P33B-04 1330h POSTER

Response of Stagnant-Lid Convection to Sudden Dichotomy Formation

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Did the thermal event responsible for the Tharsis volcanic plateau occur as a consequence of a sudden formation of the Martian crustal dichotomy? Using a 3-D spherical mantle convection model with temperature-dependent viscosity, we explore the effect of the sudden emplacement of hemispheric-scale crustal thickness variations on stagnant-lid mantle convection. Thickened crust in the "southern" hemisphere of the model causes insulation of that hemisphere which may effect the underlying mantle circulation. This leads to a transient, regional-scale partial melting event sufficient to generate the Tharsis rise during the first 0.5-1.0 billion years following the formation of the crustal dichotomy.

P33B-05 1330h POSTER

Geological Models for the Uppermost Martian Crust

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Prototype cross-sections through the uppermost 100 m of the Martian crust are attempted for several distinct terrains: (a) young and uncratered (northern lowlands); (b) young and cratered (northern lowlands); (c) older and cratered (southern highlands) and (d) older and uncratered (southern highlands). Polar regions are also considered. The cross-sections are built from four main materials (1) uncemented sediment (i.e., dust and aeolian deposits); (2) cemented sediment (e.g., evaporites, sediments consolidated by diagenesis); (3) igneous rock (e.g., basaltic lavas and related hypabyssal intrusions, impact melt); and (4) megaregolith (i.e., impact-bombarded and impact-mixed material derived from 1-3 above). Megaregolith constitutes the foundation component, given that the entire crust had probably been impact processed by the end of the heavy bombardment period. The cross-sections have been constructed primarily in order to optimize the design of an orbiting synthetic aperture radar (SAR)/Sounder system for Mars. The cross-sections are also intended for use in mission planning (i.e., site selection, rover design and equipment selection). Understanding the composition and structure of the uppermost 100 m of the Martian crust is important for future missions. We need to estimate the likely substructure for landing sites so that we can optimize mission design. This is particularly important for rover-based drilling, ground-penetrating radar technology, sampling for evidence of life, and accessing H2O. Constructing cross-sections is an iterative process, largely based on existing remote sensing data (Mariner, Viking, MGS, Odyssey), combined with analogies with other terrestrial planets, especially Earth and the Moon. In this respect, Mars shows similarities with both the Moon (e.g., in megaregolith development and its preservation) and Earth (e.g., recent volcanism, presence of sedimentary deposits).

P33B-06 1330h POSTER

Gusev crater: direction of active winds derived from the Mars Exploration *Rover Rock Abrasion Tool*

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The *Mars Exploration Rovers* (MERs) are not instrumented to measure winds directly, but might be able to give insight into wind directions using other techniques. The *Rock Abrasion Tool* (RAT) on the *Instrument Deployment Device* (IDD) on the Mars rover, *Spirit*, was used to remove dust and cut into a basaltic rock named *Adirondack* in Gusev crater on Sol 34 of mission operations. The rock abrasion operation occurred between about 1223 hr and 1518 hr in the afternoon (local solar time) and left a cavity 2.68 mm deep. An image taken after the abrasion operation showed that the rock cuttings were asymmetrically distributed around the cavity and over the rock in a direction suggesting that the cuttings were transported away from the cavity by winds. The distribution pattern (and the inferred wind) is being compared with results from wind tunnel simulations conducted prior to the mission to assess the wind-flow patterns as a function of rock, rover, and IDD positions with respect to the wind. The wind direction inferred from the RAT cuttings are also being compared with wind directions suggested by aeolian bedforms and albedo patterns seen from MER and from orbit, and with directions predicted by a model of the atmosphere for winds at mid-day in Gusev crater.

