multiple generations of crosscutting lineaments. Structures associated with strike-slip and extensional deformation are dominant, and there is very little indication of cryovolcanic activity. All strike-slip displacements are left-lateral, in agreement with predictions of diurnal tidal stresses for these latitudes [1]. Offsets determined by plate reconstructions range from few km to ∼92 km, the largest displacement measured so far on Europa (see also [2]). The variety of structures associated with strike-slip motions is surprising, and include simple fractures and ridged bands several km wide. There is no relationship between the amount of offset and the type of structure accommodating it, but it is possible that primary or secondary features (i.e., accommodating deformation elsewhere) might result in different morphologies. Extension and transtension occur across narrow (<15km wide) bands, cycloidal ridges, and triple points. Most extensional structures display axial symmetry and raised margins, indicating widening of original double ridges. We note that the relative albedo of the bands' interior does not always follow the "younger, darker" trend seen elsewhere [e.g., 3]. Precise stratigraphic analysis of the study area has allowed us to correlate the geologic histories of distant areas. In addition, the northern plains of Europa are a good location for examining temporal trends in tectonic processes without the influence of cryovolcanic activity. Changes in the style and degree of tectonic deformation are being studied by determining the different types of features and amounts of offset at different times. In addition, stereo observations are available for most of this area, and we are currently generating a digital elevation model of the local topography. Because of the extent of the stereo coverage, this information will allow us to examine the topographic signature of different kinds of structures in the same region. [1] Hoppa et al., Icarus, 141, 287-298, 1999; [2] Sarid et al., Icarus, 158, 24-41, 2002; [3] Geissler et al., Icarus, 135, 107-126, 1998.

P41A-0399 0830h POSTER

Spherical Harmonic Analysis of Mountain and Volcanic Center Distributions on Io

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Mountains and volcanic centers on Io are broadly zonally concentrated and the two distributions are anticorrelated (e.g., Schenk et al. 2001, *JGR 106*, 33,201-33,222). The mountains are tectonic in origin and the interplay between volcanism and tectonism is key to understanding their origin (McKinnon et al. 2001, *Geology 29*, 103-106; McEwen et al. 2003, in press in *Jupiter - The Planet, Satellites and Magnetosphere*). Here we extend previous analyses of these distributions beyond simple (but informative!) smoothing by means of counting circles. We initially assign equal weighting to each mountain (n = 115) and volcanic center (n = 541) in the global data sets. Spectral power analysis for the mountains shows a strong peak at l = 2 and a smaller one at l = 1, little power at l = 3, and the rest of the spectrum is "white" (flat). The volcanic center distribution shows an even stronger l = 2 peak, a modest peak at l = 1, and low spectral power for l >3. The result is that two concentrations of mountains are located at ∼ 30° N, 80° W and 30° S, 260° W, with the first being substantially larger. The two volcanic center concentrations are more nearly equatorial and quite close to the sub- and antijovian points, at ∼ 5° N, 170° W and 15° S, 345° W, again with the first being larger. We also weighted the mountains by mountain length, length x width, polygonal area (footprint), and area x height (a proxy for volume). For weighting by length, the peak at l = 1 increased slightly and the peak at l = 2 decreased, but both remained statistically significant compared with a random distribution. Power spectra of the distributions weighted by length x width or polygonal area lose much of their statistical significance at l = 1 and 2, however, due to several mountains of large areal extent outside the regions of concentration above. Nevertheless, mountain concentration positions (summing low degree terms) remain virtually the same for all weightings. Volume weighting is corrupted by the large fraction of mountains for which there are no height constraints. Lastly, a subset of only paterae (calderas) was created from the volcanic center catalog. This set of 387 paterae compares well to the 417 counted by Radebaugh et al. (*JGR 106*, 33,005-33,020, 2001). Each patera was given equal weight, and the spectral power distribution is similar to that for the full volcanic center data set. A strong peak at l = 2 is present, with a smaller peak at l = 1, and the two concentration positions are shifted slightly to the east. However, a minor, but statistically significant peak, is found at degree 6. This causes regions of small, dense concentrations at the equator with longitudes ∼ 140° W and 325° W surrounded by small, less dense concentrations and sparse areas. We will discuss the degree of correlation of the mountain and volcanic center distributions.

