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**Introduction:** We evaluate the tidal disruption of planetary embryos from dynamical, geophysical and meteoritical perspectives. It is widely believed that the present population of asteroids (and thus most meteorites) derive from material that survived intense (99.9%) mass depletion in the protoplanetary disk between Earth and Jupiter. According to this scenario, about one in a thousand bodies survived scattering, close encounters and mergers to become the ancestors of the present main belt and the precursors of meteorites. Close tidal encounters were inevitable, because a deep Roche encounter *near* a growing planet is about as likely as accretion *onto* the same planet. **Process and Implications:** This "long march" took its toll on the survivors, which begat the present asteroids and meteorites. Specifically, for very weak bodies (rubble piles, or those with deep regolith) and for gravity-dominated bodies with viscosity less than ($\nu_{lim} \sim \sqrt{G}\rho^{3/2}R^2\ 10^{11}$ poise for 100 km radius), an encounter with periapsis $< 0.5R_{roche}$ results in catastrophic removal of half the original mass [1]. Even partially molten silicate bodies have sufficiently low viscosity to undergo disruptive tidal deformation. Abundant mantle water at this early phase lowers viscosity and enhances disruption energetics. Our dynamical calculations show that a few percent of the surviving primordial asteroids underwent catastrophic tidal disruption during encounters with the transitory main-belt embryos [c.f. 2], if a majority were either partially molten or rubble piles during the first 3 Ma. Melting and differentiation of asteroid parent bodies took place during this time [3], so planetary mantles may have been tidally stripped in a process that may have been as common as giant collisions. Tidal disruption produces a symmetric chain of fragments. In models of tidal disruption [1], differentiated bodies pull apart into one or more central cores almost devoid of mantle rock, flanked by core-free bodies of diminishing size away from the center. The process need only occur a few times to resolve dilemmas associated with iron and stony-iron meteorites and their parent bodies. **Thermodynamics:** Tidal disruption induces pressure-release melting and brings core and mantle material into sudden close association across wide surface area. Silicate and iron mix as the core and deep mantle are brought, in the course of hours, to low pressure. Melts degas abruptly and generate turbulence. The shock-free disruption and mixing of parent materials can explain highly varying cooling rates within a single meteorite taxonomic type, and mantle-removal of classic M-type asteroids such as Psyche and Kleopatra without invoking intense impact bombardment that would have easily removed Vesta's crust. We also contemplate a planetary precursor phase where accretion and gravitational equilibrium are sporadically upset by pressure release events and violent degassing. **References:** [1] Asphaug, E. and W. Benz 1996, Icarus 121, 225-248. [2] Morbidelli, A. et al. 2000, MAPS 35, 1309-1320. [3] Keil, K. 2000, P&SS 48, 887-903.

### P51F-05 1120h

## Are Giant Planet Satellites Mini-solar Systems?

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The regular satellites of Jupiter and Saturn exhibit a number of characteristics strongly suggestive of formation in a thin (aspect ratio $H/r \sim 0.1$) circumplanetary gas disk (Mosqueira and Estrada 2003a). Also, the mass ratio of the largest satellites to the primary $\mu \sim 10^{-4}$ lead one to think of these satellite systems as scaled-down solar systems. Yet, the larger mass ratio for the giant planets to the primary $\mu \sim 10^{-3}$ appears to limit the usefulness of the planet-satellite analogy. If gap-opening determines the final size of at least Jupiter (Lin and Papaloizou 1993), then significantly smaller objects would be unable to truncate the disk. There are, however, at least two significant difficulties with this point of view. First, the non-linear or thermal gap-opening criterion (Lin and Papaloizou 1993) does not yield a Jupiter mass. Second, the migration timescale due to planet-disk interactions (Ward 1997) is too fast for the formation of giant planets through the core accretion process (Pollack et. al 1996) despite recent work which has lengthened it by up to an order of magnitude (Tanaka et al. 2002, D'Angelo et al. 2002, Bate et al. 2003). An alternative viewpoint has accretion taking place in a weakly turbulent disk, and the survival of both planets and satellites a direct consequence of gap-opening. In this view at least the largest satellites (Mosqueira and Estrada 2003b) and planetary cores ($\sim 10M_{\oplus}$; Rafikov 2002) were able to open gaps in the disk. However, because the waves launched by such pertubers do not become non-linear immediately, the gap begins to form a distance away from the perturber given by the shocking length of acoustic waves (Goodman and Rafikov 2001; Rafikov 2002). Estrada and Mosqueira (2003) have suggested that the annulus of material adjacent to the proto-planet that immediately precedes the runaway gas accretion phase (Pollack et al. 1996) can be used to provide the mass needed to lead to the formation of a giant planet. If so, the dilemma posed by Type I migration (Ward 1997) is mitigated, and the analogy between satellites and planets gains currency. It is possible to argue that an alternative solution to this issue may involve lowering the migration rate even further, but one should keep in mind that slower migration might allow even smaller objects to open gaps. Here we look into the issues raised by this annulus of material in the satellite context, and argue that it may not prevent satellite survival. This work was supported by a NASA PGG grant and the NRC.

