SGC053-01   Room:304   Time:May 26 08:30-08:45

Effect of tectonic environment on chemical composition of OIBs in the Pacific: implication for a deep mantle origin

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The Pacific Ocean is known to contain numerous ocean islands, seamounts and several oceanic plateaus and rises those may have formed during the large-scale magmatic event in the South Pacific. Proposed origins for this magmatism can be divided into two categories. One is mantle plume from the Earth's deep interior that is governed by mantle dynamics and the plume sometimes referred to as "superplume". The other is upper mantle process that is controlled by lithospheric dynamics, such as surface lithospheric fractures, melt focusing under broad upwellings condition and small-scale sublithospheric convection. In either case, documenting the large-scale magmatic event over both space and time may provide clues into understanding material recycling throughout the silicate Earth.

The South Pacific region is referred to as a "superswell" or the "South Pacific Isotopic and Thermal Anomaly" (SOPITA) due to its unusually shallow ocean floor, evidence of active intraplate volcanism, and the occurrence of isotopically anomalous magmas. These geophysical and geochemical features are usually attributed to a plume activity or lithospheric dynamics. Although it is unclear whether the process that is now operate in the South Pacific has been active since the Cretaceous, distinct isotopic signatures of the Cretaceous seamounts can be traced back to the magmas of SOPIAT. It might follow that single process has been active since the Cretaceous.

The notable geochemical character of this magmatism is quadratic correlation between elemental ratios (La/Yb, Sr/Y, Nb/Zr, Ta/Zr and Th/Ta) of the seamounts/island and "relative age" that can be an index of the thickness of lithosphere beneath hot spots. As the thickness of oceanic lithosphere is a function of square root of its age, these correlations suggest importance of tectonic environment to determine the chemical composition of the magmas. In addition, these correlations suggest the genetic relationship between oceanic plateaus and island/seamount chain because the elemental ratios of oceanic plateaus are on the trends. Other important geochemical feature is that the elemental ratios of mid-ocean ridge basalts (MORBs) from the East Pacific Rise (EPR) are not on these trends. This observation suggests that source material of the EPR MORBs is different from that of the seamounts and islands. Since the source material of EPR MORBs can have a representative composition of upper mantle beneath the South Pacific, this difference could imply the material flow from the deep mantle. Therefore melting of mantle plume from the lower mantle, which melting condition depends on thickness of lithosphere, can be a plausible origin of the magmatism in the South Pacific.

Keywords: Pacific, hot spots, ocean islands, Pb-Nd-Sr isotopes, superplume

SGC053-02   Room:304   Time:May 26 08:45-09:00

K and U budget in the mantle

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K, U and Th concentrations in bulk silicate Earth (BSE) are significant for isotope geochemistry, including noble gases and Pb isotopes, as well as for geothermal study as internal heat sources. While the concentration of U in BSE has been estimated from the chondritic value, K concentration of BSE is poorly constrained due to its volatility during formation of the Earth. Instead, K concentration in BSE has been calculated using U concentration in BSE multiplied by the canonical K/U ratio (13000) deduced from the relatively uniform K/U of crustal and mantle-derived rocks (e.g., O'Nions and Oxburgh, 1983). However, if subducted and dehydrated slab with low K/U occupied a considerable volume in the mantle, the presence of this "hidden" reservoir would result in a significant reduction in K/U, and hence in the total amount of K, in BSE compared to the previous estimates (Lassiter, 2004). This hypothesis has been debated (Arevalo et al., 2009). However, He-Ne-Ar isotope systematics of the HIMU reservoir, which was produced from subducted old oceanic crust, demonstrate that K/U of this reservoir should be much lower (3000) than the canonical K/U ratio (Hanyu et al., in submission), supporting Lassiter (2004)'s hypothesis.

