1000 AU and the Oort Cloud extending out to 100,000 AU. Interestingly, an increasing number of Scattered Kuiper Belt Objects in highly eccentric solar orbits are being detected near their perihelia with aphelia ranging out to 1000 AU, and these objects cumulatively experience different effects of space weathering in multiple heliospheric regions. The planned New Horizons and Interstellar Probe missions will further extend environmental measurements into the varying environmental domains of Pluto and the KBOs.

P52C-04 1615h INVITED

Radiation Chemical Weathering of Water-Rich Surfaces

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Water ice is known to exist on nineteen different moons of the four giant planets, and also on Plutos moon, the rings of Saturn, trans-Neptunian objects, and comets. Other condensed volatiles have also been detected on many of these objects. These solar system ices exist in a variety of radiation environments that can include magnetospheric ions and cosmic rays. To study the radiation chemical weathering of water-rich ices, we record changes in the mid-IR spectra of low-temperature thin ice films during ion bombardment. We have completed a variety of MeV proton irradiation experiments on both pure H_2O and H_2O-dominated ices containing CO_2, CO, CH_4, and NH_3. This talk will focus on the radiation chemical processes that lead to the formation of H_2O_2 (a detected radiation product on Europa, (Carlson et al. 1999)) and carbonic acid, H_2CO_3 (a candidate whose IR spectrum is similar to observed features on Callisto, (Carlson, 2001)). We will identify other radiation products that are most likely to be observed from mixtures such as $H_2O + CH_4$, $H_2O + CO$, $H_2O + NH_3$. The role of CO_2 in the formation of O_2 will also be discussed.

This research is funded through NRA 344-33-01 and 344-02-57

Carlson et al. (1999) *Science*, **283**, 2062

Carlson (2001) private communication

P52C-05 1630h INVITED

Hubble Space Telescope Observations of Europa and Ganymede

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The first ultraviolet images of the surfaces of Europa and Ganymede were made with the Hubble Space Telescope in 1999 and 2000. Both satellites exhibit atmospheric emissions produced by the interaction of plasma electrons trapped in the Jovian magnetosphere with their very tenuous oxygen atmospheres. The Ganymede emissions are clearly auroral in nature, while the oxygen emission from Europa appears to be correlated more closely with visibly bright surface regions. Both satellites exhibit very low ($\sim$ few percent) reflectivities at UV wavelengths (120-170 nm). At the wavelength of the strongest solar emission line in this wavelength range, HI Lyman-α (121.57 nm), Europa exhibits a surface reflectivity pattern that is anti-correlated in brightness with the visibly dark surface regions, and with the oxygen emission. At face value, the Europa observations imply either that the contaminant that darkens the surface at visible wavelengths has a lower reflectivity than the brighter visible regions (thought to be purer water ice), or that there is more hydrogen gas over the darker surface regions. Both explanations involve interaction of the trapped Jovian magnetospheric plasma with the surface of the satellite. The observations of Europa haev been challenging to explain, especially given the lack of UV reflectivity measurements for possible surface contaminants.

P52C-06 1645h INVITED

Radiolysis and Chemical Weathering on the Galilean Satellites

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The Galiliean satellites are bombarded by energetic particles that profoundly affect the surface composition. Reactive sulfur is implanted from the Iogenic plasma, and new chemical species are produced by radiolysis. Characteristic times for radiolytic destruction are very short compared to geological time scales, and the depth of direct radiolytic influence is about 1 mm, comparable to the depth of the optically observed layer.

