CRISM observations to search for hydrothermal alteration zones where fractures and mass wasting might have exposed and dispersed any altered materials, making them more detectable by OMEGA and CRISM.

P11B-1044 0830h POSTER

Numerical Simulations of Recently Observed Dark Streaks on Mars

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Recently observed dark streaks on Mars appear to be formed by a flowing fluid, possibly originating from melting ice. These streaks have been seen to form in a matter of months. They are markedly different from dust devil streaks in that they are very straight rather than twisting and curly. The dark streaks also only appear in regions where the temperature is right at 275 K, the triple point of water on Mars. Two hypotheses (of several) for their formation are that lighter dust sticks to a wet surface or brines precipitate a light rock varnish. The purpose of our study is to use numerical models to determine if the patterns associated with these dark streaks can be produced by a fluid flowing from a point source. We have used a 2-D model for fluid flow in a sloping porous medium, using the Richard's approximation of partially saturated fluid flow. The model is calculated using the TRACR3D code with water as the fluid. Our models show patterns similar to the dark streak patterns seen on Mars. We have varied the strength of the fluid source, the slope of the terrain, and the strength of capillary pressure in the porous medium to explore the range of features seen in the dark streaks. We have examined both continous and finite time sources. In future work, we will look at the effect of dissolved CO_2 in the fluid along with using brines that may precipitate minerals.

P11B-1045 0830h POSTER

Impact Craters as Indicators of Tectonic Activity in the Beta-Atla-Themis Region, Venus

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The Venus Magellan mission in the early 1990's provided radar imagery that mapped numerous impact craters, randomly distributed over the planet's surface. Analysis of these images shows that the majority of the craters remain in pristine condition, but about 25% have been modified by tectonism and/or embayment. Fully 23% of the modified craters are located in the Beta-Atla-Themis (BAT) region, just 1/6th the planetary surface. Furthermore, 61% of the craters unambiguously both tectonized and embayed concentrate in this region, together with the planetary geoid highs and profuse volcanism. The process of impact cratering has been well studied; we use their modification to assess the tectonic and volcanic activity of the BAT region. In our study we correlated Magellan radar images and topographic data to analyze the tilting for both modified and unmodified craters. We use stereo-imaging for those few craters with multiple Magellan cycle coverage to achieve higher topographic resolution. In addition, the construction of basic maps clarified the degree of modification of these features. For example, the 102.2 km diameter crater Bonheur, located on the east side of Beta-Phoebe chasma, has been heavily tectonized and tilts towards the rift. Meanwhile, the pristine crater Isabella, 176.0 km diameter, tilts away from Atla. This pattern may indicate the nature of tectonic activity of both areas. Although both Beta and Atla regiones have approximately similar crater density, the distribution of modified craters differs. Atla contains a higher concentration of modified craters (33%) than Beta (23%), and the modified craters on Beta are randomly distributed unlike those on Atla. On Atla, four of the unambiguously tectonized and embayed craters cluster near the geoid high, but embayed-only craters are minimal and tectonized-only craters become more common at lower elevations. Significantly, craters with dark parabolic halos are thought to be among the most recent 10% of features on the planet. Uvayasi, a parabola-associated crater near the peak of Atla, has been both tectonized and embayed which dates the activity here as very recent. However, no such parabolic craters occur near Beta.

P11C MCC: 3009 Monday 1020h

Science Rationale for the Jupiter Icy Moons Orbiter Mission I *(joint with A, G, SM)*

Presiding: **T Johnson,** Jet Propulsion Laboratory, California Institute of Technology**; C Niebur,** NASA Headquarters