P41B MCC: Level 1 Thursday 0830h

Planetary Missions, Instruments, and Data Analysis Techniques Posters

Presiding: **V C Gulick,** NASA Ames/SETI Institute**; R C Anderson,** Jet Propulsion Laboratory, California Institute of Technology

P41B-0400 0830h POSTER

NASA's New Millennium ST-9 Project

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NASA's New Millennium Program (NMP), has inaugurated the Space Technology 9 (ST9) mission, an integrated system validation project. DT-9 is the latest of a series of in-space technology validation activities which began in 1996 with Deep Space 1. The ST-9 mission will validate one of five technology capabilities which NASA Associate Administrator has selected as candidates for flight validation. The five technology capabilities under consideration are of great relevance to the full breadth of the NASA's Space Science endeavor. After careful review NASA is preparing a NASA Research Announcement (NRA) soliciting proposals for technology advances to provide needed capability for the following technology capability areas: 1) Solar sail capability-design metrics, scaling, deployment, propulsion and attitude control. 2) Large Space Telescope-structure and control dynamics, materials, structures, actuators, controls for fabrication, packaging and deployment, optical correction and active figure control, thermal control at cryogenic temperatures. 3) Formation Flying- autonomous operations, intersatellite communications, spacecraft formation control, and relative position estimation. 4) Aerocapture- system and performance modeling, aerodynamics and aerothermodynamics, thermal protection systems and structures, and guidance, navigation, and control. 5) Pinpoint Landing and Hazard Avoidance-sensors/algorithms for guidance and navigation, aerodynamic/propulsive maneuvering system options, terrain sensing and hazard recognition systems, and terrain sensors. It is expected that NASA will issue the NRA for technology providers for each capability area in 2003 and that at least one these five technologies capability areas will be subsequently selected for the New Millennium ST-9 technology validation experiment.

P41B-0401 0830h POSTER

An Advanced Dust Telescope

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A dust telescope is a combination of a dust trajectory sensor together with an analyzer for the chemical composition of dust particles in space. Dust particles' trajectories are determined by the measurement of the electric signals that are induced when a charged grain flies through a position sensitive electrode system. The objective of the trajectory sensor is to measure dust charges in the range 10^{-16} to 10^{-13} C and dust speeds in the range 6 to 100 km/s. The trajectory sensor has four sensor planes consisting of about 30 wire electrodes each. Two adjacent planes have orthogonal wire direction. The distance between planes is about 40 mm and the distance between electrodes in one plane is about 20 mm. The expected noise on each electrode is about 3×10^{-17} C. The signal on each electrode is sampled at 25 MHz rate. Simulated charge signals have been analyzed and dust charges and trajectories at a signal-to-noise ratio of 3 have been recovered. The dust chemical analyzers will have a sufficient mass resolution in order to resolve ions with atomic mass number up to 100. The annular impact area of the mass analyzer will be $0.1m^2$. We have constructed a numerical (SIMION) model of the mass spectrometer consisting of the target area with an acceleration grid and the single-stage reflectron consisting of two grids and the central ion detector. Ions of varying starting positions at the target, emission angles 0 to 90 degrees and energies 0 to 50 eV are flown through the spectrometer. A first result is that ions with different perpendicular (to the target normal) energies will arrive at the ion detector at different radial positions, with zero perpendicular energy in the center. A mass resolution of $M/\Delta M > 150$ can be obtained for impacts onto the annular target between 120 and 240 mm from the center. An Ion Detector of 110 mm radius is necessary to collect all generated ions. Acknowledgements: This research is supported by NASA grant NAG5-11782 and by DLR grant 50OO0201.

P41B-0402 0830h POSTER

Possible use of the Passive Remote Sensing for the Study of a two Layered Crust on the Europa Satellite

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On December 7th 1995, the Galileo mission began the study the jovian system. Among the results that his mission has obtained, it is the evidence of the existence of a liquid water ocean beneath the icy crust of Europa. Liquid water is one of the main factors that make life possible, so then life might exist in Europa. Some of the scenes that have been settled out to explain how living organisms could be present in such an extreme environment involve suppositions about the width of the icy crust. The explanation of other geological structures on the satellite also implies an estimation of the crust's width, that is why a good estimation about this parameter is very important in the geological study of this satellite. In this work, we analyze one electrodynamic model of the crust considering a two layered crust. The purpose is to obtain the optimal electrophysical parameters of measurement that permit us to estimate the crust's width. These parameters are calculated from the inverse elements of the Fisher matrix. The results obtained from this work can be used to plan future space missions to jovian satellites (in particular it could be useful for JIMO mission). The optimal algorithms for these measurements can be modified to be used in active systems of remote sensing.

