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Cruise report of KY11-06 Leg1

Cruise : KY11-06 /Leg1 / R/V Kaiyo
Research subject: Construction of Seafloor observation Network for Earthquakes and Tsunamis
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Research area : Kumano-nada
Cruise period : 2011/04/10(Sun) ～ 2011/04/18(Mon)

1. Background and Overview.

R/V Kaiyo departed from Yokohama Yamashita pier on Apr. 10 for off-Kumano area to construct submarine cable network for Earthquakes and Tsunamis (DONET). DONET is a scientific seafloor cabled observation network for observation of earthquake and tsunamis in the epicenter area of the expected Tonankai earthquake in the Nankai Trough.

The objective of the KY1106 Leg 1 cruise is to construct cased boreholes to install ocean bottom seismometers for the DONET. Ocean bottom seismographs for the DONET are installed in the borehole so that seafloor current does not interfere with the seismometer. All the boreholes were made by placing a casing in the seafloor with a tool called "Seafloor casing installing piston corer". In this cruise, total of 8 locations for borehole installation was planned. During the leg (Apr 11 to 18), Kaiyo deployed seafloor casing for ocean bottom seismographs using a seafloor casing installing piston corer for 10 times in 9 locations. After completing casing installation, Kaiyo arrived JAMSTEC headquarter pier on Apr 18th to conclude the first leg of the cruise.

2. Seafloor casing installing piston corer

Seafloor casing installing piston corer (Fig 1) is a tool developed by JAMSTEC for placing casing in the seafloor for making a borehole for ocean bottom seismograph installation. The tool holds a casing to form a borehole in the seafloor. The tool is lowered into the seafloor similarly to a piston corer and free fall when approached near the seafloor. When the piston corer penetrates in the seafloor, the casing can be released, and the corer is recovered.

When the casing is released, the corer also deploys an acoustic transponder (ROV homer) in the seafloor so that ROV can find the deployed casing in the seafloor easily in the following ROV visit to the location. When the corer penetrates in the seafloor in more than 10 degrees tilt, the casing will not be released because the ocean bottom seismographs may not be functional in such tilted borehole. The corer also obtain seafloor core sample. The core sample provides useful information such as type of seafloor material to assess seafloor environment for seismic observation.

Throughout the cruise, the length of suspension wire of the piston corer is chosen so that the corer free falls at 3.2 m above the seafloor (main wire length of 9.3m and pilot corer wire length of 7.6 m).

3. Results

Total of 10 coring in 9 different locations of 7 sites was performed during the cruise. Summary of seafloor casing installation is shown in Table 1-1 and 1-2. The table describes the time and location of deployed casing, the acoustic ID of deployed transponders, whether the casing was released or not, the length and description of obtained core sample, and the tilt of the deployed casing. These locations are shown in the maps (Fig 2 to 5).

The first coring at B-7 site resulted in failure in both coring and casing installation. The casing tilted after releasing it due to insufficient penetration by the gravel pumice layer. This casing is not suitable for seismometer installation. In E-20c location, the first trial was failure due to tilted casing more than 10 degrees. We retried in the same location and the second trial was successful.

In some of the locations (B-7, D-15, C-11), the first shot did not penetrate casing enough to allow seismometer installation in the casing by ROV. This was mainly due to hard surface sedimentary material such as sand and pebbles. In such cases, we reconsidered the location of the casing installation for softer seafloor sediment, if we can find appropriate alternate location. Coring in level seafloor location yielded better penetration except for a site near trench (C-11b) where hard turbidity silty sand seems spread around the location.

As a result of casing installations, we established 6 locations (B-7d, C-12d, D-13b, D-15d, E-19d, E-20c) suitable for seismometer installation where casing is installed with enough penetration in the seafloor. Two locations (D-15c and C-11b) have a casing installed but these are insufficient penetration. One location (B-7c) has a casing dropped in the seafloor.

