IODP-GEOPRISMS SYNERGIES

Box 2.2. GeoPRISMS Overarching Themes (Described in Section 3)

- Origin and Evolution of Continental Crust
- Fluids, Melts and Their Interactions
- Tectonic-Sediment-Climate Interactions
- Geochemical Cycles
- Plate Boundary Deformation and Geo-dynamics

IODP New Science Plan

1. Climate and Ocean Change: Reading the Past, Informing the Future
2. The Biosphere: Co-evolution of life and the Planet
3. **Deep-Earth Processes**
4. **Earth in Motion: Geohazards, fluid flow and active experimentation**

IODP NEW SCIENCE PLAN

Deep Earth Processes

- Renewing Earth's surface
- The reactive earth crust: rocks, fluids and life
- Recycling the crust: Arcs and continents

Earth in Motion

- Geohazards: Earthquakes, landslides and tsunamis
- Fluids in motion: Agents of mechanical, thermal, chemical and biological change
- Continued presence on the seafloor

GEOPRISMS (SCD) SCIENCE PLAN

- Great subduction-zone earthquakes
- Deformation across the subduction plate boundary
- Volatile, fluids, melts: storage, transfer, release and effects
- Geochemical products of subduction zones and formation of new continental crust
- Subduction zone initiation and development of mature arc systems
- Feedbacks between surface subduction processes

NISP

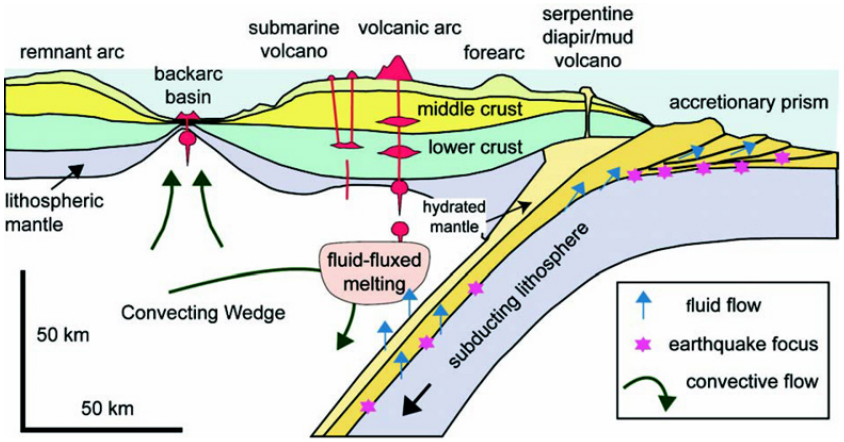
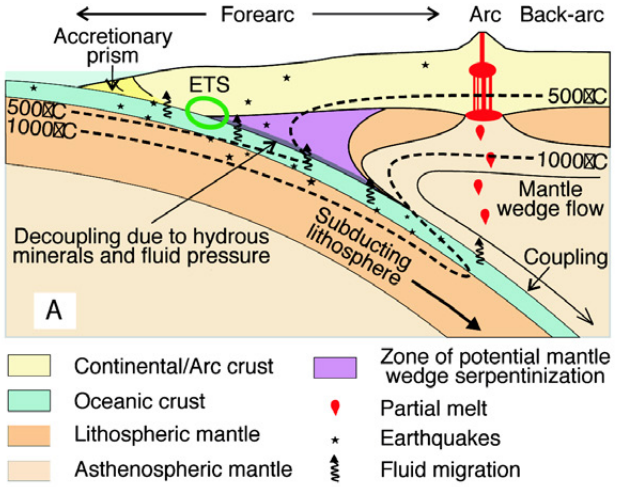


Figure 4.5: Structure of subduction zone, associated magmatic arc and back-arc basin. NanTroSEIZE drilling is currently investigating seismogenic processes in accretionary prism. Deep drilling to understand the magmatic processes that form mid-arc crust and shallower drilling to investigate submarine volcanic and hydrothermal pro cesses in arc and back-arc basin are potential targets.

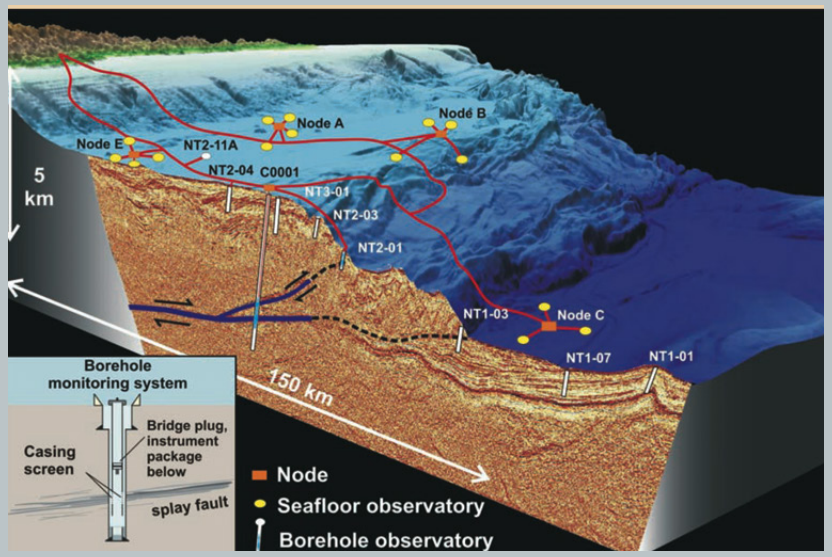
GEOPRISMS



While not all, some critical objectives described in the Geoprisms Science Plan require access to the deep Earth sampling and monitoring, which can only be achieved by scientific drilling

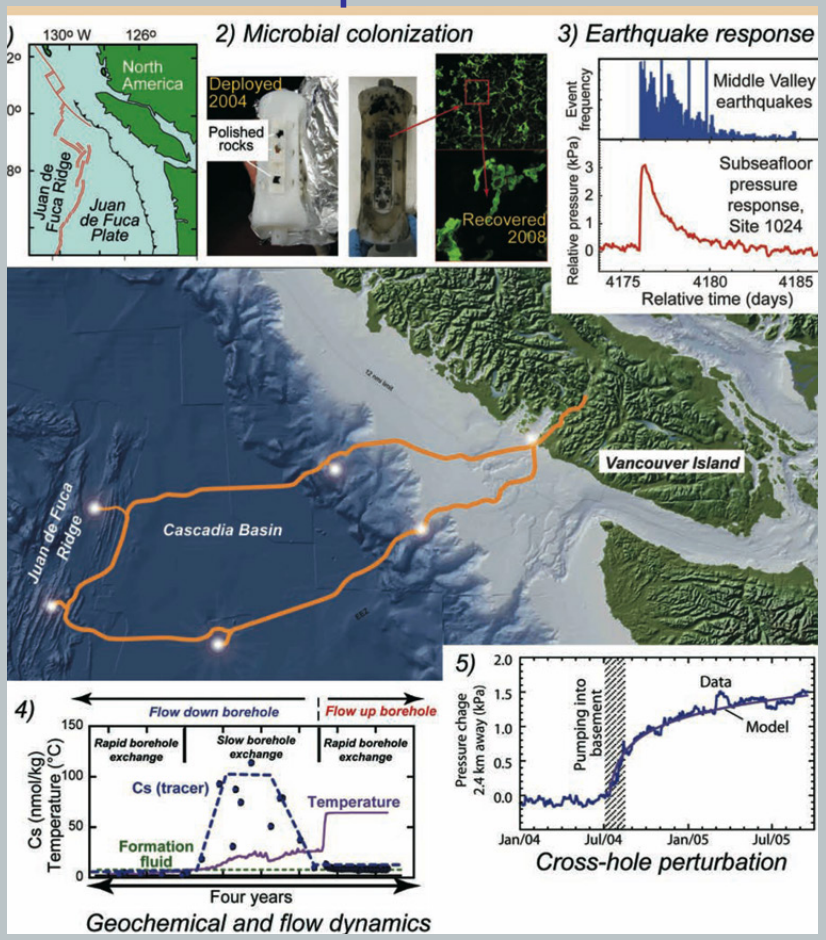
Figure 4.5. (A) Figure from Wada and Wang [2009] showing an example for a young slab subduction zone, and including the locations of slab dehydration relative to key mechanical and rheological transition along the subduction interface, including the seismogenic zone and its downdip edge where ETS has been observed, potential serpentinization of the mantle wedge , and kinematic coupling between the downgoing slab and mantle wedge. (B)