P41B-0403 0830h POSTER

Minor Body Surveyor: A Multi-Object, High Speed, Spectro-Photometer Space Mission System Employing Wide-Area Intelligent Change Detection

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Detection and characterization of the small bodies of the outer solar system presents unique challenges to terrestrial based sensing systems, principally the inverse 4th power decrease of reflected and thermal signals with target distance from the Sun. These limits are surpassed by new techniques [1,2,3] employing star-object occultation event sensing, which are capable of detecting sub-kilometer objects in the Kuiper Belt and Oort cloud. This poster will present an instrument and space mission concept based on adaptations of the NASA Discovery Kepler program currently in development at Ball Aerospace and Technologies Corp. Instrument technologies to enable this space science mission

are being pursued and will be described. In particular, key attributes of an optimized payload include the ability to provide: 1) Coarse spectral resolution (using an objective spectrometer approach) 2) Wide FOV, simultaneous object monitoring (up to 150,000 stars employing select data regions within a large focal plane mosaic) 3) Fast temporal frame integration and readout architectures (10 to 50 msec for each monitored object) 4) Real-time, intelligent change detection processing (to limit raw data volumes) The Minor Body Surveyor combines the focal plane and processing technology elements into a densely packaged format to support general space mission issues of mass and power consumption, as well as telemetry resources. Mode flexibility is incorporated into the real-time processing elements to allow for either temporal (Occultations) or spatial (Moving targets) change detection. In addition, a basic image capture mode is provided for general pointing and field reference measurements. The overall space mission architecture is described as well. [1] M. E. Bailey. Can 'Invisible' Bodies be Observed in the Solar System. Nature, 259:290-+, January 1976. [2] T. S. Axelrod, C. Alcock, K. H. Cook, and H.-S. Park. A Direct Census of the Oort Cloud with a Robotic Telescope. In ASP Conf. Ser. 34: Robotic Telescopes in the 1990s, pages 171-181, 1992. [3] F. Roques and M. Moncuquet. A Detection Method for Small Kuiper Belt Objects: The Search for Stellar Occultations. Icarus, 147:530-544, October 2000.

P41B-0404 0830h POSTER

The MECA payload on the 2007 Phoenix Mars Scout mission

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Originally developed as the Mars Environmental Compatibility Assessment on the cancelled 2001 Mars Surveyor Lander, the MECA payload will be adapted to the study of icy soils for the Phoenix 2007 Mars Scout mission. The original wet chemistry cells will be retained to analyze four discrete soil samples for a range of soluble constituents and electrochemical properties. The existing microscopy facility, including both optical and atomic force microscopes, will be requalified for use on icy samples. A new component, the Thermal and Electrical Conductivity Probe (TECP) will be carried on the end of the robot arm. Together, these elements will be called the Microscopy, Electrochemistry, and Conductivity Analyzer, retaining the original acronym. The TECP consists of four small spikes that will be inserted into the sides of an excavated trench. In addition to measuring temperature, the decay of a short heat pulse will indicate the thermal diffusivity and conductivity of the soil, for use in models of surface/atmosphere interactions. Using the same spikes, the electrical conductivity will be measured to indicate any transient wetness that might result from the excavation. Thermal analyses of such trenches indicate that they are radiation traps, and can become quite warm in direct sunlight. Since the phase diagram in the northern landing site allows for the presence of liquid water, we anticipate that surface films of water or damp soil might be detectable by this method.

P41B-0405 0830h POSTER

Resolving Diffractive Atmospheric and Surface Structures at Pluto Using New Horizons Multiple Frequency Radio Occultation and Back Propagation

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In a typical planetary radio occultation, a single frequency tone is transmitted toward a receiver as the line of sight is obstructed by or emerges from behind the planet limb, referred to as ingress and egress occultation, respectively. As the line of sight passes through the atmosphere, the carrier tone experiences a phase shift caused by both geometric and wave optic effects, e.g., refraction and diffraction. This phase information can be converted to refractivity, temperature, and pressure profiles using the Abel inversion. While this method is a very powerful tool for resolving atmospheric features, the Abel inversion is inherently diffraction-limited since it assumes geometrical optics. Therefore, by itself, the Abel inversion cannot resolve sub-Fresnel-scale structures such as sharp inversions and the planet limb. These features cause diffractive ringing in the occultation signal that limits vertical resolution in atmospheric profiles to the Fresnel scale. This is of special concern near the planet surface where the limb, behaving as a diffracting edge, can completely overwhelm subtle phase data from low altitude atmospheric features. This research addresses these problems for radio occultation experiments planned in the New Horizons mission to Pluto. The diffraction signatures from both hypothetical atmospheric structure as well as the planet limb have been modeled for single tone occultation. Further, back propagation has been determined to be an effective means of reducing the Fresnel scale. Abel inversion applied to back-propagated simulated data yields profiles with vertical resolutions improved by an order of magnitude. The New Horizons mission will also attempt to utilize multiple tones in order to produce additional profiles for a single occultation pass. This research has modeled the interaction of simultaneous, multiple tone occultation carriers and investigates the interaction and limitations imposed by the existence of multiple carriers on back propagation.

