing regions observed by VIS and HST/WFPC2 over the same wavelengths and during the same martian season. The contribution of the martian atmosphere to the observed VIS radiance is a function of the amount of aerosol particles (dust, ice) suspended in the atmosphere and on their microphysical properties (e.g., size, shape, and composition). The situation is complicated by the limited viewing geometry of the VIS imaging sequences and the general lack of aerosol absorption features in the VIS bandpasses. We plan to characterize and subsequently "remove" the effects of the atmosphere by modeling our VIS radiances combined with thermal IR radiances from the THEMIS IRS subsystem and existing knowledge/assumption about the properties of martian aerosols.

In this presentation we report initial results on color properties and visible to short-wave near-IR spectral variability of the surface at high spatial resolution, concentrating on potential MER landing sites and other regions that have been identified from previous Viking, HST, and MGS data as being spectrally anomalous. We also provide details of our atmospheric removal algorithm.