into Cordilleran-type batholiths. Major and trace element analysis in addition to field and petrographic data demonstrate that leucosomes are products from partial melting of the pelitic protolith. Compared with the metapelites, leucosomes have higher Sr, lower Nd and Sm concentrations and lower Rb/Sr ratios. The initial $^{87}Sr/^{86}Sr$ ratios of leucosomes range from 0.7125 to 0.7246, and are similar to those of the metapelite protoliths (0.7125 to 0.7243). However, the leucosomes have a much wider range of initial ϵ_{Nd} which range from -5.5 to -12.0, as compared to -8.5 to -12.3 for the metapelites. Sr and Nd isotope compositions of leucosomes, mesosomes, migmatites and metapelites suggest a disequilibrium partial melting of the metapelite protolith. In a spider diagram, two leucosomes show distinct positive Eu anomalies while the other two have negative Eu anomalies, and metapelites show consistent negative Eu anomalies. Leucosomes with negative Eu anomalies have lower Rb concentrations than metapelites and other leucosomes with positive Eu anomalies. The lower Rb concentrations and Rb/Sr ratios of these leucosomes together suggest that partial melting of metapelite is non-modal and dominated by biotite dehydration. However, the other leucosomes have greater contributions from K-feldspar breakdown, which is consistent with their relative high K concentrations and positive Eu anomalies. The various degrees of parent/daughter fractionation of both the Rb-Sr and Sm-Nd systems as a consequence of non-modal crustal anatexis would render distinct isotopic reservoirs that could profoundly influence the products of subsequent mixing events. This is not only critical for intracrustal differentiation, but also potentially an important process in generating crustal isotopic heterogeneities.

V62A-1392 1330h POSTER

Igneous Petrology of the Rift to Drift Transition in Central East Greenland

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

Lara E Heister[1] (530-752-5041; heister@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

Fifteen-hundred meters of early Paleogene tholeiites of the Milne Land Formation (MLF) in central east Greenland mark the onset of flood basalt volcanism associated with continental break-up in the North Atlantic. This stratigraphy links the compositionally diverse lower volcanics (rift succession) to the more homogenous lavas of the Geikie Plateau Formation (early drift succession) with no evidence for a hiatus in volcanism, as previously suggested. Volumetrically, the MLF is dominated by evolved FeTi basalt showing systematic variation in rare earth element (REE) abundances with stratigraphic height indicative of a decline in the mean extent and pressure of partial melting with time (Tegner et al., 1998, Nature, 395). In addition, three petrographically and geochemically distinct lava suites occur in the MLF: picrite-ankaramite, orthopyroxene (opx) phyric ankaramite, and low-TiO_2 basalt. Picrite and ankaramite flows occur exclusively in the lower 200m of the formation and are up to 35m thick. They have near-chondritic La/Sm ratios, Dy/Yb_N ratios of 1.4-1.8, and Zr/Nb ratios of 14-17, similar to primitive basalts of the lower volcanics (Fram and Lesher, 1997, J. Petrol., 38). Coarse-grained opx phyric ankaramite flows are ~10m thick with basal zones of crystal accumulation containing resorbed olivine (Fo_{80-83}), and subhedral clinopyroxene (Wo_{31-38}, En_{44-56}, Fs_{7-24}) and opx (Wo_{5-9}, En_{62-77}, Fs_{18-30}) phenocrysts. These lavas have Dy/Yb_N and Zr/Nb ratios similar to the picrite-ankaramite suite, but markedly higher La/Sm_N ratios (> 1.5). They occur ~400m above the base of MLF with lavas lacking opx but having high SiO_2 (>52wt%) or Ba/Ti×1000>20. These latter characteristics indicate crustal contamination of fractionated magmas, while the opx ankaramites reflect contamination of more primitive melts at lower crustal conditions. The low-Ti suite has sub-chondritic La/Sm ratios, near-chondritic Dy/Yb ratios, and Zr/Nb ratios of 20-55. These aphyric to sparsely phyric flows are restricted to the upper 500m of the MLF and are <10m thick. The appearance of these depleted basalts marks the onset of ocean floor-type spreading in the region, while eruption of more enriched primitive and contaminated magmas reflect the establishment of more direct conduits through the continental lithosphere accompanying plate separation. Trace element systematics among the dominant FeTi basalts, picrite-ankaramite, and low-Ti suites can be related through variable extents of melting of a heterogeneous mantle source that may contain components of subducted Iapetus crust.

V62A-1393 1330h POSTER

Origin of Large Felsic Rock Volumes in Marie Byrd Land Volcanoes:Possible Influence of Tectonic Environment and Continental Lithospheric Structure

Wesley E LeMasurier (303-556-2681; wlemasur@carbon.cudenver.edu)

University of Colorado at Denver, Dept Geology, CB172, POB 173364, Denver, CO 80217-3364, United States

The Marie Byrd Land volcanic province, in the West Antarctic rift system, includes several volcanoes with large volumes of peralkaline trachyte, phonolite, and rhyolite. The roughly 780 cu. km. of trachyte at Mt. Takahe volcano, for example, is about twice the volume of Mt. Shasta, the largest Cascade volcano.Geochemical data provide evidence for only minor amounts of crustal contamination, affecting just a small proportion of the felsic rocks, hence crustal assimilation is unlikely to have supplemented the volume of felsic rocks. Most appear to have been derived entirely by fractional crystallization of basaltic magma; but the volumes of felsic rock in Marie Byrd Land volcanoes is much larger than is found in their counterparts in oceanic islands, produced by essentially the same process, suggesting that continental structure and/or tectonic environment may have played a role in felsic rock evolution. The absence of Antarctic plate motion, over at least the past 26 m.y., seems an obvious factor. This has apparently led to repeated replenishment of the same magma chambers, rather than formation of linear chains of volcanoes. In addition, modeling results suggest that a multi-level, polybaric plumbing system within the lithosphere has acted as a filter, delaying the rise of at least some large volume magma batches, thereby prolonging and refining the fractionation process.

V62B MCC: Hall C Saturday 1330h

Xenoliths, Mafic+Felsic Magmatism Posters

Presiding: **S B Mukasa,** University of Michigan

V62B-1394 1330h POSTER

The Askja- Sveinagja Connection: Implications for the Origin of Low O-18 Magmas in Iceland

Gudmundur E Sigvaldason[2] (ges@norvol.hi.is)

Haraldur R Karlsson[1,2] (hal.karlsson@ttu.edu)

James M Browning[1] (l9jmb@ttu.edu)

[1]Department of Geosciences, Texas Tech University, Lubbock, TX 79409, United States

[2]Nordic Volcanological Institute, Grensasvegur 50, Reykjavik 108, Iceland

In our on-going effort to better understand the origin of low O-18 magmas in Iceland we have obtained new oxygen isotopic data for whole rocks from the Askja and Sveinagja volcanoes, NE-Iceland. We hoped to test the relationship between Askja and Sveinagja, namely the idea that the Sveingja 1875 fissure eruption was fed by magma migration from a shallow magma chamber located under Askja (50-70 km to the south).

Basalts were sampled from Askja (16) and Sveinagja (10). Several Askja samples came from inside the caldera but most where collected from a lava fan on the western side of the volcano. This sample set covers a time span from the end of the ice age up to the 1961 Askja eruption. Sveingja samples are from the fissure eruption of 1875 and were taken from the southern- and northernmost edges of the flow.

The overall range in delta O-18 values is from +3.2 to +4.1$^o/_{oo}$(wrt V-SMOW). Askja covers the entire range but Sveingja is less variable (+3.7 to +4.1$^o/_{oo}$). Chemically, Askja and Sveingja lavas are similar both in terms of major and trace element concentrations. MgO (wt%) for the lavas varies from 7.5 to 4.5 with Sveingja towards the evolved end. Modeling shows that the most evolved basalts in the series can be obtained through 47% crystal fractionation. Crystal fractionation, however, had minimal effect on the delta O-18 values.

Comparison with more evolved Askja products is revealing. The Askja 1875 rhyolite delta O-18 values cluster around 0$^o/_{oo}$and the MgO is 0-2 wt%. Acidic xenoliths (MgO near 0 wt%) have even lower delta O-18 values ranging down to -10$^o/_{oo}$.

It is clearly impossible to generate the 1875 rhyolite by simple mixing between magmas represented by the mafic lavas and the acidic xenoliths. Moreover, the Askja basalts appear to have experienced little crustal interaction during their ascent to the surface. The chemical and isotopic similarities between the Askja and Sveinagja basalts suggest evolution in a common magma reservoir possibly at 10-15 km depth. This implies that low O-18 magmas may exist beneath Iceland at even deeper crustal levels.

V62B-1395 1330h POSTER

Oxygen Isotopic Ratios of Mafic Volcanics from the Langjokull Region, Iceland

Haraldur R Karlsson[1] (hal.karlsson@ttu.edu)

Sveinn P Jakobsson[2]

James M Browning[1] (l9jmb@ttu.edu)

[1]Department of Geosciences, Texas Tech Univeristy, Lubbock, TX 79409, United States

[2]Icelandic Museum of Natural History, P. O. Box 5320, Reykjavik 125, Iceland

The Langjokull region is located at a interesting juncture within the Icelandic volcanic belts. It sits at the northern end of the Western Volcanic Zone (WVZ), and is flanked by the off-rift Snaefellsnes Volcanic Zone (SVZ) to the west, and by the Mid-Iceland Belt to the east (MIB). The WVZ and MIB have produced low O-18 basaltic magmas (4.0-5.5$^o/_{oo}$), whereas the SVZ has produced magmas with MORB-like values (5.5-6.0$^o/_{oo}$).

During the Upper-Pleistocene (0.01-0.78 Ma) the Langjokull region was covered with 0.75-0.85 km thick glacier. Subglacial eruptions produced two morphologically distinct types of volcanoes: ridges and tuyas. In either case these eruptions generated a distinct lithofacies sequence. The earliest eruptive phase formed basal pillow lava. This was followed by hyaloclastite, and then finally, when the volcano broke the ice, subaerial lava. Dikes were intruded through the hyaloclastite during the last stages of the eruptions.

