thin planar beds. The crests of regressive dunes migrate upstream, with the coarser fragments dropped on the upstream side of the crest. These are thought to form as a result of wet surges due to the presence of accretionary and/or armored lapilli as well as vesicles due to trapped volatiles in wet ash. Dunes in deposits further from the vent are generally thinly bedded and have gentler dip angles and shorter wavelengths. Other types of cross-stratification found at Sinker are wavy-planar beds, which are a mixture of airfall and surge, and deformed low angle dune beds (.5-1 m wavelength) containing abundant soft sediment deformation and sag structures. Found high in some sections are large-scale progressive dune-forms (1-2 m wavelength). These may be attributed to a late dry surge towards the end of eruption, just before the volcano isolated itself from all external water. The low angle cross-stratification and irregular truncations reflect the highly pulsatory nature of surges during deposition. The dune bed thicknesses and average wavelength appear to decrease away from the vent. This finer cross-stratification may be result of the same type of surges that formed the larger regressive dunes, but may represent a loss in momentum, density and turbulence as the surge travels further from its source.

V42B-0365 1330h POSTER

Facies analysis of Hlodufell basaltic subglacial to emergent volcano, SW Iceland: insights into sub-ice growth mechanisms and meltwater drainage

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Hlodufell is a subglacial to emergent basaltic volcano located 9km south of the Langjokull ice-cap in SW Iceland. This study is the first detailed facies analysis of this well-known volcano. The vertical facies architecture of the basal half of the volcano is typical of many basaltic subaqueous (including submarine) to emergent volcanoes, comprising basal pillow mounds overlain by Surtseyan eruption-fed subaqueously-deposited sediment gravity flows. However, facies in the upper part of the edifice demonstrate the influence of variable water levels more typical of englacial lakes. The Surtseyan sequence is overlain by two subaerial lava flow and cogenetic lava-fed delta sequences, separated by a second Surtseyan sequence. In addition, the uppermost lava flows are also draped by a thin veneer of Surtseyan tephra. Both lava-fed delta sequences are unusually dominated by subaerial lava breccias. This may be due to a number of factors that influence steep slope stability but the possibility of retreating ice walls should be considered. Detailed facies analysis also revealed evidence of the influence of ice on eruptive and depositional products throughout the history of the edifice. Some of the basal pillow mounds preserve metre-sized cavities with partial hyaloclastite fills, interpreted as meltout structures formed during sub-ice growth by ice-block stoping. Some mounds also have steep chill surfaces where pillows have been compressed against a rigid wall (now absent) interpreted as ice. The peripheral pillow mounds, particularly those to the immediate south of Hlodufell (Rani area) are draped by Surtseyan eruption-fed tephra deposited by erosive meltwater streamflows. The draping tephra was derived from both the first and second Surtseyan sequences. These observations illustrate that direct ice-contact and ice-block stoping was important during initial construction of the volcano and that meltwater drainage (particularly to the south) was important throughout its history.

V42B-0366 1330h POSTER

First Recorded Eruption of Mount Belinda Volcano, South Sandwich Islands

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The MODVOLC satellite monitoring system at the University of Hawaii Manoa has revealed the first recorded eruption of Mount Belinda volcano, on Montagu Island in the remote South Sandwich Islands. Here we present some initial qualitative observations gleaned from the relatively limited amount of satellite imagery available throughout the eruption, including MODIS, Landsat 7 ETM+ and ASTER data. The eruption started some time between September 12 and October 20, 2001, with low-level ash effusion. In January 2002 a Landsat 7 ETM+ image indicated possible collapse structures in the surface of the continuous ice cover within the caldera, suggesting some degree of subglacial volcanism. By May 2002, a broad area of lava or ash was observed close to the subaerial erupting centre, and activity subsequently increased to its highest observed levels in August 2002. Observations in February and March 2003, from a British Antarctic Survey ship and an aircraft of the British Royal Navy, provided the first visual confirmation of the eruption. Minor thermal anomalies continued to be observed in MODIS imagery throughout August 2003, indicating a prolonged low-level eruption or the establishment of a persistent summit lake possibly similar to that believed to occupy the summit crater (Mount Michael) on nearby Saunders Island. A dynamic lava lake on Saunders Island was first reported in 2001 and remains active.

