JAMSTEC Marine Geophysical Projects for Researches on Subduction Cycles and Deformation

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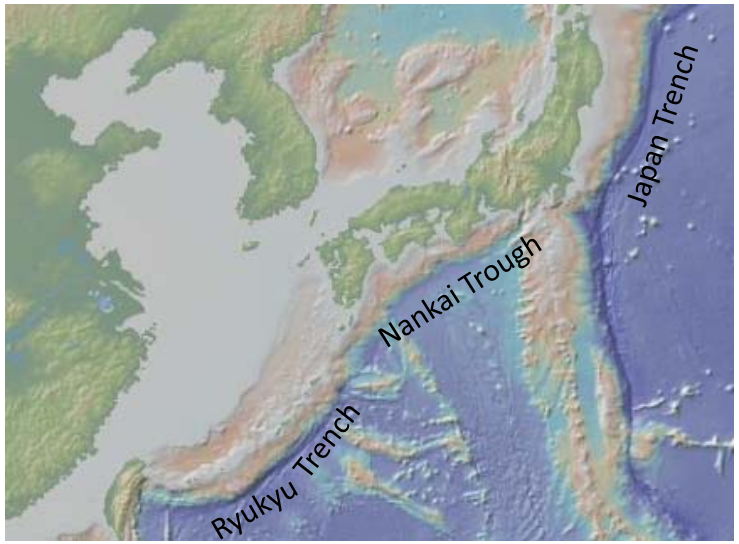
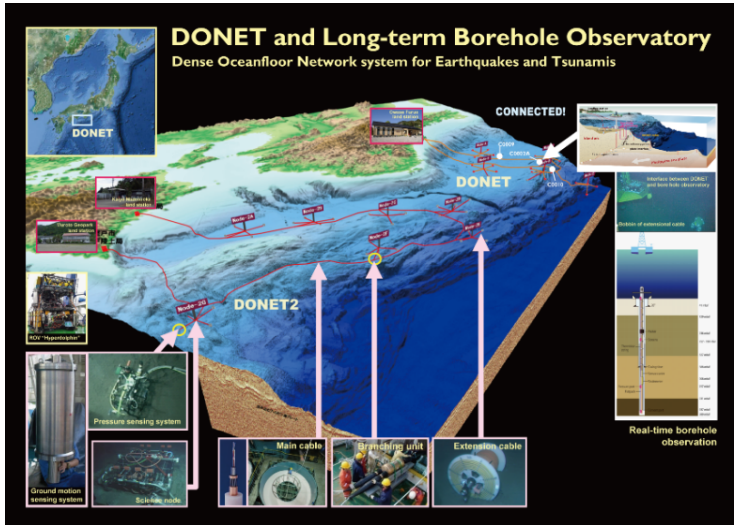
Research Center for Earthquake and Tsunami
JAMSTEC

JAMSTEC Marine Geophysical Projects

Motivation: need geophysical studies beyond researches on “normal” earthquakes in subduction zone

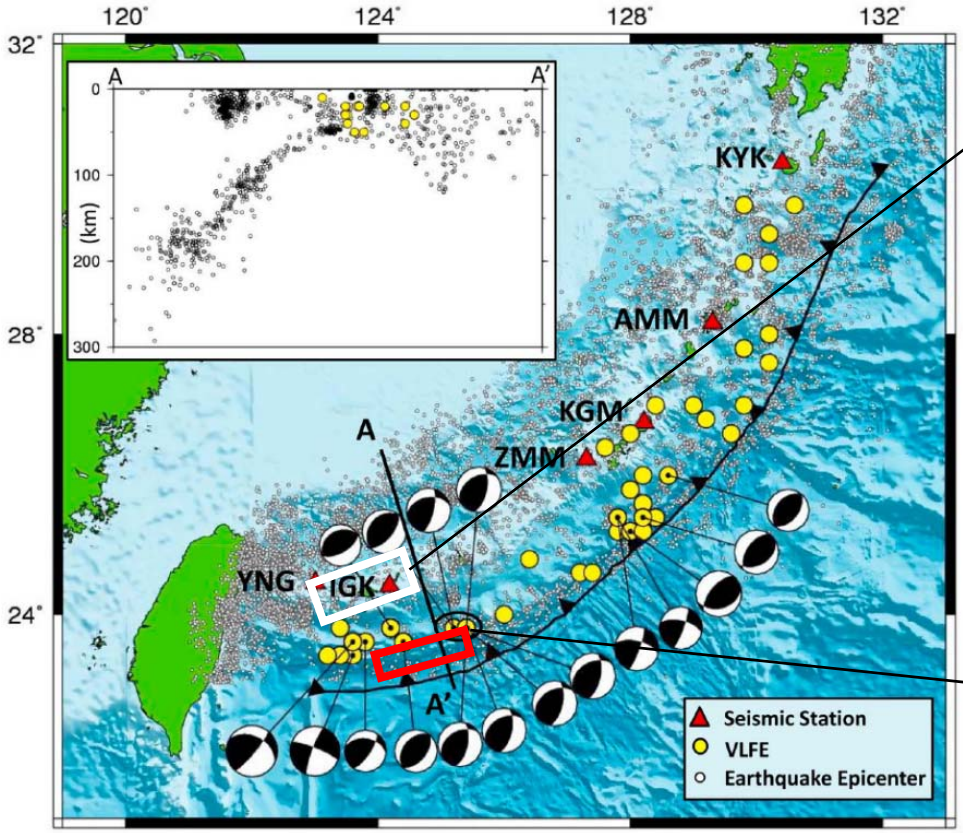
- Slow slip dominant subduction thrust
  - Ryukyu Trench
- Tsunami genic Slip to the trench
  - Japan Trench
- Outer rise bending related fault
  - Incoming plate to the Japan Trench
- Seimo-geodetic Seafloor Monitoring
  - DONET, S-net
  - Borehole observatory
  - Seafloor Geodetic

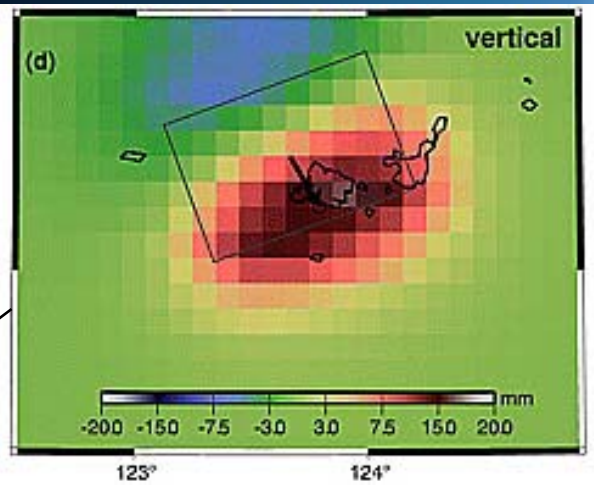




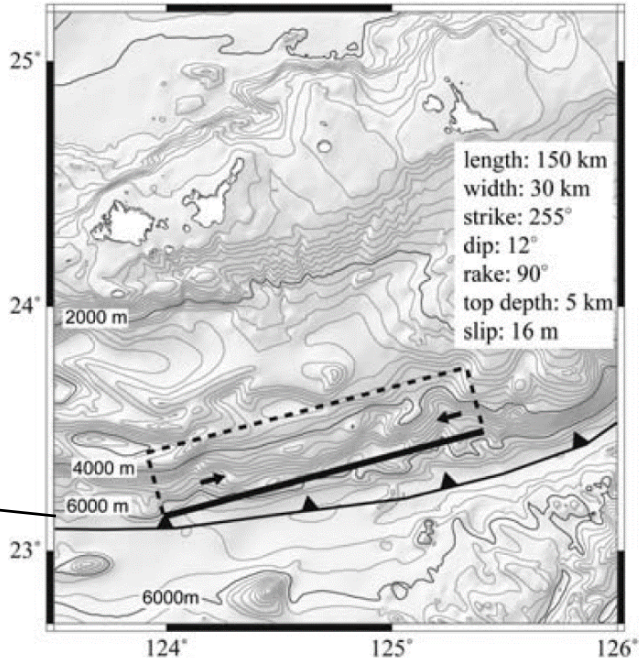
Slow slip dominant subduction thrust

- no known large thrust earthquakes in the last 300 years (Ando et al., 2009).
- very Low Frequency EQs (VLFEs) in forearc region alon the entire arc (Ando et al. 2012)





