V32G-12 1635h

Near-Solidus Trace Element Partitioning at 3.0 GPa on the Peridotite Solidus.

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Many results on the trace element and isotopic compositions of MORB indicate that melting beneath ridges begins within the garnet peridotite stability field. This conclusion is based on excesses in the activity of 230Th over its parent 238U, on enrichments in 176Hf relative to its parent 176Lu and on the general HREE pattern of MORB glasses. Garnet is unstable on the peridotite solidus at pressures below 2.8 GPa. This implies that potential temperatures of about 1450°C are required to generate significant amounts of anhydrous melt from garnet peridotite. Under these circumstances, the paradoxical result is that melting should produce about twice the thickness of oceanic crust observed and thus an alternative mechanism must exist by which to impart the garnet signature. Possible mechanisms include the entrainment of garnet pyroxenite partial melts produced at <2.8 GPa, or the presence of water in the garnet peridotite melting regime, resulting in melt production at lower temperatures and hence volumetrically less melt. An alternative explanation which negates the presence of garnet in the MORB source was proposed by Blundy et al. (1997) who attributed the 'garnet signature' to HREE compatibility in near-solidus aluminous clinopyroxene at 1.5 GPa spinel-bearing lherzolite. Since MORB is thought to represent the accumulated small volume fractional, and hence near-solidus melts, this observation is of particular significance. However since this result is not directly relevant to the onset of most MORB melt production in that it pertains to melting at cold, deep ridges, it is not clear whether these aluminous clinopyroxenes can account for the entire 'garnet signature'. In an attempt to quantify the likely contribution to MORB of spinel lherzolite melts relative to those from garnet lherzolite, we have determined the partition coefficients of the REEs, HFSEs (Zr, Hf, Nb, Ta) and Li, Sr, U and Th between cpx, opx, grt and melt at 3.0 GPa, 1500°C. These experiments use the 4-phase-saturated, near-solidus garnet lherzolite melt composition determined by Dalton et al. (in prep.) (49.9 wt% SiO2, 3.5 wt% Na2O, Mg# 82), doped with trace elements at the ppm level, and seeded with equilibrium composition ol, grt, opx and cpx. Our new partitioning data are incorporated into a dynamic melting model in order to assess the relative contribution of spinel and garnet lherzolite melts to MORB.

V41A MC: Hall D Thursday 0830h

Volcanic Observations From Space: New Results From the EOS Satellite Instruments II *(joint with G, P)*

Presiding: **M Ramsey,** University of Pittsburgh**; L Flynn,** University of Hawaii at Manoa

V41A-0972 0830h POSTER

Analysis of Vulnerability Around The Colima Volcano, MEXICO

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The Colima volcano located in the western of the Trasmexican Volcanic Belt, in the central portion of the Colima Rift Zone, between the Mexican States of Jalisco and Colima. The volcano since January of 1998 presents a new activity, which has been characterized by two stages: the first one was an effusive phase that begin on 20 November 1998 and finish by the middle of January 1999. On February 10of 1999 a great explosion in the summit marked the beginning of an explosive phase, these facts implies that the eruptive process changes from an effusive model to an explosive one. Surez-Plascencia et al, 2000, present hazard maps to ballistic projectiles, ashfalls and lahars for this scenario. This work presents the evaluation of the vulnerability in the areas identified as hazardous in the maps for ballistic, ashfalls and lahars, based on the economic elements located in the middle and lower sections of the volcano building, like agriculture, forestry, agroindustries and communication lines (highways, power, telephonic, railroad, etc). The method is based in Geographic Information Systems, using digital cartography scale 1:50,000, digital orthophotos from the Instituto Nacional de Estadstica, Geografa e Informtica, SPOT and Landsat satellite images from 1997 and 2000 in the bands 1, 2 and 3. The land use maps obtained for 1997 and 2000, were compared with the land use map reported by Surez in 1992, from these maps an increase of the 5 porcent of the sugar cane area and corn cultivations were observed compared of those of 1990 (1225.7 km2) and a decrease of the forest surface, moving the agricultural limits uphill, and showing also some agave cultivation in the northwest and north hillslopes of the Nevado de Colima. This increment of the agricultural surface results in bigger economic activity in the area, which makes that the vulnerability also be increased to different volcanic products emitted during this phase of activity. The degradation of the soil by the agriculture and forestry, mainly in the east hillslope of the volcano is another factor that generate remoulded material that in the event of an extraordinary rainfall during an explosive events, could increase the size of the lahar or generate flows of mud that may affect the towns, villages (like Atenquique, which has been affected in 1957 by a large lahar), and could generate strong damages to the communication lines affecting distant places as Guadalajara city and the Port of Manzanillo.