V42B-0367 1330h POSTER

Degassing at Basaltic Tuyas in northern British Columbia: Insights from the Hydrogen Isotopic Composition of Glasses and Whole Rocks

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Interest in subglacial volcanism was rekindled by the spectacular 1996 Gjalp eruption in Iceland. Northern British Columbia, Canada, hosts numerous flat-topped subglacial volcanoes called tuyas. Ash Mountain, South Tuya, and Three Caribou Tuya are three examples of basaltic volcanoes that began eruptive activity under glacial ice during the Fraser glaciation (25 to 10 ka). Sections of the three superbly exposed tuyas reveal a consistent stratigraphic progression from pillow lavas to hyaloclastite deposits from the base upward. Locally the sections are capped by subaerial basaltic lava flows. Based on classic eruptive models, the glassy pillow basalts and overlying hyaloclastite deposits indicate eruption of basalt within melt water caverns of increasingly shallow depths. Capping subaerial flows record the emergence of lava above the ice sheet. Large thicknesses of ice and melt water overlying the basaltic volcanoes would significantly impede the release of volatiles from the ascending magma. Degassing and ascent rates of magma are thought to exert control on eruptive style. Despite hydrogen isotopes being sensitive measures of degassing, to our knowledge no hydrogen isotope data has been collected on glassy subglacial basaltic rocks. H_2O contents and hydrogen isotopic analyses of glasses from the pillow basalts and hyaloclastite deposits should improve our understanding of degassing processes at these classic tuyas and help refine current models of subglacial basaltic eruptions. Consequently, samples of glassy pillow basalts and hyaloclastites along with crystalline basalt flows were collected at Ash Mountain, South Tuya, and Three Caribou Tuya in northern British Columbia. XRF major and trace element analyses of glassy and crystalline basalts reveal relatively primitive compositions with MgO values ranging from 5.52-10.07 wt%. Whereas Ash Mountain samples are largely tholeiitic, South Tuya and Three Caribou Tuya basalts show more alkalic affinities. In order to definitively track degassing at these subglacial volcanoes, glasses and whole rock basalts were analyzed for their H_2O concentration and hydrogen isotopic composition. At Ash Mountain, glasses from pillow basalts have higher water contents (0.54-0.66 wt%) and less depleted δD values (-87.2 to -102.0 $^o/_{oo}$) than associated hyaloclastite deposits (0.43-0.48 wt% H_2O and δD from -112.5 to -122.6 $^o/_{oo}$). Hyaloclastite glasses from South Tuya have H_2O contents similar to the Ash Mountain pillow glasses, but δD values resembling Ash Mountain hyaloclastites. Bulk rock basalts have even lower H_2O contents than either the pillow glasses or hyaloclastite deposits and exhibit extreme depletions in δD (i.e., less than -140 $^o/_{oo}$). These preliminary data support eruptive models that propose pillow basalts erupted in deeper water than hyaloclastite deposits. Moreover, the H_2O data can be used to constrain the thickness of ice overlying the basalts at the time of the eruption.

V42B-0368 1330h POSTER

Spatial Analysis of the Landbrotsholar Rootless Cone Group, South-Central Iceland: Preliminary Results

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Here, we examine the spatial distribution of the Landbrotsholar rootless cone group in South-Central Iceland. Rootless cones (or pseudo-craters) are hydrovolcanic cones of spatter and scoria that rest directly on tube-fed pahoehoe lava flows. They are formed by explosive interaction between the host lava and underlying water-saturated sediments; they do not represent primary volcanic constructs. Within a given rootless cone group, cones generally appear to be randomly distributed, lacking any obvious association with linear features such as eruptive fissures. However, in the Landbrotsholar group, some cones appear to be linearly aligned. The significance of this apparent alignment is unclear, but it might be related to sequential eruptions along preferred internal pathways (e.g., lava tubes) within the flow field and/or changes in the water content and density of the waterlogged substrate. The spatial distribution of rootless cones may therefore have important implications for the dynamics of these hydrovolcanic explosions and the mechanisms of cone formation. We employ various spatial analysis techniques to examine the Landbrotsholar rootless cone group in detail, including both global and local techniques. These methods provide a means for assessing the degrees of spatial randomness in the cone field and evaluating the statistical confidence in this assessment. Our work entails: (1) developing a filter to automatically identify rootless cones from digital images; (2) identifying spatial trends (such as linear alignments) within the cone group by applying a Hough Transform and identifying peaks in the transformed image; (3) quantifying the characteristic spacing among cones using nearest-neighbor analyses; and (4) relating these results to the underlying processes governing cone formation. Specifically, we aim to elucidate the relative roles of lava tube distribution and substrate hydrology in determining rootless cone distribution. This work may also lead to the development of a remote sensing tool to differentiate rootless cone groups from primary cone groups in digital images.

