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Studies of Martian surface geomorphology and the recent detection of near-surface water ice by Mars Odyssey gamma ray spectrometer suggest that Mars may have had a water rich past. While 2 to 5 wt.% of carbonate has been detected in the Martian dust (e.g., 1), no spectral evidence for significant deposits of evaporites (e.g., carbonates or sulfates) have been found. Most investigations into Mars aqueous mineralogy have been global in scope with only a few directed studies into localized areas (e.g., 2). We have begun searching for localized deposits of carbonates or sulfates in putative lacustrine basins. We utilize a hydrologic routing model to identify basins with large drainage areas that are shallow because such basins are more likely to accumulate aqueous minerals in high concentration. This model uses MOLA topography to determine drainage and basin patterns and depths of depressions. Evidence for surface water flow activity in these lacustrine basins are then compiled by examination of MOLA shaded relief maps, and available MOC and THEMIS imaging. Shallow basins which contain evidence for surface flow activity (stream features, ancient lakebeds) in the image data are prioritized for spectral analysis. TES emissivity spectra of candidate basins are assembled into a hyperspectral cube that allows visualizing spatial relationships that might be missed if the spectra were examined individually. The Minimum Noise Fraction (MNF) transform algorithm is run on the hyperspectral cube, producing a multiband MNF image. These images allow inter-orbital (i.e., atmospheric) variation to be identified and removed from the scene so that remaining spectral variation is related to surface spectral units. Areas of spatially-continuous MNF values are defined as regions of interest (ROI) and average spectra from each ROI are collected. These mean ROI spectra are examined by linear deconvolution using Acidalia- Syrtis-type, hematite, two atmospheric dust, two water-ice cloud, and surface dust endmembers. Spectra that are not well matched by any combination of the above endmembers are then atmospherically corrected. The atmospherically-corrected spectra are then analyzed by applying both linear deconvolution and the USGS Tetracorder algorithm using the ASU TES spectral library to determine if aqueous minerals are present. We will present TES spectra of lacustrine basins as detected by the basin fill model near Flaugergues crater and discuss their potential to harbor evidence of aqueous mineralogy. [1] Bandfield et al. 2003. Science 301, 1084; [2] Stockstill et al. 2003, Sixth Mars Conf, #3183.

P21B-0053 0830h POSTER

Thermal Infrared Spectra of Experimentally Shocked Basalt

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We acquired thermal infrared (3-40 microns) emissivity and hemispherical reflectance spectra of experimentally shocked samples of a fine-grained basalt from Grand Falls, AZ to document the spectral effects of shock as a function of increasing shock pressures (17-57 GPa). This sample contains 25% pyroxene, 20% olivine, and 45% feldspar, making it a suitable analog to the Surface Type 1 (basalt) observed in Thermal Emission Spectrometer (TES) data of Mars. Reflectance data (3-14 microns) were acquired using a Nexus 470 FTIR spectrometer at the HIGP, University of Hawaii, and emission spectra (5-40 microns) were acquired using a Nicolet Nexus 670 emission spectrometer at Arizona State University. These data complement similar previous measurements of experimentally shocked plagioclase and pyroxene relevant to interpreting spectra provided by TES. The samples were shocked using the 25-mm barrel gun at Johnson Space Center and provided 400 mg per sample. Large (2-10 mm) chips of recovered material were separated from the samples and washed to remove clinging fines, and the residual was powdered to provide a consistent grain size (~20 microns). Spectra were obtained of both the chips and the powder samples. Results for the chips show a shift in band positions in the 900-1200 wavenumber (wn) region compared to unshocked samples, consistent with the structural degradation of feldspar and subsequent formation of maskelynite and glass. The development of a band near 460 wn at high pressures is also consistent with glass formation in feldspars. Conversely, absorptions related to pyroxene remain present even at high pressures, consistent with previous work. Results for the powders show little variations with increasing pressure except for the loss of minor transparency features in the 800-900 wn region. Additional visible/near-infrared (0.35-2.50 microns) measurements of the powdered basalt samples also will be acquired at the RELAB facility. Future work will include acquisition of thermal infrared and visible/near-infrared spectra of shocked basaltic andesite from SP Flow, AZ. Acknowledgments: The authors thank P. Christensen (ASU), and P. Lucey and V. Hamilton (UH) for assistance with spectra acquisition.