P11C-01 1025h INVITED

Understanding Active Processes at the Surfaces of Jupiter's Icy Moons

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Exploration of Jupiter's icy moons, and Europa in particular, is of paramount interest to astrobiology. Europa is considered one of the most likely places in the solar system for extraterrestrial life because it appears to have a liquid ocean and may be able to tap into a vast supply of tidal energy (like its neighbor Io) to drive internal dynamics. Jupiter's other icy moons, Ganymede and Callisto, may also harbor liquid oceans, but these oceans are most likely sandwiched between high-density and low-density phases of solid ice and so have less astrobiological potential. Great uncertainty remains, however, in our knowledge of the depths to and extents of these oceans. In order to even begin searching for life on these icy moons, we must answer the basic questions: how thick is the ice? and how (and where and when) does the ocean communicate with the surface? Providing answers to these questions will require investigating the processes that are currently acting to shape or re-shape the surfaces of Jupiter's icy moons and alter their physical and chemical state. In two image data sets obtained from Voyager and then Galileo, no evidence has yet emerged to indicate geologic change over the intervening twenty years. It is possible that in future missions higher resolution imagery and other techniques employing radar interferometry may indirectly detect and localize active deformation events including impacts, fracturing, flows, relaxation and mass wasting. Thermal anomalies due to possible active deformation or vertical transport may also be detectable. Seismic sensors placed on the surface may directly detect the deformation of the surface and, with several sensors, localize regions of activity. Seismic sensors can also be used to determine the thickness of the ice and underlying ocean by tomography. The causes of such geologic activity could then be potentially identified by correlation with driving mechanisms such as tidal motion, convection, non-synchronous rotation, libration, static topography, impacts and thermal stress. It would also be important to determine the processes by which material is transported to and from the surface, including characterization of the relative importance of exogenic and endogenic contributions to surface composition. A system-wide analysis of chemical transport from Ganymede to Jupiter may be necessary to properly constrain the transport mechanisms.

P11C-02 1040h INVITED

Studying the Surfaces of the Icy Galilean Satellites With JIMO

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The Geology subgroup of the Jupiter Icy Moons Orbiter (JIMO) Science Definition Team (SDT) has been working with colleagues within the planetary science community to determine the key outstanding science goals that could be met by the JIMO mission. Geological studies of the Galilean satellites will benefit from the spacecraft's long orbital periods around each satellite, lasting from one to several months. This mission plan allows us to select the optimal viewing conditions to complete global compositional and morphologic mapping at high resolution, and to target geologic features of key scientific interest at very high resolution. Community input to this planning process suggests two major science objectives, along with corresponding measurements proposed to meet them. Objective 1: Determine the origins of surface features and their implications for geological history and evolution. This encompasses investigations of magmatism (intrusion, extrusion, and diapirism), tectonism (isostatic compensation, and styles of faulting, flexure and folding), impact cratering (morphology and distribution), and gradation (erosion and deposition) processes (impact gardening, sputtering, mass wasting and frosts). Suggested measurements to meet this goal include (1) two dimensional global topographic mapping sufficient to discriminate features at a spatial scale of 10 m, and with better than or equal to 1 m relative vertical accuracy, (2) nested images of selected target areas at a range of resolutions down to the submeter pixel scale, (3) global (albedo) mapping at better than or equal to 10 m/pixel, and (4) multispectral global mapping in at least 3 colors at better than or equal to 100 m/pixel, with some subsets at better than 30 m/pixel. Objective 2. Identify and characterize potential landing sites for future missions. A primary component to the success of future landed missions is full characterization of potential sites in terms of their relative age, geological interest, and engineering safety. Measurement requirements suggested to meet this goal (in addition to the requirements of Objective 1) include the acquisition of super-high resolution images of selected target areas (with intermediate context imaging) down to 25 cm/pixel scale. The Geology subgroup passed these recommendations to the full JIMO Science Definition Team, to be incorporated into the final science recommendations for the JIMO mission.

P11C-03 1055h

Jupiter Icy Moon Orbiter (JIMO) Remote Sensing: Geology and Geochemistry Science Goals and Objectives.