V42C MCC: Level 1 Thursday 1330h

Noble Metal Geochemistry Posters

Presiding: **J C Lassiter,**
Max-Planck-Institut für Chemie

V42C-0369 1330h POSTER

Os and Sr Isotope Signatures in Kamchatka Adakites, Nb-Rich Arc Basalts and Mantle Pyroxenites: Inferences on Mantle and Crustal Processes

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A suite of adakites, Nb-enriched arc basalts (NEABs), and mantle pyroxenites from Kamchatka have been analyzed for Os and Sr isotopes in order to investigate the relationship between the lavas and their respective veined-mantle source regions, and the extent to which crustal contamination has contributed to the enriched isotopic signatures in the lavas. The mantle pyroxenites range in $^{187}Os/^{188}Os$ from 0.1280 to 0.4138, and in $^{87}Sr/^{86}Sr$ from 0.70305 to 0.70339. The adakites and NEABs for which both Sr and Os data are available fall within the compositional range of the pyroxenites for $^{187}Os/^{188}Os$, varying from 0.1384 to 0.2983, and have $^{87}Sr/^{86}Sr$ ranging from 0.70294 to 0.70320. Os abundances in these lavas range from 12 to 112 ppt. Two distinct positive Os-Sr isotope correlations are observed amongst these samples, including a shallower trend that comprises pyroxenites and lavas from the northern arc front, and a steeper trend that comprises pyroxenites and lavas from behind the arc

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front in the south. In each of these groups, it is notable that the pyroxenites, rather than the lavas, define the radiogenic endmember. This relationship is consistent with melting of veined mantle (peridotite-pyroxenite) as the origin of the radiogenic Os signatures in the lavas. The two distinct Os-Sr isotope trends displayed by the respective pyroxenite-lava groups are further consistent with previous studies of Kamchatka peridotite xenoliths, which indicate the involvement of compositionally distinct slab-derived metasomatic fluids in the northern versus southern Kamchatka subarc mantle, related to differences in the age of the respective subducting slabs (Kepezhinskas et al., 1996; Widom et al., 2002). Other Kamchatka lavas, with Os abundances between 1.3 and 2.5 ppt and $^{187}Os/^{188}Os$ between 0.7888 and 1.2908, are significantly more radiogenic than any of the pyroxenites, and therefore most likely derive their radiogenic Os by crustal assimilation. References: Kepezhinskas, P.K., Defant, M.J. and Drummond, M.S. 1996, GCA 60, 1217-1229. Widom, E., Kepezhinskas, P. and Defant, M. 2003, Chemical Geology 196, 283-306.

V42C-0370 1330h POSTER

Oxygen - Osmium Isotopic Compositions of West Maui Lavas and the Link to Oceanic Lithosphere

