How we are trying for achieving ultra-deep ocean drilling.

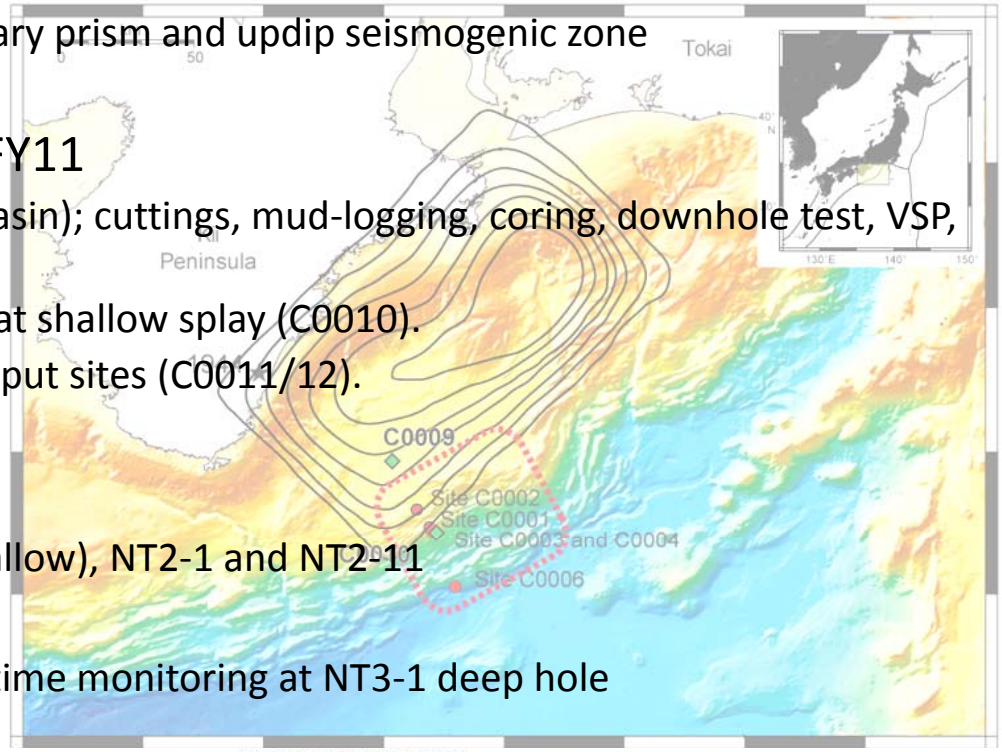
海洋超深度掘削研究実現のために我々はどう頑張っているか。

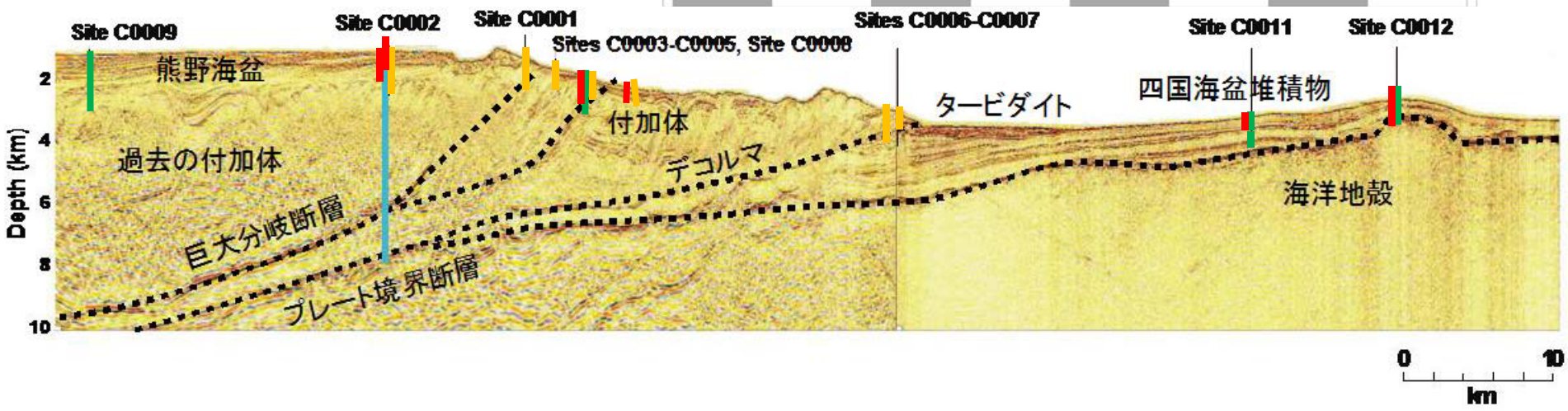
Masa Kinoshita

Japan Agency for Marine-Earth Science and Technology

4 Stages of NanTroSEIZE

- Stage 1 (2007-2008)　USFY07-08
  - Shallow transect across accretionary prism and updip seismogenic zone
  - LWD, core and downhole meas.
- Stage 2 (2009-2010)　USFY09-FY11
  - Riser drilling at C0009 (Kumano Basin); cuttings, mud-logging, coring, downhole test, VSP, Casing for observatory.
  - Casing for riserless observatories at shallow splay (C0010).
  - Coring&logging at 2 subduction input sites (C0011/12).
- Stage 3 (2010-) USFY10-
  - Riser drilling at NT3-1 (~7 kmbsf)
  - Install observatories at NT3-1 (shallow), NT2-1 and NT2-11
- Stage 4
  - Install observatory and start real-time monitoring at NT3-1 deep hole



