The oxidation state of magma bears on the liquid line of descent and the crystallization products of magmatic differentiation. For example, the differentiation of basalt towards either silica enrichment (rhyolite) or iron enrichment (ferrobasalt) hinges on the amount and composition of FeTi oxides crystallizing, that in turn hinges on magma composition and the redox state of iron. To evaluate the redox state of iron during crystallization of the Skaergaard intrusion we have carried out synchrotron micro beam Fe-XANES (X-ray Absorption Near-Edge Structure) analyses and determined the proportion of ferric iron to total iron (Fe3+/Fe) in plagioclase of the Layered Series. The advantage of using iron in plagioclase over FeTi oxides is that iron is a trace element in plagioclase and that plagioclase is the last phase affected by subsolidus equilibration. In cumulus plagioclase cores Fe3+/Fe range from 74 to 15 (based on calibration against oxides) and correlate positively with the anorthite content. The highest Fe3+/Fe (74 to 47) are in the early fractionation products formed prior to the onset of magnetite crystallization, that is in Lower Zone a and b. In the middle portion of the fractionation sequence above the appearance of FeTi oxides, that is from Lower Zone c through to Upper Zone b, Fe3+/Fe displays large within sample variation and measured values in this portion of the stratigraphy range between 62 and 34 without showing a systematic stratigraphic trend. Finally, in the extremely iron-rich cumulates with fayalitic olivine and sodic plagioclase of Upper Zone c, Fe3+/Fe ranges from 26 to 15.

These Fe-XANES results strongly indicate the Skaergaard magma was relatively oxidised prior to magnetite crystallization but thereafter became more reduced with fractionation. This result corroborates to inference from QUILF equilibrium. Hence the Skaergaard magma chamber must have been closed to oxygen exchange in order to reduce ferric iron in the magma in consequence of magnetite crystallization. While Fe3+/Fe decreases with fractionation, the total amount of FeO in the plagioclase cores (0.24 to 0.46 weight percent) increases with fractionation after magnetite-in. This cannot be explained by crystal chemistry or changing partitioning coefficients. We therefore conclude that the iron content of the magma increased with fractionation even after magnetite-in, and that ferrous iron dominated this iron-rich ferrobasaltic end product.

V32E-1038 1330h POSTER

Deeply Eroded Massif Anorthosite and Nepheline Syenite of the Chimakurti-Uppalapadu Plutons, Peninsular India: Cospatial but not Comagmatic

K. Vijaya Kumar[1] (vijay$_k$*umar92@hotmail.com*)

Carol D. Frost[1]

B. Ronald Frost[1]

[1]Department of Geology and Geophysics, University of Wyoming, Laramie, WY 82071, United States

Massif anorthosites are generally thought to be ultimately of mantle origin. However, the lack of samples representing primitive liquid compositions and paucity of early cumulates limits the understanding of the processes that produced them.

Some of the most deeply eroded massif anorthosite complexes are exposed within the southern Eastern Ghat Belt of Peninsular India, and provide an excellent opportunity to study the processes that operated in the deep magma chambers beneath the massifs. In this area Si-undersaturated nepheline syenites are associated with anorthosite complexes, a case that is not reported elsewhere in the world. The objectives of the present study are two fold: 1) to identify the processes that acted at the lowest level of the anorthosite complexes and 2) to determine the relationship between cospatial anorthosites and nepheline syenites.

Cospatial alkaline-tholeiitic magmatism is strikingly displayed in the Chimakurti-Uppalapadu plutons within Prakasam Province. The Chimakurti pluton is concentrically zoned, and from core to margin consists of 1) olivine clinopyroxenite, 2) anorthosite, 3) olivine gabbronorite and 4) gabbronorite. It emplaced at mid-crustal depths (6 kb; 16-18 km) and is undeformed and unmetamorphosed. Comparably deep-seated massifs are strongly metamorphosed (Adirondacks) and unmetamorphosed ones typically have shallow emplacement histories (Laramie). Unlike many massif anorthosite complexes, the Chimakurti pluton is associated with a gravity high of the order of 20 to 30 mGal; consistent with the presence of ultramafic cumulates. The Uppalapadu pluton is composed of nepheline syenite (NS). An arcuate band of hornblende syenite with pockets of quartz syenite and ferro-syenite (HQF series) is present between the two plutons.