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The Jupiter Icy Moon Orbiter (JIMO) Science Definition Team met with the broader science community to identify the key outstanding science goals and objectives that could be met by the JIMO mission at the Forum on Concepts and Approaches for JIMO in Houston, Texas on June 14-15, 2003. The Remote Sensing: Geology and Geochemistry subgroup identified that our primary objective was to determine the coupled compositional evolution of the Jovian Satellites by determining the composition, origin, physical state, and distribution of surface materials of all four Galilean Satellites. Europa, Ganymede, Callisto, and Io have undergone complex geological and chemical processing which have important implications for the evolution of the satellites and the habitability of Europa. To meet this goal, the following science objectives for JIMO were identified: 1) Identify major and minor surface components, distributions, geological ages, including abiotic and biotic organic molecules, trapped volatiles; 2) Characterize currently and recently geologically active areas; 3) Characterize exogenics vs. endogenic processes via spatial distribution patterns or other characteristics such as time variability (diurnal or longer timescales) of surface chemistry; 4) Map regolith thermophysical properties; 5) Determine heat flow on Europa and Io to investigate their coupled thermal evolution; 6) Determine temperature-dependent physical and chemical stability of surface components; 7) Map isotopic components that elucidate fractionation processes; and 8) Map regolith photometric properties. In addition JIMO should collect data needed to identify and characterize potential landing sites from both science and engineering perspectives given the potential for follow on missions to search for life on Europa in situ.

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P11C-04 1110h INVITED

A Science Foundation for Orbital Subsurface Radar Sounding of Jupiter's Icy Moons

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A fundamental question for both science and society is the uniqueness of life within the solar system. Biology as we know it requires free water, heat, and a flux of chemical compounds. Beyond Earth, the recently identified sub-ice oceans of Europa, Ganymede and Callisto are believed to be the solar system's other significant concentrations of free water. At present we know little about the distribution of free water or the flux of chemical compounds within these moons' icy/watery outer shells. The proposed Jupiter Icy Moons Orbiter (JIMO) presents exciting prospects for addressing these issues. The subgroup for Orbital Subsurface Science of the JIMO Science Definition Team discussed these prospects with the broader scientific community at a forum held in June of 2003. At the forum it was concluded that the primary subsurface science objective is to determine the volumetric distribution of free water (including brines) within Europa, Ganymede and Callisto. This should be accomplished through a study of the subsurface thermal and kinematic factors that control the distribution of free water and how this distribution has changed through time; in addition, a study of the relationship between these factors and observed surface features was recommended. A second subsurface science objective is to determine the means of ice-ocean interchange of material on Europa and where this material could best be sampled by future landed missions. The recommendations here were to test the hypothesis of direct exchange between any ocean and the icy mantle's cold brittle shell and shallow subsurface; an additional recommendation was made to test the hypothesis of indirect exchange with any ocean through the movement of deep ductile ice into the cold brittle shell. A final objective is to determine the geologic processes that control the exchange of material in the shallow subsurface of the three moons. This would require studying the physical properties above the annealing depth and their relationship to the mapped distributions of surface constituents, physical structures and thermal features, as well as their relationship to deeper geological processes. Because ice is characterized by very low dielectric losses, it was recognized that these investigations could be accomplished by a combination of global and localized radar profiling of thermal, compositional and structural horizons within the three moons' icy shells. This profiling should be at two scales, targeting horizons at depths of up to 30 km at 100 m vertical resolution, and at depths of up to 2 km with 10 m vertical resolution. The global profiles were recommended to have equatorial separation of at least 5° and the targeted profiles would emphasize high-resolution studies of representative surface features. To fully understand geological processes in the shallow subsurface, a consensus was also reached that the subsurface (> 1 m) heterogeneity of the regolith should be mapped at better than 100 m horizontal resolution over at least 50% of the surface of the three moons. The forum attendees also emphasized that the primary factors controlling the topography of Jupiter's icy moons are characterized by thermal, compositional and structural horizons that are likely to be detectable by electromagnetic probing. Suggested links between investigations of subsurface horizons and topography will also be presented.

