Over the past two decades, imaging radar has become a useful remote sensing tool for planetary mapping. Because much of the bedrock geology on Mars is likely covered by sand and dust, a radar imaging system should be considered a necessary compliment to other remote sensing instruments at or planned for Mars. In anticipation of such a mission and future terrestrial radar missions, radar backscatter and transmission experiments were conducted for dry and wet sand and a Mars analog dust.

To address the ability of radar to penetrate sand and dust, the experiments measured the change in radar signal for various radar and target properties to determine attenuation (dB/m), or the decrease in signal per meter. The transmission experiments were conducted using dry sand (0.3% water), two wet sands (5 and 11% water), and dry Carbondale Red Clay (CRC), an analog for martian dust because of its grain size (2 μm) and iron content (19% Al_2O_3 and 12% Fe_2O_3). The backscatter experiment was performed using dry sand, and all experiments were run over the frequency range of imaging radars (0.5 to 12 GHz).

Results show that dry sand, sand with 5% water content, and dry CRC dust all result in attenuation less than 2 dB/m at 0.5 GHz. Sand with 11% water results in attenuation of only 4 dB/m. Although it is expected that low-frequency radar will have low attenuation, the low attenuations for wet sand challenge previous claims that subsurface penetration requires extremely dry sand. Those attenuations also question the ability of a low frequency Mars radar to detect moist soil efficiently. At higher frequencies, attenuation due to wet sand increases rapidly to values that prohibit significant penetration, but dry sand exhibits a much slower increase in attenuation. At 9.6 GHz, dry sand causes attenuation of only 5.9 dB/m. It is therefore expected that higher-frequency (shorter wavelength) radar energy can penetrate dry sand deposits, possibly as much as a meter depending on the sensitivity of the radar. The attenuation due to the CRC dust is still low (5.8 dB/m) at 1.24 GHz but rises to 67.4 dB/m at 9.6 GHz. These results suggest that a multi-frequency Mars imaging radar would be most useful. Results can also help select other radar parameters to meet the science goals of future radar missions.

P71A-0455 0830h POSTER

Comparison Between the Fluid Effect on the Rotation of Earth and Mars

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The interaction between the Earth and its fluid layers (namely the fluid core, the atmosphere and the ocean) is the major cause of the fluctuations of the Earth rotation. An analogy to Mars can be made since the two planets have many similarities. In this study, we review the interaction processes on Earth and use this knowledge to investigate Mars.

It is known for more than one century that the Earth rotation is not a constant in time, and present fluctuations at various timescale. The knowledge of the angular momentum of the fluid allows to compute its effect on the Earths rotation. A similar approach can be applied to Mars. The properties relevant to the effect of the fluid layers on the planet rotation can be deduced from the angular momentum budget equation. A priori, on Mars, the inertia and surface characteristic, core status, atmosphere, CO2 condensation/sublimation process and dust storms drive the interaction processes. In analogy to the case of Earth, the details of the interaction between Mars and its fluid layers will be studied in order to estimate the relative importance of the different components of the system.

P71A-0456 0830h POSTER

Effects of Atmospheric Multipath Propagation on Radio Occultation Observables

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Atmospheric multipath propagation is a common source of error in radio occultation experiments in dense atmospheres. If not correctly detected and mapped into the ray asymptote structure, multipath effects produce unrecoverable errors in the inverse problem for the refractive index profile.

Raytracing can be used to clearly illustrate multipath caused by interacting signals following closely spaced paths in the atmosphere. Such dynamic signals occur in connection with sharp variations in refractivity with height and result in multivalued frequency with time. Closed-loop radio receivers based on phase-locked loops that are designed to receive single-valued frequency signals will fail to preserve the multivalued nature of these signals.

In order to use backprojection methods to mitigate multipath effects in the refractive index profile, it is important that there are no breaks in the collected or backprojected data. Data sets must span a continuous time series over the range of ray asymptotes required for a particular retrieval. The receivers used for radio occultation experiments are therefore expected to reliably and continuously collect data even from signals that have propagated through ducts, turbulence, or other abrupt deviations in atmospheric structure. Both high altitude radiosonde data from Earths atmosphere as well as model refractive index profiles are used to illustrate instances in which multipath occurs and to characterize the signal structures produced by multipath propagation.