V41A-0973 0830h POSTER

Advantageous GOES IR Results for Volcanic Ash Mapping at High Latitudes: Cleveland Eruptions 2001

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The February 2001 eruptions of Cleveland Volcano, Alaska allowed for comparisons of volcanic ash detection using two band thermal (10-12 micron) infrared remote sensing using MODIS, AVHRR and GOES data. The data sets differ in spatial resolution and satellite zenith angle. Whereas MODIS data has zenith angles generally <40 degrees, the GOES has zenith angles for the Cleveland volcanic clouds at 60-65 N that are around 70 degrees. Because of the geometry the rectified footprint of GOES volcanic cloud areas is much larger than MODIS and the magnitude of the negative brightness temperature difference is sometimes 2 to 3 times higher. The differences are explained by distortion of the cloud's lateral extent because of the side-looking aspect and the longer path length through the volcanic cloud because of the high zenith angle. The shape of the cloud with respect to the GOES look angle is also important to understand the differences. Results show that high latitude GOES volcanic cloud sensing up to about 65 degrees is significantly enhanced, and that corrections for zenith angle are important for GOES data interpretations. Similar enhancements should occur for volcanic clouds at locations at low latitude which are visible by GOES but displaced from the GOES geostationary latitude.

V41A-0974 0830h POSTER

Developing a Long-term Hazard Mitigation Plan for Consequent Volcanic Sedimentation Hazards at Santiaguito Dome Complex, Guatemala

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Continuous volcanic activity at Santiaguito, accompanied by seasonal monsoons, results in sediment inputs downslope into the Ro Ixpatz and Ro Samal river channels. This threatens the lives and economic stability in populated downstream areas of Guatemala's coastal slope, a region responsible for major contributions to Guatemala's foreign exchange earnings. The changing riverbeds are host to sediment and water quality problems; subsequent flooding threatens villages, nearby cropland, infrastructure, and transportation. Current research suggests that the volcanic activity results in costs equal to millions of US dollars per year. Mitigation efforts are needed to protect lives, fertile land, and valuable crops located along the river valleys and plains in the down-slope region of the volcano.

The goal of this work is to build a GIS database for the areas affected by Santiaguito to facilitate the development of a long-range (several decades) plan for hazard mitigation and infrastructure development. The GIS will include multiple TM images which have been used to quantify activity and downslope aggradation patterns (Matias et al, this meeting), digital topography obtained from IGN and USGS/VDAP, land use maps and infrastructure overlays from IGN, Guatemala, and volcanic hazard zonation maps from INSIVUMEH, Guatemala. We expect to also use LAHARZ (Iverson, R.M., Schilling, S.S., Vallance, J.W., GSA Bulletin, 1998) to supplement GIS analysis. Additionally, we plan to work with local agencies within Guatemala to improve the current mitigation strategy which mainly involves extensive annual river and near-bridge dredging and is reactive on short time scales.

V41A-0975 0830h POSTER

Analysis of Hot Springs in Yellowstone National Park Using ASTER and AVIRIS Remote Sensing

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Remote sensing data from multispectral ASTER and hyperspectral AVIRIS are used to detect and analyze terrestrial hydrothermal deposits. ASTER is beneficial for determining regional characteristics of hydrothermal areas, whereas AVIRIS has the necessary spectral resolution for detection of specific alteration minerals. Because detection of potential Mars relict hot springs will be done remotely, it is important to understand how we detect and can study these deposits on Earth. The THEMIS (Thermal Emission Imaging System) instrument, onboard Mars Odyssey, will search for thermal anomalies associated with hot springs on Mars. THEMIS and ASTER have similar spatial and spectral resolutions, therefore it is crucial to use ASTER to understand the thermal characteristics of terrestrial hydrothermal springs.

