Amazonian Epochs. Recovery of peri-glacial resurfacing rates in the middle Amazonian is followed by fluvial resurfacing rate recovery only in the late Amazonian. This suggests that the impact which formed the Lyot basin may have induced a strong cooling event on the planet. This suggestion of the profound disruption of any extant planetary climate system by the Lyot impactor is reinforced by the study of hydrogen fractionation in water samples from Mars rocks of various ages. Hydrogen fractionation in the water found in the rocks is con-stant from ALH84001 at 4.5 Gyr years old to Nahkala at 1.2.Gyr age, but increases rapidly in the Shergottites at 0.3Gyr age [4]. It has been noted recently that the Lyot basin is surprisingly free of fluvial features[5] relative to its surroundings. [1] Brandenburg J. E. (1995) Earth Moon and Planets, 67, 35-45. [2] Brandenburg J.E. (Absract)2002 Metoritics Soc.Meeting [2] Tanaka K.L. (1986). LPSC 17, JGR Suppl. 91:E139-E158. [4] Watson , L.L. Epstein S. , and Stolper, E. M, Meteoritics , 29, 547, (abstract)[5] Head J. W.III (2002) 33rd LPSC .

P42A-0422 1330h POSTER

Debris Aprons in the Tempe/Mareotis Region of Mars

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Martian debris aprons are considered to be geomorphic indicators of ground ice, and thus are important in understanding the climate and volatile inventory on Mars. Their presence suggests storage of ice in the Martian regolith, either currently or in the recent geologic past. Recent studies of aprons have focused on the eastern Hellas and Deuteronilus/Protonilus Mensae regions of Mars, which have some of the highest apron concentrations on the planet. However, there are several other locales that have significant populations of aprons. We have initiated a new study of aprons located along the northern lowlands-southern cratered highlands boundary in the Tempe/Mareotis Fossae region (43-55N, 274-294E). Seventy-three apron complexes have been identified in Viking images, and we further document their surface textures, morphometric properties, and topographic characteristics using MOC narrow-angle images, MOLA PEDR profile data, and THEMIS daytime (VIS and IR) and nighttime (IR) images. Debris apron complexes generally consist of one or more lobate deposits that surround individual massifs or small knobs, but have also been observed along the bases of escarpments and inner crater walls. The Tempe/Mareotis aprons have a similar planimetric morphology to those observed elsewhere on Mars. A series of distinctive textures are observed on the surfaces of Tempe/Mareotis aprons that can be attributed to differences in preservation state. Smooth, pitted, ridge and valley, and knobby textures characterize upper apron materials, which often appear to be mantled by a fine-grained deposit. Smooth and ridged erosional textures appear to form in low-lying areas where upper apron material has been removed. The degradation of upper apron material generally begins with a smooth, mantled surface that is gradually removed by sublimation, melting, and/or aeolian activity, which leaves behind a hummocky surface texture composed of knobs, ridges, or both. Further degradation produces subdued and smooth erosional textures in some areas, which may have contained greater abundances of ice. MOLA profiles across many of the Tempe/Mareotis aprons show a well-defined convex-upward shape similar to those observed in the eastern Hellas and Deuteronilus/Protonilus Mensae regions. However, not all apron profiles have such shapes, and many have a linear slope or a slightly convex-upwards shape. The combined textural and morphometric variability of Tempe/Mareotis aprons suggest potential differences in emplacement style or ice content in addition to preservation state. Our continued study of Tempe/Mareotis aprons will also assess the influence of geology and geologic history relative to aprons observed in other regions of Mars.

P42A-0423 1330h POSTER

Rheological properties of slope streaks with anastomosing patterns on Mars

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Slope streaks have formed during the Mars Global Surveyor mission marking geologic activity at the Martian surface. Here, we present results from numerical modeling to help explain flow-like, morphologic characteristics, which include branching and anastomosing patterns influenced by local small topographic barriers. With a photoclinometric technique to estimate their sizes, numerical simulations of slow-moving plastic flows show that a fluid rheology and a short formation period are necessary to explain these features. We estimate that the typical values of a bulk viscosity and a bulk yield strength are less than 10 Pa s and less than 10 Pa, respectively (less than 1Pa s and 1Pa are more likely). The fluidity may be attributed to water-related flow with the solid content less than 20%, but a dry grain flow with extremely low cohesion and friction angle supported by dispersive pressure or lubricant such as atmosphere or subsurface discharge of gas is also possible. The continuous features of slope streaks from point sources are more easily explained by continuous discharges of material or lubricant. In this case, the estimated flow rate is less than several m^3/s and the flow duration estimated to be less than 1day.