NISP-Box 5.3: “Stethoscope” on Earthquake Faults



DONET cabled observatory network in the Nankai Subduction zone: calibration and verification of models, monitor and sampling, active perturbation experiments, early warning system

NISP-Box 5.1: Borehole Experiments



Linking lithospheric, hydrogeologic and microbial systems- Planned network at NEPTUNE Canada

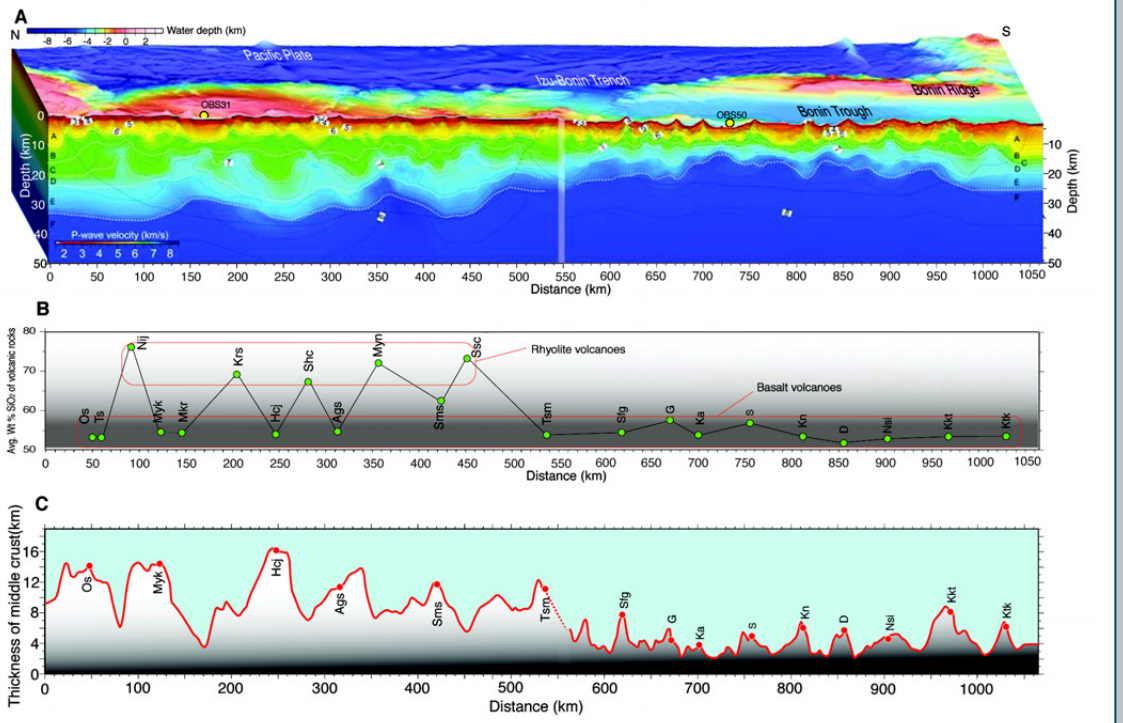


Figure 4.14. (A) Along-strike seismic velocity structure of arc crust in the Izu-Bonin arc [Kodaira et al., 2007], showing ?nely-resolved variations in crustal thickness. (B) The composition of lavas erupted at Izu-Bonin frontal arc volcanoes correlates with (C) the thickness of the low-velocity (Vp=6.0-6.5) middle crust beneath each volcanic center.