P41B-0406 0830h POSTER

Assessing Geologic Image Interpretation Errors Occurring in Extraterrestrial Robotic Exploration

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Robotic exploration of the Martian surface requires numerous interpretations of imaged data, where incorrect results can have drastic consequences. The imaging process transforms and reduces the amount of information available. Three experiments measured the differences in interpretation between imaged sediments and physical sediments. Three characteristics were analyzed: grain length, grain shape, and grain distribution. The results found the difference between the grain length measured on an image and the true length to $\pm$ 2.333 pixels ($p < 0.0001$); the difference is similar to the amount of blurring introduced by the camera. Both grain roundness and grain sphericity were classified on a scale from 1 to 6 in the shape experiment. The roundness classification differed by 0.114 categories ($p = 0.0082$) with the imaged grains being rounder. The sphericity classification differed by 0.151 categories ($p = 0.0010$) with the imaged grains being less spherical. In the distribution experiment, the subjects determined the percentage of the total image area covered by grains in six specified size ranges. The average error for each size range was 11.112 % of the total area ($p < 0.0001$). In all three experiments, the measurements taken using the imaged specimens significantly differed from the measurements taken using the physical specimens. The magnitudes of the differences were small and may not be scientifically significant.

P41B-0407 0830h POSTER

Towards Developing an Automated Science Analysis System for Mars Surface Exploration.

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We are continuing development of algorithms that will facilitate development of automated systems to assist robotic or human explorers in identifying rocks and minerals in the field. Over the past year, we have focused on algorithms with the ability to identify igneous rocks from images and spectra and on building our database of rocks and minerals. Our collection currently contains over 700 igneous, sedimentary, metamorphic rocks and mineral samples that we have identified, analyzed, and imaged. Images are taken under controlled lighting and at fixed distances. We are in the process of obtaining Raman and visible, near- and mid-infrared spectra of the entire collection to help identify the minerals that comprise the samples. Analysis of both the physical properties and the relative mineral abundances of a sample form the basis of rock identification and classification. This extensive dataset allows us to optimize and test the algorithms under a variety of conditions. We will report on the current ability of our algorithms to identify and discriminate rock types with a variety of input data. When considering color only, using the weighted k-nearest neighbors approach, the algorithm correctly identified greater than 70% of the felsic rocks, at least 70% of the intermediate rocks, and greater than 80% of the mafic rocks. Using a similar approach for texture, the algorithm correctly identified 85% of the plutonic rocks and 76% of the volcanic rocks. We have used both Bayesian and Decision Tree automated reasoning approaches to combine the results of the color and texture algorithms. Based on our tests to date, the Decision Tree method has given the best results, correctly identifying at least 80% of granites and granodiorites and greater than 70% of andesites and basalts using color and texture algorithms combined. In addition to the generally better performance, the Decision Tree method has the advantage of allowing one to trace back the algorithm's line of reasoning in reaching a final identification. Since a hierarchical method more closely follows the line of reasoning used by practicing geologists, we feel it may meet with greater acceptance in spacecraft and field applications. We are continuing to improve our algorithms and will report on their current state of development.

P41B-0408 0830h POSTER

Maximizing Rover Science Return Through Autonomous Onboard Data Analysis

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There are three recognized approaches to maximizing the amount of science data in future missions: 1) return more data to Earth by increasing the capability of the Deep Space Network (DSN) to receive higher volumes of data, 2) develop data compression techniques to transmit more information per bit and, 3) increase the quality of the data returned to Earth by analyzing and prioritizing data onboard to identify key data for downlink. The goal of the Onboard Autonomous Science Investigation System (OASIS) is to increase the science return using onboard algorithms to evaluate and prioritize science information collected during a long traverse by a rover. The system has varying levels of autonomous operations. The least intrusive operational level provides two products: a prioritized list of images for downlink and a table summarizing the data collected between communication opportunities. In this scenario, the system analyzes rover data that are already collected for engineering purposes, such as navigation images, to determine what information is the most important to send back to Earth. The system's highest operational level autonomously directs the rover to select which surface targets to explore further, alter its path, and take additional measurements, which may even include contact measurements. In between these two extremes, a number of other system scenarios exist. It is not our intention to replace the scientists on robotic missions, but rather to improve the science return by making smart decisions regarding which data to collect and return.

