Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SIT07-01 会場:A03 時間:5 月 25 日 09:00-09:15

Early stages of Philippine Sea Plate birth, growth and migration : a tribute to Anne Deschamps

Early stages of Philippine Sea Plate birth, growth and migration : a tribute to Anne Deschamps

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The early stages of the Philippine Sea Plate (PSP) are debated among the scientific community. At least one fourth of the PSP area has disappeared by subduction along the Ryukyu and Philippine trenches, obliterating the relics of its northern and western boundaries, and by subduction erosion along the estern Izu-Bonin-Mariana (IBM) margin. Furthermore, small parts might have also disappeared by intraplate local thrusting and/or subduction along the Gagua or Daito ridges. Another intriguing observation concerns the origin of the "proto-PSP" as seen in the Daito area, the southernmost West Philippine Basin, the Huatung Basin or even within the internal structure of the Izu-Bonin Arc. Indeed, Early Cretaceous ages have been discovered in most of these regions, i.e., much older than the commonly accepted ages of the PSP entrapment ranging from Early to Late Eocene . The so-called "forearc basalts" or "boninites" are often supposed to represent typical magmatism marking subduction initiation along a transform fault. A detailed examination of the geodynamic context of their emplacement allows to suggest another origin for these rocks. Even the kinematic evolution of the PSP does not make any consensus.

Based on the tremendous work that has been done by many teams since the 80's, providing key data inserting into the PSP puzzle, and including the important contribution of Anne Deschamps in the late 90's and early 20's, we can deliver an updated picture of the early stages of the PSP tectonic evolution.

キーワード: Philippine Sea Plate, tectonic evolution
Keywords: Philippine Sea Plate, tectonic evolution

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SIT07-02 会場:A03 時間:5 月 25 日 09:15-09:30

Rethinking spreading model of the northwestern West Philippine Basin (WPB): 39Ar/40Ar dating and geochemical constraints

Rethinking spreading model of the northwestern West Philippine Basin (WPB): 39Ar/40Ar dating and geochemical constraints

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We report 40Ar/39Ar dating results of basalts from the northwestern West Philippine Basin (around the Urdaneta Plateau area), with petrological/geochemical characteristics. Our samples are mostly from ROV KAIKO dives conducted in 2003.

Our dating results range from ~40 to ~32 Ma. These ages are younger than previously estimated seafloor ages based on studies for topography and magnetic anomaly lineations. In addition, geographical distribution of obtained ages appears to be incompatible with previous models. Therefore, if our dating results are correct, it requests rethinking about the spreading history of northwestern part of WPB.

Geochemical data revealed that basalts around the Urdaneta Plateau have OIB-like characteristics (as also reported in Ishizuka et al., 2013, Geology), confirming that plume activity involved in the spreading process of this part of basin.

SIT07-03 会場:A03 時間:5 月 25 日 09:30-09:45

Exhumation history of Taiwan and Mindoro orogenic belts and its implication to plate motion of the Philippine Sea plate

Exhumation history of Taiwan and Mindoro orogenic belts and its implication to plate motion of the Philippine Sea plate

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Both Taiwan and Mindoro orogenic belts form as the collision between the Eurasia continental margin and Luzon arc. We conduct the low temperature thermochronology analysis to reveal the exhumation history in both orogenic belts.

In northern Mindoro the Mesozoic green schist facies strata show the oldest zircon fission track reset ages of ca.4-6 Ma, which is consistent with the Pliocene Punso conglomerate deposition in southern Mindoro Island and therefore indicative of the beginning of collision at ca.5-6 Ma.

Meanwhile the zircon fission track ages also imply similar exhumation history in Taiwan orogenic belt. The oldest reset zircon fission track ages are also 5-6 Ma and are consistent with deposit ages of the foreland basin. In addition, the Philippine trench and Okinawa trough started to develop from ca. 5-6 Ma.

Our new data support the model of the Philippine Sea plate has changed its moving direction to NW around 5-6 Ma, which had been suggested by Hall (2002).

キーワード: Taiwan orogenic belt, Mindoro orogenic belt, Philippine Sea plate, exhumation histroy, Luzon arc
Keywords: Taiwan orogenic belt, Mindoro orogenic belt, Philippine Sea plate, exhumation histroy, Luzon arc

SIT07-04　　会場:A03　　時間:5月25日 09:45-10:00

Temporal constraints for the tectonic development of the Philippine ophiolite belts from new zircon U-Pb ages

Temporal constraints for the tectonic development of the Philippine ophiolite belts from new zircon U-Pb ages

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The tectonic framework of the Philippine Islands is important in understanding how the western Pacific margin developed along the Eurasian and the Pacific Plates since the Eocene.