In this presentation, I discuss the impact of subducted oceanic crust on the K and U(+Th) budget in the mantle. Since the subducted oceanic crust is enriched in U, but not in K by dehydration, the preservation of the subducted oceanic crust in the mantle, that is HIMU reservoir, affects the K and U budget in the silicate Earth. Mass balance calculations of K and U were conducted, assuming four major reservoirs, continental crust, depleted mantle reservoir, primitive mantle reservoir and subducted oceanic crust, after Lassiter (2004). The differences between the model presented here and that presented by Lassiter (2004) are twofold. (1) We assume variable U concentrations in the subducted oceanic crust, from U-poor dehydrated N-MORB (0.05 ppm) to U-rich bulk crust observed in natural eclogite (0.12 ppm). (2) We assume some depletion in U and K for primitive mantle reservoir, because it is not necessarily unmodified BSE, but may be moderately depleted due to it making a small contribution to the formation of continental crust (Class and Goldstein, 2005).

The estimated K/U of BSE is modified from canonical value of 13000 down to 8000-10000 by taking the presence of subducted slab into consideration, irrespective of the values chosen for the compositions of the abovementioned reservoirs, if all the oceanic crust ever subducted has accumulated, occupying 6-9 % of the mantle. In this case, K concentration in BSE is also lower than the previous estimate of 250 ppm. The fraction of primitive mantle reservoir in the silicate mantle is also estimated from the mass balance calculations. It is highly dependent on the concentration of U in the subducted crust. In particular, if U concentration in the subducted oceanic crust is relatively low (0.05 ppm), the primitive mantle reservoir should occupy at least 30% in the mantle to balance the K and U budget in the silicate Earth. This suggests that considerable amount of primitive mantle reservoir has been unmixed and isolated in the convecting mantle.

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Keywords: potassium, uranium, mantle, subducted slab

Noble gases in olivines in Udachnaya kimberlite, Siberia

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Kimberlite is known as host rock of diamonds. Although the origin of kimberlite magma is considered to be deeper than 150 km in the mantle where diamonds formed (e.g., Dawson, 1980; Haggerty, 1994), it has not been well constrained yet (e.g., Price et al., 2000; Chalapathi Rao et al., 2004; Smith, 1983).

Isotopic ratios of noble gases in various components in the Earth are significantly different resulting from that they are sensitive to addition of radiogenic/nucleogenic isotopes to primordial ones due to their low concentrations. Because noble gases can be measured with a high sensitive mass spectrometer, they are useful tracers to constrain origins of samples derived from deep interior of the Earth. Sumino et al. (2006) analyzed olivine phenocrysts in the Udachnaya kimberlite from Siberia, and clarified that they contain plume-derived noble gases. In this work, we analyzed other new sets of samples from the same kimberlite pipe to further investigate noble gas characteristics of the Udachnaya kimberlite magma.

It is important to separate several noble gas components within a sample, because there is not only intrinsic component of magma source but also secondary components acquired from surrounding materials or accumulated radiogenic isotopes produced from the decay of radioactive elements such as U, Th, and ^{40}K. We separated olivine phenocrysts that would have been less affected from the latter two components than other minerals. Since magmatic noble gases concentrated into fluid inclusions in the phenocrysts, we employed crushing method to extract noble gases selectively from them. We also applied heating method that extracts all noble gases in the phenocrysts. In this work we developed new crushing apparatus to reduce the contaminating atmospheric noble gases, which were adsorbed on the inner surface of the apparatus.

Crushing the aliquot of olivine separates reported in Sumino et al. (2006) yielded larger contributions of radiogenic ^4He and nucleogenic ^{21}Ne than the previous results. Since they exist within olivine crystal lattice, the new crusher shows higher crushing efficiency than the old one, resulting in a larger contribution of the lattice-hosted components relative to the inclusion-hosted ones. However, the total abundances of radiogenic ^4He and nucleogenic ^{21}Ne extracted from both crushing and heating indicate that the olivines studied in this work contained more radiogenic/nucleogenic components than those in the previous ones. The results suggest different noble gas isotopic compositions among the olivine crystals from the same kimberlite.