A functional representation of atmospheric multipath signal structure is used as the input to a phase locked loop. The phase locked loop simulation is representative of autonomous closed-loop receivers as opposed to those that are manually frequency-steered. The tracking performance of the phase locked loop is evaluated for these dynamic signal structure inputs. Cases where the system fails are examined to determine the extent to which closed-loop systems can be used to observe and accurately characterize such signals.

P71B MCC: Hall D Sunday 0830h

Planetary Volcanism and Tectonism Posters *(joint with V)*

Presiding: **J R Zimbelman,** Smithsonian Institution**; R Ghent,** Smithsonian Institution

P71B-0457 0830h POSTER

Down-Flow Physical Attributes of Long Lava Flows on Five Planetary Surfaces

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Physical data have been compiled for eighteen long lava flows, most of which are more than 50 km in length. Flows examined include the Carrizozo and McCartys flows, central New Mexico and the 1907 and 1984 Mauna Loa flows, Hawaii (Earth), flows near Bellona Fossae and Fea Fossae (Venus), flows near Alba Patera and Elysium Mons (Mars), the Phase III Mare Imbrium flow (Moon), and the Amirani flow (Io). Measurements of flow width, flow thickness, and local topographic slope were obtained at regular intervals along each flow. These data reveal several similarities and differences between the flows emplaced in very different environments. All of the longest flows occur on regional plains of shallow slope, generally less than 1 degree. Some flows (e.g. Mauna Loa) are clearly volume-limited while other flows (e.g. Elysium Mons) appear to have components that are cooling-limited. Differences in the gravitational acceleration on the five planetary surfaces do not correlate with flow length, but flow thickness is strongly inversely correlated with gravity except for the two smallest bodies (the Moon and Io). Some flows have relatively small length/width ratios (about 5 for Fea Fossae) while other flows have higher ratios (more than 10 for Mare Imbrium and Alba Patera), or are highly variable along the flow (Carrizozo and Amirani). These data, combined with published rheologic information obtained during emplacement of the 1984 Mauna Loa flow, provide new constraints on likely emplacement conditions for flows on the different surfaces. These new measurements represent the basic input for evaluation of several models of flow emplacement (see abstract #3651 by Peitersen et al.).

P71B-0458 0830h POSTER

Down-flow Geomorphometric Analysis and Rheological Modeling of Long Lava Flows on Five Planetary Surfaces

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A series of statistical analyses and modeling studies on a database of new geomorphometric data for lava flow on five planetary surfaces (abstract #296 ,Zimbelman et al., AGU Fall 2002) is conducted to constrain the processes active in the emplacement of long lava flows (here defined as flows whose traceable length exceeds 50 km). Flow parameters (widths and thicknesses) and environmental factors (e.g., local slopes) are registered as functions of downflow distance for each lava flow. The data are then evaluated statistically for trends suggested by current emplacement models. A strong inverse correlation has been identified between the local gravitational field and the average flow thickness; this is consistent with most of the conventional rheological flow models. The database parameters are also used to estimate rheological properties (e.g. velocity, viscosity, flow rate); inferences are then drawn. Initial results suggest that a variety of mechanisms dominate the emplacement of long lava flows. Modeled changes in rheology of some flows are consistent with the cooling of simple flow lobes, but others suggest more patterns of greater complexity . Cyclical variations are suggestive of repeated episodes or "pulses" of emplacement, while other flows demonstrate evidence for strong topographic control, or volume-limited behavior.