P42A-0424 1330h POSTER

Seasonal Weather Patterns Influencing Dune Morphology in Noachis Terra, Mars: Using a Mesoscale Model for Surface Science

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The work of the wind is the one sedimentary process that both acts on the surface and interacts with the lower atmosphere of Mars. Wind-sculpted landforms such as sand dunes are among the few features visible in spacecraft images that provide information on the aeolian sedimentary environment and surface wind circulation patterns of Mars. The study of the placement and orientations of sand dunes leads to the depositional, erosional, and transport history of sand across a region. When correlated with wind predictions from an atmospheric model, dune orientations provide not only model verification but also an understanding of the seasonal weather patterns that influence dune morphology. We have applied a mesoscale model to Noachis Terra, an 1800 km x 3500 km area of Mars containing several dune fields. The Mars Mesoscale Model 5 (Mars MM5), developed from the PSU/NCAR MM5, was run in periods spanning the Martian year, predicting seasonal wind patterns for each of nine dune fields in Noachis Terra. Dune slipface orientations were measured for all dune fields imaged by the Mars Orbiter Camera (MOC) on the Mars Global Surveyor. Preliminary results indicate a high correspondence of dune morphology with present-day seasonally-dependent wind patterns predicted by the Mars MM5.

P42A-0425 1330h POSTER

Climate Transition on Mars: CO2 Exchange Process Between Atmosphere and Ice Caps Under Paleoenvironment

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Several lines of evidence suggest that climate warming and cooling have repeated on Mars in its history. In order to study the stability and evolution of Martian climate, we construct a 2-dimensional (horizontal-vertical) energy balance climate model. The long-term CO_2 mass exchange processes between the atmosphere and CO_2 ice caps are investigated with particular attention to the albedo effects of planetary ices (H_2O and CO_2) on the climate stability. We make numerical simulations of the climate transition between warm and cold climate states taking into account the evolution of CO_2 ice cap topography (areal extent and altitude). Our results are summarized as follows. A few bars of CO_2 atmosphere presumed for early ($\sim$ 3.8 Ga) warm and wet Mars possibly begins to condense irreversibly onto polar caps when H_2O ices would cover more than several tens % of the Martian surface. This is because the effect of ice albedo causes polar cooling and thus promotes the condensation of atmospheric CO_2. Once such condensation is triggered, rapid transition into cold climate state (with lower atmospheric pressure like the present one) occurs within a time scale of about 1000 years. This is caused by the acceleration of CO_2 condensation associated with further polar cooling due to the atmospheric pressure drop. We call this transition process "collapse condensation". If the collapse condensation of a few bars of CO_2 atmosphere occurs, the resultant polar CO_2 ice caps extend toward latitudes as low as 80-70 degrees with mean thickness of several 100 meters. This areal extent is consistent with the distribution of the present polar layer deposits (PLD), and thus PLD may have some information of such CO_2 glaciation in the past. On the other hand, the low atmospheric pressure buffered by the CO_2 ice caps is possibly unstabilized when the CO_2 ice albedo decreases or the Martian obliquity increases. If the ice caps contain a large amount of CO_2 (e.g. formed by the collapse condensation), such instability causes the climate jumps to a warm state with high atmospheric pressure owing to complete evaporation of the ice cap. We call this process "runaway evaporation". The time scale for the completion of runaway evaporation is similar to that of the collapse condensation.

