Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG10-01 Room:101B Time:May 22 14:15-14:30

Seismological evidences showing along arc variation of crust and mantle evolution in the Izu-Bonin arc

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JAMSTEC has been conducting integrated active-passive source seismic studies to cover the entire Izu-Bonin arc. New seismological constraints on formation and evolution processes of the arc crust are revealed from active source data. For examples, a large volume of felsic-to-intermediate component crust having Vp of 6.0 - 6.8 km/s is predominantly observed beneath basaltic volcanic centers along the Quaternary volcanic front. We also discovered a similar along arc variation of the felsic-to-intermediate component crust in the rear-arc, which is proposed to be separated from the volcanic front after Oligocene. These findings suggest that the main part of the arc crust consisting of the felsic-to-intermediate component was created before the rear-arc has been separated from the volcanic front probably in Oligocene age. The passive-source seismic data provide additional constraint to mantle evolution process in the mantle wedge. Seismic tomography shows that low-velocity anomaly in the mantle wedge extending down to the subducting slab beneath the volcanic front coincide with thicker parts of the arc crust north of Aogashima and south of Sumisu-jima. Image of random velocity inhomogeneities obtained by S-wave peak delay times also shows remarkable along arc variations; i.e., at 30-70 km depth, strongly inhomogeneous regions were imaged beneath the Quaternary volcanoes and weak inhomogeneities were imaged on the forearc side. Those observations demonstrate that mantle up-welling to control the crustal growth may not be uniformly distributed along the volcanic front but centered at several areas, as suggested by a petrological study.

Keywords: Izu-Bonin, island arc, seismic survey, earthquake observation

SCG10-02 Room:101B Time:May 22 14:30-14:45

Pattern of fluid release from the subducting slab at the IBM margin

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Aqueous fluids released from the subducting slab play an important role in the creation and the evolution of arc crust by altering the physical properties of the overlying mantle material via hydration and by triggering hydrous melting, which is in large part responsible for arc magmatism. In this study, we investigate the pattern of fluid release from the subducting Pacific slab at the Izu-Bonin-Mariana (IBM) margin, using steady-state thermal models and the thermodynamic calculation code Perple_X, and explore its role in the formation of arc crust at the IBM margin. Geological and geophysical observations and thermo-mechanical models indicate that the distribution of hydrous phases in the lower crust and upper mantle of oceanic lithosphere can be highly localized due to fault-controlled fluid migration and hydration. However, to date, most studies of fluid flux in subduction zones have assumed a uniform distribution of mineralogically bound H_2O within given lithologies in the incoming oceanic plate. Fluid flux calculations by Wada et al. (2012) for a range of generic subduction systems show that for a given bulk H_2O content, localized hydration results in shallower H_2O release compared to uniform hydration, and that the H_2O flux off the subducting slab beneath the forearc and arc regions can be almost twice as large from a locally hydrated slab as from a uniformly hydrated slab. In this study, we will apply the approach developed by Wada et al. (2012) to the IBM subduction system and quantify the effect of localized hydration in the incoming Pacific plate on the pattern of fluid release. The hydration of the overlying mantle by the released aqueous fluids and the subsequent downdip flow of the hydrated mantle driven by the motion of the slab delay the liberation of H_2O and affect the depth distribution of fluid flux. At the IBM margin, the subducting Pacific slab is old and cold. The mantle material at the base of the mantle wedge may be altered by mechanical mixing with subducted sediments and crust and/or by the addition of Si- and Al-rich aqueous fluids. In such cases with a relatively cold condition along the interface, hydrous phases, particularly chlorite, may be stable in a thin layer along the base of the wedge to the sub-arc depth (Wada et al., 2012). In the fluid flux calculations for the IBM system, we will quantify the effect of the hydration of the overlying mantle on the pattern of fluid release. The modeling results will be compared with the location and the degree of hydrous melting in the mantle wedge inferred from geophysical and geochemical observations.