### P51F-06 1135h

## Constraints on the Galilean protosatellite disk from Jupiter's obliquity

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The obliquity of Jupiter is only 3 degrees. Although a small obliquity seems consistent with its gas accretion phase, there are processes that could have altered it after its formation. The current spin axis precession period of Jupiter is $\sim 4.5\langle 10^5$ years due mostly to the solar torque exerted on the Galilean satellites (*e.g.,* Ward 1975; Harris and Ward 1982; Tremaine 1991). However, this would have been up to $\sim O(10^2)$ shorter if a minimum mass pre-satellite disk had been present. If this disk were subsequently photoevaporated after the solar nebula itself was dissipated, Jupiter's precession frequency would have drifted through one of the mutual orbital precession frequencies of Jupiter and Saturn, *i.e.,* the so-called $\nu_{16}$ that describes the precession of their orbital nodes with a period of $P_{16} \sim 5\langle 10^4$ years. An adiabatic passage could generate an obliquity of 25.6 degrees (*e.g.,* Henrard and Murigande 1987). This could be avoided if passage is fast enough to be non-adiabatic, in which case the final obliquity is rate dependent (*i.e.,* Ward *et al.* 1976). If $\alpha_S$ denotes the spin axis precession parameter, which is a function of the circumplanetary disk and satellite masses in addition to the Jovian oblateness (*e.g.,* Ward 1975), and we define $\Omega_{pole}\{\Delta_S/\Delta_S$ and calculate its value to yield an obliquity comparable to Jupiter's current obliquity, we obtain $O(10^5)$ years. But since the change in $\alpha_S$ would be due primarily to dissipation of the protosatellite disk, we conclude that a disk life much longer than this is not consistent with Jupiter's low obliquity spin state. Alternatively, the pre-satellite disk may have been of insufficient mass to cause passage through the Jupiter-Saturn resonance (*e.g.,* Canup & Ward 2002).

### P51F-07 1150h

## Accretion of the Galilean Satellites

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We consider a scenario in which the Galilean satellites form within a circumplanetary accretion disk produced during the end stages of gas accretion onto Jupiter. In Canup and Ward (2002), we identified disk conditions compatible with three main constraints on satellite formation: 1) disk temperatures low enough for ices in the general region of Ganymede and Callisto, 2) satellite accretion times of $10^5$ years or more for consistency with an incompletely differentiated Callisto, and 3) satellite survival against inward orbital decay due to disk density wave torques. We found that such conditions can be simultaneously satisfied in a disk produced by a very slow inflow of gas and solids to Jupiter, with an implied rate of inflow during the satellite formation era of less than a Jovian mass per five million years. A similarly slow inflow rate is implied by the requirement that Jupiter had contracted to a radius smaller than the orbits of the Galilean satellites by the time of their formation (Magni and Coradini 2003). A slow inflow rate yields a much lower steady-state gas surface density than is implied by augmenting the mass of the current satellites to solar composition as has been done previously, and instead yields a "gas-starved" protosatellite disk. This implies that satellite accretion occurred in a relatively gas-free environment, and at a rate regulated by the inflow rather than by the local orbital period. Here we consider the ramifications of this gas-starved disk model for the accretional histories of the Galilean satellites, including implications for their individual growth times, and impact and migration histories.

### P51F-08 1205h

## ESTIMATING THE EFFECTIVENESS OF COSMIC RECYCLING IN THE HISTORY OF PLANETARY RINGS AND RING MOONS

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Strong evidence implies that small moons near the giant planets, like the asteroids they resemble, are best described as piles of rubble. These re-constituted small bodies are the source of material for planetary rings. Previous calculations by Colwell and Esposito show the short lifetimes for such moons imply that we are nearly at the end of the age of rings. Does this philosophically unappealing result truly describe our solar system and the rings that may surround giant extra-solar planets? Calculations from a Markov chain model explicate how inclusion of recycling can lengthen the lifetime of rings and moons. Non-linear effects not previously considered are also important. We apply our results to Saturn's F ring and to Neptune's ring arcs.