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We use stratigraphically-controlled sequences of late shield-stage lavas from West Maui to investigate age-dependence and fine-scale complexity of chemical variation within this Kea-type Hawaiian volcano. With new O and Os isotope data we identify unique geochemical signals indicative of complex processes of mixing among source components. In W. Maui lavas, $\delta^{18}O$ and $^{187}Os/^{188}Os$ range from 4.5 to 5.2 and 0.1316 to 0.1394, respectively. One sample ($^{187}Os/^{188}Os$ =0.158) has very low [Os] (20 ppt) and likely has been severely contaminated by shallow oceanic crust. These compositions, as well as $^{87}Sr/^{86}Sr$ (0.7034-0.7037) and $^{206}Pb/^{204}Pb$ (18.36-18.54), are typical of shield-stage lavas from other Kea-type volcanoes. Some W. Maui compositional variability correlates with stratigraphic height. All shallow samples have $^{187}Os/^{188}Os \geq 0.1333$, and all deep samples have $^{187}Os/^{188}Os \leq 0.1330$. The deep samples show a negative $^{187}Os/^{188}Os$ - $^{87}Sr/^{86}Sr$ correlation, but the shallow samples show no Os - Sr isotopic correlation. $^{187}Os/^{188}Os$ correlates with no other measured isotopic compositions except for $\delta^{18}O$, for which the deep and shallow samples define two sub-parallel inversely correlated trends. $\delta^{18}O$ shows no other correlation with stratigraphy or other measured isotopic tracers. The inverse O-Os isotopic correlation of W. Maui is distinct from that observed for other Hawaiian volcanoes (e.g. Mauna Kea, Koolau) or within the Hawaiian suite as a whole. Age-dependent sampling of at least three components is required to describe the O-Os-Sr isotopic variation we observe at W. Maui. Similar intra-volcano correlation in $^{87}Sr/^{86}Sr$ - $^{206}Pb/^{204}Pb$ - trace element compositions is consistent with mixing of small-degree partial melts of gabbroic oceanic crust with plume-derived Kea-type magmas. We infer that this gabbroic endmemember is characterized by $\delta^{18}O < 4.5$ and $^{187}Os/^{188}Os > 0.133$. The remainder of the variability is the result of short-lived chemical heterogeneities in the Kea plume endmember.

V42C-0371 1330h POSTER

Platinum-Group Element Variations in Hawaiian Lavas: Constraints on the Role of Sulfides during Melt Generation and Fractional Crystallization

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Platinum-group elements (PGE) are highly compatible in mantle and magmatic sulfides, with sulfide melt/silicate melt partition coefficients typically on the order of 10^4 or higher. PGE abundances in basaltic melts are therefore very sensitive to the presence or absence of residual sulfides during melt generation and the fractionation of magmatic sulfides during crystallization. PGE abundances (Ir, Os, Ru, Pt, Pd) were measured in lavas from Mauna Kea and Koolau volcanoes, Hawaiian Islands to constrain the abundance of residual sulfide in the Hawaiian plume during melt generation as well as the role of sulfide fractionation during melt evolution. Iridium, Os, and Ru are positively correlated with MgO content in lavas ranging from ~6-28 wt.% MgO. Bulk partition coefficients during fractional crystallization range from ~4 (Ir) to ~7 (Os). The compatible behavior of Ir, Os and Ru in Hawaiian melts likely reflects the high compatibility of these elements in Cr-spinel, which coprecipitates with olivine in most Hawaiian lavas. In contrast, no significant trend is observed in Pt or Pd abundances with MgO content, indicating bulk partition coefficients for these elements of ~1. Pt and Pd are predicted to be incompatible in Cr-spinels, but are highly compatible in magmatic sulfides ($D_{sulfide/silicate} = 4.5x10^4$) . The low bulk partition coefficients for Pt and Pd in the Koolau and Mauna Kea lavas indicate that sulfide segregation was insignificant during fractional crystallization, even in lavas that have experienced up to 25% olivine fractionation. Lack of sulfide saturation/segregation could reflect sulfur degassing in shallow magma chambers. However, deep submarine lavas from the HSDP-2 Mauna Kea drillcore display similar PGE trends. Therefore, it is likely that primary Hawaiian magmas (with ~15-16 wt.% MgO) are at least ~20-25% sulfur undersaturated when they reach crustal levels. If the source of Hawaiian lavas contains residual sulfide, primary Hawaiian melts should be sulfur-saturated at their depth of origin. However, because sulfur solubility increases with decreasing pressure, sulfur-saturated melts generated at depth become undersaturated as they rise, provided they do not reequilibrate with sulfide-bearing mantle during ascent. Sulfur undersaturation in primary Hawaiian lavas thus precludes significant interaction with the oceanic lithosphere during magma ascent. Bulk partition coefficients for the PGEs during melt generation are constrained from the PGE abundances in primitive Hawaiian lavas assuming primitive mantle abundances in the Hawaiian plume. Bulk partition coefficients during melt generation are higher than those for fractional crystallization, ranging from ~3.5 (Pt) to 14 (Ir). Significantly, MgO-Ir, -Ru, and -Os trends are identical in the Koolau and Mauna Kea lavas, suggesting similar PGE and sulfide abundances in the sources of these two suites. Based on available sulfide/basalt PGE partition data, the bulk partition coefficients for melt generation are consistent with no more than ~100-150 ppm residual sulfide (~30-50 ppm sulfur) in the Hawaiian plume. If primary Hawaiian melts are generated by ~5% partial melting and contain ~1000 ppm sulfur, this suggests a sulfur content in the plume prior to melting of ~100 ppm, significantly less than the sulfur content of primitive mantle. Low sulfur abundances in the plume may reflect the presence of significant quantities of recycled oceanic crust and lithospheric mantle that have had volatile species removed during subduction-induced dehydration.