P33C CC: 220 C-E Wednesday 1330h

Small Bodies Posters *(joint with V)*

Presiding: **A R Hildebrand,** University of Calgary**; R Binzel,** Massachusetts Institute of Technology

P33C-01 1330h POSTER

ANTS/PAM: Future Exploration of the Asteroid Belt

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The Autonomous Nano-Technology Swarm (ANTS) is applied to the Prospecting Asteroid Mission (PAM) concept, as part of a NASA RASC study. The ANTS architecture is inspired by success of social insect colonies, based on the division of labor within the colonies: 1) within their specialties, individual specialists generally outperform general-ists, and 2) with sufficiently efficient social interaction and coordination, the group of specialists generally outper-forms the group of generalists. ANTS as applied to PAM involves a thousand individual specialist sciencecraft', one subswarm per target, in an environment where detection and tracking of irregular, infrequent targets is a major chal-lenge. Workers, carry and operate eight to nine different scientific instruments, including spectrometers, ranging and radio science devices, imagers. The remaining specialists, Messenger/Rulers, provide communication and coordina-tion. The non-expendable propulsion system is based on autonomously deployable and configurable solar sails, a system suitable to a low gravity environment. The design of the neural basis function requires a minimum of 4 or 5 specialists for collective decision making. Allowing for ten instrument specialist teams and compensating for antici-pated high attrition, we calculate an initial minimum of 100 per subswarm should allow characterization of hundreds of asteroids. The difficulty in observing irregular, rapidly moving, poorly illuminated objects is largely overcome by the ANT sciencecraft capability to optimize conditions for each instrument. Components are composed of carbon nanotubules reversibly deployable from NEMS nodes, allowing 100 times decrease in packaging volume. 1000 smart 10 centimeter, 1 kg cubic boxes create a 1000 kg 1 meter cube.

URL: http://ants.gsfc.nasa.gov

P33C-02 1330h POSTER

ANTS/SARA: Future Observation of Saturn's Rings

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The Saturn Autonomous Ring Array (SARA) mission concept applies the Autonomous Nano-Technology Swarm (ANTS) architecture, a paradigm developed for exploration of high surface area and/or multi-body targets. ANTS architecture involves large numbers of tiny, highly autonomous, yet socially interactive, craft, in a small number of specialist classes. SARA will acquire in situ observations in the high gravity environment of Saturn's rings. The high potential for collision represents an insurmountable challenge for previous mission designs. Each ANTS nanocraft weighs approximately a kilogram, and thus requires gossamer structures for all subsystems. Individual specialists include Workers, the vast majority, that acquire scientific measurements, as well as Messenger/Rulers that provide communication and coordination. The high density distribution of particles combines with the high intensity gravity and magnetic field environment to produce dynamic plasmas. Plasma, particle, wave, and field detectors will take measurements from the edge of the ring plane to observe the result of particle interactions. Imagers and spectrome-ters would measure variations composition and dust/gas ratio among particles using a strategy for serial rendezvous with individual particles. The numbers and distances of these particles, as well as anticipated high attrition rate, re-quire hundreds of spacecraft to characterize thousands of particles and ring features over the course of the mission. The bimodal propulsion system would include a large solar sail carrier for transporting the swarm the long distance in low gravity between deployment site and the target, and a nuclear system for each craft for maneuvering in the high gravity regime of Saturn's rings.

URL: http://ants.gsfc.nasa.gov

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P33C-03 1330h POSTER

Diffusion and Structure of Meteor Trails in the E-Region Ionosphere

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A meteoroid penetrating the Earth's ionosphere leaves behind a trail of dense plasma which disperses with time. For micrometeoroids, which comprise the majority of all meteoroids bombarding the Earth, the only practical way to observe the trail is using radars. An important feature of radar images from large-aperature radars is the non-specular echoes, which show strong aspect sensitivity and remain visible for a relatively long time in a broad altitude range within the E-region ionosphere. We have argued that non-specular echoes result from radar signals scattered from turbulent electron density irregularities generated by plasma instabilities. Strong electrostatic electric fields and diamagnetic drifts developing during the plasma trail diffusion drive these instabilities. In order to draw quantitative conclusions about the meteoroids based on radar measurements, we need to model this instability process. This modeling in turn requires

