transition could temporarily halt the melting of peridotite ascending along a mantle adiabat, provided this peridotite begins its ascent at 1.5 GPa between approximately 1250 − 1300° C and contains sufficient Al and Na to stabilize plagioclase. We investigated this potential temperature interval in detail using the thermodynamic modeling program pMELTS (Ghiorso et al., in press) and combined output from pMELTS with trace element modeling to determine whether such a mechanism would result in a detectable REE pattern signature in derived partial melts. Volumetrically significant amounts of plagioclase are predicted by pMELTS to form during both batch and perfect nonmodal fractional melting of MM3 (Baker and Stolper, 1994) composition peridotite. In fact, enough plagioclase forms that it is still present when melting resumes again at lower pressure (0.4-0.2 GPa). This effect is pronounced at low potential temperatures of 1235° C, where 9 wt% plagioclase remains at the commencement of low-pressure melting. The presence of plagioclase in contact with melt is often presented as an explanation for negative Eu anomalies in REE patterns. However, our preliminary trace element models of this interval of coexisting plagioclase and melt frequently show small positive anomalies as a result of the much larger contribution of clinopyroxene to the melt fraction. The calculated positive Eu anomaly decreases in magnitude as more clinopyroxene is added to the melt fraction. REE patterns for batch melts are concave-up and range from moderately to weakly LREE enriched ($(La/Yb)_N$ = 13-2). Aggregate fractional melts produce REE patterns that range from moderately LREE enriched ($(La/Yb)_N$ = 13) and concave-up to weakly LREE depleted ($(La/Yb)_N$ = 0.15) and concave-down.

V51B-1012 0830h POSTER

Snowflake Troctolite and Other Experimental Delights in Melts of the Kiglapait Lower Zone

S. A. Morse[1] (413-545-0175; tm@geo.umass.edu)

Brad A. Sporleder[2] (bj92684@binghamton.edu)

John B. Brady[3] (jbrady@science.smith.edu)

[1]Geosciences, UMass, 611 No. Pleasant St., Amherst, MA 01003-9297, United States

[2]Geological Sciences, SUNY, Binghamton, NY 13902-6000, United States

[3]Geology, Smith College, College Lane, Northampton, MA 01063, United States

At 5 kb in graphite the cotectic trace (OL+PL+L) is within error a straight line in an XY transform of the ternary FSP-OLHY-AUG in which altitude Y=FSP and radial X = OLHY/(OLHY+AUG), all glasses calculated as the oxygen norm with ferrous ratio set at 0.9. The trace runs from X 0.8, Y 0.725 to X 0.38, Y 0.6 and is precisely parallel to but 2% lower in FSP than the summation liquid trace (Morse 1981 GCA), which in turn is derived from and parallel to the modal trace (Morse 1979 JPET). A basal LZ rock lies on the tangent to the cotectic trace. The location of the cotectic is indifferent to apatite content, to limited Fe-Ti oxide content, and to whether An and Fo are evolved or not; in sum, it is affected solely by the AUG content, which runs from 5% to saturation at 24%. Olivine settling occurs in some runs in less than 3 hours. Time studies show little change in PL composition, but significant change in OL composition, which appears to nucleate early and gain Fo for at least 24 hours. The mean KD(Fe/Mg)=0.35 for OL/L may therefore be a bit higher than the equilibrium value. D(XAb) in PL/L follows a linear partitioning relation with KD=0.524 +/- 0.037. D(FeO) in PL/L is scattered about 0.032 +/- 0.006. One run exactly on the cotectic crystallized several large PL snowflakes (radiating microspherulites) in eutectoid intergrowth with OL, which also locally contains PL and melt inclusions. One of these has 10 radial blades with uniformly spaced, oriented, angular OL patches that appear to be in structural continuity. In this structure, OL is more abundant than the cotectic ratio, and PL is too close to the L composition. The growth rate of these features is about 10x that of normal crystals grown off the cotectic. Rare nucleation of PL from scarce centers has driven the boundary L metastably into the OL field, causing it to nucleate in overabundance. In the natural case (Berg, CMP 72, 1980) snowflakes up to 15 cm diameter were caused by over-precipitation of OL, driving the L into the PL field.

V51B-1013 0830h POSTER

The Stability of phlogopite and amphibole up to 2.0 GPa and partial melting experiments of a metasomatic mantle (NHD-peridotite) at 1.0 GPa

Rommulo Vieira Conceiao[1] (+55 51 3316 7140; rommulo@if.ufrgs.br)

David H Green[2] (David.H.Green@anu.edu.au)

[1]Universidade Federal do Rio Grande do Sul, Av. Bento Gonalves, 9500, Bairro Agronomia, CX Postal: 15001, Porto Alegre, RS 91 501 970, Brazil

[2]Reseach School of Earth Sciences, Australian NAtional University, Canberra, ACT 0200, Canberra, ACT 0200, Australia

High pressure experiment were carried on a model metasomatized peridotite composition from the Northern Hessian Depression (NHD-peridotite) at water-saturated (plus 0.4% water) and water-undersaturated (plus 0.15% water) conditions. The original peridotite consists of a depleted peridotite (anhydrous peridotite xenoliths) and a metassomatic component (magnesian phlogopite from metasomatized xhenoliths). At water-saturated conditions, amphibole and phlogopite are stables above the solidus. Amphiboles breaks 10°to 50°C above the solidus from 0.5 to 1.5 GPa while phlogopite breaks at 25°to 125°C above the solidus. At water-undersaturated conditions, amphibole-out curve coincides with the solidus one. Phlogopite is stable in a very small temperature interval above the solidus.

In an attempt to characterise the nature of the liquid in equilibrium with a metasomatized peridotite at 1.0 GPa out of the phlogopite stability field, a series of sandwich experiments were carried out. The composition of these liquids are basalt-andesitic, at water-saturated conditions, and trachy-andesitic, under water-undersaturated conditions. They correspond to 20% and 17% of partial melt. These results reinforce the previous studies observation that the presence of K_2O in the mantle moves the harzburgitic cotetic towards the silica-saturated to oversaturated side and that potassic (shoshonitic?), alkaline-rich and silica-saturated magmas could be formed directly from partial melt of a phlogopite-bearing lherzolite mantle.