P21B-0054 0830h POSTER

Gray Hematite Distribution within Valles Marineris

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Valles Marineris is one of three regions on Mars where TES has identified gray crystalline hematite. In the other two locations, Meridiani Planum and Aram Chaos, a strong correlation between the hematite distribution and geologic units has been found. We have used MOC, THEMIS, and MOLA data to determine if a similar correlation exists for hematite within Valles Marineris. After studying the larger patches of hematite within the canyons, we find a correlation between hematite abundance and distinctive geologic units for some patches, but not all. In Ophir and Candor Chasma, the hematite correlates to relatively brighter, dustier units in daytime THEMIS infrared images, but the correlation is moderate and other units with similar infrared properties have no corresponding hematite. Using the narrow angle MOC images, we have determined that the hematite signatures correspond to areas where patches of brighter material are exposed from beneath overlying dark units and dunes. This type of exhumation is similar to the hematite unit at Meridiani Planum. In Eos and Capri Chasma, the hematite appears to cross over geologic units seen in the THEMIS data sets, but no MOC images are available to assess the geology at the higher resolution. The presence of hematite also varies widely with topography, with one patch of hematite occurring across 2 km of relief in central Candor Chasma. In general, hematite occurs more prevalently on the canyon floors adjacent to the interior layered deposits, rather than on the layered deposits themselves. Our current results are based upon the hematite distribution map of Christensen et al. [J. Geophys. Res., 105, 9623-9642, 2000] but we hope to refine these TES compositional maps in order to more precisely correlate hematite to geologic features seen in the MOC and THEMIS data sets.

P21B-0055 0830h POSTER

Glass and Phyllosilicate Obfuscation (and Clarification) on Mars

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Several authors have postulated that contributions from glasses and phyllosilicates to thermal emission spectra of the Martian surface may be difficult to distinguish TES spectra. We explore this presumption by generating 336 sets of two-component numerical mixtures of glass and phyllosilicate spectra and then deconvolving these mixtures using a linear least squares algorithm with a variety of end member suites. Three end member scenarios are explored for laboratory, TES, and THEMIS-resolution mixtures: 1) a variety of glasses and phyllosilicates including those used to make the mixture are included in the end member suite (a control case), 2) the glass and phyllosilicate spectra used to make the mixture are excluded from the end member suite, and 3) only the phyllosilicate used to make the mixture is excluded. For each mixture and each end member scenario, the modeled abundances of glass and phyllosilicate are tracked, as are the compositions of the mineral end members used in substitutions. Model results indicate that exchange of glasses for phyllosilicates and vice versa does occur when one or both end members used to make the mixture is excluded. The degree of substitution is variable depending on the specific excluded members, however, a few trends are observed. In end member scenario two, glass is underestimated by 10-64% (absolute) if Si-K_2O glass is in the mixture, and it is overestimated by 11-50% (absolute) if pure Si-glass is in the mixture. Scenario three shows up to 20% absolute difference from the known fraction of glass content, but most analyses show less than 10% absolute difference. This result suggests that when the correct glass end member is included in the end member suite, phyllosilicate end members only minimally substitute for glass end members.

P21B-0056 0830h POSTER

High-Silica Rock Coatings on Mars: Constraining Secondary Silicate Mineralogy and Chemical Weathering Processes on Mars.