The basement rocks of the Philippine Islands are characterized by the presence of ophiolitic complexes exposed among the islands. Yumul (2007, Island Arc) defined four belts in the Philippine ophiolites and proposed that they progressively become younger towards west, from Early ? Late Cretaceous at the easternmost belt to Eocene - Oligocene in the west. However, most of the ophiolitic complexes have been dated by radiolarians and foraminifera in the overlying sediments and lacked reliable radiometric ages from the igneous rocks.

To precisely determine the igneous ages of the Philippine ophiolites, we have conducted SHRIMP zircon U-Pb dating of the gabbroic and leucocratic rocks collected from the ophiolitic complexes in the Philippine Islands, including those from Luzon (Zambales, Isabela, and Lagonoy ophiolites), Masbate (Balud ophiolite), Tablas (Sibuyan ophiolite), Dinagat, and Cebu.

New zircon ages show that most of the ages obtained from the northern ophiolite belts are Eocene in age, from 52 Ma to 41 Ma. These ages coincide well with the opening of the West Philippine Basin (49 ? 33 Ma, Taylor and Goodliffe, 2004, GRL), which is a backarc basin formed behind the incipient Izu-Bonin-Mariana Arc. Furthermore, geochemical data available from the igneous rocks in the eastern ophiolite belts show backarc basin basalt-like geochemical affinities (e.g. Yumul, 2007), suggesting that these ophiolites are genetically associated with the West Philippine Basin.

On the contrary, southern ophiolites are significantly older, gabbroic and leucocratic rocks that are associated with the ophiolitic complex in Cebu and gabbroic rocks in Lagonoy and Dinagat ophiolites are Jurassic to Late Cretaceous (200 - 90 Ma) in age. Similar Mesozoic arc and ophiolitic rocks have recently discovered in the Daito Ridges, currently located north of the West Philippine Basin. Such Mesozoic terranes in the Philippine Sea Plate may potentially be correlated to the Mesozoic ophiolites in the southern Philippines, before the opening of West Philippine Basin in the Eocene.

SIT07-05　　会場:A03　　時間:5 月 25 日 10:00-10:30

約 50Ma 前後のフィリピン海テクトニクスに関する新たな制約
Geologic and geochronological constraints on the Philippines Sea tectonics around 50 Ma

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Exp. 351 scientific party[6]
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Recent geological and geophysical survey cruises as well as IODP drilling expeditions in the Philippine Sea are providing new geologic and geochronological information useful for tectonic reconstruction of the Philippine Sea plate. Especially, tectonic reconstruction around 50 - 55 Ma, i.e., the period immediately before and after the subduction initiation to form Izu-Bonin-Mariana (IBM) arc is of particular interest, because it is critical for understanding the possible tectonic processes to enable subduction initiation.

In this contribution, the following three sets of data recently published or obtained from this region will be introduced, and possible tectonic models which could consistently explain the new data will be discussed.

1) OIB-like magmatism in the Philippine Sea: $^{40}Ar/^{39}Ar$ ages from a 1000km NW-SE line of oceanic plateaus in and around the West Philippine Basin (WPB) demonstrates that they formed as a time-progressive volcanic chain mirrored either side of the WPB backarc spreading center (Ishizuka et al., 2013). In the north this chain is bounded by a Mesozoic remnant arc (i.e., Daito Ridge group). Geochemically these oceanic plateaus have an EM-2 ocean island basalt (OIB) signature matching the older 45-51 Ma volcanic edifices discovered overlapping the remnant arc and intervening basins. The wide distribution of these edifices could mark the first arrival of upwelling mantle. These features are consistent with the extension and splitting of the Mesozoic arc terrane, driven by regional upwelling centered on the impact of the mantle plume at c. 51 Ma.

2) YK10-14 and YK13-08 cruises by R/V Yokosuka investigated Palau Basin (southernmost part of the Philippine Sea plate) and southern part of WPB obtained some crucial geological and geophysical data (Sasaki et al., 2014) for reconstruction of the Philippine Sea Plate. $^{40}Ar/^{39}Ar$ dating of dolerite sample from the Palau Basin crust exposed at the Mindanao Fracture Zone gave a plateau age of 40.4 Ma. This result indicates that the spreading of the Palau Basin was still going on at 40.4 Ma. This age is within an age range of active spreading of the WPB (e.g., Okino and Fujioka, 2002). This strongly implies that contrary to the previous hypotheses, the Palau Basin formed while the WPB was still opening, and the Palau Basin is not the oldest part of the WPB.

3) IODP Exp.351, targeted evidence for the earliest evolution of the Izu-Bonin-Mariana arc following inception, was conducted in Amami Sankaku Basin (ASB), west of the Kyushu-Palau Ridge (KPR), i.e., paleo-IBM arc. Igneous basement of this site, which presumably corresponds to the basement of the IBM arc, was successfully recovered. On-board preliminary data suggests that basaltic basement is early-middle Eocene (or older) and geochemically similar to forearc basalts from IBM forearc. This implies that the area of initial seafloor spreading associated with subduction initiation covers an area from forearc to reararc of future IBM arc.