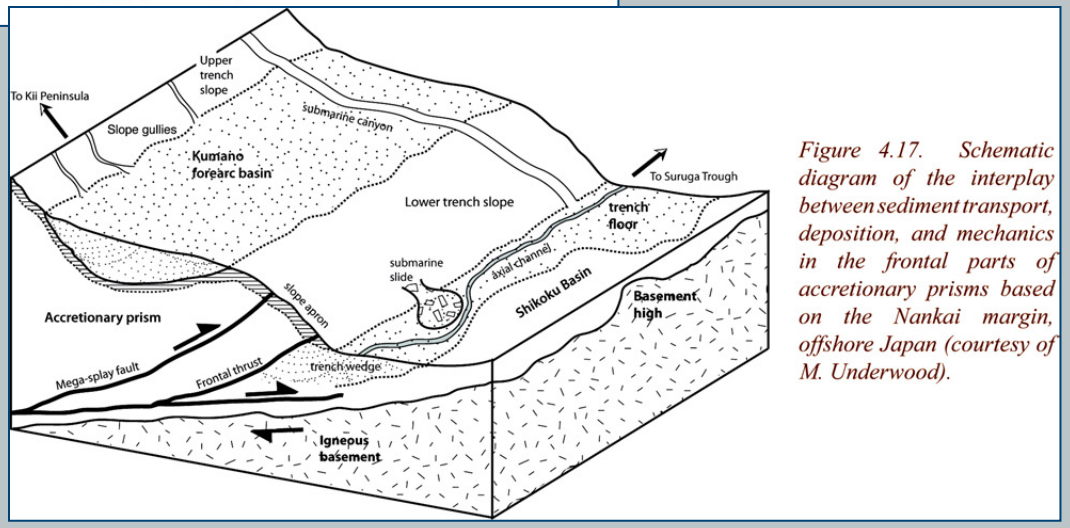
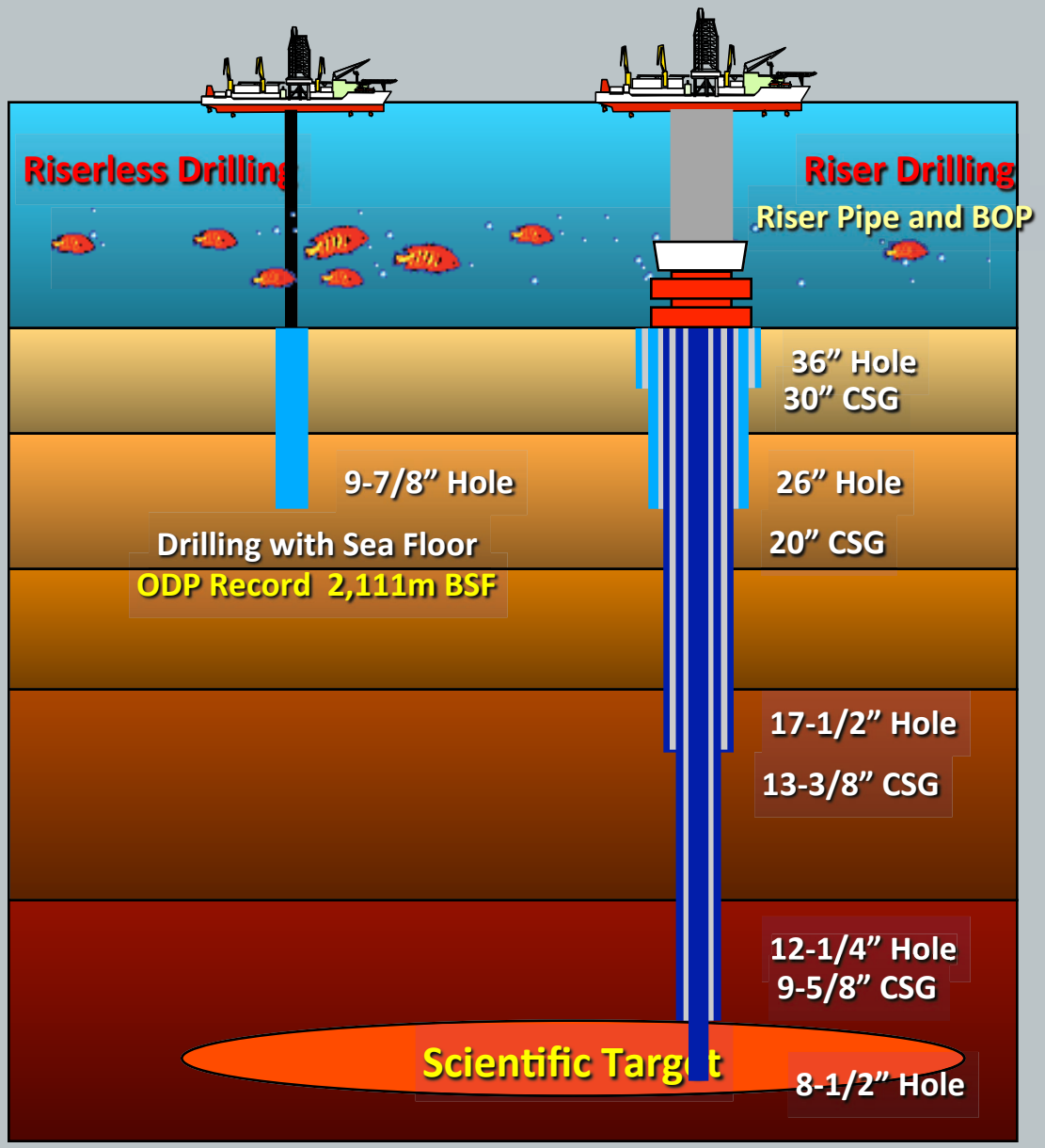
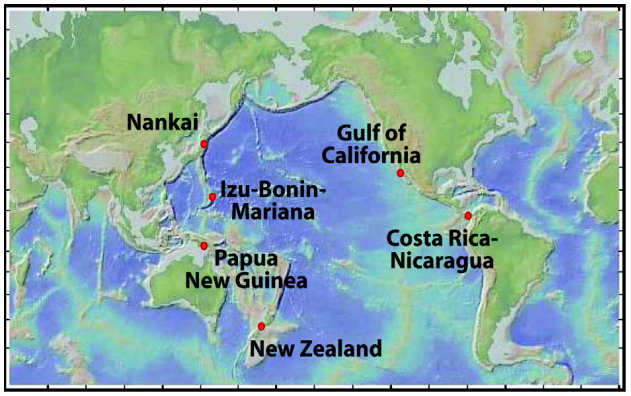
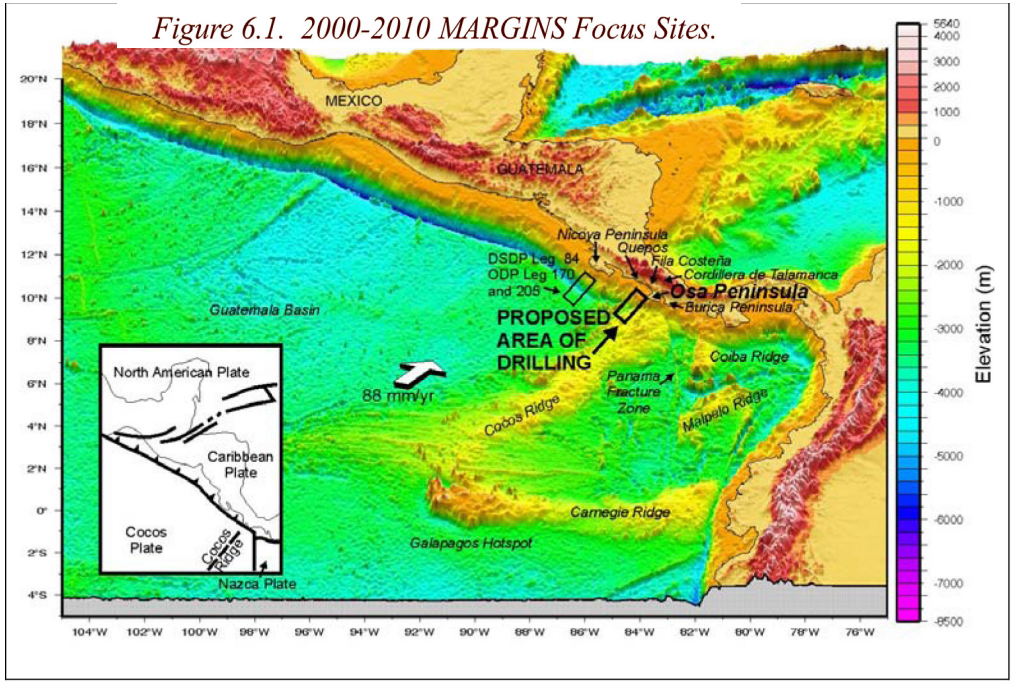


Figure 4.17. Schematic diagram of the interplay between sediment transport, deposition, and mechanics in the frontal parts of accretionary prisms based on the Nankai margin, offshore Japan (courtesy of M. Underwood).