P42B MCC: 2000 Thursday 1340h

Applications of Planetary Radars II *(joint with G)*

Presiding: **T G Farr,** Jet Propulsion Laboratory, California Institute of Technology**;** **J J Plaut,** Jet Propulsion Laboratory, California Institute of Technology

P42B-01 1345h INVITED

Investigation of Planets and Small Bodies Using Decameter Wavelength Radar Sounders

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Decameter wavelength radar sounders provide a unique capability for the exploration of subsurface of planets and internal structure of small bodies. Recently, a number of experimental radar sounding instruments have been proposed and/or are planned to become operational in the near future. The first of these radar sounders is MARSIS (Picardi et al.) that is about to arrive at Mars on ESA's Mars Express for a two-year mission. The second radar sounder, termed SHARAD (Seu et. al), will fly on NASA's Mars Reconnaissance orbiter in 2005. MARSIS and SHARAD have complementary science objectives in that MARSIS (0.1-5.5 MHz) is designed to explore the deep subsurface with a depth resolution of $\sim$100 m while SHARAD (15-25 MHz) focuses its investigation to near-surface ($<$ 1000 m) with a higher depth resolution of $\sim$ 10-15 m. In addition to its subsurface exploration goals, MARSIS, that has a frequency range between 0.1 to 5.5 MHz, will study the ionosphere of Mars and providing a wealth of new information on Martian ionosphere. Both MARSIS and SHARAD have the potential of providing answers to a number of questions such as depth of ice-layers in the polar region and recently discovered ice-rich regions in both northern and southern hemispheres of Mars. The next generation of radar sounders will benefit from high power and high data rate capability that is made available through the use of Nuclear Electric generators. An example of such high-capability mission is the Jovian Icy Moons Orbiter (JIMO) where, for example, the radar sounder can be used to explore beneath the icy surfaces of Europa in search of the ice/ocean interface. The decameter wave radar sounder is probably the only instrument that has the potential of providing an accurate estimate for the ocean depth. Another exciting and rewarding area of application for planetary radar sounding is the investigation of the deep interior of small bodies (asteroids and comets). The small size of asteroids and comets provides the opportunity to collect data in a manner that enables Radio Reflection Tomographic (RRT) reconstruction of the body in the same manner that a medical ultrasound probe can image the interior of our body. This paper provides

an overview of current technical capabilities and challenges and the potential of radio sounders in the investigation of planets and small bodies.

P42B-02 1400h INVITED

Monitoring Volcanoes in Kamchatka and the Kuriles Using Shuttle Radar Topography Mission (SRTM) and MODIS Data

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Recently-released topographic data from the Shuttle Radar Topography Mission (SRTM) are being used as part of a joint collaboration between the U.S. Geological Survey, Univ. Alaska, and Univ. Hawaii to investigate the diversity of volcanic activity within the Kurile Islands and Kamchatkan Peninsula. SRTM data have a spatial resolution of 90 m, a vertical accuracy of ~10 meters, and provide unique information on the height, slope and aspect of the ~50 historically active volcanoes in the region. SRTM data also provide the context information for the position of hotspots on the volcanoes, serving as an aid to the geolocation of thermal anomalies on active volcanoes (e.g., Sheveluch, Bezymianny and Karymsky) using the MODIS instruments on NASA's Terra and Aqua spacecraft. Using the MODVOLC algorithm, we use MODIS observations to provide the team with thermal alerts for the volcanoes in a time frame that is typically less than 24 hours after at-sensor measurement of the emitted radiance. Under the Hawaii Synergy Project, we are also building a database of Landsat 7 data that can be merged with the SRTM elevation data to aid in visualization of the region. The application of SRTM data to the monitoring of the volcanoes will be discussed.