P71B-0459 0830h POSTER

Lava Lakes on Io

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Calderas are the most ubiquitous volcanic construct on Io's surface. Data from Galileo has shown that many Ionian calderas are active and that activity is often confined to the caldera's interior. We use observations from Galileo's Near-Infrared Mapping Spectrometer (NIMS) to study the thermal emission from several Ionian calderas. Galileo's close fly-bys of Io from 1999 to 2001 have allowed NIMS to image the calderas at high spatial resolution (1-30 km pixel). At these scales, several of the calderas reveal greater thermal emission around the edges, which can be explained as the crust of a lava lake breaking up against the caldera walls. Comparisons with imaging data show that lower albedo areas (which are indicative of young lavas) coincide with higher thermal emission areas on NIMS data. Other calderas, however, show thermal emission and features in the visible that are more consistent with lava flows over a solid caldera floor. Identifying eruption styles on Io is important for constraining eruption and interior models on Io. We will focus on the thermal analysis of NIMS data from the last two successful fly-bys of Galileo, in particular, on observations of the calderas Tupan, Emakong, Gish Bar, Culann, Chaac, and a small caldera near Tohil, and examine the distribution of thermal emission, how it had varied with time, and the implications for eruption styles. The new observations suggest that lava lakes may be common on Io, perhaps much more than on Earth, possibly reflecting differences in volcanic plumbing and magma composition.

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P71B-0460 0830h POSTER

Monitoring Io volcanic activity using the Keck AO system: 2-5μm sunlit and eclipse observations

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Galileo provided us with spectacular images of the volcanically active Io moon over the last 7 years, but we understand little about the physical processes occurring on this moon. Groundbased monitoring programs help characterize the long time evolution of Io's volcanic activity, such as the frequency, spatial distribution and temperature of hot spots and outbursts.
Our group started a monitoring program of Io's volcanic activity using the Keck II Adaptive Optics (AO) system and its recently installed near-infrared camera NIRC2. Here we report groundbased observations of Io conducted in December 2001 (UT), at 0.05" resolution (120-140 km on Io) in K', i.e., 4 times better than HST and than global Galileo NIMS images. Our 1-5 micron data enable us to determine the temperature of individual hot spots, a key parameter for geophysical/volcanic flow models. We will present:

i) Io in reflected sunlight in K', L', and M bands. We used Io itself as reference source for the wavefront sensor of the AO system. Our L and M-band images show both reflected sunlight and thermal emission from volcanic hot spots. The contrast of images is enhanced using the MISTRAL deconvolution algorithme. The 12 images taken on 10 days provides a complete survey of Io surface during one full rotation. 26 active hot spots were detected on the entire surface in L band (3.8μm), approximatively three times more in M band (4.7μm). One active hot spot is seen in K band (2.2μm) in the Pele area. A study of individual hot spot (temperature, emission area, nature) will be presented.

ii) Io in eclipse. While Io is in Jupiter's shadow, it is invisible to the wavefront sensor, but its hot spots are easily visible in the near-infrared. We imaged Io during the 18 Dec. 2001 eclipse using Ganymede (30" from Io, moving relative to Io at 0.5"/min) as a reference source. A dozen of faint hot spots are detected at both K' and L', allowing temperature estimates for each of them.

Keck Science team is composed of S. Kwok, P. Amico, R. Campbell, F. Chaffee, A. Conrad, A. Contos, B. Goodrich, G. Hill, D. Sprayberry, P. Stomski, P. Wizinowich (W.M. Keck Observatory).

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URL: http://astron.berkeley.edu/~fmarchis/Science/Io

P71B-0461 0830h POSTER

A Tale of Two Hot Spots: Charting Thermal Output Variations at Prometheus and Amirani from Galileo NIMS Data