P11C-05 1125h INVITED

The Power of JIMO for Determining Galilean Satellite Internal Structure and Origin

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The spectacularly successful Galileo mission has opened up a planetary system (the Galilean satellites) for detailed exploration. The current state and origin of these bodies may tell us about many general aspects of the origin and evolution of planets as well as the processes that govern and structure in large icy (and rocky) bodies. JIMO offers the prospect of an enormous increase in our understanding in the following ways: (1) Determination of the global differentiation structure by characterizing the hydrostatic part of the gravity field (primarily J2 and C22) and the pole and thus spin obliquity. Although it is commonly supposed that Galileo gave us the correct moments of inertia, this is based on assumptions and could be wrong for Callisto especially. (2) Detection of oceans through the detection of eccentricity tidal response in both gravity and altimetry. Theoretical estimates indicate that the tidal response with and without an ocean are markedly different (especially for Europa) so this will be a very clear determination of ocean presence. (3) To the extent possible, the actual ice thickness will also be determined from tidal response. This is most important but also most difficult for Europa, because of our imperfect understanding of ice properties. The best prospect for success comes from the combination of many different kinds of measurements. (4) Orbital acceleration is detectable and will tell us about the tidal orbital evolution. (5) Magnetic field measurements will tell us about Ganymede's dynamo and the nature of Europa's ocean. (6) Non-hydrostatic gravity will tell us about the dynamic state of the rocky core and possibly the convective state of an ice shell. (7) Heat flow measurements are difficult but very valuable if possible. (8) Last but not least, all of these measurements will yield greatest return if they are in conjunction with probe measurements of Jupiter's deep atmospheric composition. This abstract has benefited form the entire JIMO Science Definition team and participants at the June workshop.

P11C-06 1140h INVITED

A Search for Signs of Life and Habitability on Europa

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Europa is a key target in the search for life beyond the Earth because of consistent evidence that below the icy surface there is liquid water. Future missions to Europa could confirm the presence and nature of the ocean and determine the thickness of the ice layer. Confirming the presence of an ocean and determining the habitability of Europa are key astrobiology science objectives. Nevertheless, the highest priority objective for astrobiology will be a search for life. How could a search for life be accomplished on a near-term mission given the thick ice cover? One answer may lie in the surface materials. If Europa has an ocean, and if that ocean contains life, and if water from the ocean is carried up to the surface, then signs of life may be contained in organic material on the surface. Organics that derive from biological processes (dead organisms) are distinct from organics derived from non-biological processes in several aspects. First, biology is selective and specific in its use of molecules. For example, Earth life uses 20 left-handed amino acids. Second, biology can leave characteristic isotopic patterns. Third, biology often produces large complex molecules in high concentrations, for example lipids. Organic material that has been on the surface of Europa for long periods of time would be reprocessed by the strong radiation field probably erasing any signature of biological origin. Evidence of life in the ocean may be found on the surface of Europa if regions of the surface contained relatively recent material carried up from the ocean through cracks in the icy lithosphere. But organic material that has been on the surface of Europa for long periods of time would be reprocessed by the strong radiation field probably erasing any signature of biological origin. Thus, the detailed analysis required may not be possible via remote sensing but direct sampling of the material below the radiation processed upper meter is probably required.

P11C-07 1155h INVITED

Field and Plasma Science with the Jupiter Icy Moons Orbiter (JIMO)