URL: http://infomart.soest.hawaii.edu

P42B-03 1415h

Probing the Subsurface of Mars with MARSIS on Mars Express

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The Mars Express orbiter carries an instrument called the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS). The MARSIS experiment is a joint project between NASA and the Italian Space Agency. The primary objective of MARSIS is to detect, map and characterize subsurface material discontinuities in the upper portions of the crust of Mars. These may include boundaries of liquid water-bearing zones, icy layers, geologic units and geologic structures. Secondary objectives include characterization of the surface topography, roughness and reflectivity, and passive and active ionospheric sounding. Detection of water and ice reservoirs will address many key issues in the hydrologic, geologic, climatic and possible biologic evolution of Mars, including the current and past global inventory of water, mechanisms of transport and storage of water, the role of liquid water and ice in shaping the landscape of Mars, and the stability of liquid water and ice at the surface as an indication of climatic conditions. MARSIS is a multi-frequency, coherent pulse, synthetic aperture radar sounder. The instrument features flexibility in frequency selection for adaptation to the Mars environment, and a secondary, receive-only antenna and data channel to minimize the effects of surface "clutter" on subsurface feature detection. The instrument will acquire echo profiles of the subsurface of Mars at a lateral spacing of approximately 5 km and a vertical (depth) resolution of 50-100 m. Four frequency channels will be available for use: 1.8, 3.0, 4.0 and 5.0 MHz. The lower frequency channels, which are likely to penetrate more deeply, will be used during night-side operations, when the ionospheric plasma frequency is lowest. The primary antenna consists of a simple dipole with a total length of 40 m. If aquifers occur only at great depth (> 5-10 km) in the martian crust, they may elude detection by MARSIS. However, shallower reservoirs of liquid water, perhaps associated with thermal anomalies or an insulating upper stratigraphy, should detectable. Many other stratigraphic and structural boundaries are expected to be identified by the radar sounding, providing a view into third dimension of the geology of Mars.

P42B-04 1430h INVITED

Potential Capabilities of a Rover Deployed Ground Penetrating Radar on Mars

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Ground Penetrating Radar (GPR) is capable of addressing a variety of geological problems on the Earth and planets and the instrument has become ensconced as an efficient means for non-intrusive definition of physical properties to 10's of meters depth. Given these capabilities, it is likely that measurements made by a rover-deployed GPR on Mars could constrain near-surface geology and structure. These GPR data could enable 3-D mapping of local stratigraphy and penetrate beneath eolian drift or snow masking layered or ground-ice-rich units and gullies. GPR data could also help define the degree of post-depositional weathering, and provide geologic context necessary to guide other rover instruments. Finally, GPR provides the potential to detect rover hazards (e.g., voids or dust-filled cracks) prior to their engagement. Careful consideration of the various factors influencing radar performance on Mars instills confidence that a GPR can achieve 10-20 m penetration in many settings and motivates development of a rover-deployable impulse GPR. Design of our system has focused on development of prototype antennas in parallel with fabrication of a control unit possessing low mass, volume, peak power, and data requirements of 0.5 kg, 3400 cc, 3 W, and 0.3 MB/day (for 50 meter traverses), respectively. In order to maximize potential penetration and resolution of a Mars GPR, the capability for both high and low frequency investigations has been incorporated. Testing of the prototype antennas in terrestrial analog settings confirms the ability to define near-surface stratigraphy that is critical for accurate interpretation of geologic setting. A model based on the Finite-Difference Time-Domain (FDTD) method is also being used to constrain likely GPR capabilities on Mars and is capable of modeling the complete instrument configuration including antennas, rover, surface roughness, and rocks. Simulations highlight the potential value of investing in such models that may enable identification of diagnostic signatures (such as signal attenuation, frequency content, and phase response) and facilitate inference of dielectric contrasts useful in constraining the local geology and setting.

P42B-05 1445h

Long-Wavelength Imaging Radar - A Window on Near-Surface Processes

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Radar observations of the terrestrial planets and the Galilean satellites have often been used to study the roughness and dielectric properties of their surfaces and near-surface environments. Longer radar wavelengths are most effective for deep probing, and can reveal subtle variations in bulk chemistry, the population of suspended rocks or voids, and sub-surface geologic features. We report here on applications of new L- and P-band (24-70 cm wavelength) radar observations of the Moon and Mars-analog terrestrial sites. The new 70-cm lunar observations have a spatial resolution of 300 m, representing a 10-fold improvement over previous maps. Images of the lunar poles do not support the existence of thick, Mercury-like deposits of ice in permanently shadowed craters. Any ice within the radar-observable areas must thus occur as disseminated grains or thin interbedded layers within the regolith. The new images also provide much greater spatial detail of geochemical differences among the mare basalt flows, and regional variations across the southern highlands that appear to correlate with large basin ejecta deposits. L- and P-band AIRSAR images and L-band SIR-C images, for a number of arid or semi-arid regions (Hawaii, Death Valley, Northern Arizona, Egypt), are being used to test theoretical predictions of backscatter from volume scatterers and buried surfaces. We are supporting these imaging radar studies with field topography measurements, ground-penetrating radar surveys, and laboratory sample analysis to constrain the sources and expected polarimetric properties of surface and sub-surface echoes. This work is an important step in refining the requirements on orbital radar systems for Mars and the Galilean satellites. Part of the research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA.