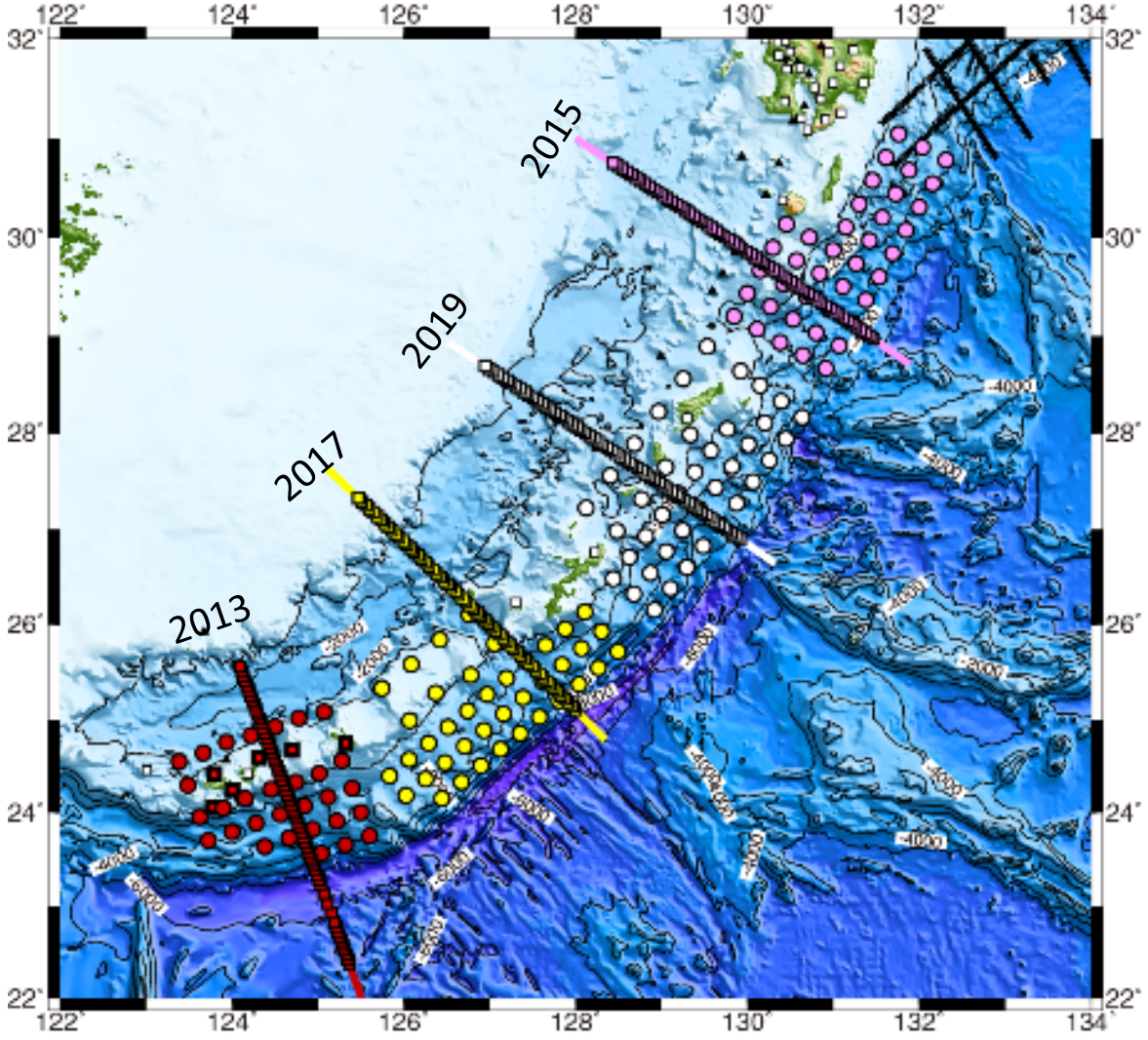
Slow Slip Events (Heki & Kataoka, 2008)



Yaeyama Tsunami EQ in 1771 (Nakamura, 2009)

Slow slip dominant subduction thrust

MEXT Nankai-Ryukyu Project 2013-2020



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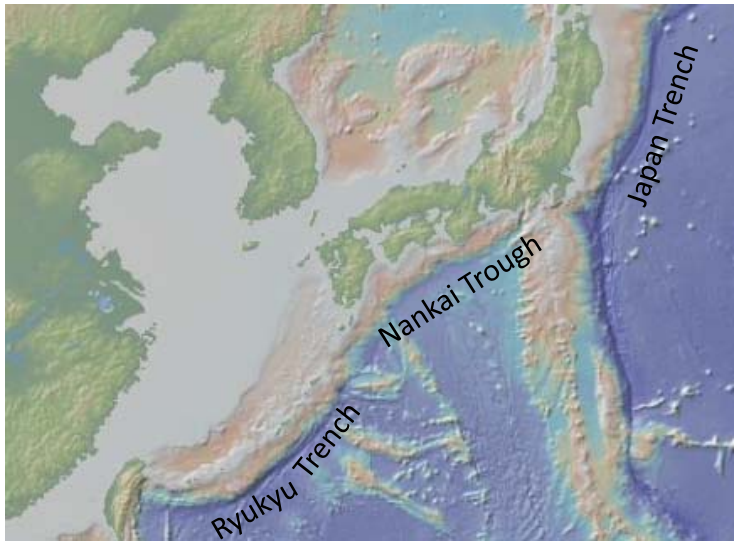
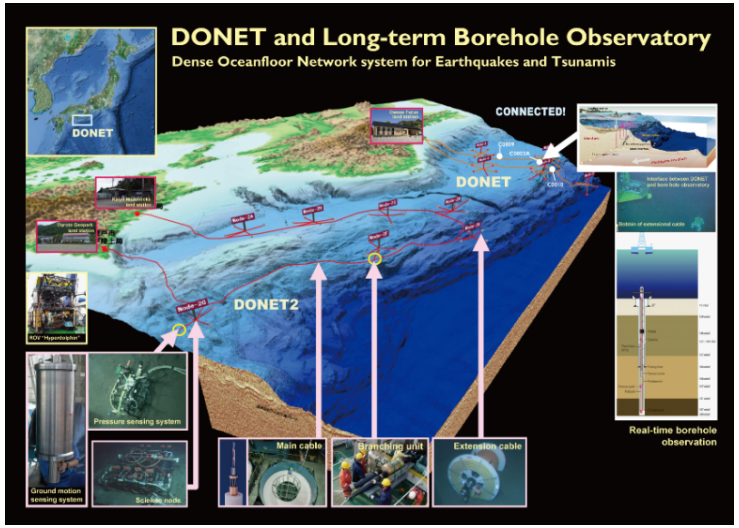
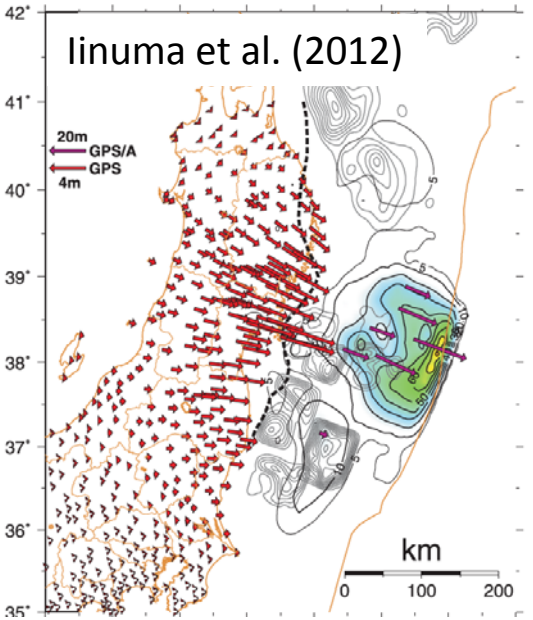