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The field and plasma investigations from JIMO would address fundamental science objectives related to chemistry, internal structure and evolution of Jupiter's Galilean icy satellites. In addition, data collected during the cruise phases of the mission would identify azimuthal asymmetries in the structure and dynamics of the Jovian magnetosphere. The Priority 1 objectives identified by the field and plasma subgroup assisting the JIMO SDT are: (1a) determine the presence and distribution of subsurface liquid water in the icy Galilean moons, (1b) determine the nature of satellite-magnetosphere interactions including the radiation environment of these moons, and (1c) determine the surface composition and properties of materials on these moons. The key investigations that reveal the presence and distribution of subsurface liquid water are low-frequency sub-surface sounding and the magnetic induction response of conducting oceans to the changing magnetic field in the rest frames of the moons. The magnetic field is also perturbed by the interaction of the moon with the Jovian plasma. Plasma observations and/or DC electric field measurements are therefore required to separate the internal and external sources of magnetic field perturbations. Further information on the thicknesses and properties of the moon ice crusts, and on the changing magnetic environments of the moons related to the induced fields, would be provided by a low frequency sub-surface sounder (working at kHz to MHz as compared to GHz used by ice penetrating radar). The surface composition objective can be addressed from in situ measurements of neutral or charged species in the moon atmospheres, ionospheres, dust clouds, and orbital gas tori, and by spectrographic imaging of neutral atoms and x-rays from the irradiated surfaces. The Priority 2 objectives are (2a) understanding the asymmetries in the structure and dynamics of Jovian Magnetosphere and (2b) understanding the deep internal structure of the icy Galilean moons. In the cruise phases of the mission, data collected from all local times at near-constant radial distance would help us determine local time asymmetries of the magnetosphere with an unprecedented accuracy. The internal structure objective can be addressed by inferring the magnetic induction response of the cores of the moons at very low frequencies. Electric field, plasma, energetic particle, and radio sounding measurements would further constrain the induction response. Since studies of Io are not a stated goal of JIMO mission, investigations of Io and its torus were assigned to Priority 3. Monitoring of the Io torus with ultraviolet auroral imaging and decametric radio emissions, and of Io's volcanism through imaging, would provide information about one of the principal sources of plasma and dynamics in the Jovian magnetosphere. We will also discuss how, in a conceivable extended phase of the mission, in-situ measurements near Io would shed light on the internal state and structure of this highly active moon and its interaction with the magnetospheric plasma.

P11C-08 1210h INVITED

Objectives for Atmospheres and Ring Science for the Jupiter Icy Moons Orbiter

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The Solar System Exploration Decadal Survey was made public in draft form in June 2002. It lists 12 key scientific questions, of which 4 are most relevant to the planet Jupiter: 1. Over what period did the gas giants form, and how did the birth of the ice giants (Uranus, Neptune) differ from that of Jupiter and its gas-giant sibling, Saturn? 2. What is the history of volatile compounds, especially water, across our solar system? 3. How do the processes that shape the contemporary character of planetary bodies operate and interact? 4. What does our solar system tell us about the development and evolution of extrasolar planetary systems, and vice versa? The Decadal Survey, which was asked to provide a prioritized list of the most promising avenues for flight investigations, recommended a Jupiter Orbiter with Probes (JPOP) as the highest priority giant planets mission in the New Frontiers line. The goals of that mission are: 1. Determine if Jupiter has a central core to constrain ideas of its formation 2. Determine the planetary water abundance 3. Determine if the winds persist into Jupiter's interior or are confined to the weather layer 4. Assess the structure of Jupiter's magnetic field to learn how the internal dynamo works 5. Measure the polar magnetosphere to understand its rotation and relation to the aurora JPOP was proposed as a high inclination orbiter whose low equatorial perijove enabled it to make detailed measurements of the gravitational and magnetic fields as well as the polar magnetosphere. The probes mainly addressed the water abundance and deep winds. The gravitational field measurement also addressed the deep winds as well as the central core. The JIMO opportunity arose after the Decadal Survey report was written, and is different from the opportunity afforded by a New Frontiers mission. JIMO offers a potential breakthrough in remote sensing: The 1-3 Mbps data rate is 2 orders of magnitude greater than that of previous missions. The circular orbit offers continuous planet viewing during the 3 months between satellite encounters. The 10-30 kW of power offers advantages for radio occultations and other active sensors. In addition, JIMO can carry a probe, which can determine the water abundance, deep winds, and thermal structure to 100 bars. At the Forum on Concepts and Approaches for JIMO in Houston, Texas on June 14-15, 2003, the Atmospheres and Rings Subgroup came up with the following prioritized list of objectives: 1. Composition, structure, chemistry, and dynamics of Jupiter's atmosphere. 2. Composition, structure, and dynamics of icy moon atmospheres. 3. Composition, structure, dynamics, and time variability of the atmosphere of Io. 4. Nature of the interaction between magnetosphere, satellites, and Jupiter. 5. Structure, composition, energy budget, and variability of satellite tori. 6. Structure and particle properties of the Jovian ring system Each objective has several prioritized investigations, and each investigation has a prioritized list of measurements. These will be presented at the meeting. Some of the measurements require a probe; others can be done from the JIMO orbiter. With or without a probe, the JIMO mission can answer fundamental questions about atmospheres, rings, and satellite tori in the Jupiter system.