キーワード: フィリピン海プレート, 伊豆小笠原マリアナ弧, 海洋島玄武岩, 西フィリピン海盆
Keywords: Philippines Sea plate, Izu-Bonin-Mariana arc, OIB, West Philippine Basin

SIT07-06 会場:A03 時間:5 月 25 日 10:30-10:45

Upper-mantle shear-wave structure under Asia from Automated Multimode Inversion of waveforms

Upper-mantle shear-wave structure under Asia from Automated Multimode Inversion of waveforms

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An automated multimode inversion technique of partial waveform was applied to available data of broadband stations in Asia and surrounding regions.

It performs a fitting of the complete waveform starting from the S-wave onset to the surface wave. Assuming the location and focal mechanism of a considered earthquake as known, the first basic step is to consider each available seismogram separately and to find the velocity perturbations that can explain the filtered seismogram

best. In a second step, each velocity perturbations serves as a linear constraint in an inversion for a 3D S-wave velocity model of the upper mantle.

We collected data for the years from 1977 to 2012 from all permanent stations as well as temporary experiments for which data were available.

In this way, a huge data set of about 12 million seismograms came about from which about 2.3 million seismograms provide 8 million linear constrains for the resulting 3D model.

The frequency content of the data associated with the sensitivity kernels as well as the path density in the considered region allows us to perform a high resolution tomography at a continental scale.

The resulting models exhibit an overwhelming detail in relation to the size of the region considered in the inversion. They are to our knowledge the most detailed models of shear wave velocity currently available for Asia and surroundings. Most prominent features are a details on the morpholoogy of the Tibetan Plateau and its extent at depth that are properly mapped.

The vertical extent of its lithosphere as well as other cratonic lithosphere could be imaged at depths greater than 200 km. Orogenic volcanism is almost exclusively found in regions of shallow asthenosphere and in areas where the depth of the LAB changes significantly, along the passive margins.

キーワード: Tomography, Asia, Surface-waves
Keywords: Tomography, Asia, Surface-waves

SIT07-07 会場:A03 時間:5 月 25 日 11:00-11:30

Subducted-slab constraints on late Cenozoic motion of the Philippine Sea plate and its collision with continental Asia

Subducted-slab constraints on late Cenozoic motion of the Philippine Sea plate and its collision with continental Asia

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The geology of the Eurasian margin near Taiwan and Japan contains a record of Philippine Sea plate tectonics from the Miocene to present-day. We present a detailed reconstruction of late Cenozoic Philippine Sea plate motions, for which we emphasize the implications for the geology of Taiwan, Japan, and East China Sea. The new Philippine Sea plate reconstruction is based on 3D mapping and unfolding of subducted slabs from seismic tomography of East Asia.

Using mapped slab constraints, we show that:

[1] The Pacific subduction zone near the Marianas and southern Izu-Bonin has remained +/– 250 km near its present-day position since at least ~45 Ma, which provides an eastern limit to the Philippine Sea plate.

[2] A major 8000 km x 2500 km ocean once existed in the area now occupied by the Philippine Sea plate and is imaged as a set of flat slabs in the upper part of the lower Mantle. This now-vanished ocean, which we call the *East Asian Sea* stretched from present-day Taiwan and the Ryukyus to a southern limit near northern Australia and New Zealand.

[3] The subducted Philippine Sea plate near the Ryukyus has a maximum ~1000 km NS length and a western NS edge of ~1600km. Therefore the northern edge of the Philippine Sea plate was far from continental Asia in early and middle Cenozoic when it was near the Equator, based on paleomagnetism.

[4] The Eurasian slab has a NS edge of ~3000km against which the northern Philippine Sea plate fit prior to initiation of the Manila trench subduction, providing a western limit to the Philippine Sea plate.

[5] These slab constraints severely limit the longitudinal position of the Philippine Sea plate and rule out models involving large late Cenozoic rotations. Geologic constraints near the continental Asian margin and paleomagnetism help fix the latitudinal position of the Philippine Sea plate.

Our slab-constrained plate tectonic model implies that from the Eocene to Miocene, the *East Asian Sea* progressively subducted southwards, overrun by a northward moving Philippine Sea plate that originated as part of the Indo-Australian Ocean. In middle Miocene, the arc that formed at the pre-subduction northern margin of the Philippine Sea plate collided with the Ryukyu and SW Japanese continental margin, with deformation penetrating deeply into the East China Sea. Erosion of the collisional mountain belt fed turbidite fans that extended ~1000km south onto the Shikoku basin of the Philippine Sea plate. This arc-continent collision was followed by subduction of Philippine Sea lithosphere under Eurasia and opening of the Okinawa trough backarc basin. Between 1-2 Ma the Philippine Sea plate motions changed from NNW to its present-day Pacific-like WNW motions, based on the limited ~450 km extent of the Eurasian/South China Sea slab near Taiwan.