Field, petrographic, mineralogical and geochemical evidence suggests that the Clinopyroxenite-Anorthosite-Gabbro (CAG) suite of Chimakurti is formed by crystal-liquid fractionation (compounded by plagioclase buoyancy and re-melting) of tholeiitic magma. The calculated parental liquid REE concentrations to the CAG suite show LREE-enriched patterns with positive Eu anomalies, similar to the proposed parental liquids to other massif anorthosites. The HQF series represents residual liquids to the parental magma that produced CAG suite, but with crustal inputs. Attempts to model the derivation of Si-oversaturated HQF series from Si-undersaturated NS and vice-versa were not successful. The NS could be the end product of a long liquid-line-of-descent of mantle-derived alkali basaltic magma or a partial melt of shallow melting of metasomatised mantle or alkali basalt. The second possibility is favored because of the predominance of felsic rocks and almost complete absence of mafic rocks in the Uppalapadu pluton.

This study strongly suggests that 1) the ultimate source for massif anorthosites is tholeiitic mantle and the early stage of differentiation is dominated by Al-rich clinopyroxene fractionation, 2) the cospatial anorthosites and nepheline syenites are not cogenetic, but the nepheline syenites require an alkalic source. This magmatic association in the Prakasam Province is akin to the coeval alkalic and tholeiitic basalt magmatism of many rift-related environments.

V32F MC: 305 Wednesday 1330h

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

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

V32F-01 1330h INVITED

Hekla's February 26, 2000 Eruption as seen and Measured from Space using MODIS, TOMS and AVHRR.

W I Rose[1] (906 487 2367; raman@mtu.edu)

G J S Bluth[1] (906 487 3554; gbluth@mtu.edu)

I M Watson[1] (906 487 2045; watson@mtu.edu)

Tianxu Yu[1] (tyu@mtu.edu)

Yingxin Gu[1] (906 487 1782; yigu@mtu.edu)

[1]Michigan Technological University, Geological Engineering and Sciences, Houghton, MI 49931, United States

The 26 February eruption started at 1819 UT. Like other Hekla events, it had a brief explosive phase which reached a seismic intensity peak after about one hour, producing a volcanic cloud that reached 11 km high. The explosive eruption then declined in intensity and a lava eruption continued from fissure vents for several days (Smithsonian GVN Bulletin). AVHRR (1945, 2125 UT) and MODIS (2100 UT) thermal IR data depict a cold (-70 C) plume with strong signal of ice during the explosive phase. The earliest (1945 UT) image has a core region with a weak volcanic ash signal and high optical depth (>2) and represents the only signal of ash found in 18 AVHRR and 6 MODIS images studied over the next 36 hours as the ice-rich volcanic cloud was tracked to the N and NNE of Iceland. The ice masses in the drifting cloud, retrieved from IR data, peak at about 100 kT 10 hours after eruption and then decline to less than 20 kT after 35 hours. SO2 masses estimated in the cloud about 17 hours after eruption were about 100 kT, while the total volume of tephra and lava erupted for the entire eruption was about 0.11 km3. We also can measure the SO2 signal with MODIS, where the ice signal complicates our results. MODIS IR retrievals yield a peak SO2 burden of 18 g m2. Multispectral MODIS IR data can be used to estimate the sulfate mass in the Hekla cloud at 1-4 kT throughout the 36 hour period. TOMS AI data also do not show an ash signal [Krotkov et al, 2000, EOS Transactions 81 (48) F1277]. We interpret the Hekla cloud to be ash-poor and gas (H2O and SO2) rich, perhaps the result of an early gas-rich explosion as carefully described by S Thorarinsson (1967, Visindafelag Islendinga, Reykjavik) for the 1947 eruption, observed from the ground during excellent visibility. Overall our results portray the stratospheric injection of an ash-poor volcanic cloud, generated in the very early stages of a small volume basaltic andesite eruption. The results compare well with previous Hekla eruptions, but the satellite detectors provide a new tool to measure from above. An unintentional aircraft encounter with an atmospheric research aircraft [Miller et al, 2000, EOS Transactions 81 (48) F1277] provided data to potentially validate SO2 and particles. The damage inflicted on the plane is consistent with volcanic ash as is aerosol particle detector data which includes significant "non volatile" aerosol. Thus there is apparently ash that was undetected by both the IR and UV detectors.