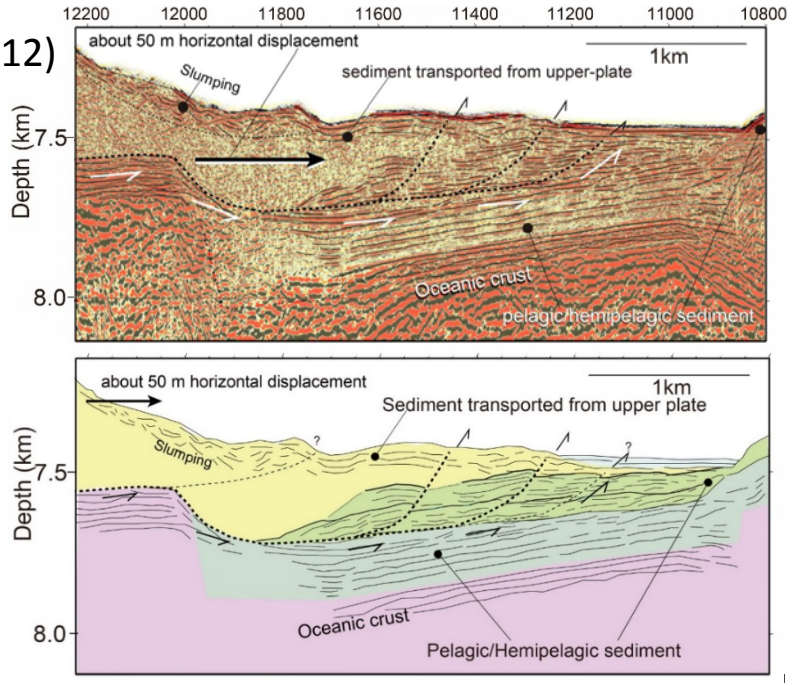
Slip to the trench

Post earthquake observation

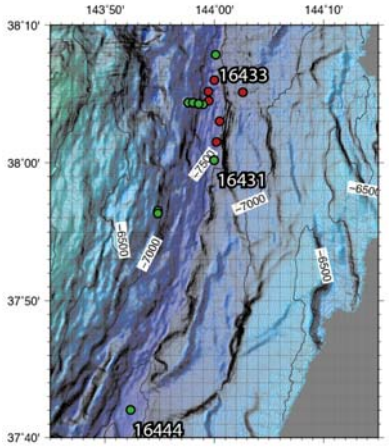


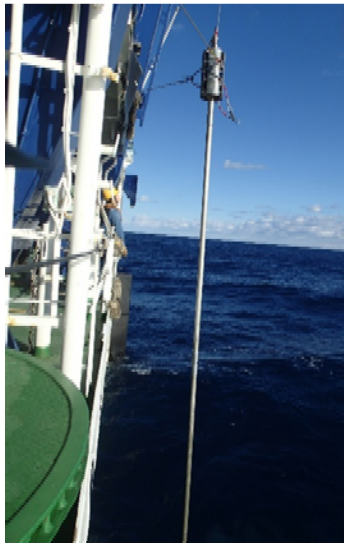
Large co-seismic slip obtained by seafloor geodetic data

Kodaira et al. (2012)



Co-seismic deformation along the seismic fault reaching to the trench



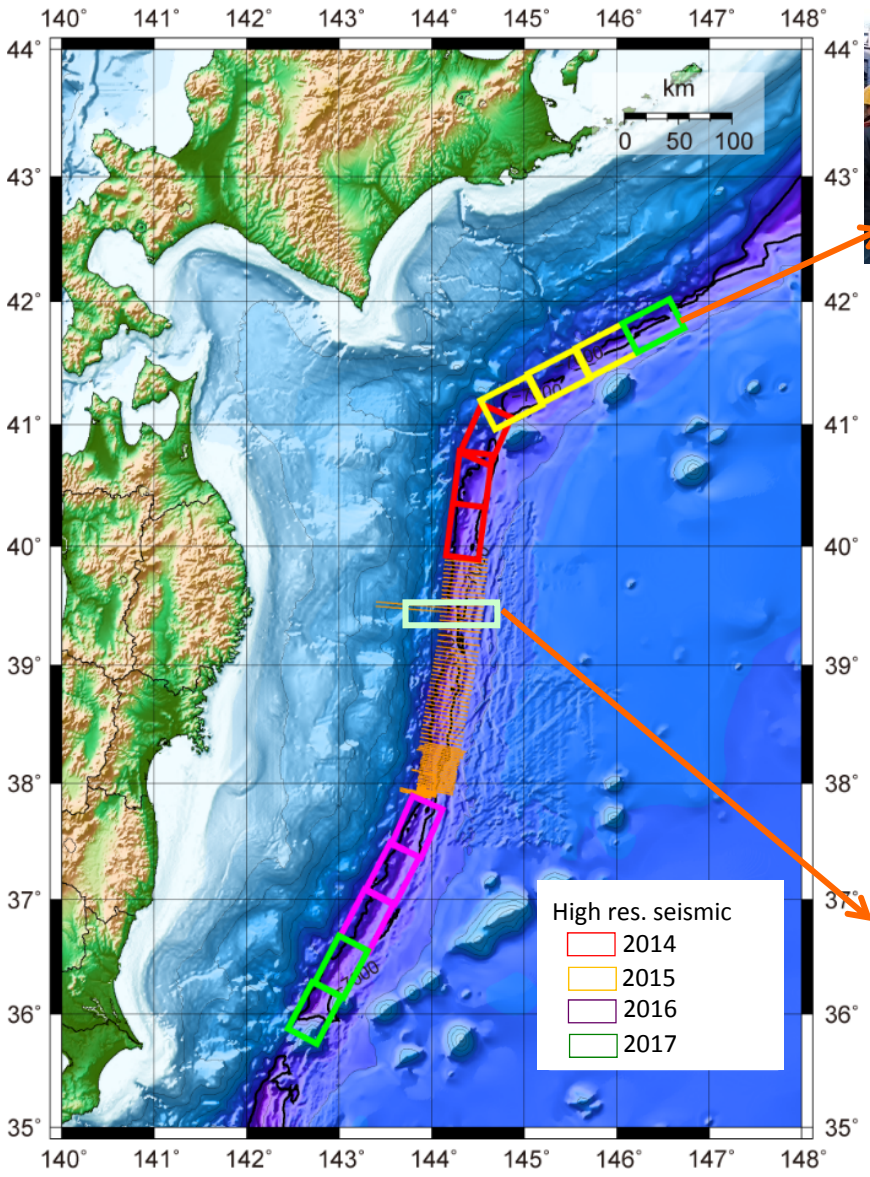


Piston coring at the trench axis

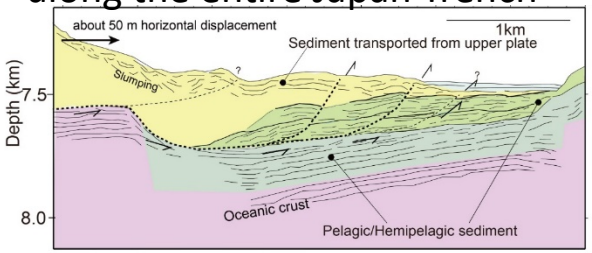
Only observed in the central Japan Trench. No information of spatial variation along the entire Japan Trench

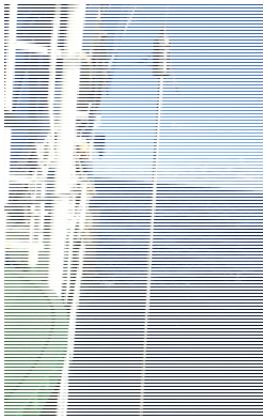
Slip to the trench

JSPS Project “JDASH” 2014 -2017
Tohoku Univ., JAMSTEC, ERI, Kyoto U.