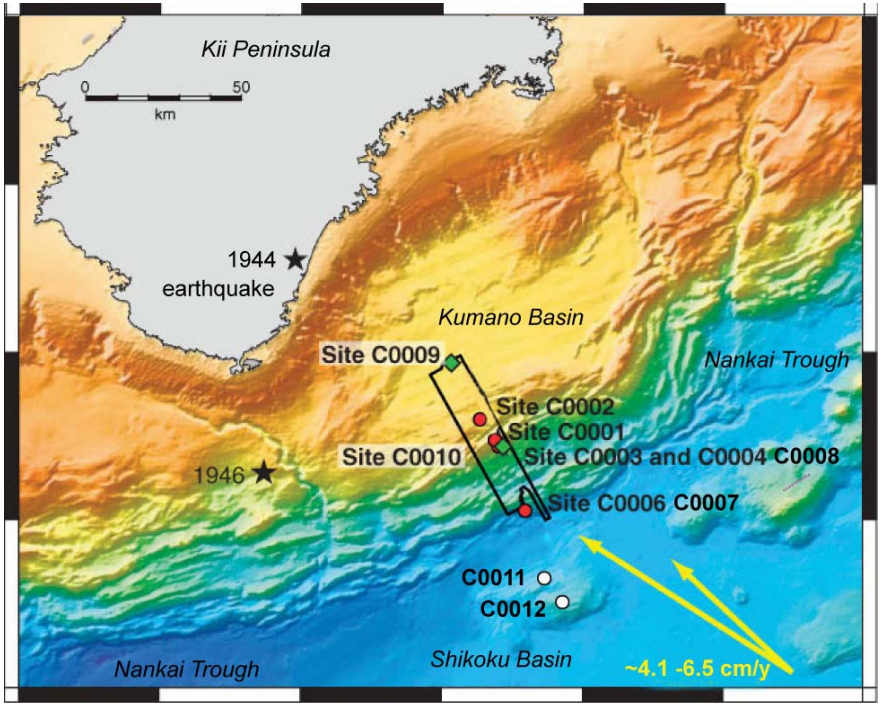


IODP Exp. 314/315/316/319/322/326

NanTroSEIZE
Stage 1 and 2

Expedition:	Co-chief Scientists:
314: Sep - Nov 2007	Masataka Kinoshita & Harold J. Tobin
315: Nov - Dec 2007	Juichiro Ashi & Siegfried Lallemant
316: Dec 2007 - Feb 2008	Gaku Kimura & Elizabeth Screaton
319: May-Aug 2009	Eiichiro Araki, Tim Byrne, Lisa McNeill & Demian Saffer
322: Sep-Oct 2009	Michael B. Underwood & Saneatsu Saito

The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) is a multiexpedition drilling project to investigate fault mechanics and the seismogenic behavior of subduction zone plate boundary faults by coring and long-term borehole observatories.



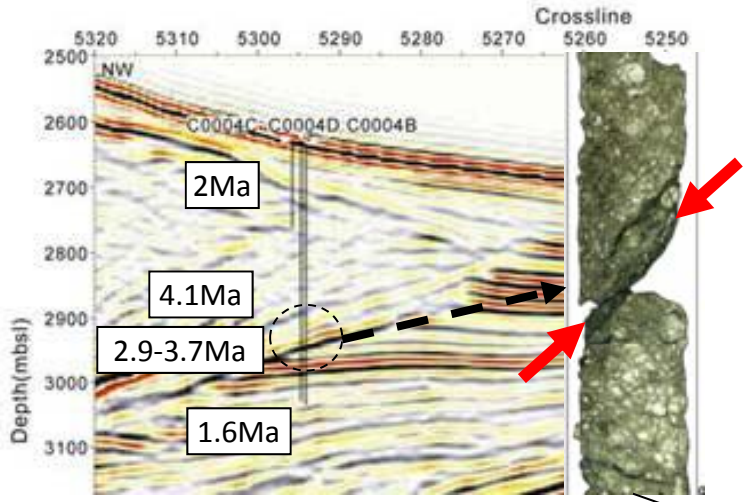
Main objectives:

- In situ physical conditions and the state of stress within different parts of the subduction system during an earthquake cycle.
- Mechanisms controlling the updip aseismic–seismic transition along the plate boundary fault system.
- Strain accumulation and release, mechanical strength of the plate boundary fault at 6-7 km depth.
- Role of “Mega-splay” fault in accommodating slip and influencing tsunami generation.

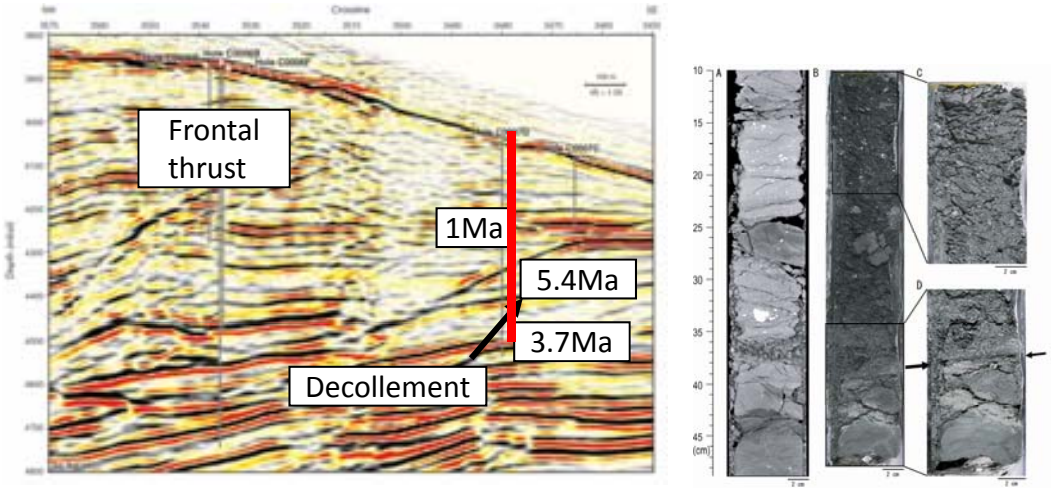
Primary results from IODP Seismigenic zone drilling: Two shallow fault zones – both seem active