knowledge of spatial/temporal distribution of the driving polarization electric field and plasma density. Previously, we performed such modeling in the simplest case for a trail aligned strictly along the geomagnetic field [1]. However, the majority of routinely observed meteoroids have a significant angle between these two directions. The dynamical theory and simulations of meteor trail diffusion were developed starting in the 1960s (e.g., [2-5]). While these earlier papers caught some aspects of the plasma trail dynamics, they did not provide accurate predictions for the polarization electric field because they did not properly treat interaction between the trail and background ionospheric plasma. In this paper, we present results of our recent 2-D analytical theory and numerical computations, which for an arbitrary angle between the magnetic field and the trail axis take into account the current closure in the background plasma. This study provides us with quantitative knowledge of the electric field spatial distribution and dynamics. We show that the non-specular echo should disappear well before the true dispersion of the meteor trail itself. Using our theory and observations of non-specular meteors should yield information about meteor trails and the surrounding atmosphere.

[1] M. Oppenheim et al., J. Geophys. Res., 108, SIA 8-1, ID 1064 (2003). [2] T. R. Kaiser et al., Planet. Space Sci., 17, 519 (1969); [3] W. M. Pickering and D. W. Windle, Planet. Space Sci., 18, 1153 (1970); [4] W. Jones, Planet. Space Sci., 39, 1283 (1991); [5] R. E. Robson, Phys. Rev. E, 63, 026404 (2001)

P33C-04 1330h POSTER

Petrophysical Characterization of Stony Meteorites Using Low Field Magnetic Susceptibility: Initial Results From Anisotropy Measurements

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Low field magnetic susceptibility represents a fast, systematic and non-destructive technique of meteorite classification [1-4]. We previously reported measurements of bulk susceptibility, and its frequency dependence, along with a proxy' measure of anisotropy, on 204 specimens from 108 different meteorites in the National Meteorite Collection of Canada [5,6]. Measurements were performed on a Sapphire Instruments Model 2B. Bulk susceptibility values followed expected trends, governed by metal content, with values increasing from LL, to L, to H, to E chondrites. Frequency dependence (19000 vs 825 Hz) was greatest in H and C chondrites. Aubrites (AUB) and Howardites (HOW) had the lowest. Anisotropy of magnetic susceptibility (AMS) was measured using a proxy' approach: the mean value determined from a series of random sample orientations was compared with repeated measurements in one orientation. AUB, E chondrites and Martian SNCs had the largest inferred anisotropies, while LL and C chondrites had the lowest. Here we report initial results from a follow-up study. Quantitative measurements of the AMS were made on 67 stony meteorite specimens. AMS measurements [3,5,6,7,8,9] can provide information on the physical fabric of the meteorite, and may relate to its deformational history. Samples measured show significant degrees of anisotropy ranging from 1-50 % for an individual specimen (in parentheses is the number of specimens used in the class mean): AUB (5), Acapulcoites (1) and E chondrites (10) display the largest degrees of anisotropy, 40±11 (1 standard deviation), 34, and 24±10, respectively. These classes are followed by Diogenite (1) 20, H (13) 14±7 and L (10) 13±6 chondrites, Brachinite (1) 11, Ureilite (2) 8, Eucrite (4) 7±4, C chondrites (14) 6±3, and Rumurutiite (1) 4. These results match a similar trend based on the proxy' method [5,6]: AUB and E chondrites were found to have the highest inferred anisotropies followed by tightly grouped H and L chondrites, with C and LL chondrites having the lowest inferred anisotropies. The magnitudes of the ellipsoid shape varied significantly within meteorite class, and there is variability between classes. The mean ellipsoid shape and standard deviation for each class follows. Prolate ellipsoids: AUB (+17±15), Diogenite (+8), E chondrites (+4±13), and Ureilite (+4). Oblate ellipsoids dominate the remaining classes: Acapulcoite (-31), Brachinite (-15), L chondrites (-7±10), H (-5±12), Eucrite (-6±4), C (4±3) and Rumurutiite (-3). There is consistency of AMS among multiple specimens of the same meteorite. Future work on samples from the National Meteorite Collection of Canada will also include measurements of the intensity of natural remanent magnetization, and of bulk density. These techniques, measuring several physical properties non-destructively, show great promise for characterizing meteorites. References: [1] Kukkonen I.T. & Pesonen L.J. (1983) Bull. Geol. Soc. Finland 55: 157-177. [2] Terho M. et al. (1993) Studia geoph. et geod. 37: 65-82. [3] Rochette P. et al. (2001) Quaderni di Geofisica, 18, 30 p. [4] Rochette P. et al. (2003) Meteor. Planet. Sci. 2002, 38(2). [5] Smith D.L. et al. (2003) Abstract 1939, Lunar Planet. Sci. XXXIV. [6] Smith D.L. (2003). B.Sc. Thesis, Carleton U., Ottawa. [7] Sneed et al. (1988) Meteoritics. 23, 139-149. [8] Morden S.J & Collinson D.W. (1992) Earth Planet Sci. Lett. 109, 185-204. [9] Smith D.L. et al. (2003) Abstract 5275, Met. Soc. 66.