Riserless Drilling
Riser Drilling
Riser Pipe and BOP
36” Hole
30” CSG
9-7/8” Hole
26” Hole
Drilling with Sea Floor
20” CSG
ODP Record 2,111m BSF
17-1/2” Hole
13-3/8” CSG
12-1/4” Hole
9-5/8” CSG
Scientific Target
8-1/2” Hole

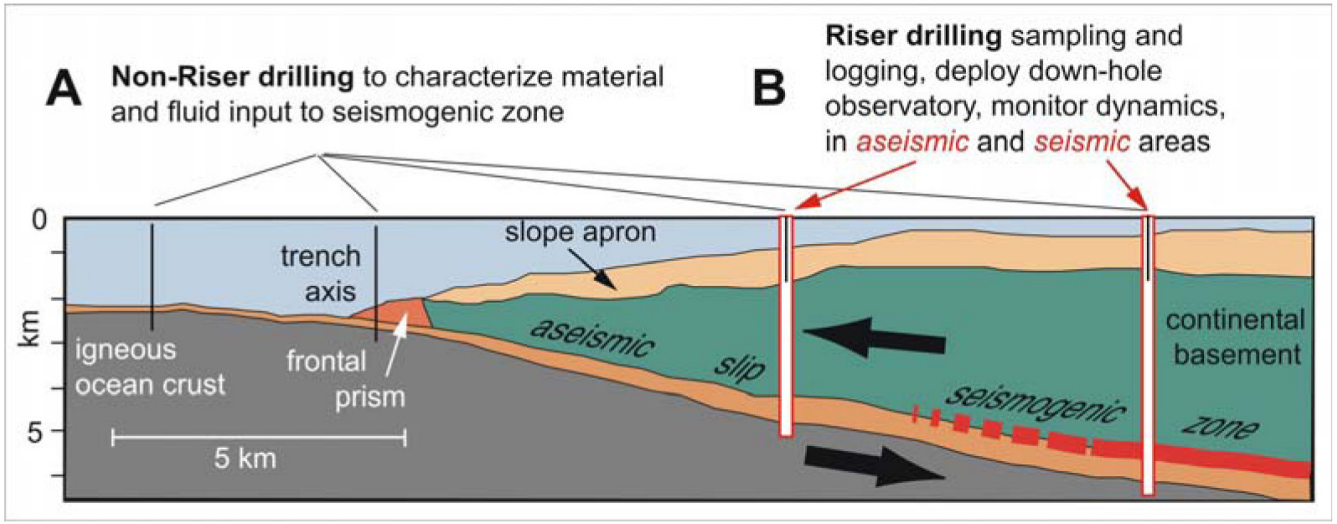
CRISP: Sampling the seismogenic zone in an erosive plate boundary





- Transition from stable to unstable slip corresponds to transition from fluid rich to drier fault
- Fluid pressure affect localization of faulting and locking
- Geological, physical and structural characteristics influence fault mechanics and transition from stable to unstable slip
- Plate relief, thickness of subduction channel, material/fluid properties affect seismogenesis and rupture propagation

CRISP-A: Proposal 537A-Full

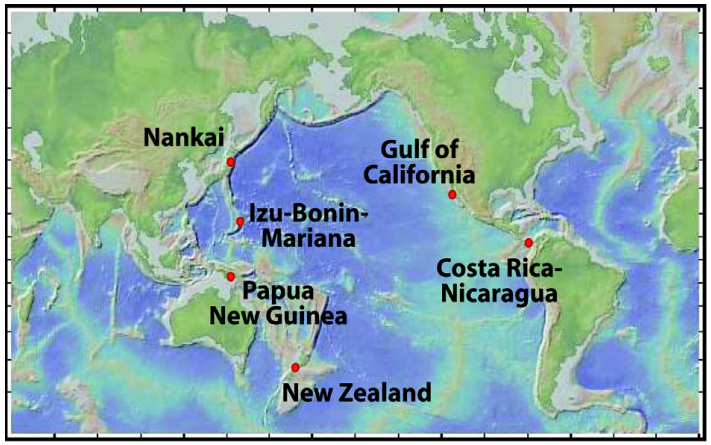


Submitted 30 June 2006

Program A- Characterization of subducting plate, sampling shallow decollement, installing long term observatories

Drilling 5 sites, two of which will be deepened during program B (riser drilling)

EXP 334 (scheduled for Mar-April 2011, 29 days) will only drill 2 of the proposed sites: Slope sites CRIS 3B and 4A



USIO *JOIDES Resolution*

Expedition Schedule

Figure 6.1. 2000-2010 MARGINS Focus Sites.

Expedition	Expedition Number	Port (Origin)	Dates[1,2]	Total Days (Port/Sea)	Days at Sea (Transit[3]/ Operations)	Co-Chief Scientists
South Pacific Gyre	329	Papeete, Tahiti	9 October–13 December 2010	65 (4/61)	9/52	S. D'Hondt F. Inagaki
Louisville	330	Auckland	13 December 2010–12 February 2011	61 (5/56)	8/48	A. Koppers T. Yamazaki
Transit		Auckland	12 February–15 March 2011	31 (5/26)		
CRISP	334	Puntarenas, Costa Rica	15 March–13 April 2011	29 (2/27)	1/26	P. Vannucchi K. Ujiie
Superfast[5]	335	Puntarenas, Costa Rica	13 April–3 June 2011	51 (4/47)	7/40	D. Teagle B. Ildefonse
Non-IODP			3 June–16 September 2011			
Mid-Atlantic Microbiology	336	Bridgetown, Barbados	16 September–19 November 2011	64 (4/60)	10/50	K. Edwards W. Bach
Mediterranean Outflow[6]	339	Ponta Delgada, Azores	19 November 2011–19 January 2012	61 (5/56)	5/51	TBD

JR (non-Riser) Plans

SPC-approved FY12 plan

- 18 Sept-17 Nov. 2011 Mid-Atlantic Microbiology
- 20 Nov.-18 Jan. 2012 Med Outflow plus APL
- 20 Jan.- 15 May Non-IODP
- 15 June - 2 Aug. Cascadia***
- 5 Aug.- 2 Oct. S. Alaska

****contingent of funds and engineering development plan*

POTENTIAL FY13 shiptrack

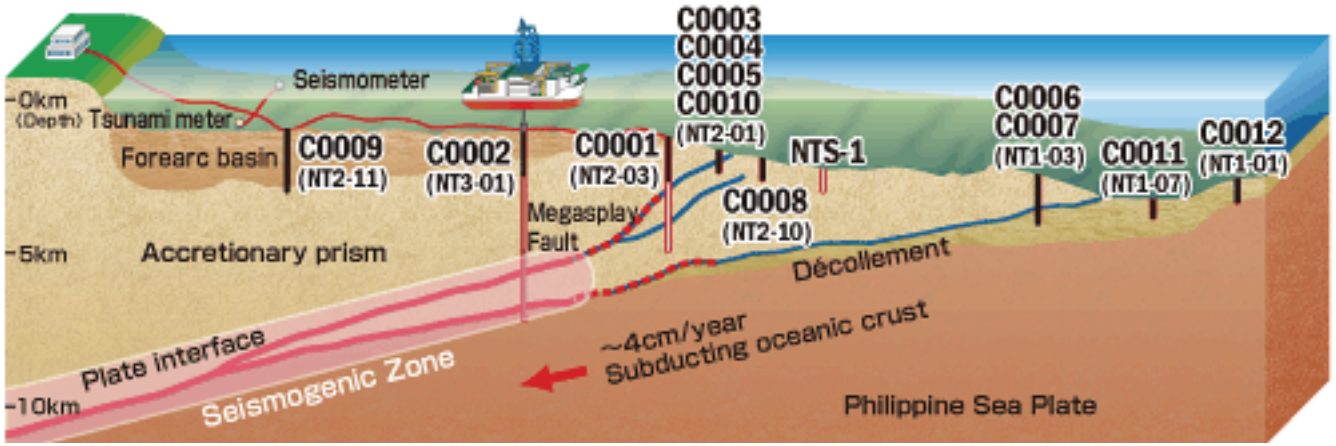
- Interval of non-IODP work
- Operations in the Western Pacific
- Transit and operations in the Indian Ocean.