P41B-0409 0830h POSTER

Auto-Detection of Impact Crater Statistics and Crater Morphologies in Mars THEMIS Data

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One of the challenges of planetary science is the development of tools adequate to provide automated crater statistics, for use in chronology, geomorphology and a variety of other investigations. We will present the current results of an ongoing effort to develop new tools for culling THEMIS imagery for crater statistics. Our eventual goal is to generate crater density and age maps of Mars. We are also developing tools to probe the morphologies and near-surface compositions of type-class craters. One crater type of particular significance is the rampart crater, which is unique to Mars. These are widely believed to be the result of impacts into volatile-rich surface materials. We will present the results of our examination of the spectral and morphological properties of several rampart craters in THEMIS IR images as a demonstration of image processing and automated feature extraction techniques. Using techniques developed at Los Alamos National Laboratory, we are able to obtain an automated count of craters in an image, their centroids and radii, extract spectra and compare them to spectral libraries of known reference minerals.

URL: http://genie.lanl.gov

P41B-0410 0830h POSTER

Automated geologic mapping in Hellas Basin, Mars using THEMIS and GENIE

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Most of Mars has been geological mapped using traditional methods of visual interpretation of images from orbiting spacecraft. New high spatial resolution multispectral data being returned by THEMIS contains valuable, additional information that can be compared to and used to improve these traditional maps. Automating the analysis of large amounts of multispectral imagery requires new, adaptive software tools. We use the Los Alamos GENIE (GENetic Imagery Exploitation) genetic programming system to generate automated spatio-spectral image processing algorithms for comparing and mapping the martian surface using THEMIS multispectral images. Our test area is the Hellas Basin because it has good coverage in the released THEMIS images. In addition, it has been extensively mapped and presents a variety of geologic features: impact craters, aeolian deposits, volcanics, lacustrine/ice features, and channels representing a broad spectrum of geologic units on Mars. We present results that compare previous geologic mapping of the Hellas Basin to new compositional spectral maps. In addition, we test automatic geologic mapping guided by limited human input, and discuss how this approach could enable a more efficient process for analyzing multispectral imagery.

P41B-0411 0830h POSTER

Automated Extraction of Planetary Digital Elevation Models

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Digital elevation models (DEMs) are invaluable products for planetary terrain interpretation [i.e. 1,2,3]. Typically, stereo matching programs require a user-selected set of corresponding points in the left and right images (seed points) to initiate automated stereo matching routines, which then find matching points between the two images. User input of seed points for each stereo pair can be a tedious and time-consuming step. An automated stereo matching tool for planetary images is useful in reducing or eliminating the need for human interaction (and potential error) in choosing initial seed points. In our software, we implement an adaptive least squares (ALS) correlation algorithm [4] and a sheet-growing algorithm [5]. The ALS algorithm matches a patch in the left image to a patch in the right image; this algorithm iteratively minimizes the sum of the squares between the patches to determine optimal transformation parameters. Successful matches are then used to predict matches for the locations of surrounding unmatched points (sheet growing algorithm). Matching is initiated using either automatically generated seed points or manually picked seed points. We are developing strategies to identify and reduce the number of errors produced by the stereo matching software; additional constraints may be applied after the matching process to check the validity of each match. We are currently testing the stereo matcher on image pairs using correlation patch sizes ranging from 9×9 pixels to 25×25 pixels. A rigorous error analysis will be performed to better assess the quality of the results. Initial results of DEMs derived from Mariner 10 images compare well with DEMs generated by another area-based stereo matcher [6]. Our ultimate goal is to produce a user-friendly, robust stereo matcher tool that can be used by the planetary science community across a wide variety of image datasets. [1] Herrick R. and Sharpton V. 2000, JGR 105, 20245-20262. [2] Oberst J. et al. 1997, Eos 78, 445-450. [3] Smith D. et al. 1999, Science 284, 1495-1503. [4] Gruen A. 1985, S. Afr. J. of Photogramm. Rem. Sens. Cart. 14(3), 175-187. [5] Otto G. and Chau T. 1989, Image Vision Comput. 7, 83-94. [6] Cook A. and Robinson M. 2000, JGR 105,9429-9443.