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Thermal Emission Spectrometer (TES) data have been fundamental to understanding Martian surface mineralogy. These data, however, require careful modeling based on laboratory spectroscopic measurements, and modeling of some minerals for Mars has been equivocal. Due to high degrees of spectral similarity, it is difficult to distinguishing silicate glass, clay minerals, zeolites, palagonitized glass, and other secondary products such as amorphous silica as components of surface rock spectra. Deciphering the nature of secondary mineral products on Mars is of key importance to understanding the role of water at the Martian surface over time. It is of central interest to distinguish primary glass from secondary silicate minerals, and secondary minerals from one another to better constrain the degree and mechanisms of aqueous alteration. Observations of Martian surface materials indicate some degree of atmosphere-water-rock interaction. These include nanophase ferric-iron oxides from visible/near-infrared spectroscopy, concentrated hematite deposits identified with TES, high water contents of rocks measured by the Alpha Proton X-ray Spectrometer, sulfate and halide minerals inferred from lander geochemical measurements, and carbonate minerals identified in Martian dust with TES data. Mass balance suggests that if there are oxides, salts, and carbonates there must also be secondary silicate phases present on Mars, which may be identifiable with TES. Identifying the types, distribution, and abundance (or absence) of secondary silicates will enable better constrains to be placed on Martian chemical weathering processes and the role water has played at the Martian surface. We suggest that rock coatings dominated by amorphous silica are geologically reasonable for Mars and may be consistent with TES data. Laboratory measurements of silica-coated rocks show that thin, micrometer-scale silica coatings have a substantial impact on rock spectra. Consequently, if authegenic silicates occur as coatings, small amounts of these materials may be identifiable in TES data. In addition, coating and substrate spectra add non-linearly, and means other than linear mineral devolution will be required to model Martian surface mineralogy if coatings are present. Pure SiO_2 coatings, however, cannot explain TES observations. Thus, we are investigating a compositional range of Al-bearing amorphous silicates, including Al-bearing opals and allophanes, for inclusion in thermal emission mineral libraries as possible Martian materials. The positions of spectral features in these materials are predicted to match to TES spectra better than pure SiO_2. Rock coatings of short-range order aluminosilicates would indicate relatively minor water-rock interaction, and may constrain Mars to a cool and dry yet geochemically active planet.

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P21C MCC: 3002 Tuesday 1020h

Latest Results From Mars Odyssey II

Presiding: **J L Bandfield,** Arizona State University**; A B Ivanov,** Jet Propulsion Laboratory, California Institute of Technology

P21C-01 1020h

Martian Surface Emissivity and Surface Spectral Units: Results from the Thermal Emission Imaging System

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A number of atmospheric correction techniques have been developed for use with data returned from the Thermal Emission Imaging System (THEMIS) onboard

the Mars Odyssey spacecraft. Three separate algorithms are used for mapping and determining Martian surface mineralogical units. The radiative contribution of atmospheric dust and water ice emission are variable relative to the signal received from surfaces of different temperatures, causing a distortion in relative equivalent emissivity. The atmospheric emission contribution to a THEMIS scene is determined and removed using a training region of constant emissivity, but variable temperature, in a non-linear, least-squares solution. With the removal of atmospheric emission contributions to a scene, the atmospheric correction problem is greatly simplified and only a single multiplicative term is required for each spectral band to solve for surface emissivity. This term can be found using either a training region (typically a dusty surface) or the scene average emissivity determined using lower resolution surface emissivity maps produced from Thermal Emission Spectrometer (TES) data. A third algorithm was developed to produce spectral unit maps using a least-squares fit of spectral endmember shapes to the THEMIS scene surface emissivity. This algorithm produces spectral unit maps and can also be used to account for and correct variable water ice within an image. Initial results are consistent with results from the TES investigation and a limited number of spectral units are apparent including surface dust, basaltic to andesitic compositions, and olivine. Mineralogically unique compositions are not common on Mars at the sub-kilometer scale.

P21C-02 1035h

THEMIS Observations, Discoveries and Predictions for the MER A Landing Site in Gusev Crater