キーワード: Philippine Sea plate, arc-continent collision, Shikoku basin turbidites, Taiwan tectonics, southwest Japan tectonics, East China Sea tectonics
Keywords: Philippine Sea plate, arc-continent collision, Shikoku basin turbidites, Taiwan tectonics, southwest Japan tectonics, East China Sea tectonics

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SIT07-08 会場:A03 時間:5 月 25 日 11:30-11:45

付加 vs 造構性浸食?新生代西南日本縁辺
Accretion vs. tectonic erosion in Cenozoic margin of southwest Japan

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Accretionary and erosive margins provide tectonic end-members within our understanding of the subduction zone setting, and how these tectonic processes might be recorded and recognizable in ancient subduction complexes remains a challenging issue. Tectonic erosion includes sediment subduction and basal erosion along the plate boundary megathrust which drags down the crust of the upper plate into the mantle. This process means that the ”evidence” for such erosion is commonly based on lost geological tectono-stratigraphic data, i.e. gaps in the record, and must be speculated from indirect phenomena such as subsidence of the forearc slopes. A topographically rough surface to the subducting oceanic plate, such as that provided by seamounts, has been suggested to work like an erosive saw carving into the upper plate. Another mechanism of basal erosion has been suggested to be hydrofracturing of upper plate materials due to dehydration-induced fluid pressures, resulting in entrainment of upper plate materials into the basal decollement. Considering the interaction between the ˜30 km thick crust of the upper plate and subducting oceanic plate, a subduction dip angle of ˜15 ^{0} , and convergent rate of ˜10 cm/year, at least ˜1 Ma of continuous basal erosion is necessary to induce clear subsidence of the forearc because the width of plate interface between the upper crustal and subducting plates is about 115 km (30/cos15 ^{0}). In several examples of subduction zones, for example the Japan Trench and the Middle America Trench off Costa Rica, the subsidence of a few thousand metres of the forearc, combined with a lack of accretionary prism over a period of several million years, suggest that the erosive condition needs to be maintained for several to tens of million years (e.g. von Huene & Lallemand 1990) .

Such an age gap in the ancient accretionary complex would be one of the signals for tectonic erosion in the past. Recently, a hypothesis that a tremendous amount of tectonic erosion has taken place during Early Cretaceous and middle to late Miocene time has proposed based on age gaps in the accretionary complex. Such age gaps in the accretionary complex, however, do not automatically imply that tectonic erosion has taken place, as other interpretations such as no accretion, cessation of subduction, and/or later tectonic modification, are also possible. In the case of the middle to late Miocene period, for example, a drastic tectonic change after the opening of the Japan Sea and clockwise rotation of southwest Japan may be linked to ridge subduction or a switch in subduction from the Pacific to Philippine Sea Plate. Recent drilling in the forearc of the Nankai Trough suggests that the accretion was renewed at ˜6 Ma after igneous activity intruding the early Miocene accretionary prism. Kimura et al. (2014) interpreted that the subduction ceased between ˜12 Ma to ˜8 Ma due to the transference of subduction from the Pacific Plate to the Philippine Sea Plate, as opposed to the ”continuous subduction with subduction erosion” viewpoint. These different scenarios need to be tested in the future.

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SIT07-09 会場:A03 時間:5 月 25 日 11:45-12:00

ダイナミックに発達する南海トラフ付加体
Dynamic evolution of accretionary prism in the Nankai Trough

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To evaluate evolution of accretionary prism as well as forearc basin, we analyzed seismic reflection data acquired in the Nankai Trough. On the seismic profiles, the volcanic layer can be identified as strong reflection at the surface of accretionary prism beneath landward edge of the Kumano forearc basin. The accretionary prism beneath the strong reflection was constructed before the deposition of volcanic layer (14-15Ma). The undeformed basin sediment above the volcanic layer indicates that the old accretionary prism has not been much deformed after construction of the forearc basin. The accretionary prism trench-ward of the old prism was constructed at ~6Ma. The age gap of accretionary prism indicates that plate subduction (or accretion process) was halted from 15Ma to 6Ma. Because the trench-ward younger accretionary prism is much deformed, the undeformed older accretionary prism beneath the volcanic layer could work as backstop. We further find a continuous ridge system beneath the Kumano forearc basin sediment and interpret that it was generated by activities of previous splay fault. The previous splay fault develops parallel to the backstop interface as well as the coastline of the Kii peninsula. These observations demonstrate that the evolution of accretion prism including backstop interface is not stable process, but it is strongly influenced by the plate convergence rate and direction.