4. Conclusions

During the KY1106 Leg 1 cruise, we established 6 locations (B-7d, D-13b, C-12d, D-15d, E-19d, E-20c) suitable for seismometer installation where casing is installed with enough penetration in the seafloor. In the following cruises with ROV Hyper Dolphin, seismometer will be installed in these locations to start long-term seismic observation with connection to the DONET network.

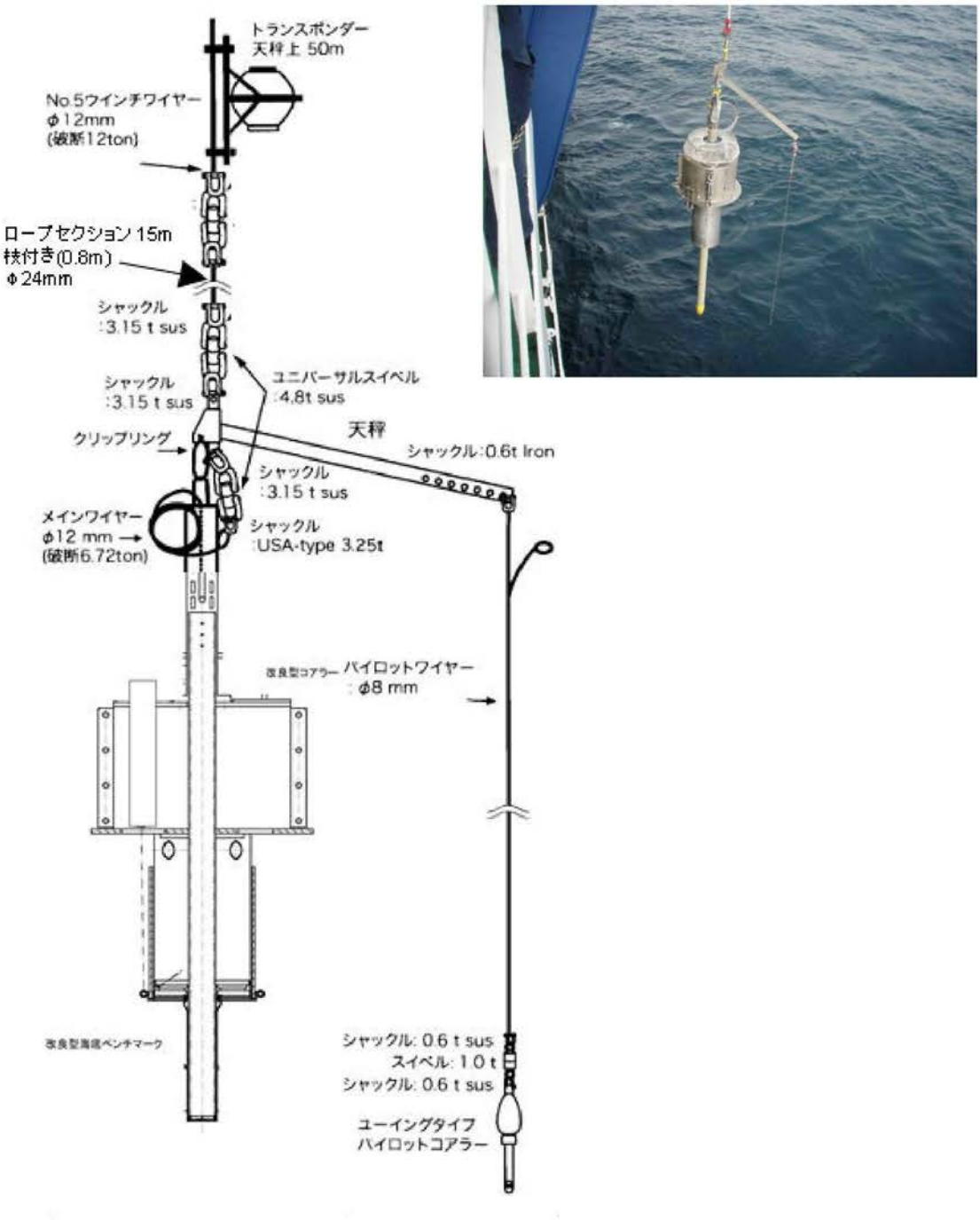

Figure 1. Seafloor casing installing piston-corer.