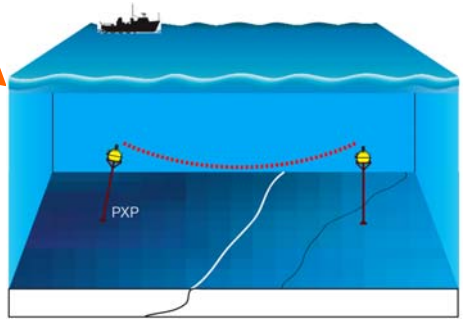


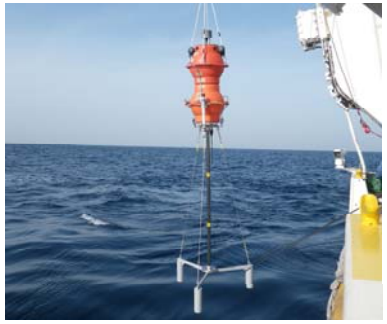
High resolution seismic survey along the entire Japan Trench





Piston coring along the trench





Tohoku U. Acoustic Distant Meter across the trench to monitor plate motion

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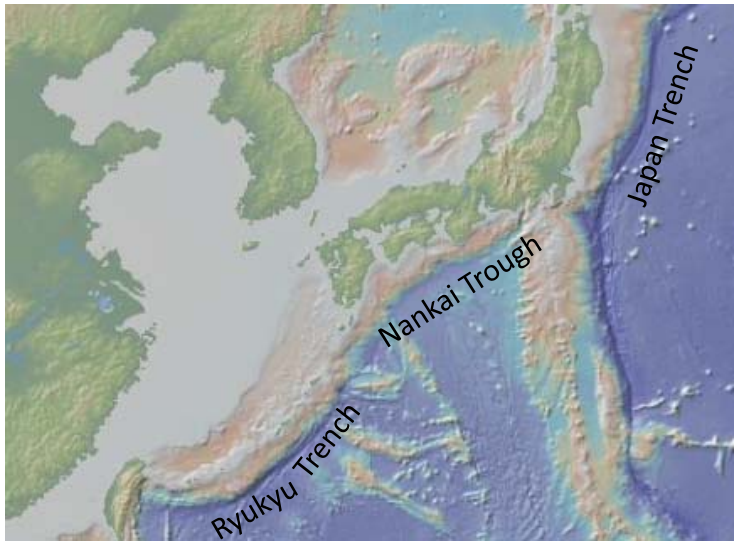
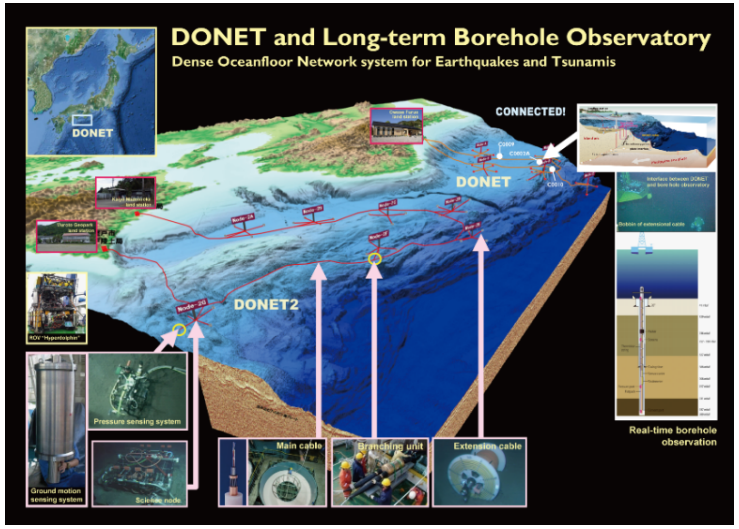
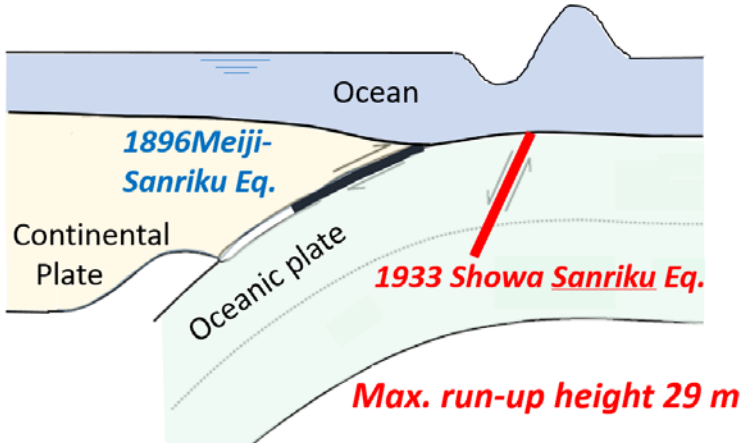




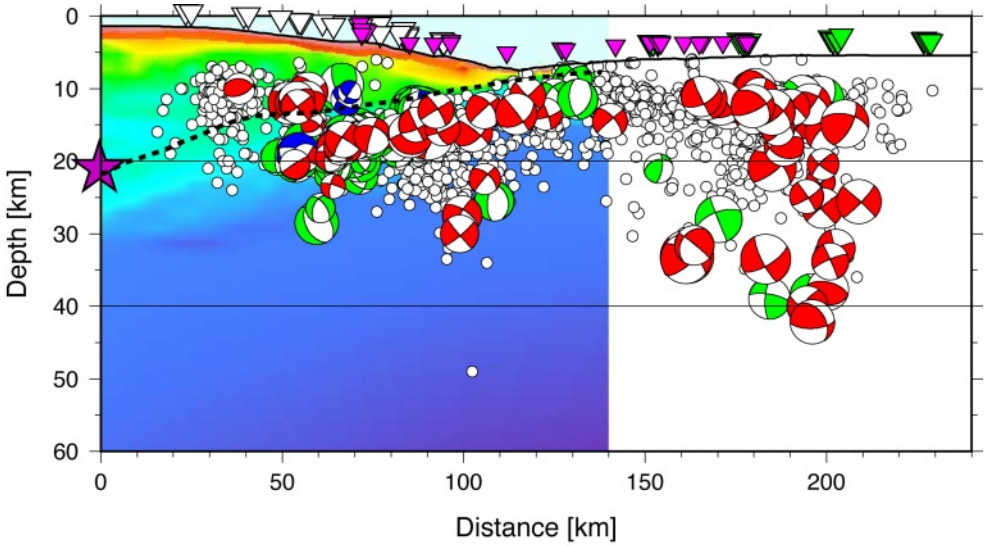
Outer rise bending related faults

	Shallow megathrust	Outer-rise earthquake
Japan Trench	1896/6/15 MeijiSanriku M 8.0	1933/3/3 ShowaSanriku M 8.4
Aleutian Trench	1965/2/4 M 8.7	1965/3/30 M 7.6
Kuril Trench	2006/11/15 M 8.3	2007/1/13 M 8.1
Tonga Trench	2009/9/29 M ～8	2009/9/29 M ～8
Japan Trench	2011/3/11 M 9	? ? ?



