IRIS Subduction Zone Observatory: white paper (2016)
https://www.iris.edu/hq/workshops/2016/09/szo_16

Izu-Ogasawara (Bonin) Arc as integrated Subduction Zone Observatory

- Is there aseismic subduction zone after all? -

Hitoshi Kawakatsu (Earthquake Research Institute, The University of Tokyo)
Douglas Wiens (Washington University in St Louis)

We propose to organize an integrated observational science program focusing on the Izu-Ogasawara (Bonin) arc as a subduction zone observatory. One of the fundamental scientific questions with social interest raised after the 2011 Tohoku earthquake is whether there are any "***aseismic*** subduction zones" as advocated by the conventional "comparative subductology" view (e.g., Uyeda & Kanamori, 1978). In order to understand subduction zone megathrust seismogenesis, it is necessary to understand why some megathrusts seemly show no large subduction zone earthquakes. Does the entire shallow thrust zone move by aseismic creep? Does some of the motion take place as slow slip events, perhaps accompanied by tremor and very low frequency earthquakes?

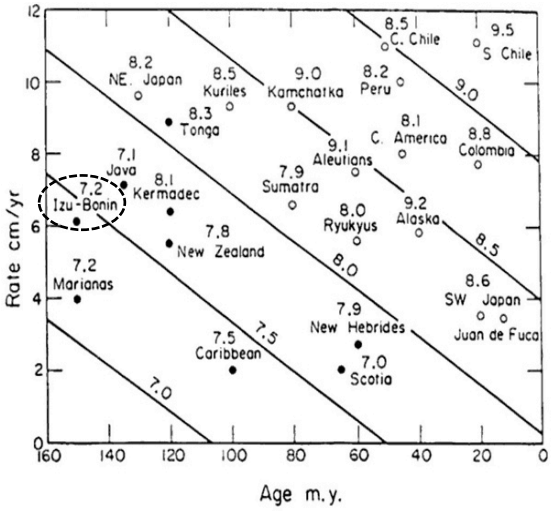
The IO-arc is considered the type example of an "aseismic" subduction zone, and is also located in a highly accessible area (geographically/politically) from Japan suitable for sea-floor observations (geodesy, OBS, OBEM, etc.). It also poses a threat for those who live around the arc for possible tsunami disasters due to potential megathrust earthquakes that might be expected if it is a ***seismic*** arc instead. With help of the recent advances of the seafloor geodesy technology, we should be able to solve this problem within a concentrated 10 year research program. A combination of seafloor geodesy and broadband OBSs will clarify the mode of slip and possible presence of tremor and slow earthquakes, Further, the IO-arc offers a variety of interesting scientific objectives, e.g., a newly formed volcanic island (Nishino-shima), an active volcanic arc, forearc serpentine diapirs, and other targets for detailed active source seismic (FWI) and EM (CSEM) imaging; also the entire arc itself offers a perfect seismological/geodynamical target for detailed investigations (e.g., origin of mantle wedge/sub-slab anisotropy, volatile cycling, deep seismicity, effects of changing subduction dip and double subduction, etc.). The IO-arc is a perfect target for SZO, as it offers a wide variety of scientific themes, not limited to the arc magmatism (e.g., Kodaira et al., 2010).

We welcome any interested parties to participate this exciting scientific endeavor, possibly expanding the target area with inclusion of the Mariana arc, etc.

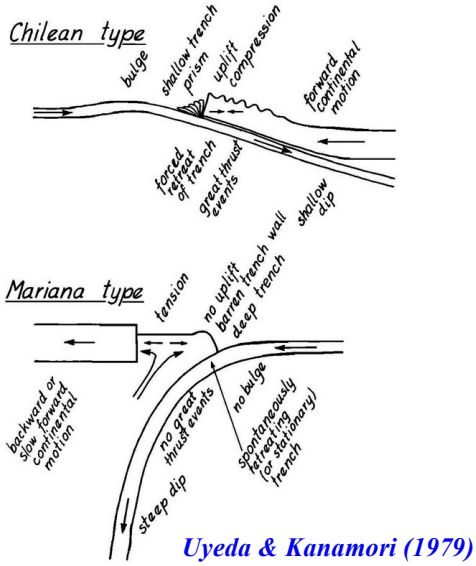
List of themes and figures:

(1) ***Is there any aseismic subduction zone?***

We attempt to "solve" this question via sea-floor geodesy (e.g., Yokota et al, 2016, Nature).