Additionally we measured olivine samples separated from another Udachnaya kimberlite. The results showed distinct behavior during stepwise crushing. Magmatic He isotope ratio is similar to that of subcontinental lithospheric mantle, and radiogenic ^4He and ^{40}Ar contributions increase with the progress of crushing. The results are similar to those of the previous work. Meanwhile, Ne isotope ratios deviate from typical mantle trends toward larger contribution of nucleogenic ^{21}Ne in a Ne three-isotope plot. This is clear contrast to the previous results, in which Ne isotopic feature is explained by a two-component mixing between air and less-nucleogenic mantle component than the MORB source (Sumino et al., 2006). Since the grain sizes of the new olivine separates are relatively larger than the proper phenocrystic olivines which should be smaller than 200 microns in size (Kamenetsky et al., 2008), there might be a larger number of xenocrysts in the new separates. Inclusions in the xenocrysts may be enriched in radiogenic/nucleogenic isotopes compared with phenocrysts containing noble gases in the source magma. This work revealed that contribution of radiogenic/nucleogenic components accumulated in crystals with an old age (350 Ma of the Udachnaya kimberlite, Maas et al., 2005) becomes significant even if the crushing extraction method is applied.

SGC053-04 Room:304 Time:May 26 09:15-09:30

Evaluation of parent body processes on presolar components in chondrites

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Chondrites and differentiated meteorites at the bulk meteorite scale commonly show small but resolvable mass-independent isotopic deviations from the terrestrial values in refractory elements (e.g., Cr, Ti, Mo, Ru, Ba, Sm). At least some of these anomalies are nucleosynthetic in origin, and have been interpreted to reflect incomplete mixing of isotopically diverse presolar materials in the protosolar nebula, although uniform, terrestrial isotopic compositions in bulk chondrites have been reported for some elements (e.g. Sr, Os). Processes that occur on parent bodies such as thermal metamorphism and aqueous alteration can also potentially affect the isotopic compositions of bulk chondrites. Isotopic investigation of acid residues from primitive chondrites may shed light on this problem. The residues are rich in a variety of isotopically anomalous presolar grains which can control the isotopic composition of bulk chondrites. In this study, we analyzed Os isotope compositions in acid residues from four CMs (MET 01070, ALH 83100, Murchison, QUE 97990) and three CRs (GRO 95577, EET 92042, GRA 95229).

All the CM/CR-residues are characterized by positive epsilon-Os (eOs) values that are resolvable from the solar (= terrestrial) component, suggesting the enrichment of Os isotopes produced by the s-process. There are significant variations in eOs values across CM-residues. The magnitude of the positive Os isotope anomalies in the residue of the ALH 83100 (CM1/2) (e188Os = +3.10) is nearly twice as large as those present in residues from Murchison (CM2) (e188Os = +1.66). The residue of MET 01070 (CM1) has eOs values (e188Os = +2.31) larger than those of Murchison, whereas that from QUE 97990 (CM2.6) has the smallest deviation in eOs values from zero among all CM chondrites (e188Os = +0.95). Variations in the magnitude of the eOs values are also observed in residues from CR chondrites, where the residue from GRO 95577 (CR1) showed the largest positive Os isotope anomalies (e188Os +2.64). We propose that the observed isotopic variation was caused by the destruction of presolar phases via progressive aqueous alteration on the CM/CR parent bodies, rather than any nebular processes creating heterogeneous distributions of presolar grains that predate the planetesimal formation. Some petrologic observations of CM chondrites point to the occurrence of aqueous alteration prior to parent body accretion. However, destruction of presolar phases during preaccretionary alteration would result in the modification of Os isotopic compositions at the bulk meteorite scale, which is evidently not the case. The enrichment of s-process Os isotopes in the residues from highly altered CM/CR chondrites implies that aqueous alteration on the parent body preferentially destroyed the r-process-Os carrier(s) and modified it into an acid leachable phase in the chondrite matrices, while acid resistant s-process-rich grains (SiC, graphite) survived. This process, however, did not disturb the Os isotopic composition at bulk meteorite scale. Even though bulk chondrites are isotopically homogeneous in Os, our new results suggest that parent body aqueous/metamorphic processes have acted on the distribution of Os among presolar phases. This suggests that isotopic anomalies reported for some other elements that have been interpreted as reflecting nebular heterogeneities, may partly or wholly be the result of parent body processing. Presolar phases that are enriched in certain nucleosynthetic components could release these components upon destruction of the hosting phases. If the element is more highly soluble than Os, fluid transport could lead to the formation of isotopically modified bulk samples whose isotopic compositions are not representative of the whole parent body. Thus, isotopic heterogeneities among bulk chondrites should not automatically be interpreted as evidence for nebular heterogeneity.