キーワード: 地震探査データ解析, 付加体, 南海トラフ, ダイナミックな変動, バックストップ
Keywords: seismic data, accretionary prism, nankai trough, dynamic evolution, backstop

SIT07-10 会場:A03 時間:5 月 25 日 12:00-12:15

西南日本の 15Ma 以降の火成活動史とテクトニクスに関する新たな制約：四国海盆の IODP EXP.322 の結果から
New constraints on the volcanic and tectonic evolution of SW Japan since 15 Ma from IODP EXP. 322 in the Shikoku Basin

中嶋 健 [1*] ; 檀原 徹 [2] ; 山下 透 [2] ; 岩野 英樹 [2] ; 小田 啓邦 [1] ; 金松 敏也 [3] ; Zhao Xixi[4]
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中期中新世以降の西南日本とフィリピン海プレートのテクトニックモデルと火成活動の起源については、「プレート三重点固定仮説」と「プレート三重点移動仮説」との間で論争が続いている（Kimura et al., 2014)。本研究は、IODP NanTroSEIZE 地震発生帯掘削の第 322 次航海により四国海盆で行われた二つの掘削坑の凝灰岩と砂岩の挟在、鉱物組成及びフィッション・トラック年代測定の結果から 15 Ma 以降の西南日本の火成活動史とテクトニクスに新たな制約を与えることを目的とする。掘削地点では、15-14.5 Ma に様々な鉱物組成の多量の凝灰岩が堆積したが、フィリピン海プレートの急速な沈み込みに起因した可能性がある。14.5-10.5 Ma には凝灰岩の堆積が減少する一方、 12 Ma 頃までは四国海盆には広大な海底扇状地砂岩が堆積した。砂岩の鉱物組成と砕屑性ジルコンのフィッション・トラック年代測定の結果は、砂岩の起源が熊野酸性岩とその他の西南日本であることを示唆した。10.5-8 Ma には凝灰岩とタービダイトの堆積が停止し、半遠洋性堆積物の堆積速度が減少したことから、西南日本の火成活動とテクトニクスが静穏であったことを示唆する。8-7 Ma には伊豆弧起源とみられる安山岩質~ 玄武岩質の凝灰岩・スコリアが増加し、チャネル状の火山砕屑性砂岩とシート状の凝灰質砂岩が堆積した。 7-5.5 Ma に再び火成活動が静穏化した後、5.5 Ma から凝灰岩の挟在は増加した。本研究の結果は、「プレート三重点移動仮説」とは不調和で、むしろ「プレート三重点固定仮説」を支持する。すなわち若い四国海盆の急速な沈み込みにより中期中新世の西南日本外弧の火成活動が生じたとともに、伊豆弧が中部日本に 15 Ma 頃までには衝突を開始したとする説である。また本研究は 10.5-6 Ma の間はフィリピン海プレートが沈み込みを停止し、その後沈み込みが再開したことを示唆する。

キーワード: 西南日本, フィリピン海プレート, テクトニクス, 火成活動, IODP
Keywords: SW Japan, Philippine Sea Plate, tectonics, volcanism, IODP

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(May 24th - 28th at Makuhari, Chiba, Japan)

SIT07-11 会場:A03 時間:5 月 25 日 12:15-12:30

西太平洋における現在と過去の収束境界のテクトニクスの比較：潜水科学の総括
Present day comparison to the past convergent margin tectonics in Western Pacific by submersible dives

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Although some people believe that catastrophism overcomes uniformitarianism in the geological history, yet the concept of The present is a key to the past is adoptable and adaptable to the general understanding in a generic space and time dimension. As for the convergent margin geology and tectonics, the present is observable mostly under the sea by coring and submersible research, while the past is on land. Through various expeditions to the Japanese trenches, including Japan trench, Boso triple junction area, Sagami trough and Nankai trough in addition to some Izu-Bonin-Mariana trenches (Ogawa et al. (eds.) 2011 Springer Solid Earth Series 8), we conclude the best way of classifying these types of margins is into three categories: 1) erosion and collapsing, 2) partial accretion, and 3) full accretion. The Japan trench is known as a typical erosional type although a small scale accretionary prism has developed in its toe, partly during the 2011 Tohoku earthquake (Kodaira et al., 2012). However, this prism may be a temporary feature that will be recycled by large scale erosion and collapse associated with huge scale landsliding (Kawamura et al., 2012; Strasser et al., 2013). The landward side of the Sanriku Escarpment is largely underlain by Miocene diatomaceous, calcite-cemented breccias that show tectonic erosion and collapse has occurred during the past 10 Myrs (Ogawa, 2011). The Boso TTT triple junction is another example of a large collapsed margin, in which under the thin cover of Pleistocene are recycled Miocene diatomaceous sediments of 15 Ma that can be mapped from the Bonin (Ogasawara) trench to the south, north to Boso on land (Ogawa and Yanagisawa, 2011). Most of the on land Miocene to Pleistocene accretionary prisms in Miura-Boso peninsular areas (Emi, Miura and Chikura prisms) are the result of accretion from the Izu forearc side to Honshu, and the trench sedimentation and accretion style is well correlatable to the present Nankai trough section (Kobayashi, 2002). Thick trench fills form fold-and-thrust belts in which methane-supported chemosynthetic bio-communities with calcareous concretions are developed on the splay faults between the forearc basin with many debris flows and mud diapirs. The structural styles in the present Nankai prism documented by the *Shinkai 6500* JAMSTEC expeditions (Kawamura et al., 2009, 2011; Anma et al., 2011 and others) are almost equivalent to the on land observations in the Miura-Boso areas as many duplexes, thrust faults, and isoclinal folds, commonly with layer parallel faults (Hanamura and Ogawa, 1993; Yamamoto et al., 2005; Michiguchi and Ogawa, 2009, 2011; Muraoka and Ogawa, 2011). Only the Pliocene to Pleistocene Chikura prism was developed from fully ponded trench fill sediments, which are equivalent to the present Sagami Bay of the northern Sagami trough (Ogawa et al., 1989). The type of margin, the erosional to collapsed type margin (Japan trench, Boso triple junction), a stepwise sector development of prism (Nankai prism), or a ponded trench fill prism (Sagami Bay) might be due to the type of trench-fill sediments; without, or partly filled, or fully sedimented.