Keywords: Subduction zones, Thermo-petrologic model, Fluid flux, Subducting slab, Mantle wedge, Arc volcanism

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SCG10-03 Room:101B Time:May 22 14:45-15:00

Uranium-series evidence for variations in subduction components along the Izu volcanic arc

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Uranium-series isotopes can provide information about the time-scales of processes in subduction zones such as fluid transfer from the subducted slab to the mantle wedge, melt generation within the mantle wedge and ascent of the melts to the surface. Yet, critical aspects of these isotopic systems are not well understood. Traditionally, 238U excesses over 230Th in arc magmas has been interpreted to reflect the relative affinity of U for an aqueous fluids that transports it into the subarc mantle while Th remains immobile but recent U-Series models for the Mariana arc (Avanzinelli et al., 2012) indicate that some Th is transferred to the arc in the fluid which will affect conclusions on the time-scales of subduction zone processes. The Izu arc is highly depleted in most incompatible elements which allows components derived from the subducting slab to be more clearly identified. Samples from several islands of the Izu arc have large 238U excesses over 230Th which suggests that the compositions of magmas from this part of the Izu-Bonin-Mariana (IBM) arc are dominated by fluids derived from the subducting slab.

Trends in U-series isotopes in other arcs worldwide and in particular in the Mariana arc in the southern segment of the IBM arc have been interpreted as mixtures between fluids derived from the subducted slab and a sediment melt. Variations in U-Series isotopes within the more depleted Izu arc indicate a negligible influence of sediment melts. Instead, samples from different islands are mixtures between a fluid that is compositionally similar to the fluid end-member in the Mariana arc and the depleted sub-arc mantle. The U-series data for the Izu arc as well as differences in the enrichment in fluid-mobile elements show that the magnitude of the fluid-flux is highly variable within the Izu arc. Trends in the U-series data indicate that Th is mobilized in the fluid. Furthermore, the unusual trends in the U-series data for the Izu arc allow us to gain information about the compositions of both the fluids derived from the subducted slab as well as the sub-arc mantle.

REFERENCES:

Avanzinelli, R., Prytulak, J., Skora, S., Heumann, A., Koetsier, G., Elliott, T. (2012) Geochimica et Cosmochimica Acta 92, 308-328

Keywords: U-Series, Izu arc, fluids, time-scales

SCG10-04 Room:101B Time:May 22 15:00-15:15

Evidence from melt inclusions for magmas stalling at mid-crustal depths

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Primitive porphyritic basalts containing wehrlite and dunite crystalline aggregates were recovered from the northwestern slopes (1390-1135 mbsl) of West Zealandia Seamount (~16^o 53' N), southern Mariana Arc, by the ROV Hyper-Dolphin during cruise NT09-08, in June 2009. Olivines within the wehrlite (Fo_{83-90}) and dunite (Fo_{84-91}) aggregates, and the phenocryst population (Fo_{77-82}) contain glassy silicate melt inclusions. The compositions of these olivines and the volatile contents of the inclusions they host (analyzed by electron microprobe, laser ablation inductively coupled plasma mass spectrometry and micro-Fourier-transform infrared spectroscopy) suggest a crustal origin for the aggregates. Maximum H_2O and CO_2 contents in inclusions from olivine in the wehrlite aggregates of 4.23 wt.% and 809 ppm, respectively, suggest final equilibration at ~300 MPa, equivalent to depths of ~11 km. Inclusions in the dunites and phenocryst olivine populations are more evolved and contain maximum H_2O and CO_2 contents of 4.52 wt.% and 402 ppm, respectively. These suggest final equilibration at ~180 MPa, equivalent to depths of ~6 km. Geophysical surveys of the crustal structure in this area of Mariana Arc estimate the total thickness of the crust beneath West Zealandia to be ~19 km, with lower-middle crust and middle-upper crust boundaries at ~11 and ~6 km, respectively. These correspond to the inclusion equilibration depths suggesting that magmas are stalling at these boundaries and trapping melts as they crystallize. Comparison with volatile contents in other melt inclusions suggests that magmas commonly stall at 6 to 12 km beneath Mariana Arc volcanoes, and indeed beneath volcanoes in other arcs. This has important implications as it may represent a fundamental relationship between magma stalling, differentiation and the generation of middle crust in the Izu-Bonin-Mariana Arc system and other arcs.