Keywords: chondrite, presolar grain, aqueous alteration, osmium isotope

SGC053-05 Room:304 Time:May 26 09:30-09:45

Fractal distribution of mercury inclusions in quartz by in situ X-ray computed tomography (CT) system

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Large amounts of data are obtained by contemporary analytical instruments and observation systems. Mathematical and statistical analysis of the obtained data serves for the states or origin of objective matter. As X-ray computed tomography (CT) analysis has been developed in medical imaging method, the CT analysis for terrestrial materials yields a new approach in resolving their internal structure and origin (e.g., Tsuchiyama et al, 2009). We here investigate in situ X-ray CT analysis of mercury inclusions in quartz, and discuss relationship between the inclusions and the quartz using mathematical and statistical analysis.

We used quartz crystal (2 cm x 5 cm x 5 cm) from San Benito, California. This crystal contains visible mercury inclusions of their size, 1-2 mm, and this crystal is a suitable sample for the CT analysis because great density difference between the inclusions and the crystal. We used a microfocus X-ray CT system (Shimazu Corp., SMX-225CT), and obtained 260 CT images of 2-D slices over rotating a sample. The obtained images were processed using an image processing software.

These 2-D binary images were utilized for fractal and multifractal analysis using box-counting method. Obtained fractal dimension (D) is 1.76, suggesting that the distribution of mercury inclusions in quartz indicate planate form (D=1, linear form; D=2, planate form). Based on multifractal analysis, fractal structure could not be uniform because its singularity is widely. As the fractal structure of mercury inclusion are formed by random walk of mercury particles in Euclid spatial, the mercury inclusion would coincide with quartz growth or flow without constrained situation. Preliminary results from in situ X-ray computed tomography (CT) analysis also yield to recognize quantitative and spatial information of the inclusions in the quartz using fractal and multifractal analysis.

Reference
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Keywords: fractal, random walk, mathematical and statistical analysis, X-ray computed tomography system, mercury inclusions, in situ observation

Developement of tin isotopic analysis for cassiterite and its archaeological application

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[Introduction] Bronze products are alloys composed of Cu, Sn, and Pb and they were used before iron products had become common. For provenance studies of bronze materials, Pb isotopic composition has been utilized (Brill and Wampler, 1965). However, this method includes a problem that if raw materials from different localities are mixed, Pb isotopic composition of bronze can not indicate their origins. Additionally, some ancient bronze products seem to have experienced recycling, and mixing could occur during recycling. So Pb isotopes are not always helpful to determine provenances of bronze products.

Budd et al., (1995a) proposed that Sn isotopes are useful to detect recycling of bronze products, since metallurgical processes could cause measurable Sn isotope fractionation because Sn is volatile and has the largest number of isotopes among all elements. Although Cu, other main component of bronze could show isotopic fractionation, no significant isotopic fractionation has been detected for Cu (Mathur et al., 2009). Moreover, it was concluded that Pb isotopic fractionation during metallurgical process was smaller compared with isotopic variation among each locality (Barnes et al., 1978; Budd et al., 1995b). So Sn isotope is expected to give us an aid in the provenances studies of bronze.

Tin isotope analysis for ancient bronze products was carried out by Gale (1997). This research showed that there was no significant isotopic difference between the analyzed bronze products and concluded that these samples did not experience recycling with metallurgical processes. However, variation of Sn isotopic composition was detected in preliminary investigation for bronze products discovered from China (Nakai, unpublished).

In order to evaluate recycling by Sn isotopes, we need an assumption that raw materials of tin ore (cassiterite) have uniform Sn isotopic composition regardless of their origins. Haustein et al. (2010) reported a series of Sn isotopic data for cassiterite and observed the largest significant variation of the isotopic composition (about 0.6 permil).

[Objective] Although variations of Sn isotopic composition have been detected in nature, there are few studies for cassiterite. In addition, analytical methods are not standardized. So we have established the method of Sn isotopic analysis for cassiterite and applied to cassiterite from Japan. These cassiterite samples are provided by Dr. Ishihara at National Institute of Advanced Industrial Science and Technology (AIST).