Europa's radiolytic products include hydrogen peroxide and molecular oxygen, as well as a hydrated material that exhibits a strong trailing side enhancement. Carlson, Johnson, and Anderson (*Science* **286**, 97-99, 1999) identified the latter as hydrated sulfuric acid and proposed that it is part of Europa's radiolytic sulfur cycle, wherein elemental sulfur, sulfur dioxide, hydrogen sulfide, and sulfuric acid are in dynamic equilibrium between continuous production and destruction. A dark material that is spatially associated with hydrated sulfuric acid was suggested to be radiolytically produced sulfur allotropes. Sulfur dioxide was also found to be associated with the hydrate (Hendrix et al., Eurojove, 2002) and is present at levels consistent with the abundance of sulfuric acid and measured radiolysis rates (Carlson et al., *Icarus* **157**, 456-463, 2002). Ion implantation can provide the observed amount of total sulfur in just 30,000 years, suggesting that burial by impact gardening may be occurring. The variegated surface color may be due to diapiric heating of the surface, which sublimates water and preferentially concentrates lower vapor pressure sulfurous material. Any endogenic sources of sulfurous material would be rapidly assimilated into the radiolytic sulfur cycle.

Ganymede contains O_2 in its surface and atmosphere, likely produced from the radiolysis of H_2O. Both Ganymede and Callisto show CO_2 in their surfaces, and a corresponding CO_2 atmosphere has been found on Callisto. The trailing side enhancement of surficial CO_2 on Callisto suggests that charged particle impacts generate CO_2 and perhaps H_2CO_3 and C_2O_3.

P52C-07 1700h INVITED

Electron- and Vacuum Ultraviolet Photon-Induced Weathering of Outer Solar System Surfaces

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This talk will present an overview of the non-thermal processes involved in the electron- and vacuum ultraviolet (VUV) photon-induced transformation of outer solar system surfaces. An emphasis will be made on i.) Understanding the initial electronic states created during electron impact and VUV photon absorption, ii.) The subsequent energy partitioning and release of excited fragments, iii.) The reactive scattering of atomic and molecular fragments and iv.) The trapping of products. Experiments are carried out using ultrahigh vacuum surface science techniques to achieve the very low vacuum and low temperatures typical of the outer solar system. The use of tunable excitation sources, quadrupole and time-of-flight mass spectrometry and Fourier transform infrared spectroscopy allows the determination of product branching ratios and absolute cross sections as a function of energy. The specific systems discussed will be pure and mixed (CO2:H2O) low-temperature ices, frozen sulfuric acid hydrates and flash-frozen sodium and magnesium sulfate brines. The mixed ices are simple models of comets and icy grain surfaces, whereas the latter are reasonable surrogates for the non-ice material(s) present on Europa. The talk should clearly indicate the important role electronic transitions play in chemically altering surfaces present in regions within the solar system that contain magnetospheres.

P61A MCC: Hall D Saturday 0830h

Space Weathering of Solid Surfaces in the Solar System and Elsewhere II Posters *(joint with SA, SH, SM)*

Presiding: **R W Carlson,** Jet Propulsion Laboratory**; G H Jones,** Imperial College

P61A-0338 0830h POSTER

Interplanetary field enhancements - evidence of an interaction between the solar wind and interplanetary dust

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In 1980, 1983 and 1986 Pioneer Venus Orbiter detected sharply peaked magnetic disturbances lasting generally of the order of 15 minutes when Venus was downstream from the orbit of the asteroid 2201 Oljato. Events were much more frequent when Oljato was close to conjunction with Venus than when it was near aphelion. Similar events were seen at other ecliptic longitudes at 0.72 AU and at 1.0 AU by ISEE 3 and IMP 8, but none with such a tight grouping. Recently, such events have been found further from the Sun and well out of the ecliptic by the Ulysses spacecraft. Taking into account the radial expansion of the solar wind, these events agree in size, duration and occurrence rate with the early PVO, ISEE and IMP measurements. The Ulysses events too have been attributed to the interaction of the magnetized solar wind with interplanetay dust particles co-orbiting with their parent bodies. We compare the properties of the enhancements observed at quite different locations in the solar system, and discuss the possible processes that lead to their formation.