Keywords: melt inclusions, volatiles, middle crust

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SCG10-05 Room:101B Time:May 22 15:15-15:30

A tale of two magmas: Contrasting MORB-Boninite reaction trends in IBM forearc moho transition zone

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Petrographic and geochemical analysis of spinel from 35 lower crustal dunites, harzburgites, wehrlites and gabbros recovered from the inner trench slope of the Bonin Ridge (BR) reveals 2 groups of samples which reacted with distinct melt compositions. The first group (Group M) consists of peridotites (cpx-harzburgite), wehrlites, and gabbroic rocks with medium Cr# (100 x Cr / Cr + Al) spinels ranging from 45 to 60 and high TiO2 and Al2O3 spanning ˜0.1-2.25 and ˜12-30 wt. % respectively. The second group (Group B) consists of only dunites and cpx-free peridotites with high Cr# spinels ranging from 65 to 94 and low TiO2 and Al2O3 spanning ˜0-0.12 and ˜3-21 wt. % respectively. Clinopyroxene is present in samples from group M but not group B. Clinopyroxene major element compositions range from 98 to 86 in Mg# with low TiO2 (0 - 0.11 wt. %) and heavily depleted REE compositions similar to depleted MORB mantle peridotite clinopyroxenes. The group M and group B samples are the result of melt-rock reaction with a mid-ocean ridge basalt (MORB)-like melt and a more depleted boninitic melt respectively. MORB-like forearc basalts (˜50-52 Ma) and boninites (˜44-48 Ma) recovered from the BR have been interpreted to represent a change from decompression melting at subduction initiation to flux melting and boninitic volcanism. The group M and group B samples are a record of the change from MORB-like melts created by decompression melting of already depleted mantle at or soon after subduction initiation to arc-type flux melting and boninite volcanism. Further, the presence of melt-hybridized peridotites and gabbroic rocks with spinels belonging to group M and not group B suggests that the lower crust and the mantle transition zone of the BR may be dominated by gabbroic rocks and material related to the FABs. This would imply that a large portion of the lower crust in the fore-arc was formed during or shortly after subduction initiation and is similar in composition to MOR lower crust.

Keywords: peridotite, Bonin Ridge, melt-rock reaction, subduction initiation, spinel, moho transition zone

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SCG10-06 Room:101B Time:May 22 15:30-15:45

Various arc magmas from a common plate slab: Sources and genetic conditions of the coexisting alkali basalts, sub-alkali

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In response to the subduction of the young Shikoku Basin of the Philippine Sea Plate (PSP) slab, arc magmas have been active through the late Cenozoic in the SW Japan arc (<15 Ma). Extremely various magma types occurred including oceanic island-type basalt (OIB), shoshonitc to mildly alkalic to sub-alkalic basalts with arc signatures, high-Mg andesites (HMAs), and adakites. The OIB-type basalt was related to the Japan Sea back-arc basin opening and the rests of the lavas with arc signatures were regarded as the results of re-initiation of subduction and subsequent progressive westward subduction of PSP. However, arguments present in both the origin of the magmas and their tectonic implications. To address these issues, we analyzed 324 lava samples from seven Quaternary volcanoes in the SW Japan arc. Geochemical examinations negated possibilities of the origin of the adakites either from lower crustal melts or fractionated melts from mantle derived basalt. We further investigated the genetic conditions of the entire suite lavas using a geochemical mass balance model, Arc Basalt Simulator version 4 (ABS4). The ABS4 model suggested that the adakites originated from slab melts with minimal interactions to the mantle peridotite. Greater involvement of the peridotite fractions in slab melt-fluxed mantle melting explained fairly well the geochemical variations of shoshonites, alkali to sub-alkali basalts, and HMAs. We thus propose that the various arc magmas in the SW Japan arc originated simply by a common slab melt-fluxed mantle melting mechanism with varied conditions including source materials of the slab melts, mantle melting depth and temperature, degree of melting, and slab melt fractions. Such the volcanism began at ~15 Ma, therefore, such the hot subduction system induced by the subduction of the Shikoku Basin, should have been initiated by the time.

Keywords: SW Japan, volcanic rock, magma, geochemistry, modeling

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SCG10-07 Room:101B Time:May 22 15:45-16:00

Forming continental crust: Density sorting in subducted arcs

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In recent work (Hacker, Kelemen & Behn EPSL 2011; Behn, Kelemen, Hacker, Hirth & Massone, Nature Geoscience 2011) we investigated pathways for *relamination*: return of compositionally buoyant, subducted material to the base of arc crust. *Delamination* of dense lithologies from the base of arc crust is invoked to convert mafic arc sections to felsic bulk continental crust (BCC; e.g., Ringwood & Green Tphys 66; Herzberg et al CMP 83; Kay & Kay Geol. Rundsch. 91; Ducea & Saleeby 96; Jull & Kelemen JGR 01). However, even in arcs where evidence for delamination of dense roots is compelling, remaining crust can be mafic (e.g., Kelemen et al. Treatise Geochem (ToG) 03; Green et al. J Petrol 06). To form felsic crust may require that more than 50% of the crust reaches granulite facies, perhaps during multiple episodes of thickening. In contrast, subduction of arc lithologies to eclogite facies (via arc-arc collision or subduction erosion) and *relamination* provides an opportunity for density sorting in a single stage.