P33C-05 1330h POSTER

Ureilite Carbon and mg Number

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Ureilites are carbon-bearing ultramafic achondrites composed primarily of olivine and pyroxene with intergranular fine-grained metal, sulfides, and silicates. Carbon (up to 6.5 wt%) is either amorphous or present as graphite, lonsdaleite, and/or diamond. It has been shown that carbon-silicate redox (i.e. "smelting") reactions are responsible for the positive correlation between modal percent pigeonite and mg# and for the negative FeO-MnO trend seen in the mineral and bulk compositions of ureilites. Carbon redox reactions are strongly exothermic and pressure dependent; so ureilites with the largest mg# are the most reduced, experienced the highest temperatures, and formed at the lowest pressures, i.e. near the surface of the ureilite parent body. Ureilites with the largest mg# have the smallest δ^{18}O and the largest Δ^{17}O. To further investigate possible relationships, we performed carbon isotope and electron probe measurements on a suite of 27 ureilites in order to see the type of correlation that exists between mg# and carbon. Mg#s of olivine cores, carbon contents, and δ^{13}C data were taken from this study and the literature, and averaged. Polymict ureilites were not considered. A well-defined negative correlation is observed between the mg# of olivine cores and Δ^{17}O. A less well-defined negative correlation may exist between mg# of olivine cores and δ^{13}C, but there is substantial scatter in the data. However, a well-defined negative correlation exists between mg# of olivine rims and δ^{13}C. At first glance, this trend is unexpected: if ureilites with the largest mg# experienced the greatest amount of reduction, they should have the largest δ^{13}C and the correlation between mg# and δ^{13}C should be positive. A plot of carbon content versus δ^{13}C seems to show a general trend: the smaller the carbon content, the heavier is the carbon. This general trend is exactly what one would expect if smelting has affected the ureilite parent body: the more C is consumed during smelting, the heavier the residue become. However, mg#s do not support this interpretation: ureilites with the largest mg# have the smallest carbon content and the smallest δ^{13}C, while ureilites with the largest mg# have the opposite. To explain this apparent contradiction, one needs to consider that ureilites have experienced two reducing events. The first one is recorded in the cores of the olivine crystals while the second is seen in the strongly reduced rims. During the heating of the ureilite parent body, the olivine cores first equilibrated with the carbon and their mg# were fixed according to their depth: the deepest olivine experienced little reduction, had low mg#, relatively light carbon (δ^{13}C < -10 $^o/_{oo}$) and high carbon content (about 7-8 wt%); the shallowest olivines experienced the greatest reduction, resulting in high mg#, relatively light carbon (δ^{13}C < -8 to -10$^o/_{oo}$) and low carbon content (about 4 wt%). The second reducing event was marked by a sudden drop in pressure (possibly due to an impact that disrupted the parent body). During this event, olivines that formed at depth were now strongly reduced along their rims (the cores preserved their initial mg#), their carbon became heavier (δ^{13}C > -8$^o/_{oo}$) and their carbon content decreased (below about 4 wt%). On the other hand, olivines that formed initially near the surface of the parent body did not experience much change in terms of mg#, δ^{13}C, and carbon content.