P12A MCC: Level 2 Monday 1330h

Science Rationale for the Jupiter Icy Moons Orbiter Mission II Posters

(joint with A, G, SM)

Presiding: **J R Spencer,** Lowell Observatory**; A R Hendrix,** Jet Propulsion Laboratory, California Institute of Technology

P12A-1046 1330h POSTER

JIMO Surface Composition Investigation of the Galilean Moons Via High-Resolution Analysis of Ejecta Dust Particles

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Galileo in-situ dust measurements have shown that the Galilean moons are surrounded by tenuous dust clouds formed by collisional ejecta from their icy surfaces, kicked up by impacts of interplanetary micrometeoroids. The majority of the ejecta dust particles have been sensed at altitudes below five radii of these lunar-sized satellites. Average particle radii were between 0.5 and 1 micron, just above the detector threshold, indicating a size distribution decreasing towards bigger particles. The dust particles in the clouds consist of surface material from their parent bodies. They carry information about the properties of the surface from which they have been kicked up. In particular, these grains may carry organic compounds and other chemicals of biological relevance if they exist on the icy Galilean moons. In-situ analysis of the grain composition with a sophisticated dust analyzer instrument flying on a Jupiter Icy Moons Orbiter can provide important information about geochemical and geophysical processes during the evolutionary histories of these moons which are not accessible with other techniques from an orbiter spacecraft. Thus, spacecraft-based in-situ dust measurements can be used as a diagnostic tool for the analysis of the surface composition of the moons. This way, the in-situ measurements turn into a remote sensing technique by using the dust instrument like a telescope for surface investigation. An instrument capable of very high resolution composition analysis of dust particles is the Cometary Secondary Ion Mass Analyzer (COSIMA). The instrument has been built for ESA's comet orbiter Rosetta and is based on a high-resolution reflectron-type time-of-flight ion mass spectrometer.