When arc crust is subducted to eclogite facies, what compositions are buoyant and might return to the crust? We evaluate this using Perple_X (Connolly AJS 90) to calculate densities for volcanic rocks (Aleutians: Kelemen et al. AGU Monogr 03; Singer et al. JGR 07; IBM: Jordan, CentAm & IBM Geochem Database v. 1.02, 12), plutonic rocks in the Aleutians (Kelemen et al. AGU Monogr 03), and plutonic rocks representative of IBM mid-crust (Kawate & Arima Island Arc 98; Haraguchi et al. CMP 03; Saito et al. J Petrol 07; Tamura et al. J Petrol 10).

More than half of Aleutian lavas and plutons are buoyant relative to mantle peridotite in eclogite facies conditions (700-800 C, 3-4 GPa). Density instabilities could return them to the overlying crust. In detail, compared to the range estimated for BCC, Ta concentrations are slightly higher (average volcanics) and lower (average plutons), but a 1:1 mixture of volcanic and plutonic components is within the range for all major and trace elements with sufficient data. Western Aleutian volcanic rocks have the lowest Pb and Sr, and the highest Nd and Hf isotope ratios of any arc worldwide; recycled continental material is absent or negligible. BCC created there is juvenile, derived from the depleted mantle, not from recycling.

Density sorting of IBM compositions produces a similar result. Most primitive and high Mg# IBM lavas and plutons are depleted in K and highly incompatible elements compared to BCC (Kelemen et al. ToG 03). However, more than 80% of IBM lavas and plutonic samples are denser than the mantle in eclogite facies. The remaining, buoyant fractions are similar to BCC, though density sorted IBM data contain slightly higher HREE and lower Ta and Nb, and have a lower Mg#, compared to BCC.

In subduction erosion, forearc material in the subducting package can be $>$ 200 C before erosion so buoyant lithologies reach 700-800 C faster, and in larger volumes at a given time, than in arc-arc collision, facilitating the formation of buoyant diapirs. Subduction erosion rarely, if ever, transports compositionally buoyant material deep into the convecting mantle. Because subducted buoyant material can return to the crust, it is questionable to add eroded material to observed arc volumes to derive crustal growth rates.

Buoyancy instabilities during subduction erosion or arc-arc collision accumulate buoyant, felsic components into the crust, with the composition of BCC. This provides a uniformitarian, end-member process for genesis and evolution of BCC.

Ongoing calculations (similar to Tatsumi et al. G-cubed 2000) will estimate isotope characteristics for the denser fraction of subducted arc crust remaining in the mantle.

Keywords: Continental Crust, Density sorting, Subduction zone

SCG10-08 Room:101B Time:May 22 16:15-16:30

Origin of the proto-Philippine Sea Plate and the discovery of Mesozoic basement beneath the northern Izu-Bonin Arc

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The Izu-Bonin Arc is widely regarded to be a typical intra-oceanic arc, with the oceanic Pacific Plate subducting beneath the Philippine Sea Plate, an evolving complex of active and inactive arcs and back-arc basins. It is dominated by oceanic crust forming three large back-arc basins; Shikoku, Parece Vela, and West Philippine Basins, making the present Philippine Sea Plate look like an "oceanic" plate. However, all of these back-arc basins were formed after subduction at Izu-Bonin Arc had begun, at ~52 Ma (Ishizuka et al. 2011, EPSL). Little is known about the proto-Philippine Sea Plate, which existed along with the Pacific Plate at the time of subduction initiation and before the formation of back-arc basins.