P61A-0339 0830h POSTER

The Optical Effects of Space Weathering Products on Silicate Surfaces

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The current paradigm for the optical alteration of soils due to space weathering processes involves the deposition of surface correlated nanophase iron ($npFe^0$), deposited both as a vapor from micrometeorite impacts and via solar wind sputtering. These alterations due to $npFe^0$ will effect all surfaces that contain iron-bearing minerals and are exposed to the harsh environment of space, i.e. the Moon, Mercury, asteroids. Space weathered materials containing $npFe^0$ have distinct optical properties. In addition to reducing the strength of spectral bands, space weathering adds a "characteristic continuum" to spectra that is generally darker and redder than the original material. The exact shape of this continuum, however, is dependent on both the amount and the size of the $npFe^0$ present. Miniscule amounts of $npFe^0$ ($<$ 0.1wt%) cause the spectra to become sharply curved in the visible, while leaving the near-IR relatively unaffected. As $npFe^0$ accumulates (0.2-0.4 wt%), the continuum becomes less curved and significantly redder through the entire Vis-NIR range, eventually becoming nearly linear. These effects have been observed with natural lunar soils (Noble et al, MAPS 2001). With additional $npFe^0$ the spectra darken further, progressively losing redness until finally, with $>$1.0 wt% $npFe^0$, the spectrum becomes dark and featureless. The size of the $npFe^0$ is also important to the spectral properties. Small $npFe^0$ grains cause reddening, while larger grains only result in darkening. To better constrain the size where this reddening to darkening transition occurs, we have created synthetic analogs using silica gel impregnated with various amounts of $npFe^0$. Because these gels contain defined pore sizes, we can somewhat control the size of $npFe^0$ created, allowing comparison of samples with different $npFe^0$ sizes. Initial results suggest that the transition from reddening to darkening occurs between 15 and 25 nm.

P61A-0340 0830h POSTER

Ion-irradiation of materials spectrally similar to the non-ice surface of Callisto

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The three outer satellites of Jupiter are commonly referred to as 'icy satellites', but their surfaces contain significant amount of non-ice materials and the surface of Callisto is mostly covered by a non-ice lag-deposit. The non-ice material(s) on Ganymede and Callisto contain volatiles including CO_2 and SO_2. The distribution of CO_2 and SO_2 on Callisto demonstrate clear, but separate, relationships with the bombardment of the surface by energetic particles trapped in the Jovian magnetosphere. We attempt to explain the presence of these volatiles in the non-ice material on Callisto by irradiating pellets of powered minerals and mixtures that are spectrally similar to the non-ice material on the surface of Callisto (implying a compositional similarity). Pellets of phyllosilicates, palagonite, and mixtures of the minerals with carbon (used as a spectrally neutral darkening agent) were irradiated with singly- and doubly-charged approx. 1 MeV oxygen and sulfur ions. Heating, outgasing of trapped atmospheric gases, and possible production of new gases result from the irradiation. Bombardment by singly-charged oxygen ions heat the pellets samples more than bombardment by doubly-charged oxygen ions. Heating is greater in carbon-bearing samples than in carbon-free samples. A palagonite/carbon mixture heats and outgases more under bombardment than a phyllosilicate/carbon mixture. We are currently exploring the cause of the different heating and are determining if volatiles (not just trapped atmospheric gases) are produced during bombardment.

P61A-0341 0830h POSTER

Modeling Amorphization of Crystalline Water Ice on Europa, Ganymede, and Callisto

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We have used the collision cascade program MARLOWE to simulate radiation damage of crystalline water ice on the surfaces of Callisto, Europa, and Ganymede. The conversion of crystalline water ice to its amorphous phase by UV and ion radiation has been well studied [1], [2]. This amorphization process is countered by temperature dependent crystallization. We have previously modeled amorphization of water in the Kuiper Belt where the crystallization process is negligible [3], [4]. We then modeled the amorphization process on the icy Galilean satellites, however, the model failed at timescales over 10000 seconds [5]. We have changed the model to run at long timescales for this meeting. We have also implemented a transformation method to randomize the initial energies of ions. We plan to run simulations with Hydrogen, Oxygen and Sulfur ions to determine the extent of damage and how it compares with the rate of crystallization.