P12A-1047 1330h POSTER

Io Science Opportunities From the JIMO Mission

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Io is the only place beyond Earth where we can watch geological processes in action. It has much to teach us about large-scale volcanic processes in general, the history of the early Earth, which at one time may have had a heat flow approaching Io's 2 – 3 W m^{-2}, and the nature of tidal heating in the Jupiter system and beyond. Though the nominal mission of the proposed Jupiter Icy Moons Orbiter (JIMO) does not include close approaches to Io, the mission can still make unique and important contributions to the understanding of Io and its active volcanism. Dynamic volcanic phenomena (e.g., active lava flows and pyroclastic events) typically evolve on timescales of hours to weeks and on spatial scales up to tens of kilometers. However, existing coverage of Io does not cover this range of spatial and temporal scales, and thus has provided very limited ability to watch volcanic activity as it happens. Galileo provided spatial resolution down to a few meters but temporal resolution no better than a few months, and Earth-based techniques provide temporal resolution down to hours or days but spatial resolution no better than $\sim$ 100 km. A 0.5 meter aperture telescope on JIMO could image Io from the distance of Ganymede with diffraction-limited resolution ranging from 1 km in the visible to 25 km at 10 μm. Io observations could be concentrated in the several-month periods of Jovicentric orbit while JIMO transfers between icy satellite orbits, causing minimal interruption to JIMO's icy satellite mapping program. If JIMO has a scan platform capable of rapid pointing, full-disk observations of Io could be taken as frequently as once per hour, for example, interleaved with observations of other targets such as Jupiter and long-range observations of the icy satellites. Io-optimized instrumentation would include the following: (i) A 0.2 – 0.3 μm spectrograph for mapping atmospheric SO_2 and other species; (ii) Visible imaging in several broadband and narrowband filters from 0.35 – 1.0 μm, for geomorphology and observations of plumes and pyroclastic deposits, and atmospheric emissions in eclipse; (iii) A 1 – 5 μm spectrograph for both reflectance spectroscopy of surface species and measurements of the temperature and area of hot volcanic materials via their thermal emission; and (iv) thermal infrared imaging in several broadband filters from 5 – 30 μm, for studies of lava flow cooling, surface thermal inertia, and global heat flow. With this instrumentation we could watch the complete evolution of several major eruptions on Io over the course of the JIMO mission. Science results would include, for example: (i) Magmatic temperatures during the early phases of major eruptions, providing critical constraints on magma composition and Io's interior structure; (ii) Rates of supply of gas from volcanic eruptions to Io's atmosphere, and condensed volatiles to its surface; (iii) The influence of major eruptions on Jupiter's magnetosphere, using other magnetospheric observations from JIMO; (iv) Rates of magma generation, providing constraints on volcanic "plumbing" and lava composition; (v) Accurate measurement of Io's endogenic heat flow and its spatial distribution, with implications for understanding Io's interior structure and the orbital and tidal evolution of all the Galilean satellites. While science return would be even greater if JIMO was able to approach Io closely, huge advances in our understanding of Io will be possible even from relatively distant observations, if Io science is given sufficient priority in the planning of JIMO's instrumentation and observations.

P12A-1048 1330h POSTER

Io in the Infrared - Science Opportunities with the JIMO Mission

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The Jupiter Icy Moons Orbiter (JIMO) presents an opportunity to greatly improve our understanding of the most dynamic body in the solar system. Io is the best place to study tidal heating of the Galilean moons, provides unique insights into Earth history and is a unique laboratory for basic planetary physics. Many important questions about Io remain after Galileo that cannot be addressed from Earth or Earth orbit, but could be answered by limited observing time from JIMO with the appropriate instrumentation. Here we outline objectives in the infrared. We discuss two major science issues that can be addressed with infrared observations from JIMO: Io's heat flow and surface chemistry. This would build on the results from the Galileo NIMS and PPR experi-ments. Tidal Heating: A major puzzle is that recent estimates (using ground-based and Galileo observations) are higher than predicted by steady-state tidal heating rates. It is necessary to understand why this is so on Io to properly understand tidal heating on Europa. We need high spatial resolution measurements of the spatial distribution of Io's thermal radiation and accurate measurements of its bolometric Io's surface chemistry: Io's surface chemistry is still largely unknown except for SO_2, which is ubiquitous on the surface. The composition of Io's very high temperature magma is unknown. Since surface areas not covered by SO_2 are fairly small (a few km^2), infra-red spectroscopic observations at spatial resolutions around 1 km, which would be unique to JIMO, are needed. Two major limitations of the existing long wavelength coverage on Io are limited spatial coverage at high spatial resolution - particularly at high spectral resolution and limited coverage of the Jupiter facing hemisphere. The former prevents obtaining unmixed spectra of unique surface features (such as fresh flows) - and the latter has makes it difficult to interpret global behavior of Io. To understand Io, one needs to map Io at spatial resolutions better than one kilometer over the spectral range 0.8 to about 40 microns, and to obtain a reasonable spatial coverage at spectral resolutions high enough to measure isotopic fractionation. The spectral range includes iron bands (0.8-1.3 microns, mineral and volatiles bands (1-15 microns) and thermal measurements (0.8 to 40 microns). Most these needs could be met with limited observing time from JIMO, an-swering many of the important remaining questions about Io.

P12A-1049 1330h POSTER

Monitoring Jupiter's Atmosphere for Tidal Oscillations

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