[Experiment] Cassiterite was crushed in a stainless mortar and powdered in an agate mortar. About 1 mg of powdered sample was weighed into PFA vials. 0.3 ml of hydroiodic acid was added and heated overnight by using teflonbomb at 100^oC. Subsequently, samples were dried at 80^oC and leached in hydrochloric acid. The procedures were repeated until the sample is dissolved. Moreover, hydrofluoric acid and perchloric acid were added if some residue remained. We used an extraction chromatography system to separate Sn from other elements (Yi et al., 1995) and purified tin solutions were diluted in 2% nitric acid including trace of hydrofluoric acid. Sb was added for external fractionation correction. The Sn solutions were analyzed by a MC-ICP-MS (the Micromass Isoprobe). Sn isotopic ratios of samples were evaluated as the deviation from Sn isotopic ratios of standard.

[Result] As a result, we also observed significant variations of Sn isotopic composition for cassiterite samples. We detected up to 0.16 permil per mass for Japanese cassiterite and each sample was followed mass dependent isotopic fractionation. We detected Sn isotopic variationas large as 0.7 permil per mass in ancient bronzes from China, which is larger than the variation in cassiterite samples. So the results of this study suggest a possibility that Sn isotopes could be used to detect recycling.

Keywords: tin, stable isotope, cassiterite, ICP-MS, archaeology

SGC053-P01 Room:Convention Hall Time:May 26 10:30-13:00

Fully automated open column separation system - "Columnspider I" for efficient preparation of isotope analysis

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Sr, Nd, Pb and Hf isotope ratios are fundamental in our research on the evolution of the Earth's interior and surface. Until recent it was difficult to process rocks with very low concentrations or to target individual minerals in a tiny sample. At IFREE, JAMSTEC we have developed improved analytical methods for high precision analysis of very low concentration and small sized samples. This has expanded the scope of application of isotope analysis on broader variety of rock samples. The number of important samples we want to process has greatly increased. Therefore we must significantly improve the efficiency of the sample analysis and particularly the sample preparation.

Thermal Ionization Mass Spectrometer that includes some level of automation is used for measuring the samples without much labor and with decent speed. However the sample preparation process requires lengthy and labor-heavy pre-treatment compared to the actual measurements. Despite there are other simpler methods for direct sample measurement (laser ablation) the conventional method of separating the target elements using open column chromatography is still valuable and preferred in many cases.

In general, the rock sample preparation for isotope analysis is roughly divided into three steps: 1.Decomposition of the sample; 2.Extraction of the target element; 3.Dilution (MC-ICP-MS) or Loading on filaments (TIMS); All these three stages require cumbersome and lengthy manual labor. The most time-consuming and monotonous processes are found in the case of 2.Extraction of the target element. The possibility for human error is also very high here. Many of the sub-processes are easy to automate and it's relatively easy to simulate human manipulations.

This put the beginning of the project for a pipette robot that JAMSTEC and HOYUTEC CO.LTD. successfully co-developed. The fully automated open column separation system "Columnspider I" can be set up with 10 samples for simultaneous separation and extraction of target elements. By using this equipment we are able to save labor and valuable time and dramatically improve the performance for the preparation of the samples. In the context of the whole process of isotope analysis we expect it to play major role in achieving accurate analysis of increased number of samples. In this presentation I will introduce the features of "Columnspider I" in detail.

Keywords: Fully automated separation system, Open column, Sr,Nd,Pb,Hf isotope, Preparation, Column separation, Pipette robot

SGC053-P02 Room:Convention Hall Time:May 26 10:30-13:00

Determination of Ce isotopic ratio using a three-step separation procedure and thermal ionization mass spectrometry

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The rare earth elements (REE) have two long-lived decay systems, the ^{147}Sm-^{143}Nd and ^{138}La-^{138}Ce. The combination of those isotope ratios provides information on ages, initial ratios, and enables estimation of the time-integrated REE evolution of complex geological reservoirs in the mantle or crust. However, the variation of Ce isotopic ratio ($^{138}Ce/^{142}Ce$) due to secular radiogenic decay to ^{138}Ce is smaller than those of Nd isotopic ratio because of the low abundance of ^{138}La and its long half-life. Therefore, highly precise determination of Ce isotopic ratios is necessary to obtain reliable data for application of geochemical studies.