We have obtained delta O-18 values for 21 basalts from six different ridges and tuyas in the region. These samples include every the lithofacies type except hyaloclastite. Two to five samples were taken from each volcano most from the tuyas.

Delta O-18 values for the whole rock suite range from 4.0-5.5$^o/_{oo}$(wrt V-SMOW). However, variations within each volcano are less than 0.5$^o/_{oo}$. There is no clear correlation between major element chemistry and delta O-18 values indicating that fractionation had little effect. MgO values for these rocks vary from 6-13 wt%. There is a slight hint of regional variation in our data. Thus the northernmost tuya (Eiriksjokull) has the highest delta O-18 values, whereas the southernmost tuya (Hlodufell) has the lowest.

It is interesting to note that even the largest of these volcanoes, the 48 km^3 tuya Eiriksjokull, shows little variation in delta O-18 (5.0-5.4$^o/_{oo}$). This is in stark contrast with the chemically similar but younger, smaller (15 km^3) shield volcano to the south. The delta O-18 values of the shield volcano (Skjaldbreidur) vary between 4.6 and 5.5$^o/_{oo}$. It thus appears that, in terms of O-18, more homogeneous melts were produced in the Langjokull region than during recent times.

V62B-1396 1330h POSTER

Trace Element Geochemistry of Alkalic Rocks from Haleakala Volcano, Hawaii

Keri M Craven (kericraven@hotmail.com)

Attila Kilinc (attila.kilinc@uc.edu)

Field and chemical studies of volcanic rocks in Hawaii have revealed that the islands were formed through four distinct stages of volcanism: pre-shield, shield, post-shield, and post-erosional (Clague and Dalrymple, 1987). The alkalic rocks produced during the post-erosional stage of island development are believed to be the result of either low-pressure fractionation of magmas or low degrees of melting of mantle source material.

Nine samples from Haleakala Volcano, East Maui, Hawaii ranging in composition from basalt to hawaiite to mugearite have been analyzed using INAA in order to estimate the degree of melting of source rocks required to produce the post-erosional stage alkalic rocks of the island. Five of these samples are from the post-erosional Hana Volcanic Series (HVS) and four are from the highly-alkalic historic flow (1790?).

A chondrite-normalized REE plot of the INAA data shows enrichment in light REE similar to plots for the alkalic Honolulu volcanics (Clague and Frey, 1982). Yb values for the Haleakala rocks range from 39 to 61 parts per million, indicating that garnet was not present in the zone of magma generation from mantle peridotite.

P-T calculations by Craven and Kilinc (2002) on the same series of post-erosional stage Hana Volcanic Series (HVS) and historic flow (1790?) samples indicate that they formed from 1417C/ 21.7 Kb to 1415C/

21.5 Kb and 1240C/ 7.6 Kb to 1353C/ 14.7 Kb, respectively. These pressures suggest that the magmas formed or separated from the residual material in the spinel peridotite zone of the mantle.

Shaws (1970) trace element modal melting equation was used to estimate the degree of melting of the spinel peridotite to produce the Haleakala alkalic magmas.

Cliq/Csource = 1/{D + F(1-D)} (1)

For highly incompatible elements such as Th, La and Ce for which the bulk partition coefficient (D0) approaches 0, equation (1) reduces to:

Cliq/Csource = 1/F (2)

Using the concentrations (Csource) for Th, La and Ce in glass inclusions in spinel peridotite (Eggins et al. 1998) we calculated the degree of melting using equation (2).

Preliminary results of these calculations indicate 4-12 per cent partial melting using Th concentrations, 5-13 per cent melt using La, and Ce yielded 7-16 per cent melt. These results support the conclusion that alkalic rocks of Haleakala Volcano represent low degrees of melting in the mantle rather than low-pressure fractionation of magmas. Calculated degrees of melting based on trace element and REE data provide additional support for the above P-T calculations which plot close to the solidus of Takahashi et al.s (1983) upper mantle peridotite solidus curve.

V62B-1397 1330h POSTER

In-place alkalic lavas recovered from Hilina Bench off-shore Kilauea, Hawaii: significance in reconstructing ancient Kilauea history

Jun-Ichi Kimura[1] (81-852-32-6462; jkimura@riko.shimane-u.ac.jp)

Thomas W. Sisson[2]

Michelle Coombs[2]

Peter W. Lipman[2]

[1]Shimane University, Nishikawatsu 1060, Matsue 690-8504, Japan

[2]U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025, United States

Lava samples recovered from off-shore Hawaii Island, using remote and manned submersibles during JAMSTEC cruises in 1998, 1999, and 2001, were analyzed for major and trace elements. On the scarp below the Hilina bench ($\sim$ 3000 m bmsl), clasts of alkali and transitional basalt were recovered from debris-flow breccias, but tholeiite basalt of modern Kilauea type is absent (Sisson et al., 2002). In 2001 (dive K508), a succession of in-place pillow lavas of alkali basalt was found for the first time on the slope above the Hilina bench, along a well-exposed a rib. These in-place samples of alklic material in relative shallow water depths provide a critical link between modern-day and ancestral Kilauea. The rib is part of ancient Kilauea volcano that has remained in place, while the Hilina Bench contains slide/slump material from Kilauea (Lipman et al., 2002). At the same water depths but $\sim$15 km to the southwest, Dive K207 sampled a series of alkali basalt breccia clasts that are compositionally similar to the in-place lavas of K208. In contrast, a dive on Papa'u Seamount (K509), located at the upper southwest margin of the bench, traversed massive breccias of subaerially erupted tholeiitic basalt. The breccias are compositionally similar to Mauna Loa lavas, and must be ancient landslide material from this volcano. Geochemical characteristics of transitional basalts from the slope above the Hilina bench are related to historical Kilauea tholeiites in major and trace elements. Alkali basalts from both the lower flank of the Hilina bench and the upper rib are more Ti rich than the transitional basalts, with elevated light-rare-earth and large-ion-lithophile elements. Various binary plots between highly incompatible trace element pairs define confined straight lines, including historical Kilauea tholeiite, the transitional basalts, and the Hilina alkalic pillows, suggesting a common mantle source with different degrees of partial melting. However, chemistry of these basalts differ from the more alkalic basanite and nephelinite lava clasts from the lower flank (Sisson et al., 2002). The highly alkaline lavas would have derived from different mantle sources, perhaps from perimeters of the Hawaiian mantle plume, whereas alkali, transitional, and tholeiitic basalts are from more central parts of the plume. The in-place alkalic pillow basalts provides new insights on earlier growth history and changes in states of basalt sources during the magmatic evolution of Kilauea, which is still in progress.

V62B-1398 1330h POSTER

Deep Water Multibeam Sonar Surveys on the Hawaiian Ridge

Joel E Robinson[1] ((650)329-5322; jrobins@usgs.gov); Barry W Eakins[1] (beakins@usgs.gov); John R Smith[2] (jrsmith@soest.hawaii.edu); Kenji Satake[3] (Kenji.satake@aist.go.jp); Eiichi Takahashi[4] (etakahas@geo.titech.ac.jp); Jiro Naka[5] (nakaj@jamstec.go.jp); Toshiya Kanamatsu[5] (toshiyak@jamstec.go.jp)

[1]U.S. Geological Survey, 345 Middlefield Road - MS 910, Menlo Park, CA 94025, United States

[2]Hawaii Undersea Research Lab , University of Hawaii 1000 Pope Road MSB 303, Honolulu, HI 96822, United States

[3]Active Fault Research Center, AIST-GSJ, Tsukuba, Ibaraki 305-8567, Japan

[4]Earth and Planetary Science Center, Tokyo Institute of Technology 2-12-1Ookayama, Meguroku, Tokyo 152-8551, Japan

[5]Deep Sea Research Department, JAMSTEC 2-15 Natsushima-cho, Yokosuka 237, Japan

The Japan Marine Science and Technology Center (JAMSTEC) sponsored four collaborative cruises by Japanese and US scientists, in 1998, 1999, 2001, and 2002, to build a greater understanding of deep marine geology around the Hawaiian Islands. These cruises have surveyed over 600,000 km^2 of the seafloor with a multibeam seafloor mapping sonar system (Seabeam 2112), made robotic and manned submersible dives, collected dredge and piston core samples, and performed single channel seismic, gravity, and magnetic surveys.

The JAMSTEC sonar surveys are the most comprehensive synoptic dataset for the Hawaiian Islands since the lower-resolution GLORIA surveys by the U.S. Geological Survey in the 1980s. The Seabeam system produces wide-swath contiguous contour maps and acoustic backscatter images. The surveys generated detailed maps of previously known features and imaged some features for the first time. The new surveys determined block distribution, orientation, and structure of the enormous Nuuanu and Wailau landslides, which lie just north of the islands of Oahu and Molokai. Many of the volcanic rift zones were surveyed; the Puna, Hilo and Hana ridges in their entirety. Slumped flanks of several islands and rift zones were mapped, including Hilina, South Kona, Laupahoehoe, and Pololu (Hawaii Island), Hana (Maui), and Clarkes landslide (SW of Lanai). The detailed bathymetry confirms involvement of a compressional component at the toes of some slumps. Most of the large North Arch volcanic field, first located by GLORIA, was mapped, and many low-relief lava flows and vents were imaged. The SW Oahu volcanic field was surveyed in detail for the first time; it consists of both flat-topped and steep-sided cones and low-relief lava flows. The transitional-stage chemistry of the field makes it distinct from alkalic lava fields on the North and South Arch.