Outer-rise large normal fault earthquake often occurred following a shallow large megathrust event

Obana et al., 2012, 2013



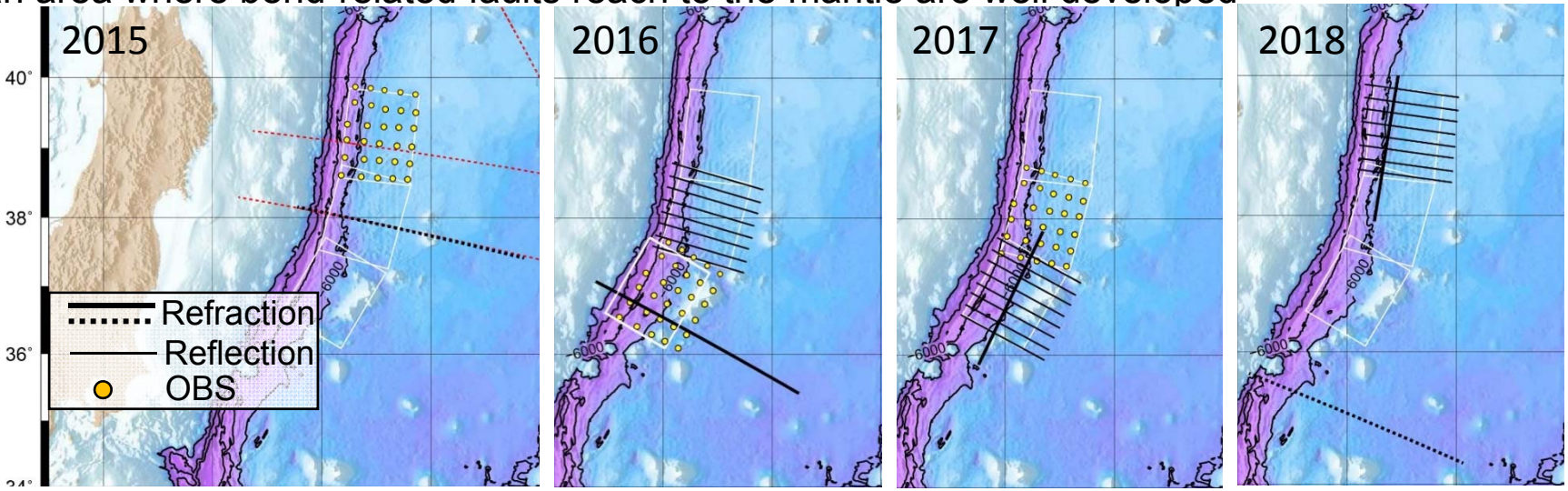
Earthquake observation at the trench to the outer-rise: normal fault aftershocks are observed down to 40 km deep in the outer rise

Tsunami hazard from the outer-rise earthquake in the Japan Trench should be taken into consideration based on a line of those evidences (Lay et al., 2011). We need to know distribution of potential earthquake faults to be used for tsunami warning system

Outer rise bending related faults

JSPS Outer Rise Project 2015-2019

Step1: wide-anlge seismic OBS study for imaging structural variation toward the trench to identify an area where bend-related faults reach to the mantle are well developed

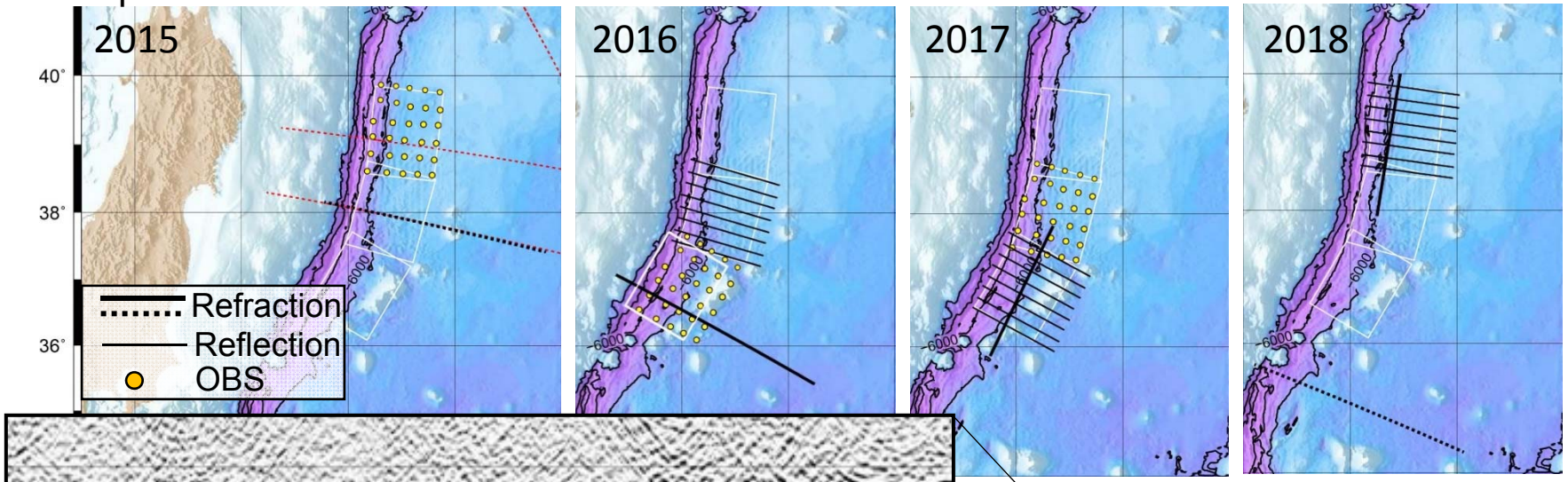


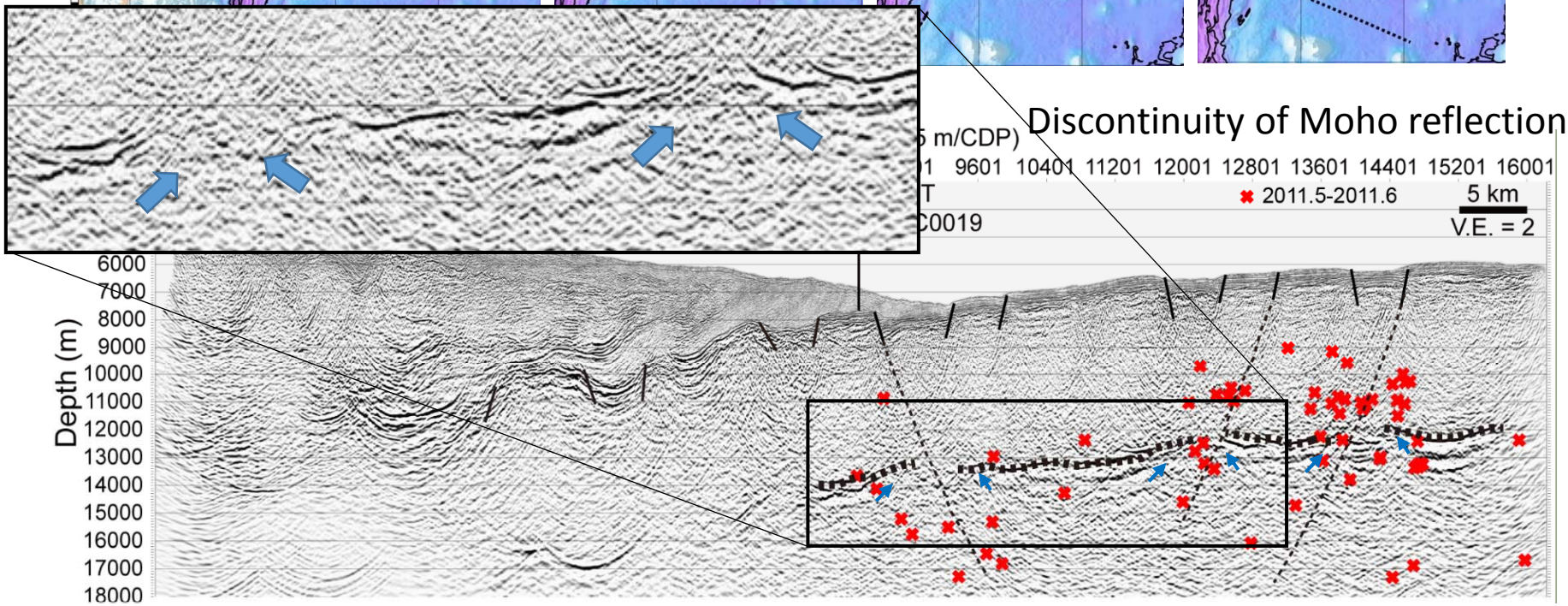
Off Miyagi profile (Fujie et al., 2015, JpGU). Decreasing P-wave velocity and increasing Vp/Vs are observed from ~150 km seaward of the trench.