P33C-06 1330h POSTER

High Resolution Shape and Topography of Eros - Preliminary Results From NEAR Imaging Data

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A program has been developed for determining small body shape and topography from imaging data, using multiple image stereography and photoclinometry. A preliminary study using 1600 F4 images of Eros, 90 percent of them between 10 m/pixel and 30 m/pixel, has produced a 1.57 million vector model with an average resolution of about 30 meters. The postfit residual of the 7.2 million vectors which went into the model was less than 8 m/dof. The model predictions correlate better with observed gravity harmonics than does the laser altimetry model, its coverage is more uniform, and it has far less noise. More generally, the method allows the synthesis of all imaging data into a single high-resolution data structure that can be displayed in a variety of ways for geological analysis.

P33C-07 1330h POSTER

Meteoroid Plasma Density and Mass Determination Using a New Spherical Scattering Method Applied to Head Echoes

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Large-aperture radars have the ability to detect the high-density plasma that forms around a meteoroid, measuring reflections called head echoes. To determine the head echo plasma density, we have modeled the scattering of a radar wave by meteor-generated plasma. This allows us to use head echo measurements to infer plasma density and, subsequently, meteoroid mass with unprecedented accuracy. To validate our new scattering method, we first used the spherical scattering model to compare densities derived from simultaneous VHF and UHF measurements of individual head echoes. We then converted the maximum plasma density from these head echoes to meteoroid masses by using an ionization model and compared these values with those obtained from a meteoroid ablation model. These tests indicate that our scattering method produces consistent results across frequencies that agree remarkably well with the ablation model for most meteor measurements. The data presented in this research derives from a set of measurements collected by ALTAIR at both VHF and UHF during the Leonid 1998 and 1999 showers. This new technique allows meteor researchers to use highly sensitive, large-aperture radars to map meteoroid masses and origins for particle masses down to 10-8 grams.

P33C-08 1330h POSTER

Space Dust Charging: Laboratory Simulation

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A number of phenomena connected with dust within the solar system can be explained by their electric charging. While the parameters of plasma in the solar system are relatively well known, important material properties (e.g., coefficients of photoemission, yield of secondary emission, working functions, etc.) of dust grains should be accounted approximately. We are presenting laboratory observations of charging/discharging processes of micron-size grains levitating in a vacuum chamber and exposed by electron/ion beams in the energy range from several hundred of eV to several keV. We are using melamin formaldehyd (MF) spherical 2.5 micron grains as well as MF grains with a surface covered by different metals. Measured equilibrium surface potentials are compared with simple secondary emission model results. The analysis of experimental results reveals that secondary emission played a prominent role in the establishment of charge on the grains.

P33C-09 1330h POSTER

Mosaicking of NEAR MSI Color Image Sequences

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Of the over 160,000 frames of 433 Eros captured by the NEAR-Shoemaker spacecraft, 21,936 frames are components of 226 multi-spectral image sequences. As part of the ongoing NEAR Data Analysis Program, we are mosaicking (and delivering via a web interface) all color sequences in two versions: I/F and photometrically normalized I/F (30° incidence, 0° emission). Multi-spectral sets were acquired with varying bandpasses depending on mission constraints, and all sets include 550-nm, 760-nm, and 950-nm (32% of the sequences are all wavelengths except 700-nm clear filter). Resolutions range from 20 m/pixel down to 3.5 m/pixel. To support color analysis and interpretation we are co-registering the highest resolution black and white images to match each of the color mosaics. Due to Eros's highly irregular shape, the scale of a pixel can vary by almost a factor of 2 within a single frame acquired in the 35-km orbit. Thus, map-projecting requires a pixel-by-pixel correction for local topography [1].