V51B-1014 0830h POSTER

Nano-scale Characterization of Basalt - Quenched Lava and Reheated Products

Dorothee J.M. Burkhard[1] (+49 6421 2827026; burkhard@mailer.uni-marburg.de)

Richard Wirth[2] (+49 331 2881371; wirth@gfz-potsdam.de)

[1]Institute for Mineralogy, University of Marburg, Marburg 35032, Germany

[2]GeoForschungsZentrum, Telegrafenberg, Potsdam 14473, Germany

In order to trace the mechanism of crystallization in basalt we investigated basalt lava from active Pu'u O'o, Kilauea, Hawaii with TEM. We considered (1) quenched melt (glass, obtained by dipping a hammer into the lava (April 1996) and subsequent quenching in air), and (2) that glass after reheating for 48 hr at 850°C, and (3) after reheating for 48 hr at 930°C. Previous investigations had illustrated interface-controlled growth of pyroxene and Fe-Ti oxides at 850°C and volumetric growth of these phases in addition to plagioclase above 920°C [1]. In general, (1) is a perfect glass to the nano-scale. Occasional inhomogeneities are identified as plagioclase. With a size of no more than approximately 100 unit cells, these "crystals" might be considered as nuclei. Dendrites of pyroxene, identified on the micron scale with back scattered electrons [1], occur as a sequence of slightly displaced plates with equal orientation on the nano-scale. HREM, diffraction pattern and EDS confirm that this is augite, in agreement with investigations on the micron-scale [1]. Fe-Ti oxides occur isolated in the matrix with a diameter less than 100 nm, in contrast to the micron-scale, where Fe-Ti oxides appear at the apices of augite. In (3) we find in addition plagioclase with thin lamellae, indicating twinning. In (3),augite contains lamellae parallel to (001), and they are identified as pigeonite by HREM and electron diffraction. Pigeonite lamellae occur also in (2), however, less developed. Electron diffraction suggests that reflections of augite correspond to the space group C 2/c, and of exsolved pigeonite to P 21/c, which is a low pigeonite. These exsolution phenomena are undistiguishable from what is usually observed in relation to high cooling rates [e.g. 2]. The stability of pigeonite at these temperatures suggests a Fe/Fe+Mg ratio above 0.6 for pyroxene in the quadilateral [3]. Microprobe analyses [1] suggest ratios of 0.4 to 0.5.

[1] Burkhard D.J.M. (2001) J. Petrol. 42, 507-527; [2] Philpotts A.R. (1990) Principles of Igneous and Metamorphic Petrology, Prentice; [3] Lindsley A.(1983) Am. Mineral. 68, 477-493.

V51B-1015 0830h POSTER

Sr Diffusion in Biotite and Phlogopite Micas

Bruno J. Giletti[1] (1-401-863-2242; bruno_giletti@brown.edu)

Graham D. Layne[2] (1-508-289-2405; glayne@whoi.edu)

[1]Brown University, Dept. of Geological Sciences, Providence, RI 02912, United States

[2]Woods Hole Oceanographic Inst., MS 23, Woods Hole, MA 02543, United States

A new approach permits measurement of Sr diffusion parallel to the layers in micas. We used an ion microprobe (SIMS) to drill a hole approximately 200 um (micrometers) in diameter through the middle of a mica flake. An 86Sr-bearing water solution provides an infinite 86Sr reservoir to the cylindrical hole wall and the Sr diffuses across the wall into the mica, migrating mainly parallel to the layers.

Profiles in a natural biotite have been measured on Cameca ims 1270 and 3f SIMS following runs at 700-800 C and 1 kBar water pressure. A step scan away from the hole in 3 um steps was made, measuring the 86Sr/30Si ratio. Data were reduced using an equation for heat loss from a pipe (Carslaw and Jaeger, 1959, Conduction of Heat in Solids). Experiments are being run dry on a synthetic fluor- phlogopite to 1200 C; and hydrothermally on natural biotite and phlogopite specimens up to 800 C.

Preliminary data on the biotite hydrothermal experiments give Arrhenius equation parameters of Do = 3.1e-4 m2/s and Q = 274 kJ/mol. Synthetic F-phlogopite run dry gives Do = 5.6e-7 m2/s and Q = 246 kJ/mol. The difference at 800 C is a factor of 25. Experiments are currently being run hydrothermally on natural biotite and phlogopite specimens with different F contents and/or different Mg/(Mg+Fe).

V51B-1016 0830h POSTER

Electrical Conductivity of Hydrous Wadsleyite: Implications for the Water Content of the Transition Zone

Brent T Poe[1] (49-0921-553734; Brent.Poe@uni-bayreuth.de)

Claudia Romano[2] (romano@uniroma3.it)

James A Tyburczy[3] (1-480-965-2637; jim.tyburczy@asu.edu)

[1]Bayerisches Geoinstitut, University of Bayreuth, Bayreuth 95444, Germany

[2]University degli Studi di Roma Tre, Dipartimento delle Scienze Geologiche, Roma, Italy

[3]Arizona State University, Dept of Geological Sciences, Tempe, AZ 85287-1404, United States

Recent laboratory work by Xu et al. (2000) has demonstrated that the electrical conductivity profile of the mantle can be reasonably approximated from the measured conductivities of the major mineral constituents such as olivine, wadsleyite, ringwoodite and silicate perovskite. Where the approximation shows lesser agreement with recent geophysical electrical conductivity models, particularly at transition zone depths, consideration of the effects of minor constituents that might affect the electrical properties of minerals is required. For the transition zone, only the conductivities of nominally anhydrous minerals have previously been measured, yet both wadsleyite and ringwoodite, which compose a substantial proportion of the transition zone, can incorporate up to several weight percent water into their structures. Knowing the effect of dissolved water on the electrical conductivities of these minerals can thus provide some constraints on the amount of water in the transition zone. We have obtained preliminary results for the electrical conductivity of hydrous wadsleyite, synthesized at 12 GPa and 1100 C in a welded Pt capsule using a multi-anvil apparatus. The recovered material was cut into a 0.5 mm thick disk for in-situ measurement by complex impedance spectroscopy also at 12 GPa. The nominal H2O content of the sample was about 1 wt per cent, although quantitative analyses for water have yet to be made at the time of this writing. We find that the water-bearing wadsleyite is approximately 1 to 1/2 orders of magnitude more conductive than the nominally dry wadsleyite over the temperature range 600 to 1050 C. The activation energy for conduction, however, is lower such that the hydrous and anhydrous conductivities would be equivalent at a temperature of about 2000 C. A more complete study involving samples varying in water content is expected to provide a thorough understanding of the effect of dissolved water on the electrical properties of minerals related to Earth's mantle.