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Galileo Near Infrared Mapping Spectrometer (NIMS) data show that the active ionian volcanoes Prometheus and Amirani have significant thermal emission in excess of non-volcanic background emission in every geometrically appropriate NIMS observation. The 5 μm brightness of these volcanoes shows considerable variation from orbit to orbit. Like the flank eruptions on Kilauea, Hawai'i, which began in 1983, these ionian volcanoes exhibit periods of elevated activity. A study of the 5 μm thermal emission in all low-spatial resolution NIMS observations (both night and day-time) from June 1996 (Orbit G1) to May 2001 (Orbit C30) shows that the Prometheus thermal output (uncorrected for emission angle, e) ranges from 4 to 21 GW/μm, and Amirani shows greater variations, from 4 to 31 GW/μm. Correcting all thermal outputs for observations where e$< 60^{\circ}$ yields an average Prometheus output of 13.3 GW/μm (standard deviation of 7.3 GW/μm) and a larger average Amirani thermal output of 44 GW/μm (standard deviation of 26 GW/μm). Prometheus showed its greatest e-corrected thermal emission during November 1997 (33 GW/μm), more than four times that seen in June 1996 (orbit G1; see Davies *et al.*, 2000, Icarus, **148**, 212-225) and Amirani showed its greatest thermal emission during May 1997 (orbit G8), nearly 100 GW/μm, nearly five times that seen during orbit G1. Prometheus and Amirani spectra obtained at night show that the overall spectral shape of the thermal emission from 2 to 5 μm does not greatly change. The style of eruption is not resulting in disproportionately large areas at very high temperatures in relation to cooler crustal areas, such as seen at Pillan in 1997 and at Pele, indicating that the style of eruption is not changing, just the areal extent of activity. Scaling magma eruption rates derived from G1 NIMS data yields maximum and average volumetric eruption rates of 337 and 154 $m^3\ s^{-1}$ for Amirani, and 128 and 52 $m^3\ s^{-1}$ for Prometheus. The style and behavior of eruptions at Prometheus and Amirani are apparently very like current Kilauea flank activity, a more-or-less continuous eruption with emplacement of mostly insulated surface flows, punctuated with periods of increased activity. Prometheus and Amirani are on a much greater areal scale, however. These eruptions are generally effusive and non-explosive: that there is no large-scale fire-fountaining observed indicates that the magma is relatively low in volatiles. Magma, fed from a deep source, may be stored in near-surface magma chambers where degassing takes place, before erupting at the surface. Alternatively, the magma may already be low in dissolved volatiles, or is of such low viscosity that explosive release of gas is not taking place.
This work was performed at JPL-Caltech under contract to NASA. AGD is supported by NASA PG&G grant 344-30-23-09.

P71B-0462 0830h POSTER

The Emerging Resurfacing History of Europa

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We have completed the geologic mapping and analysis of pole-to-pole transects across the leading and trailing hemispheres of Europa. Our results show that ~50% of the mapped areas has been resurfaced since the period of background ridged plains formation (comprising the last 50-100 Myr.): ~30% by tectonic processes and ~20% by chaotic disruption. Further, the geologic record indicates a transition from tectonic- to cryovolcanic-dominated resurfacing. The style of tectonic processes changed with time, from intensive, closely spaced fracturing and ridge building forming background plains, to infilling of inter-plate gaps forming broad bands, to gradually narrower and farther-spaced ridges and ridge complexes. In both hemispheres, these lineaments rotated with time in senses consistent with nonsynchronous rotation predictions. The lack of lineaments overprinting impact structures (with the exception of Tyre) suggests that the intensity of tectonic resurfacing decreased rapidly after the formation of ridged plains. Units associated with chaotic disruption overprint one another (in areas that broadly match regions where the regional thermal gradient has been raised by tidal dissipation), fragmenting the evidence for early cryovolcanic activity. Old, subdued chaos has been reworked to form younger chaos areas by merging of small patches of disruption; the most recent chaos features appear to be slightly elevated with respect to the surrounding plains. These observations suggest that chaos formed by disruption and emplacement of buoyant material from the subsurface, which became topographically and morphologically subdued with time.

One possible interpretation of the mentioned trends and changes is the gradual thickening of Europas lithosphere throughout the visible geologic history: the degree of fracturing and plate displacements decrease in a thickening shell, while lineaments become narrower and more widely spaced; formation of chaos regions can take place where the thickness threshold for solid-state convection is exceeded, and can be aided by the preferential tidal heating of more ductile ice. In a long-term context, we cannot determine at this point whether this thickening trend would reflect a drastic change in the thermal evolution of the satellite, or more stable cycles of tectonic and cryovolcanic activity. Future global mapping and geophysical measurements of the current state of the lithosphere may provide the information needed to strengthen this emerging scenario and to solve some of the outstanding issues.