V32F-02 1350h

Analysis of Airborne Ash and Elevated Surface Temperatures Detected on Multiple Satellite Data Sets of the Mt Cleveland Eruption, 2001

Kenneson G Dean[1] (907-7364; ken.dean@gi.alaska.edu); Jonathan Dean[1] (907-474-6499; jdehn@gi.alaska.edu); David J Schneider[2] (907-786-7037; djschneider@usgs.gov); Kenneth R Papp[1] (907-474-6839; kpapp@gi.alaska.edu); Matt R Patrick[1] (907-474-6839; patrick@gi.alaska.edu); Pavel Izbekov[1] (907-474-5269; pavel@dino.gi.alaska.edu)

[1]Geophysical Institute University of Alaska Fairbanks, PO Box 757320, Fairbanks, Ak 99775-7320, United States

[2]AVO U.S. Geological Survey, 4200 University Ave., Anchorage, Ak 99508, United States

Mt. Cleveland volcano erupted in February and March 2001 producing elevated surface temperatures and ash plumes that were detected on multiple satellite data sets. A large explosive eruption that occurred on 19 February sent an ash cloud to an altitude of 9 km and was observed on Geostationary Observation Environmental Satellite (GOES), NOAA Advanced Very High Resolution Radiometer (AVHRR) and the new Moderate Resolution Imaging Spectrometer (MODIS) data. This ash cloud formed a narrow ribbon that was 1000 km long and drifted to the NE across Alaska over the next three days, disrupting air traffic throughout the region. An analysis of GOES data shows the growth and evolution of the ash cloud, and its segmentation into three parts, two of which were pulled into a barometric low and lost to view in the southern Gulf of Alaska and the third drifted north over the Arctic Ocean. Samples of the ash were collected from Nikloski, 70 km away. The ash was fine grained (mostly less than 63 micron in size) and composed of 90% glass (pers. comm. J. Gardner). Puff, a volcanic ash dispersal model, accurately predicted the movement of the complex eruption cloud on 19 February, and clouds from the 11 and 19 March eruptions. However, high-resolution, forecast wind-fields on 19 March resulted in Puff simulations that did not agree with satellite observations. Landsat 7 data recorded the 11 March eruption provided detailed observations of the plume and hot debris and ash on the southern and western slopes, which were the source of the elevated surface temperatures observed on the AVHRR data on that date. Post-eruption analyses of AVHRR data showed a possible thermal anomaly at Mt. Cleveland 3 weeks prior to the 19 February event. This eruption demonstrated that GOES can be used to track airborne ash in spite of the large pixel size (greater than 25 km2) at high latitudes. The area traversed by the February eruption cloud, as seen on satellite data, was one of the largest in the north Pacific region. The large area was due to the meteorological conditions at the time of the eruption.

V32F-03 1405h

Satellite Remote Sensing of Volcanic Clouds Using the Moderate Resolution Imaging Spectroradiometer (MODIS).

Iain Matthew Watson[1] (+1 906 487 9251; watson@mtu.edu); William I Rose[1] (raman@mtu.edu); Vincent J Realmuto[2] (vince.realmuto@jpl.nasa.gov); Gregg J.S. Bluth[1] (gbluth@mtu.edu); Christina Bader[1] (cebader@mtu.edu); Tianxu Yu[1] (tyu@mtu.edu); Yingxin Gu[1] (yigu@mtu.edu)

[1]Department of Geological Engineering and Science, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295, United States

[2]Visualisation and Earth Applications Group, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena,, CA 91109-8099, United States

The Moderate Resolution Imaging Spectroradiometer (MODIS) has acquired images of several eruption clouds since its launch in December 1999. We are now in a position to retrieve information about SO_2, $SO_4{}^{2-}$, ice and ash, using the constituents different transmissive properties in the thermal infrared. We are able to compare our SO_2 retrievals with the Total Ozone Mapping Spectrometer (TOMS) and our ice and ash retrievals with Advanced Very High Resolution Radiometer (AVHRR) and Geostationary Satellite (GOES) data.

We have mapped SO_2 using MODIS from both the 19 Feb. 2001 eruption of Cleveland volcano, Alaska, and the 26 Feb. 2000 eruption of Hekla, Iceland and are able to compare the maps directly with TOMS data. The scale of the Hekla eruption is more conducive to comparison with the larger footprint of TOMS, and preliminary results suggest good spatial and SO_2 burden agreement.

We have mapped ice and ash for the Hekla and Cleveland eruptions respectively. Comparisons between MODIS and AVHRR/GOES are encouraging, in terms of both brightness temperatures and retrieved cloud parameters (effective radius and optical depth). For the aerosol retrievals we have also been able to compare the retrieved results to a forward model in which we specify the aerosols size and type, the clouds height and thickness and the atmospheres pressure, temperature and relative humidity profiles. Results suggest the MODIS retrievals are in reasonable agreement with the forward model, as the atmosphere has a relatively minor effect on such a high, dry plume as Heklas.