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THEMIS has "followed the water" and discovered the youngest water flow into the MER A landing site in Gusev crater. This flow has a rumpled looking texture and is interpreted to be viscous material emanating from the mouth of Ma'adim Vallis. The flow can be traced for over 150 km across the floor of Gusev. This flow is emplaced on top of the smooth plains material and covers the whole western half of the landing ellipse. The flow does not show up in THEMIS IR indicating that it is mantled with at least a few cm of dust. This flow is either a debris flow (15-40% water volume content) or hyperconcentrated flow (40-80% water volume content) and not a lava flow based on its morphology, geologic setting, and lack of nearby volcanic sources. Debris flow deposits can be differentiated from hyperconcentrated flows on the basis of particle sorting, sedimentary structures, and inferred rheological properties. Access to this deposit will allow sampling of the most recent water related sediment in the basin. A very interesting relationship has been found to exist for many craters in the region of Gusev. These craters contain stacks of layered sedimentary deposits. It should be noted that these craters lack a large inflowing channel system. A similar layered morphology is seen on the floor of Gusev, especially the SE portion of the crater, where a 190 m thick deposit is being eroded. We propose that this material in Gusev is the remnant of a formerly more extensive regional unit related to the layered deposits seen in the many nearby craters. This observation suggests that the region was formerly buried by several hundred meters of material that is now being exhumed. This also implies that Ma'adim Vallis was a superposed channel that cut down from above and across Gusev. We also offer another scenario for Gusev in that it received periodic outwash deposits and may have contained shallow ephemeral playas with short lifetimes and not deep long lived lakes as suggested by some researchers. If indeed a lake ever formed here we feel that it is very possible that the lake sediments may have been primarily eroded away and or buried. Thereby making it difficult for MER A to sample and identify any putative lacustrine sediments with the Athena payload. It may be possible that impact craters have dredged up these putative deposits. Other large craters 30 to 86 km diameter located around Gusev are likely to have contributed material to the floor of Gusev. Additionally, Apollinaris Patera located only 300 km away is also very likely to have dumped ash into Gusev. Predictions: MER A should find a landscape similar to VL 1 and MPF in terms of thermal inertia, albedo, dustiness and topography. However, rock abundance will be half that of previous sites. In terms of landforms it will depend on where MER A lands in the ellipse. A hummocky debris flow covers the western half of the ellipse and relatively smooth cratered plains cover the eastern half of the ellipse. The smooth plains unit appears to be composed of many thin layers and the rover could possibly encounter layered mini mesas and buttes. The smooth plains material also has dark aeolian streaks superimposed upon it. These dark streaks are depositional in some locations because they are draped on bright aeolian bedforms. These bright aeolian bedforms then take on a dark appearance in these locations. The bright aeolian bedforms may be granule ripples and/or the remnant of an eroded layer. These features are scattered throughout the ellipse. Finally, small impact craters and ejecta may be observed.

P21C-03 1050h

Physical Properties of the MER and Beagle II Landing Sites on Mars

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The ESA Beagle II and the NASA Mars Exploration Rover spacecraft are scheduled to land on the martian surface in December 2003 and January 2004, respectively. Mission operations and success depends on the physical properties of the surfaces on which they land. Surface structural characteristics such as the abundances of loose, unconsolidated fine material, of fine material that has been cemented into a duricrust, and of rocks affect the ability to safely land and to successfully sample and traverse the surface. Also, physical properties affect surface and atmospheric temperatures, which affect lander and rover functionality. We are in the process of analyzing surface temperature information for these sites, derived from MGS TES and Odyssey THEMIS daytime and nighttime measurements. Our approach is to: (i) remap thermal inertia using TES data at 3-km resolution, to obtain the most complete coverage possible; (ii) interpret physical properties from TES coverage in conjunction with other remote-sensing data sets; (iii) map infrared brightness using daytime and nighttime THEMIS data at 100-m resolution, and do qualitative analysis of physical properties and processes; and (iv) derive thermal inertia from THEMIS nighttime data in conjunction with daytime albedo measurements derived from TES, THEMIS, and MOC observations. In addition, we will use measured temperatures and derived thermal inertia to predict surface temperatures for the periods of the missions.

P21C-04 1105h

THEMIS High-Resolution Atmospheric Thermal and Visible Imaging Campaign

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THEMIS offers a unique opportunity to examine mesoscale atmospheric features on Mars in the visible and infrared. The high spatial resolution (~100 meter per pixel) of the system comes at the cost of imaging spatial coverage, requiring atmospheric features to be targeted. Over the course of the past year, we have been targeting areas and features identified in MOC WA imaging as part of a THEMIS "atmospheric campaign." These features include topographic cloud systems, polar hood clouds, convective clouds, local dust storms in Hellas and along the retreating edge of the southern seasonal ice cap, and dust fronts in the northern high latitudes. Typically 2-3 band color images and 3-10 band infrared images have been acquired, both with roughly 100 meters per pixel. We will describe the targeting and its rationale, show initial results from the campaign, and provide some interpretation of observed features.