V51C MC: Hall D Friday 0830h

Mantle Melts (Rifting, LIPs)

Presiding: D John, USGS

V51C-1017 0830h POSTER

Lithospheric structural controls on magma composition: the Kenya Rift

Peter A. Omenda[1] (254-311-20233; pomenda@kengen.co.ke)

Silas Simiyu[1] (254-311-20233; ssimiyu@kengen.co.ke)

Elizabeth Y. Anthony[2] (915-747-5483; eanthony@geo.utep.edu)

G. Randy Keller[2] (915-747-5850; keller@geo.utep.edu)

Robert L. Dean[2] (915-747-5483; rdean@geo.utep.edu)

[1]Kenya Electricity Generating Company, Ltd., Olkaria Geothermal Power Station, P.O. Box 785, Naivasha, Kenya

[2]University of Texas at El Paso, Department of Geological Sciences, El Paso, TX 79968, United States

Lithospheric structure, as delineated by geophysics, plays a fundamental role in both felsic and mafic magmatic compositions in the Kenya Rift. With respect to the mafic rocks, there are, first, silica-undersaturated basanites of the Chyulu Hills. This location is off-axis to the rift, where the lithosphere is thick. The lavas have been modeled as high-pressure, small degree partial melts. This origin contrasts to that for the silica-saturated transitional basalts, basaltic trachyandesites, and andesites in the axis of the rift. These magmas were generated by higher degrees of partial melt and are also much more evolved, with Mg numbers approximately 40 to 50. The lavas have seen substantial crystal fractionation prior to eruption.

An important component of lithospheric structure within the rift axis is the Kenya Dome: it is an area of thick crust and high elevation and heat flow. The crust is made thicker by a 6.8 km/sec lower crustal layer. Immediately below this crust is a very slow upper mantle. Velocities become more lithospheric to the south of the Kenya Dome in the vicinity of Suswa. This lithosphere then thickens southward into Tanzania. The felsic central volcanoes of the rift, which are significant geothermal targets, reflect these lithospheric variations. Eburru and Olkaria are both centered on the Kenya Dome. Eburru is pantellerite and can be modeled as resulting from crystallization of silica-saturated basalt. Olkaria is comendite and resulted from fusion of lower crustal syenite. That we find such distinct petrogenesis for two closely spaced volcanoes indicates that this area of very warm mantle has the temperatures necessary to generate high degree partial melt magmas, which evolve into pantellerites, and also fuse the lower crust. Suswa, which is the southernmost volcano and in the area where lithosphere thickens, is composed on phonolites, which can be modeled as resulting from crystallization of silica-undersaturated mafic parents. Presumably, the thicker lithosphere lends itself to generation of high-pressure, low degree partial melts similar to those found in the off-axis Chyulu Hills.

V51C-1018 0830h POSTER

Geochemical Evidence for Mantle Plume Involvement in the Early History of the Central Atlantic Ocean

Philip E Janney[1] (pjanney@fmnh.org)

Paterno R Castillo[2] (pcastillo@ucsd.edu)

[1]Field Museum of Natural History, 1400 S. Lake Shore Dr., Chicago, IL 60605, United States

[2]Scripps Inst. of Oceanography, 9500 Gilman Dr., La Jolla, CA 92093-0220, United States

Controversy surrounds the issue of whether mantle plume activity was responsible for Pangean continental rifting and massive flood volcanism (resulting in the Central Atlantic Magmatic Province or CAMP, emplaced around 200 Ma) preceding the opening of the central Atlantic Ocean in the Early Mesozoic. Our new Sr-Nd-Pb isotopic and trace element data for the oldest basalts sampled from central Atlantic oceanic crust by deep-sea drilling show that oceanic crust generated from about 160 to 120 Ma displays clear isotopic and chemical signals of plume contamination (e.g., $^{87}Sr/^{86}Sr_i$ = 0.7032 to 0.7036, $\epsilon_{Nd}(t)$ = +6.2 to +8.2, incompatible element patterns with positive Nb anomalies), but these signals are muted or absent in crust generated between 120 and 80 Ma, which resembles young Atlantic normal mid-ocean ridge basalt (N-MORB). The plume-affected pre-120 Ma Atlantic crust samples are isotopically similar to lavas from the Ontong Java Plateau, and may represent one isotopic end-member for CAMP basalts. The strongest plume signature is displayed near the center of CAMP magmatism but the hotspots currently nearest this location in the mantle reference frame appear younger than Cretaceous age and are isotopically distinct from the oldest Atlantic crust. The evidence for widespread plume contamination of the nascent Atlantic upper mantle, combined with a lack of evidence for a long-lived volcanic chain associated with this plume, leads us to propose that the enriched signature of early Atlantic crust, and possibly the eruption of the CAMP, were caused by a relatively short-lived, but large volume plume feature that was not rooted at a mantle boundary layer. Such a phenomenon has been predicted by recent numerical models of mantle circulation (Cserepes and Yuen, EPSL 183, 2000).

V51C-1019 0830h POSTER

Contribution of Pyroxenite-Derived Melts to Baikal Rift-Related Magmatism

Joanne S Garner[1] (jgar98@esc.cam.ac.uk)

Sally A Gibson[1]

Robert N Thompson[2]

Geoff M Nowell[2]

[1]Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge CB3 9JQ, United Kingdom

[2]Department of Geological Sciences, University of Durham, South Road, Durham DH1 3LE, United Kingdom

The Baikal Rift is a zone of active lithospheric extension, which started to develop ∼35 Mya. The ∼20 to 3 Ma Vitim Volcanic Field (VVF) lies on the eastern shoulder of the rift, where the present-day lithospheric thickness is 100-125 km. The VVF consists of ∼5000 km^3 of alkali basalts and minor olivine tholeiites. 400 drill core samples have been used to study temporal and spatial variations in the 700 m thick volcanic pile.

MgO contents of the Cenozoic Vitim lavas vary from 14.6-3.3 wt.%. High contents of Na_2O (2.4-5.5 wt.%) and incompatible trace elements (e.g. La = 13.2-60 ppm) suggest that the parental melts were generated by moderate to low degrees of partial melting. A wide range in $[La/Yb]_n$ ratios (5-33) suggests variation in the degree of partial melting. Trace element ratios, e.g. Ba/Sr and La/K, suggest that phlogopite and possibly amphibole are present as residual mantle phases during generation of the alkali basalts but not the tholeiites. Both have been identified in lherzolite and pyroxenite xenoliths from the VVF.