P71B-0463 0830h POSTER

Under the Volcano: Gravity Evidence for an Extinct Magma Chamber Beneath Syrtis Major, Mars

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Syrtis Major is a Hesperian age shield volcano on Mars, 1100 km in diameter and just 1 km high. Two calderas, Meroe Patera and Nili Patera, are set within a broader topographic summit depression. The regional gravity field is well modeled by flexural support of the surface topography. For a crustal density of 2800 kg m^{-3} and a mantle density of 3400 kg m^{-3}, the best fit elastic lithosphere thickness is 10 to 15 km. Increasing the crustal density requires a decrease in the lithospheric thickness. There is a pronounced free-air gravity anomaly over the summit caldera complex. This gravity high has an amplitude of 100 mGal through spherical harmonic degree 40 and 124 mGal through spherical harmonic degree 50 and is thus robustly determined by the Doppler tracking data from Mars Global Surveyor. The anomaly has a high degree of axial symmetry, with a low amplitude extension to the south.

The gravity high occurs over the caldera's topographic low and thus requires the presence of dense material in the subsurface. The spatial association between the caldera and the buried mass anomaly suggests that the subsurface structure is due to the accumulation of dense igneous cumulates in a now solidified magma chamber. Because of the symmetry of the observed anomaly, it is modeled as a buried vertical cylinder in order to minimize the number of free parameters that must be constrained. The width of the observed anomaly constrains the cylinder radius to a maximum of 150 km. Assuming that the intrusive body is olivine similar to the martian meteorite Chassigny (Fo68, density 3500 kg m^{-3}), the intrusive body has a minimum thickness of 5 km. A pyroxene rich intrusive, similar to the martian meteorite Nakhla, would have a lower density and thus a greater minimum thickness. The total mass anomaly is between 1.8-2.7 $\cdot 10^{17}$ kg. This constitutes only 5-10% of the total mass of the volcano and its subsurface root. Thus, generating the required amount of cumulate minerals is probably not a difficult petrological problem.

URL: http://www.lpi.usra.edu/science/kiefer/home.html

P71B-0464 0830h POSTER

On the late stage eruptive activities of Ceraunius Tholus, Mars estimated by MOLA and MOC images

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Ceraunius Tholus, one of the medium-sized volcanoes at the Tharsis plateau on Mars, shows several enigmatic features and thus it is a target of intensive imaging by MGS(Caplinger 2001). Plescia(2000), based on the Viking images, argues that the basic construct is a basaltic shield although the lava flows are not wel rcognized, and postdated coverage of pyroclastic materials by plinian eruption is suggested. This means transition of eruption style from effusive type to explosive one. Higuchi and Kurita(2002) recently analysed the surface slope distribution of this volcano by using MGS-MOLA data. They revealed that, 1)the slope distribution pattern is quite similar to that of the terrestrial scoria cone though the size is largely different, 2)the eastern flank preserves the original morphology while the western half exhibits a sign of secondary modification such as edifice collapse, and 3)the surface is smoother in the western flank at the length scales of several km to 100m than that in the eastern flank. We consider that this is a kind of giant scoria cone.

In this report, coupled with this quantitative morphological study we discuss the eruption style of Ceraunius Tholus and its variation with time based on MOC high resolution images. We particularly focuss on the clear morphological difference between the western and the eastern flanks revealed by MOC images. The surface of the western flank is characterized by abundance of flute marks(scouring pattern) radiating from the central caldera. This scouring pattern is considered to be created by hydrodynamic erosion of suspended flow. This indicates ground-hugging intense flow events happened at the late stage of the volcanic activity, which seems to overflow from the lower part of the caldera rim. Several small craters are buried by this flow and they remained tear-drop type erosional left-overs in the downstream. The nature of this flow event is discussed based on these morphological features.