V32F-04 1420h

Use of MODIS for volcanic eruption cloud detection, tracking, and measurement: Examples from the 2001 eruption of Cleveland volcano, Alaska

David J Schneider[1] (907-786-7037; djschneider@usgs.gov)

Fred J Prata[2] (Fred.Prata@dar.csiro.au)

Yingxin Gu[3] (yigu@mtu.edu)

Matthew Watson[3] (watson@mtu.edu)

William I Rose[3] (raman@mtu.edu)

[1]U.S. Geological Survey, Alaska Volcano Observatory, 4200 University Drive, Anchorage, AK 99508, United States

[2]CSIRO, Atmospheric Research, PB 1 Aspendale, Victoria 3195, Australia

[3]Department of Geological Engineering and Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931, United States

The Moderate-resolution Imaging Spectroradiometer (MODIS), launched in December 1999 aboard the Terra satellite, has new capabilities that will improve the detection, tracking, and measurement of volcanic clouds. Volcanic clouds containing silicate ash, volcanic gases, aerosols, and water are potentially hazardous to aircraft. More than 100 aircraft have sustained documented damage over the past 20 years as a result of encountering volcanic clouds. This paper reports analytical results and interpretations of data from the MODIS instrument obtained for volcanic clouds generated during the 2001 eruption of Cleveland volcano.

Cleveland volcano, located in the east-central Aleutian Islands 1500 km southwest of Anchorage, had explosive ash-producing eruptions on February 19, March 11, and March 19, 2001 that erupted material to altitudes of 4.5 to 10.6 km above sea level. The Alaska Volcano Observatory (AVO) does not seismically monitor Cleveland volcano; however, the eruptions were detected and the volcanic clouds were tracked by AVO using near real-time AVHRR and GOES satellite data.

Contemporaneous MODIS, AVHRR, and GOES data of the eruption clouds from all three events were analyzed retrospectively and preliminary results demonstrate: 1) Improved sensitivity for ash detection using MODIS versus AVHRR and GOES. The magnitude of the brightness temperature differences utilizing MODIS bands centered at 8.5 and 12.0 microns is 2-3 times greater than the magnitude of the brightness temperature differences calculated using AVHRR and GOES bands centered at 10.7 and 12.0 microns; 2) The ability to detect the sulfur dioxide component of volcanic clouds using the brightness temperature difference between MODIS bands centered at 7.3 and 12.0 microns. Separation of volcanic ash and sulfur dioxide was observed in the volcanic cloud generated by the February 19 eruption using this technique; 3) Volcanic ash mass retrievals from GOES and MODIS data (utilizing similar wavelengths) are generally in agreement with each other, especially during early stages (tens of hours) of cloud transport.

Near real-time access to MODIS data is possible through its direct broadcast capabilities, and can provide volcano observatories and meteorological agencies with greatly improved capabilities for operational volcanic cloud analysis. The AVO plans to utilize near real-time MODIS data of Alaskan volcanoes through a new receiving station currently being installed at the University of Alaska Fairbanks Geophysical Institute.

V32F-05 1435h

Observations of Active Volcanoes Using the EO-1 Satellite

Luke P Flynn[1] (808-956-3154; flynn@higp.hawaii.edu); Andrew JL Harris[1] (808-956-3157; harris@higp.hawaii.edu); Robert Wright[1] (808-956-3159; wright@higp.hawaii.edu); Clive Oppenheimer[2] (44-1223-339-382; co200@cus.cam.ac.uk); Leon R Geschwind[1] (808-956-3159; leon@higp.hawaii.edu); Stephen Donegan[1] (808-956-3159; donegan@higp.hawaii.edu); Harold Garbeil[1] (808-956-6325; harold@higp.hawaii.edu)

[1]HIGP/SOEST, University of Hawaii 2525 Correa Road, Honolulu, HI 96822, United States

[2]Department of Geography, University of Cambridge Downing Place, Cambridge CB2 3EN, United Kingdom

Previous satellite observations of active volcanoes have been hampered by instruments that are primarily designed to measure surface reflectance of the Earth's vegetation. Sensors detecting radiation in the near-IR and IR are frequently saturated by highly radiant active volcanic features. Two satellite instruments, Hyperion and the Advanced Land Imager (ALI) on the Earth Observing -1 (EO-1) offer a means to circumvent saturation issues. Hyperion is a hyperspectral instrument that collects data in 242 narrow spectral bands between 0.4 and 2.5 microns and produces images that are 7.5 km x 100 km. For each 30m x 30m pixel, accurate atmospheric corrections and multiple component thermal models for lava flows can be generated. ALI is a Landsat-like instrument having 10 spectral bands at 0.4 - 2.35 microns. One of these, the 1.2 micron band, is sensitive to high temperature thermal anomalies such as overturning lava lakes and open lava channels. ALI also has a 10-m panchromtic band that allows for greater detailed mapping of volcanic features. ALI and Hyperion analyses for Erta Ale (Ethiopia), Mt. Etna (Sicily), Santiaguito (Guatemala), Popocatepetl (Mexico), and Mayon (Philippines) will be presented. While distribution of these data sets is limited to the EO-1 Science Team, the future of NASA's high spatial resolution terrestrial observation program will likely be based on a hybrid of these EO-1 sensors.