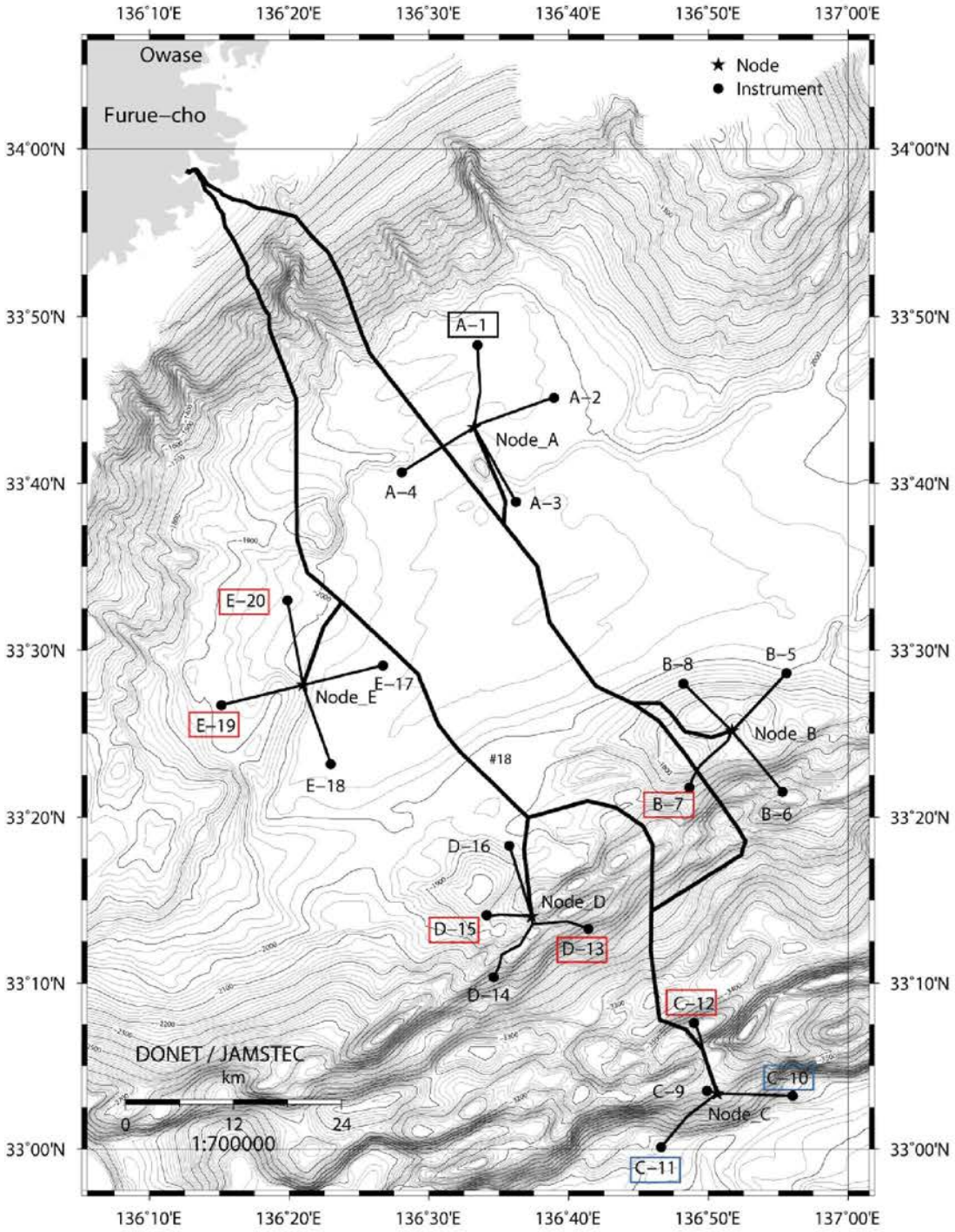

Figure 2 Location map of DONET network in the Nankai Trough.

