

Cruise report of NT1010

R/V Natsushima ROV HyperDolphin

Chief scientist : Eiichiro Araki (JAMSTEC DONET)

Research area: off Sanriku Japan Trench

Shipboard science party: Eiichiro Araki, Kazuya Kitada, Toshinori Kimura, Morifumi Takaesu.

Cruise period : June 8, 2010 (JAMSTEC Yokosuka) – June 11, 2010 (Miyako)

1. Background and Overview

In this study, using seafloor borehole observatory, we observe for long-term continuously the motion of overriding plate above theseismogenic zone in Off-Sanriku, Japan Trench. In 1999, we installed borehole sensors in two boreholes (JT1 and JT2) off Sanriku seafloor during Ocean Drilling Program Leg186. The sensors installed were strainmeter, tiltmeter, broadband seismometers. The sensors were installed only approximately 10km above the seismogenic plate boundary.

We have corrected data for a year or two from the borehole observatories in two locations (JT1 and JT2, Figure 1) by a series of campaign observation since 1999. Obtained tilt data from the JT2 borehole shows the drift of the borehole tilt is an order of a few micro radians a year. We may expect an event of 1 micro radian or so if we have a 8 cm slip below the observatory. The threshold of detectable tilt of approximately a few radian is comparable to possible amplitude of the signal from local slow slip event. Therefore, we need continuous observation for several years to assess existence of aseismic slip event.

We improved instruments installed in JT1 and JT2 borehole observatories to minimize power required to run the observatory to realize continuous long-term monitoring over years using batteries.

A series of ROV operations to replace to low-power instruments were conducted in JT1 and JT2 borehole in 2008 during R/V Kairei KR0808 cruise. In 2009, R/V Natsushima with Hyper Dolphin visited JT2 observatory (NT0914 cruise) to collect data from JT2 observatory through communication to the observatory. Tilt data was recovered from JT2, but only for slow sample dataset due to limitation of bandwidth of communication between the ROV and the seafloor instrument.

In this cruise, we recover the seafloor instruments to collect whole dataset observed in the JT1 and JT2 observatory.