[1] Kouchi, A. and T. Kuroda, Nature, 1990. 344: 134. [2] Strazzulla, G., et al., JGR, 1991. 96(E2): 17547. [3] Mastrapa, R.M.E. and R.H. Brown, LPSC #32 #1381, 2001. [4] Mastrapa, R.M.E. and R.H. Brown, DPS #33 #08.07, 2001. [5] Mastrapa, R.M.E. and R.H. Brown, LPSC #33 #1111, 2002.

P61A-0342 0830h POSTER

Gas-Surface Chemical Exchange in the Near-surface Atmosphere of Europa

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The very tenuous O_2 atmosphere of Europa is a near-surface (or surface-bounded) atmosphere [1]. It is produced by the radiolysis of Europa's surface due to exposure to solar ultraviolet radiation and energetic magnetospheric plasma ions and electrons. Earlier we developed a collisional Monte Carlo model of Europa's atmosphere [2] accounting for adsorption, thermalization and re-emission of condensed O_2, a stable decomposition product of H_2O radiolysis. Dissociation and ionization by magnetospheric electron and solar UV-photon impact, and collisional ejection from the atmosphere by the low energy plasma were also taken into account. It was found that to account for the production of oxygen emission observed by HST [3] larger surface fluxes of O_2 are required than those assumed in earlier work from measured fluxes of magnetospheric particles [4]. This has since been shown to be due to the fact that radiolysis is occurring in a regolith and not on a laboratory surface [5].

In this report we present the results of an expanded Monte Carlo model of Europa's atmosphere. In this model the sublimation and sputtering sources of H_2O molecules and their molecular fragments are also included. Therefore, we account for water and oxygen photochemistry in the near surface atmospheric region and for adsorption-desorption of radiolytic water products onto the satellite surface. This expanded model allowed us to emphasize the important role of chemical exchange in the atmosphere-surface interface of Europa. The numerical modeling of chemical composition in both the near-surface gas-phase boundary region and the satellite surface provides a more complete accounting of the chemical pathways occurring in the icy satellite surface material following decomposition by the solar ultraviolet radiation and the energetic magnetospheric plasma. The model will eventually be expanded to include the effect of the release of trace amounts of SO_2 and CO_2 that are trapped in the surface ice.

[1] Johnson, R.E., 2002, in Atmospheres in the Solar System: Comparative Aeronomy Geophy. Mono. AGU, p. 203. [2] Shematovich and Johnson, 2001, Adv. Space Res., v.27, 1881. [3] Hall et al., 1998, Astrophys. J., v.499, 475. [4] Cooper et al., 2001, Icarus, v.149, 133. [5] Johnson et al., 2003, In Jupiter: Satellites, Atmosphere, Magnetosphere. Ed. by F. Bagenal, Univ. of Arizona Press, 2003.

P61A-0343 0830h POSTER

Space Weathering of Leonid Shower Meteoroids

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When comets are exposed to solar radiation, they emit dust particles that rapidly disperse in the interplanetary medium. There, they experience weathering due to heating and cooling cycles, solar wind implantation, and collisions. The result is to facilitate breakup of the grains, make the remaining units more (or less) cohesive, and change the volatile element contribution (sodium containing minerals and organics). The breakup of grains is evident in the presence of meteor clusters during meteor showers. Spectacular examples have recently been detected during Leonid storms. These are particularly interesting for understanding space weathering of solid surfaces, because the epoch of ejection of the grains and the duration of exposure to the interplanetary medium is known. All are from very recent returns of the parent comet to perihelion. In addition, the sputtering of meteoroids by air molecules during entry in the Earth's atmosphere may be a usefull analog in understanding the source of the sodium atmosphere of the Moon and Mercury. In certain conditions, an early release of sodium is observed. Results from NASA's Leonid Multi-Instrument Aircraft Campaign (Leonid MAC) and ground based Leonid storm observations will be discussed in this context. First results from the recent November 2002 Leonid MAC mission will be shown.