For precise determination of Ce isotopic ratio, it is necessary to separate Ce from the matrix and isobaric interfering elements. A three-step chemical separation procedure was developed for Ce separation in this study, which was proved to be able to sufficiently remove the isobaric interfering elements with low procedural blank. Ce was first separated as a REE fraction via cation exchange column with HCl. Then Ce alone was isolated from other REEs by selective extraction technique with chelating resin (Tazoe et al., 2007). In this step, Ce was separated easily from other REEs by oxidation from Ce^{3+} to Ce^{4+} using $KBrO_3$ in nitric acid. Ce was further purified using a third cation exchange column with HIBA as the eluent, which was modified from Makishima and Nakamura (1991).

The Ce isotopic ratios were measured by multicollector static measurement using TIMS (TRITON TI, Thermo Fisher Scientific Co., Germany) equipped with nine Faraday cups at IFREE, JAMSTEC. The Ce ion beams were measured as oxide species (CeO^+) to obtain stable and large ion beams. During the Ce isotope measurement, Ce oxide ion beams were obtained at the intensity of 3 ~ 10 X 10^{-11} A for $^{142}Ce^{16}O$ using a double Re-filament technique. The mass-dependent fractionation of Ce isotope ratio were normalized to $^{136}Ce/^{142}Ce=0.01688$ and $^{140}Ce/^{142}Ce=7.947$ using the power law. The $^{18}O/^{16}O$ ratios were obtained in situ measurement. The data acquisition time for 450 ratios was about 1.2 hours. The analytical reproducibility and precision in the measurement of JMC 304, which is Ce isotope reference material (Tanaka and Masuda, 1982), were obtained +/- 0.008 % (2S.D., n=46) and < +/- 0.003 %, respectively.

The Ce isotope measurements of the Ames Laboratory Ce metal reference material (Willbold, 2007) were performed with an analytical reproducibility of +/- 0.007 % (2S.D., n=36) with normalization to JMC 304 in order to eliminate any inter-laboratory biases. The Ce isotope ratio for BCR-1, the USGS geochemical reference samples, was 0.0225646 +/- 0.0000004 (2 siguma$_m$, n = 7) and consistent with previously reported data (Makishima and Nakamura, 1991). We also performed the measurement of Ce isotope ratios in seven geological reference materials (JB-1a, JB-3, JA-1, JA-2, JR-1, JG-1a, and JMn-1) and the results were consistent with reported data but with improved analytical precision.

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Keywords: Ce isotope ratio, TIMS, JMC304, BCR-1, chemical separation

SGC053-P03 Room:Convention Hall Time:May 26 10:30-13:00

Two primary magmas derived from Samoan mantle plume: less-degassed tholeiitic and EM2-type alkalic magmas

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Alkali basalts from Tutuila Island, American Samoa are interpreted as products of binary mixing of magmas derived from isotopically distinct source components (Farley et al., 1992): PHEM (primitive helium mantle, $^3He/^4He$ >24 R_A)-type and EM2-type. Our new data show that the isotopic ratios in these lavas correlate with trace element ratios, clinopyroxene compositions, and phenocryst assemblage. PHEM-type basalts have lower Nb/Zr, LREE/HREE, and $^{87}Sr/^{86}Sr$ and higher $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ ratios than EM2-type basalts. PHEM-type basalts include augite and orthopyroxene, while EM2-type basalts contain diopside together with olivine and/or plagioclase. The presence or absence of othopyroxene and the difference in Ca-Ti-Na contents in clinopyroxenes suggest that the PHEM- and EM2-type end-member magmas are of tholeiitic and alkalic compositions, respectively. The reaction rims around the orthopyroxene phenocrysts indicates that PHEM-type tholeiitic end-member magmas mixed with EM2-type alkaline magmas before they were erupted. These results suggest that formation of tholeiitic basalts associated with the Samoan mantle plume can be detected by phenocryst assemblage and mineral compositions. Lack of systematic correlation between isotopic ratios and stratigraphy suggests that the end-member magmas were generated in the same period. The coexistence of tholeiites and alkaline magmas places important constraints for melting conditions and source materials for the Tutuila basalts.