# P52A MCC: Level 1 Friday 1330h

## Impact Cratering Posters

*Presiding:* **D H Abbott,** Lamont-Doherty Earth Observatory; **B A Karlow,** Lawrence Livermore National Laboratory

### P52A-0471 1330h POSTER

## MARID Suite Minerals in Ejecta Layer from Ewing Crater (Core PLDS-111P) in the Central Equatorial Pacific

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The Ewing crater is a 150 km diameter impact crater located between the Clarion and Clipperton fracture zones in the central equatorial Pacific about 10 degrees east of the longitude of Hawaii. The crater is early part of the late Miocene in age (7-11 Ma). The typical excavation depth of impact craters is about 1/10th of their diameter. Thus, the Ewing crater should have excavated down to 15 km, well below the oceanic Moho at 6 to 7 km depth. We test the impact origin of the Ewing crater by looking at the composition, morphology, and X-ray diffraction characteristics of minerals in the top part of core PLDS-111P. These minerals appear with abundant impact spherules and microtektites, at least 40 total in a 6-gram sample. We found high Ti amphibole with etching on the ends of the crystals. Etching of crystal terminations is characteristic of placer deposits and impact deposits. High Ti amphibole is characteristic of the MARID suite (Mica (Phlogopite)-Amphibole-Rutile - Ilmenite-Diopside). We have also found phologopitic mica, ilmenite and diopside in our sample. We did not find rutile, but rutile can be absent in the MARID suite. We have also found zircon and apatite, both of which are accessory minerals of the MARID suite. The MARID suite is confined to areas where the mantle has been heavily metasomatized. Previously documented occurrences of the MARID suite are from kimberlites and veins in metasomatized periodotites. Because the oceanic crust beneath the Ewing crater is Eocene (34-55 Ma) in age, kimberlites are unlikely to form. The most likely alternative is that the MARID suite minerals are from mantle that was metasomatized by normal processes of hydrothermal alteration within the oceanic plate. This metasomatized material was brought to the surface by excavation of the suboceanic mantle during the impact of the bolide that formed the Ewing crater. The impact hypothesis is supported by microcraters (10 to15 microns in diameter) found in phlgopite and ilmenite, similar to ones on surfaces of associated microtektites.

## P52A-0472 1330h POSTER

### The Ewing Impact Structure: Progress Report

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We have previously reported on the discovery of the Ewing impact structure. It is 150 km in diameter and is located in the equatorial Pacific between the Clarion and Clipperton fracture zones. We have now mapped the distribution of microtektites and other types of impact spherules. The microtektite bearing cores form a half circle to the south with a straight edge that passes through the center of the crater. This pattern of tektite distribution matches the pattern that has been modeled for deep-water impacts. The impact melt bodies that are the source of the magnetic anomalies associated with the crater also lie in the southern half of the crater. Thus, the overall pattern of microtektite and impact melt distribution is consistent with an impactor on an inclined trajectory that arrived from the north and sprayed ejecta to the south. We have found an impact melt bomb that is part of the distal ejecta blanket. The impact melt bomb is about 10 cm by 6 cm in size. It contains unmelted marine sediment in the center that is surrounded by impact melt glass. So far, attempts to date glassy spherules and impact melt glass have been unsuccessful. Thus, our best estimate of the age of the impact is derived from diatom biostratigraphy, which gives an age of 7 to 11 Ma. In this time period, there are three major climatic excursions that might be related to the Ewing impact event. In most of the region, the 5000-meter water depth precludes using the more numerous foraminiferal zones and oxygen isotope stratigraphy to more precisely date the ejecta layer. Detailed studies of the mineralogy of the ejecta layer in core PLDS-111P have failed to find any quartz at all, shocked or unshocked. However, this core received its ejecta from the southern half of the crater, where the pre-impact basement was composed of normal oceanic crust. To the north, a minor fracture zone cuts the crater. This fracture zone is a potential location of plagiogranites, which are quartz normative. The fracture zone also contains local topographic highs that are shallow enough to retain foraminifera. By concentrating our efforts on carbonate rich cores that sample the ejecta from the northern half of the crater on or near the fracture zone, we hope to determine a more accurate biostratigraphic age for the Ewing impact event. We will also examine the mineralogy of these samples to see if quartz or opaque minerals are present. Both quartz and some opaques can show characteristic shock deformation features.