P71B-0465 0830h POSTER

Viscosity and Density of Fe-Rich Silicate Melts Relevant to Mars

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Observations from Mars missions have revealed that Mars has had a very active igneous history. While volcanism on Mars is thought to have occurred in the first half of the planets history, recent evidences suggest that Mars may, in fact, still be volcanically active. An improved understanding of the unique geological history and evolution of Mars relies on the development of models for the planets interior and hypotheses regarding the planets formation and evolution. This, in turn, requires a knowledge of the physico-chemical properties of Martian magmas. Of all the properties of interest, viscosity and molar volume are those that most tightly control the dynamics of magmas.composition of Martian magma has been derived from the composition of the SNC Martian meteorites and it is generally accepted that Martian magma may contain up to 18 wt% of iron. Unfortunately existing models to calculate the physico-chemical properties of Martian magmas are insufficient in at least one important aspect: they are not calibrated for the high iron contents inferred in Martian magmas. In order to rectify this we are developing an experimental program to determine the physico-chemical properties of iron-rich silicate melts relevant to Mars, from which the partial molar properties of both iron components (FeO and Fe_2O_3) will be derived.a first step, compositions in simple iron-bearing systems have been studied. Variable amounts of iron (up to 30 wt%) have been added to the anorthite-diopside eutectic composition, a basalt analogue. The high-temperature viscosities and densities of these melts have been measured in air by concentric cylinder method and using the Pt-based double-bob Archimedean method, respectively. These measurements suggest a decrease of the viscosity with increasing Fe-content and an increase of the density with increasing Fe-content. In addition, the oxidation state of iron in these samples as a function of temperature was investigated by wet chemistry methods. Preliminary results show that Fe_2O_3-content decreases with increasing temperature (i.e., about 10% within the temperature range investigated, namely between 1300 and 1600°C).

P71B-0466 0830h POSTER

Rayleigh-Taylor Instabilities as a Mechanism for Coronae Formation on Venus

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Coronae are Venusian quasi-circular volcano-tectonic features that range in size from 60km-1000km. They are believed to form over small-scale mantle upwellings. Previous models of corona formation can best match the observed topographic morphology when the upwellings cause the cold, dense lower lithosphere to delaminate, sinking into the mantle and deforming the surface. These complex evolutionary models can predict the general topography of most classes of coronae and can also account for most of the deformation observed around coronae. The size and depth at which these plumes might originate is unclear, however, and the relatively close spacing of coronae is surprising if these plumes originate from deep in the mantle. We here investigate an alternative causal mechanism for coronae based on the idea that gravitational instability of the dense mantle lithosphere could also explain the observed topography and gravity. In Rayleigh-Taylor instability, coupled downwelling and upwelling develops from an initial perturbation in lithospheric thickness. Recent analysis of gravity data suggests that deformation of the crustal layer may play an important role in causing surface topography for coronae and explaining volcano-tectonic deformation features. We examine the role of crustal thickness in forming specific corona morphologies using "basil", a 2D finite deformation program adapted to calculate viscous deformation assuming cylindrical axisymmetry. Instantaneous flow fields are integrated forward in time in order to compute the final strain field. Rayleigh-Taylor instability with imposed cylindrical axisymmetry produces either central depression surrounded by a positive topographic annulus (or vice-versa). If deformation is small we observe that linear growth rates q are the same for either form of the instability. We find this rate to be maximum at wavenumber k=2.5 for rigid boundary models, but the wavelength of deformation lengthens to k=0.32 for free-slip boundaries. When a low density crust is added (crust viscosity = mantle viscosity), we observe that surface topography above a central downwelling evolves from an initial central depression to central uplift surrounded by a depressed annular region, and find that the growth rate is now maximum at k=1.3 for free-slip boundaries. Adding a low density crust reduces q for all k as the buoyant crustal layer inhibits the growth of the instability. Whether the surface is elevated or depressed depends on crustal buoyancy and crustal viscosity.

P71B-0467 0830h POSTER

The Role of the Crust and Elastic Lithosphere in the Formation and Evolution of Venusian Type 2 Coronae

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The population of over 500 coronae provide a useful means of probing the structure of the lithosphere on Venus. We examine the admittance signature for all the 37 Type 2 coronae (defined as having less than 50% complete fracture annuli) that are well resolved in the gravity data using both Cartesian and wavelet admittance approaches. We obtain a wide range of elastic thicknesses, from 10 to 85 km. Larger values are derived from bottom loading models, which have not been used in most prior studies of Venus. Estimates of crustal and elastic thicknesses obtained for Type 2 coronae span the range obtained for Venus globally. Neither the thickness of the elastic lithosphere nor the crust appear to control whether Type 1 coronae, Type 2 coronae, or volcanoes form over small scale mantle upwellings. Using the estimated lithospheric properties, loading signature, and geologic characteristics, we examine the factors controlling corona morphology, size, and fracture pattern (Type 1 versus Type 2). Elastic thickness has no correlation with diameter, and thus does not limit the location of coronae. The ratio of the crustal thickness to plume diameter does not control morphology as a function of size, as predicted by a spreading drop model. However, rim only coronae, which are predicted to form via isostatic rebound of crust thickened by delamination are clearly supported by a density interface. This interface could be the basalt-eclogite transition, which would favor delamination and might be more common in the plains. Lithospheric properties for Type 2 coronae vary with topographic morphology. The complex processes that form different morphologies preclude a simple increase in elastic thickness over time. Overall the stage of evolution and formation mechanism account for the majority of variability found in Type 2 corona morphology, and probably for Type 1 coronae as well. The role of a density interface and delamination of the lower lithosphere are likely more important in understanding the evolution of the Venusian lithosphere than variations in elastic thickness.