Site name with squares: Seismometer to be installed. (black: casing prepared in the previous cruises, red: casing prepared during KY1106 cruise, blue: casing prepared with partial penetration).

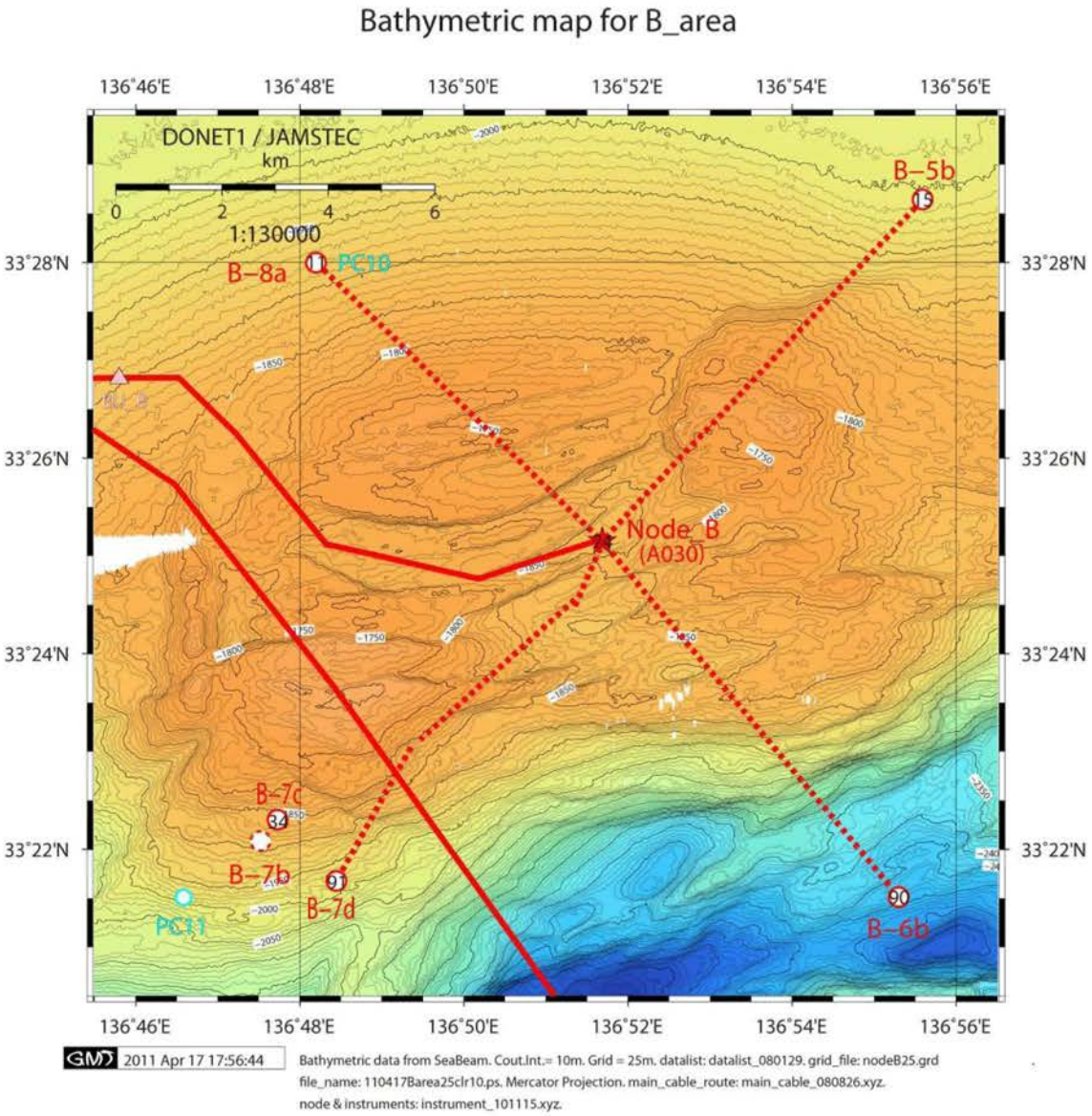

Figure 3. Close up location map around B node of the DONET.