To investigate the crustal structures of the proto-Philippine Sea Plate, we conducted manned-submersible SHINKAI6500 and Deep-Tow camera surveys during cruise YK10-04 of the R/V YOKOSUKA in April 2010 at the Daito Ridges. The Daito Ridges comprise the northwestern Philippine Sea Plate along with what are regarded as remnants of the proto-Philippine Sea Plate. Submersible observations and rock sampling revealed that the Daito Ridges expose deep crustal sections of gabbroic, granitic, and metamorphic rocks, along with volcanic rocks ranging from basalt to andesite. Jurassic to Cretaceous magmatic zircon U-Pb ages have been obtained from the plutonic rocks, and whole-rock geochemistry of the igneous rocks indicates arc origins. Furthermore, mafic schist collected from the Daito Ridge has experienced amphibolite facies metamorphism, with phase assemblages suggesting that the crust was thicker than 20 km at the time. These finds show that the Daito Ridges represent developed crustal sections of the Mesozoic arc that comprises part of the proto-Philippine Sea Plate, and, together with the tectonic reconstruction of the proto-Philippine Sea Plate (Deschamps and Lallemand 2002, JGR), they suggest that subduction of the Izu-Bonin Arc initiated at the continental margin of the Southeast Asia, possibly correlating with the Mesozoic island-arc and ophiolite complexes exposed in the southwest Pacific margins, such as those in the Philippine Islands. Only later did it acquire an "intra-oceanic"-like setting through the formation of the backarc basins.

Furthermore, detrital zircon ages from volcaniclastic sandstones collected from northern Izu-Bonin forearc, counterpart of the Daito Ridges, yield Mesozoic to Paleozoic ages, indicating that similar Mesozoic basement may even exist beneath the present Izu-Bonin Arc. To confirm this hypothesis, we have conducted a SHINKAI6500 survey on the landward slope of the northern Izu-Bonin Trench during cruise YK11-07 of the R/V YOKOSUKA in September 2011. The collected samples are dominantly andesite with two diorite samples, and preliminary zircon U-Pb dating of the diorite sample yielded Cretaceous (~100 Ma) magmatic age as well as abundant Paleozoic to Proterozoic detrital zircons. Preliminary whole-rock geochemistry of the andesite and diorite samples show clear arc-signatures, confirming that a preexisting basement composed of Mesozoic arc crust underlies at least part of the present northern Izu-Bonin Arc.

These new insights on the crustal structure of the proto-Philippine Sea Plate and the discovery of preexisting Mesozoic arc basement beneath the Izu-Bonin Arc raise serious doubts about the intra-oceanic nature of the Izu-Bonin Arc system. Previous petrologenetic and geochemical models, used to interpret the seismic crustal structures of the present Izu-Bonin Arc, have assumed oceanic crust as a preexisting basement, and on the basis of these new results such models now need to be reconsidered.

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Temporal variation of OIB-like magmatism in the Western Philippine Sea-link to spreading of the West Philippine Basin-

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We present new $^{40}Ar/^{39}Ar$ ages as well as geochemical data for samples recovered from oceanic plateaus in the West Philippine Basin (WPB) and Daito Ridge group in the Philippine Sea. This data defines the volcanic history of OIB-like magmatism in and around the WPB and enables a tectonic reconstruction of the early history of the Philippine Sea, which is crucial for understanding the subduction nucleation process along the Izu-Bonin-Mariana arc.

Benham Rise (south of the spreading centre), Urdaneta Plateau and Oki-Daito Rise (north of the spreading centre) are the oceanic plateaus in the WPB, distributed on both sides of the extinct spreading centre of the basin. The northern margin of the WPB is marked by Daito Ridge group, which is composed of Eocene-Mesozoic remnant arc structures. New drilling and dredge sampling recovered volcanics with OIB-like geochemical characteristics (an overall enrichment of incompatible elements and associated radiogenic isotopes) from the oceanic plateaus as well as volcanic edifices overlapping the remnant arc and neighboring ocean basin. In addition, basalts from the WPB are found to have variable enrichment relative to N-MORB.

The age range obtained from the OIB-like basalts from the Urdaneta Plateau (34.6 to 38.0Ma) agrees with that reported from the Benham Rise, which is located at similar distance from the extinct spreading centre. Meanwhile, older ages of around 40.5-44.39 Ma were obtained from basalts from the Oki-Daito Rise, north of Urdaneta Plateau. The obtained $^{40}Ar/^{39}Ar$ age range implies that the Urdaneta Plateau and Oki-Daito Rise represent age-progressive record of OIB-like magmatism in the northern half of the West Philippine Basin, and the source for the OIB-like magmatism existed near the spreading centre of the WPB at least between c. 35-45 Ma. Based on this assumption, half spreading rate of the WPB is estimated to be about 5.5 cm/y between 35.8 and 44.4 Ma.

The OIB-like magmatism is not restricted to the plateaus, but is also found on the WPB floor. This might indicate that besides the continuous supply of the enriched mantle providing the magmatism that formed the plateaus, enriched asthenospheric mantle was also present as either irregularly distributed regions beneath Philippine Sea, or was dispersed and mixed with the active spreading regime.