P21C-05 1120h

Polar Warming in the Mars Lower Thermosphere : Odyssey Accelerometer Data Interpretation Using Coupled General Circulation Models

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New Mars thermospheric density (and inferred scale height and temperature) information was obtained by the Mars Odyssey Accelerometer during aerobraking exercises (Ls = 265-310; F10.7 = 175-200) covering Northern latitudes on both the dayside and nightside of the planet. Altogether, 600 vertical structures were obtained over 95 to nearly 170 km during this perihelion season on Mars. No global or regional dust storms erupted during this Odyssey aerobraking period (Sept. 2001 to Jan. 2002). Also, there was apparently no substantial effect of the dust storm that occurred well before the start of Odyssey aerobraking (summer 2001). Odyssey provided the first in-situ determinations of atmospheric density at Northern latitudes during winter, extending to nearly the equator (on the nightside) as aerobrakling concluded. Only preliminary analysis of Odyssey aerobraking data over 100-130 km has thusfar been conducted [Keating et al., 2003]. Densities into the Northern polar night appear to decrease as expected from previous MGS Phase 1 Accelerometer data obtained during the same season (at lower latitudes). However, the Northern winter night revealed by Odyssey possessed a distinct polar warming (over 100-130 km) that intensified as the spacecraft periapsis approached the pole. Temperatures near 100-110 km were discovered to increase with latitude (60-90N) from 100 to 200 K, maximizing near the North pole on the Mars nightside. This winter polar warming may be generated from adiabatic heating resulting from the subsiding branch of a strong inter-hemispheric circulation cell (South to North) during perihelion [Forget et al., 1999]. No such winter polar warming was observed during MGS Phase 2 (MGS2) aerobraking exercises over the Southern polar night during aphelion conditions (Ls = 90). It is likely that variable seasonal dust distributions contribute to a stronger summer-to-winter circulation cell supplying dynamical heating to the Northern winter pole (Ls = 270); the opposite summer-to-winter circulation cell (Ls = 90) is weaker resulting in reduced dynamical heating to the Southern winter polar region. The coupled NASA Ames Mars General Circulation Model (MGCM) and the Michigan Mars Thermospheric General Circulation Model (MTGCM) are exercised for both perihelion and aphelion conditions using observed MGS Thermal Emission Spectrometer (TES) dust distributions appropriate to the Odyssey and MGS2 aerobraking periods. Improved CO_2 15-micron cooling and near IR heating formulations are used in both MGCM and MTGCM codes resulting in upgraded simulations for this study. Latitudinal distributions of densities and temperatures are presented from these coupled simulations and contrasted with longitudinally averaged aerobraking data. The underlying MTGCM heating terms are displayed in order to illustrate the seasonally variable processes that contribute to polar warming in the Mars thermosphere.

P21C-06 1135h

Surface Properties of Mars' Northern High and Polar Latitudes, Including the Phoenix Landing Site

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The unprecedented spatial resolution of the Mars Odyssey Thermal Emission Imaging System (THEMIS) is used to infer and compare the optical and thermal infrared properties of martian high-latitude and polar surfaces. Materials of interest include the north polar layered deposits (NPLD), the dark, dune-forming material associated with the north polar cap complex, and the ground ice-rich, latitude-dependent layer (the landing site of the Phoenix Scout mission). To address these goals, we have targeted and acquired THEMIS data as

part of the Mars Odyssey Participating Scientist program. We use these THEMIS data in order to understand the morphology and color/thermal properties of the NPLD over relevant (i.e., m to km) spatial scales. We have assembled color mosaics of the data in order to map the distribution of ices, the different layered units, dark material, and underlying basement. The color information from THEMIS is crucial for distiguising these different units, which are less distinct on Mars Orbiter Camera images. In the NPLD, we wish to understand the nature of the marginal scarps and their relationship to the dark material. Co-registered Mars Orbiter Laser Altimeter (MOLA) data provide a measure of scarp morphologies and may help identify the process(es) eroding the NPLD (e.g., mass wast-ing, wind, sublimation). The dark material (or perhaps a darker layered unit in planar configuration) is present at the feet of many scarps, but expresses dune bedforms only tens of kilometers away from the scarps. MOLA will help identify the relationship between the spatial distribution of dark material, the presence of bedforms, and the influence of topography. We have derived the thermophysical properties of the different materials using THEMIS and Mars Global Surveyor Thermal Emission Spectrometer (TES) data, also resulting in a new map of the thermal inertia of Mars' northern hemisphere. Such analyses are complicated by the need for atmospheric correction (of both radiatively active CO2 and dust) and accurate surface temperatures. In order to derive thermal inertias and thermally derived albedos, we employ a 1-D, radiative-convective thermal model of Mars surface, subsurface and atmosphere. The model uses simultaneous (or seasonally relevant) TES atmospheric dust opacities. We also are studying the effects of surface slopes on insolation using MOLA topographic data.