Solid red line: DONET backbone cable.

Dashed red line: DONET extension cable (including of plan).

White circles with solid red relief shows locations with casing installed, with dashed red relief indicates casing was not installed. Transponder IDs are shown in each location if a mini-transponder is installed. Circles with cyan letters indicates piston core samples in the previous cruises.

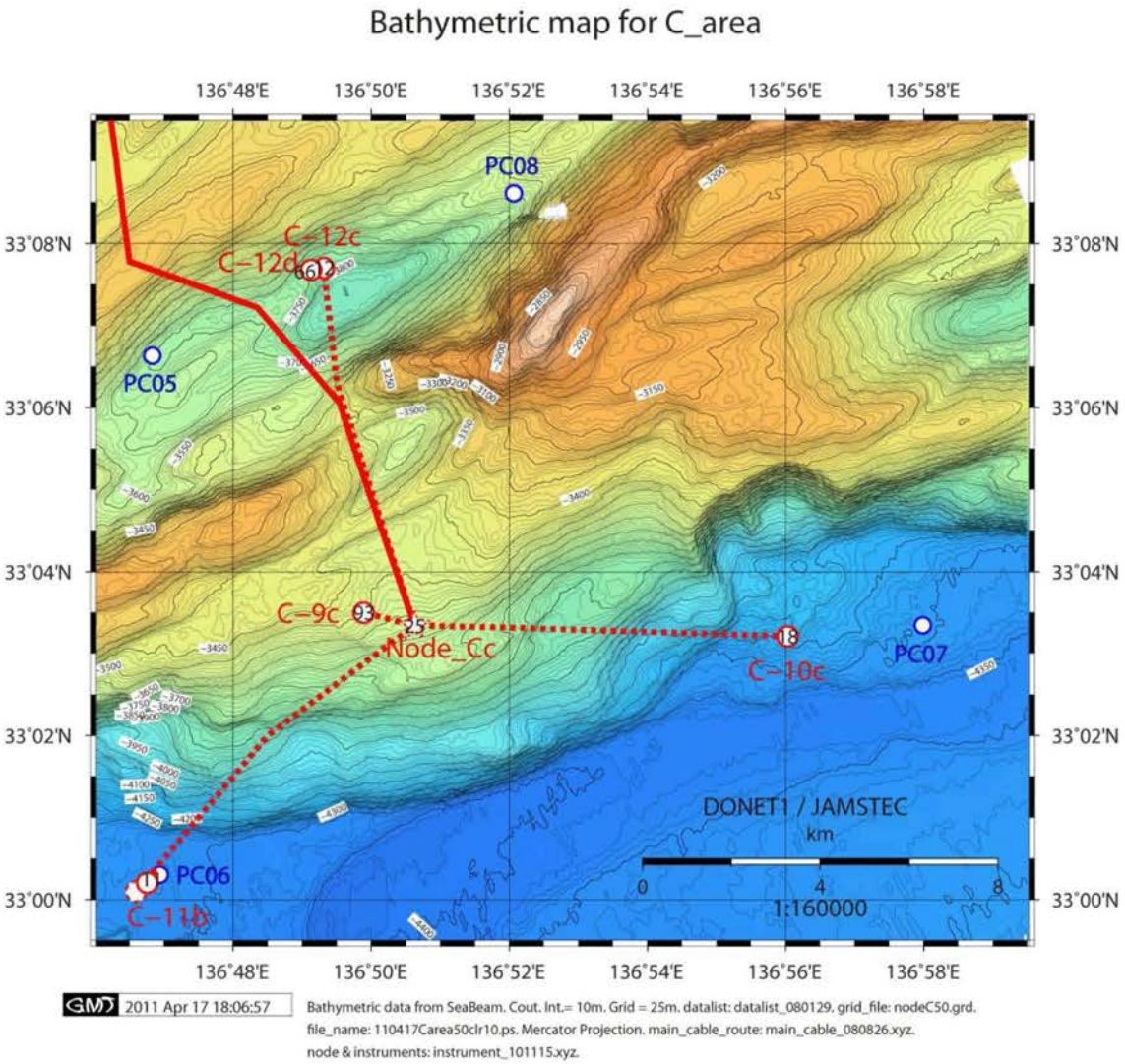

Figure 4 Close up location map around C node of the DONET.

Solid red line: DONET backbone cable.

Dashed red line: DONET extension cable (including of plan).

White circles with solid red relief shows locations with casing installed, with dashed red relief indicates casing was not installed. Transponder IDs are shown in each location if a mini-transponder is installed. Circles with blue letters indicates piston core samples in the previous cruises.