V42C-0372 1330h POSTER

Highly Siderophile Element Partitioning in Partial Melting Residues : a Case Study in Some Pyrenean Harzburgites (France).

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Highly siderophile elements (HSE: Os, Ir, Ru, Rh, Pt, Pd and Re) in mantle peridotites are mainly (>90%) concentrated into base-metal sulfide microphases (BMS). During partial melting, BMS are extracted along with the partial melt and are completely consumed by 15-20% partial melting. At the same time, Pd and Re progressively enter the partial melt while Os, Ir, Ru and sometimes Pt remain in the peridotitic residue even when BMS have been completely extracted. Identifying the mineral(s) concentrating the refractory HSE (Os, Ir, Ru) and Pt in refractory peridotites will provide a better understanding of the behavior of these elements and their radiogenic isotopes during partial melting and melt extraction processes. Such a study has been done on three spinel harzburgites from the Lherz massif (French Pyrenees) using electron microprobe (EMP) and scanning electron microscope (SEM) coupled with isotope dilution (ID)-ICP-MS analyses of whole-rock and mineral separates. These samples (0.3-1.22 wt. % Al_2O_3) show S contents ranging between 100 and <5 ppm (Lorand et al., 1999 and unpublished data). Whole-rock HSE concentrations are 2-5 ppb for Ir, Ru and Pt, 0.2-2 ppb for Pd and 15-70 ppt for Re, in good agreement with the previous analyses of Lorand et al. (1999). The CI-normalized patterns show a progressive depletion from Ir and Ru to Pt, Pd and Re. Pt_N/Ir_N, Pd_N/Ir_N and Re_N/Ir_N are subchondritic (0.7-0.77; 0.52-0.08; 0.23-0.05, respectively; N: CI-normalization after Horan et al., 2003). Pd and Re concentrations as well as Pd_N/Ir_N and Re_N/Ir_N decrease with the extent of partial melting. Orthopyroxene contains <10 ppt Ir, <40-255 ppt Ru,<10-420 ppt Pt, 4-76 ppt Pd and <5-335 ppt Re; these concentrations vary widely between different aliquots separated from the same sample. Clinopyroxene broadly shows the same range of HSE concentrations (50-210 ppt Ir, <30-320 ppt Ru, <215 ppt Pt, <30 ppt Pd and <5 ppt Re) while Cr-spinel is HSE-richer (1200-4300 ppt Ir, <30-2500 ppt Ru, 1700-11300 ppt Pt, 350-7100 ppt Pd and 40-340 ppt Re). Because of their low HSE contents and/or their low modal abundances, neither orthopyroxene, clinopyroxene nor spinel can account for the whole-rock HSE abundances of Pyrenean harzburgites. The large variations of concentrations in pyroxenes or spinel suggest that HSE do not reside in the lattices of these minerals but more likely occur as included microphases. The other potential HSE-rich minerals are then olivine and/or intergranular HSE-rich microphases such as HSE alloys or sulfides. High-resolution electron microbeam techniques have been unsuccessful in detecting these microphases, suggesting that, if they exist, they are smaller than 1 μm. Lorand et al., 1999. J. Pet. 40, 957-981. Horan et al., 2003. Chem. Geol. 196 , 5-20.