Scattered light problems with the NEAR Multi-Spectral Imager (MSI) required the acquisition of ride along zero exposure calibration frames. Without correction, scattered light artifacts within the MSI were larger than the subtle color differences found on Eros [see details in 2]. Successful correction requires that the same region of the surface (within a few pixels) be in the field-of-view of the zero-exposure frame as when the normal frame was acquired. Due to engineering constraints the timing of frame acquisition was not always optimal for the scattered light correction. During the co-registration process we are tracking apparent ground motion during a sequence to estimate the efficacy of the correction, and thus integrity of the color information.

Currently several web-based search and browse tools allow interested users to locate individual MSI frames from any spot on the asteroid using various search criteria (cps.earth.northwestern.edu). Final color and BW map products and supporting information will be delivered to the scientific community and general public through a similar interface. Image products will be available in both Portable Network Graphics (PNG) and Integrated Software for Imagers and Spectrometers (ISIS) formats. Comments and suggestions on the search and browse tools are welcome at: jdigilio@earth.northwestern.edu.

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[2] Murchie, S., M. Robinson, D. Domingue, H. Li, L. Prockter, S. Edward Hawkins, III , W. Owen, B. Clark and N. Izenberg, Inflight Calibration of the NEAR Multispectral Imager: II. Results from Eros Approach and Orbit, Icarus, Volume 155, Issue 1, January 2002, Pages 229-243.

URL: http://cps.earth.northwestern.edu/

P33C-10 1330h POSTER

Silicon Carbide from the Canyon Diablo Meteorite and the Ewing Impact Structure

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One hundred years ago, Henri Moissan reported his discovery of silicon carbide (SiC) in the Canyon Diablo Meteorite. Since then, other researchers tried, but failed to replicate his findings. In our study of highly oxidized samples of the Canyon Diablo Meteorite, we found two carbon nodules, respectively 1 cm and 2 cm in size; the latter is no longer in the matrix which had disintegrated into rust. We found several SiC crystals in these nodules. Most of them show color zoning, planar deformation features (PDFs), black inclusions and black rims. The X-ray diffraction pattern of a 60-micron crystal showed a 6H polytype structure for the host in addition to a weak lattice, related to that of the host by a 2-degree rotation about the a-axis. We believe that the weak lattice was derived from the PDFs. We also report here the first find of SiC from deep sea sediments on the rim of the Ewing Impact Crater, located near the Equator at about 10 degrees east of the longitude of Hawaii. The SiC crystals also contain PDFs. An X-ray diffraction study showed 6H structure for the host, and 15R structure for the PDFs. Thus, 15R seems to be the high-pressure phase, a potentially useful marker for shock deformation events. Implications of our study are as follows. (1) Because all occurrences of terrestrial SiC are associated with kimberlites, SiC found at impact sites might have originated from space, or, by transformation of terrestrial materials by impact mechanisms. (2) The extreme sturdiness of SiC might enable it to resist alteration, long after other impact markers have decomposed. (3) Hence, SiC crystals, with or without PDFs, though small in size and few in number, might provide clues for deciphering possible relationships between impact events and global extinction of species.