Outer rise bending related faults

JSPS Outer Rise Project 2015-2019

Step2: Mapping potential earthquake faults based on fine-scale seismic reflection images and earthquake activities





after Nakamura et al. (2014)

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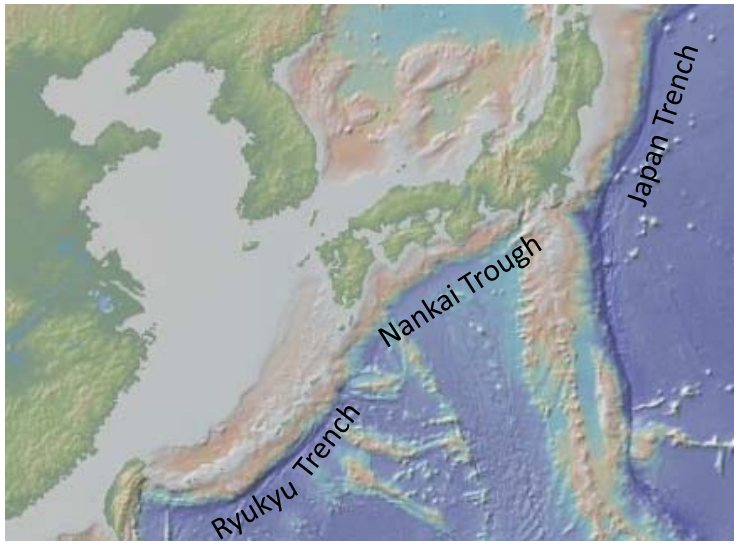
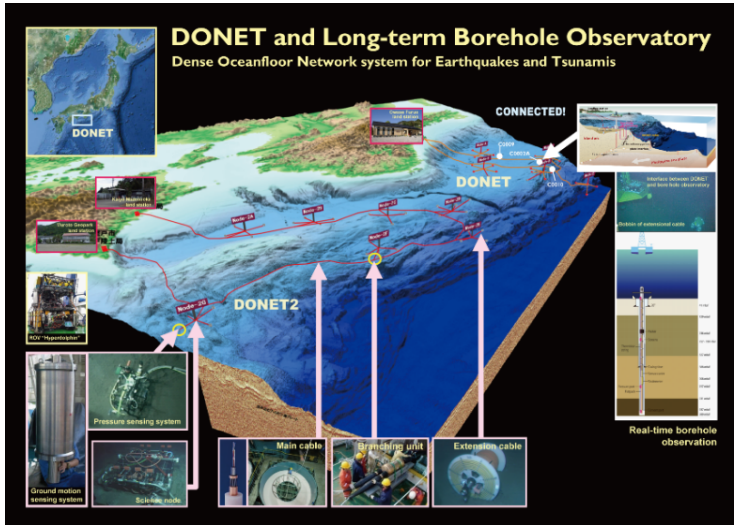


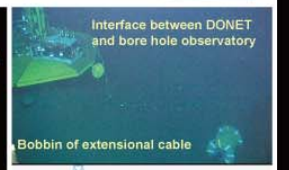


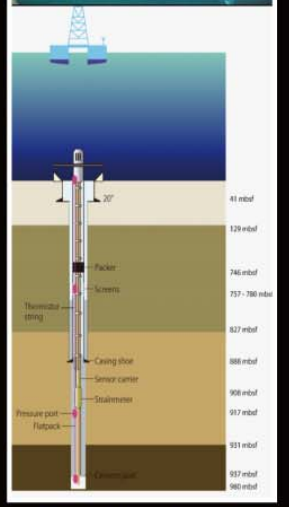
Seimo-geodetic Seafloor Monitoring

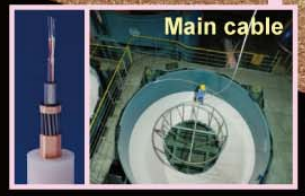
Dense Oceanfloor Network system for Earthquakes and Tsunamis
DONET

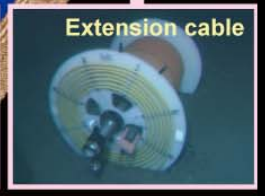
Borehole observatory

CONNECTED!