V32F-06 1510h

The first year of volcanic data from ASTER: Case studies of Bezymianny and Sheveluch Volcanoes, Kamchatka

Michael S. Ramsey[1] (412-624-8772; ramsey@ivis.eps.pitt.edu)

Jonathan Dehn[2] (907-474-6499; jdehn@gi.alaska.edu)

[1]Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA 15217, United States

[2]Geophysical Institute/Alaska Volcano Observatory, University of Alaska Fairbanks, Fairbanks, AK 99775, United States

The ASTER instrument has several global data acquisition goals including perhaps the most ambitious: volcanic eruption monitoring. ASTER is tasked with the observation of over 1100 of the world's active volcanoes during different local times and seasons. This nominal schedule can be augmented with more numerous acquisitions during times of increased activity at a particular volcano. Because it is the first satellite instrument to acquire high spatial resolution data from the visible to thermal infrared wavelength region and has the ability to generate digital elevation models, it is particularly useful for numerous aspects of volcanic remote sensing. For example, the multispectral thermal infrared capability of ASTER is critical for monitoring low temperature thermal anomalies and mapping both chemical and textural variations on lava dome surfaces . However, even during eruptions when ASTER is in an increased acquisition mode, the repeat time is not sufficient for its use strictly as a monitoring tool. High temporal frequency data from GMS and AVHRR provide this service and have been used in conjunction with ASTER to provide a complete framework of two eruptions on the Kamchatkan Peninsula, Russia.

Short wave and thermal infrared ASTER data were used to monitor eruptions and map the volcanic products at Bezymianny and Sheveluch Volcanoes over the past year. From June 1, 2000 to July 1, 2001 activity at these volcanoes increased and was monitored by the Alaskan Volcano Observatory using the AVHRR thermal anomaly alert procedure. Bezymianny has been one of the most historically active volcanoes on the Kamchatkan Peninsula, producing dome-forming eruptions and less-common large ash plumes. Over 60 ASTER scenes of Bezymianny have been collected, and show obvious thermal anomalies covering hundreds of pixels. The data also have been used to map textural variations on the active lava dome and subsequent small pyroclastic flows. Sheveluch volcano is also noted for dome-forming eruptions, large ash plumes, and pyroclastic flows. A new eruption in May and June of 2001 resulted in dome emplacement and an ash column greater than 10km in height. The scale of this eruption produced aviation advisories for the north Pacific and prompted an expedited ASTER data request. Data clearly show new pyroclastic deposits, a west-trending plume, and large thermal anomalies at the summit. The high spatial and spectral resolution of ASTER coupled with the excellent radiometric accuracy makes it an ideal tool for volcanic observations. Where coupled with ongoing operational monitoring programs, the data are extremely useful in discrimination of small surface targets in addition to providing enhanced volcanic mapping capabilities.

URL: http://ivis.eps.pitt.edu/projects/nopac/

V32F-07 1525h

The Thermal Stealth Flows of Santiaguito: A Landsat 7 ETM+ Perspective

Oto Matias[1,2] (906 487 2531)

Andrew J.L. Harris[3] (808 956 3157; harris@higp.hawaii.edu)

Luke P. Flynn[3] (808 956 3154; flynn@higp.hawaii.edu)

Bill I Rose[2] (906 487 2531; raman@mtu.edu)

[1]INSIVUMEH, 7a Av. 14-57, Zona 13, Guatemala City, Guatemala

[2]Department of Geological Engineering and Sciences, Michigan Technological University, Houghton, MI 49931, United States

[3]HIGP/SOEST, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, United States