V42C-0373 1330h POSTER

Precise Pt-Re-Os Isotope and PGE Systematics of 2.7 Ga Pyke Hill Komatiites, Canada

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The Os isotopic composition of the modern upper mantle is relatively well constrained, but only limited data on the Re-Os systematics of the Archean mantle are available. Pt-Os isotope studies have so far not been performed on Archean mantle-derived rocks, mostly due to analytical limitations and insufficient availability of appropriate geological record. In this study, precise Re-Pt-Os isotopic and PGE abundance data for 2.7 Ga Pyke Hill komatiites have been obtained. These are LILE-depleted mantle melts with 28% MgO characterized by CI chondrite-normalized Pd/Ir = 4.0, Os/Ir = 1.1, and Os = 2.3 ppb. Calculations establish a non-CI-chondritic PGE pattern for the mantle source of the lavas. This pattern is similar to that of an average depleted spinel lherzolite and of enstatite chondrites. The precise Re-Pt-Os isotopic data for bulk rock cumulate komatiite samples from a single lava flow define isochrons on the Re-Os and Pt-Os diagrams with ages of 2725+/-33 and 2843+/-640 Ma and initial 187Os/188Os = 0.10902+/-16 and 186Os/188Os = 0.1198318+/-18, respectively. These correspond to initial gamma(Os) = +0.62+/-0.15 and epsilon(Os) = +0.57+/-0.15, respectively, relative to the chondritic references currently in use. These precise initial values interpreted to represent the composition of the Abitibi komatiite mantle source are higher than those in carbonaceous chondrites, but closely match recently obtained precise Os isotopic compositions of enstatite and ordinary chondrites recalculated at the time of the lava emplacement. These data provide strong evidence that vast regions in the Archean mantle evolved with long-term HSE relative abundances similar to those in enstatite and ordinary chondrites.

V42C-0374 1330h POSTER

Major and Trace Element Geochemistry and Os Isotopic Compositions of Komatiites From Dundonald Beach, Abitibi Greenstone Belt, Canada

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We have examined the major and trace elements, and Os isotopic compositions of a suite of cumulate and spinifex textured komatiitic rocks from the Dundonald Beach area, part of the ~2.7 Ga Abitibi greenstone Belt, Ontario, Canada. This suite of rocks forms a series from peridotitic komatiites (MgO ~ 42 wt.% on a volatile-free basis) to komatiitic basalts (MgO ~8 wt.%). Based on major element oxide ratios (e.g. Al_2O_3/TiO_2 ~21-26 and CaO/Al_2O_3 typically <= 1) and unfractionated HREE characteristics (e.g. $(Gd/Yb)_N$ ~0.9-1.1), these rocks are similar to the spatially associated Al-undepleted komatiites from Alexo and Munro Townships. Also, these rocks are strongly LREE-depleted ($(La/Sm)_N$ = 0.41-0.67; $(Ce/Yb)_N$ = 0.41-0.70)) and have variable total REE (4-22 ppm). A strong negative correlation between Mg# and total REEs suggests that the REE patterns of these rocks are primary features of their mantle source. The Re-Os isotope results for whole-rock komatiites and chromite separates from a single flow yield a model 3 isochron age of 2606 ± 55 Ma. This age is slightly younger (~50 Ma) compared to the U-Pb zircon ages of the associated volcanics reported from the presumed extension of the same Kidd-Munro assemblage in Alexo and Munro Townships. The initial $^{187}Os/^{188}Os$ ratio (0.1090 ± 0.0019) obtained from the regression is essentially chondritic (γ_{Os}(T) = -0.2 ± 1.7). The peridotitic komatiites have the highest Os concentrations and low $^{187}Re/^{188}Os$ ratios (up to ~4.2 ppb and < 0.5, respectively) among the whole rocks, whereas the komatiitic basalts have relatively low Os concentrations (~0.3 ppb) and high $^{187}Re/^{188}Os$ ratios (~3.1-11.9). For these komatiites, Os was compatible with the mantle residue ($D_{Os}^{mantle-melt}$ ~7.6), whereas Re was moderately incompatible (D_{Re} ~0.6), typical of most komatiitic magmas. The absence of a strong correlation between Os and Ni concentrations in the whole-rocks suggests that the distribution of Os in these rocks is not primarily controlled by fractionation of olivine. The apparent $D_{Re}^{ol+chmt/liq.}$ (~0.7), on the other hand, suggests that Re was moderately incompatible in olivine and/or chromite during the differentiation of komatiitic magmas. A chondritic initial Os isotopic composition for the mantle source for these komatiites is consistent with that previously reported for the komatiites from Alexo and Munro Townships. Our Os isotopic results for Dundonald komatiites, combined with those reported for Alexo and Pyke Hill komatiites, therefore, suggest that a major portion of the ~2.7 Ga mantle source for the komatiites in the Abitibi greenstone belt was dominated by Os with chondritic isotopic compositions. Also, the LREE-depleted, yet chondritic Os isotopic composition for the mantle source of these komatiites is indistinguishable from the projected chondritic composition of the contemporaneous depleted convective upper mantle.