V62B-1399 1330h POSTER

Intra-Volcano Compositional Variability and the Role of Oceanic Lithosphere in West Maui and East Molokai Volcanoes

Amy M. Gaffney[1] (agaffney@u.washington.edu)

Bruce K. Nelson[1] (bnelson@u.washington.edu)

Janne Blichert-Toft[2] (jblicher@ens-lyon.fr)

[1]Dept. of Earth and Space Sciences, University of Washington, Box 351310, Seattle, Wa 98195, United States

[2]Laboratoire des Sciences de la Terre, Ecole Normale Superieure de Lyon, 46 Allee dItalie, 69364 Lyon Cedex 7, France

West Maui and East Molokai, two Hawaiian volcanoes with depleted, Kea-type isotopic compositions, show fine-scale, intra-volcano isotopic correlations in the shield-stage lavas that are distinct from intervolcano correlations across the Hawaiian chain. Strong isotopic similarities exist in stratigraphic sections through the late shield stage of these two contemporaneous (1.5-2 Ma) Kea-type volcanoes.

The depleted Hf, Pb, Sr and Nd isotope compositions of W. Maui and E. Molokai show limited variability and have a strong affinity to the Hawaiian Kea component. ϵ_{Hf} ranges from +11.5 to +13.5 and +12.6 to +13.3 in W. Maui and E. Molokai, respectively; W. Maui shows an increase in ϵ_{Hf} with depth. $^{206}Pb/^{204}Pb$ compositions are 18.34-18.54 and 18.42-18.59 for these same volcanoes. Hf and Pb isotope compositions do not correlate significantly. Even over a limited isotopic range, ϵ_{Nd} compositions (W. Maui: +6.6 to +7.6; E. Molokai: +7.1 to +7.3) correlate inversely with $^{87}Sr/^{86}Sr$ (W. Maui: 0.70337-0.70363; E. Molokai: 0.70341-0.70362). $^{87}Sr/^{86}Sr$ and $^{206}Pb/^{204}Pb$ compositions in E. Molokai and deeper samples from W. Maui show a positive, linear correlation. This trend is orthogonal to the inter-volcano Hawaiian trend, and thus does not reflect mixing between components that typically dominate archipelago-scale sampling of magma sources in Hawaii.

A positive Sr-Pb isotope correlation may reflect involvement of oceanic lithosphere, the geochemical signature of which is age-dependent. We have modeled the isotopic compositions of upper, hydrothermally altered basaltic segments and lower gabbroic segments of ancient (1.5-2 Ga) and younger (110 Ma) oceanic lithosphere. The fine-scale compositional trends we observe at W. Maui and E. Molokai are consistent with the interaction of plume-generated Kea-type magmas with the local, 110 Ma Pacific lithosphere. These compositional variations are observed only in specific sections of the stratigraphy, and so must result from processes that operate over time scales much shorter than the life of the volcano.

V62B-1400 1330h POSTER

Temporal Trends in the Global Compositions of Igneous Rocks

Roy F. Torley[1] (1-541-746-8933; bandura1@efn.org)

Alexander R. McBirney[2] (1-541-346-4569; mcbirney@darkwing.uoregon.edu)

[1]Dr. Roy F. Torley, Consultant, 1318 "R" Street, Apt. 3, Springfield, OR 97477-2675, United States

[2]Department of Geological Sciences, 1272 University of Oregon, Eugene, OR 97403-1272, United States

The IGBA igneous databank, compiled about 20 years ago by Dr. Felix Chayes, contained at least 19,000 petrological analyses of igneous and plutonic rocks from throughout the world and spanning time from the Archean to the present. It exists in two forms, one being the original ASCII format as entered on 80-character-per-line punch cards, and the other in a format accessible by Microsoft Access 97. This databank, though in need of updating, contains a wealth of data that may offer clues to the Earth's chemical and thermal evolution. It differs from others in that it includes, in addition to location and chemical compositions, petrographic and mineralogical details, and stratigraphic and radiometric ages. We are currently bringing the file up to date by entering data from more recent publications.

Our initial investigations show that the file can be used to explore long-term trends in the compositions of common igneous rocks. For example, we find that the K/Rb ratio of flood basalts declines steadily from the earliest Archean until about the end of the Paleozoic, then increases at least until the Miocene. The same trend is seen in rhyolites, but data on younger rocks show that the trend reversed again around mid-Miocene time and has been declining until the present. Since K and Rb concentrations are governed mainly by the stability of amphibole and phlogopite in the source region, the temporal trends we observe could reflect global changes in the geothermal gradient and depths of melting. We see a somewhat similar effect in ocean island basalts from Paleocene time to the present.

The $K_2O/(K_2O + Na_2O)$ ratio of flood basalts and rhyolites also shows similar behavior, that is, a decline from the Archean to Mesozoic and increase until Miocene time, though the pattern is less clear than that of K/Rb.

These preliminary results show that databank can provide valuable information on the chemical and thermal evolution of the Earth.

V62B-1401 1330h POSTER

Geochemistry of Oceanic Island-Arc and Active Continental Margin Volcanic Suites: Some Statistical Evaluations and Implications Using the Database GEOROC

Baerbel Sarbas (49-6131-305222; sarbas@mpch-mainz.mpg.de)

Max-Planck Institut fuer Chemie, Postfach 3060, Mainz 55020, Germany

The major- and trace-element and the isotopic compositions of volcanic rocks from island arcs and active continental margins are compared using the comprehensive dataset available in the geochemical database GEOROC (http://georoc.mpch-mainz.gwdg.de). The data surveyed include the Aleutian, Kurile, IBM, Indonesian, Vanuatu, Tonga, Kermadec, Lesser Antilles, and Scotia island arcs. Active continental margins are the Andean, theCentral American, the Mexican, and the Cascade arcs.

Average major-element compositions are tabulated for basalts, basaltic andesites, andesites, dacites, and rhyolites from the individual oceanic and continental

V

arcs. Major-element variation diagrams show similar patterns for volcanic rocks from oceanic island arcs and active continental margins. Low-K series magmas are poorly represented, while high-K and shoshonitic magmas are more common in the active continental margin settings compared with the island-arc volcanic suites.

With the GEOROC database, the well known overall depletion of high-field strength elements such as Nb, Ta, Ce, Zr, and Hf relative to large-ion-lithophile elements such as Rb, Sr, Ba, Pb, U, and Th can be verified for arcs from both oceanic and active coninental margin settings. It also allows more detailed insights into the geochemical signature of individual arcs.

The Sr, Nd, and Pb isotopic composition of most oceanic island-arc volcanic rocks shows an overlap with the composition of OIB and MORB, with the exception of samples from the Indonesian and Lesser Antilles arcs, consistent with the involvement of subducted upper-crustal material in these arcs. Among the active continental margin settings, the Cascades, the Mexican, and the Central American arcs as well as the Southern and Northern Volcanic Zones of the Andean Arc overlap with the composition of OIB, whereas volcanic rocks from the central Andean Arc show high $^{87}Sr/^{86}Sr$ and low $^{143}Nd/^{144}Nd$ ratios.

There appears to be no distinctive grouping of arc compositions in any island-arc versus continental type, rather a continuous range from Tonga-Kermadec and Scotia at one extreme with Indonesia and the Andes at the other.

V62B-1402 1330h POSTER

An Assessment of the Composition of Oceanic Island Basalts and Fractionates

Bernard M. Gunn[1] (bernieg@iconz.co.nz)

Baerbel Sarbas[2] (sarbas@mpch-mainz.mpg.de)

[1]Volcanic Data Research, 48 Lagoon Ave., Wanaka 9192, New Zealand

[2]Max-Planck-Institut fuer Chemie, Postfach 3060, Mainz 55020, Germany

Oceanic islands which rise above sea-level almost invariably have a composition more enriched in LILE than the underlying MORB basalts, they also have distinctive fractionation trends terminating in some of the most LILE-enriched rocks known. A massive compilation of more than 12000 lines of analytical data for these islands, and now residing in the GEOROC database at Mainz, Germany, allows us to make much more accurate statements as to the composition of this small aggregate of the Earth's crust. Previous estimates have been made on a few hundred samples at most.

Compositions for all major elements, trace elements, and REE may be little different from MORB in restricted areas of the Icelandic spreading centre, but tholeiitic members of the bulk of Iceland, the Galapagos, Reunion, Hawaii and some of the early members of other groups, e. g., of the Eaio Shield in the Marquesas and in the early members of the Canary Islands are usually enriched in LILE by factors of x20 N-MORB. They are, however, less enriched than the most enriched, very small degree partial melts occasionally found in MORBs, but have a distinctively different finger print.

The bulk of oceanic islands are composed of undersaturated alkaline rocks which range from mildly alkaline alkali-basalt-hawaiite-mugearite-trachyte to lineages of basanite-phonolite. There is also a wide range in Na/K in all of these, from a ratio of 1 to 4. The series is quite continuous and may even vary in a single island group. No "Dupal Anomaly" of separate high K rocks exists.

Variation diagrams show a distinctive pattern of linear, even slightly concave, distribution of alumina/MgO, terminating at a maximum of 14% Al_2O_3 in tholeiites, to 16-18% Al_2O_3 in trachytes to as high as 25% Al_2O_3 in phonolites. Continued fractionation of the latter leads to the sudden decrease in alumina and Ba to as low as 8% Al_2O_3 in the pantellerites which are unusually enriched in such elements as Zr and Nb.

Certain element ratios change consistently. Zr/Nb, which can be found in the range 15-100 in MORBs, occurs at 15-11 in tholeiitic OIBs. Below a ratio of 10 the rocks are alkaline and the Zr/Nb remains constant through fractionated series of basalt to near trachyte. It is 7 in the comenditic island of Socorro, 8.8 in the mildly alkaline Westmann islands, but as low as 2.5 in the nephelinitic islands of Tubuai or Mangaia. Zr/Nb does not seem to be affected by Na/K ratio.

The more potassic members are elevated in K, Rb, Ba, Th, and light REE but not in Cs. The best average OIB is obtained by limiting inclusion to rocks between 5 and 14% MgO, otherwise the high Zr, Nb and low Ba of the phonolites distorts the resulting multi-element normalized fingerprint.

We note that the range in OIB composition both with alkalinity and K/Na is similar to that seen in the other great division of crustal rocks, those of continental andesitic affinity.