Thick, slow moving block lava flows are associated with extrusive activity at dacitic systems, where lava core depressurization during flow front collapse generate devastating block and ash flows. During January 2000 and 2001 we used two Landsat 7 ETM+ images along with ground-based observations to collect dimensional and rare thermal data for an active dacitic block flow at Santiaguito (Guatemala). This provided unique insights into block flow cooling and emplacement mechanisms. Flow velocity was low (12.5 m d^{-1}), in spite of steep (>10°) slopes, a result of high shear stress (>6 x 10^4 N m^{-2}) and viscosity (>4 x 10^9 Pa s). The flow surface consisted of a thick (1.9-3.4 m), cool (40-111) crust of meter-sized, sub-angular blocks. The flow surface was so cool that the flow was almost thermally invisible in the ETM+ data, requiring ground-based observations to guide image interpretation. The ETM+ data reveal that extremely effective insulation by the thick crust results in core cooling of 0.08 h^{-1}. These low cooling rates make block flows the most thermally efficient of all styles of lava flow emplacement, allowing cooling limited flow lengths of several kilometers, in spite of low eruption rates (<0.5 m^3 s^{-1}). While low surface temperatures make block flows invisible to short wave infrared satellite-based sensors, the low velocity also contributes to the steathyness of these flows. Their stealthyness, however, masks the fact they can extend many kilometers, moving the block and ash flow source closer to vulnerable communities.

V32F-08 1610h

Emplacement of Basaltic Flow Fields: New Insights Using MODIS/ASTER Airborne Simulator (MASTER) Data

Jeffrey M Byrnes[1] (412-624-6673; jmbst102@pitt.edu)

Michael S Ramsey[1] (ramsey@ivis.eps.pitt.edu)

David A Crown[2] (dcrown+@pitt.edu)

[1]University of Pittsburgh, Geology and Planetary Science, Pittsburgh, PA 15260, United States

[2]Planetary Science Institute, 620 North Sixth Avenue, Tucson, AZ 85705, United States

Surface units that reflect local emplacement conditions within the 1969-1974 Mauna Ulu lava flow field (Kilauea Volcano, Hawaii) have been identified and are being mapped using field observations and remote sensing analyses. Investigation of a preliminary study site on and below Holei Pali utilized high-resolution color aerial photographs [Byrnes and Crown, 2000. J Geophys Res 106, 2139-2151] and TIMS (Thermal Infrared Multispectral Scanner) airborne data. Four surface units were identified that are related to the state of the lava during emplacement and were found to be correlated with the pre-eruption topography but not to the major lava tube segments mapped previously. These units show variations at visible wavelengths related to color, the presence of a glassy surface crust, and unit (dm- to m-scale) morphology. Variations at thermal wavelengths are presumably related to surface variations in phenocryst abundance, vesicles/micron-scale roughness, and glass. Interpretations based on the TIMS data are significantly limited by noise in available data covering the flow field.

The present study uses MASTER (MODIS/ASTER airborne simulator) data to extend the spatial and spectral coverage of the Mauna Ulu flow field. Preliminary analyses of the data (corrected for atmospheric effects) indicate that: (1) additional classes of surface units (such as shelly pahoehoe) can be identified within the flow field, and (2) systematic changes in emplacement occurred from the proximal to the medial and distal portions of the flow field. Comparison with ASTER images indicates that similar classes of surface units may be discriminated in both datasets, though MASTER is preferable for this study because it provides: (1) higher spatial resolution (especially in thermal bands), and (2) constant pixel size for all wavelengths. These factors allow for discrimination of smaller flow units and more accurate correlation of visible- and thermal-wavelength spectral signatures. The higher spectral resolution of MASTER does not appear to significantly enhance unit discriminability because the additional bands do not appear to be responsive to differences in surface units.

V32F-09 1625h INVITED

Advances in Thermal Infrared Mapping of Volcanic Sulfur Dioxide Plumes

Vincent J. Realmuto[1] (818-354-1824; vince.realmuto@jpl.nasa.gov)

Matthew I. Watson[2] (906-487-2045; watson@mtu.edu)

[1]Jet Propulsion Laboratory, California Institute of Technology, M.S. 168-514 4800 Oak Grove Drive, Pasadena, CA 91107, United States

[2]Michigan Technological University, 1400 Townsend Drive Houghton, MI, 49931 USA 1400 Townsend Drive Houghton, MI, 49931 USA 1400 Townsend Drive, Houghton, MI 49931, United States

The current tools for estimating the sulfur dioxide (SO2) concentrations of volcanic plume from multispectral thermal infrared (TIR) imagery were developed using data acquired from aircraft flying at altitudes less than 10 km. The advent of MODIS and ASTER TIR observations from space presents new challenges for the plume mapping procedures. The original mapping tools have been updated and modified to address these challenges.