HREE ratios (e.g. $[Gd/Lu]_n$ = 3-7) are higher than those found in mantle plume-related picrites, such as those from Hawaii and West Greenland. In the VVF, these correlate positively with FeO (7.7-11.9 wt.%), suggesting that FeO-rich mafic lavas (nephelinites) were generated at relatively high pressures and within the garnet stability field. Major element models suggest that the high Fe and Na contents cannot be generated by melting fertile peridotite e.g. KLB-1; a pyroxene-rich source is more appropriate. This model predicts a maximum of 12% melting, at 25-35 kbar. This is consistent with predictions from REE inversion models. These require enrichment by a metasomatic melt; this contribution is smaller for the tholeiitic basalts (2%) than for the nephelinites (5%). Xenolith studies show that the lithospheric mantle beneath the VVF was infiltrated by metasomatic melts forming pyroxenite veins. These appear to have been remobilised during rifting and contributed to the parental melts of the VVF. Sr, Nd and Hf isotopes will be used to further constrain melt source regions.

V51C-1020 0830h POSTER

Geochemical and Geochronological Constraints on the Origin of the Northern Nevada Rift

David A. John[1] (650-329-5424; djohn@usgs.gov)

Alan R. Wallace[2] (775-784-5789; alan@usgs.unr.edu)

Robert J. Fleck[1] (650-329-4658; fleck@usgs.gov)

[1]USGS, 345 Middlefield Rd., Menlo Park, CA 94025, United States

[2]USGS, Mackay School of Mines UNR, Reno, NV 89557, United States

The northern Nevada rift (NNR) is a narrow 500-km long, NNW-trending aeromagnetic anomaly stretching from the NV-OR border to SE NV. It has been postulated that NNR formed by impingement of a mantle plume (Yellowstone hot spot) on the lithosphere at about 16.6 Ma (Zoback and Thompson, 1978). The surface trace of NNR is marked by aligned middle Miocene volcanic and hypabyssal rocks, normal faults, and narrow basins that formed during the early stages of WSW-ENE-oriented Basin and Range extension. The central part of NNR (Snowstorm to Roberts Mountains) is underlain by middle Miocene volcanic rocks and dikes that form a high-K tholeiitic series. $^{40}Ar/^{39}Ar$ dating and field relations indicate a progression from widespread early mafic flows and dikes (basalt to andesite, 50-58 wt. % SiO_2, Mg#=57-28, 16.5 to 15.1 Ma) to local sequences of trachydacite flows (62-70 wt. % SiO_2, 15.4 Ma), rhyolite domes, flows and tuffs (70-77 wt. % SiO_2, 15.2 to 14.8 Ma), and late basalt flows (48-52 wt. % SiO_2, Mg#=61-52, 14.7 Ma). Early mafic sequences within single ranges may have erupted in <200,000 years, but no regular age progression for the initiation of mafic magmatism along NNR is evident. Mafic flow sequences show irregular compositional variation with stratigraphic position but generally become more silicic upward. Initial 87/86Sr ratios, 206/204Pb, and 208/204Pb vary stratigraphically: basal part of early mafic flows (.7050, 18.9, 38.4), upper part of early mafic flows (.7064-.7072, 19.2, 38.8-38.9); trachydacite (.7078-.7087, 19.1-19.3, 38.8-39.2); rhyolite (.7081, 18.9, 38.7-39.0). The early mafic flows have pronounced depletions for Ti, Nb, and Ta and high Ba/Nb and La/Nb relative to OIB. These data suggest that the early mafic flows were derived from subcontinental lithospheric mantle previously enriched by subduction. Isotopic data for the upper parts of early mafic rocks and for the more felsic rocks are consistent with mixing between enriched lithospheric mantle and lower crust melts from the Central Pb Province of Nevada (Sri=.707-.710; 206/204Pb=19.3-19.6; 208/204Pb=39.0-39.7; Tosdal et al., 2000). If NNR formed from a mantle plume, we have found no evidence for an asthenospheric contribution to NNR-related magmas.

V51C-1021 0830h POSTER

Helium in the Archaean komatiites revisited: significantly high $^3He/^4He$ ratios revealed by fractional crushing gas extraction

Takuya Matsumoto[1] (+81-6-6850-5497; matsumoto@ess.sci.osaka-u.ac.jp)

Akihiro Seta[1] (seta@ess.sci.osaka-u.ac.jp)

Jun-ichi Matsuda[1] (matsuda@ess.sci.osaka-u.ac.jp)

Yuelong Chen[2] (chyuelong@sina.com)

Shoji Arai[3] (ultrasa@kenroku.kanazawa-u.ac.jp)

[1]Department of Earth and Space Science, Graduate School of Science, Osaka University, Toyonaka, Osaka 560-0043, Japan

[2]School of Geology and Mineral Resources, China University of Geoscience, 29 Xueyuan Road, Beijing 100083, China

[3]Department of Earth Science, Kanazawa University, Kakuma-machi, Kanazawa 920-1192, Japan

In order to provide constraints on $^3He/^4He$ ratios in the Archaean mantle source, we have analysed helium isotopic compositions in 2.7Ga old Archaean komatiites from the Abitibi green stone belt, Ontario, Canada. Two spinifex-textured komatiites yielded significantly high $^3He/^4He$ ratios of about 30Ra (where Ra denotes the atmospheric $^3He/^4He$ ratio) in fractions released by sequential crushing. These results are the first confirmation of the occurrence of high $^3He/^4He$ component in Archaean komatiites after the intriguing finding by [Richard et al., Science 273 (1996) 93-95] in komatiites from a nearby locality, Alexo. We also found that the crystal structure of the komatiites was significantly enriched in a radiogenic component (^4He) and that the radiogenic ^4He in the crystal structure was actually degassed by a crushing gas extraction, indicating that the nominal $^3He/^4He$ ratios measured by crushing are lower limits for the $^3He/^4He$ ratio of an intrinsic component. By constraining the release behaviour of radiogenic ^4He by crushing, we have estimated the initial $^3He/^4He$ ratio of an inclusion-trapped component to be 73 (+7.8/-5.5) Ra. A mantle source with such a high $^3He/^4He$ ratio at 2.7Ga would, if evolved in a closed-system, have present-day $^3He/^4He$ ratio of 46-60Ra, indicating that the komatiites from Munro had been trapped their helium from a mantle reservoir with very high $^3He/^4He$ ratio in the context of the present-day value. However, whether or not such a source can be considered as the one that is equivalent to the primitive mantle source (such that sampled at hotspots) is highly model-dependent. If a closed-system evolution model were assumed, helium in the Munro komatiites is not likely to be derived from the MORB-source-like reservoir. However, the notion that the komatiites may be derived from a depleted reservoir in terms of trace elemental and isotopic geochemistry might requires an alternative view for the evolution of $^3He/^4He$ ratio in ancient mantle reservoirs, as has been demonstrated by a recent model calculation by [Seta et al., Earth Planet. Sci. Lett. 188 (2001) 211-219] in which the $^3He/^4He$ ratios in the MORB mantle source could have been as high as those in the primitive (less-degassed) mantle source in Archaean.