ASTER and AVIRIS data are being used to characterize the hot spring deposits in the Lower, Midway, and Upper Geyser Basins of Yellowstone National Park in the visible to thermal infrared wavelengths. ASTER data are being analyzed to determine broad scale characteristics of the hot springs and their deposits, identify thermal anomalies, and create large scale mineral maps of these basins. Image processing shows differences in these basins, including extent of thermal alteration, alteration minerals, and classifications. Comparisons of active, near-extinct, and extinct geysers are also being completed through remote sensing.

Field observations of these basins provide ground truth for comparison to the results of the remote sensing data. Fourteen study sites were selected based on diversity in size, types of deposits, and activity. This study included detailed site surveys such as land cover analysis, photography, Global Positioning Satellite data collection, radiometric analysis, and field spectroscopy. Samples of hot spring deposits, geyser deposits, and soil samples were collected and are being analyzed with a laboratory spectrometer that gathers information from the visible to thermal infrared wavelengths.

The results of this remote sensing and field study will lead to a greater understanding of spectral differences in active versus extinct springs, how to search for similar features on Mars, and what characteristics and anomalies the potential Martian hydrothermal features may have in the thermal infrared region.

V41A-0976 0830h POSTER

Volcanism at Pacaya, Guatemala 1985-2001: Potential of TM Images in Assessing Strombolian Activity

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Pacaya is a basaltic volcano with a history of catastrophic collapse which has exhibited nearly continual low-level eruptive activity since 1965, and has also had periods of violent explosions. In the current year one of the authors (Matias) is beginning a synthesis of the diverse observational data on Pacaya's activity of that exist for the past four decades as a step toward improving the ability to assess potential hazards from the volcano. This is particularly important because the volcano (1) is located 25 km S of Guatemala City, (2) falls along the local airport final approach route, (3) has caused airport closure for several days in 2000, (4) is located in a national park where it and is thus visited and closely viewed by large groups of tourists every day, and (5) has 500-2000 inhabitants living within 5 km of its active crater. Since 1985 a time series of >25 cloud-free Landsat Thematic Mapper and Enhanced Thematic Mapper Plus images have been assembled and these are being used with ground-based observations, mapping and modeling as an important tool in (a) quantifying activity (e.g. calculation of eruption rates and flow volumes), (b) tracking changes at the volcano and (c) in establishing time-based patterns that may be useful in hazards assessment. The study is just beginning and will be presented as a work in progress. Our plan is to interact with the large number of scientists who have visited this exciting volcano. Because we have abundant ground-based observational data to complement the satellite observations, we expect to be able to evaluate the potential value of multispectral satellite observations in tracking activity at Pacaya.

V41A-0977 0830h POSTER

Observing Active Volcanism on Earth and Beyond With an Autonomous Science Investigation Capability

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Operational constraints imposed by restricted downlink and long communication delays make autonomous systems a necessity for exploring dynamic processes in the Solar System and beyond. Our objective is to develop an onboard, modular, automated science analysis tool that will autonomously detect unexpected events, identify rare events at predicted sites, quantify the processes under study, and prioritize the science data and analyses as they are collected. A primary target for this capability is terrestrial active volcanism. Our integrated, science-driven command and control package represents the next stage of the automatic monitoring of volcanic activity pioneered by GOES. The resulting system will maximize science return from day-to-day instrument use and provide immediate reaction to capture the fullest information from infrequent events. For example, a sensor suite consisting of a Galileo-like multi-filter visible wavelength camera and an infrared spectrometer, can acquire high-spatial resolution data of eruptions of lava and volcanic plumes and identify large concentrations of volcanic SO_2. After image/spectrum formation, software is applied to the data which is capable of change detection (in the visible and infrared), feature identification (both in imagery and spectra), and novelty detection. In this particular case, the latter module detects change in the parameter space of an advanced multi-component black-body volcanic thermal emission model by means of a novel technique called the "Grey-Box" method which analyzes time series data through a combination of deterministic and stochastic models. This approach can be demonstrated using data obtained by the Galileo spacecraft of ionian volcanism. The system autonomously identifies the most scientifically important targets and prioritizes data and analyses for return. All of these techniques have been successfully demonstrated in laboratory experiments, and are ready to be tested in an operational environment. After identification of a target of interest, an onboard planner prioritizes resources to obtain the best possible dataset of the identified process. We emphasize that the software is modular. The change detection and feature identification modules can be applied to any imaged dataset, and are not confined to volcanic targets. Applications are therefore widespread, across all NASA Enterprises. Examples include detection and quantification of extraterrestrial volcanism (Io, Triton), the monitoring of features in planetary atmospheres (Earth, Gas Giants), the ebb and flow of ices (Earth, Mars), asteriod, comet and supernova detection, change detection in magnetic fields, and identification of structure within radio outbursts.