## P52A-0473 1330h POSTER

### Accretion of Cometary Material as a Function of Impact Angle

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It has been proposed that comets provided the raw ingredients for life during the first billion years of our planet's history. To investigate this possibility, we simulated comet-Earth impacts at a variety of impact angles. Our goal was to determine the mass fraction of material that would be likely to survive a terrestrial impact and come to rest as an isolated pond of water. We employed the Eulerian adaptive mesh refinement (AMR) code, GEODYN, in a 2-D, Cartesian (plane-strain) system. In the calculations, the impactors were modeled as solid-ice comets 1 km in diameter impacting into granite at escape velocity (11.2 km/s). The simulations were computed to a time of 2 seconds, long enough for multiple reverberations of the compression and rarefaction waves to propagate through the comet. Thermomechanical variables relevant to assessing comet conditions during the impact event were monitored at 1000 evenly distributed locations throughout the comet. At each location, the magnitude and orientation of the particle velocity vector were used to determine the fraction of comet mass that escapes Earth's gravity during the impact event. Pressure, density and temperature were also monitored to assess the survivability of organic matter distributed thoughout the comet. We determined that the fraction of comet mass that escapes Earth's gravity is not a simple monotonic function of impact angle. For example, the 15° impact showed the least accretion (61%) and the 90° impact had total accretion, but the 10° impact retained significantly more mass (at 71%) than the 15° impact. We also found that a significant amount of the comet experiences low peak temperatures; this was somewhat surprising given that the Earth target was a granitic hard rock. Approximately 80% (or 3x108kg) of the 10° impactor experienced temperatures between 250-350°C and corresponding pressures of 4.5-8.2 GPa. If the organic matter present in comets experienced similar conditions, we would expect it to survive with little deleterious alteration. We will consider the dispersion and final aerial distribution of our comet impactors. We will present our results using the phase diagram for $H_2O$ and experimental data from hypervelocity impact experiments. This work was performed under the auspices of the U.S. Department of Energy by University of California Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

## P52A-0474 1330h POSTER

### Ablation process of the 1999 Kobe meteorite inferred from shockwave data

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Fireballs or meteoroids passing through the atmosphere with high velocities generate strong shockwaves. The shockwaves are often detected by ground instruments such as a seismometer. The seismological records provide two kinds of information, the shockwave arrival time and the amplitude of the ground motion generated by the shockwave at each seismic station. The shockwave arrival time data enable us to determine the trajectories of the fireballs. For example, Ishihara *et al.* (2003) determined the trajectory of the 1998 Miyako fireball using the arrival times. In this report, we show that the amplitude data are also useful to study fireball phenomena. The amplitude of the shockwave depends on the energy release rate or the reduction rate of the mass and velocity of the fireball. Therefore, it is expected that the amplitude data can be used to study the ablation process of a meteoroid in the atmosphere. We investigate the ablation process of the 1999 Kobe meteorite using the seismological records. The amplitudes of the ground motions are converted to the amplitudes of the atmospheric shockwaves using a conversion formula given by an experiment and a theoretical consideration (Ben-Menahem and Singh, 1981). The obtained amplitudes of the shockwaves on the ground are in a pressure range from 1 to 30Pa. The shockwave amplitudes and representative source dimensions at the sources in the upper atmosphere, whose locations have been determined by the analysis of the arrival times of the shockwaves (Ishihara *et al.*, 2001), are calculated by the formula of ReVelle (1976). Then we estimate the radius of the meteorite, adopting a relation R=Md, where R is the representative dimension, d is the radius, and M is the Mach number of the meteorite motion. The results show that the diameter of the Kobe meteorite has changed from $\sim$ 2 m at 70 km to $\sim$ 0.7m at 30 km and that at 30 $\sim$ 25 km the size has rapidly decreased. This rapid size change is caused by a fragmentation of the meteoroid.