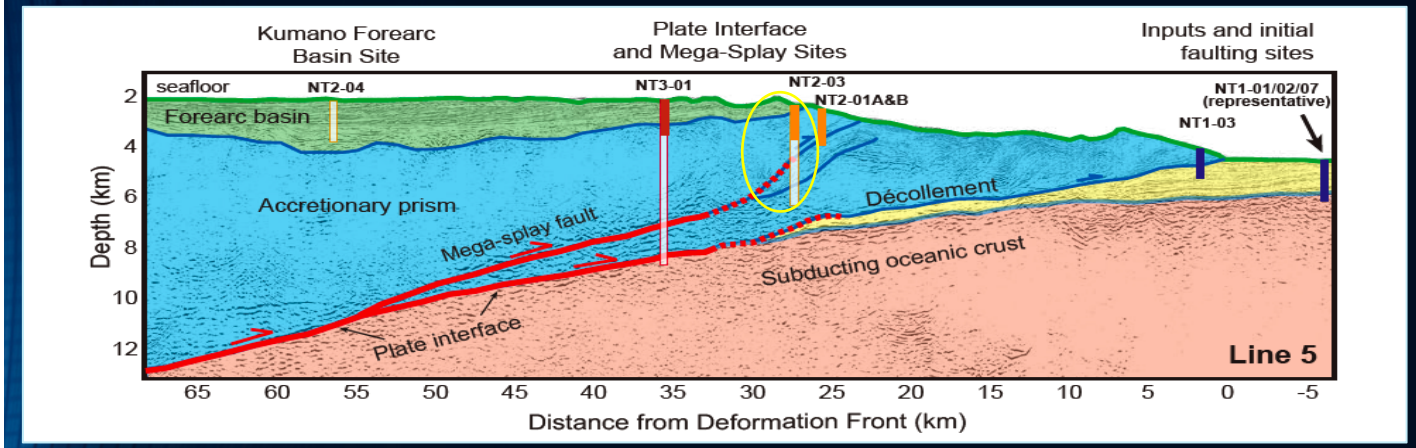


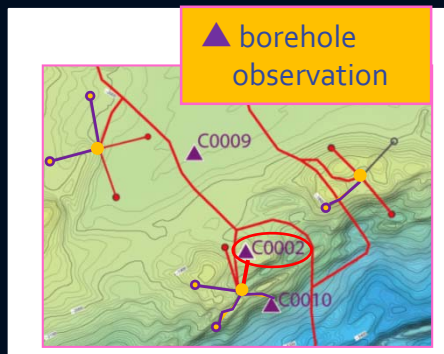


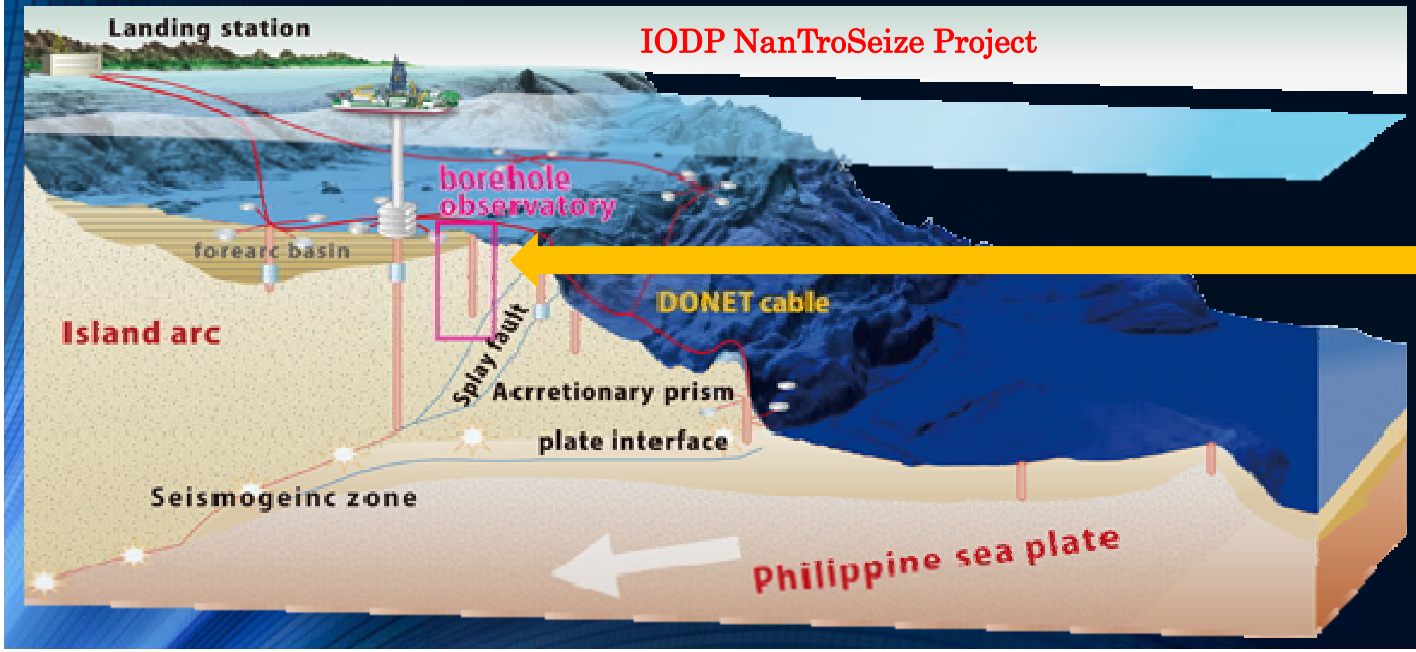
DONET2 (DONET1)
Backbone cable length：
~350km(~250km)
# of Branching Unit：7 (5)
# of Node：7 (5)
# of Observation system：29 (20+2)

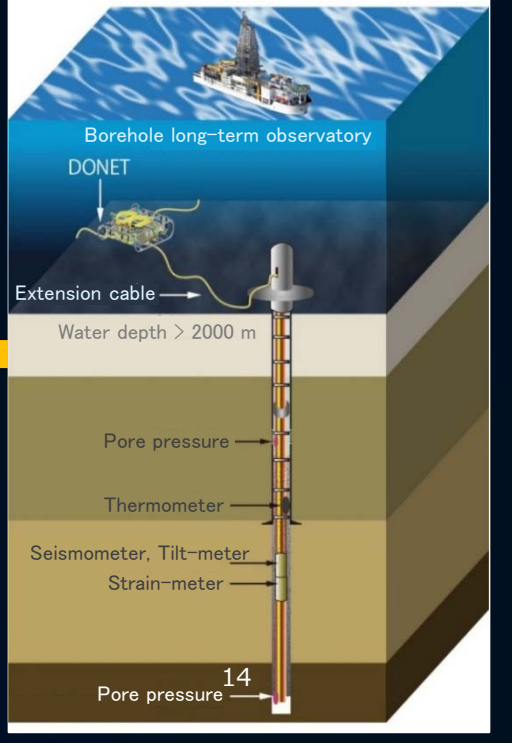
Seimo-geodetic Seafloor Monitoring

IODP borehole observatory have been connected to DONET since 2013
Data are available from Jamstec data site





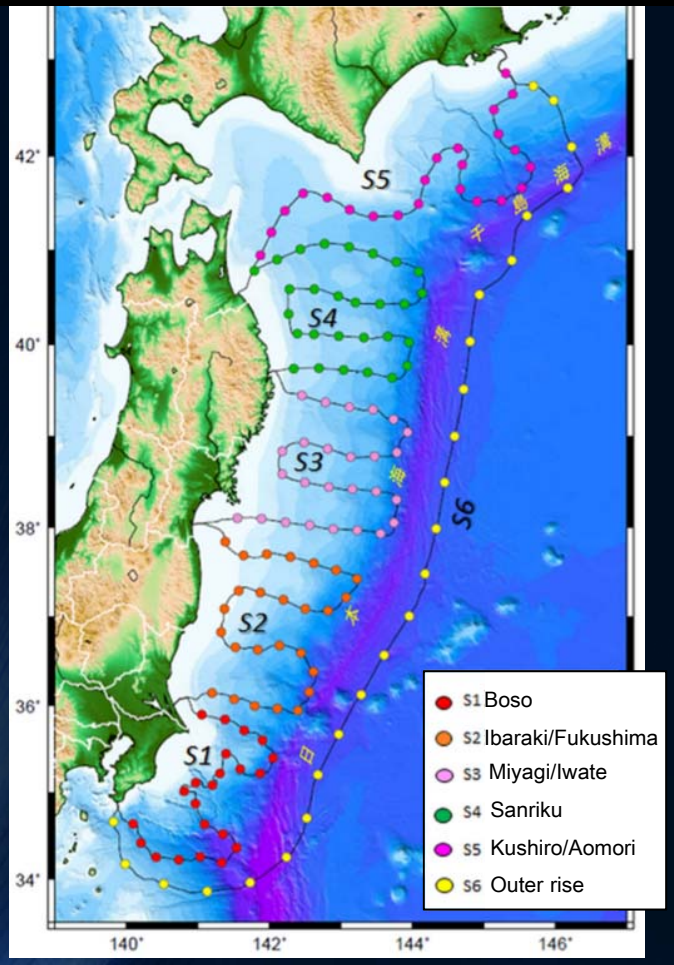




Seimo-geodetic Seafloor Monitoring

Seafloor observation Network for Earthquakes and Tsunamis along the Japan Trench (S-net) NIED