POST 2013

- NSF is bargaining for 12 month operations….

NanTroSEIZE

Nankai Trough Seismogenic Zone Experiment



Proposal History

2001-09 First pre-proposal 603-Pre was submitted

2002-10 First Complex Drilling Project proposal 603-CDP was submitted

2004-06 603-A and –B were ranked #2 and #3 in SPC meeting

2004-10 First Project Scoping Group meeting

~ 2007 Multi-stage, multi platform project plan developed

NanTroSEIZE

Nankai Trough Seismogenic Zone Experiment

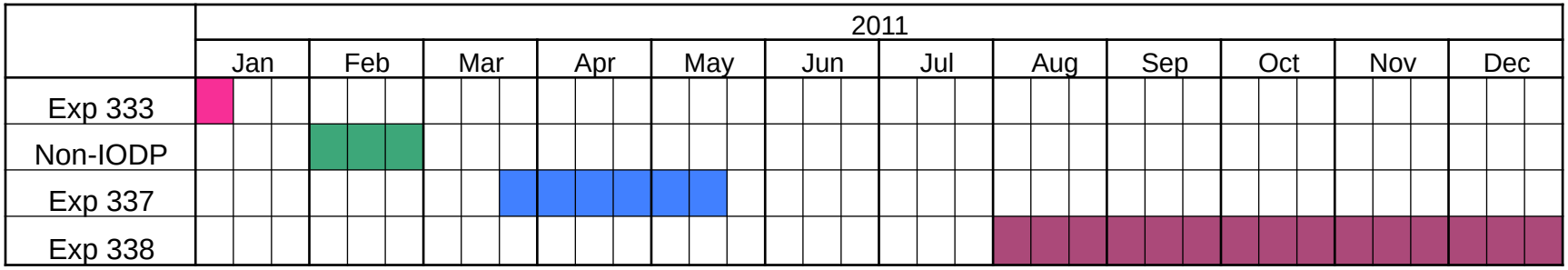
Stage 1 (2007 Sep to 2008 Jan)		
Exp 314	Kinoshita & Tobin	LWD across the transect C1 to C6
Exp 315	Ashi & Lalleman	Coring at C1 and C2, up to 1057 mbsf
Exp 316	Kimura & Screaton	Coring at C4, C6, C7 and C8 up to 493.5 mbsf
Stage 2 (2009 May to 2009 Oct)		
Exp 319	Araki, Byrne, McNeill & Saffer	Observatory installation at riser C10 and riserless C9
Exp 322	Saito & Underwood	Input sites coring at C11 and C12
Stage 2 (2010 Jul to 2011 Jan)		
Exp 326	Kinoshita & Tobin	Riser top hole installation at C2
Exp 332	Araki & Kopf	Observatory replacement/installation at C10 and C2
Exp 333	Henry & Kanamatsu	Shallow coring at input sites C11, C12 and MTD deposits site NTS-1

NanTroSEIZE

Nankai Trough Seismogenic Zone Experiment

- Site C0002 is the centerpiece of the NanTroSEIZE project, intended to access the plate interface fault system, which slipped coseismically in the 1944 Tonankai earthquake and a very low frequency (VLF) seismic events that occurred in 2004-5.
- The primary targets include both the basal décollement and the reflector known as the “mega-splay fault”.
- The mega-splay fault reflection lies at an estimated depth of 5200 mbsf and the top of subducting basement at ~6800 mbsf. The planned ultimate target depth for this site is 7000 mbsf.
- Exp 338 will deepen the hole to 3300 mbsf.

Chikyu Plans



- Japan Drilling Company (JDC), using D/V Chikyu, procured a contract starting mid 2011 for exploration drilling offshore Sri Lanka (Notice: Nov 15-19, 2010).

- NanTroSEIZE Riser drilling planned for 2011 will be postponed.

- **New plan**: collapse the planned 2011 and 2012 NanTroSEIZE drilling efforts into one single, long operation starting around mid-year 2012. Advancing the seismogenic zone project in the subsequent and final year of IODP (2013) to penetrate and sample the mega-splay fault at around 5 km depth (plate boundary at around 7 km depth).

http://iodp.org/index.php?option=com_content&task=view&id=536&Itemid=1195

…from NSF

Problem now: Whereas the original understanding was that Chikyu was built for IODP, it has become clear that the importance of IODP within JAMSTEC has dropped considerably

Not only industry but other Japanese agencies: gas hydrate and drilling to the Moho

NSF response: VERY frustrated

Short time response (Nantroseize) Negotiations resulting from the schedule change resulted in added 4 months of drilling.

Consulted with PMT

Need a warranty letter from JAMSTEC-still waiting for it to go up the contractual change.

Longer time (?)

All still in negotiations BUT under consideration is the stop of international funds to Chikyu. A program not quite as integrated (consortium). More of a US control=more science community input

No longer give priority funding to Chikyu over other platforms. Talks about extra $ for Chikyu are no longer happening

Not known the role of Japan in the new international program, with not as strong leadership from Japan

Future of Riser drilling- No answer from NSF

Top-hole mud circulation system (mud circulated for borehole control)

- Intriguing possibility. Industry is interested, including JR

  BUT

- JR may be too small; No funding at hand to do this; 10-15 years from now

Advice, issues to consider

- Are resources really available to deliver the plan (National Academy Board)
- Going from 1 km to 3 km makes an ENORMOUS difference. Deep holes need t be treated as “going to Saturn”
- With the changes in funding (recession, allocations, leadership changes)- Need to be FLEXIBLE and plans need to be SCALABLE depending on resources available with identifiable benchmarks
- Program needs to be realistic and achievable with resources available

GeoPrisms-themed proposals in SPC-OTF

603AFull2	NanTroSEIZE Phase 1: Reference Sites	OTF	Underwood	Active Partially Drilled	NR	Pac
603BFull2	NanTroSEIZE Phase 2: Mega-Splay Faults	OTF	Kinoshita	Active Partially Drilled	R+ NR	Pac
603CFull	NanTroSEIZE Phase 3: Plate Interface	OTF	Suyehiro	Active	R	Pac
603DFull2	NanTroSEIZE: Observatories	OTF	Screaton	Active	NR	Pac
633Full2	Costa Rica Mud Mounds	OTF	Br[illegible]kmann	Active	NR	Pac
659Full	Newfoundland Rifted Margin	OTF	Shillington	Active	NR	Atl
681Full2	Lesser Antilles Volcanic Landslides	OTF	Le Friant	Active	NR	Atl
693APL	S. Chamorro Seamount CORK	OTF	Wheat	Active	NR	Pac
637Full2	New England Shelf Hydrogeology	OTF-Hold	Person	Active	MSP	Atl
589Full3	Gulf of Mexico Overpressures	SPC	Flemings	Active Partially Drilled	NR	Atl
703Full	Costa Rica SeisCORK	SPC	Brown	Active	NR	Pac
748Full2	Nice Airport Landslide	SPC	Stegmann	Active	MSP	Med