## P52A-0475 1330h POSTER

### Reconstructing the Shock Wave From the Wolfe Creek Meteorite Impact.

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The Wolfe Creek meteorite crater is an 800m diameter impact structure located in the Tanami Desert near Hall's Creek, Western Australia. The crater formed <300000 years ago, and is the 2nd largest crater from which fragments of the impacting meteorite (a medium octahedrite) have been recovered. We present the results of new ground based geophysical (magnetics and gravity) surveys conducted over the structure in July-August, 2003. The results highlight the simple structure of the crater under the infilling sediments, and track the extent of deformation and the ejecta blanket under the encroaching sanddunes. The variations in the dip of the foliations around the crater rim confirm that the crater approached from East-Northeast, as deduced from the ejecta distribution, and provide constraints on the kinetic energy and angle of the impactor. We also use the distribution of shocked quartz in the target rock (Devonian sandstones) to reconstruct the shock loading conditions of the impact using the Grieve and Robertson (1976) criterion. We also use a Simplified Arbitrary Langrangian-Eulerian hydrocode (SALE 2) to simulate the propagation of shock waves through a material described by a Tillotson equation of state. Using the deformational and PT constraints of the Wolfe-Creek crater, we can estimate the partitioning of kinetic energy as a result of this medium-size impact.

## P52A-0476 1330h POSTER

### The Seismic Effect of Impacts on Asteroids: Early Modeling Results

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Crater counts made from the NEAR spacecraft images of the asteroid 433 Eros have revealed a paucity of small craters on this small body. Seismic shaking from impacts has been cited as a potential means of small crater erasure, and we present early results from mathematical, hydrocode, and seismic waveform modeling used to investigate this hypothesis. The seismic effects of an impact on a small body can be divided into two categories: (1) surface shaking due to the passage of discrete seismic pulses shortly after impact, and (2) surface shaking due to reverberations following the dispersion of seismic energy throughout the body. Seismic pulse effects are magnified due to the very low surface gravity of these bodies, with relatively small impacts having global seismic effects. An impact producing a 1 km diameter crater on a 20 km diameter asteroid will generate surface accelerations of over 10 g (where g is the asteroid's surface gravitational acceleration) out to an angular radius of 50 deg from the impact site, more than 2 g accelerations over the remaining surface of the asteroid, with a secondary peak of 2-10 g accelerations near the antipode of the impact. In addition, due to their small size and potentially high seismic quality factors ($Q > 3000$, based upon the lunar seismic data), asteroids can experience seismic reverberations lasting for several minutes following an impact. These reverberations will cause additional surface shaking, primarily at the peak frequencies injected by the impact (1-200 Hz). Impacts which produce craters in the 0.1-1 km diameter range on a 20 km diameter asteroid are able to generate reverberations of better than 1 g vertical acceleration over the entire surface. This secondary shaking may thus contribute strongly to modification of the surface topography.

## P52A-0477 1330h POSTER

### Numerical Modeling of the Impact-Induced Hydrothermal System at Sudbury Crater

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An understanding of impact-generated hydrothermal systems is crucial for deciphering the environment on early Earth and Mars, as well as predicting promising locations for finding evidence of past life on Mars. Impact events and early life may be tightly connected – a sudden increase in the number of impact events which occurred at $\sim$3.9 Ga coincides remarkably well with the earliest isotopic evidence of life on Earth at $\sim$3.85 Ga, and hydrothermal systems generated by impact events can provide a habitable environment for thermophilic organisms. Several hydrothermal systems associated with terrestrial impact craters have been identified on the basis of mineralogical evidence. Examples of known systems include the 35 km Manson crater, the

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80 km Puchezh-Katunki crater, and the 250 km Sudbury crater. In order to better constrain the expected lifetimes of these systems and further understand their mechanics, a finite-difference computer simulation is used to evaluate the effects of convective cooling by circulating water and steam. In this work we present modeling results of water and heat transport shortly after the formation of the Sudbury impact crater in present-day Ontario, Canada. Our model predicts that an impact-induced hydrothermal system associated with a Sudbury-sized impact crater can remain active for at least $10^5$ - $10^6$ years. While the location and volume of the habitable zone within the crater changes as the crater undergoes cooling, it is sufficiently long-lived for an ecosystem to develop. The insight into the mechanics of these systems gained from this model can help locate hydrothermal vents and hydrothermally altered minerals at Martian impact craters.