V51C-1022 0830h POSTER

New Isotopic Constraints on the Lithospheric Mantle Source of Karoo Picrite Basalts: Nuanetsi Revisited With Multiple Collector ICP-MS.

Robert M. Ellam (44-1355-270130; r.ellam@suerc.gla.ac.uk)

Scottish Universities Environmental Research Centre, SURRC Rankine Avenue, East Kilbride G75 0QF, United Kingdom

Karoo picrite basalts from the Mwenezi (previously Nuanetsi) region of SE Zimbabwe provide some of the strongest evidence yet that the sub-continental lithospheric mantle is implicated in flood basalt petrogenesis. Isotope signatures, which fall outside the range recorded in oceanic basalts, clearly indicate interaction with the continental lithosphere. Furthermore, elevated levels of elements which are relatively depleted in continental crust (e.g. Sr, Nb, Ti), and the association of low $^{143}Nd/^{144}Nd$ with low $^{187}Os/^{188}Os$, imply a source within the mantle, rather than crustal, lithosphere. A substantial lithospheric mantle contribution to the Karoo picrite basalts seems inescapable. However, it has been less clear whether these lavas were derived wholly from mantle lithosphere, or whether they formed through lithospheric contamination of magmas originating within the sub-lithospheric convecting mantle.

New Pb and Hf isotope data for the Mwenezi picrite basalts have been obtained by multiple-collector ICP-MS. Pb isotope data, obtained using the Tl normalisation technique, are in close agreement with previous TIMS Pb isotope measurements, and therefore imply that the (pyrometer controlled) TIMS data were reliably corrected for mass-dependent instrumental isotope fractionation. It is therefore possible to interpret the Pb isotope data with new confidence, despite the limited range in initial Pb isotope compositions (e.g. $^{208}Pb/^{204}Pb_{(0)}$ = 37.6 - 38.7), and these data offer a significant new constraint on the origin of the Mwenezi lavas.

Pb-Nd isotope arrays for the picrite basalts define hyperbolae which are consistent with binary mixing. The assymptotes of a least squares hyperbolic fit to the Mwenezi Pb-Nd isotope data can be used to constrain mixing end-members. These indicate a low ϵ_{Nd} (< -12) component with relatively low $^{208}Pb/^{204}Pb$ and a radiogenic Pb end-member with ϵ_{Nd} ~ -3.2. Thus, both end-members have low ϵ_{Nd} compared with oceanic basalts and hence, both are best attributed to lithospheric mantle source regions. Such arrays are not readily reconciled with a contribution from the sub-lithospheric mantle. Nonetheless, if the Karoo picrite basalts derive wholly from lithospheric mantle sources, there must be important corollaries associated with the production of such magnesian magmas apparently without advective heat transfer from the asthenosphere.

V51C-1023 0830h POSTER

Continental Flood Basalt Chemistry, Age and Volcanic Volumes

Eric Humler[1] (00 33 1 44 27 50 88; humler@ipgp.jussieu.fr)

Cecile Doubre[2,3] (00 33 1 44 27 24 35; doubre@ipgp.jussieu.fr)

[1]Laboratoire de Geosciences marines, 4, place Jussieu, Paris 75252, France

[2]Laboratoire de Tectonique, Institut de Physique du Globe 4, place Jussieu, Paris 75252, France

[3]Laboratoire de Geodynamique des Rifts et des Marges passives, Universite du Maine Av. Olivier Messiaen, Le Mans 72085, France

We have compiled a large collection of published chemical analyses of the 11 known continental flood basalts of the last 250 millions years. Only basaltic lavas and some related basic intrusive rocks are considered to be representative of the major episodes. Differentiation trends exhibit varying amounts of scatter, the trends for SiO_2, FeO, and TiO_2 are quite well defined, have slopes of the same sign, and can be represented adaquately by straigth lines. In contrast, the trends of CaO, Al_2O_3 and Na_2O are often poorly defined. There are clear differences in major element abundances between volcanic suites, particularly for elements with well defined slopes. The results of our regressions are generally consistent with those of Turner and Hawkesworth (1995), Peng et al (1994) and Lassister and DePaolo (1997), although some differences exist. Examination of the global data base shows that there are systematic global variations in continental flood basalt chemistry that correlate with age. Old CFB, such as the Central Atlantic and Karoo-Ferrar, show the following characteristics: low Na_2O, TiO_2 and FeO, high SiO_2. In contrast, basalts associated with recent breakups such as Afar-Yemen and Ethiopia, show the opposite chemical trends. Between these old and young continental breakup, a continuum of compositions is observed. The observed chemical systematics suggest that basalts associated with old breakups are derived by larger extent of melting at shallower mean pressures of melt segregation. Estimating the original volumes of lava in flood basalt provinces is rendered difficult due to subsequent erosion, partial destruction during continental collisions or burial beneath passive margin sedimentation wedges. Many CFBs were erupted in geologically brief intervals (0.5 to 2 Ma) although some, notably the Siberian Traps and Brito-Arctic Province, were emplaced in two or more distinct phases separeted by quiescent intervals. Our calculated emplacement rate show correlation with major element chemistry. Within the context of current models for CFB formation, we will discuss the simple functional dependence on age of the melting processes.

V51C-1024 0830h POSTER

Continental Tholeiites Related to the Kerguelen Plume: Insights From Hf Isotopes

Stephanie Ingle[1] (32-2-650.22.40; single@ulb.ac.be)

Dominique Weis[1]

Nadine Mattielli[1]

Jane Barling[2]

Ray W. Kent[3]

[1]D.S.T.E. Universite Libre de Bruxelle, 50 Ave. F.D.Roosevelt, Brussels B-1050, Belgium

[2]D.E.E.S. Rochester University, Hutchinson Hall 227, Rochester, NY 14627, United States

[3]Coventry University, Priory Street, Coventry CV1 5FB, United Kingdom

Continental tholeiites including the Bunbury Basalt (130-123 Ma; southwestern Australia) and the Rajmahal Traps (~117 Ma; eastern India) erupted proximal to early Kerguelen plume activity. Tholeiites recovered at ODP Site 1137 on Elan Bank, a western salient of the Kerguelen Plateau (~109 Ma), share remarkable geochemical similarities to the early Cretaceous Bunbury and Rajmahal continental basalts. Bunbury, Rajmahal and Site 1137 basalts all contain subgroups distinguishable by variable extents of continental crust contamination. Vertical linear arrays in Pb-Pb isotopic diagrams ($^{206}Pb/^{204}Pb$ ~18.0) are diagnostic of these basalts while $(^{87}Sr/^{86}Sr)_T$ and ϵ_{Nd}(T) range from 0.7040 to 0.7086 and +2 to -6, respectively. These variations are consistent with derivation from a common mantle source followed by assimilation of ancient continental crust.