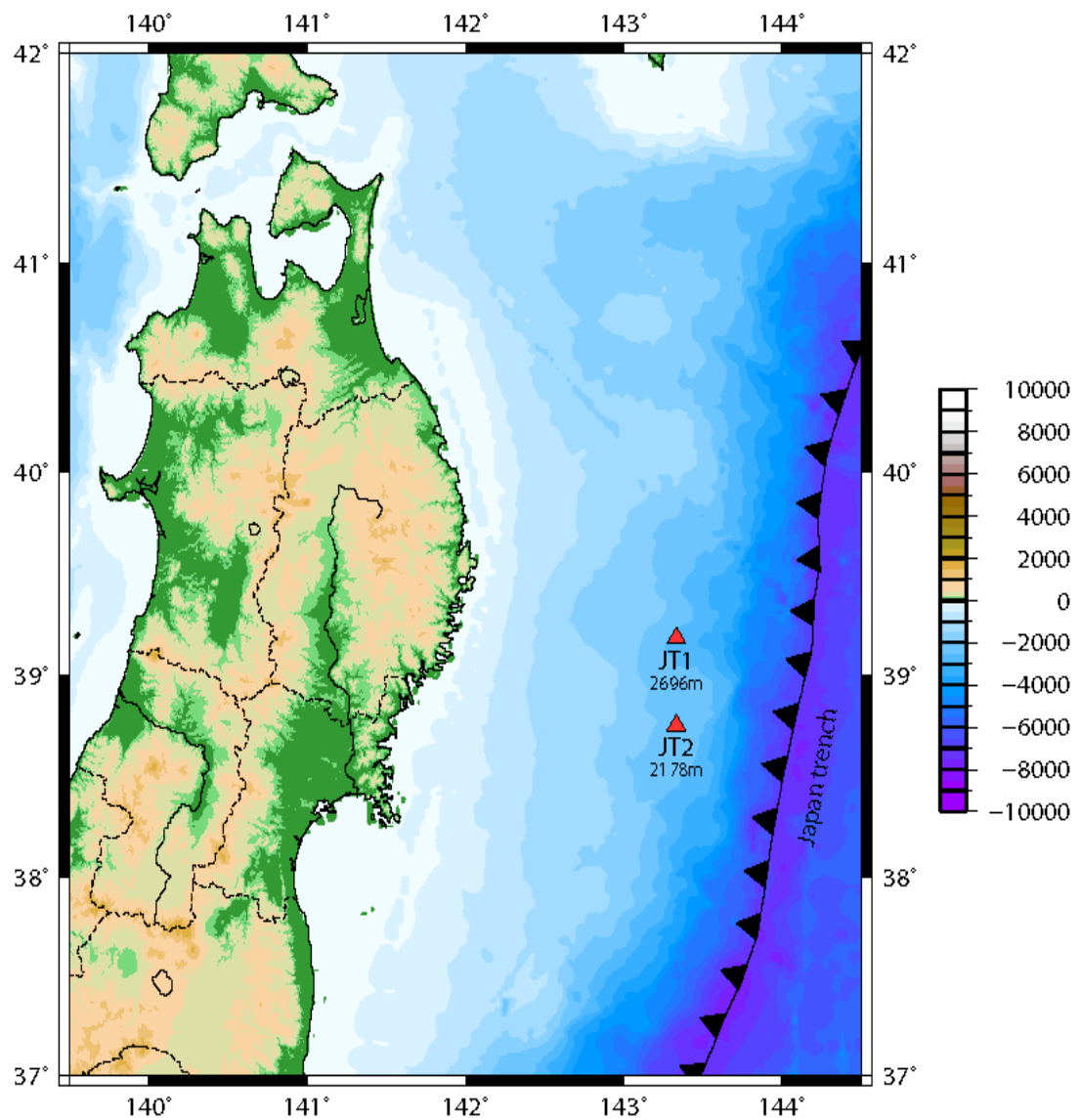


Figure 1 NT1010 Leg 1 cruise area map. Site location are the following;

JT1	39-10.8510°N	143-19.9255°E	2696m
JT2	38_45.1115°N	143_19.9890°E	2178m

2. Methods

In our borehole observation system, all the sensors are installed in the bottom of the borehole (Figure 2). We have four sensors, strainmeter, tiltmeter, two types of broadband seismometer. The depths of the borehole of JT1 and JT2 are approximately 1.2km and 1.1km respectively. From the borehole sensors, separate electrical cable connect uphole. The cables are terminated by under water mating connectors in the seafloor. Seafloor instruments called GBOX is connected to the under water mating connectors (UMC) to feed power to the borehole sensors and to digitize signal from the sensors. The GBOX also controls borehole sensors. The GBOX is connected to batteries package called SAM. The batteries are housed in a Titanium sphere. The SAM equips two under water mating connectors. The one connector connects GBOX and the other connector can be connected to ROV to communicate to GBOX through SAM.

In the past, we used older type GBOX that can control all four borehole sensors, but the power consumption was large as to conduct continuous long-term observation.

In KR0808 cruise, we deployed very low power GBOX dedicated for tilt observation. By using the GBOX, we are able to feed borehole tiltmeter, and digitize and record tilt data in non-volatile memory in the GBOX. The data recorded in the GBOX can be read by ROV communication. We are able to level the tiltmeter both manually and automatically. The tiltmeter is leveled by motor in the borehole tiltmeter automatically when the tilt data becomes off-the-scale.

The SAM has 14V 1300Ah Lithium batteries which can run the observation system more than two years continuously.