V41A-0978 0830h POSTER

Impacts on Volcanic Ash Detection Caused by the Loss of a 12.0 Micrometer "Split Window" IR Band on GOES Imagers

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Beginning with the Geostationary Operational Environmental Satellite (GOES)-M spacecraft (successfully launched July 23, 2001) through GOES-P (2007), a 12.0 micrometer (μm) "Split Window" InfraRed (SWIR) band (4 km resolution) on the GOES Imager will be replaced by a 13.3 μm channel (8 km resolution). Differences between the brightness temperatures at 12.0 and 10.7 μm (known as the Two-Band Split Window (TBSW)) have been successfully used in tracking hazardous volcanic ash clouds since first becoming available on GOES-8 in 1994.

In order to assess the effects of this Imager channel reconfiguration on volcanic ash detection, GOES Imager or Sounder data from six weak to moderate eruptions were analyzed to see how volcanic ash coverage would look with and without the SWIR channel. The GOES Sounder has all IR bands currently on the GOES Imager, plus the 13.3 μm band, although the latter is at a lower resolution (10 km). The analysis was completed using software which generates principle component images that display unique information available from all available IR data. The best principle component depiction of the ash cloud for each event was compared to a subjective estimate of the actual ash cloud coverage based on: (1) analysis of all available GOES data, including visible images, (2) the evolution of the volcanic cloud from its eruption to image time, and (3) graphic analyses from Volcanic Ash Advisory Centers.

Preliminary results indicate that the loss of the SWIR band will result in an increase of mis-identified ("false") ash pixels which varies diurnally. During the daytime, the increase in false pixel rate was be minimal (∼1-2 percent). For the single nighttime case, the false pixel rate increased by a factor of ∼4, likely due to the loss of shortwave reflectance at 3.9 μm. However, most of the mis-identified ash is not contiguous with the true ash, suggesting that a human analyst armed with animated 30 minute interval GOES imagery will be able to provide a reasonably good estimate of ash cloud area. Detection capability will be good, although there was evidence that thinner ash will not be detected as well without the SWIR.

Inclusion of data from the 13.3 μm IR band appears to provide a slight positive impact, allowing for better discrimination of ash from thin cirrus clouds. A "silver lining" in this new instrument configuration may be the ability to utilize the 13.3 μm IR for better estimation of optically thin ash clouds by the use of a "CO_2 slicing technique." In summary, we will still be able to observe and track significant volcanic ash clouds in the GOES-M through P era (2002-2007+), but with some degradation that will be most significant at night.

V41A-0979 0830h POSTER

Monitoring Debris Flows on Mt. Rainier with Airborne Multispectral Data

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Catastrophic debris flows on Mt. Rainier present the greatest volcanic hazard in the Cascade range and are a primary threat to nearby heavily populated areas. Two classes of debris flows have been documented: 1) those associated with volcanic activity and/or collapse of weak hydrothermally altered rocks 2) more frequent, smaller debris flows resulting from glacial outburst floods. The first class results from structural collapse due to the coupling of weak hydrothermally altered rocks with intense rainfall, melting snow and ice, earthquakes, and/or thermal activity in the volcano. Structural-collapse debris flows on Mt. Rainier have occurred throughout the Holocene including the Osceola mudflow (5600 yrs. ago) that lowered the summit by 600 meters and covered 550 km^2 with thick debris-flow deposits. Seismic, remote-sensing and field studies have documented the widespread occurrence and mineralogy of hydrothermally altered rock and link the hydrothermal alteration to magmatic-hydrothermal and steam-heated systems. The second class of debris flow occurs when intense rainfall, melting snow and ice leads to the sudden collapse of naturally ponded water. This outburst incises a channel, incorporates sediment, and can transform into a debris flow as it moves downslope. For example, on August 14, 2001, intense summer solar insolation enhanced melting on the Kautz Glacier and resulted in flooding and debris flow initiation.