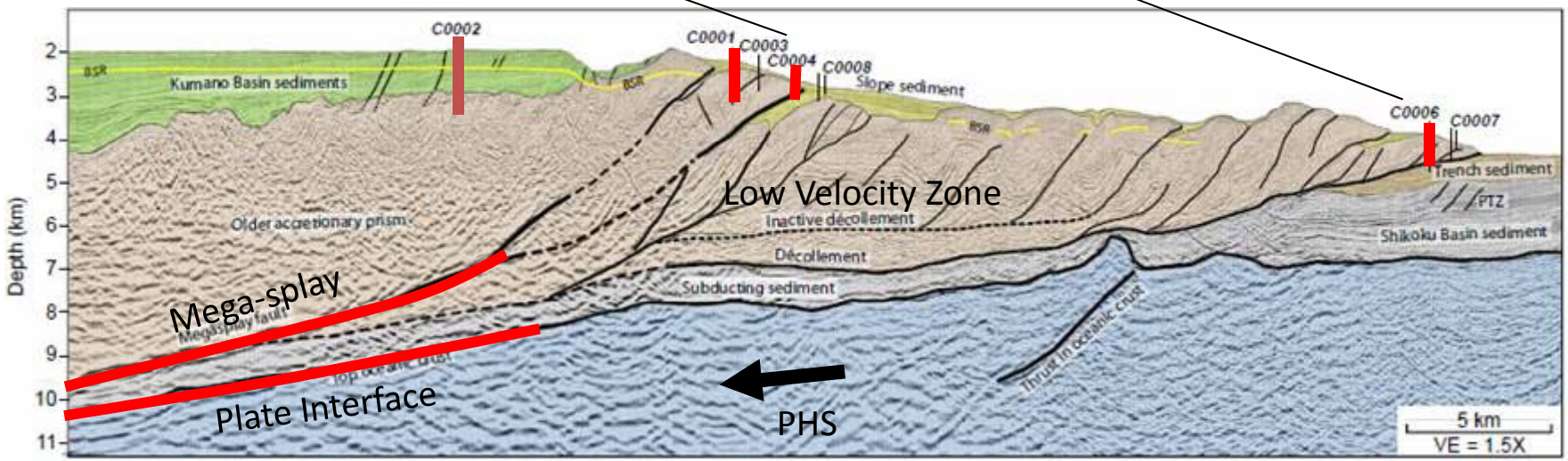
- Narrow fault zone / Age reversals / Evidence for high-speed slip