V62B-1403 1330h POSTER

New Lunar Meteorite Northwest Africa 773: A Tholeiite from the Moon?

Timothy J. Fagan[1] (81-3-5734-2717; fagan@geo.titech.ac.jp); G. Jeffrey Taylor[2] (1-808-956-6488; gjtaylor@higp.hawaii.edu); K. Keil[2] (1-808-956-6488; keil@higp.hawaii.edu); T. L. Hicks[2] (1-808-956-6488; hicks@higp.hawaii.edu); M. Killgore[3] (1-520-470-9515; meteoritelab@cybertrails.com); T. E. Bunch[4] (1-650-604-5000; tbear1@cableone.net); J. H. Wittke[5] (1-928-523-4561; james.wittke@nau.edu); D. W. Mittlefehldt[6] (1-281-483-5043; david.mittlefehldt1@jsc.gov)

[1]Tokyo Institute of Technology, Dept. Earth Planetary Sciences 2-12-1 Ookayama Meguroku, Tokyo 152-8551, Japan

[2]HIGP/SOEST University of Hawaii at Manoa, 1680 East-West Road POST 602, Honolulu, HI 96822, United States

[3]Southwest Meteorite Lab, SML, Payson, AZ 85547, United States

[4]NASA-Ames, NASA, Moffett Field, CA 94035, United States

[5]Northern Arizona University, Department of Geology, Flagstaff, AZ 86811, United States

[6]NASA-JSC, NASA, Houston, TX 77258, United States

Olivines and pyroxenes in gabbroic rock fragments from the recently found meteorite Northwest Africa 773 (NWA773) show evidence of Fe-enrichment broadly similar to the tholeiitic trend defined for terrestrial rocks. The meteorite consists of two main lithologies: a two-pyroxene olivine gabbro and a fragmental, heterolithic breccia. The olivine gabbro lithology consists of olivine (Fo68), pigeonite (Wo11En65), augite (Wo36En50), and plagioclase (An90), with minor K,Ba-feldspar (Or89Cs04Ab04An02), chromite, Ca-phosphates, ilmenite, troilite and metal. The texture is dominated by cumulate olivine crystals up to 1300 m across and pyroxenes of slightly smaller grain size. Plagioclase feldspar is interstitial and K,Ba-feldspar is restricted to interstitial sites enriched in incompatible elements.

The breccia lithology consists of a variety of clasts, but most of these can be plausibly linked to the olivine gabbro or more Fe-rich differentiates from the same magmatic system. Pyroxenes from the breccia exhibit continuous trends in Mg/(Mg+Fe) and Ti/(Ti+Cr) from values similar to the olivine gabbro (0.79 and 0.18, respectively) to extremely differentiated compositions (0.06 and 1.00, respectively). Olivines are characterized by compositions ranging over Fo71-55 and Fo13-01. The fayalitic olivines occur in clasts with silica, +/- hedenbergitic pyroxene. These variations in mineral composition can be explained as a consequence of extreme Fe-enrichment in a single pluton or related plutonic bodies on the Moon. The presence of silica in NWA 773 is due primarily to Fe-enrichment of residual liquid into ?the forbidden zone? of the pyroxene quadrilateral. The Fe-enrichment trend and cumulate textures suggest that NWA 773 may have originated from a magmatic system broadly similar to terrestrial layered mafic intrusives.

V62B-1404 1330h POSTER

Field and Geochemical Studies of Quaternary Alkaline Volcanism Near Atlin, British Columbia, Canada

Andrew C McCarthy[1] ((520) 408-0627; mccarthy@geo.arizona.edu)

Anna L Bye[2] ((810) 636-7375; annabye@hotmail.com)

Benjamin R Edwards[3] ((717) 254-8934; edwards@dickinson.edu)

Bob Anderson[4] ((604) 666-2693; boanders@NRCan.gc.ca)

[1]The University of Arizona, Department of Geosciences, Gould Simpson Building, Tucson, AZ 85721-0077, United States

[2]Insight Environmental Services, Inc., 5892 Sterling Drive, Howell, MI 48843, United States

[3]Dickinson College, Department of Geology, P.O. Box 1773, Carlisle, PA 17013-2896, United States

[4]Natural Resources Canada, 605 Robson Street, Suite 101, 14th Floor, Vancouver, BC V6B 5J3, Canada

We report the results of recent field and geochemical studies of Quaternary to Recent(?) volcanic features at Volcanic Creek, Cracker Creek, Ruby Creek and Ruby Mountain, approximately 50 km east of the town of Atlin in northwestern British Columbia. Fieldwork was completed during July 2000 and confirmed previous work suggesting that all of the features are Quaternary in age. Three of the features, Volcanic Creek, Cracker Creek, and Ruby Mountain, are considered to be distinct volcanic centers. Work in progress is partly aimed at determining if the Ruby Creek flow originated from Cracker Creek, Ruby Mountain, or an as yet undiscovered vent. Mapping at Volcanic Creek further delineated several previously described volcanic features including a cinder cone complex comprising two overlapping cones and one or two(?) lava flows extending 2-3 km down the valley of Volcanic Creek. Glacial material (till and/or outwash) directly overlies parts of the lava flows, indicating that at least some of the volcanism was pre-Holocene. However, the cinder cone complex, which maintains a cone-like shape, is made up of loose, unconsolidated scoria material. The survival of the cones at Volcanic Creek indicates either 1) volcanism sufficient to build up the cinder cone complex occurred after the last glacial maximum, or 2) the hillside location of the complex protected it from glacial erosion. The single cone at the head of Cracker Creek also sits in a glaciated valley; however, the degree of compaction and induration at this cone leads us to conclude that it is also pre-Holocene in age. The Ruby Creek lava flow is overlain by glacial till as well. Ruby Mountain, the volumetrically largest of the four features, is a volcanic cone that produced multiple lava flows. Its dissected morphology is also consistent with a Quaternary age.

Samples of volcanic material from all four features were analyzed for major and selected trace elements by XRF and ICP-MS. All samples plot as basalt/trachybasalt in the TAS classification, with values of MgO (7.7-10 wt. %), TiO2 (2.1-2.5 wt. %), and K2O (1.4-1.9 wt. %), typical of mildly alkaline mafic rocks. Trace element patterns for samples from Volcanic Creek show little within center variation and also follow a trend typical of nepheline-normative alkali-olivine basalt (highly enriched light REE's relative to chrondrite). Preliminary results from Pearce Element Ratio analysis for samples from Volcanic Creek show that the majority of the samples from this center probably derive from the same magma batch but were partly affected by olivine fractionation.

V62B-1405 1330h POSTER

Petrochemistry of Mafic Rocks Within the Northern Cache Creek Terrane, NW British Columbia, Canada

Joseph M. English[1] (1-250-9207060; englishj@uvic.ca)

Stephen T. Johnston[1]

Mitchell G. Mihalynuk[2]

[1]University of Victoria, SEOS, Petch Building, PO Box 3055, STN CSC, Victoria, BC V8W 3P6, Canada

[2]BC Geological Survey Branch, 5th Floor, 1810 Blanshard Street, Victoria, BC V8V 1X4, Canada

The Cache Creek terrane is a belt of oceanic rocks that extend the length of the Cordillera in British Columbia. Fossil fauna in this belt are exotic with respect to the remainder of the Canadian Cordillera, as they are of equatorial Tethyan affinity, contrasting with coeval faunas in adjacent terranes that show closer linkages with ancestral North America. Preliminary results reported here from geochemical studies of mafic rocks within the Nakina area of NW British Columbia further constrain the origin of this enigmatic terrane. The terrane is typified by tectonically imbricated slices of chert, argillite, limestone, wacke and volcaniclastic rocks, as well as mafic and ultramafic rocks. These lithologies are believed to represent two separate lithotectonic elements: Upper Triassic to Lower Jurassic, subduction-related accretionary complexes, and dismembered basement assemblages emplaced during the closure of the Cache Creek ocean in the Middle Jurassic. Petrochemical analysis revealed four distinct mafic igneous assemblages that include: magmatic 'knockers' of the Nimbus serpentinite mélange, metabasalts of 'Blackcaps' Mountain, augite-phyric breccias of 'Laughing Moose' Creek, and volcanic pediments to the reef-forming carbonates of the Horsefeed Formation. Major and trace element analysis classifies the 'Laughing Moose' breccias and the carbonate-associated volcanics as alkaline in nature, whereas the rest are subalkaline. Tectonic discrimination diagrams show that the alkaline rocks are of within-plate affinity, while the 'Blackcaps' basalts and 'knockers' from within the mlange typically straddle the island-arc tholeiite and the mid-ocean ridge boundaries. However, primitive mantle normalized multi-element plots indicate that these subalkaline rocks have pronounced negative Nb anomalies, a characteristic arc signature. The spatial association of alkaline volcanic rocks with extensive carbonate domains points to the existence of seamounts within the Cache Creek ocean. However, the precise origin of the 'Laughing Moose' breccias remains somewhat uncertain and may be related to a subsequent rifting event. To conclude, preliminary data from the Nakina region show it to be dominated by two different petrogenetic components: alkaline volcanic rocks of within-plate affinity, and primitive arc-related, subalkaline mafic rocks. An accretionary complex/ oceanic arc origin may provide a mechanism to explain the lithological diversity within the Nakina area.