GeoPrisms-themed active proposals

Proposal	Short title	Lead proponent	Geoprism objectives	Platform/ # sites (depth penetration)
696F3	Izu-Bonin-Mariana Deep Forearc Crust	Pearce	Subduction Initiation and ophilite models	Non-riser IBM-2 (old Site 786B) 1500m
698F3	Izu-Bonin-Mariana Arc Middle Crust	Tatsumi	Continental crust formation Intra-Oceanic arc	Riser IBM-4 (5500 m) (2km middle crust)
692F	Flemish Cap Rifted Margin	Hopper	Continental thinning	Non-riser 5 sites (500-250 m)
704F2	Sumatra Seismogenic Zone	Goldfinger	Forearc development and Earthquake rupture	Non-riser SUMA 4B (800m) SUMA 5B (1200m) SUMA 7A (700m)
707CDP3	Kanto Asperity Project: Overview	Kobayashi	Complex drilling umbrella proposal	Non riser and Riser
710Pre2	Gulf of Corinth Rift	McNeill	Continental extension and early rift development	Non-riser 6 sites (400-2000m)
715F	Mediterranean Landslides	Camerlenghi	Submarine landslides	Non-riser 17 sites (200-600m)
725F2	NE Atlantic Volcanic Rifted Margin	Huismans	Volcanic rifted margins	Riser and Non-riser 12 sites (250-4000m)
740F	Galicia Margin Rift History	Reston	Crustal breakup, detachment techtonics	Non-riser 8 sites (600-1900m)
749Pre	Gulf of California Rifting & Microbiology	Teske	Continental rifting: geomicrobiology	Riser (?) (~200°C) 10 sites (400-1300m)
770F2	Kanto Asperity Project: Observatories	Sato	Geodetic and geophysical monitoring of slow slip events	Non-riser 6 sites (300 to 650 m penetration)
781Pre	Hikurangi subduction margin	Wallace	Slow-slip events	Non riser and riser HSM-01A (1140m) HSN-01B (6000 m) HSM-02A (320 m) HSM-03A (1160 m)
782Pre	Kanto Asperity Project: Plate Boundary Deformation	Yamamoto	Types of seismicity at Slow-slip and stick-slip asperities	Riser KAP-7 (6950m) KAP-8 (6500m)

Post-2013 scientific ocean drilling program

- New process and structure will promote greater programmatic investment in community development of proposals and use a streamlined evaluation structure/process
- Names of new panels are still floating around. Currently two panels: PEP (Proposal Evaluation Panel) and SEA (Science Executive Authority)- to take on the responsibilities currently held by SSEP, SPC and SASEC
- Terms of Reference- Drafts have been floating around, but not clear yet
- SASEC will likely determine names and Terms of Reference in its January meeting.

Proposal evaluation Post 2013

- First proposal deadline will be 1 Oct., 2011.
- The new SAS will encourage community to nature proposals through workshops.
- Proponents are expected to submit fairly mature proposals.
- Proponents will have only one chance to revise.
- IOs will be involved in proposal evaluation.

Proposal evaluation Post 2013

- First proposal deadline will be 1 Oct., 2011.
- The new SAS will encourage community to nature proposals through workshops.
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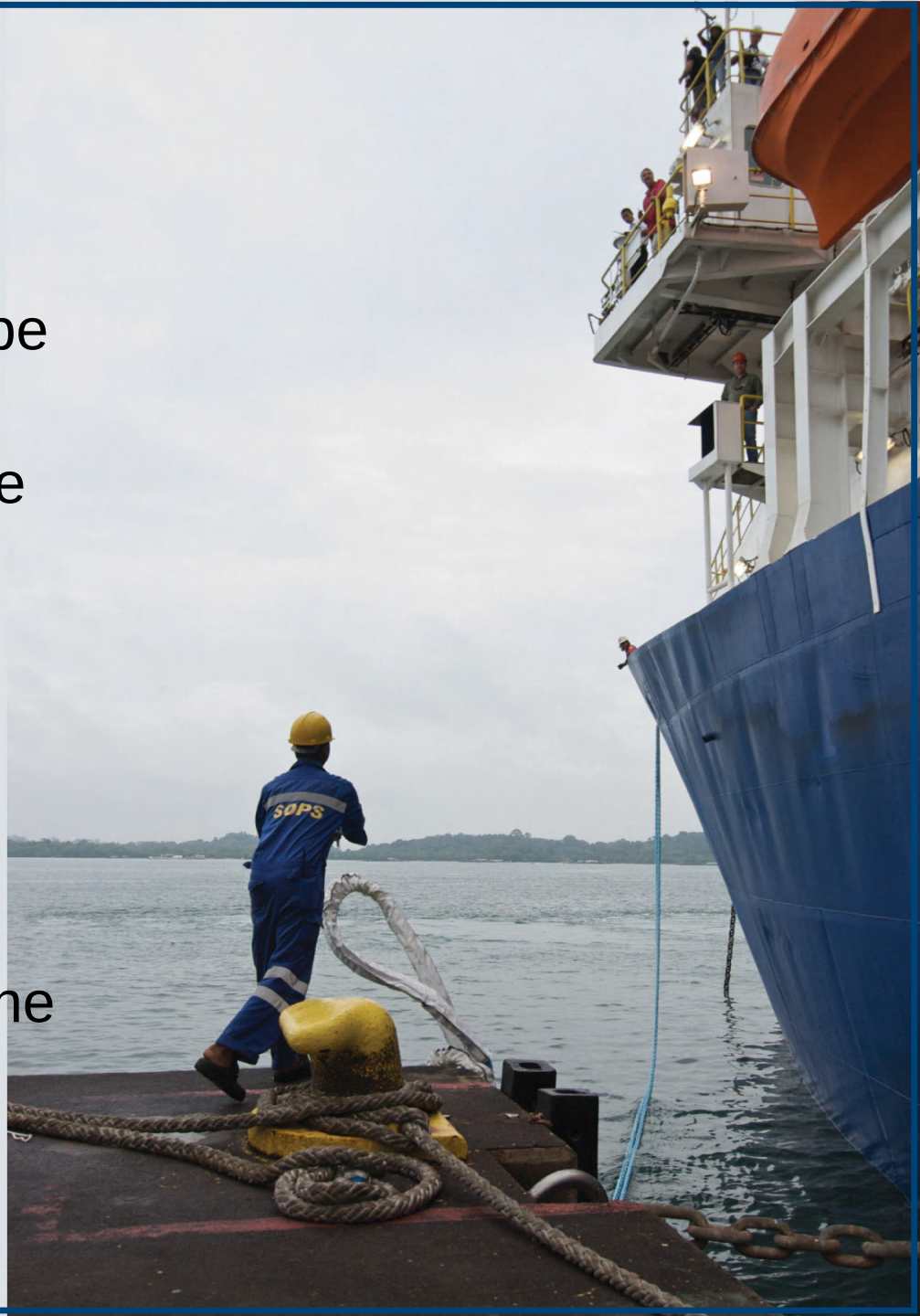
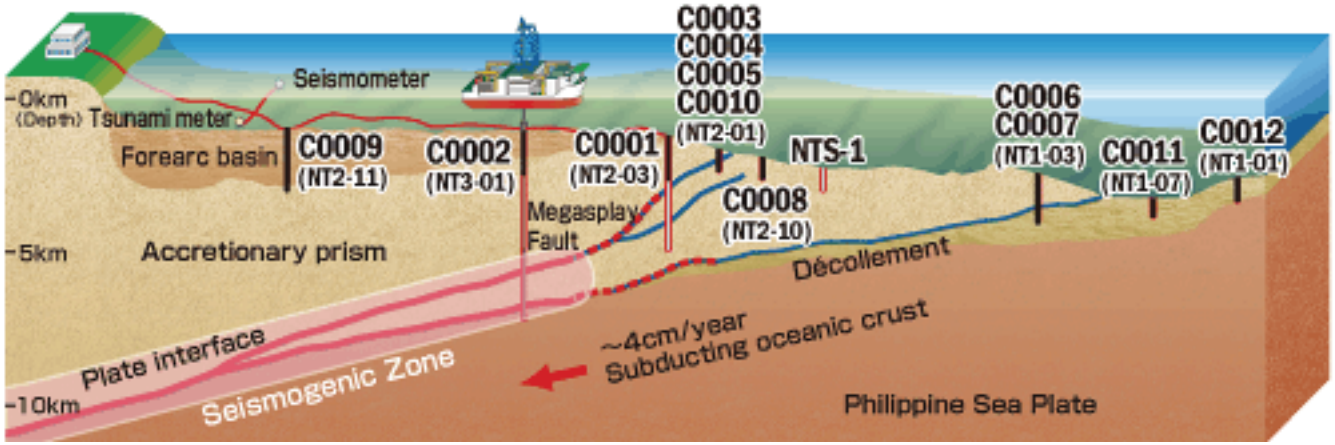
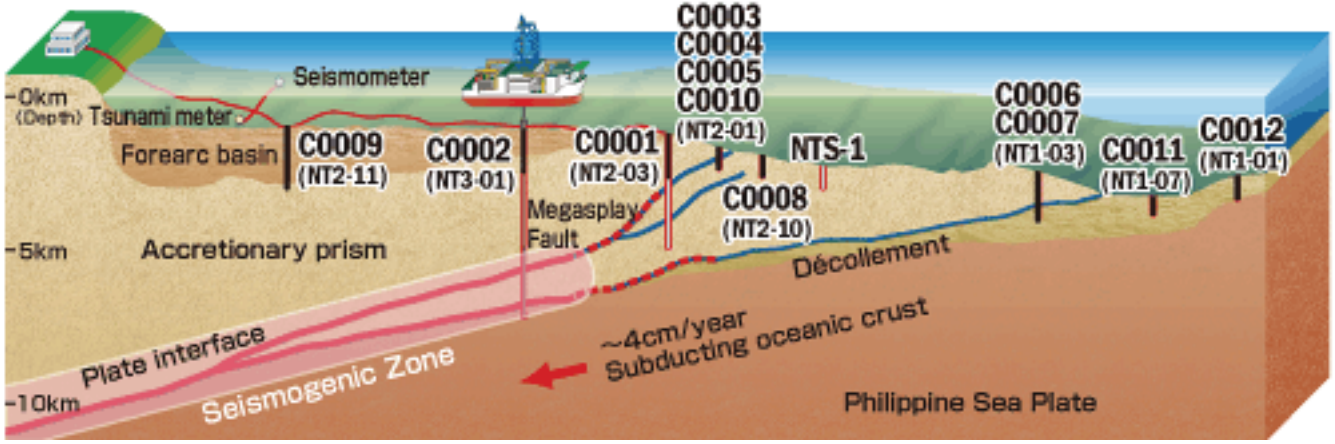