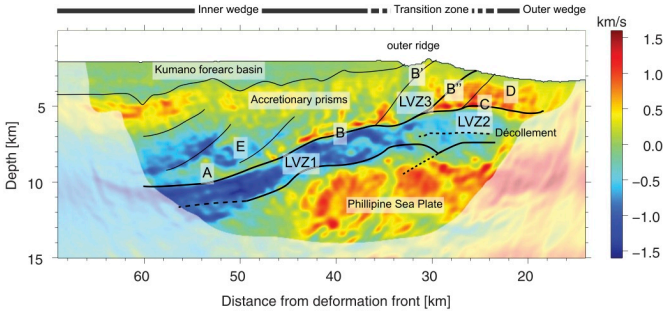


Ruff & Kanamori (1980)

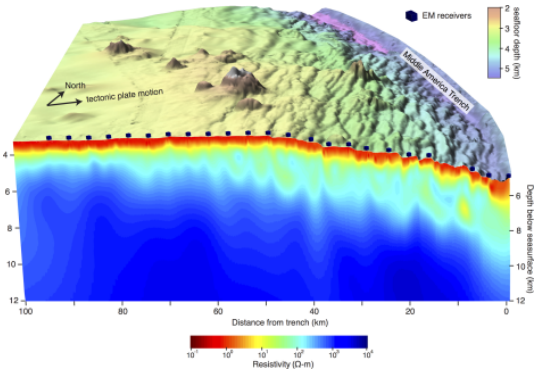


Uyeda & Kanamori (1979)

(2) ***High resolution imaging of fore-arc and volcanoes***

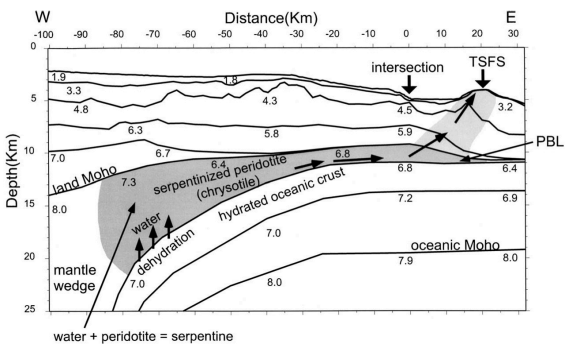


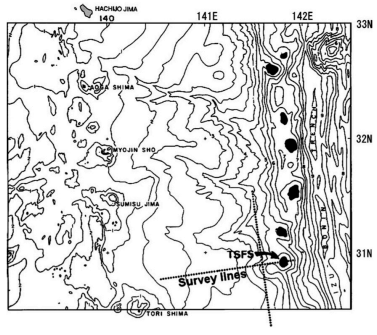
FWI by Kamei et al. (2013)



CSEM by Naif et al. (2015)

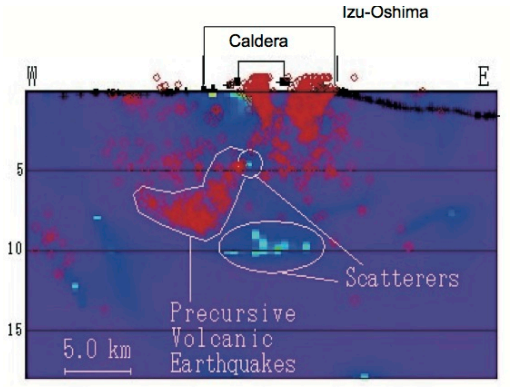
i) Serpentine diapirs





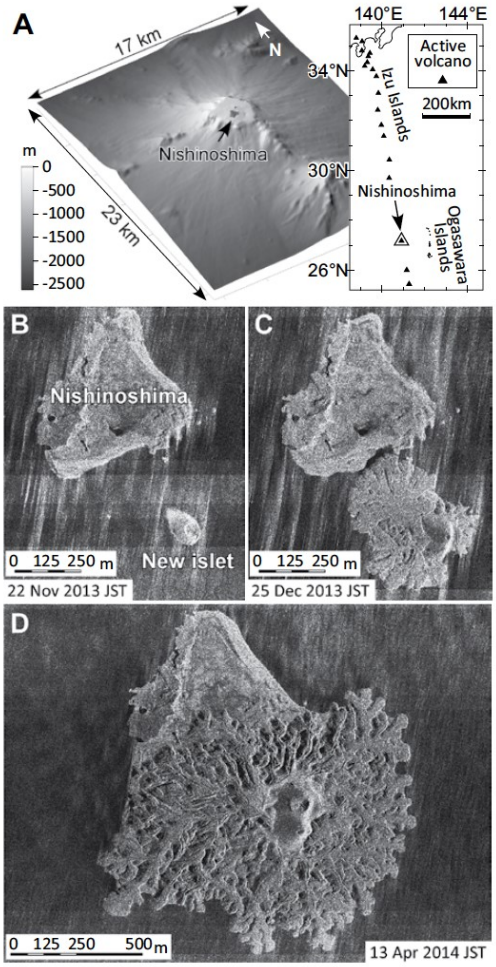
Kamimura et al. (2002)

ii) Izu-Oshima volcano magma chamber



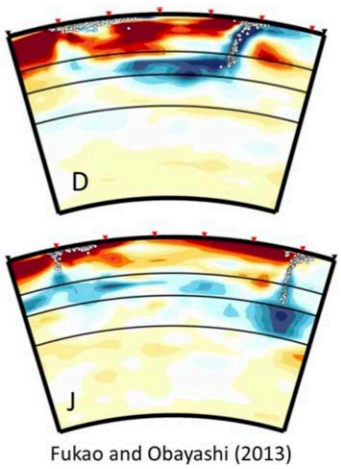
Mikada et al. (1997)