V62B-1406 1330h POSTER

Timing of Basalt Flows in the Shanwang Basin, Shandong Peninsula, Eastern China

Ruixuan Zhao[1]

Baofu Han[2]

Juhn G. Liou[1] (650-723-2716; liou@pangea.stanford.edu)

[1]Stanford University, Department of Geological and Environmental Sciences, Stanford, CA 94305, United States

[2]Peking University, Department of Geology, Beijing 100871, China

The Shanwang Basin, located within the North China block, is famous for its Miocene lacustrine fossil deposits of 30 meters thick. The sediments occur an extraordinarily well-preserved and taxonomically highly diverse fossil biota. From these biota fossils, we know that the age of lacustrine sedimentation is about 10 to 16 Ma. In order to better constrain the timing of the deposits, three flows of olivine-bearing basalts layered with sediments from the Shanwang area were dated. Our K/Ar whole rock analysis yielded the eruption ages of the basaltic flows to be roughly 15.23 ± 0.17 to 9.83 ± 0.22 Ma. To obtain more precise age data, we have also applied ^{40}Ar-^{39}Ar dating to three samples of basalts, using stepwise thermal extraction of Ar. The age spectra of three basalt samples all show two plateau ages. Argon released from the basalts in the laboratory at low extraction temperatures yielded low plateau ages of 13.28 ± 0.14 to 14.41 ± 0.07 Ma. These ages are considered to be the eruption ages of basaltic flows and are more reliable than the K/Ar ages. However, argon released at high extraction temperatures yielded much higher plateau ages of 29.00 ± 0.07 to 29.37 ± 0.10 Ma. Since these basalts carry olivine-rich xenoliths, we think that these high plateau ages are caused by the ancient radiogenic ^{40}Ar that was never diffused from the xenoliths during immersion in the magma. This ^{40}Ar caused an increase in the apparent age for the high-temperature extractions. Therefore, we only consider the low plateau ages as the eruption ages of the basalt flows. Combing both K/Ar and ^{40}Ar-^{39}Ar analyses, this study has established the age limits for eruption of the basaltic flows in the Shanwang Basin. We conclude that three eruption events have occurred at about 15.23 ± 0.17 to 11.65 ± 0.36 Ma in the area.

V62B-1407 1330h POSTER

Petrogenesis and Source Characteristics of Intraplate Volcanism in Syria

Marc-Sebastian M Krientiz[1] (+49 431 880 3694; mk@gpi.uni-kiel.de)

Karsten M Haase[1] (+49 431 880 2865; kh@gpi.uni-kiel.de)

Klaus Mezger[2] (+49 251 8333471; klaush@nwz.uni-muenster.de)

Mohamed A Shaik Mashail (021 2236130)

[1]Marc-Sebastian Krienitz, Institute of Geosciences Christian-Albrechts-University Olshausenstr. 40, Kiel 24118, Germany

[2]Klaus Mezger, Institut fuer Mineralogie Universitaet Muenster Corrensstr. 24, Muenster 48149, Germany

Syria is situated in the northwestern part of the Arabian platform and is covered by several thousand square kilometers of volcanic rocks of Miocene to Recent age. Most volcanic fields occur in western Syria along the Dead Sea Rift, but several lava fields are found in the northeastern parts of the country. On the basis of a large set of volcanic rock samples we are able to determine the geochemical characteristics of the magmatic sources and evaluate processes controlling the major and trace element chemistry as well as the isotopic composition of these rocks.

The sample suite comprises basalts, alkali basalts and basanites as well as basaltic andesites, foidites, phonotephrites, trachytic basalts and trachytes. The erupted lavas do not represent primary magmas, but have undergone fractional crystallisation of ol +/-cpx (+/-plag, +/-mt). The variation of the major element composition (e.g., SiO_2 51.439.7 wt.%, Fe_2O_3 ^{tot} 14.811.6 wt.%) of primitive samples cannot be due to fractionation processes, but suggests different degrees and depths of partial melting as well as assimilation of continental crustal material leading to higher SiO2 and lower Fe_2O_3 ^{tot} contents.

Isotopic compositions of the whole sample suite range from 0.703 to 0.705 and from 18.6 to 19.4 in $^{87}Sr/^{86}Sr$ and $^{206}Pb/^{204}Pb$, respectively, and $^{143}Nd/^{144}Nd$ ratios vary between 0.51286 and 0.51299. In NW Syria most of the lavas show low Ce/Pb and the most radiogenic Sr isotope ratios. Assimilation of melts from both upper and lower continental crustal rocks results in low Ce/Pb ratios and very radiogenic Sr isotopic compositions as observed in the volcanics.

Samples show chondrite-normalized Dy/Yb ratios of 1.03.5 and chondrite-normalized La/Sm ratios of 5.12.9 for a given unradiogenic Sr isotopic composition. The highest La/Sm ratios occur in lavas from western Syria and the lowest in the east. This variation is the result of variable degrees of partial melting of the source regions containing garnet as a residual phase, where higher degrees of partial melting are reached in the east than in the west.

At least two different mantle sources can be defined for uncontaminated samples with unradiogenic Sr composition: a) W-Syria: high $^{206}Pb/^{204}Pb$ and low Nd isotopic composition than b) NE-Syria: relatively low $^{206}Pb/^{204}Pb$ and high $^{143}Nd/^{144}Nd$ ratios. These sources are different from the Afar plume composition and thus no influence of this plume is observed in the Syrian lavas.

V62B-1408 1330h POSTER

Lithospheric Mantle Evolution Beneath the Bering Sea Volcanic Province: An Isotopic and Trace Element Study of Peridotite Xenoliths and Their Host Lavas

Samuel B. Mukasa[1] (1-734-936-3227; mukasa@umich.edu)

Alex V. Andronikov[1] (1-734-936-3227; andron@umich.edu)

[1]University of Michigan, Department of Geological Sciences, Ann Arbor, MI 48109

Several islands in the Bering Sea region and close by mainland areas in Alaska and Russian Fareast (Chukchi Peninsula) have been sites of alkaline basaltic volcanism during much of the Neogene and comprise the Bering Sea Volcanic Province (BSVP). Most of the rocks erupted during this activity are olivine-, plagioclase-, and clinopyroxene-phyric, except for those on St. George Island in the Pribilofs, which are plagioclase-free. The volcanic rocks vary in composition from alkaline-ultramafic rocks (St. George basanites) to basalts with up to 50.6 percent SiO_2 (young volcanic rocks in the Imuruk Lake area). All samples are MgO-rich (6.3-11.0 wt. percent) with mg-numbers of 50 to 63. Total alkalis (Na_2O+K_2O) range from 3.6 to 7.5 wt. percent. The rocks are enriched in highly incompatible trace elements and display strongly fractionated REE patterns with La_N/Yb_N=4.7-23.7. That accompanied by a positive correlation between the LREE and alkalinity suggests presence of garnet in the source. The rocks have depleted Nd-Sr isotopic compositions ($^{143}Nd/^{144}Nd$=0.512939-0.513139; $^{87}Sr/^{86}Sr$= 0.702653-0.704342) overlapping with mid-ocean ridge basalts (MORB) and the depleted varieties of ocean island basalts (OIB). Twelve samples out of a subset of fifteen dated using the $^{40}Ar/^{39}Ar$ methods yield a range of ages from 6.0 to 0.04 Ma. The remaining three samples were found to be too poor in radiogenic ^{40}Ar to date reliably, consistent with the very youthful appearance of the flows. During the 6.0-0.04 Ma interval, >700 km^3 of magma was erupted. Volcanic activity in the region appears to have increased through time with only about 55 km^3 of lava erupted before 3 Ma, but 250 km^3 within the last 300 k.y. Eruption rates also seem to have increased through time: the 6-Ma Imuruk Lake basalts were erupted at the rate of 70 m^3/km^2/yr, whereas basalts in the St. Michael volcanic field (< 0.6 Ma) are estimated to have achieved the highest rate of 330 m^3/km^2/yr.

Mantle xenoliths were found in lavas throughout the BSVP. Many xenoliths display evidence for metasomatic enrichment, both modally (amphibole and phlogopite) and in terms of major oxide and trace element abundances. An interesting regional pattern has been identified in the characteristics of the metasomatism. Peridotite xenoliths from Seward Peninsula farthest north in the BSVP display only signs of metasomatic enrichment by silicate melt migration through fractures, suggesting that the rocks originated from the shallow mantle while those from Nunivak Island near the center of the BSVP seem to have been affected by both melt- and fluid-induced metasomatism. Xenoliths and a peridotite massif on St. George Island farthest south in the BSVP are important for having no signs of metasomatism, modal or cryptic. Because peridotites from this locality closest to the currently active Aleutian arc are not metasomatised, we propose that metasomatism in the Nunivak and Seward Peninsula peridotites farther to the north is not related to the Aleutian arc. Rather, it is the result of the amalgamation of Alaskan terranes during Cretaceous subduction.

V62B-1409 1330h POSTER

Exsolution Times of Hawaiian Garnet Pyroxenites

Shantanu Keshav[1] ((305)-348-2365; skesha01@fiu.edu)

Gautam Sen[1] ((305)-348-2299; seng@fiu.edu)

[1]Dept.Earth Sc.and FCAEM, Florida Intl' Univ., Miami, FL 33199, United States

Salt Lake Crater, Oahu is best known for its wide variety of crustal and mantle xenoliths. Among this suite of xenoliths, garnet-bearing ones are unique inasmuch as their presence makes Hawaii only the second locality in oceanic regimes where deeper portions of the lithospheric mantle have been sampled. In this study we focus on a suite of garnet-bearing pyroxenites that are magmatic assemblages consisting of olivine, clinopyroxene, and garnet. As cooling took place from magmatic temperatures, primary clinopyroxene exsolved orthopyroxene, spinel, and garnet. In this study we estimate the time required to produce the exsolution lamellae of opx in the host cpx from compositional and physical (temperatures of re-equilibration) constraints. This time is not necessarily the length of time the xenoliths resided in the mantle since they may have been at high temperatures above the solvus for an unspecified period of time. Nevertheless, the values obtained can be considered minimum residence times of the xenoliths in the mantle. Most exsolved opx lamellae in the host cpx are 25-150 microns thick with some noticeable clustering around 25-80 microns. Application of the two-pyroxene thermometer gives the final equilibration temperature range from 950-1150oC. Homogenization experiments on the diopside-pigeonite system (Brady and McCallister 1983) were used to calculate the residence times. Taking halfwidths of exsolution lamellae between 25-150 microns, a time calculation was made on the basis of an average Ca-Mg-Fe effective binary diffusion relationship. For 25, 50, 100, and 150 microns halfwidths with temperatures ranging from 1150-950oC, the calculated exsolution times ranged from 209-30290, 836-121163, 3344-484562, and 7525-1.0E+6 years, respectively. Interestingly, the time range retrieved here approximates the time interval between the shield-building stage of Koolau volcanism and the post-erosional Honolulu Volcanics (HV). Also, existing trace element and limited isotope data have shown that the SLC garnet pyroxenites could have crystallized from HV-type melts. Our calculated residence times of these xenoliths are in accord with the conclusion that they precipitated from HV-type melts.