We use 20-m resolution airborne MODIS/ASTER Simulator (MASTER) data (50 bands, 0.4-13 μm) collected on August 26, 2001 to evaluate the use of multispectral data for monitoring both types of debris flows. Data processing includes topographic correction, atmospheric correction using MODTRAN, and calibration using ground-truthing data. Due to low snowfall in the Pacific Northwest during the winter of 2001, this data set provides a unique opportunity to examine the reflective and emissive properties of exposed hydrothermally altered rock. We evaluate rock strength by looking at the spatial extent and magnitude of hydrothermal alteration and compare our results with a 20-meter 1994 AVIRIS (220 bands, 0.4-2.25 μm) study. TIR data are used to document evidence for sub-ice fumaroles or heat vent activity by differentiating between solar-heating effects and internal thermal activity. Using water absorption bands and TIR data, we estimate snow water content and temperature to evaluate if MASTER data can be used to monitor areas (E.g. Kautz Glacier) that are prone to melting and ponding of water that may lead to debris flows.

V41A-0980 0830h POSTER

MODIS and TOMS Retrievals of Volcanic Sulfur and Ash Emissions from Nyamuragira Volcano

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The Moderate Resolution Imaging Spectrometer (MODIS) on board the Terra platform has the ability to retrieve sulfur dioxide, sulfate and ash burdens (using 4 bands in the IR spectrum). MODIS images are available at least once per day, with a nadir resolution of 1 km. NASA's Total Ozone Mapping Spectrometer (TOMS) uses 6 ultraviolet wavelengths to retrieve sulfur dioxide quantitatively and map ash and aerosols. TOMS images are available once per day, with a nadir resolution of 39 km. Thus retrievals using the two instruments have the capability for fairly robust cross-validation.

Nyamuragira volcano, in the Democratic Republic of Congo, has produced 12 distinct periods of activity over the past 20 years, most recently in February-March of 2001. TOMS data include daily images from Feb. 6 - 21, typically observed 0900 - 1100 GMT. SO2 emissions were observed on 9 days following the initial eruption; on several other days there were traces of sulfur dioxide signals which will continue to be investigated. Archived MODIS data have been analyzed during the morning overpass (about 0900 GMT) for the first two post-eruption days, with more analyses planned to coincide with the TOMS retrievals. To help constrain cloud altitudes and sulfur emissions derived from the satellite data, we use the Goddard isentropic trajectory model to track parcel trajectories over short periods of time. Gridded meteorological fields from the Goddard Data Assimilation Office's GEOS-3 product are used as input.

Comparisons of gas, ash and aerosol retrievals from the TOMS and MODIS sensors will provide a good test under tropical (wet) atmosphere conditions. TOMS-measured SO2 emissions for the first 5 days ranged from 50-500 kt, followed by 6 days of generally lesser emissions (20-100 kt). TOMS detected sulfate aerosols on six days, but detection was not directly correlated to SO2 amounts. MODIS retrievals show a NW-drifting sulfur dioxide cloudmass coincident with clouds mapped by TOMS, and consistent with tropospheric

wind trajectories, but also ash plumes following distinctly different SW trajectories which TOMS did not detect.

V41A-0981 0830h INVITED POSTER

Automated Volcanic Eruption Detection Using MODIS

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The Moderate Resolution Imaging Spectroradiometer (MODIS) flown on-board NASA's first EOS platform, Terra, offers complete global data coverage every 1-2 days at spatial resolutions of 250, 500, and 1000-m. Its ability to detect emitted radiation in the short (4 micron) and long-wave (12 micron) infrared regions of the electromagnetic spectrum, combined with the excellent geolocation of the image pixels (200-m), make it an ideal source of data for automatically detecting and monitoring high-temperature volcanic thermal anomalies. This presentation will describe the underlying principles of, and results obtained from, just such a system, developed at the Hawaii Institute of Geophysics and Planetology. Our algorithm interrogates the MODIS Level 1B stream for evidence of high-temperature volcanic features. Once a hot-spot has been identified its details (location, emitted spectral radiance, satellite observational parameters) are written to an ASCII text file and transferred via FTP to HIGP, where the results are posted on the internet (http://modis.higp.hawaii.edu). The global distribution of volcanic hot-spots can be examined visually at a variety of scales using this web-site, which also allows easy access to the quantitative data contained in the ASCII files themselves. We outline how the algorithm has proven robust as a hot-spot detection tool for a wide range of eruptive styles at both permanently and sporadically active volcanoes including Soufriere Hills (Montserrat), Popocatepetl (Mexico), Bezymianny (Russia), and Merapi (Java), amongst others. We also present case studies of how the system has allowed the onset, development and cessation of discrete eruptive events to be monitored at Nyamuragira (Congo), Piton de la Fournaise (Reunion Island), Shiveluch (Russia), Kilauea (Hawaii) and Etna (Sicily).