URL: http://leonid.arc.nasa.gov

P61A-0344 0830h POSTER

Erosion of Hydrocarbons from a Carbon Substrate

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Energetic electrons and ions, UV photon and cosmic ray ions can induce desorption of molecules from surfaces [1] including whole organic molecules [2]. This is important in a number of solar system scenarios, from interplanetary grains to meteors and comets. Experiments detecting the ejected neutrals are generally difficult and the amount of useful available data is small. New advances in simulation techniques allow a reasonable representation of organic materials and, therefore, can give insight into desorption mechanisms. We have simulated the desorption from a relatively simple model system: a small hydrocarbon molecule absorbed on amorphous hydrogenated C. This can be representative of desorption from surfaces which are electrical insulators which occurs in response to electronic excitations produced by the incident radiation. We performed classical MD simulations using the Brenner potential, a bond-order potential where "chemistry" is roughly taken into account. As the electronic excitations relax, the lattice is rapidly and locally heated and the absorbed molecule is vibrationally excited. Therefore, we either rapidly heating the substrate or directly add kinetic energy to the hydrocarbon atoms in the adsorbed molecule which can cause expansion in the size of the molecule [3]. In order to validate the second scheme quantum molecular dynamics simulations were carried out, using a non-adiabatic tight binding code that allows the introduction of electromagnetic fields to simulate photon bombardment [4]. The non-adiabaticity of this code takes into account excited states in the electronic configuration. The configuration of the system after few ps can be taken as the initial condition for the classical calculation and the system can be followed during much longer times, using realistic excitation modes. Results will be given that can be applied to the efficiency of ejection of organics from solar system surfaces by energetic ions.

[1] E.M. Bringa and R.E. Johnson, 2002, Astrophys. J. in press.

[2] R.E. Johnson, R.M. Killen, J.H. Waite, W.S. Lewis, Geophys. Res. Letts. 25, 3257 (1998).

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[4] B. Torralva et. al., Phys. Rev. B 64,153105 (2001).

The work of E.M.B. and B.T. was performed under the auspices of the U.S. Department of Energy and Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48

URL: http://dirac.ms.virginia.edu/~emb3t/grains/grains.html

P61A-0345 0830h POSTER

Surface-Plasma-Photon Interactions and Sputtered Atmosphere of Asteroidal Objects

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After its first detection by Piazzi of Palermo on January 1, 1801 and the later orbital determination by Gauss of Goettingen in the same year, a space mission has finally been planned to study the largest asteroid, 1 Ceres, at the dawn of the 21st Century. This mission which is appropriately named "DAWN" will provide comprehensive surface mapping of the geological structures and mineralogical properties of this important planetary body of primitive nature. In spite of its relatively small size (diameter = 914 km), Ceres could have a very complex formation history and physical structure. For example, its solar wind interaction could be analogous to that of Mercury in case of the existence of an intrinsic magnetic dipole of significant magnitude. Futhermore, because of its large distance from the Sun, we expect that polar caps of water and perhaps also carbon dioxide ice will exist on Ceres. The extension of the ice caps will depend on the thermal sublimation process and the surface sputtering effects by solar wind protons and solar radiation. In this work, we will assess the possible ice coverage on the surface of Ceres as a function of latitude and the associated volatile transport process. From a consideration similar to the modelling of the sodium atmospheres of Mercury and the Moon, we will present preliminary results on the size and structure of the sodium corona of Ceres created by particle sputtering and meteoroid impact. On this basis, we will provide predictions of several possible scenarios of surface weathering and erosion effects at Ceres.