### P52A-0478 1330h POSTER

## A Theory of Impact Cratering in Extremely Low Density Solids and Application to Track Shape Formation in Aerogels

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Aerogels are superior in their ability to capture partially (if not completely) intact hypervelocity projectiles. The capture of hypervelocity projectiles of modest velocities ($v \sim 1 - 7$ km s$^{-1}$) in ultra low-density solids such as aerogels typically results in the formation of carrot-shaped impact craters. Several sample return missions currently in transit (e.g. Stardust) or in planning use aerogel as a capture medium of hypervelocity dust particles. In addition, several aerogel collector arrays have previously been deployed in Low Earth Orbit (LEO) since the early 1990s. These collectors, in addition to recording carrot shaped tracks, have recorded impact events with crater morphologies that do not have laboratory analogs. The origins of these anomalous tracks (and the micrometeorites that created them) are unknown because of the absence of a theoretical understading of impact cratering in aerogels. In this paper, therefore, I propose and develop a general model for impact cratering of a compactile type in a extremely porous media such as aerogels; my model adopts general arguments that derive shock wave attenuation properties in porous solids and apply these to aerogel. The model proposed here details the relationship between the energy loss of a projectile and impact cavity formation. I empirically test this model by self consistently accounting for the energy loss of projectiles in aerogel using a simple drag model together with a component that accounts for the mechanical strength of the aerogel. I show that this model suitably accounts for the slowing of spherical glass beads shot into aerogels of various densities and at various velocities. I find that the range of 20 $\mu$m sized glass beads fired into 14 mg cm$^{-3}$ and 50 mg cm$^{-3}$ aerogels at hypervelocities is substantially shorter than what one would expect based on previous work with 106 $\mu$m glass beads. An examination of captured projectiles reveals that aerogel aggregation by the projectile is a significant contributor to the anomalous slowing and is responsible for the observation that the range of projectiles captured into aerogel is not a single valued function of the velocity. Together with a simple energy loss model I generated theoretical track shapes and compared these with actual track shapes in 14 mg cm$^{-3}$ and 50 mg cm$^{-3}$ aerogels. The agreement between actual impact craters in aerogel and my model is remarkable given the simplicity of the model. I conclude by discussing implications that these results may have for the Stardust mission and impact cratering on porous asteroids such as Mathilde.

### P52A-0479 1330h POSTER

## Geochemistry of K/T-boundary Chicxulub ejecta of NE-Mexico

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Many K/T sections all over the world contain impact spherules supposed related to the Chicxulub event. This study focus on ejecta layers in NE-Mexican profiles. We carried out systematic XRF and synchrotron radiation measurements on such spherules at the HASYLAB and ANKA facilities as well as microprobe analyses (CAMECA SX50). Area scans on tektite-like material of the Bochil section reveal a pronounced zonation in the inner part, dominated by Ba and Sr whereas secondary CaCO3 dominates in the altered margin. The composition of the spherules from the Mesa-Juan Perez section differ significantly from the Beloc (Haiti) and Bochil tektite glasses. At Mesa-Juan Perez, spherules are either extremely rich in Fe and Ca or consist of smectite, some of those carry carbonate inclusions. Yttrium, La and Ce are zoned within the smectite with concentrations below the detection limit and up to 20 g/g The Ca-rich inclusions are enriched in Y (up to 35 g/g) and La (18 g/g) and, compared to the surrounding smectite, also in Ce (up to 34 g/g). The Ce enrichment in spherules from the Mesa-Juan Perez section indicates impact-melted carbonates of the Yucatan carbonate platform as possible precursor rocks. Recent investigations focus on the chemistry of melt rock samples from the PEMEX wells Yucatan-6 and Chicxulub-1: Their average composition (mean of 250 data points in wt-percent ) is 61.6 for SiO2, 0.16 for TiO2, 18.07 for Al2O3, 0.01 for Cr2O3, 1.98 for Na2O, 1.5 for FeO, 0.05 for MnO, 0.01 for NiO, 0.31 for MgO, 9.14 for K2O, 3.44 for CaO, and 0.01 for SO2. These results are in some cases comparable to the geochemistry of ejecta glasses, e.g. from Beloc (Haiti).