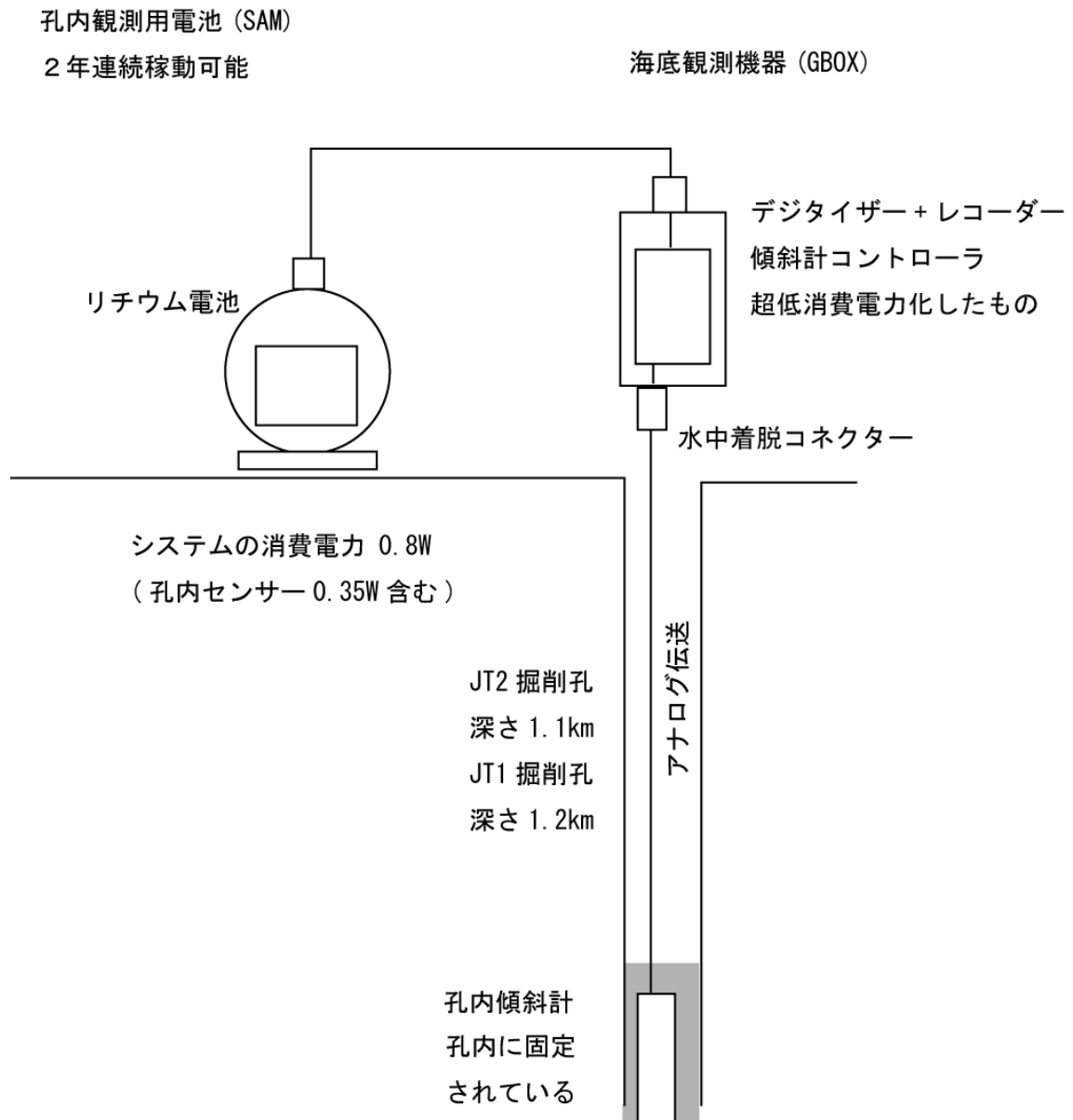


Figure 2. Schematic diagram of off-Sanriku borehole tilt observation system (JT1 and JT2)

3. Operations and Results

R/V Natsushima departed Yokosuka on June 8, 2010 for off-Sanriku Japan Trench research area.

In June 9, 2010, we revisited JT2 borehole observatory by ROV Hyper Dolphin. After checking status of the observatory by connecting cable, the SAM battery and the GBOX data recorder was recovered. To protect connectors of the borehole observatory from sediment, a cover was placed on the connectors. We also

recovered an ROV homer (acoustic transponder) from the observatory.

On June 10, 2010, we visited JT1 borehole observatory by ROV Hyper Dolphin. Similarly to the JT2, we recovered both the SAM battery and the GBOX data recorder.

R/V Natushima arrived at Miyako on June 11 to conclude NT1010 Leg 1 cruise.

Tilt data for 4-5 month period were obtained from both JT1 and JT2 borehole observatory. The borehole tilt data is shown in Figure 3. The borehole tilt data exhibit initial drift for a week or so, probably caused by a heat produced in the tiltmeter. After the initial drift, tilt data exhibits clear tidal change with smaller drift rate in the same direction. The tilt record was obtained 20 times a second. Therefore, the record contains many local and teleseismic events.