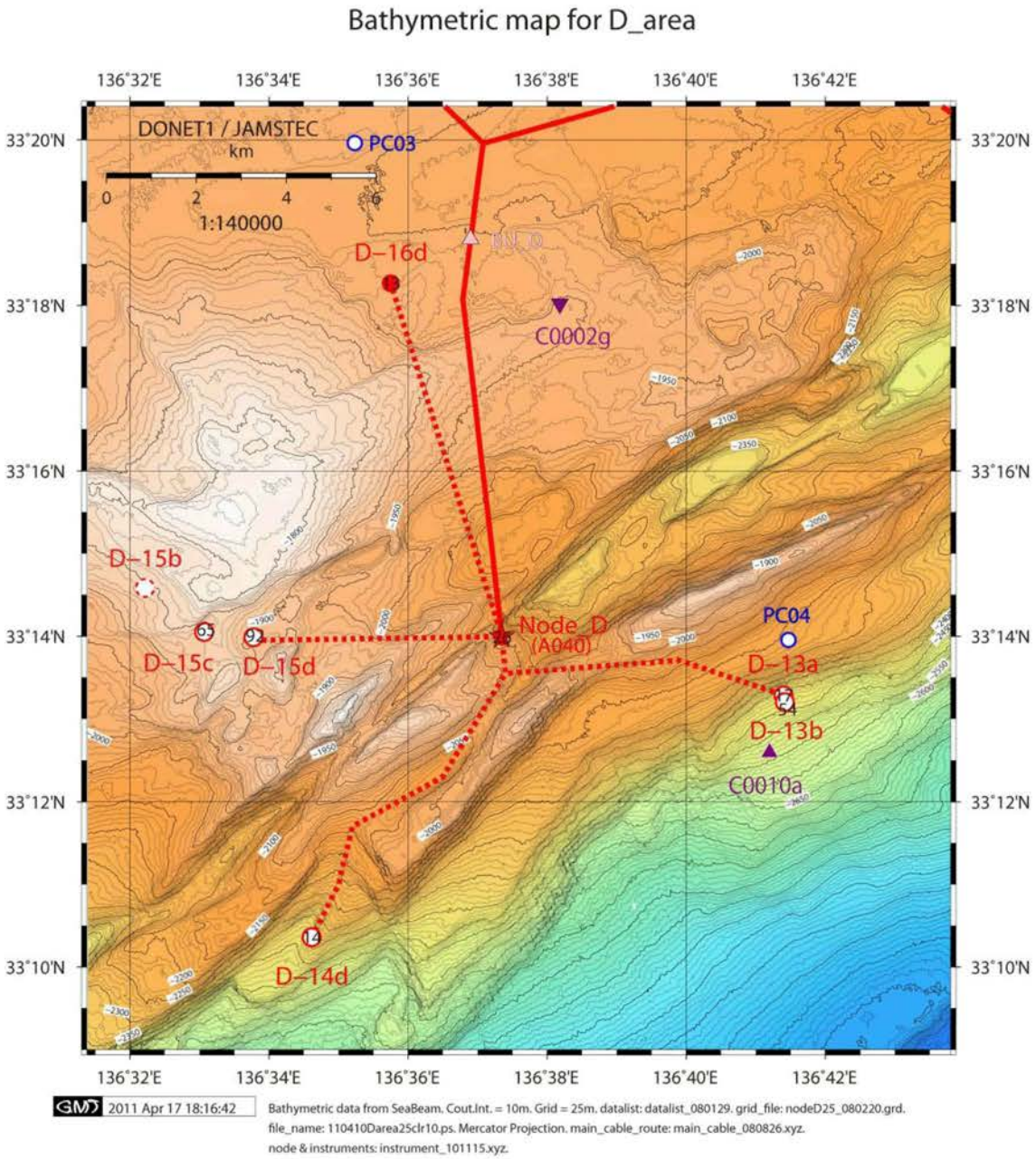

Figure 5 Close up location map around D node of the DONET.

Solid red line: DONET backbone cable.

Dashed red line: DONET extension cable (including of plan).

Red circle (D16) is a DONET observatory operating.

White circles with solid red relief shows locations with casing installed, with dashed red relief indicates casing was not installed. Transponder IDs are shown in each location if a mini-transponder is installed. Circles with blue letters indicates piston core samples in the previous cruises. Purple triangles indicate IODP observatory holes.