P42B-06 1500h

Recent Goldstone Solar System Radar Observations

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Planetary radar exploration started on the ground with the detection of the Moon in 1946. In recent years, the Goldstone Solar System Radar (GSSR) has for example made contributions to (i) understanding of the hazards and trafficability at various proposed Mars robotic landing sites, (ii) under-standing of polar water ice for the terrestrial planets and the surfaces of the icy Galilean satellites, (iii) measurement of the lunar polar topography at high resolution, and, (iv) in conjunction with the Green Bank and Arecibo telescopes, to high precision measurement of planetary rotation. Additionally, the GSSR has made a significant contribution to the radar-detected portion of the known NEO population; the radar-detected portion now stands at around 5%. Near Earth Object (NEO) radar detections provide astrometric information for long-term orbit prediction. Additionally, recent observations make the case for radar albedo and shape characterization, for which radar is uniquely suited, which enhance long-term NEO orbit predictions. For the past three years GSSR has averaged 5 quick-turnaround observations of newly discovered NEO's per year, for a total of 8 asteroid targets per year. Clearly, Earth-based radar astronomy lays the ground-work for and supports the exploration of the solar system by spacecraft, both with (e.g., Mars Express, Mars Reconnaissance Orbiter, Cassini) and without radar systems (e.g. Lunar Prospector, MUSES-C, and MESSENGER).

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P42B-07 1515h INVITED

Terrestrial Radar Sounding Studies of Thermal, Compositional and Structural Interfaces Analogous to Those Hypothesized for Europa's Icy Mantle

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Jupiter's moon Europa is characterized by a pervasive icy mantle underlain by a global ocean. The distribution of free water and brines within Europa's icy/watery shell and the processes within the ice that control the exchange of material both with the surface and the ocean will determine Europa's suitability for harboring life. On Earth's ice sheets, radar sounding has proven to be a powerful tool for both determining the volumetric distribution of free water/brines and understanding both ice/ocean and near-surface exchange processes. Here we review the working hypotheses for the formation and evolution of Europa's icy shell from the perspective of the implied thermal, compositional and structural horizons that can be probed electromagnetically; this is paired with an identification of a suitable terrestrial analog for each horizon. An example

of an electromagnetically probable thermal horizon on Europa would be one characterized by water (or brine) pockets lying along a eutectic at the base of cold brittle ice lying over warmer ductile ice (that is possibly convecting). Such an interface is hypothesized to lie within a few kilometers of Europa's surface. An analogous electromagnetic horizon on Earth is the boundary between polar ice and the temperate ice that lies beneath it on the glaciers of Svalbard. A compositional horizon on Europa that might be electromagnetically probed would be the ice-ocean interface beneath a simple (thermally conducting) shell that has been modified by tidal/tectonic processes. Another compositional horizon would be the boundary with accreted ice that is hypothesized to lie beneath inactive "chaotic" zones in these models. Many electromagnetic analogs for the compositional horizons in these tidal/tectonic models can be found in Antarctica's floating ice shelves and subglacial lakes. One also expects ubiquitous near-surface structural horizons associated with both transform and normal faulting in the tidally/tectonically modified models of Europa's icy mantle. The analogous electromagnetic horizons on Earth may be found in the shear margins and grounding zones of the Antarctic valley glaciers and ice streams. Our ultimate goal is to review the relevant radar studies of analogous polythermal glaciers and Antarctic ice shelves as well as to present new results from our most recent airborne radar studies of Antarctic ice stream, valley glacier and subglacial lake analogs.