Shallow portion of mega-splay

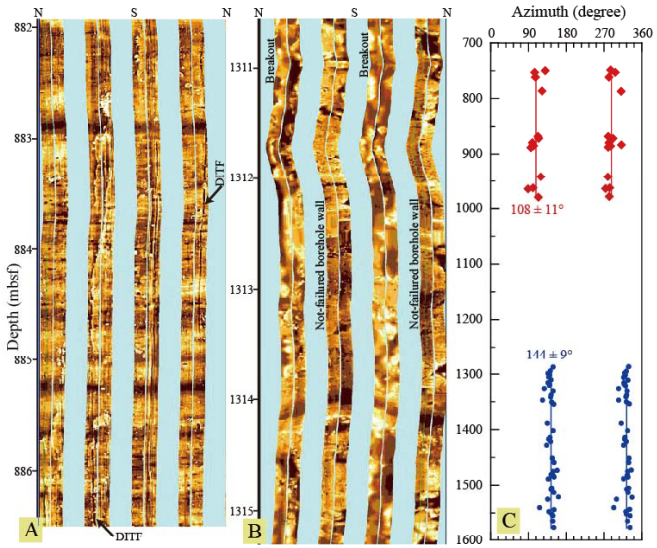


Decollement at the toe

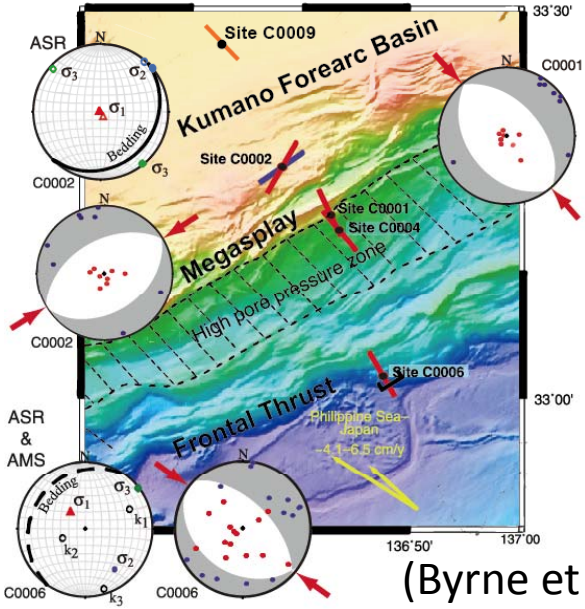




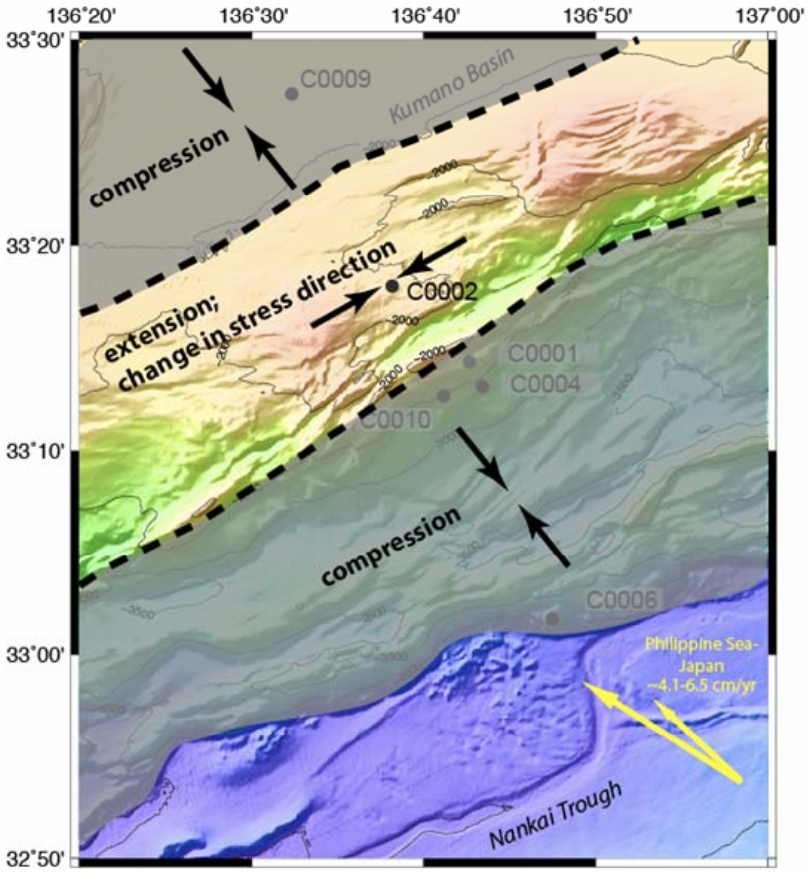
Stress orientation and magnitude using in-situ borehole image, ASR, AMS and fault kinematic analysis



(Lin et al., in press)



(Byrne et al., 2009)



- Horizontal max. stress orientation approximately coincide with plate convergence azimuth, except for at C0002 “extension”
- σ1 = Sv, not SHmax

Communication is a key.

- Cooperation in several levels
  - On site: drillers and technicians
  - Researchers

(IODP Operation Review Task Force meeting in 2008) Challenges in Planning

- Communication
  - International operation needs special treatment. State clearly, say no when not understood, confirm if it is fully understood, etc.
  - To the English natives – give us more time to digest your messages.
  - To the operators – give us more time to understand the importance of your suggestions.
  - Clarify who's responsible for what
  - CC's role must be fully recognized.

Challenges – Planning

- Lesson
  - Be proactive.
  - Project Management Team's role is more important. Needs to provide appropriate guidance to Implementation Organization.
  - Be as flexible as possible. On-site re-scheduling, discussed among onboard executive members, is the most effective way to maximize scientific performance.

Comments from Japanese point of view

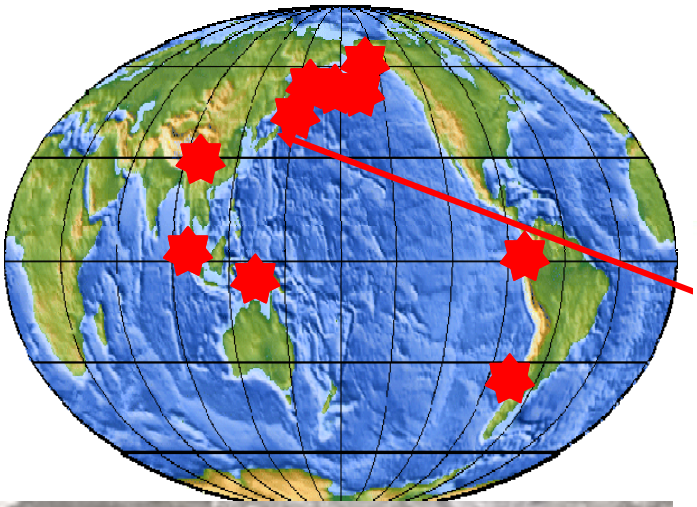
- For the maximum outcome to be made, real collaboration is useful and necessary. This is why we need *substantial* communication.
- Contribution can be made on each persons' expertise; it does not have to be in a same manner.
  - Research expertise
  - Logistics advantages

Comments from Japanese point of view

- We Japanese have stronger concern about great earthquakes and tsunamis. Our ancestors even though of politically using these events as a ‘renewal of framework’. This is why Japanese tax payers agree with investing huge money into scientific drilling.
- US scientists, engineers and admin persons have lots of experience on ocean scientific drilling and measurements.