P41B-0412 0830h POSTER

A LASER RIMS Instrument to Date Igneous Rocks, Measure Geochemistry, & Characterize Alteration in-situ on Mars

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We are evaluating science and design requirements for a laser desorption (LD) resonance ionization (RI) mass spectrometer (MS) for in-situ measurements of rock age and geochemistry on Mars. These measurements are critical for calibrating cratering statistics and constraining the age of planetary surfaces. In addition, this instrument would allow us to measure the geochemical and isotopic composition of surface rocks to provide insight into the formation and evolution of the martian crust and mantle. We have developed a prototype LDRIMS instrument design, based on a new type of MS integrated with existing lasers. We will demonstrate its theoretical potential to achieve the required sensitivity and precision for measurement of rubidium and strontium (Rb-Sr) and neodymium-samarium (Nd-Sm) isotope systems, providing multiple and hence robust estimates of formation age. An instrument using this approach can have two modes, "RI" and "LD". The "RI" mode could be used to selectively ionize and precisely measure the abundance of Rb-Sr isotopes, allowing us to constrain the age of igneous rocks to $< \pm 250$ Ma. Implementation of a miniature multi-bounce reflectron time of flight mass spectrometer (MB-RTOF-MS) is critical to overcoming issues of measuring high-speed ion pulses (<10 ns), while maintaining a precision of 5000+, and a size, mass, and power consistent with a future flight-capable design. The second mode, "LD" collects all desorbed ions, providing high precision (part per thousand or better) elemental measurements of the composition of the surface. This mode requires lab calibration in order to understand the relationship between the instrument design and "matrix effects", the influence of surface composition on the ionization and elemental abundance. This instrument design is envisioned as enabling chronological and geochemical measurements for the 2009 Mars Science Laboratory (MSL) and follow-on Scout and landed missions, though it could be used for any rocky body in the solar system, and hence is important for the Discovery and New Frontiers Programs.

P41B-0413 0830h POSTER

Portable X-ray Fluorescence Unit for Analyzing Crime Scenes

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Goddard Space Flight Center and the National Institute of Justice have teamed up to apply NASA technology to the field of forensic science. NASA hardware that is under development for future planetary robotic missions, such as Mars exploration, is being engineered into a rugged, portable, non-destructive X-ray fluorescence system for identifying gunshot residue, blood, and semen at crime scenes. This project establishes the shielding requirements that will ensure that the exposure of a user to ionizing radiation is below the U.S. Nuclear Regulatory Commission's allowable limits, and also develops the benchtop model for testing the system in a controlled environment.

P41B-0414 0830h POSTER

Sensitivity to environmental properties in globally averaged synthetic spectra of Earth

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We are using computer models to explore the observational sensitivity to changes in atmospheric and surface properties, and the detectability of biosignatures, in the globally averaged spectrum of the Earth. Using AIRS (Atmospheric Infrared Sounder) data, as input on atmospheric and surface properties, we have generated spatially resolved high-resolution synthetic spectra using the SMART radiative transfer model (developed by D. Crisp), for a variety of conditions, from the UV to the far-IR (beyond the range of current Earth-based satellite data). We have then averaged over the visible disk for a number of different viewing geometries to quantify the sensitivity to surface types and atmospheric features as a function of viewing geometry, and spatial and spectral resolution. These results have been processed with an instrument simulator to improve our understanding of the detectable characteristics of Earth-like planets as viewed by the first (and probably second) generation extrasolar terrestrial planet detection and characterization missions (Terrestrial Planet Finder/Darwin and Life finder). This model can also be used to analyze Earth-shine data for detectability of planetary characteristics in disk-averaged spectra.

URL: http://www.vpl.ipac.caltech.edu

P41B-0415 0830h POSTER

A Polar Orbiter to Probe Jupiter's Deep Atmosphere, Interior Structure and Polar Magnetosphere

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The recent National Academy of Sciences Decadal Survey for Solar System Exploration recommended a Jupiter polar orbiter with deep probes as one of the new missions to consider for NASA's New Frontiers program. The report identified five key questions related to solar system formation and evolution that require a Jupiter polar orbiter; (1) determine whether Jupiter has a core, (2) measure the global oxygen and nitrogen abundance in Jupiter, (3) map the high order Jovian magnetic field, (4) explore the Jovian polar magnetosphere, and (5) investigate Jupiter's deep winds and internal convection. Additionally, the Committee for Solar and Space Physics in their National Academy Decadal survey also recommended a Jupiter polar orbiter mission to explore the Jovian polar magnetosphere and aurora. In this paper, we describe a Jupiter polar orbiter mission that addresses both the

Solar System Exploration and Solar and Space Physics decadal surveys recommendations. Using a combination of gravity and magnetic field observations, microwave radiometry, in-situ fields and particles, and remote sensing, the mission can help to answer the above referenced key scientific questions. An overview of mission design, science payload, and measurement requirements will be presented. The mission will be proposed as a candidate for NASA's New Frontiers program. The JPL contribution to this paper was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

P41B-0416 0830h POSTER

SIR- Upcoming Near Infrared Investigations of lunar surfaces

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Multispectral photometry has proven to be an extremely useful tool to investigate the surface chemistry, mineralogy, and light scattering properties of the Moon. ESA's upcoming SMART-1 mission to the Moon should significantly extend our knowledge about lunar evolution by providing new high resolution multispectral images over a wider range of illumination/ observation geometries compared with earlier missions. We will present an overview of SIR - the new compact lightweight NIR instrument on SMART-1, operating between 940-2400 μm and will discuss some of the targets SIR is going to investigate.