P42B-08 1530h

The Surface of Titan: Arecibo Radar Observations

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The Arecibo 12.6 cm radar system was used to obtain echo spectra for Titan in late 2001 and late 2002. A circularly polarized signal was transmitted with the Arecibo 305 m antenna and the echo was received in both the OC (expected for a mirror like reflection) and SC senses of circular polarization. For most of the observations Arecibo was used to receive the echo but for one observation in 2001 and for most of the 2002 observations the new 100 m Green Bank Telescope (GBT) was also used. Arecibo's limited tracking time combined with the 2 hr 15 min round-trip-light time to the Saturn system meant that it could only receive the echo for about 30 min corresponding to 0.5 deg of Titan rotation. For echo reception with the GBT the signal-to-noise ratio is lower but the echo can be received for the full round-trip-time corresponding to over 2 deg of motion of the sub-earth point on Titan. Sixtenn spectra were obtained in 2001 at sub-earth points uniformly spaced over the full range of longitudes. The 9 Arecibo/Arecibo and 15 Arecibo/GBT observations in 2002 did not provide uniform coverage. The latitudes of the sub-earth tracks in 2001 and 2002 were 25.9S and 26.2S, respectively. Most of the echo power is contained in a broad diffuse component. However, about 70% of the spectra show a weak specular echo that varies in width and amplitude with sub-earth longitude. The disk averaged normalized radar backscatter cross section varies from about 0.12 near 270 deg to about 0.19 at 90 deg, the longitude of the high near-IR albedo feature. The errors on these values are dominated by systematic errors of about 30%. The circular polarization ratio varies from about 0.4 to 0.6. The OC cross sections as a function of sub-earth longitude correlate very strongly with the disk integrated 2 micron albedoes from Griffith et al (1998). Fits of combined diffuse and specular scattering laws to the 16 2001 spectra resulted in 12 statistically significant specular echoes with the normalized cross sections ranging from 0.007 to 0.04 and rms slopes from 0.5 deg to 3.5 deg. These values for the cross sections are generally consistent with those expected for reflections from liquid hydrocarbons. A mix of liquid ethane, methane and nitrogen at Titan's surface temperature has a dielectric constant in the range of 1.65 to 1.81 (Thompson and Squyres, 1990) corresponding to radar cross sections between 0.016 to 0.022. The measured cross sections are also consistent with reflections from a higher dielectric constant surface of which only a fraction is smooth enough to give a specular echo. References: Griffith, C.A., T. Owen, G.A. Miller and T. Geballe, Nature, 395, 575-578, 1998. Thompson, W.R. and S.W. Squyres, Icarus, 86, 336-354, 1990.

P42C MCC: 2000 Thursday 1600h

Life in the Martian Regolith, Present and Past *(joint with B, C)*

Presiding: **A P Zent,** NASA Ames Research Center**; I Friedmann,** Florida State University

P42C-01 1600h INVITED

Challenges to Life on Mars — Ecological Perspective

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This talk will address the habitability of Mars by considering major environmental challenges against the tolerance limits of microorganisms from extreme terrestrial environments including the Antarctic desert and permafrost. At the planet surface, the combination of low atmospheric pressure (below the triple point of water), high fluxes of ultraviolet radiation, and one or more powerful oxidants are likely to create sterilizing conditions that will be a barrier to the colonization and dispersal of microorganisms. In the subsurface below, long-term survival is dependent upon the frequency and duration of warm, metabolically active periods that are needed to repair cellular damages. Low temperature itself does little harm to microorganisms, but a long dormant period will accrue lethal dosages of ionizing radiation and amino acid racemization. It is probable that within the depth range of current sampling technologies, there are no conditions for extant life, leaving organic or inorganic fossils as the only legitimate target in the search for life on Mars.

P42C-02 1615h INVITED

Water bearing halites: Oases of Mars?

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Without liquid water there can be no life as we know it. This tenet focuses our search for extraterrestrial life on celestial bodies that had, or may still have, this essential substance. Searching for extraterrestrial life means selecting samples likely to protect water this requires reaching water containing perma-frosts, underground aquifers, or evaporites. Assuming one finds life similar to that on Earth how can we know it is from another planet and not contamination? This paper focuses on recent isolations of living microbes from halite that is at least 250 million years old. The presentation traces the recent data and theoretical considerations providing evidence for the age of the microbe, differences between it and modern relatives and its survival within water-bearing minerals. The evidence that evaporites may be a natural mechanism for maintaining life under adverse conditions is compelling and suggests that similar materials may be targets on Mars and elsewhere.