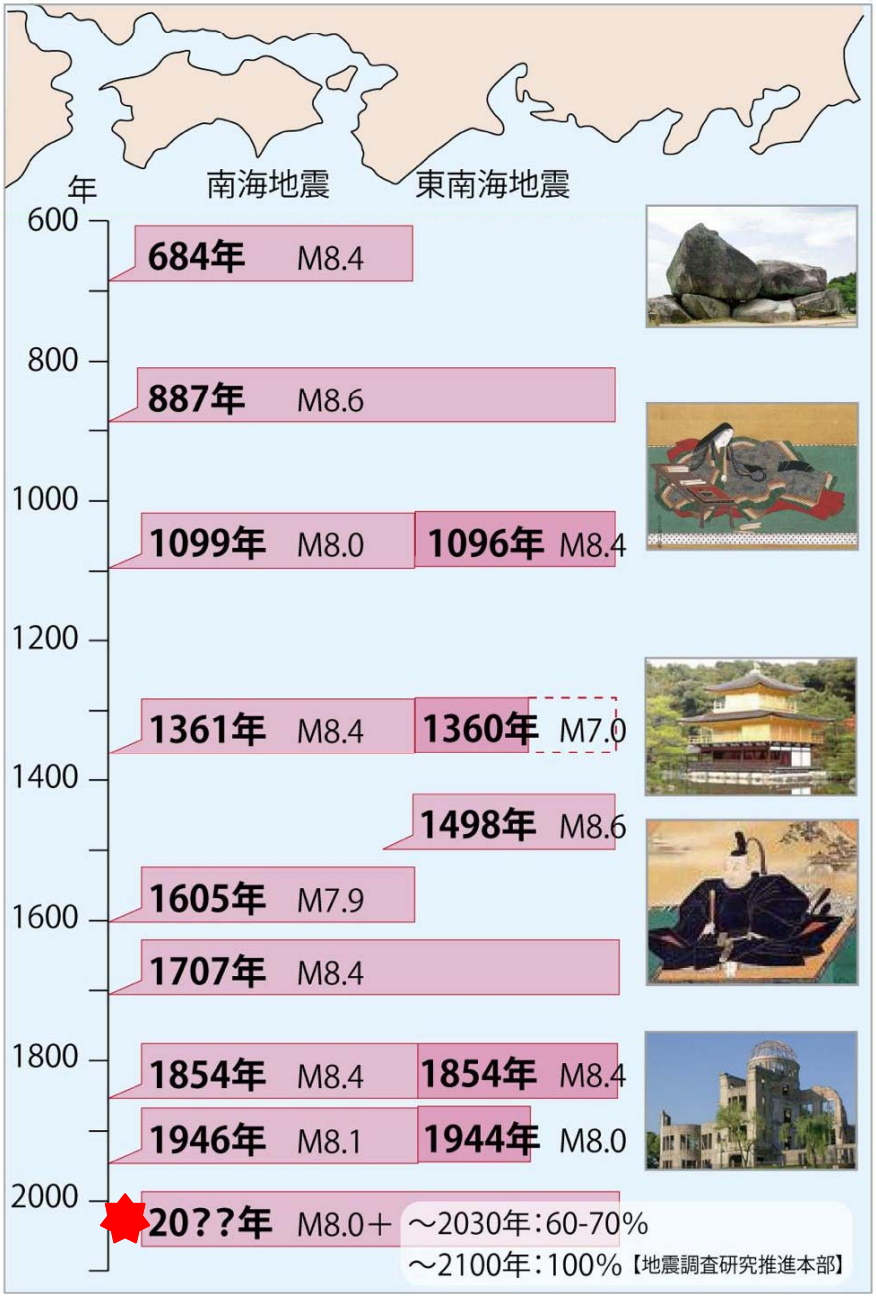
10 world-largest events

1906 Equador
1923 Kamchatka
1938 Banda
1950 Tibet
1952 Kamchatka
1957 Alaska
1960 Chile
1963 Kuril
1964 Alaska
1965 Rat Alaska
2004 Sumatra
2005 N.Sumatra



1944年Tonankai EQ. 三重県地震防災読本

Historic records of eartquakes in the Tokai-Nankai region

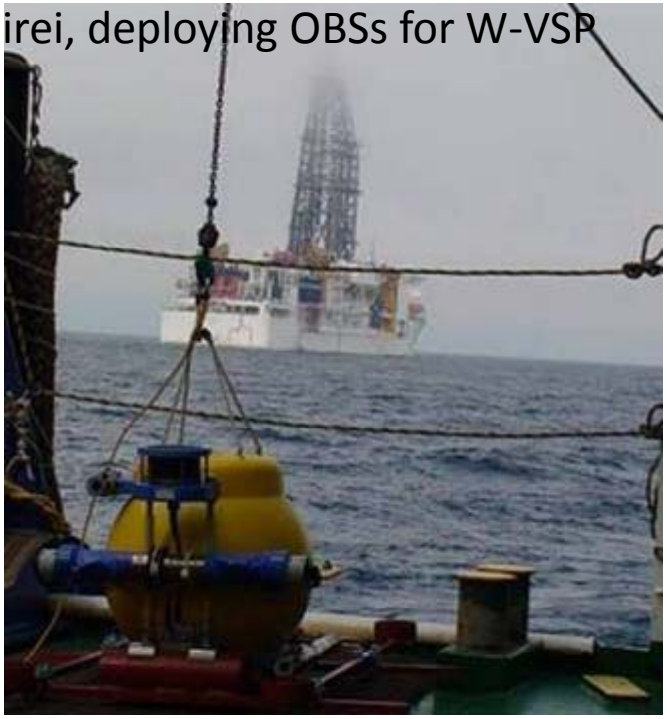


Comments from Japanese point of view

- Different perspective on the ‘meetings’: on-site decision vs. homework (or backdoor) approach.
- My own approach: Keep on ‘following’ what others say, trying to catch up what they mean. As long as they head for the right direction I keep silent. Otherwise I prepare raising hand to comment, or wait for a break for personal (which is easier) communications.