P71B-0468 0830h POSTER

The Effect of Small Scale Convection on the Uplift Rate of Beta Regio

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Recent evidence suggests that the Beta Regio equatorial highland, generally considered to be a plume-related structure, was emplaced over a relatively short period of time in the recent Venus history (100 - 400 m.y.). Numerical simulations which use this evidence as a new constraint on geodynamic models show that it is difficult to satisfy simultaneously the constraint on the uplift rate and the constraints on gravity, topography and rheology.

One possible solution is that the effective viscosity contrast between the mantle and the lithosphere does not exceed about 10^4. If our simple models do capture the basic dynamics of formation of Beta Regio, this value implies that the viscosity of the lithosphere is softer than olivine at subsolidus temperatures and that the Venusian lithosphere may not be much stronger than the terrestrial one.

We investigate another possible interpretation of these results - the effect of small-scale convection which can be developed in the plume or in some other type of upwelling. This can significantly accelerate the uplift rates of Beta Regio and satisfy the timing constraints.

P71B-0469 0830h POSTER

Short-wavelength Contractional Structures in Venusian Fold Belts: Additional Constraints From New Models

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We have previously reported on the development of very short-wavelength (<1 km) contractional topography (VST) in Venusian crustal plateau fold belts, which show structures with wavelengths from ~100 m to >30 km [1, 2]. We simulated the initiation and growth of VST using finite-element models with uniform composition and elasto-visco-plastic rheology undergoing simultaneous cooling and shortening. The models were constrained by Magellan SAR imagery and motivated by the current plume hypothesis for crustal plateau origin [3, 4]. We determined that VST developed only in models with surface temperatures near 1000 K and elevated thermal gradients derived from a halfspace cooling model with initial uniform temperatures of 1200-1400 K. Model rheological profiles indicated a truly viscoplastic character, in which both creep and plastic mechanisms were significant at shallow depths. The resulting topography showed both very short-wavelength components and slightly longer-wavelength, low amplitude folds, as is common in Venusian crustal plateau fold belts.

New simulations with greater spatial extent and higher mesh resolution allow further exploration of the interplay between viscous and plastic processes during VST development. Wider models allow more detailed investigation of viscous folding on the 1-4 km scale. We also employ temperature-dependent thermal conductivity [5] to better represent the thermal behavior of the model crust. The additional insight and expanded parameter space provided by these new models allow us to place improved constraints on the early thermal and mechanical evolution of crustal plateaus.

[1] Ghent, R.R., R.J. Phillips, V.L. Hansen, and D.C. Nunes, Eos Trans. AGU, 83(19), Spring Meet. Suppl., Abstract P21A-05, 2002. [2] Ghent, R.R., R.J. Phillips, and V.L. Hansen, 2001, Eos Trans. AGU, 82(47), Spring Meet. Suppl., Abstract T41B-0865, 2001. [3] Hansen, V.L. and J.J. Willis, Icarus, 132, 321-343, 1998. [4] Phillips, R.J. and V.L. Hansen, Science, 279, p1492, 1998. [5] Hofmeister, A, Science, 283, p1699, 1999.

P71C MCC: Hall D Sunday 0830h

Stable Isotopes and the Search for Life in the Solar System II Posters

(joint with B, V)

Presiding: **S J Mojzsis,** University of Colorado

P71C-0470 0830h POSTER

Variable Carbon Isotopes in ALH84001 Carbonates

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