Distribution of OIB-like magmatism at c. 44-48 Ma, which is older than those found from the plateaus in the WPB, on pre-existing Daito Ridge group appears to indicate that this magmatism is not necessarily associated with spreading, but might have been caused either by upwelling of enriched mantle or regional extension which triggered decompression melting of enriched mantle. Variable enrichment observed for the WPB basalts implies that the upwelling enriched mantle (or melt derived from it) contaminated the ambient asthenospheric mantle in this region. Upwelling of this enriched mantle plume head might have triggered initiation of spreading of the WPB by uplifting and heating of overlying arc crust by the similar process proposed for continental breakup (e.g., Courtillot et al., 1999).

Keywords: West Philippine Sea, OIB, 40Ar/39Ar age, oceanic plateau

SCG10-10 Room:101B Time:May 22 16:45-17:00

Why we need drill deep into the oceanic arc crust?

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The continental crust, the most differentiated end-member of the components of solid Earth, is andesitic in overall composition (e.g. Rudnick & Gao, 2003). Thus, it is widely thought the continental crust has been created, or at least recycled, in subduction zones for the last ~3.5 Ga (eg. Taylor, 1967, Rudnick, 1995). However, how andesite is generated, the so-called 'andesite problem', has long been a central question of igneous petrology.

At first glance, intra-oceanic arcs do not appear to be the right place to study the production of andesitic magmas, because (1) modern magmatism at the intra-oceanic Izu-Bonin-Mariana (IBM) arc is bimodal, with basalt and rhyolite predominating (Tamura & Tatsumi, 2002); and (2) turbidites sampled during Ocean Drilling Program (ODP) Leg 126 in the Izu-Bonin arc, which range in age from 0.1 to 31 Ma, are similarly bimodal (Gill et al., 1994), suggesting that the bimodal volcanism has persisted throughout much of the arc's history. Moreover, such bimodal magmatism is not unique to the Izu-Bonin arc, with the 30-36.5 degrees S sector of the Kermadec arc, another example of an intra-oceanic arc, also exhibiting it (Smith et al., 2003; 2006; Wright et al., 2006). So why and how do we study the intra-oceanic arcs to solve the 'andesite problem'?

Closer inspection of the IBM arc remarkably reveals the presence of a significant volume of middle crust with seismic velocities of 6.0-6.8 km/s throughout the entire arc (Calvert et al., 2008; Kodaira et al., 2007a,b; Kodaira et al., 2008; Kodaira et al., 2010; Takahashi et al., 2007; Takahashi et al., 2008; Takahashi et al., 2009). This is remarkable because these velocities are characteristic of a wide range of intermediate-felsic plutonic/metamorphic rocks (Christensen & Mooney, 1995; Behn & Kelemen, 2003, Behn & Kelemen, 2006) and are similar to the mean velocity of andesitic continental crust, such material would not be expected to be present on the basis of the bimodal volcanism. Moreover, this crust is presently thickest beneath basaltic volcanoes and thinnest beneath rhyolitic volcanoes (Kodaira et al., 2007), which is another enigma.

One possible way to understand this phenomenon is to investigate arc crustal sections exposed on land in order to examine the relationship between volcanic and plutonic rocks and the generation of andesitic magmas, as exposed arc crustal sections typically include middle crust composed of diorite to tonalite to granodiorite (e.g. Kawate & Arima, 1998; Busby et al., 2006; DeBari & Greene, 2011). However, in the IBM arc, remnants of this old crust have never been found at the northern end of the arc, where it is colliding with the Honshu arc (Izu collision zone) (e.g. Tani et al., 2010; Tamura et al., 2010). Tamura et al. (2010) suggest that IBM arc middle crust in the collision zone was partially melted during the collision and then intruded into the overlying upper crust of the Honshu and IBM arcs. This resulted in the complete loss of chronological information, original mineralogy and possibly their original composition, and thus any information related to their original source. Similarly, any continental crust we observe on the surface of the Earth will have experienced deformation, metamorphism, and been otherwise processed, perhaps several times from its creation in subduction zones to the present day, thus overprinting, resulting in the loss of, key information that can provide clues to its genesis.

'Ultra-Deep Drilling into Arc Crust' is the best way to sample unprocessed juvenile continental-type crust in order to observe the active processes that produce the nuclei of new continental crust, and to examine the nature of juvenile continental crust being generated at intra-oceanic arcs.