Airborne remote sensing experiments have demonstrated that atmospheric water vapor is variable on spatial scales as small as 25 m. Despite this high potential for variation, the conventional practice in plume mapping has been to assume that the distribution of water vapor can be characterized with a few radiosonde measurements or single climatological model. This assumption is not valid for MODIS TIR data, which have a spatial resolution of 1 km (at nadir) and swath width of 2300 km. ASTER TIR data have higher spatial resolution (90 m at nadir) than MODIS data, but the width of an ASTER swath (60 km) ensures that there will be variations in water vapor within a scene. To address the challenge of characterizing the variations in water vapor, we have developed a technique to estimate the water vapor abundance on a pixel-by-pixel basis. This technique will also be used to characterize the distribution of ozone in the atmosphere.

The observations of volcanic plumes from low-altitude aircraft are typically confined to areas near the source vents and the conventional practice has been to assume that the unique radiometric signatures of plumes can be attributed to SO2 gas. By providing synoptic views of entire plumes and clouds, MODIS and ASTER increase the likelihood that sulfate aerosols are present in the scene. The radiative transfer model used in the plume mapping procedure does not provide much flexibility with regards to aerosol size distribution, number density, and composition.

To address the issues of mapping sulfate aerosols in addition to SO2 gas, we now isolate the radiative emission and absorption due to the plume from that of the rest of the atmosphere. This new strategy gives us explicit control over the aerosol parameters used in the radiative transfer calculations and allows us to model the combined effects of aerosols and gas. This modeling technique will be extended to silicate ash particles, water droplets, and ice particles.

V32F-10 1640h

Satellite Images: Invaluable Tools for Localizing and Mapping Miocene Calderas Prospected for Epithermal Au in Northeastern Mediterrenean Basin

Maria Kouli[1] (30-61-997613; MKouli@upatras.gr)

Konstantinos Vamvoukakis[1] (30-61-997613; kvam$_2$001@$yahoo.com$)

Karen St Seymour[1,2] (30-61-997613; kstseymr@upatras.gr)

Sophia Lamera[1] (30-61-996290; slhydr@yahoo.co.uk)

Elias Paraskevas[1] (30-61-996290; SLamera@upatras.gr)

[1]Laboratory of Ore Deposits and Volcanology, Department of Geology, University of Patras, University of Patras,Rion, Patra 26500, Greece

[2]Department of Chemistry, Concordia University, Concordia University Montreal, Montreal H4B1R6, Canada

Remote sensing methods combined with field investigations have successfully localized two caldera structures in the 17 my volcanic complex of the island of Lesvos. The junctions of these structures with tectonic lineaments are very important for hydrothermal fluid circulation and deposition of epithermal Au.

In the central part of Lesvos island a major caldera structure that of Vatoussa, is traced on SPOT-PAN imagery with an elliptical shape and with its major axis trending northwesterly. The northeastern part of this nested caldera, which is a much larger structure and encloses the caldera reported in the literature, is presently under sea level.

The Vatoussa caldera is outlined and also encompasses volcanic domes, which are intensely hydrothermally altered. The western caldera wall displays well the radial caldera faults and is also marked by a megabreccia unit.

The Stipsi caldera is smaller than reported in the literature with a circular outline intercepted by a major northeasterly trending tectonic zone. Volcanic domes invading the periphery and the caldera floor follow this direction. Remote sensing techniques have localized numerous intense hydrothermal alterations internal and external to the Stipsi caldera.

V32F-11 1655h

Temperature Distribution Analysis of July 2001 Mount Etna Eruption: a Multi-Sensor Image Data Comparison

Valerio Lombardo[1] (39-51860439; lombardo@ingv.it); Fabrizia Buongiorno[1] (39-0651860439; buongiorno@ingv.it); Laura Colini[1] (39-0651860337; colini@ingv.it); David C Pieri[2] (1-818-354-6299; dave@lithos.jpl.nasa.gov); Fawzi Doumaz[1] (39-0651860421; doumaz@ingv.it); Luca Merucci[1] (39-0651860385; merucci@ingv.it)

[1]Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, Rome 00143, Italy

[2]Jet Propulsion Laboratory, Earth and Space Sciences Division, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

On July 17th and 18th 2001 several fractures opened on the southern flank of Mt. Etna origining different lava flows spreading both in Valle del Bove and towards Nicolosi town. On July 29th an airborne campaign equipped with an image spectrometer was performed over Mt. Etna to acquire image data of the eruption. The campaign was organized to permit a simultaneous acquisition with the TERRA , EO-1 and LANDSAT 7 satellites. This multi-sensor acquisition over an active lava flow represented a unique opportunity to study the temperature distribution and at the same time to compare the different sensors capabilities for this type of volcanic events. The preliminary observations of the different data sets enlighten the importance of the data quantification and of the gain setting of the instrument. Surface temperature analysis was performed on distinct lava flows by using dual-band and triple-band techniques. Temperature distribution is peculiar for each different lava flow and appears to be related to the ageing of the flows. This means that the monitoring of the lava thermal status may be used as powerful tool for volcanic hazard prediction especially if combined with an detailed study of the topography through Digital Elevation Model analyses. The airborne high-spatial resolution images allow for the creation of a mathematical and physical model of the temperature distribution. This model must be subsequently tested on satellite data characterized by a lower spatial resolution but a higher time frequency of acquisition.