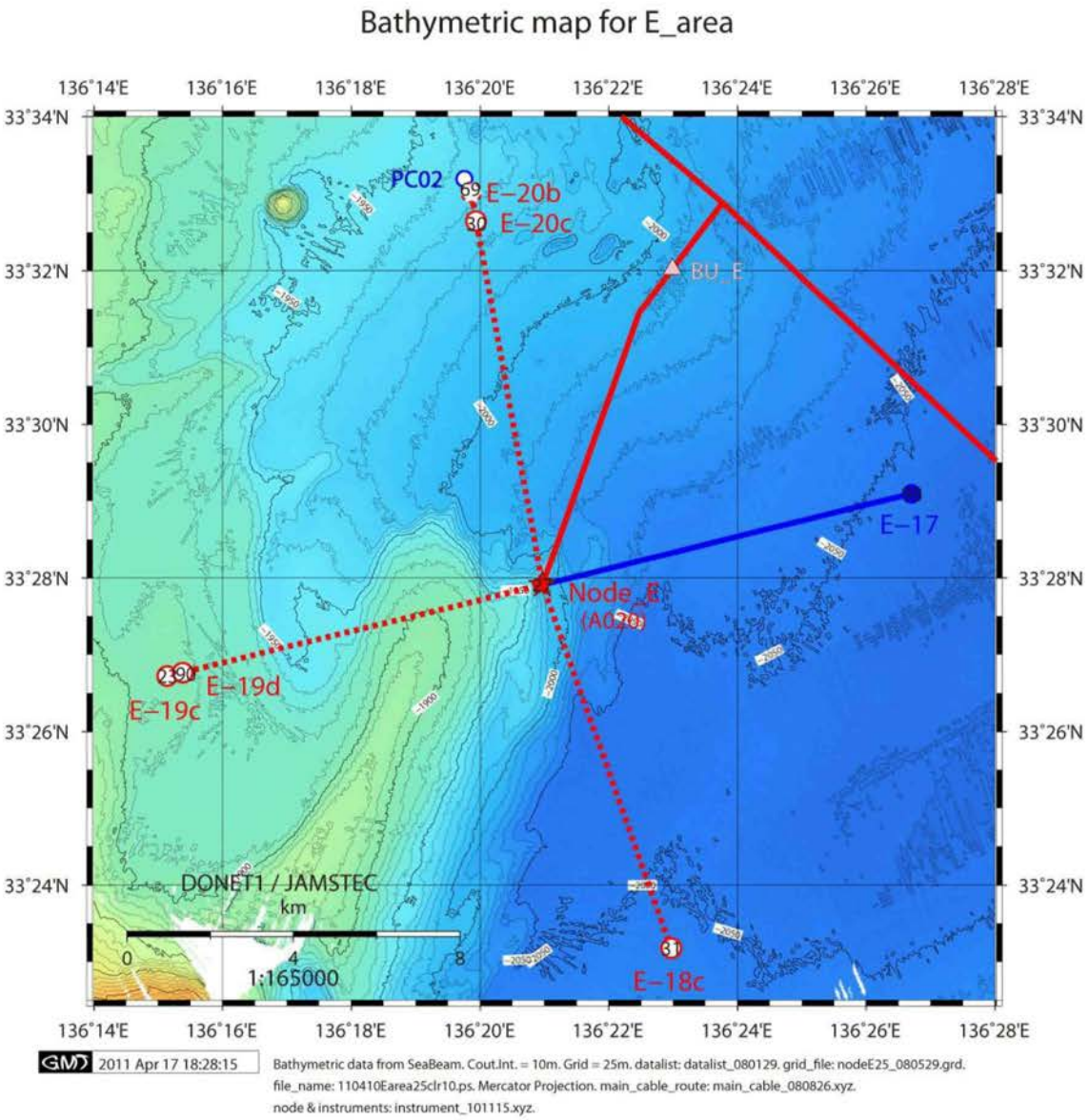

Figure 6 Close up location map around E node of the DONET.

Solid red line: DONET backbone cable.

Dashed red line and a blue line: DONET extension cable (including of plan).

White circles with solid red relief shows locations with casing installed, with dashed red relief indicates casing was not installed. Transponder IDs are shown in each location if a mini-transponder is installed.

Blue circle is DONET observatory (E-17) operating.

Circles with blue letters indicates piston core samples in the previous cruises.

#	Location ID	Deployment (JST)	Location estimated from acoustic transponder		Target depth	Transponder ID	Csg release
			Latitude	Longitude			
01	B-7c	2011/04/11 09:02	33-22.3058'N	136-47.7313'E	1,856m	34	Yes
02	D-13b	2011/04/11 14:58	33-13.2069'N	136-41.4176'E	2,434m	54	Yes
03	E-20c	2011/04/12 11:21	33-32.6276'N	136-19.9228'E	1,973m	30	No
04	E-20c	2011/04/12 15:44	33-32.6496'N	136-19.9404'E	1,973m	30	Yes
05	D-15c	2011/04/13 09:02	33-14.0542'N	136-33.0670'E	1,878m	65	Yes