(3) ***Volcanic island formation (Nishi-no-shima)***
This is a great target for geophysical, geological, volcanological, biological and environmental investigations

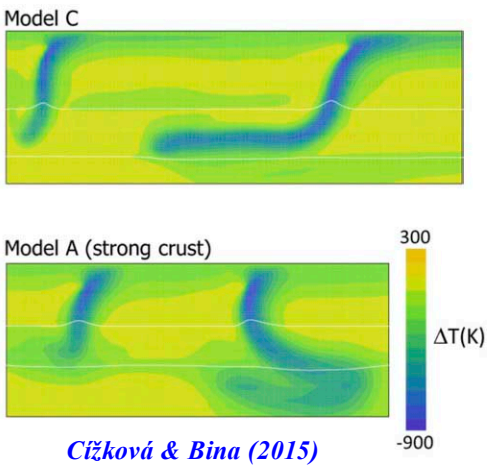


Maeno et al. (2016)

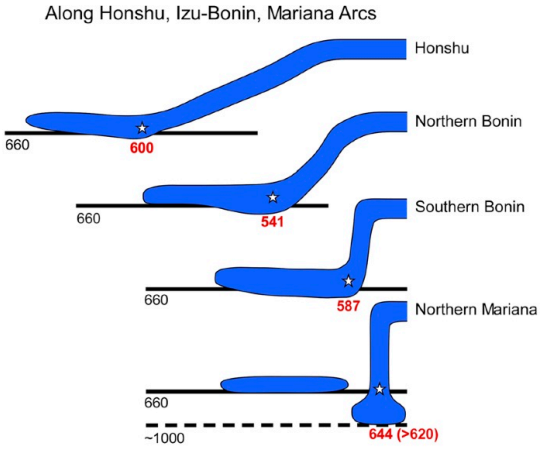
(4) ***Arc scale seismology and geodynamics***
IO-arc also offers lots interesting geodynamical problems with the entire-arc can be fully accessed via ocean bottom instruments (OBS, OBEM, etc.).



Fukao and Obayashi (2013)



Cížková & Bina (2015)



Fukao & Obayashi (2013)

References:

1. Cížková, H., and Bina, C.R. (2015), Geodynamics of trench advance: Insights from a Philippine-Sea-style geometry, ***Earth Planet. Sci. Lett.*** 379, 95-103, doi:10.1016/j.epsl.2013.08.011.
2. Fukao, Y., and M. Obayashi (2013), Subducted slabs stagnant above, penetrating through, and trapped below the 660 km discontinuity, ***J. Geophys. Res. Solid Earth***, 118, 5920-5938, doi:10.1002/ 2013JB010466.
3. Kamei, R. , R. G. Pratt and T. Tsuji (2013), On acoustic waveform tomography of wide-angle OBS data - strategies for pre-conditioning and inversion, ***Geophys. J. Int.***,194, 1250-1280, doi: 10.1093/gji/ggt165.
4. Kamimura, A., Kasahara, J., Shinohara, M., Hino, R., Shiobara, H., Fujie, G., and Kanazawa, T. (2002), Crustal structure study at the Izu-Bonin subduction zone around 31 degrees N: implications of serpentinized materials along the subduction plate boundary, ***Phys. Earth Planet. Inter.*** 132, 105-129.
5. Kodaira, S., N. Noguchi, N. Takahashi, O. Ishizuka, and Y. Kaneda (2010), Evolution from fore‐arc oceanic crust to island arc crust: A seismic study along the Izu‐Bonin fore arc, ***J. Geophys. Res.***, 115, B09102, doi:10.1029/2009JB006968.
6. Maeno, F., Nakada, S. and Kaneko, T. (2016), Morphological evolution of a new volcanic islet sustained by compound lava flows. ***Geology***, 44, 259-262, doi:10.1130/G37461.1.
7. Mikada, H., H. Watanabe, and S. Sakashita (1997), Evidence for subsurface magma bodies beneath Izu-Oshima volcano inferred from a seismic scattering analysis and possible interpretation of the magma plumbing system of the 1986 eruptive activity, ***Phys. Earth Planet. Inter.***, 104, 257-269.
8. Naif, S., K. Key, S. Constable, and R. L. Evans (2015), Water-rich bending faults at the Middle America Trench, ***Geochem. Geophys. Geosyst.***, 16, 2582- 2597, doi:10.1002/2015GC005927.
9. Ruff, L., and H. Kanamori (1980), Seismicity and the subduction process, ***Phys. Earth Planet. Inter.***, 23, 240-252.
10. Uyeda, S., and H. Kanamori (1979), Back-arc opening and the mode of subduction, ***J. Geophys. Res.***, 84, 1049-1061.
11. Yokota, Y., T. Ishikawa, S. Watanabe, T. Tashiro and A. Asada (2016), Seafloor geodetic constraints on interplate coupling of the Nankai Trough megathrust zone, ***Nature***, 534, 374-377, doi:10.1038/ nature17632.