P61A-0346 0830h INVITED POSTER

Radiation Chemical and Photochemical Weathering: Going Beyond Water-Ice Chemistry

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Although H_2O is certainly the most common ice material in the Solar System, other molecules are present and of interest. Our laboratory work has shown that space weathering, by vacuum-UV photons and MeV ions, will result in a very rich chemistry among known ice components, such as H_2O, N_2, CO, and CH_4. Acid-base reactions, electron transfer, and free-radical chemistry will all play a role in transforming icy surfaces into active regions of organic and pre-biological chemistry. In this presentation I will review some of our recent results concerning the radiation chemistry and photochemistry of known ice molecules, emphasizing organic materials as opposed to H_2O-dominated chemistry. Comparisons will be made among known surface ices and a few predictions of new molecules and ions will be made. Similarities in chemical reactions among families of molecules will be presented. Finally, some suggestions will be made for data needed to better understand the nature and extent of weathering and its role in astrobiology.

P61B MCC: Hall D Saturday 0830h

Fundamental Discoveries in Planetary Science: The Color of Worlds II Posters *(joint with V)*

Presiding: **C R Chapman,** Southwest Research Institute**; J M Sunshine,** Science Application International Corporation

P61B-0347 0830h POSTER

Dawn Discovery Mission: A Journey to the Beginning of the Solar System

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In December 2001, NASA announced the selection of the Dawn mission to Vesta and Ceres as the next mission to be undertaken in the Discovery series. Dawn examines the role of size and water content in planetary evolution, contrasting the primitive and apparently wet protoplanet, Ceres, with its dry and highly evolved neighbor, Vesta. Dawn maps the surface in visible and infrared wavelengths to determine its mineralogical composition and crustal properties, uses gamma ray and neutron spectroscopy to determine its elemental composition and magnetometry and radio science to probe the interior and laser altimetry to provide precise topography. Dawn is a partnership between UCLA, representing the science team members, the Jet Propulsion Laboratory, Orbital Sciences Corporation, the German Aerospace Center, DLR and the Italian Institute for Space Astrophysics, IAS. The mission uses ion propulsion to fly to Vesta, orbit it at a variety of altitudes for close to a year, leave Vesta orbit, fly to Ceres and orbit it similarly. The spacecraft carries a framing camera provided by DLR's Institute of Space Sensor Technology and Planetary Exploration in Berlin; a mapping spectrometer provided by the Istituto di Astrofisica Spaziale in Roma, a gamma ray and neutron spectrometer provided by the Los Alamos National Laboratory, a laser altimeter provided by NASA's Goddard Space Flight Center and a magnetometer provided by UCLA. This paper summarizes the mission goals, and the trajectory, orbits, and instruments that enable the mission to attain those goals.

P61B-0348 0830h POSTER

Searching for Evidence of Aqueous Processes on Mars Through Spectral Identification of Alteration Minerals

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The surface mineralogy on Mars holds information about the environmental and geochemical records on that planet and may provide clues to past aqueous processes there. Analysis of the kind of chemical alteration that has taken place on Mars provides insights into major climate and environmental factors such as when and how much water was present on the surface of Mars. Surface images taken by Odyssey-THEMIS and MGS-MOC have introduced the possibility that aqueous processes have occurred in recent martian history and evidence from GRS on Odyssey for H2O-ice and/or hydrated minerals supports this as well. However, little evidence for alteration minerals on Mars is available from the spectral images to date. Work is underway in the lab and in the field in order to characterize the spectral properties and formation conditions of these minerals in volcanic and hydrothermal sources on Earth so that these minerals may be revealed in future spectral datasets of Mars if present. Determining whether or not hydrated iron oxides and sheet silicates are present in the dust on Mars is important for assessing potential aqueous and hydrothermal processes that may have occurred there. Sheet silicates and hydrated iron oxides typically require water for formation and specific sheet silicates are favored depending on the degree of moisture, temperature and other conditions. These minerals are frequently observed in altered volcanic material and hydrothermal springs on the Earth and would be expected on Mars if water was present. The motivation for this study is to gain information about possible aqueous processes on Mars through analysis of the chemical alteration that has taken place there. Identification of aqueous alteration on Mars would imply the presence of water and, thus, would have important implications for astrobiology, climate, and geoscience on Mars.