URL: http://www.uni-karlsruhe.de/~img/seite_489.html

### P52A-0480 1330h POSTER

## Hugoniot measurements using 15 J laser-propelled flyer sheets

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Flyer acceleration facilities with a high intensity laser, "laser gun", have been developed for the past two decades mainly in the field of high-pressure physics. Also in planetary science, laser guns should have some advantages, comparing to conventional guns such as powder guns and two-stage light-gas guns. First, the experiments with laser guns can be carried out under cleaner conditions because there is no gas from explosives. Second, the experiments can be carried out with a short time interval (every 30 minutes); a dozen of shots can be easily done within a day. Third, a high-intensity laser gun can achieve flyer-velocities higher than the escape velocity of Earth, 11.2 km/s, which is not achieved using powder or two-stage light-gas guns. We develop a flyer acceleration facility using a glass laser of University of Tokyo with an maximum energy of 15 J, a pulse width of 15 ns, a spot diameter of 700 $\mu$m, and an intensity of about 100 GW/cm2. Aluminum (Al) sheets with a thickness of 50 $\mu$m, which are attached to a glass base by adhesive, are irradiated. Vapor of Al and adhesive pushes the Al sheets to high velocities. At present, the flyer velocity is up to about 3 km/s due to the small intensity. Using this gun, we perform measurements of the Hugoniot equation of state. Flyer velocity and shock speed in a sample are measured simultaneously with a high-speed camera, and pressure and particle velocity in the sample are estimated by the impedance matching method. Here, as a sample, we use a meteorite (an ordinary chondrite, ALH769) and Hugoniot data are obtained. It should be noted that this measurement system can be used when a laser is upgraded and flyer velocity achieves more than 10 km/s.

### P52A-0481 1330h POSTER

## Impact Flashes in Saturn's Rings

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Over the past decade, impact flashes have been observed on the moon and in the laboratory in both the IR and visible parts of the spectrum. These phenomena have been used to constrain impact parameters, such as impact velocity and composition. With the arrival of the Cassini spacecraft at Saturn in July 2004, we embark on a study of impact flashes in Saturn's rings. We begin by modeling high energy, hypervelocity impact events using CTH, a shock physics hydrodynamics code developed at Sandia National Laboratories. The simulated impacts involve two centimeter- to meter-sized icy bodies impacting each other at velocities over 30 km/s. Each body is composed of pure water ice and incorporated into the code using an ANEOS equation of state. The resulting impact-induced vapor plume is post-processed to consider its radiative evolution. The results of this study will be used as an aid to planning observational time on Cassini's Ultraviolet Imaging Spectrograph (UVIS).

# P52B MCC: 2000 Friday 1340h

## Planetary Ionospheres and Magnetospheres II *(joint with SH, SM)*

***Presiding:*** **C Paranicas,** Applied Physics Laboratory, Johns Hopkins University**; D H Crider,** Catholic University of America

### P52B-01 1340h

## Evidence of ionospheric Holes in the Venus Nigthtside Ionosphere as Crossings of the Pioneer Venus Orbiter (PVO) Through Plasma Channels Near the Magnetic Polar Regions

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Data obtained from the PVO orbiter electron temperature probe (OETP) and magnetic field observations conducted in the Venus nightside ionosphere reveal that the ionospheric holes detected in that region represent crossings of the PVO through plasma channels that extend downstream from the magnetic polar regions. The electron density profile and the magnetic field signature measured across the nightside ionosphere in orbit 85 show that the spacecraft moved through plasma channels (in an ionosheath-plasma channel-ionosphere transit) in which the magnetic field magnitude and its orientation are similar to those encountered within the ionospheric holes. The enhanced ( 30 nT) magnetic field intensity measured within the channels, which accounts for that present within the holes, results from the accumulation of the magnetic field that is forced by the solar wind thermal pressure on the polar upper ionosphere in a manner similar to what occurs near the subsolar region where the solar wind kinetic energy density is replaced by the accumulation of magnetic field fluxes around the ionosphere. The large [ 10(exp-7) ergs cm-3] kinetic energy density that the solar wind maintained in orbit 85 suggest wide and deep plasma channels extending downstream from the magnetic polar regions of the Venus ionosphere and that resulted from the extensive local erosion produced by the solar wind. The fact that an intense [ 10(exp 5) cm-3] peak electron density was measured deep in the umbra by the midnight plane near the trajectory periapsis ( 200 km) during that orbit indicates that the nightside ionosphere did not disappear despite the large value of the solar wind dynamic pressure. A geometry of the ionopause traced across the magnetic polar regions is suggested to account for the maintenance of large ionospheric electron densities near the midnight plane and the absence of such densities far away from that plane when there are large solar wind dynamic pressures.

### P52B-02 1355h

## Simulation of Energetic Neutral Atom Images at Venus

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We present simulated images of energetic neutral atoms (ENAs) produced in charge exchange collisions between solar wind protons and neutral atoms in the