06	E-19d	2011/04/13 14:36	33-26.7577'N	136-15.4015'E	1,905m	90	Yes
07	C-12d	2011/04/14 08:39	33-07.6799'N	136-49.1303'E	3,755m	66	Yes
08	C-11b	2011/04/14 15:18	33-00.2036'N	136-46.7584'E	4,339m	11	Yes
09	B-7d	2011/04/15 08:56	33-21.6749'N	136-48.4491'E	1,977m	91	Yes
10	D-15d	2011/04/17 08:32	33-13.9894'N	136-33.7779'E	1,908m	92	Yes

Table 1-1. Summary of seafloor casing installation.

#	Location ID	Corer tilt		casing penetration	core description	Remarks
		X(°)	Y(°)			
01	B-7c	-3.2	3.4		coarse grain	Tilted after release
02	D-13b	2.1	2.3	1.830m	mud	
03	E-20c	-10.7	-0.9	1.390m	sandy mud	
04	E-20c	-3.4	-0.3	1.290m	sandy mud	
05	D-15c	-0.1	-0.1	1.155m	sand and mud, coarse grain at btm	
06	E-19d	-6.8	-3.8	1.450m	mud with sand	
07	C-12d	-6.5	0.0	1.880m	silt	
08	C-11b			0.910m	fine grain sandy silt	w/o tiltmeter
09	B-7d	-5.0	-0.7	1.420m	sandy, coarse grain at btm	
10	D-15d	-5.4	1.3	1.450m	massive fine sand	

Table 1-2. Summary of seafloor casing installation (continued)