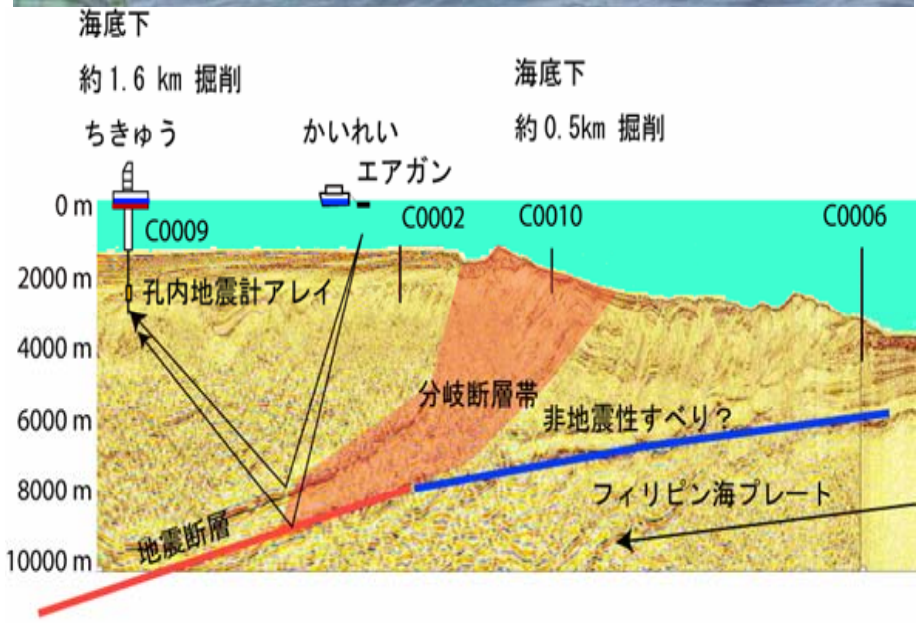
Walk-away/Circular VSP with 8 OBSs around the site C0009