Hf isotopic compositions of the Rajmahal Group II basalts have ϵ_{Hf}(T) as low as -6.5. The Bunbury Gosselin basalts, with comparable ϵ_{Nd}(T), have ϵ_{Hf}(T) only as low as -2.7. We interpret this discrepancy in ϵ_{Hf}(T) as representing involvement of crust of different age and composition in the petrogenesis of these more contaminated basalts. Hf isotopes, together with Pb, Sr and Nd isotopes, in the Rajmahal Group II and Site 1137 basalts produce coherent trends indicating that the contaminating crust involved during this stage of Kerguelen Plateau formation most likely originated from the Indian subcontinent.

Shallow-level assimilation of continental crust by enriched plume-like mantle-derived magmas is suggested by the relative variation of $\Delta\epsilon_{Hf}$ in the Bunbury Gosselin, Rajmahal Group II and Site 1137 basalts. Two distinct, oblique trends in $(^{176}Hf/^{177}Hf)_T$ vs. radiogenic Pb isotopic composition ($^{208}Pb*/^{206}Pb*$) originate from the Kerguelen plume and diverge toward two different types of continental crust inferred to be involved in the petrogenesis of these basalts. Our data highlight the presence and importance of the Kerguelen plume in the early Cretaceous during the opening of the incipient Indian Ocean.

V51C-1025 0830h POSTER

Evidence for Preferential Melting of the Enriched Components in Polynesian Plumes

C. W. Devey[1] (+49-421-218-9205; cwdevey@uni-bremen.de); K. S. Lackschewitz[1]; D. F. Mertz[2,3]; B. Bourdon[4]; J.-L. Cheminee[5]; J. Dubois[5]; C. Guivel[6]; R. Hekinian[7]; P. Stoffers[8]

[1]Fachbereich 5 - Geowissenschaften, Univ. Bremen, Bremen 28334, Germany

[2]Inst. fuer Geowissenschaften, Univ. Mainz, Mainz 55099, Germany

[3]Max-Planck-Inst. fuer Chemie, Postfach 3060, Mainz 55020, Germany

[4]Laboratoire de Geochemie, Inst. Physique du Globe, 4, place Jussieu, Paris 75252, France

[5]Inst. Physique du Globe, 4, place Jussieu, Paris 75252, France

[6]Lab. Petrologie Structurale, Univ. de Nantes, Nantes 44322, France

[7]IFREMER, Brest, Plouzane 29280, France

[8]Inst. fuer Geowissenschaften, Univ. Kiel, Kiel 24118, Germany

Although much work has been and is being done on the subaerial parts of ocean island volcanoes, we still know relatively little about the submarine stages of their growth. Drilling on islands (e.g. Stolper et al. J. Geophys. Res. 101, 11593-11598, 1996) will help to answer some of the outstanding questions, it must, however, be complemented by sampling of present-day submarine activity. The subaerial parts of the Pitcairn and Society hotspot traces in Polynesia consist of isolated islands constructed from one or at most two volcanic edifices. This is in stark contrast to the seafloor expressions of the active hotspots, which consist of many small volcanoes associated with several larger ones (e.g. Binard et al. Tectonophys. 186, 293-312, 1991; Tectonophys. 206, 245-264, 1992). Samples from these small volcanoes show them all to be erupting highly fractionated magmas derived exclusively from the enriched, isotopically-extreme plume components (EM-I at Pitcairn, EM-II at Society), evidence that these components have the lowest melting temperatures and are the first product of melting of the plume source. We conclude that the first melt batches from the plume source establish a new conduit system to the surface and are highly cooled and fractionated in the lithosphere in the process. Only if subsequent magma batches from the same source region re-use the same plumbing system do the conduit walls become sufficiently heated for basic magmas to traverse the lithosphere and erupt, leading to the growth of a larger volcano and possibly eventually an island.

V51C-1026 0830h POSTER

In search of the hiatus in early Tertiary volcanism in the North Atlantic LIP

Lara E. Heister[1] (530-752-5041; heister@geology.ucdavis.edu)

Michelle A. Gras[1] (530-752-5041; gras@geology.ucdavis.edu)

Charles E. Lesher[1] (530-752-9779; lesher@geology.ucdavis.edu)

[1]University of California, Davis, One Shields Ave., Davis, CA 95616, United States

Ocean drilling and land-based studies in Southeast and West Greenland have identified a hiatus in volcanic activity lasting ~2 Ma, marking a "quiet" interval between arrival of the ancestral Iceland plume beneath Pangaea (Phase I: ~62-58 Ma) and seafloor spreading in the North Atlantic (Phase II: ~56-54 Ma). Larsen et al. (1999, Geol.Soc., Lond. 156) have argued that coal-bearing sediments between the lower and middle formations on the Faeroe Islands also mark a pause in volcanic activity between Phase I and Phase II. They correlate this stratigraphic interval across the Atlantic basin to the East Greenland margin. We have examined in detail the boundary between lavas of the Nansen Formation and Milne Land Formation on the East Greenland margin where the specific correlation was made. The horizon between these formations, along the northeastern shore of Nansen Fjord (68° N, 30° W), is a 10 m thick, well-exposed volcanogenic deposit. Thirteen oriented samples were collected from the bottom to the top of this unit. The rocks are composed of 0.04-3 mm clasts including: scoriaceous, fluidal, and blocky palagonitized and chloritized glass shards; euhedral, subhedral, and broken olivine, augite, and plagioclase; accretionary lapilli; sub-rounded to angular basalt fragments. The matrix is composed of fine-grained ash, now altered mostly to chlorite. These petrographic observations show that the entire unit, prior to regional metamorphism, was composed of pyroclastic basaltic material. The preservation of delicate glass shards and euhedral crystals, and the lack of non-volcanic material, indicates that this is a primary pyroclastic deposit. Crystal morphologies such as large, euhedral olivine and clusters of granular augite are also found in the overlying olivine-pyroxene phyric flows of the Milne Land Formation. This deposit represents an explosive phase preceding effusive eruption of the earliest plateau lavas of the Milne Land Formation. Based on these findings, there does not appear to be a "quiet" interval in volcanic activity as reported elsewhere in the North Atlantic LIP. This may reflect the proximal position of East Greenland margin to the axis of the ancestral Iceland plume.