(References) Anma et al. 2011 Springer Solid Earth 8, 169-196; Kawamura et al. 2009 GSAB 121, 1629-1646 doi: 10.1130/B26219.1; Kawamura et al., 2012 GRL 39, L05308, doi:10.1029/2011GL050661, 2014, Marine Geology 356, 44?49; Kobayashi, 2002 Marine Geology 187, 3-30; Kodaira et al., 2011 Nature Geosci. doi: 10.1038; Hanamura & Ogawa 1993 Island Arc 3, 126-141; Michiguchi & Ogawa 2009; GSASP480 249?262, oi:10.1130/2011.2480(12); 2011 Springer Solid Earth 8, 229-246; Muraoka & Ogawa, 2011GSASP 480, 233?247, doi:10.1130/2011.2480(11); Ogawa, 1989 Tectonophysics 160, 135-150; Ogawa, 2011 Springer Solid Earth 8, 39-52,; Ogawa & Yanagisawa 2011 Springer Solid Earth 8, 53-73; Strasser et al. 2013 Geology 41, 935?938 doi:10.1130/G34477.1; Yamamoto et al. 2005 Tectonics, 24, TC5008, doi:10.1029/2005TC001823.

Keywords: subduction zone, accretionary prism, erosional margin, collapse, submersible

Japan Geoscience Union Meeting 2015
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SIT07-12 会場:A03 時間:5 月 25 日 14:15-14:30

Where have all the slabs gone in the Northwestern Pacific subduction zones?
Where have all the slabs gone in the Northwestern Pacific subduction zones?

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Based on the new high-resolution seismic image of the mantle beneath the northwestern Pacific subduction zones (Obayashi et al., 2015, in preparation), we discuss the fate of subducted Pacific slabs in the region, as well as their possible relation with the opening of Japan Sea and the widespread off-arc Cenozoic volcanism in Northeast China.

It is well known that the slab subducting from the Japan Trench (Honshu slab) is stagnant in the mantle transition zone. The stagnant slab extends to the west and reaches to northeast China where several late Cenozoic volcanoes exist. These volcanoes are located far from the volcanic front of the Honshu slab subduction and some study proposed the relation between the off-arc volcanoes and the stagnant Honshu slab. The active magmatism started about 25Ma and followed by opening of the Japan Sea back-arc basin that separated Japan away from Eurasia continent. It is suggested that the both surface phenomena were caused by upwelling asthenosphere from petrological viewpoint.

The new tomographic P-wave velocity model with focus on the northwestern Pacific is obtained by combing P data from NECESSArray with global data. Differential travel times between any two stations as a function of frequency are inverted by taking finite frequency effect into account to improve resolution through the upper mantle. The result indicates, to our surprise, the absence of long-tailed stagnant Honshu slab in the mantle transition zone beneath NE China, which was earlier interpreted by Tang et al. (2014, Nature Geoscience) as a gap of the stagnant slab for a deep upwelling in the region that may feed the Changbaishan volcanism. With a help of geodynamic modeling (Honda, 2014, G-cubed), we hope to revisit this issue, as well as the geodynamics of the Northwestern Pacific subduction zones to understand where all the slabs have gone.

キーワード: スラブ, 日本海
Keywords: slab, Japan sea

SIT07-13 会場:A03 時間:5 月 25 日 14:30-14:45

Plate tectonic reconstruction of the northwest Pacific stagnant flat slabs under Japan, Korea and NE China

Plate tectonic reconstruction of the northwest Pacific stagnant flat slabs under Japan, Korea and NE China

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An extensive swath of stagnant flat slab tomographic anomalies have been documented within the 410 to 660 km mantle transition zone under Japan, Korea and NE China, downdip of the northwest Pacific trench Benoiff zones (e.g. Fukao et al., 1992; Zhao et al., 2015). In this study we mapped these slab anomalies in 3D from MITP08 global seismic tomography (Li et al., 2008) and used these slabs to constrain a new regional NW Pacific plate tectonic reconstruction in the Cenozoic.