V41A-0982 0830h POSTER

Geomorphometric Analysis of Debris Flow Terraces at Mount Rainier, WA Using Spacecraft Acquired Topography

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Methods used in extracting digital topography from remote sensing data include photogrammetry, interferometry, altimetry and photoclinometry. Two recent spaceborne missions use some of these methods for generating global DEM coverages at horizontal resolutions less than 100 m per pixel. This study evaluates and compares the utility of such data for estimating inundation levels of past debris flows based on the upslope heights and cross-sectional extents of terraces preserved in river valleys. Deposits from Mount Rainier representing debris flow volumes spanning several orders of magnitude are used as case examples for testing this idea.

ASTER DEMs are derived photogrammetrically by measuring the parallax between a stereo pair of images acquired simultaneously by nadir- and aft-viewing instruments. The two channels used (3N and 3B) have near-infrared bandwidths of 0.76-0.86 microns and a base/height ratio of 0.6 for the stereo pair. SRTM DEMs are currently being produced interferometrically from C- (5.6 cm wavelength) and X-band (3 cm wavelength) synthetic aperture radar (SAR) by measuring the phase differences between SAR images acquired by two antennas spaced 60 m apart.

Terraces of the Electron mudflow, National lahar, and Tahoma lahar deposits were all resolved in cross-sectional profiles extracted from the ASTER DEM. These profiles were compared to profiles from a level 2 USGS DEM that was corrected for systematic errors such as canopy, and resampled to the 30 m resolution of the ASTER DEM. The ASTER DEM was co-registered to the USGS DEM, which will later be co-registered to the SRTM DEM when it becomes available.

About 28 km downstream of Mount Rainier, both datasets reveal a terrace of the Electron mudflow at least 25 m high above the channel of the Puyallup River. The ASTER DEM appears to resolve tributary drainages more clearly than the USGS DEM, but unfortunately derives topography at the top of the canopy, which is up to 26 m above the floor of the terrace at this location. Photogeologic interpretation of ASTER VNIR channels confirms that this part of the valley is forest covered. About 8 km further downstream, the ASTER DEM resolves the shape of a landslide deposit younger than the Electron mudflow, which was not as clearly resolved in the USGS DEM. Errors in the measured heights of debris flow terraces will be compared between the ASTER and SRTM data, as well as the utility of interpolation-based resampling methods for reducing its effects and enhancing the signature of the underlying terrain.

V41B MC: 305 Thursday 0830h

New Directions in Experimental Mineralogy and Petrology I *(joint with T, MR, HG)*