V51C-1027 0830h POSTER

Spatial and Temporal Variations in Melting Within the Lithosphere Above the East African Mantle Plume - Evidence from the Mt. Meru/Mt. Kilimanjaro Region, N. Tanzania

Martin A Roberts[1] (+44 1223 333405; mrob98@esc.cam.ac.uk)

Sally A Gibson[1] (+44 1223 333401; sally@esc.cam.ac.uk)

[1]Department of Earth Sciences, University of Cambridge, Downing Site, Cambridge CB2 3EQ, United Kingdom

The temporal variation in composition of Quaternary magmatism in northern Tanzania primarily reflects the diverse style of metasomatic enrichment that occurred within the SCLM as a consequence of the

southward propagation of the EAR over the plume head. Low factors (~1.2) and thick lithosphere preclude a significant amount melt generation in the East African plume head beneath this part of the EAR.

The earliest volcanic activity in this part of northern Tanzania occurred between 8 Ma and 2 Ma and is represented by regional flood lavas, the Monduli volcanic centre and early activity at Kilimanjaro. These magmas are mildly alkaline and volatile-poor. Fractionated heavy rare-earth element ratios and relative depletions at Ti, Rb and K are consistent with melting of a phlogopite/amphibole-bearing garnet peridotite source. This early melting appears to have been initiated by conductive heating of H_2O-rich metasomatic veins in the basal lithosphere (at depths up to ~150 km). Subsequent localised crustal extension at ~1.2 Ma immediately precedes the generation of small-volume silicate melts (melilitites and melanephelinites), which are characterized by relatively high Zr/Hf. These melilitites are typically associated with the eruption of carbonatite tuffs. The most recent phase of volcanism (<0.2 Ma), on the eastern flank of the EAR in northern Tanzania, is represented by strongly alkaline magmas at Mt. Meru, and mildly alkaline magmas at Mt. Kilimanjaro. The Meru lavas are characterised by similar compositions to CO_2-rich glasses that occur in mantle xenoliths from the nearby Olmani cone.

The genesis of the Meru magmas requires wide-scale melting of CO_2-rich metasomatised lithosphere (~100 km) to produce the large volume (>150 km^3) of erupted magmas. Conduction models show that conductive heating of the lithosphere by a mantle plume over the ~10 Ma volcanic history of the region can produce the required melting of the lithosphere

V51C-1028 0830h POSTER

Helium Isotope Compositions in Springs From the Three Sisters Region, Central Oregon, USA.

Matthijs C Van Soest[1] (510 486 5659; mcvansoest@lbl.gov)

B Mack Kennedy[1] (510 486 6451; bmkennedy@lbl.gov)

William C Evans[2] (650 329 4514; wcevans@usgs.gov)

Robert H Mariner[2] (650 329 4507; rmariner@usgs.gov)

[1]Center for Isotope Geochemistry, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd. MS 70A-4418, Berkeley, CA 94720, United States

[2]USGS, 345 Middlefield Rd., MS 434, Menlo Park, CA 94025, United States

The Three Sisters region has recently come under increased scrutiny after the discovery by Satellite Radar Interferometry (InSAR) of a broad area of uplift centered approximately 5 km west of the South Sister volcanic edifice (Wicks et al., 2001). The bulge, which at its center reaches a maximum of 10 cm, formed between 1998-2000. The exact cause for the uplift is unknown, but observations from other volcanoes and results from numerical modeling imply that the most likely cause is the movement of magma up to mid-crustal (~6.5 km depth) levels (Wicks et al., 2001).

The area of uplift coincides with an area where spring chemistry shows anomalously high levels of chloride and carbon emissions (Ingebritsen et al., 1994). These features pre-date the bulge by at least a decade and can also be indicative of a magmatic source. It is unclear if the bulge and the geochemical anomalies are directly related, but both point to the presence of magma below the Three Sisters area.

Within the scope of a monitoring project that has recently been initiated to study the development of the bulge and any accompanying changes in the fluid/gas chemistry of springs in the Three Sisters area, 10 gas samples were collected for noble gas analysis in July 2001. Two of these samples were taken from cold bubbling springs located close to the center of the bulge and the remaining 8 were obtained from well documented geothermal springs within the general area of Central Oregon.

Helium isotope ratios (reported as R_c/R_a where R_c = air corrected $^3He/^4He_{sample}$ and R_a = $^3He/^4He_{air}$) for these 8 samples range from 2.8 to 5.1 R_a which is in agreement with existing data reported in a study carried out by Unocal in the early 1980's of geothermal springs in this area. The data show a relationship with distance to the bulge/South Sister volcano: all samples within a radius of 30 km have helium isotope ratios in the range of 4.5 to 5.1 R_a, while samples that fall outside this radius have distinctly lower helium isotope ratios (<4 R_a).

The two samples from the center of the uplift area have helium isotope ratios that are significantly higher (7.4 and 8.6 R_a) than the data for the other springs. This clearly demonstrates the presence of a mantle derived magma at some depth below the bulge and the occurrence of permeable pathways to the surface for gas of magmatic origin.

At this time, due to a lack of literature noble gas data for the exact area of the bulge, it cannot be determined if the occurrence of these high ratios, which are a common feature in other Cascade Range volcanoes, coincided with the formation of the bulge or if they predate the uplift. This remains a subject for further study.

References: Wicks, C. Jr., Dzurisin, D, Ingebritsen, S. E., Thatcher, W., Lu, Z., and Iversen, J. (2001) Magmatic activity beneath the quiescent Three Sisters volcanic center, central Oregon Cascade Range, USA, abstract AGU Fall meeting, this volume.

Ingebritsen, S. E., Mariner, R. H., and Sherrod, D. R. (1994) Hydrothermal systems of the Cascade Range, North-Central Oregon. USGS Professional paper 1044-L 88p.

Acknowledgements: We acknowledge Unocal for granting permission to use helium isotope data collected by them during a regional study in the early 1980's.

V51C-1029 0830h POSTER

The Depleted Mantle Component in Kerguelen-Plume Related Magmas

Sonia Doucet[1,4] (sdoucet@ulb.ac.be); Dominique Weis[1]; James S. Scoates[1]; Kirsten Nicolaysen[2]; Frederick A. Frey[3]; André Giret[4]

[1]DSTE, Univ. Libre de Bruxelles, Brussels 1050, Belgium

[2]Geology, Lawrence University, Appleton, WI 54912, United States

[3]EAPS, MIT, Cambridge, MA 02139, United States

[4]Géologie-Pétrologie, CNRS-UMR 6524, Univ. Jean Monnet, Saint-Etienne 42023, France

The Northern Kerguelen Plateau (NKP) and the Kerguelen Archipelago formed on the Antarctic plate after 43 Ma when Broken Ridge was split from the Kerguelen Plateau by spreading along the South-East Indian Ridge (SEIR). A depleted mantle component, similar to that of SEIR-MORB, is present in basalts from the NKP (Site 1140; 34 Ma) and from the Kerguelen Archipelago (26-29 Ma), but is absent in the youngest (<25 Ma) flood basalt sequences on the archipelago. This decrease in the depleted component appears to be correlated with time i.e., distance from the SEIR. We are investigating the oldest basaltic sections on the archipelago to constrain the origin of the depleted component in KA lavas.