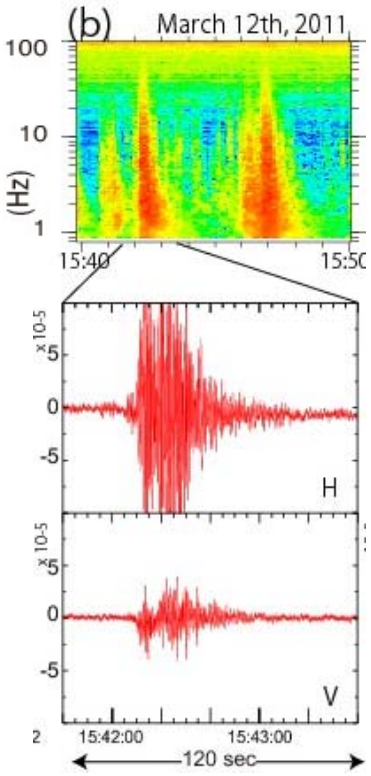
In-line type seismometer-pressure sensors

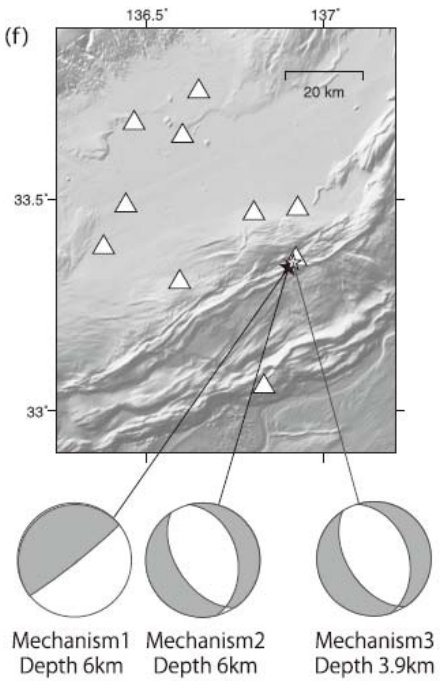


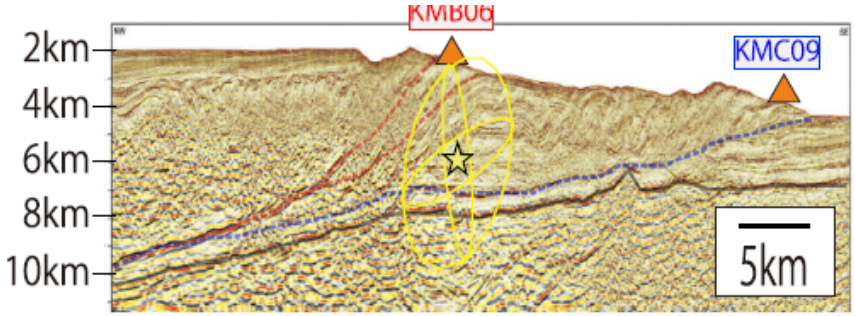
DONET will be transferred to NIED in 2016. DONET1 data have been opened through NIED site since 2014

Seimo-geodetic Seafloor Monitoring

Small VLF events (Toh et al., 2014)



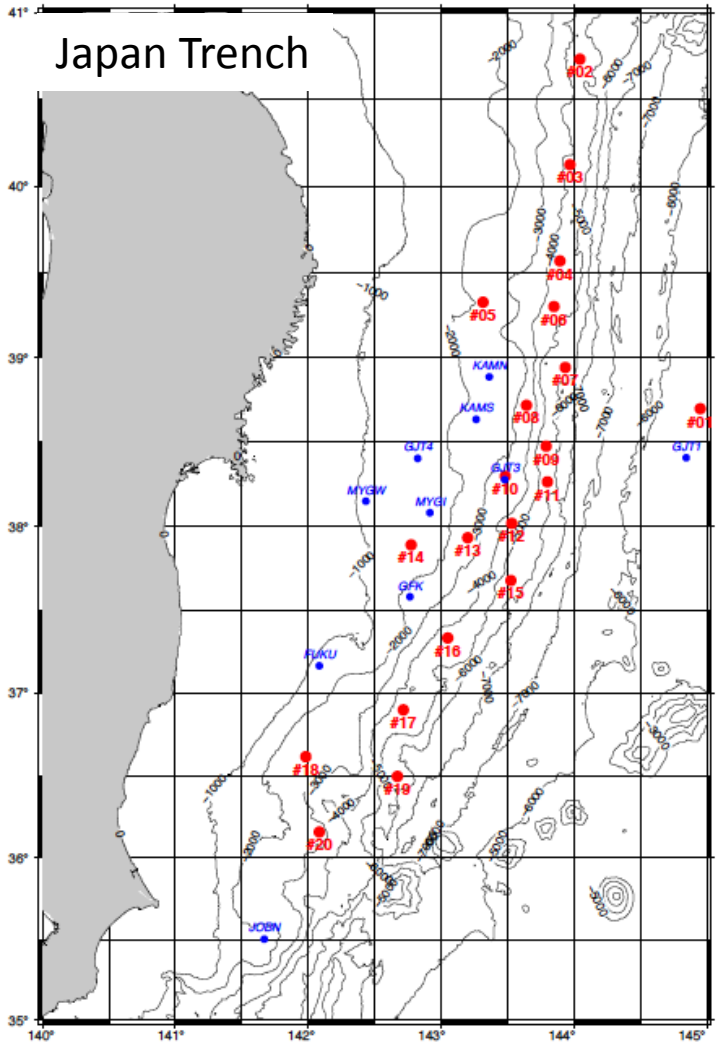




- Frequency range 2- 8 Hz,
- Source duration ~17s of M=3.0 event
- Normal fault earthquakes at shallow depths within the accretionary prism

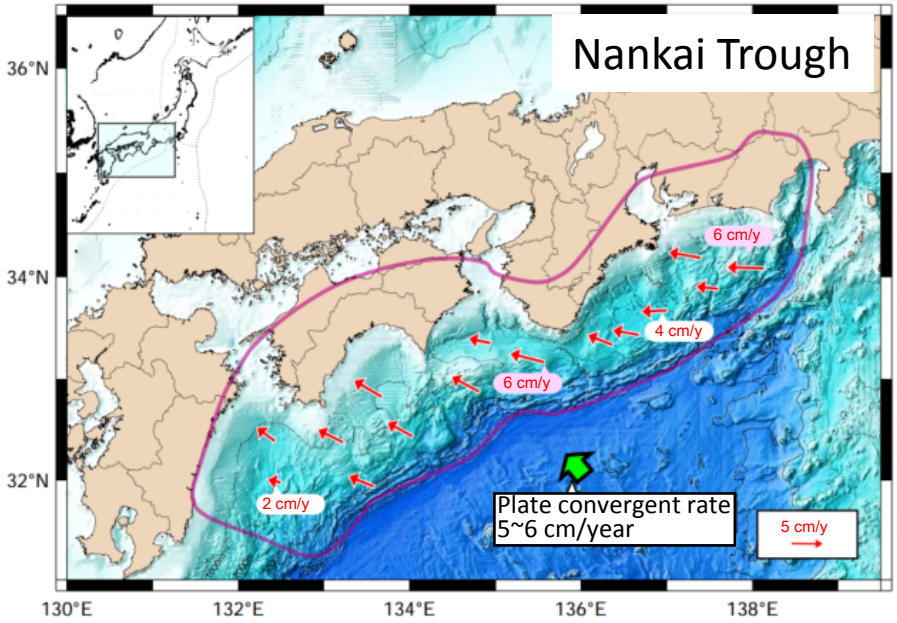
Seimo-geodetic Seafloor Monitoring

Acoustic/GPS, Japanese institution's activity



Tohoku univ. in collaboration with Jamstec

www.kaiho.mlit.go.jp/info/kouhou/h27/k20150818/k150818-1.pdf



Japan Coast guard

Acoustic unit for geodetic survey is installed on R/V Yokosuka

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