Presiding: **R Angel,** Virginia Tech**; G Fiquet,** Universite Paris

V41B-01 0830h INVITED

Some challenges for Seismology and Mineral Physics Research

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The seismological challenges for a better understanding of the dynamics, composition, and evolution of Earth's mantle are many but focus on (1) the upper mantle transition zone (wavespeed variations, radial gradients, and nature of and depth to seismic discontinuities), (2) the fate of deep sinking slabs and the relative wavespeed variations in the lower mantle, and (3) the seismologically inferred complexity just above the core mantle boundary. In the past decade our ability to map lateral variations in seismic wavespeed in Earth's mantle has improved significantly mainly as a result of dramatic increases in computer power and quantity and quality of seismic data, and results of seismic imaging are now routinely interpreted with constraints from mineral physics. However, the interpretation of the inferred wavespeed variations (e.g. in terms of temperature, composition, volatiles, anisotropy) is difficult because the coverage of data used to construct S wave models differs from that used for P models and the magnitude of wavespeed variations is often poorly constrained owing to uneven sampling, regularization of seismic inversions, and wave propagation effects such as wavefront healing. But some interesting observations can still be made. We - and others - have inferred changes in the character of wavespeed variations near 1500-2000 km depth, but there is no convincing evidence for any interface in that depth range. Recent studies have detected differences in the behavior of P and S wavespeed, e.g., the increase of the ratio dlnVs/dlnVp with depth, in particular beneath 1500 km depth. This is unlikely to be a global phenomenon and may occur primarily in regions away from zones of recent subduction (e.g., Saltzer et al, GRL, 2001). Analysis of the available theoretical and experimental data on elastic parameters suggest that these observations cannot be explained by thermal variations alone, but for a more specific and quantitative interpretation we need a better description (or extrapolations) of the elastic properties as a function of temperature, pressure, and composition, including the effects of Al and Ca, for silicates at lower mantle conditions. Furthermore, an adequate (multi component) description of the phase transformations (e.g., element partitioning, pressure and Clapeyron slope of the transition) is required to understand the seismological observations pertinent to the discontinuities and the deformation of subducted slabs in the upper mantle transition zone. Finally, numerical models based on thermal convections are likely to oversimplify the processes in Earth's interior, and more realistic thermochemical modeling should be considered to investigate, for instance, the fate of the slab fragments that have sunk into the lower mantle (e.g., compositional buoyancy), the presence of any pressure-induced compositional gradients, and the effects on dynamics of the temperature and pressure dependence of such physical parameters as thermal expansion and diffusivity. These pose some of the challenges for a concerted effort to understand to composition and evolution of our planet over geological time.

V41B-02 0900h INVITED

Electrical Properties of Deep Earth Materials

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Knowledge of the electrical properties of Earth materials at high P and T can contribute to knowledge of the phases present at depth and of the temperature profile of the interior. Electri-cal properties of rocks are strongly dependent on temperature and on the presence (or ab-sence) of highly conducting mineral phases, fluids or melts, or pathways. Recent laboratory determinations of mineral conductivities allow comparison of observed mantle conductivity profiles with conductivity models that include temperature and composition constraints. The influence of hydrogen or water on electrical conductivity of nominally anhydrous minerals is just beginning to be measured experimentally; preliminary results are consistent with an in-crease in conductivity due to the presence of H, but the effect may be modest at transition zone temperatures. Calculations and point defect models are beginning to shed light on the en-ergetics of hydrogen defects. Such models are important for complete understanding of the process and extrapolation to conditions not easily experimentally studied, such as oxygen and or hydrogen fugacity variations at very high pressures. Inferred conductivities of hydrogen-bearing olivine have lead to interpretation of oceanic conductivity profiles away from ridges as indicating the presence of H-rich sublithospheric mantle and the interpretation of continental conductivity profiles as indicating that sub cratonic mantle is unusually dry. The bulk electrical response of partially molten rock systems, the influence of melt compositional variations at low melt fractions, and the influence of textural equilibration under high-pressure, high-temperature conditions have begun to be studied directly, although detailed calculation of full bulk properties from the starting point of the real melt distributions, including melt pockets and blind alleys as well as interconnected channels, is yet to be achieved. New visualization meth-ods such as high resolution X-ray tomography will be needed to obtain novel results in this area. A developing area is that of electrochemical interactions between metals (molten and solid) and silicates such as may occur at the core-mantle boundary. Such interactions may not mimic those occurring at low pressures, and the results may have implications for generation of mantle plumes and propagation of the Earth's magnetic field.

V41B-03 0930h

Mineralogy of the Lower Mantle by the Combined Method of Laser-heated DAC and ATEM

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The development of laser-heated diamond anvil cell (DAC) experiments enable us to study the mineral compositions of the lower mantle. However, it is generally very difficult to precisely characterize the materials synthesized by DAC with the conventional methods because those materials are very fine-grained, mostly submicron. An analytical transmission electron microscope (ATEM) is a very powerful tool to characterize those materials because by ATEM we can analyze both structures and compositions of those materials in a nanometer scale. Therefore, the combination of laser-heated DAC and ATEM is a very promising approach for the study of the mineralogy of the lower mantle.

Although they are powerful, both laser-heated DAC and ATEM have several problems to be settled. We present our recent attempts to solve those problems, focussing on ATEM. Ultrahigh pressure materials are very weak against an electron beam and easily become amorphous. We are trying to overcome this problem by introducing a high-sensitive TV camera for TEM by which we can observe electron images and diffraction patterns under the very weak electron beam. Another problem with ATEM is the selective removal of elements during ion-thinning of the ultrahigh pressure