V62B-1410 1330h POSTER

High-pressure Polybaric Fractionation and Spinel-Garnet-Liquid Reactions in Garnet-bearing Xenoliths from Oahu: Evidence from CMAS

Gautam Sen[1] (305-348-2299; seng@fiu.edu)

Shantanu Keshav[1] (305-348-2365; skesha01@fiu.edu)

Dean C Presnall[2] (202-478-8948; presnall@gl.ciw.edu)

Yi H Weng[3] (765-282-6072)

[1]Earth Sc., FIU, Univ. Park, Miami, FL 33199, United States

[2]Geophysical Lab, CIW, Washington, D.C., DC 20015, United States

[3]Geosciences, Univ Texas at Dallas, Dallas, TX 75083, United States

Salt Lake Crater (SLC), Oahu, is best known for its wide variety of crustal and mantle xenoliths. Among this suite of xenoliths, garnet-bearing ones are unusual inasmuch as their presence makes Hawaii only the second locality in oceanic regimes where deeper portions of the lithospheric mantle have been sampled. Many xenoliths do not contain primary orthopyroxene (opx), and for the ones that do contain opx, evidence is slowly emerging that opx is in chemical disequilibrium with the other phases. A suite of xenoliths that contain primary (magmatic) olivine, clinopyroxene (cpx), and garnet was the focus of this study. Many xenoliths are characterized by the presence of spinel-cored garnets with no other phase being present between spinel core and garnet rim. Past studies have hypothesized that such textures developed during subsolidus, near-isobaric, cooling of a spinel-bearing magmatic assemblage during transgression through the spinel/garnet lherzolite boundary. A necessary condition for such a model is that olivine/opx must be a by-product of the spinel-pyroxene subsolidus reaction, phases that are not present in the spinel-garnet reaction zones in the xenoliths. Based on the absence of olivine/opx in the spinel-garnet zones and the resulting mass imbalance, a simple cooling model for the generation of spinel-cored garnets is unlikely to be valid. It is also interesting to note that xenoliths that have spinel-cored garnets also contain large, primary (texturally) garnets that do not have spinel in the core. Furthermore, in all cases of spinel-cored garnets, the thickness of the rim is fairly uniform, suggesting that such rims formed due to a melt-present reaction.

To understand the generation of xenoliths at SLC, a polybaric model based on liquidus phase relations in the simplified CaO-MgO-Al_2O_3-SiO_2 (CMAS) system at 3 and 5 GPa is proposed. The xenoliths at SLC have olivine, cpx, and garnet. In the CMAS system, a univariant line with this fractionating assemblage (Fo, Di, Gt, and Liq) exists only at P>3 GPa. Also, an increase

V

in pressure results in expansion of the garnet volume at the expense of the spinel volume. If a melt generated at P>3 GPa ascends to shallower depths (but still at P>3 GPa), shrinkage of the garnet volume and expansion of the spinel volume would place the liquid composition within the spinel volume at this lower pressure. Spinel fractionation would then drive the liquid composition to the spinel-garnet divariant surface, which is a reaction surface for at least a moderate pressure interval above 3 GPa. At this surface, spinel reacts with the liquid to generate garnet. At this stage of crystallization, no other phases are present, which is consistent with the uniform width of the garnet rims in the xenoliths, which have not experienced interference from growth of other phases. With increasing fractionation, we hypothesize that the liquid reaches the Fo-Di-Gt-Liq univariant line where all three of these phases crystallize and the liquid is exhausted. This aspect of the model must remain a hypothesis until further data are obtained to clarify the form of the phase relations. In any case, the existence of the univariant line Fo-Di-Gt-Liq only at P>3 GPa indicates that the entire crystallization process of these xenoliths must occur at these high pressures.

V62B-1411 1330h POSTER

Hf-Nd-Sr Isotope Systematics of Peridotite Xenoliths and their Host Basalts: Inferences for the Nature and Evolution of the Continental Lithospheric Mantle

Dmitri Ionov[1,3] (33467143935; ionov@dstu.univ-montp2.fr)

Dominique Weis[1,2] (6048221697; dweis@eos.ubc.ca)

[1]DSTE - ULB CP 160/02, Avenue FD Roosevelt, 50, Brussels 1050, Belgium

[2]EOS - UBC, 6339 Stores Road, Vancouver, BC V6T 1Z4, Canada

[3]Lab. Tectonophysique - ISTEEM, cc49, Universite de Montpellier 2, Montpellier 34095, France

Hf and Nd isotopic compositions of clinopyroxene, garnet and amphibole separated from over 40 spinel and garnet peridotite xenoliths in Late Cenozoic volcanic rocks from Siberia and Mongolia were determined on a Nu Plasma MC-ICPMS instrument at Universit Libre de Bruxelles. Their $^{176}Hf/^{177}Hf$ values range from 0.2830 to 0.2842 indicating that parts of the shallow off-cratonic lithospheric mantle have much more radiogenic Hf isotope signatures than those inferred for a typical depleted mantle from studies of oceanic basalts. Some of those samples yield Precambrian Lu-Hf model ages (1-2 Ga), similar to or slightly lower than those found for the xenoliths in kimberlites from the South African and Northern Canadian cratons (Simon et al., 2002; Schmidberger et al., 2002).

Many of the peridotites plot within the terrestrial Hf-Nd-Sr isotopic arrays defined by MORB and OIB indicating uniform mixing between the depleted and enriched sources. Depleted, poorly metasomatised peridotites have high $^{176}Hf/^{177}Hf$ (as well as high $^{143}Nd/^{144}Nd$ and low $^{87}Sr/^{86}Sr$) and plot on the extension of the terrestrial Hf-Nd array. Importantly, LREE-Sr-enriched peridotites with negative Hf anomalies plot above the Hf-Nd and Hf-Sr arrays. $^{176}Hf/^{177}Hf$ values in basalts hosting the xenoliths range from 0.2827 to 0.2831 and plot within the Hf-Nd mantle array. The absence of the high $^{176}Hf/^{177}Hf$ values in the basalts indicates that their parental magmas do not have a substantial contribution from the lithospheric mantle. Similarly, the absence of these high $^{176}Hf/^{177}Hf$ values in the OIB indicate that delaminated lithospheric mantle was not an essential component in its source regions. The Lu-Hf ages for coexisting cpx-garnet and cpx-amphibole pairs are similar to or slightly higher than their Sm-Nd and Rb-Sr ages. They are commonly somewhat higher than the eruption age of host volcanic rocks and possibly indicate incomplete isotopic inter-mineral equilibration in the coarse-grained peridotites.

Our study indicates that Hf isotopic compositions in mantle peridotites, in particular those derived by high degrees of partial melting, are much less affected by metasomatism than their Sr-Nd isotopic compositions. The Lu-Hf isotopic system appears to better preserve the record of ancient depletion events than the Sm-Nd and Rb-Sr systems and can, together with Re-Os isotope systematics, be used to assess mantle depletion ages.

V62B-1412 1330h POSTER

Subduction-related metasomatism recorded as noble gas compositions in the Finero Phlogopite-Peridotites, Italian Western Alps

Takuya Matsumoto[1] (matsumoto@ess.sci.osaka-u.ac.jp); Tomoaki Morishita[2] (moripta@kenroku.kanazawa-u.ac.jp); Jun-ichi Matsuda[1] (matsuda@ess.sci.osaka-u.ac.jp); Toshiyuki Fujioka[1] (fujioka@ess.sci.osaka-u.ac.jp); Masamichi Takebe[3] (takebe@gcl.eps.nagoya-u.ac.jp); Koshi Yamamoto[3] (yamamoto@eps.nagoya-u.ac.jp); Shoji Arai[2] (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]Department of Earth Science, Kanazawa University, Kakuma, Kanazawa 920-1192, Japan

[3]Department of Earth and Planetary Science, Graduate School of Environmental Studies, Nagoya University, Cikusa-ku, Nagoya 464-8602, Japan

It has been demonstrated that noble gases trapped in fluid inclusions of ultramafic xenoliths are quite useful tracers of metasomatic events in the lithospheric mantle. Some recent study on noble gases in Horoman ultramafic complex, Hokkaido, Japan, revealed that the orogenic peridotites can also be a suitable target for noble gas study and that they contain a homogeneous mixture of mantle-He and air-Ar, suggesting a possible recycling and preservation of heavier noble gases of surface reservoirs in the deeper mantle domains (Matsumoto et al., 2001). Here we report results of our new investigation on noble gases in a unique specimen having thin layer of very fine-grained apatite and opx in the fresh phlogopite lherzolite from Finero ultramafic complex, Italian Western Alps. We have also examined fresh olivine grains separated from a phlogopite-lherzolite without such apatite-layer. The fluid inclusions of this olivine separates appeared to be very rich in radiogneic component such as ^{4}He, ^{21}Ne and ^{40}Ar, suggesting the derivation of fluids from a crust-like reservoir. Such a crustal component appeared to be also contained in the samples with the apatite-opx layer, but we need to have an additional isotopically distinct component to explain progressive increase in ^{3}He concentration and decrease in $^{40}Ar/^{36}Ar$ ratios observed towards the apatite-rich layer. High ^{3}He contents and low $^{40}Ar/^{36}Ar$ ratios are consistent with the signature expected for the slab-derived metasomatic fluid as was observed in Horoman ultramafic complex. There is a clear mixing trend defined in a $^{3}He/^{36}Ar$ versus $^{40}Ar/^{36}Ar$ diagram with the crustal and slab-derived fluids as endmember compositions, suggesting that the complex had metsomatised by fluids derived from geochemically distinct regions at distinct geotectonic settings. The parental melt or fluids responsible for the formation of the apatite-rich layer should be derived from the slab-derived component, which is consistent with a notion that the Finero mantle was once in the mantle wedge.