P61B-0349 0830h POSTER

The Lunar Crash of 1953: A Crater is Identified

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In 1953 an amateur astronomer observed and photographed a flash on the Moon (Stuart, 1956). This event is the only unambiguous record of the rare crash of an asteroid-sized body onto the lunar surface. We estimate that the energy of the event was about 0.5 megatons, resulting in a 1-2 km sized impact feature, and that the radius of the impacting body was about 20 m. Such an event occurs every 10-50 years. Although below the resolution limit of ground-based telescopes, this crater should be visible on space-based images of the Moon obtained by the Lunar Orbiter and Clementine missions. A search of images from the Clementine mission reveals a 1.5 km feature with a high-albedo, blue, fresh-appearing ejecta blanket at the location of the flash. Spectral analysis of the crater reveals it to be bluer and fresher than other young craters. Our results suggest that the effects of space weathering occur rapidly on the Moon.

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Stuart, L. (1956). The Strolling Astronomer. Vol 10, 42-43.

P61C MCC: Hall D Saturday 0830h

Planetary Atmospheres Posters *(joint with A)*

Presiding: **A Toigo,** Cornell University**; D A Brain,** Laboratory for Atmospheric and Space Physics, University of Colorado

P61C-0350 0830h POSTER

Fractionation of the Early Terrestrial Atmospheres: Dynamical Escape

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Hydrodynamic escape may have played a significant role in the early fractionation of the atmospheres of the terrestrial planets. This possibility has been demonstrated in the last two decades by numerous models that show radial, transonic flow of hydrogen can occur in the presence of sufficient solar EUV flux, thought to exist in the first few 100 Myr. The models show that the larger the solar flux the greater the mass of the fractionating species, which are accelerated to escape speeds by the hydrogen wind through drag processes. As the atmospheres evolve and the solar EUV flux wanes, the maximum mass of flowing gas constituents decreases until all gases become static. We show that fractionation can continue beyond this point when non-radial flow and dynamically enhanced Jeans escape are considered. For example, the early terrestrial atmospheres are thought to have had large hydrogen contents, resulting in exobase altitudes of a planetary radius or more. In this case, rotational speeds at the exobases of Earth and Mars would be large enough for light constituents to "spin" off and fractionate, especially at equatorial latitudes. Also, in the presence of transonic flow of hydrogen only, non-radial expansion throws heavier gases to high altitudes in the exosphere, accompanied by strong bulk speeds at the exobase, which results in enhanced thermal escape fluxes and fractionation.

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P61C-0351 0830h POSTER

A Cold Jovian Arctic Polar Vortex: Evidence from Infrared Imaging

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A prominent cold arctic airmass in Jupiter is revealed by thermal images taken at NASA's Infrared Telescope Facility (IRTF) during Jupiter's northern summer in 1999. This cold airmass is well defined by a sharp 4-degree thermal gradient in both the stratosphere and the upper troposphere and tropopause regions. The latitude boundary of the cold airmass oscillates in longitude with principal wavenumber 5–6. This longitudinal oscillation is coincident with the oscillation of the boundary of the thick polar hood that is detectable in reflected sunlight that is sensitive to particles around Jupiter's tropopause ($\sim$100 mbar pressure), using IRTF 2.3-μm and HST WFPC2 890-nm images. The sinusoidal boundaries slowly rotate prograde with respect to the interior. The proximity and similarity of the thermal and particle boundaries suggests that the phenomenon is a classical polar vortex of the same type as seen in the Earth's antarctic. Testing of possible gaseous entrainment within the vortex' area would verify or refute similarities with polar vortices in the Earth, Venus, Mars and possibly Titan. This phenomenon is relevant to studies of terrestrial meteorology by measuring the extent to which stratospheric phenomena can drive tropospheric properties. Detailed