P21C-07 1150h

Martian polar layered deposits: the latest from the THEMIS investigation.

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In this work we present the latest imaging data acquired by the Mars Odyssey THermal EMission Imaging System (THEMIS) and place it into context of the Mars Global Surveyor (MGS) data. This work concentrates on comparison of properties of North and South polar layered deposits (PLD) observed in thermal IR and visible channels of the THEMIS camera. We are primarily interested in major properties of the layers in both ice caps: their continuity, morphology and stratigraphy. These questions can be addressed by THEMIS VIS color images, along with MOC high resolution data and MOLA Digital Elevation Models (DEM). THEMIS Visible Imaging Subsystem (VIS) was used to obtain full coverage of the South Polar Layered Deposits (SPLD) during early spring, when this area is still covered by seasonal frost. This mosaic covers all of the South Polar region poleward of 80S. The staircase structure of the layered deposits is clearly seen. Layers in the North PLD (NPLD) are much smoother and don't exhibit staircase structure. Discontinuities and unconformities are much more evident in the SPLD rather than in NPLD. MOC high-resolution images taken along the troughs and layers provide excellent context. We will also present initial results on monitoring seasonal changes in "swiss cheese" terrains. The most useful band for polar observations with THEMIS IR camera is band 9 (12.57 micron). Band 10 (14.88 micron) data can be used for atmospheric calibration. High resolution THEMIS IR data allows us to distinguish bulk properties of of layered terrain and ice. While we were not able to distinguish between individual layers, we will present initial observations of temperature trends in the polar layered deposits. Our ultimate goal is to characterize continuity, morphology and stratigraphy of the polar layered terrains and suggest mechanisms and timescales for their formation. Our approach is to use THEMIS VIS images to investigate continuity of the layers in the layered deposits and their stratigraphic relationships using high-resolution MOLA topography. MOC images provide important morphological detail. We will also attempt to detect heating or cooling trends in THEMIS Thermal IR imagery for selected troughs in the PLD and interpret these data in terms of thermophysical properties (e.g. thermal inertia) of the layers.

P21C-08 1205h INVITED

Results from the Martian Radiation Environment Experiment

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Ionizing radiation in space presents a potentially serious health hazard to astronauts on long-duration missions outside the geomagnetosphere. As a precursor to possible human exploration, the Martian Radiation Environment Experiment, MARIE, is returning the first detailed radiation data from Mars. MARIE is designed to measure the nearly constant flux of energetic Galactic Cosmic Rays (GCR) and intermittent Solar Particle Events (SPE). Despite considerable uncertainties in the normalization of MARIE data, comparisons to model calculations show good agreement, well within the estimated errors. The radiation dose equivalent on Mars from GCR is predicted to be 0.2 - 0.3 Sieverts/yr. (This is approximately 1000 times higher than the cosmic ray dose received on Earth.) In Mars orbit, over the first 16 months of operation, MARIE data show an annual dose equivalent of 0.4 +- 0.1 Sv/yr. That the measured rate is higher than the calculation is expected, since in orbit there is a contribution from low-energy particles that do not survive transport through the atmosphere. Additionally, SPE during this period have contributed about 0.04 Sv/yr to the average annual dose equivalent, a figure that can vary substantially over the course of the solar cycle. The implications of these data for human exploration will be discussed.