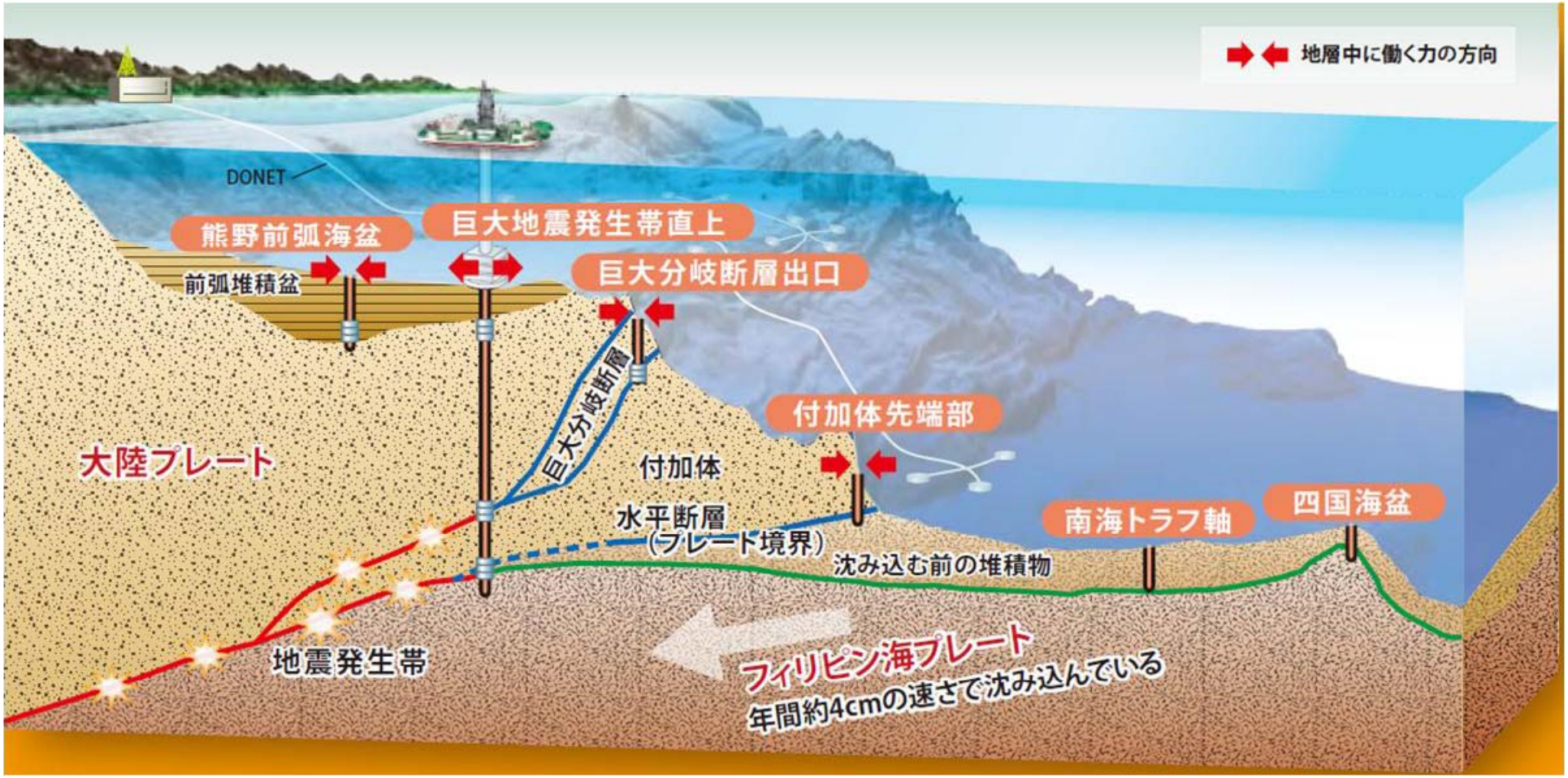
R/V Kairei, deploying OBSs for W-VSP



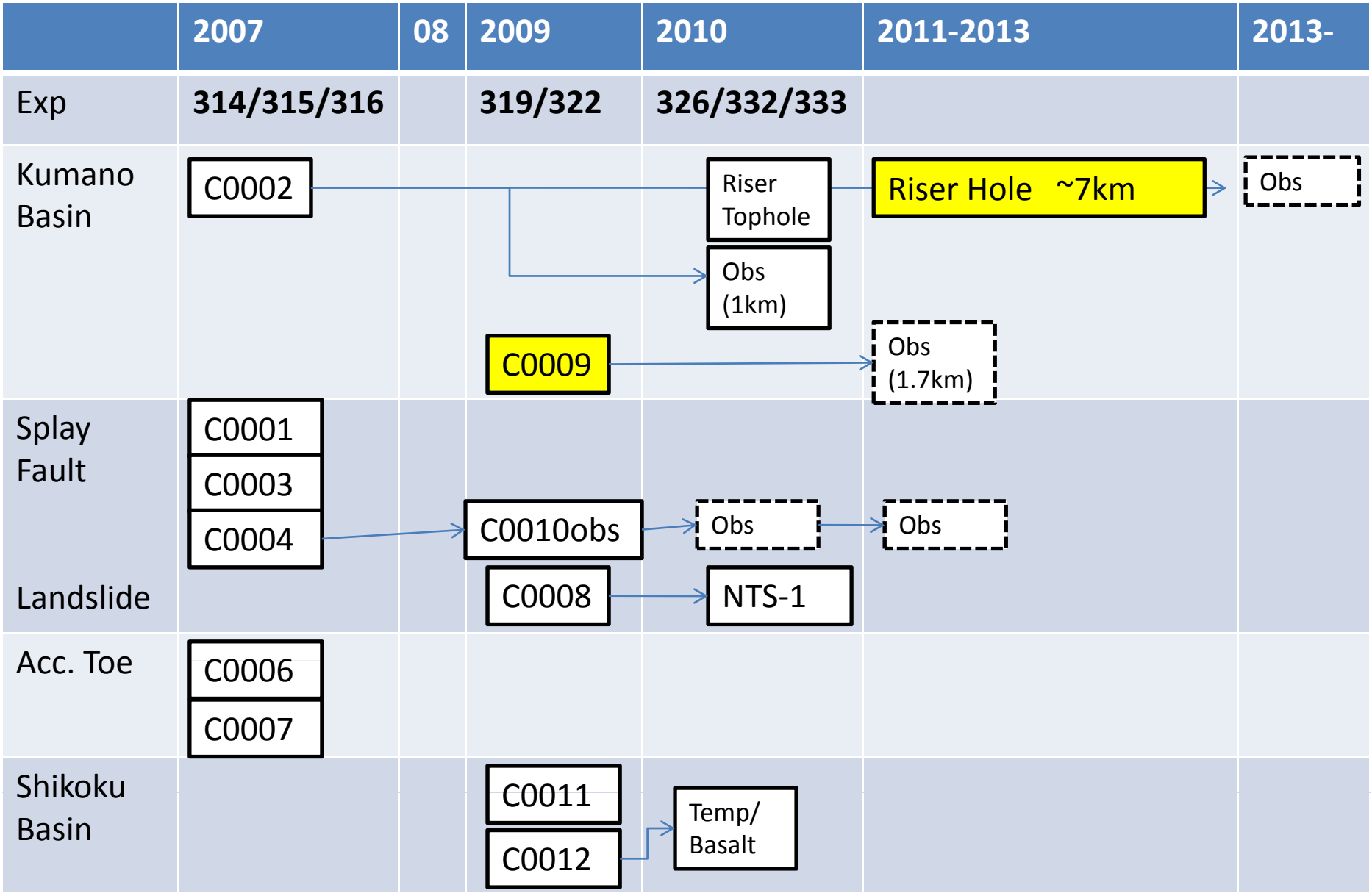
R/V Kairei during air-gun shooting operation