V62B-1413 1330h POSTER

Sr, Nd, and Pb Isotopic Geochemistry of Rhyolites from the Eastern Rhodopes, Bulgaria

Rositsa Ivanova[1] (yotzo@router.geology.bas.bg)

George D Kamenov[2] (kamenov@ufl.edu)

Yotzo Yanev[1] (yotzo@router.geology.bas.bg)

[1]Geological Institute, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria

[2]University of Florida, Department of Geological Sciences, Gainesville, FL 32601, United States

Paleogene Eastern Rhodopes Volcanic Area (ERVA) is part of a more than 2000 km long magmatic belt in SE Europe extending from the Inner Dinarids (West Bosnia-Herzegovina) to Western Anatolia (European Turkey). Volcanic activity occurred during the Late Eocene-Early Oligocene and was spatially related to extensional Paleogene shallow marine basins underlain by a high-grade metamorphic basement. The volcanism is bimodal in character, with minor mafic (basalts) and major intermediate (mainly andesites) to acid (mainly rhyolites) volcanics present in similar volumes. This work focuses on Maritsa volcanic group (36-32 Ma) located in the NE part of the ERVA, S Bulgaria. The volcanic group comprises Lozen volcano composed of dacites, rhyodacites, and rhyolites, St Marina rhyolite dome, and Sheinovets rhyolite dome-cluster located within a caldera with the same name.

Measured present day 87Sr/86Sr of the rhyolites range from 0.7075 to 0.7180, however on a plot 87Rb/86Sr vs 87Sr/86Sr the data form an errorchron (MSWD=21) with 30.5 +/-3.6Ma age and 87Sr/86Sr initial equal to 0.7074. Pb isotopic compositions in all of the volcanoes show similar values ranging from 18.712 to 18.768 in 206Pb/204Pb, 15.643 to 15.687 in 207Pb/204Pb, and 38.790 to 38.922 in 208Pb/204Pb. Nd isotopes show also little variations with 143Nd/144Nd ranging from 0.51242 to 0.51249. The similarity in the isotopic compositions between the volcanoes suggests common, homogeneous magmatic source. Crustal origin of the rhyolites as a result of melting of the metamorphic basement is not plausible because the rhyolites have different Sr and Nd isotopic compositions from the gneisses in the ERVA. Sr and Nd isotopic data for the rhyolites differ also from the basalts (i.e. possible mantle melts) in the Eastern Rhodopes region. Rhyolites have higher 87Sr/86Sr and lower 143Nd/144Nd ratios compared to the basalts, thus suggesting involvement of crustal component in the magma generation, most probably the metamorphic basement that underlies the volcanoes. On 143Nd/144Nd vs 87Sr/86Sr diagram the rhyolites plot on a mixing curve between the basalts and the gneisses from the metamorphic basement indicating about 70% mafic and 30% basement component involved in their genesis. Lead concentrations in the mantle is relatively low compared to the upper crust and the Pb isotopic signature in lavas generated in continental volcanic arcs is often completely dominated by crustal components. The rhyolites have more radiogenic 207Pb/204Pb and 208Pb/204Pb isotopic compositions than the basalts and plot entirely within the field defined by the metamorphic rocks in the ERVA suggesting that any mantle derived Pb was completely swamped by crustal Pb.

Our isotopic results provide evidence for extensive crustal contamination of the felsic magmas in the region. Mafic melts, generated either during subduction or delamination ascended in the mantle wedge until they become stalled at a level of neutral buoyancy. Crustal melting and assimilation occurred at that level accompanied by homogenisation and crystal fractionation in large magma chambers until the evolving magmas reached the required density to re-establish buoyant ascent. The observed isotopic homogeneity in the felsic volcanoes in the region suggests that large zone of MASH at crustal levels existed during the Paleogene beneath the ERVA.

V62B-1414 1330h POSTER

Lithium Isotopes; a Potential aid to Understanding Granite Petrogenesis

Colleen Bryant[1] (61-2-61250316; Colleen.Bryant@anu.edu.au)

Bruce Chappell[2]

Vickie Bennett[1]

[1]RSES, Australian National University, Canberra, ACT 0200, Australia

[2]GEMOC, Macquarie University, Sydney, NSW 2109, Australia

Significant enrichment in ^{6}Li occurs during the weathering of continental crustal materials to clays, contributing to depleted $\delta^{7}Li$ in the resultant sedimentary rocks. As such Li isotopes potentially provide a unique perspective on the nature of crustal components involved granite genesis. Carboniferous-Permian granites of the New England Batholith (NEB), Australia, emplaced in a Devonian-Triassic arc setting, are subdivided into 5 major supersuites[1]. Bundarra and Hillgrove are both S-types, interpreted to be derived from strongly weathered arc rocks[1], and immature greywackes[2], respectively. Moonbi, Uralla and Clarence River represent three distinct I-type supersuites. Moonbi granites are high-K and strongly oxidised. Uralla granites are medium-high-K, and more reduced. Clarence River are low-K, isotopically primitive granites, equivalent to arc magmas.

Li isotopes were evaluated using MC-ICP-MS analysis under conditions of reduced RF power. This 'cool' plasma technique yields precision equivalent to TIMS $(2\sigma SD; 0.5^{o}/_{oo}, 680W; 0.7^{o}/_{oo}, 800W)^{3}$. Overall variations of $\sim 10^{o}/_{oo}\delta^{7}Li$ are observed, greater than the differences observed in arc lavas worldwide ($\delta^{7}Li = \sim 2$ to $7^{o}/_{oo}$). Clarence River granites typically have $\delta^{7}Li > 4^{o}/_{oo}$, similar to lavas from sediment poor island arcs (e.g. Izu-Bonin and Kuriles). Bundarra granites have low $\delta^{7}Li$, consistent with involvement of more strongly weathered source components. The higher $\delta^{7}Li$ ($< 4.9^{o}/_{oo}$) observed for Hillgrove supports the inferred derivation from immature arc sediments[2]. Moonbi and Uralla overlap with the lighter values observed for arc lavas. The slightly heavier values for Uralla granites are consistent with the greater involvement of sedimentary components in the latter. Although no simple delineation exists between NEB S- and I-type granites, Li isotopes provide important insights into the nature of the crustal components involved in granite magma-genesis.

[1]Shaw, S.E. & Flood, R.H. 1981. JGR, 86, 10530-10544. [2]Landenberger, B. & Collins, W.J. 1995. In Brown, M. & Piccoli, P (eds), The origin of granites and related rocks. p86.[3]Bryant et al. (sub.) JAAS.

V62B-1415 1330h POSTER

Petrologic Development of Wrangell Volcanic Field Basement Granitoids From White Mountain, Nabesna, Alaska

Darin C. Snyder[1] (513-529-3217; snyderdc@muohio.edu)

William K. Hart[1] (hartwk@muohio.edu)

[1]Miami University, Department of Geology, 114 Shideler Hall, Oxford, OH 45056, United States

The White Mountain granitoid suite represents an isolated window into Cretaceous age magma intruded into the Wrangellia terrane basement of this region. Locally the granitoids are unconformably overlain by ∼ 2.5 Ma rocks of the Skookum Creek Volcanic Complex. Although the total area of exposed granitoid at White Mountain is relatively small (∼ 1 km^2), significant complexities exist. Post dating the emplacement of the main granitoid bodies was a second episode marked by intrusion of intermediate composition dikes. Field evidence suggests that the granitoid was at least partially crystallized at this time. The main granitoid suite consists of six surficially isolated bodies all of which are calc-alkaline and metaluminous, ranging in composition from hornblende-biotite quartz diorite to biotite granodiorite. Two of the exposures, comprising ∼ 20% of the total exposed granitoid, are enclave-bearing, with the hosts representing the most evolved material at White Mountain and the enclaves amongst the least evolved. The enclaves typically are <15 cm in size and circular to oval in shape, and are intermediate in composition (∼ 54 wt.% SiO_2), with significant modal clinopyroxene, amphibole and interstitial oxide. Field, chemical, and petrographic evidence indicate that the enclaves do not represent xenoliths of wall rock. $^{40}Ar/^{39}Ar$ analyses were performed on one host and two nonenclave-bearing samples (1 biotite and 2 hornblende, respectively) providing cooling ages between 113.3±1.3 and 117.38±0.54 Ma.

The main granitoids range from 0.5 to 6 wt.% MgO with enclaves extending this to 9 wt.%. Most of the nonenclave-bearing granitoids fall between 4 and 5 wt.% MgO. When plotted vs. MgO, other major elements define linear trends with breaks in slope between 4 and 5 wt.% MgO. Within this same interval, Rb, Ba, Zr, and Zn exhibit a wide range in concentrations. Sub-samples from one granitoid exhibit textural and geochemical evidence for mixing at the low MgO end of the compositional spectrum. The enclaves are enriched in HREE and lack quenched margins, suggesting that they may represent cumulates from a now more evolved material. However, the enclaves contain the highest $^{143}Nd/^{144}$Nd ratios measured in the granitoid suite. The above observations require processes including, but not limited to mixing/unmixing; processes such as crystallization in an open magmatic system.