V42C-0375 1330h POSTER

Partitioning of Au up to 23 GPa: Implications for core formation of the Earth

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The core formation process (the segregation of metal and silicates) left an excess of siderophile elements in the mantle compared to siderophile element abundances predicted from metal-silicate partitioning experiments conducted at 1 bar (Ringwood, 1979). One hypothesis that explains the mantle abundances of siderophiles is that metal-silicate equilibration occurred at greatly elevated temperatures and pressures, where siderophilic behavior may be decreased. Because there is a paucity of data for highly siderophile element partitioning at mantle relevant conditions (P, T, X), we are investigating Au partitioning between metal-sulfide and silicate liquids. Experiments were carried out in a "Walker-type" 6-8 multi-anvil device in a 1100 ton press. Pressures from 5 to 14 GPa and 14 to 23 GPa have been investigated using an 8 mm or 3mm TEL assembly, respectively. Single crystal MgO capsules were used in both assemblies. We chose the Richardton H-chondrite as starting material because it has an appropriate sulfide fraction (12 wt% S), compared to the possible light element abundance of S in the Earth's core, and the silicate approaches a Bulk Earth composition after reaction with the MgO capsules. Experiment durations at superliquidus temperatures (1700 - 2400 C) were from 4 to 9 minutes. Au in the metal-sulfide quench products was measured using the Cameca SX-50 electron microprobe at the University of Arizona. Secondary ion mass spectrometry (SIMS) was used to measure Au in the quenched silicate liquid in depth profiling mode. The intersection of microblebs (or "nuggets") of Au-rich material during the analysis could be identified and subtracted before calculation of Au contents of the quenched silicate fraction. D(Au)metal-sulfide/silicate ranges from 19000 to 100 The addition of microbleb contributions to the silicate lowers D(Au) by an order of magnitude or less. D(Au) decreases with increasing pressure. A linear fit to the data intersects the D(Au)core/mantle of Earth (300) at 21GPa. This suggests an average equilibration depth of 570 km of descending metal droplets in a silicate magma ocean. This is a slightly lower pressure than suggested by Righter and Drake (1999) but still within their uncertainty.. Although the contribution of Au-bearing microblebs to D(Au) is less than expected, dissemination of such microblebs in a magma ocean could represent a physical mechanism of inefficient core formation.

V42C-0376 1330h POSTER

Towards a Precise and Accurate Estimate of the Platinum Group Element Composition of the Primitive Upper Mantle

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Determining precise and accurate platinum group element (PGE) abundances in peridotites is key for the detection of primordial and secondary (i.e., magmatic) heterogeneities of the PGE in the mantle, and may be used to establish model PGE compositions of the primitive upper mantle (PUM). In conjunction with $^{187}Os/^{188}Os$ (reflecting the Re/Os of PUM), the PGE model composition of PUM, in particular its Pd/Ir, may help in tracing the source of the late siderophile element influx at 1 AU by comparison with data for chondrites (Horan et al. 2003). We have determined Os, Ir, Ru, Pt, Pd and Re abundances in samples from continental peridotite massifs and peridotite xenoliths. The new approach uses isotope dilution and high-pressure, high-temperature digestion in Carius tubes at 345° C, as most other techniques are either not precise enough, or do not access the complete PGE budget during the digestion of peridotites (Meisel et al. 2003, and in press). Reproducibility and accuracy are controlled by multiple analysis of the peridotite standard UB-N, for which the PGE content is now well constrained through high-T-P digestion and Na2O2-NaOH fusion. New data for peridotites from the Pyrenees and Lanzo indicate that, in some cases, Ir and Ru contents may have been underestimated by up to 50-80% by older techniques using NiS-fire assay, resulting in overestimates of Pd/Ir. The new data also show a good correlation of Pd/Ir with Al, suggesting a Pd/Ir of PUM between 1.5 and 2.0, comparable to or higher than EH chondrites. Data for peridotite xenoliths from Hannuoba (China), while also correlating with Al, show larger scatter in Pd/Ir than the European samples. This could be an analytical artifact, because most of the Chinese samples were digested in standard Carius tubes at 220° C. High-T-P digestions will be performed to test this hypothesis and data on other peridotites are being obtained to constrain the composition of PUM.