Our mapped slabs included the Izu-Bonin, Kuril, and Kamchatka slabs, their associated stagnant flat slabs, and other regional slabs. The mapped slabs were then unfolded (i.e. structurally restored) to a spherical Earth surface to assess their pre-subduction geometries. The unfolded slab constraints were input into plate tectonic reconstructions using Gplates software.

When unfolded the western Pacific stagnant slabs have a minimum 2000 km east-west length. The mapped northern stagnant slab edge near the western Aleutians and the southern edge at the southernmost Izu-Bonin trench are roughly east-west and consistent with transform directions predicted by mean Pacific motions since 47.5 Ma.

Using the slab constraints in a quantitative plate reconstruction, we show it is unlikely the stagnant slabs were subducted by simple eastward retreat of Eurasia in the Cenozoic relative to a mantle reference. Instead, we show that the stagnant slabs were formed by ~3500 km of Eocene to present-day fast western Pacific subduction at the eastern margin of a slow-moving Eurasia. After subduction, the Pacific slabs advanced westward >2000 km under NE Asia within the mantle, pushed westward along the mantle transition zone by the fast Pacific subduction. We discuss the fit of this plate reconstruction against the timings of Japan Sea, Kuril Basin and Okhotsk Sea opening and NE China intraplate volcanism. We show possible reasons why the stagnant flat slabs did not penetrate the lower mantle. Today the western Pacific stagnant flat slabs form a barrier that has prevented other NE Asia slabs from penetrating the lower mantle.

キーワード: western Pacific, plate tectonic reconstruction, stagnant slab, Izu-Bonin, Kuril-Kamchatka, seismic tomography
Keywords: western Pacific, plate tectonic reconstruction, stagnant slab, Izu-Bonin, Kuril-Kamchatka, seismic tomography

Japan Geoscience Union Meeting 2015
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SIT07-14 会場:A03 時間:5 月 25 日 14:45-15:00

日本周辺の沈み込み帯のトモグラフィー、地質発展史、数値モデルの結合
Combining tomographic results, geologic history and geodynamic modeling in the subduction zones around Japanese Islands

本多 了 [1*]
HONDA, Satoru[1*]

[1] 本多　了
[1]Satoru Honda

In this presentation, I show the slab feature estimated from the seismic tomography result combined with the recent estimate of d(ln Vp)/dT [Karato, 2008] and the upper limit of potential temperature estimated from the deep earthquakes and the theoretical modeling of the subducting slab [Emmerson and McKenzie, 2007]. Obtained results show a significant gap and/or the diluted slab in the topmost lower mantle just below the stagnated slab in the transition zone, that is consistent with the previous view of the flushing or avalanche of the mantle flow caused by the interaction between the mantle convection and the endothermic phase transition at the 660 km depth. However, such intermittent flow may not occur, if the strongly temperature-dependent viscosity is taken into account. It is also known that the slab morphology, especially, the stagnation of slab, is controlled by the movement of surface plate. Thus, to understand the slab morphology in the subduction zone around the Japanese Islands, I construct a simple 2D model of subduction zone which takes into account the geologic factors such as the opening of the Japan Sea. I find two possibilities of the cause of the existence of such gap and diluted slab: the opening of the Japan Sea and the subduction of old ridge.
Keywords: subduction zone, seismic tomograohy, geologic history, geodunamic modeling, Japanes Islands

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SIT07-P01 会場:コンベンションホール 時間:5 月 25 日 18:15-19:30

フィリピン海の発達史：大陸棚調査で得られた磁気異常データからの考察
Tectonic evolution of the Philippine Sea: Magnetic data collected during the Japanese continental shelf survey

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Marine magnetic anomalies have been used to date the seafloor, characterize the oceanic crust and reconstruct the evolution process of ocean basins. Japanese continental shelf survey project has collected high-quality, dense magnetic data in the Philippine Sea and the adjacent areas for two decades. The compiled and processed magnetic anomaly data improve our understanding of the tectonic history of the area. Clear magnetic lineation patterns in the Shikoku, Parece Vela basins allow us to elaborate the spreading history of these basins, including the initiation and cessation process of the backarc opening. The anomalies associated with the Kyushu-Palau Ridge also record the transitional phase from arc volcanism to backarc rifting-opening. The West Philippine Basin, Daito Ridges and its intervening small basins, that was formed before the formation of the paleo-IBM arc, show their specific magnetic characteristics. These areas are considered to have moved northward and rotated after their formation. The skewness analysis of magnetic data can provide us some insights about paleo-latitude and/or rotation.