Keywords: OIB, Samoa, primary magma

SGC053-P04   Room:Convention Hall   Time:May 26 10:30-13:00

Magmatic processes of mafic dykes in Ryoke belt at Awaji and Shodo Islands, southwest Japan

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The synplutonic mafic dykes are widely exposed at Awaji and Shodo Islands in southwest Japan, which intrude into the Ryoke plutonic rocks of granitoids and/or gabbroic rocks (Yoshikura and Atsuta, 2000). Mode of occurrences of mafic dykes in the Awaji Island is characterized by the alignment of melanoclatic lenticular enclaves with several centimeters in length. On the other hand, the mafic dykes in the Shodo Island occur as continued shape of mafic swarm intrusions.

Constituent minerals of mafic enclaves in Awaji Island or dyke in Shodo Island are plagioclase, hornblende and biotite. The chemical composition of plagioclase in the mafic rocks from the Awaji Island is An_{25-95}. On the other hand, chemical compositions of plagioclase in the mafic rocks from Shodo Island is An_{27-67} in matrix parts, and An_{62-92} in the phenocrysts parts.

The SiO_2 wt.% contents of the mafic rocks from Awaji Island, and those from Shodo Island are 46-59, and 50-63, respectively. On the N-type MORB normalized spiderdiagram, the mafic rocks in both sites are shown similar by the LIL elements enriched and HFS elements depleted pattern. Moreover, on the variation diagrams, the Ti and V contents are shown by negative trends with respect to the variation of SiO_2 contents. The K and Na contents are shown same or more value than granitic rocks. But most of the composition of granitic rocks are plotted on the extension line of enclaves.

These results suggest that the mafic dykes in Awaji Island and Shodo Island were formed by the processing of chemical mixing between mafic magma and felsic magma or alkaline fluid. The result that the SiO_2 contents do not show significant correlation with respect to the variation of Fe/Mg ratio, and the presence of quartz and biotite in the mafic rocks of the lowest SiO_2 contents (49 wt.%) may further support the evidence of chemical mixing between mafic and felsic magmas.

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Keywords: Ryoke belt, mafic rock, dyke, geochemistry, magma process

SGC053-P05 Room:Convention Hall Time:May 26 10:30-13:00

Improvement of web application of KML generator for visualizing geochemical data of rocks and sediments in Google Earth

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At present, cross-disciplinary researches are popular for constructing a new structure model on the Earth's interior. To promote these researches, visual presentation of different kinds of geochemical/geophysical data at once will be a great help to integrate and understand the research results from different fields. The layer system of the various virtual globes, e.g., Google Earth, easily provides the overlaying image of different types of geographic data on the same area. To plot the geographic data in Google Earth, the data should be written by Keyhole Markup Language (KML). For compiling various research results from different geoscience fields in Google Earth, we have developed several applications generating KML from original analytical/observational datasets. Our project launched in 2007 and we have already developed successful applications, called KML generator, for visualizing seismic tomographic model, geomagnetic field model, and geochemical data of rock and sediment samples in Google Earth. One of the KML generators converts geochemical and isotopic datasets in several online database systems into KML and allows users to visualize those data easily in Google Earth. The generator accepts data files produced by the database systems PetDB, SedDB, GEOROC, and GANSEKI and template data files that users themselves make. The data are plotted three-dimensionally as a bar graph on the surface of the virtual Earth at the sampling site for the rock and sediment samples. The major element compositions of samples can also be displayed as a stacked bar graph. A web application for the generator has already been available since 2008, so anyone can set the parameters for visualization over the Internet. Here we have improved User Interface (UI) of the web application to set the parameters of the generator intuitively. The sampling sites of the samples existing the uploaded data file will be plotted in map on the web UI of the generator, and the data range of selected composition or isotope ratio will also be graphically illustrated. For visualizing of one type of the composition or isotope ratio, histogram will be illustrated, and for ratio between two types of them, two-dimensional scattergram having x-axis for one type and y-axis for other type, will be constructed. These graphical images will help user to set the parameters, e.g., the data range to be plotted and the color of the graphs, for visualizing the data in Google Earth. Moreover, the visual image of the geochemical data in Google Earth can be confirmed on the web browser by using Google Earth API before the downloading the KMZ file.

Keywords: geochemical data, isotopic data, visualization, Google Earth, KML, web application