V42D MCC: Level 1 Thursday 1330h

Isotope Geochemistry Posters

Presiding: **K H Rubin,** University of Hawaii

V42D-0377 1330h POSTER

^{234}U-^{238}U in volcanic rocks

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New and literature ($^{234}U/^{238}U$) data on standards and rocks erupted from volcanoes in each of the major tectonic environments are analyzed to evaluate the significance, magnitudes and causes of ($^{234}U/^{238}U$) variations within the global data set. The data set is limited to high precision mass spectrometric (MS) data, which are required to resolve small disequilibria differences (0.2-0.3%) and to distinguish them from secular equilibrium. The principle finding is that statistically significant ^{234}U-^{238}U disequilibrium exists in 10-15% of volcanic rocks (413 total samples) and it varies systematically by tectonic setting. This disequilibria causes the mean ($^{234}U/^{238}U$) of all volcanic rock data to be >1 outside of standard error ($2\sigma_m$) and outside of the limitations imposed by U standards data. This is true regardless of ^{234}U decay constant (λ234U) used to convert MS atomic abundance ratio data to activity ratios. A subset of this data set also allows for an independent test of 4 different λ234U used in the literature: ($^{234}U/^{238}U$) =1.000 in intraplate subaerial volcanic (SV) rocks using the most recent λ234U (Cheng et al., Chem. Geo., 169, 2000) indicating that this decay constant is preferable to older, more commonly employed values. The SV data also indicate a closed melt system for U exchange in volcanoes of this tectonic setting. ($^{234}U/^{238}U$) >1 in many convergent margin lavas and mid-ocean ridge basalts (MORB) indicate addition of U with a marine isotopic fingerprint during or after petrogenesis (i.e., as alteration). ^{234}U-^{238}U disequilibrium and ^{238}U- ^{230}Th disequilibrium are strongly correlated in convergent zone data but not in MORB, indicating different controls on both ratios in the two environments. This and other major and trace element covariations with ($^{234}U/^{238}U$) are perhaps best interpreted as predominantly reflecting AFC of young altered crust at ocean ridges, and a combination of crustal AFC and deeper marine-derived fluid addition to the convergent zone lavas when ($^{234}U/^{238}U$) >1.

V42D-0378 1330h POSTER

Improving the Sensitivity of Uranium Isotope Ratio Measurements

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Accurate and precise measurements of natural and anthropogenic 235/238 U isotope ratios are important for a range of investigations where the amount of sample is extremely restricted and/or the analyte is only present in ultra-trace quantities. Examples include biological, cosmochemical, environmental, geological, and radiological studies. We have developed and validated a novel method using our Nu Instruments Nu Plasma Multi Collector Inductively Coupled Plasma Mass Spectrometer (MC-ICPMS) and a 233U, 236U mixed double spike for the measurement of 235U/238U ratios. Our multi-dynamic technique employs the installed quadrupole zoom optics and fixed positioning of the ion counting detectors such that rather than the commonly used mass dispersion of 1 or 2, we utilize a mass dispersion of 1.5. Using this configuration, we can simultaneously monitor the 235U and 238U ion beams in the first cycle followed by a second cycle that simultaneously monitors the 233U and 236U beams. This innovative approach allows us to correct for the considerable, but consistent, instrumental mass fractionation and ion-counter amplification bias within each sequence. Since we were hesitant to use a U500 (235U, 238U equal atom) solution for spike calibration because of possible enriched U laboratory and instrumentation contamination, we used a U960 (terrestrial 235U/238U) solution for isotopic calibration of the spike. This standardization corrected for the small amounts of 235U and 238U in the spike solution by using a U960 standard solution. With a mean intraday 2-sigma precision of 1.5 permil and an overall 2-sigma precision of 2.25 permil using individual sample sizes of 350 pg (8.8 × 10 E11 atoms), we are confident our technique will be useful for identifying U isotopic anomalies present in many sample types.

V42D-0379 1330h POSTER

^{15}N Enriched Archean Crust, or ^{15}N Depleted Crust Recycled into -6 $^{o}/_{oo}$ Upper Mantle?

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