V32G MC: 304 Wednesday 1330h

Geomaterials: Melts and Melting

Presiding: **N Bagdassarov,** University of Frankfurt**; J Webster,** American Museum of Natural History

V32G-01 1330h

Pressure Dependence of Tg in Silicate Glasses From Electrical Impedance Measurements

Nikolai S. Bagdassarov[1] (+49(0)6979823376; nickbagd@geophysik.uni-frankfurt.de)

Jerome Maumus[1] (+49(0)6979824926; maumus@geophysik.uni-frankfurt.de)

Brent Poe[2] (brent.poe@uni-bayreuth.de)

Anatoliy B. Sloutskiy[3] (70951373055; sloutskiy@geokhi.ru)

Vadim K. Boulatov[3] (70951373110)

[1]Institut fr Meteorologie und Geophysik, Universitt Frankfurt, Feldbergstrasse 47, Frankfurt am Main D-60323, Germany

[2]Bayerisches Geoinstitut, Universitt Bayreuth D-95447 Bayreuth Bayerisches Geoinstitut, Universittsstrasse 30, Bayreuth D-95447, Germany

[3]Vernadskiy Institute of Geochemistry, Russian Academy of Sciences, Kosygin str. 19, Moscow 117975, Russian Federation

The pressure dependence of the glass transition temperature (T_g) in silicates correlates with a pressure dependence of viscosity. For example, albite glass has a negative pressure dependence of shear viscosity and T_g, diopside and sodium trisilicate glasses have positive pressure dependence of T_g and viscosity. Electrical conductivity measurements are easier to conduct at high pressures than rheological measurements. By means of electrical impedance measurements T_g in glasses may be estimated from the temperature dependence of impedance, if the mobility of charged defects correlates with structural defects. Below T_g activation energy of electrical conductivity is less than that at T> T_g. The intersection point of two Arrhenius dependencies of electrical conductivity as function of 1/T defines T_g. In this study T_g has been estimated for anorthite, albite, haplo-granitic and silica glasses in atmospheric furnace and in 3 types of high-pressure apparatus: piston-cylinder, belt and multi-anvil presses. Electrical impedance measurements were conducted in the frequency range 100 kHz - 0.01 Hz. The measured glass transition temperature in anorthite varies with pressure P (in GPa): $T_g = 850°C + 5°/GPa \times P$, in albite glass the pressure dependence on $T_g = 685°C - 8°/GPa \times P$; in HPG8 $T_g = 777°C - 45°/GPa \times P$; and in silica glass $T_g = 1050°C + 17°/GPa \times P$. Dielectric relaxation times calculated from the imaginary component of the dielectric modulus are three orders of magnitude smaller than structural relaxation times and increases at high pressures. With the pressure increase activation energy of dielectric relaxation in anorthite increases having the activation volume of ca. $10 \pm 5 cm^3$/mol, in albite glass the activation volume is small and negative $-2 \pm 1 cm^3$/mol.

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Thermal Expansion of Supercooled Haplobasaltic Liquids Obtained via Container-based Dilatometry

Donald B. Dingwell[1] (dingwell@petro1.min.uni-muenchen.de)

Joachim Gottsmann[2] (j.gottsmann@open.ac.uk)

[1]IMPG, LMU Theresienstrasse 41/III, Muenchen 80333, Germany

[2]Department of Earth Sciences, The Open University Walton Hall, Milton Keynes MK7 6AA, United Kingdom

The thermal expansion of supercooled liquids in the haplobasaltic (anorthite-diopside) system have been determined using methods of container-based dilatometry. We have been investigating thermal expansivities over temperature ranges of up to 170 K.

The expansivity data obtained in this study agree well with estimates provided by previous dilatometric determinations in the system that have relied on alternative experimental strategies. The data have been combined with high temperature, superliquidus determinations of melt density to obtain expressions for the volume-temperature relationships of liquids in the anorthite-diopside system. The volume-temperature

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