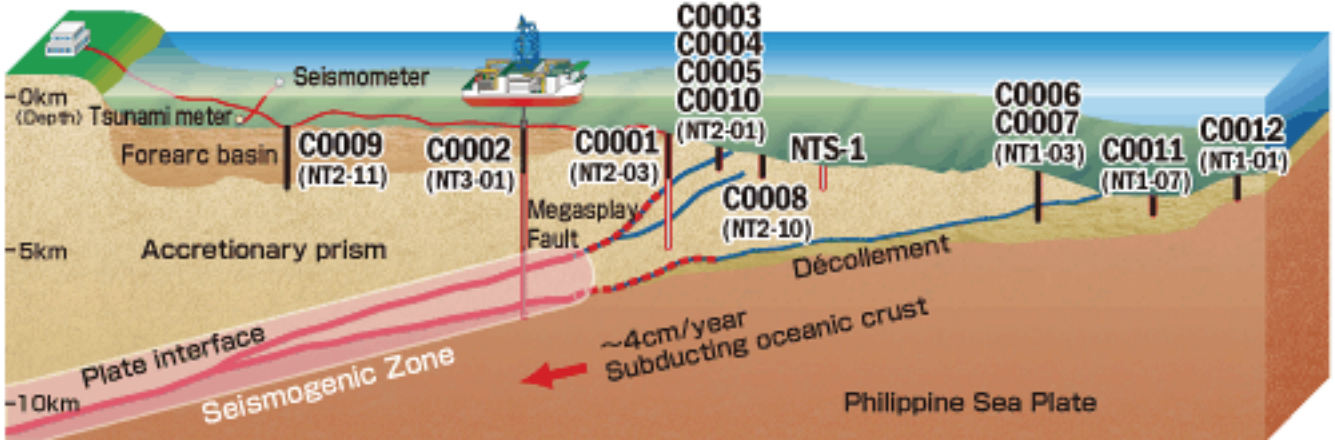
Exp 326	NanTroSEIZE Plate Boundary Deep Riser 1	15 July to 20 Aug	(H. Tobin) (M. Kinoshita)
Exp 331	Okinawa Deep Hot Biosphere	1 Sep to 4 Oct	Ken Takai Mike Mottle
Exp 332	Riserless Observatory 2	25 Oct to 12 Dec	Achim Kopf Eiichiro Araki

Exp 326: Installed a casing to 872.5 mbsf and a wellhead at Site C0002. This hole will be used for the deep riser drilling to 7 km bsf.

Exp 332: Installing a permanent riserless CORK observatory at Site C0002. Replace the temporary observatory with a newly designed sensor at Site C0010.