V62B-1416 1330h POSTER

Geology and the origin of trachytes and pantellerites from the Eburru volcanic field, Kenya Rift

Jesus M. Velador[1] (915-747-5843; velador@geo.utep.edu)

Peter A. Omenda[2] (pomenda@kengen.co.ke)

Elizabeth Y. Anthony[1] (eanthony@geo.utep.edu)

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

[2]Kenya Electricity Generating Company, P.O. Box 785, Naivasha 999, Kenya

The Eburru volcanic field is located in the Kenya Rift, where it is part of the very young axial volcanic activity. The Eburru field belongs to the complex of volcanoes – Menegai, Eburru, Olkaria, Longonot, and Suswa – that are centered on the Kenya Dome. All of these volcanoes are prime targets for geothermal energy, with Kenya's one geothermal plant at Olkaria.. Correlation with dated volcanism implies that the activity at Eburru is at most approximately 500,000 years. The surfaces preserved on the youngest flows suggest that they erupted within the last 1,000 years. Mapping indicates that the volcanic field is divided into an older western section, composed of pantellerites (Er1) and overlying, faulted trachytes (Et1), and a younger eastern section. The eastern section has a mapable ring structure, and is composed of trachytes (Et2) and pantellerites (Er2). Some of these flows may be contemporaneous, but the final phase of eruption is exclusively pantellerite. We have chemical data for all units except the older pantellerites. The data indicate that the trachytes and rhyolites are both pantelleritic in terms of their alumina and iron contents. This is in contradistinction to the rhyolites immediately adjacent at Olkaria, which are comenditic. Concentrations for all elements are highly elevated, except for Ba, Sr, K, P, and Ti that show deep negative anomalies. The relationship between the trachytes (Et2) and pantellerites (Er2) is one in which the pantellerites consistently have the highest concentrations in all elements, including those with negative anomalies. Correlation coefficients for pairs such as Zr and Rb support the field evidence for the western Et1 trachytes being a separate magmatic event from the Et2 and Er2 units of the eastern field. Sanidine is the principal phenocrystic phase in these rocks, and thus the elevated Sr and Ba in the pantellerites preclude simple crystal fractionation to derive pantellerite from trachyte. Bailey and Macdonald (1975, Min. Mag. 40, 405-414) reached the same conclusion and noted high correlation coefficients among F, Zr, and Rb on one hand and Cl, Nb, and Y as a second group. They argued that a halogen-bearing vapor is important to the genesis of the pantellerites. We have verified the same elemental correlations for our data set. Lowenstern (1994, Amer. Min. 79, 353-369) documented immiscible halide fluids in fluid inclusions from the type locality Pantelleria, Italy. This direct observation of halide lends credence to the importance of fluids in peralkaline rhyolites. We are currently examining fluid inclusions from the Eburru samples for similar evidence of a complex volatile phase.

V62B-1417 1330h POSTER

Rift Volcanics or Rhyolitic Sills? The Jurassic-Cretaceous Rhyolitic Rocks of the Whetstone Mountains, Southeastern Arizona

Christie Cowee[1] (ccowee@nmsu.edu)

Nancy J. McMillan[1] (nmcmilla@nmsu.edu)

[1]New Mexico State University, Department of Geological Sciences MSC 3AB, Las Cruces, NM 88003, United States

Previously mapped as both intrusive and extrusive, the rhyolitic bodies found within the Bisbee Group rift sedimentary rocks of the Whetstone Mountains were thought to represent the silicic end member of bimodal volcanism associated with extension of the Late Jurassic Mexican Borderland rift. However, preliminary investigations indicate that all the rhyolitic bodies are shallow intrusive sills and dikes that have intruded the Bisbee Group sediments parallel/sub-parallel to bedding. The age of the intrusions can be constrained by the age of the Bisbee Group rocks (Late Jurassic) and cross cutting relationships with a 74 Ma pluton, meaning the rhyolitic bodies may be tectonically related to either rifting or to early Laramide deformation.

The following lines of evidence suggest that these rhyolitic bodies are related to the extension of the Mexican Borderland Rift rather than Laramide deformation: 1.) The rhyolites found in the Whetstones are consistent with a high silica end member of bimodal volcanism associated with rifting, versus the intermediate composition magmas associated with Laramide deformation. 2.) Local deformation within the Whetstone Mountains has folded both Bisbee Group sedimentary rocks and the rhyolitic sills. One such fold has been truncated by the 74 Ma pluton restricting the age of the compressional structures to early Laramide and providing further evidence that the sills where emplaced and cooled long before folding occurred. 3.) The low abundance of hydrous minerals (<2% biotite), no vesiculation, no magma-water interaction at intrusion contacts, and general lack of volcanism indicate that these were dry silicic rift related magmas.

Columnar jointing, chilled margins, and aphanitic porphyritic textures point to emplacement of the magma at shallow depths. It is thought that the sedimentary rocks were dry at the time of magma emplacement due to lack of magma-water interaction. However, it is permissible that the magmas were emplaced only a few million years after sedimentary deposition suggesting that the magmas are Latest Jurassic to Early Cretaceous in age. If so, these rhyolites would extend the duration of rift magmatism within the Mexican Borderland Rift.

V62B-1418 1330h POSTER

Re-examining the Petrogenesis of the Tschicoma Dacite, Jemez Volcanic Field, NM: Geochemical and Geochronologic Evidence for Distinct Pulses of Volcanism

Leigh Justet[1] (702-895-4616; leighjustet@hotmail.com)

Terry L Spell[1] (702-895-1171; tspell@ccmail.nevada.edu)

Matthew Thirlwall[2] (44-0-1784-443609; matthewt@gl.rhul.ac.uk)

[1]University of Nevada Las Vegas, Department of Geoscience 4505 Maryland Parkway Box 454010, Las Vegas, NV 89154-4010, United States

[2]Royal Holloway University of London, Department of Geology, Egham, Surrey TW20 0EX, United Kingdom

Coupled sets of Sr and Nd isotopic, major and trace element, and $^{40}Ar/^{39}Ar$ age data were obtained for 22 of 24 of the mapped Tschicoma Formation dacite domes in the Jemez Volcanic Field (JVF), New Mexico. These data indicate that Tschicoma Formation dacite was erupted in two distinct pulses that underwent different petrologic evolutions. The first pulse was erupted ∼7.4-7.2 Ma in the northwest portion of the JVF as a series of andesite and trachyandesite domes. Magmas erupted from these vents may be chemically related to one another by simple fractional crystallization models. Isotopic compositions vary from $^{87}Sr/^{86}Sr$ = 0.70493 to 0.70506 and ϵNd = -2.2 to -3.6 and suggest that minor lower crustal contamination occurred. The second eruptive interval occurred ∼4-3 Ma. Activity was centered in the northeast portion of the JVF and was exclusively dacitic in composition. These magmas evolved by fractional crystallization and mixing with basaltic magmas. Modeling implies that fractionation of a small amount of observed phenocrysts was accompanied by significant amounts of basaltic contamination. The isotopic data range from $^{87}Sr/^{86}Sr$ = 0.70450 to 0.70433 and ϵNd = -3.3 to -2.0 and also demand addition of less evolved mafic magma. The data further suggest that a Lobato basalt sample collected in the vicinity of the dacite vents represents the mafic contaminant. This Lobato basalt was erupted coincident with the dacite eruptions and isotpically lies on-trend with the dacite mixing line. Previous K/Ar dates and geochemistry suggest a continuum of dacitic eruptions from 3.2 to 6.9 Ma, and did not resolve the two pulses of volcanism. Thus, mapped Tschicoma dacite actually represents two chronologically and chemically distinct magmatic events, separated by ∼3 Ma. Previous work on the JVF suggests that the JVFs early evolution was dominated by an andesite shield while its later evolution was characterized by an initial period of dacitic volcanism accompanied by minor basaltic eruptions and culminated in the caldera-forming eruptions of the Bandelier tuff. This study suggests that a larger volume of dacite was erupted earlier in the JVFs evolution, while a smaller volume was erupted later than previous thought; an observation that could have implications for understanding the role tectonism played in the evolution of the JVF.

V62C MCC: 132 Saturday 1330h

The Big Score: Twenty Years of Research on the Pu'u 'O'o - Kupaianaha Eruption, Kilauea Volcano, Hawai'i I *(joint with S, T)*

Presiding: **J Kauahikaua,** U.S. Geological Survey**; M O Garcia,** University of Hawaii

V62C-01 1330h INVITED

The Pu'u 'O'o-Kupaianaha Eruption of Kilauea Volcano: The First 20 Years

Christina Heliker ((808) 967-8807; cheliker@usgs.gov)

Hawaiian Volcano Observatory US Geological Survey, PO Box 51, Hawaii National Park, HI 96718, United States

The Pu'u 'O'o-Kupaianaha eruption on Kilauea's east rift zone, which began January 3, 1983, is the volcano's longest rift-zone eruption during at least the past 600 years. The early years of the eruption were memorable for lava fountains as high as 460 m that erupted episodically from the Pu'u 'O'o vent. From June 1983 through June 1986, 44 episodes of fountaining fed channeled 'a'a flows and built a cinder-and-spatter cone 255-m high. For the past 16 years, however, the activity has been dominated by nearly continuous effusion, low eruption rates, and emplacement of tube-fed pahoehoe flows. The change in eruptive style began in July 1986, when the activity shifted 3 km downrift to a new vent, Kupaianaha, where overflows from a lava pond built a broad, low shield, 1 km in diameter and 56 m high. For much of the next 5.5 years, tubes delivered lava to the ocean, 12 km away. In February 1992, the Kupaianaha vent died, and the eruption returned to Pu'u 'O'o, where a series of flank vents on the southwest side of the cone has erupted nearly continuously for 11 years, again producing a shield and tube-fed pahoehoe flows to the coast. Since late 1986, lava has entered the ocean over 70 percent of the time. More than 210 hectares of new land have formed during this eruption, as lava deltas build seaward over steep, prograding submarine slopes of hyaloclastic debris and pillow lava.

The estimated long-term effusion rate of this eruption, averaged over its first 19 years, is approximately 0.12 km^3 per year (dense-rock equivalent). The total volume of lava produced, 2.1 km^3, accounts for over half the volume erupted by Kilauea in the last 160 years. The composite flow field covers 105 km^2 of the volcano's south flank and spans 14.5 km at the coastline, forming a lava plain 10-35 m thick.

V