P22A MCC: Level 1 Tuesday 1330h

Latest Results From Mars Odyssey III Posters

Presiding: **O Aharonson,** California Institute of Technology**; K A Milam,** Planetary Geosciences Institute, University of Tennessee

P22A-0057 1330h POSTER

Specular Reflection of Odyssey's UHF Beacon from the Northern Latitudes of Mars

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In the morning (UTC) of August 29th, 2003, with Mars in it closest opposition in 60,000 years, the Mars Odyssey spacecraft was tracked with the SRI 46-m dish antenna located in the Stanford foothills. At 07:44 UTC, Odyssey's UHF Relay was turned on, with its 10 watt beacon in CW mode, and a 22 dB/Hz SNR signal was received three minutes later at the SRI dish. The Doppler compensated frequency of 437.100 MHz was observed using real time spectrograms that revealed a weaker, 0 dB/Hz SNR signal crossing the Odyssey beacon with the apparent Doppler signature of a specular surface reflection. Further analysis of the Doppler profile supports the interpretation of a surface reflection which traverses northern Martian latitudes from 16 N to close to the pole and back down to 60 N. The reflection's intensity profile laid across the ground track affords a comparison of the UHF's 0.7 m wavelength with the surface reflections from the X-band MGS occultation profiles.

P22A-0058 1330h POSTER

THEMIS Observations of Domes and Associated Lineaments in Arcadia Planitia

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The northern plains of Mars contain several high concentrations (Acidalia, Utopia, Elysium, etc.) of small (<10 km diameter) domes, proposed to be volcanic. Recent data sets from the Mars Global Surveyor and Mars Odyssey spacecraft provide new insight into the formation of domes in Arcadia Planitia. Daytime and nighttime thermal infrared (TIR) data from the Thermal Emission Imaging System (THEMIS), visible images from THEMIS and the Mars Orbiter Camera, and elevation data from the Mars Orbiter Laser Altimeter were used to study a 390,000 km ^{2} area ∼1500 km to the northwest of Elysium Mons. Of interest is a region centered on Tyndall crater and bordered by Phlegras Montes to the west. The area is characterized by gentle, westward-sloping plains, with noticeable slope breaks along several N-S trending wrinkle ridges. Several hundred circular domes dot this area. Domes display features consistent with a volcanic origin. Most are circular to slightly elliptical at their base, with basal diameters ranging from 0.5-6 km. Summits typically rise <300 m above the surrounding plains. Domes have shallow slopes (lacking significant slope breaks) that range from 1-9°. Visible images and TIR-derived temperature data suggest that slopes are composed of finer-grained material (as compared to the coarser-grained summits). Less than 25% of domes appear to have summit depressions and 1% show fractured summit areas. Some domes appear to be randomly distributed, but many are aligned in chains according to wrinkle ridge orientations. Using THEMIS data, we have detected over 165 domes that are aligned with and superimposed upon over 145 lineaments. Most lineaments are <500 m in width and range from 1-66 km in length. Many lineaments do follow N-S trends similar to those of wrinkle ridges, although other orientations are common. Several lineaments can be seen as open fractures, while others appear to be filled with fine-grained sediment. While most domes are superimposed upon lineaments, 3 domes area appear to be cross-cut by lineaments. No laterally extensive flows have been detected as emanating from lineaments, nor have similar lineaments been detected immediately outside the study area. The association of domes and lineaments is consistent with observations of volcanic constructs along open fissures in many terrestrial volcanic fields. Assuming a volcanic origin, the dome-lineament relationship suggests localized, structurally-controlled eruptions along open fissures. Initial extension caused the opening of fractures, which was followed by localized extrusions. Such localized development can provide information about eruption rates, magma compositions, or the physical properties of erupted lava. Either during or after volcanic activity, continued extension led to several domes being dissected by fissures.

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Can Chabazite Account for the Water Observed on the Equator of Mars?

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Up to 13 weight% of water-equivalent hydrogen has been reported for large near-equatorial areas of Mars based on neutron data from the Mars Odyssey orbiter (Feldman et al., 2003). Water ice is unlikely to explain this observation because it is not stable near the martian equator. Magnesium sulfate hydrate, clays, and zeolites have been suggested as possible water-bearing mineral constituents on the surface of Mars, perhaps partially accounting for this enigmatic water. Whether these minerals can retain H_2O under extreme Martian surface conditions is, however, not well constrained. The present study focuses on the natural zeolite chabazite (ideally $Ca_2Al_4Si_8O_{24}.12H_2O$) because chabazite is a common alteration product of basaltic rocks similar to those that are likely to be common on Mars. It also forms in the soils of the Dry Valleys region of Antarctica, cited by several studies as analogs

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