P42A MCC: Level 1 Thursday 1330h

Geological Evidence for Recent Climate Change on Mars III Posters

(joint with A, C, GC)

Presiding: **L K Fenton,** Arizona State University**; M Kreslavsky,** Brown University

P42A-0417 1330h POSTER

Secondary Crater Populations on the Martian South Polar Layered Deposits

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Understanding the formation and evolution of the Mars South Polar Layered Deposits (SPLD) is an important step toward unraveling Martian climate history. The cratering record on the SPLD suggests that the surface of these deposits has been recently modified. Extremely shallow large (>800 m) impact craters along with a lack of small (<800 m) impact craters might argue for a recent resurfacing event that erased small craters and degraded large ones (Koutnik et al. 2002). Secondary crater fields on the SPLD, produced by the ejection of material from a primary impact event, are important stratigraphic markers that can shed light on the modification history of the deposits. Using MOC, THEMIS and MOLA data, we examined the broad secondary crater field surrounding McMurdo crater (84.5S, 0W) on the SPLD, the field surrounding a 15 km crater at 80.5S, 284W on the SPLD, and the field surrounding a 43 km crater at 81S, 285W off of the SPLD. These datasets provided us with the opportunity to compare and contrast the morphologies of craters in different secondary crater fields both on and off of the deposits. We measured the depth to diameter (d/D) ratios of secondary craters and compared them with those of other primary craters on the deposits measured by Koutnik et al (2002). Among secondary craters on the SPLD, we found a correlation between crater d/D and the steepness of the slope on which the crater resides. Specifically, craters with extremely low d/D ratios (indicating high modification) are found more often on flat areas. Those with high d/D ratios are often associated with scarps and are on higher slopes. This indicates that there have been different resurfacing rates over areas as small as several hundred square kilometers and that modification occurs more readily on flat areas. We examine different mechanisms that may have led to decreased d/D ratios such as blanketing, ice flow, wind erosion or viscous relaxation. We find that the d/D ratios of secondary craters on flat regions of the SPLD are comparable with the extremely low d/D ratios of the primary craters elsewhere on the deposits measured by Koutnik et al (2002). The d/D ratios of secondary craters on the SPLD on slopes are comparable with the d/D ratios of the secondary craters off of the SPLD in rock. This indicates that craters on slopes have been protected from significant modification. Koutnik, M., S. Byrne, and B. Murray (2002) JGR, 107, (E11).

P42A-0418 1330h POSTER

Seasonal Variations of Albedo and Temperature of the North Polar Cap of Mars.

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Previous observations of Viking and MOC have suggested that the north polar residual ice cap exhibits albedo variations between Mars years and within the summer seasons. Our work makes use of the Mars Global Surveyor-Thermal Emission Spectrometer (MGS-TES) data sets. TES can supplement these initial observations, since it provides calibrated albedo, temperature and repeat coverage of the poles, allowing for detailed seasonal coverage. The TES data of the northern summer season allows us to observe the albedo and temperature evolution and explore how that variability relates to climate and atmospheric models. While TES provides excellent seasonal coverage the spatial footprint is 3x6 km eliminating the level of detail somewhat. We will present seasonal and interannual variations of temperature and albedo as observed by TES. To date we have explored variations in the first northern summer, which were taken from March to May of 1999. The first part of the season has a large high albedo area from approximately -60 to 60 W and 80 to 85 N. This area decreases significantly in albedo during the season. Some outlying valleys of the cap appear to show some brightening later in the season from 30 to 90 W and 85 N. This area may have been interpreted in the past as brightening albedo but it appears to be only relative brightening compared to the larger area that has since decreased in albedo. We see an anomalous bright spot throughout the season at -30 W and 88 N. We also see some bright outliers later in the season at 180 W and 75 N,which is near Kovolev, and 10 to 15 W and 78 N. The temperature of the cap is shown to have a stronger variation at the beginning of the season and towards the end it has a more homogeneous temperature. There appears to be a 50 % decrease in temperature extremes from the beginning of the season to the end. Through comparisons with MOC and MOLA data we hope to observe where topography and smaller scale albedo variations may be affecting our measurements. Acknowledgments: This material is based on work currently supported by NASA under the MDAP program, Grant: NAG5-12223 to the University of Nevada, Reno.