キーワード: テクトニクス, フィリピン海, 地磁気異常, 背弧海盆, 島弧
Keywords: tectonics, Philippine Sea, magnetic anomaly, backarc basin, arc

SIT07-P02 会場:コンベンションホール 時間:5月25日 18:15-19:30

台湾緑島に産するマントルかんらん岩捕獲岩の岩石学的特徴
Petrography of mantle xenoliths from Lyudao, in the Luzon arc, Taiwan

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台湾南東部の緑島は，ルソン弧の北端に位置し，主に安山岩質火山岩，火山砕屑岩からなる火山島である．この緑島およびその南位置する蘭嶼からは安山岩中にかんらん岩捕獲岩が産出することが知られている (Chen, 1988 Acta Geol. Taiwanica)．同じくルソン孤からは，バタン島（Arai and Kida，2000 Island Arc; Arai et al., 2004 J. Petrol.），ピナツボ火山（Kawamoto et al., 2013 PNAS），シアヤン島（飯塚義之氏未公表データ）からかんらん岩捕獲岩が産出する．同じ火山孤から複数の地点でかんらん岩捕獲岩が採取されているということは，沈み込み帯におけるマントルウエッジのかんらん岩の一般的・地域別の特徴とその理由を検討することが可能であり，特に北端に位置する緑島は重要である．しかし，緑島のかんらん岩捕獲岩は，Chen (1988) で報告されて以降，詳細な報告がなされていない．そこで，本研究では，台湾緑島に産するかんらん岩捕獲岩の岩石学的特徴を明らかにすることを目的とする．

緑島に産するかんらん岩捕獲岩は，大半がハルツバーガイトであり，かんらん石ウェブステライトも見られる．ハルツバーガイトにおいて，細粒の部分と粗粒の部分が共存しており，それらの構成鉱物の量比は同一である．細粒の部分は鉱物粒径が 1mm 未満で，粗粒の部分は数 mm である．このように，細粒の部分と粗粒の部分が共存し，それらの構成鉱物の量比が同一である点は，バタン島に産するマントルかんらん岩捕獲岩と類似している (Arai et al. 1996)．母岩とかんらん岩捕獲岩の境界部には角閃石が見られる．粗粒な部分のかんらん石の Fo 値 [=100Mg/(Mg+Fe^{2+}) 原子比] は 91-92 である．斜方輝石の Al_2O_3 含有量は 2.4-3.5wt%で，Mg# [=Mg/(Mg+Fe^{2+}) 原子比] は 0.90-0.92 である．単斜輝石の Al_2O_3 含有量は 1.7-4.3wt%，Cr_2O_3 の含有量は約 1wt%, Mg#は 0.90-0.94 であり，TiO_2 および Na_2O の含有量は非常に少なく 0-0.2wt%である．スピネルの Fe^{3+}/(Cr+Al+Fe^{3+}) はおおむね低い値を示し 0.2 未満であり，Cr# [=Cr/(Cr+Al) 原子比] は 0.4-0.6，TiO_2 含有量は 0-0.1wt%である．

キーワード: 捕獲岩, マントル, かんらん岩, ルソン弧, 台湾, 緑島
Keywords: xenolith, mantle, peridotite, Luzon arc, Taiwan, Lyudao

SIT07-P03 会場:コンベンションホール 時間:5 月 25 日 18:15-19:30

Deformation history of the Chimei Fault, eastern Taiwan: Insights from paleostress and fold analysis

Deformation history of the Chimei Fault, eastern Taiwan: Insights from paleostress and fold analysis

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The Chimei Fault, the only fault cutting across the Coastal Range in eastern Taiwan, is the boundary fault that thrusts the forearc basement (Tuluanshan Formation) over the forearc sedimentary rocks (Paliwan Formation). Although previously deemed to be a reverse fault with strike-slip component, paleostress pattern along the Chimei Fault zone has not yet been established. In order to reconstruct the deformation history of the fault, this study carries out paleostress and fold analysis along a well-exposed outcrop in the central part of the Coastal Range.

The Chimei Fault zone is composed of 100 and 500-m wide damage zones in the hanging wall and the footwall, with several sets of subsidiary faults developed intensely. Based on crosscutting relationship, the fault-slip data could be divided into three stages. The earliest stage is characterized by the left-lateral fault slickensides that crosscut mineral veins related to heat flow activity in the Tuluanshan Fm. In the footwall, a 100 m-wide fold zone, including boudins and mud-filled veins, indicates deformation of buried unconsolidated sedimentary rocks during the second stage. The third stage is characterized by brittle subsidiary faults. The predated folds and postdated brittle faults indicate that the deformation depth of fault rocks decreased during faulting. In addition, both folds and faults show N-S compression, suggesting that two structural processes record the same paleostress status.

The three-stage evolution could be comparable to previous reconstruction from paleomagnetic analysis: (1) The initial left-lateral component is consistent with island-arc movement since late Miocene; (2) Folding and faulting of the footwall then illustrate the N-S forearc closure since late Pliocene.

キーワード: fault damage zone, paleostress analysis, fold analysis, reverse fault
Keywords: fault damage zone, paleostress analysis, fold analysis, reverse fault