Two of the oldest basaltic sections on the northwestern Kerguelen Archipelago (Ruches and Fontaine, 28 Ma) reveal the eruption of two isotopically different types of magmas within ~1 myr. Their isotopic and trace element characteristics are between Kerguelen plume ($^{87}Sr/^{86}Sr_i$ ~0.7052) and depleted SEIR-like ($^{87}Sr/^{86}Sr_i$ ~0.703) compositions and show no simple magma mixing trends. The stratigraphically lower, isotopically depleted basalts ($^{87}Sr/^{86}Sr_i$ ~0.7045) are overlain by transitional and isotopically heterogeneous ($^{87}Sr/^{86}Sr_i$ ~0.7047-0.7056) high-MgO basalts. This transition reflects the increasing contribution with time of the Kerguelen plume source. The depleted component may represent contamination of plume-derived magmas by depleted upper mantle under the archipelago, similar to the source for SEIR-MORB. This could account for the geographical distribution of the depleted component in the northwest and central part of the Kerguelen Archipelago. It could also explain the absence of a depleted component in < 25 Ma alkali basalts that formed by deeper melting, when the Kerguelen Archipelago was further away from the ridge, and the lithosphere thicker. Alternatively, the depleted component could represent entrained upper mantle associated with the Kerguelen plume. There is no evidence for an intrinsic depleted component in the Kerguelen plume source.

*ARC and Eurodoc (région Rhône Alpes) grant

V51C-1030 0830h POSTER

A Lower Mantle Origin for the Worlds Biggest LIP? A High Precision Os Isotope Isochron From Ontong Java Plateau Basalts Drilled on ODP Leg 192

Ian J Parkinson[1] (+44 1908 659780; I.J.Parkinson@open.ac.uk)

Bruce F Schaefer[1] (+44 1908 659781; B.F.Schaefer@open.ac.uk)

ODP Leg 192 Shipboard Scientific Party[2]

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

[2]Ocean Drilling Program, Texas A and M University, College Station, TX 77840, United States

Basalts drilled on ODP Leg 192 from the Earths largest igneous province, the Ontong Java Plateau (OJP) yield a Re-Os isochron age of 121.5+/-1.7 Ma and an initial $^{187}Os/^{188}Os$ ratio of 0.1295+/-0.0011. The basalts are from four ODP sites located over a 1000 km apart. The generation of such a high precision isochron using the Re-Os isotope system indicates the source of the OJP is remarkably homogeneous, with an Os isotope composition very similar to that of the primitive mantle. Their high Re contents (1000-1600 ppt) and relatively high Os contents suggest that they are produced by melting beyond sulphide-out in the mantle. Other trace element data support the conclusion that these basalts are derived by high degrees (25-30%) of partial melting of the mantle. Such high degrees of partial melting may assist in homogenising the Os isotopic signature of the source region. The Os isotope data indicate that there is no core signature in the source of the OJP basalts analysed in this study, but that they are more likely derived from entrained lower mantle.

V51C-1031 0830h POSTER

Mantle Evolution Associated With the Rio Grande Rift: Geochemistry of Upper Mantle Xenoliths

Young-woo Kil[1] (1-303-384-2011; ykil@mines.edu)

Richard F. Wendlandt[1] (1-303-273-3809; rwendlan@mines.edu)

[1]Dept. of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401

Upper mantle xenoliths from three locales associated with the southern Rio Grande Rift have been investigated to determine lithosphere composition, chemical processes, and pre-eruptive pressure and temperature conditions. Sample locations, Potrillo and Elephant Butte within the rift axis and Adam's Diggings, located 50 km west of the rift axis, were specifically selected to evaluate spatial differences in mantle evolution. Xenolith suites from all locations included spinel lherzolites, harzburgites, and pyroxenites hosted in basanite and alkali basalt. Thin section, electron microprobe, and LA-ICPMS analyses were used to obtain detailed textural information, mineral compositions, and whole rock geochemistry.

Xenoliths are classified as protogranular, porphyroclastic, or equigranular texture types. Equigranular texture types occur in the off-axis site. Recrystallized olivine grains are larger in xenoliths from sites along the rift axis than from the rift shoulder. Geothermal gradients based on mineral compositions, utilizing two-pyroxene and olivine-spinel geothermometers and the Ca-in olivine geothermobarometer, indicate temperatures off the rift axis at Adam's Diggings that are 75^o-100^oC cooler for a given pressure than under the rift axis. Whole rock chemical data and mineral modes support an early depletion event affecting xenoliths from all locations: Al_2O_3, CaO, Na_2O, TiO_2, V, Sc, Yb, and clinopyroxene content decrease with increasing MgO. The average $(La/Yb)_n$ of clinopyroxenes are 12.37, 0.95, and 1.14 for Adam's Diggings, Elephant Butte, and Potrillo xenoliths, respectively. This LREE enrichment and the occurrence of phlogopite that is interpreted to be primary in xenoliths from the off-axis site indicate both cryptic and modal metasomatic events. Both LREE-enriched and -depleted lherzolites are present at rift axis sites. Differences in recrystallized olivine size, xenolith textures, composition, and pre-eruptive pressure-temperature conditions between rift axis and rift flank locations suggest that the upper mantle underlying the Rio Grande Rift has undergone partial melting and at least two metasomatic episodes by melt and fluid.

V51D MC: 305 Friday 0830h

Conduit Processes During Explosive Basaltic Eruptions II *(joint with P, S, T)*

Presiding: **M Ripepe,** Universita di Firenze**; M Hort,** University of Kiel

V51D-01 0835h INVITED

Linking Surface Observations to Sub-Surface Processes in Basaltic Explosive Eruptions

Lionel Wilson (+44-1524-593889; L.Wilson@Lancaster.ac.uk)

Env. Sci. Dept., Lancaster University, Lancaster LA1 4YQ, United Kingdom

Along with magma volatile content, magma rise speed is the main control on the characteristics of explosive eruptions. Key issues are the extent to which gas bubbles are distributed non-uniformly in the magmatic liquid and the extent to which gas bubbles do not have a monodisperse size distribution. Larger, early nucleating bubbles overtake smaller, later nucleating