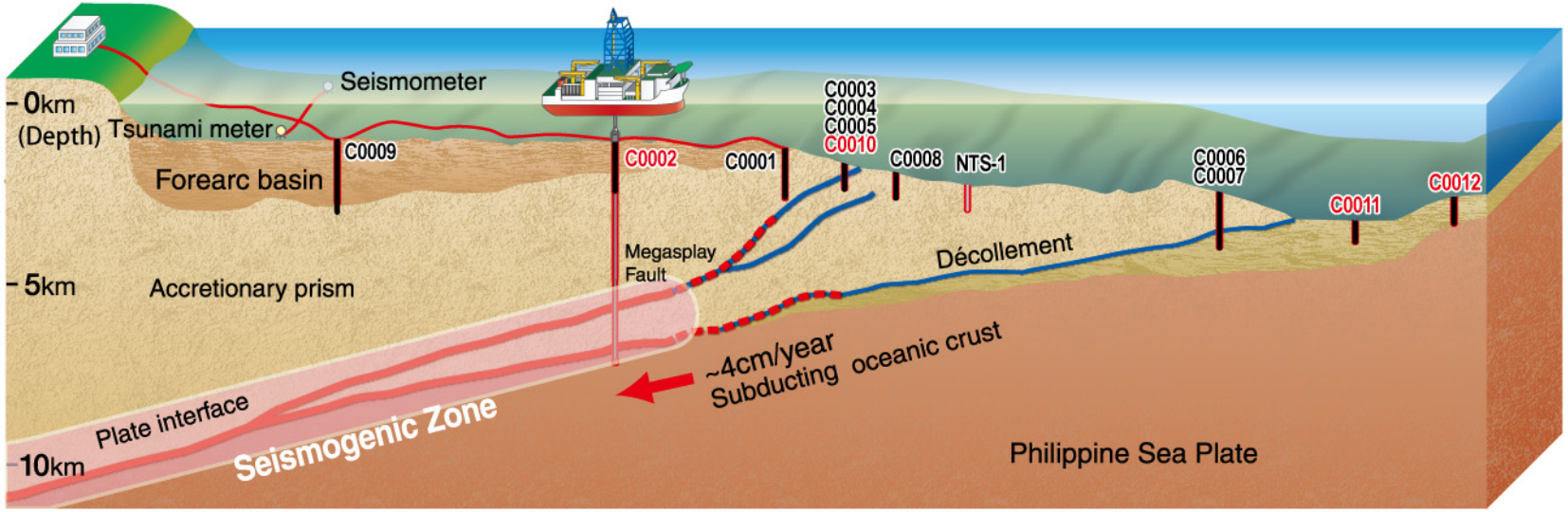
Exp 333	**Inputs Coring 2 and Heat Flow** *Coring and heat flow measurements at inputs sites (C0011 and C0012). Coring mass transport deposits associated with major splay fault (NTS-1A).*	12 Dec to 10 Jan	Toshiya Kanamatsu Pierre Henry
non-IODP			
Exp 337	Coalbed biosphere Shimokita	March - May, 2011	F. Inagaki Kai-Uwe Hinrichs
non-IODP			



Exp 338	**NanTroSEIZE Plate Boundary Deep Riser - 2** • Deepen the Hole C0002F to 3300 mbsf. The riser hole is intended to access the plate boundary faults at an ultimate depth of 7000 meters. • Spot coring within the inner wedge accretionary complex • LWD and wireline logging, downhole stress, pore pressure and permeability tests, • A zero-offset and/or walkaway VSP	Aug 2011 to Jan 2012	TBD

NanTroSEIZE

Nankai Trough Seismogenic Zone Experiment



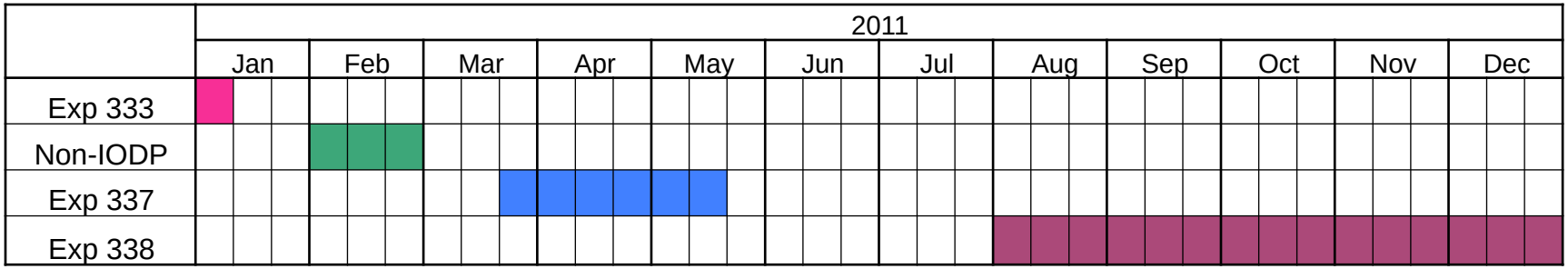
NanTroSEIZE

Nankai Trough Seismogenic Zone Experiment

Future plan

- IODP Site C0002 is the centerpiece of the NanTroSEIZE project, intended to access the plate interface fault system, which slipped coseismically in the 1944 Tonankai earthquake.
- This zone also coincides with the location of very low frequency (VLF) seismic events occurred in 2004-5.
- The primary targets include both the basal décollement and the reflector known as the “mega-splay fault”.
- The mega-splay fault reflection lies at an estimated depth of 5200 mbsf and the top of subducting basement at ~6800 mbsf. The planned ultimate target depth for this site is 7000 mbsf.
- Exp 338 will deepen the hole to 3300 mbsf.

Chikyu's schedule in 2011



Exp 337: Deep coalbed biosphere off Shimokita

Riser drilling to 2200 mbsf, targeting bio-geochemical process in and around the coal bed.

Exp 338: NanTroSEIZE Deep plate boundary riser 2

Extending the top hole at C2 to 3300 mbsf, by riser drilling with LWD and spot cores.

All operation schedule is subject to change

- The full range of NanTroSEIZE investigations will occur in four stages:

- * Stage 1, calls for drilling and sampling at six drill sites to characterize the region's geology and provide geotechnical information for subsequent deep riser drilling (see Figure 1).
- * Stage 2 involves drilling the first of two deep holes, using Chikyu's unique riser drilling technology to target the mega-splay fault zone (where an array of faults occur) at ~3,500 meters below the seafloor.
- * Stage 3 focuses on 6,000-meter deep drilling into the seismogenic zone and across the plate interface into subducting crust.

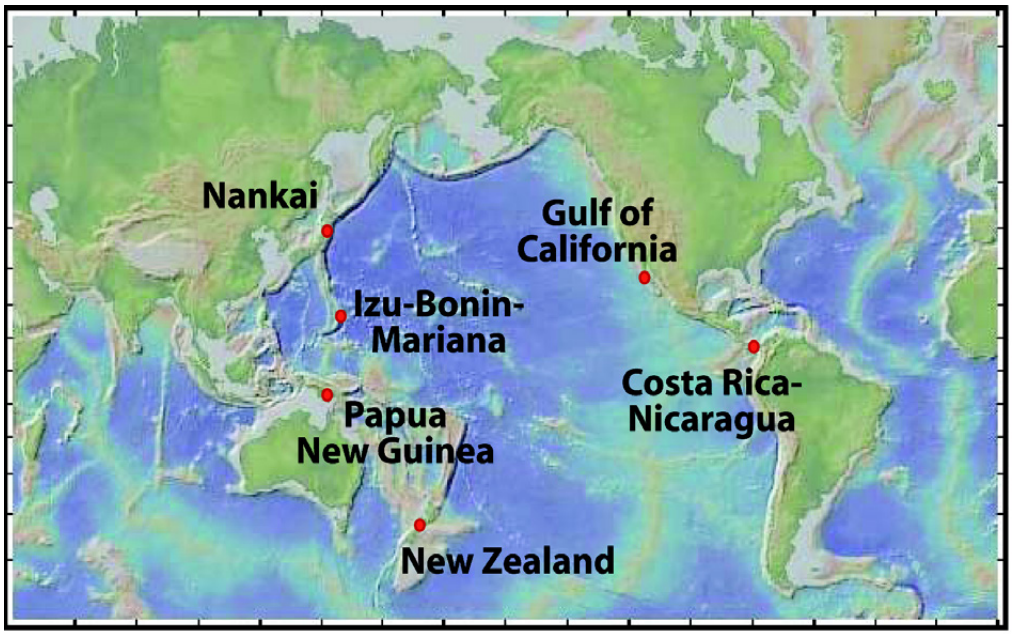


Figure 6.1. 2000-2010 MARGINS Focus Sites.