P33D CC: 220 C-E Wednesday 1330h

Planetary Science General Contributions III Posters *(joint with A, GP, T, V, NG)*

Presiding: **G S Orton,** Jet Propulsion Laboratory, California Institute of Techology**;** **J G Digilio,** Northwestern University

P33D-01 1330h POSTER

Geometry of Stable Capture Zones for Planets Earth and Venus: Implications for Pathways of Planet Evolution

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The sister planets, Venus and Earth, have greatly contrasting environmental surface conditions. Earth has conditions that were conducive to the development of a thriving biological system while Venus has surface conditions that do not permit life. The theme explored here is that gravitationally captured satellites can make a tremendous difference in the evolutionary pathway of a terrestrial planet. During the past few years we have been able to demonstrate that whole-body (gravitational) capture of a lunar-mass body is physically possible in a coplanar, three-body context. We use a fourth-order Runge-Kutta integration code with a subroutine that simulates energy dissipation within the interacting bodies within 20 planet radii. Mapping of two-dimensional, coplanar parameter space in the region of the orbits of planets Venus and Earth has led to the identification of two retrograde (clockwise motion) and two prograde (counterclockwise motion) zones for capture orientations for both planet-planetoid combinations. The parameters mapped are planet anomaly (position of the planet at the beginning of the encounter simulation) and planetoid orbital eccentricity (relative to a circular orbit for the planet). The post-capture history of a terrestrial planet is largely determined by the direction of capture. Retrograde capture, after post-capture orbit circularization, results in a progressive DECREASE in the size of a circular planetoid orbit and a concomitant decrease in the prograde rotation rate of the planet. In contrast, prograde capture, after post-capture orbit circularization, results in a progressive INCREASE in the size of the circular planetoid orbit and a concomitant decrease in the prograde rotation rate of the planet. Thus, the mode of capture can leave a major imprint on the evolutionary history of a terrestrial planet.

P33D-02 1330h POSTER

Atmospheric Rotational Effects on Mars Based on the NASA Ames General Circulation Model: Angular Momentum Approach.

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The NASA-Ames general circulation model has been used to compute time series for atmospheric inertia and relative angular momentum terms. Model outputs were used also to compute time series representing the inertia terms due to CO2 condensation and sublimation on the surface of Mars. Some of these terms were used to generate time series representing the forcing functions for the equatorial components of the linearized Liouville equations of rotational motion. These equations were then solved numerically for a period of a Martian year (669 sols) to obtain a time series for the position of the rotation pole on the surface of Mars. The results of the investigation indicate that mass variation in the atmosphere is as important as the formation and sublimation of ice caps on the surface of the planet. Numerical integration of the equations of rotational motion yields pole displacements as large as 32.8 cm (ice caps solution), 40.9 cm (atmospheric effects), and 35.3 cm (both effects combined). Fourier analysis of the time series corresponding to the equatorial components of pole displacement for the ice caps solution as well as the atmospheric effects solution shows that the (1/3)-annual harmonic has the largest coefficient in three cases, with magnitudes in the 8-10 cm range. Fourier analysis of the equatorial components of polar motion for the combined solution yields main harmonics of 5.66 cm (x), (1/3)-annual and 7.86 cm (y), annual.

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Gravity-inferred Crustal Attributes of Visible and Buried Impact Basins on Mars

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Impact basins of Mars reveal important insights on martian tectonic evolution. They involve strongly disrupted, depressed regions of crust with likely enhanced porosity and permeability that may locally concentrate water and other crustal fluids. We assess the crustal details of impact basins by separating the Mars Global Surveyor free-air anomalies into terrain-correlated and terrain-decorrelated components. The separation is based on the correlation spectrum between the free-air anomalies and the gravity effects evaluated from the topography mapped by the Mars Orbital Laser Altimeter. For topographically visible multi-ring basins like Isidis, striking circular patterns of alternating terrain-correlated free-air maxima and minima mark the uncompensated components of the central mantle plug and surrounding rings. The first vertical derivatives of these anomalies effectively estimate the basin ring locations and a transient cavity depth-to-diameter ratio of 0.09 that is in good agreement with the ratio observed for lunar nearside multi-ring basins. For the Isidis Basin, we obtain an excavation depth of roughly 62 km and a 2 km high-density basin fill that may cap the central basin. Subtle quasi-circular depressions in

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