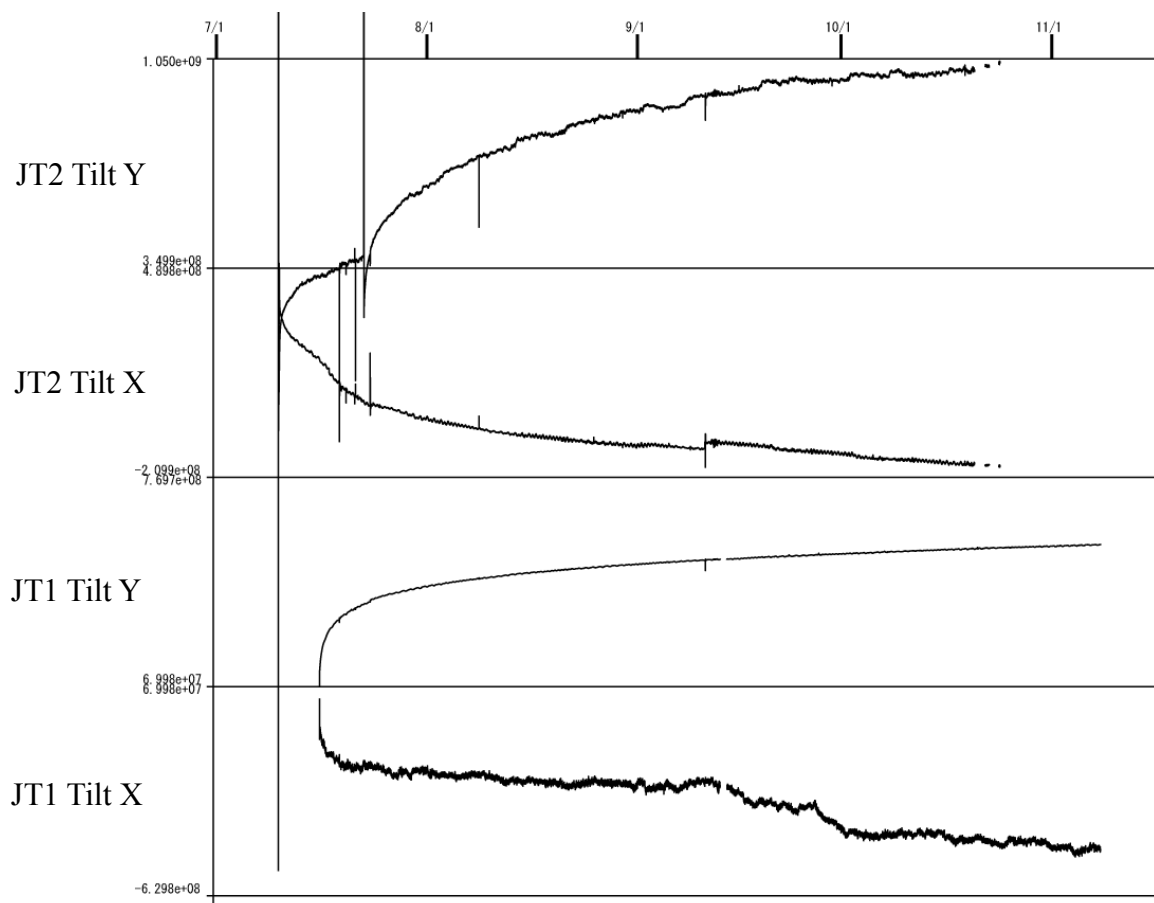


Figure 3. Tilt record in 2008 from the JT1 and the JT2 borehole observatory.

4. Conclusions

During the NT1010 cruise, we have successfully recovered tilt data from two borehole observatories JT1 and JT2. The seafloor instruments for the borehole observation was recovered for maintenance. The both observatories may be operated by installing seafloor instruments in the next visit to the observatories.

Acknowledgement.

The recovery of data recorder in the seafloor was impossible without skilled operations performed by the captain and the crew of R/V Natsushima and ROV Hyper Dolphin operation team. We thank for their professional work to support our test during the NT1010 Leg1 cruise.