Borehole seismometer array

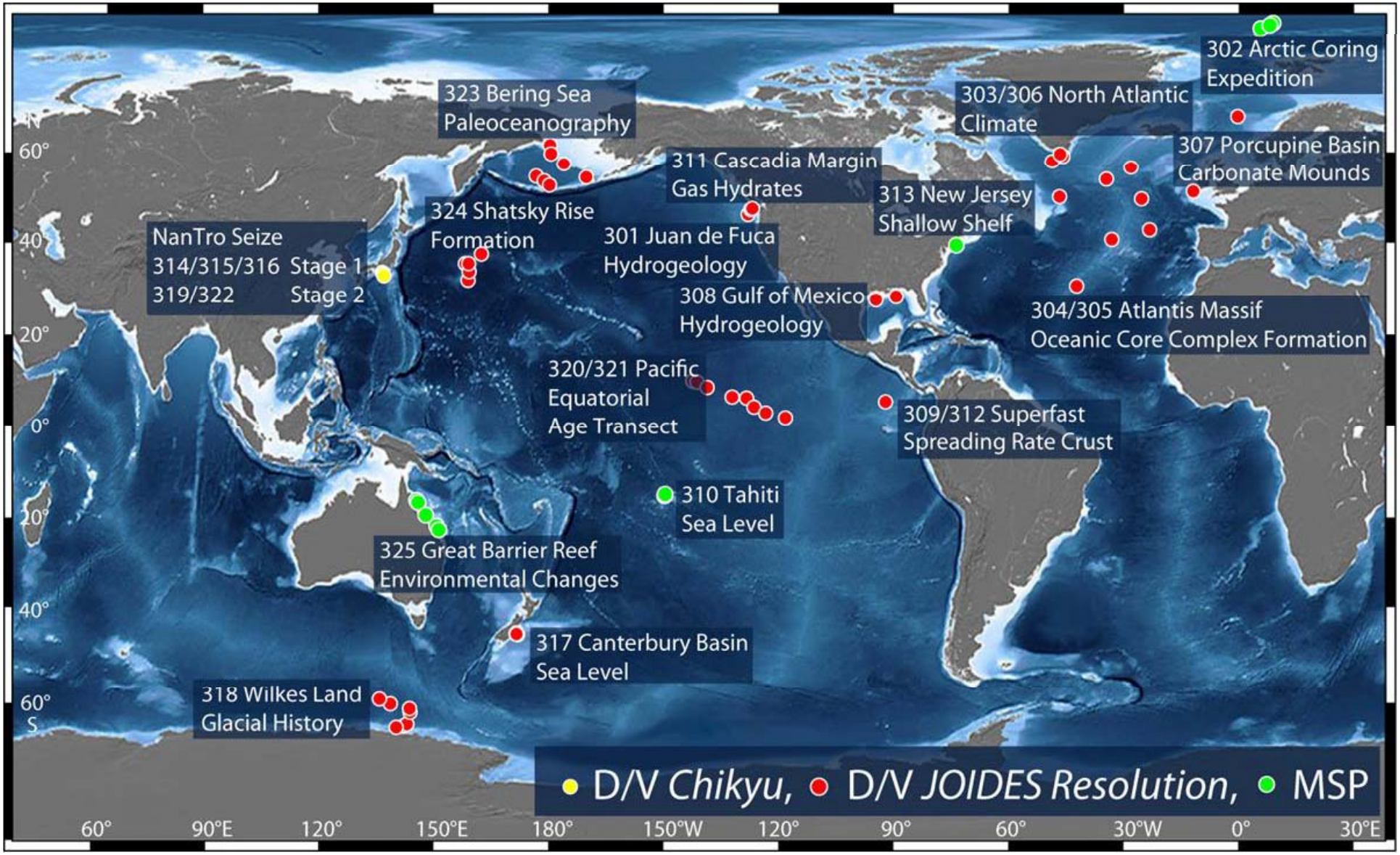



地層中に働く力の方向
DONET
熊野前弧海盆
巨大地震発生帯直上
巨大分岐断層出口
前弧堆積盆
巨大分岐断層
付加体先端部
大陸プレート
付加体
水平断層
(プレート境界)
南海トラフ軸
四国海盆
沈み込む前の堆積物
地震発生帯
フィリピン海プレート
年間約4cmの速さで沈み込んでいる

NanTroSEIZE Achivements & Plan



IODP Expeditions 301-325(326/327)



Planning for a New Drilling Program

- ✓**NEW program to replace IODP by end of September 2013**
- ✓**All IODP's 24 national members pursue funding; some prospective new members may as well. Funding request 200+ million US$/year for 10 years**
- ✓**Funding agencies (24+) organized in IWG+ is planning for the new program assisted by IODP-MI and SAS**
- ✓**A new science plan in under development, based on the INVEST report, and other community work shop reports**
- ✓**The science plan is drafted by Science Plan Writing Committee (SPWC) under tight time constraints (January – December 2010)**
- ✓**Second draft for community review August 24 - Sept 21, 2010**
- ✓**SPWC meeting October 6-10 2010 will include a science writer**

Planning for a New Drilling Program

The Four Grand Challenges

- ✓**Climate and Ocean Change: Reading the Past Informing the Future**
- ✓**The Biosphere: Co-evolution of Life and the Planet**
- ✓**Deep Earth Processes**
- ✓**Earth in Motion: Geohazards, Fluid flow, and Active Experimentation**

Earth in Motion: Geohazards, Fluid flow, and Active Experimentation

✓**In-situ observation of Earth, fluid and life processes as they take place on human time scale; a permanent presence within the ocean floor with opportunity for real-time observations**

✓**Linking to ocean observatory data (i.e., rates of solid earth exchange with the hydrosphere)**

✓**Perturbing the natural systems and monitor the outcome; laying the foundation for modeling of natural systems**

✓**Potential for huge societal impact, e.g.:**

- **@ Understanding earthquake cycles**
- **@ Carbon sources and fluxes related to gashydrates**
- **@ CO_2 sequestration experiments**
- **@ Slope stability and submarine landslides**

Ends here

IODP Platforms

D/V *JOIDES Resolution*

D/V *Chikyu*

Mission Specific Platforms
e.g. *Icebreaker Vidar Viking*