P42A-0419 1330h POSTER

Earthly and Otherworldly Glaciers on Mars: Expressed Subsurface Subpolar Ice and "Plate Tectonic" South Polar Ices

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DIRTY SUBPOLAR GLACIERS: Deeply etched internal structures of debris-covered glaciers or rock glaciers occur widely on Mars at middle latitudes. Differentially sublimated folds, crevasses, medial moraines and flow lines are expressed now as a variety of pits, troughs, hummocks, and ridges; they reveal much about the extent of sublimation and the history of flow and accumulation that originally gave rise to these structures. In many regards, they appear like usual terrestrial debris-covered glaciers (including rock glaciers). These sublimated remnant structures are not uniformly distributed on the planet; they exhibit a definite relationship to latitude. The more deeply etched icy flows occur generally in the latitude belt from 30 to 40 degrees (north and south), where possibly very little ice remains near the surface. Between 40 and 55 degrees, most of these partly sublimated flows appear to be still icy. Poleward of that, many of them show very little evidence of any sublimational loss of ice, and instead appear as thick mantling blankets sometimes having subtle flow lines. Inferences for the distribution of ground ice and the role of sublimation are similar to those inferred from the distribution and morphology of small polygons; these results are also consistent with theoretical models of the distribution of ground ice and with Mars Odyssey neutron spectroscopy of the distribution of hydrogen in the upper meter of Mars. A peculiar aspect of dirty glaciers on Mars is their current lack of an evident zone of atmospherically driven accumulation; instead, accumulation of some dirty glaciers appears to be due to load-driven expression of ice originating probably in massive crustal layers; for others, atmospheric accumulation may occur at other times during the obliquity cycle of Mars. SOUTH POLAR ICE SHEET: Previously I have reported on evidence for flowing, faulting, folding south polar ice, with the evidence for the more ductile types of deformation concentrated within the area of perennial CO2 ice. This part of the polar cap exhibits strong evidence for convergent flow tending to close the quasi-spiral structured troughs, as predicted by finite-element modelers. A rich phenomenology accompanies this closure. In some cases, good evidence exists for one icy sheet overriding another. Elastic plate flexural responses, with attendant small-scale tectonism, is quite common, as is evidence for ductile deformation. Analogs drawn from Earth's lithosphere provide compelling explanations for some of these features. Smooth, topographically enclosed flat areas in the south polar deposits may be the surface expressions of subglacial lakes or refrozen lakes.

P42A-0420 1330h POSTER

Evidence for an Ocean in the Northern Lowland Plains of Mars Based on Crater Depth/Diameter Measurements

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It has been suggested that the complex history of Mars includes one or more ancient oceans and that the Vastitis Borealis Formation (VBF) is an ice-rich, fine-grained sedimentary deposit left as a remnant of these oceans. In many places in the northern lowland plains the VBF partially fills craters and mantles the surrounding terrain. Here we examine new crater depth (d) and diameter (D) measurements to test the hypothesis that VGF was deposited from a large body of water. The d and D for 2,102 craters (D ranging from 2 km to >100 km) were measured in the northern lowlands in Utopia, Arcadia, Acidalia, and North Pole regions, and in the northern highlands in the Tempe Terra, and Deuteronilus regions. Crater depths were measured in two ways, from the floor to the rim (d_R), and from the floor to the surface surrounding the crater (d_S). The data show that both types of d/D relationships (d_S/D and d_R/D) of craters in the northern plains are different than the same type of relationships for craters in the northern highlands or anywhere else on the planet. In particular, the d_S/D relationship shows that the floors of many craters in this region are at or near the same elevation as the surrounding terrain, unlike in all other regions where depth is a function of diameter. Examination of THEMIS and MOC images has revealed that craters with floors at or near the same elevations as the surrounding terrain are also the ones partially filled with VBF. This suggests that the VBF is the cause of the unique d_S/D relationship. In addition, the partially filled craters north of 45°N are typically shallower than similar craters south of 45°N (the latitude predicted for Mars' maximum obliquity). These relationships are consistent with those predicted for a terrain mantled by an ice-rich sedimentary mantle that is undergoing deflation by sublimation and with the hypothesis that VBF is a ice-rich deposit left by an ancient ocean.

P42A-0421 1330h POSTER

The Big Chill: Did The Lyot Impact Produce a Late Climate Cooling on Mars?

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The Lyot impact basin is a double ringed basin of outer diameter 200km that formed late in Mars history. It was noted by the author[1,2] that the creation of the Lyot impact basin in the Northern Hemisphere of Mars in the early Amazonian Epoch [3] appears to coincide with the 30x reduction of fluvial and peri-glacial resurfacing rates between the Late Hesperian and Early