P42C-03 1630h INVITED

Unfrozen Water in the Martian Regolith

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The martian high-latitude, volatile-rich mantle deposit, at least locally, contains more ice than can be accounted for in undisturbed pore volume. Excess ice cannot be cold-trapped from the atmosphere; hypotheses for how excess ice might occur include burying surface ice, or post-depositional in situ processing that causes the formation segregated ice. The terrestrial record indicates that segregated ground ice occurs in a limited number of ways: outright melting and flow, or temperature-dependent suction that develops in a porous freezing soil. Implicit in the post-depositional formation of segregated ice is significant H2O mobility, and consequently, the periodic presence of substantial unfrozen water in the mantle deposit. It is possible that the mantle represents the remnants of a dusty snowbank, or frozen body of surface water. Post-depositional processing would be limited to vapor-phase dessication of the upper tens of centimeters. The correspondence between vapor-phase transport models and the observed GRS distribution of ice suggests that vapor phase transport has operated to redistribute H2O in the deposit. Wedge ice would satisfy the GRS observations, but requires relatively saturated conditions to form in the same manner terrestrial wedges form. In unsaturated soils, water responds to potentials resulting from osmotic and interfacial (matric) forces. Only in near-saturated soils are gravitational potentials strong enough to drive flow. Cryosuction is a response to negative pressure potential in wet soils, and is the dominant redistribution mechanism in unsaturated soil. Cryosuction requires unfrozen water, and effective hydraulic conductivity that allows water to be transported to the freezing front. Accurate orbital tracking through the past few million years of Mars history indicates that substantial unfrozen water might have occurred in many instances, depending upon the meteorologic response to obliquity variations.

P42C-04 1645h

The Potential for Melting of Subsurface Ice at the Phoenix Lander Latitudes in Mars' Recent Past

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The Phoenix Lander will set down on the surface of Mars in the northern plains between 65N and 75N. Odyssey's Gamma Ray Spectrometer and Neutron Spectrometer have detected large hydrogen abundances in this latitude band that are most likely due to the presence of ice within 50 cm of the surface. Here we report the results from the Ames general circulation model (GCM) on the ability of solar heating and subsurface conduction to melt these deposits. If melting did occur at some time in the past, it would make these latitudes particularly interesting for biological investigations. Melting is not possible in the present epoch because temperatures never get high enough even though surface pressures in this latitude band do exceed the triple point of water. However, about 25,000 years ago the longitude of perihelion was shifted 180 degrees such that perihelion occurred near northern summer solstice rather than northern winter solstice. Simulations of that epoch show broad regions where surface temperatures exceed 273 K enhancing the potential for melting. Indeed, surface temperatures and pressures exceed the triple point for water for as much as 90 sols of total time at some locations. A key question, of course, is whether the ice seen by Odyssey was actually present at those times and if so, at what depth below the surface. This will depend on the ability of the ice to diffuse through the soil and the water vapor content of the atmosphere. However, the short precessional time scale may limit the amount of water that can diffuse out of the soil. And the atmospheric water content will be higher with perihelion at northern summer solstice. We plan to explore these possibilities with the Ames GCM.

P42C-05 1700h

The Phoenix Scout Mission

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Phoenix will restore the 2001 lander to flight condition and select a scientic payload from instruments flown on Mars Polar Lander and delivered for the 2001 lander. Landing in May 2008 at the beginning of northern Summer, Phoenix will explore the subsurface ice layers discovered by Odyssey scientists at about 70 N latitude. Descent and panoramic imaging will reveal the small scale geology of this ice-rich region and a robotic arm will dig layer by layer beneath the surface. A German-supplied camera on the arm will examine the trench walls for stratigraphic clues to the origin of the region. Two instruments on the deck will receive samples taken from various depths from the surface to an impermeable ice layer. A thermal evolved gas analyzer (TEGA) will accept samples in one of eight ovens,