



R/V Natsushima “Cruise Report”

NT14-13

Title of the cruise

1. On site calibration of a pressure gage using a mobile
pressure sensor

2. Temporal variation of Rn emanation at faults

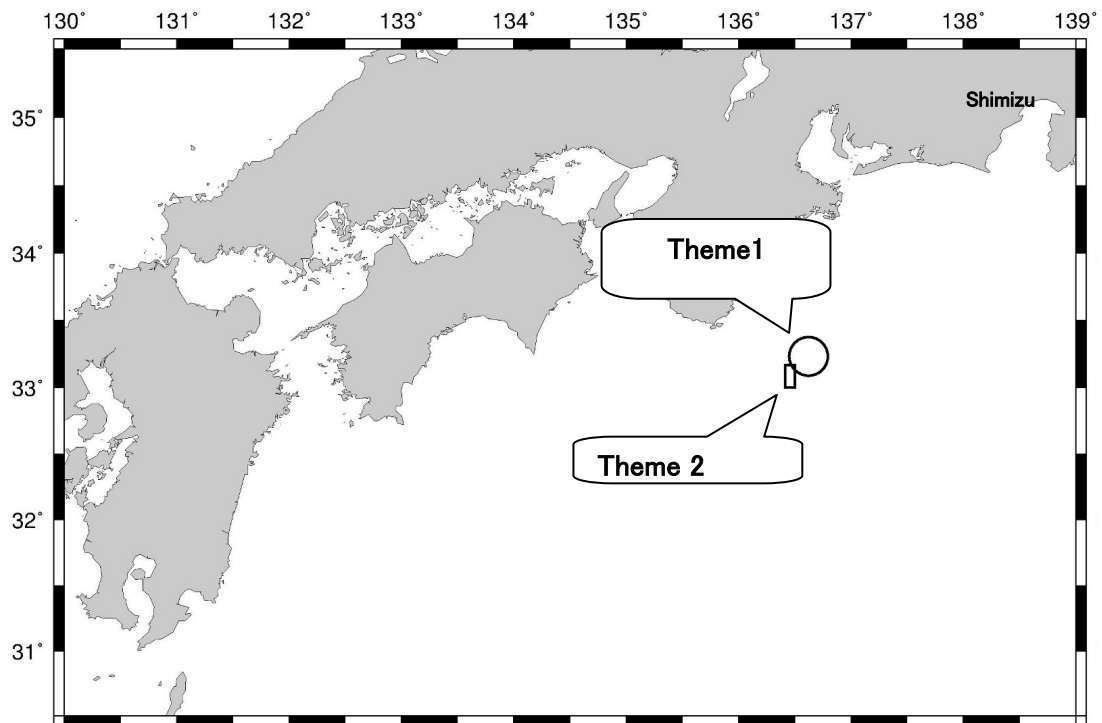
survey area: off Kumano-nada

August 2, 2014 – August 6, 2014

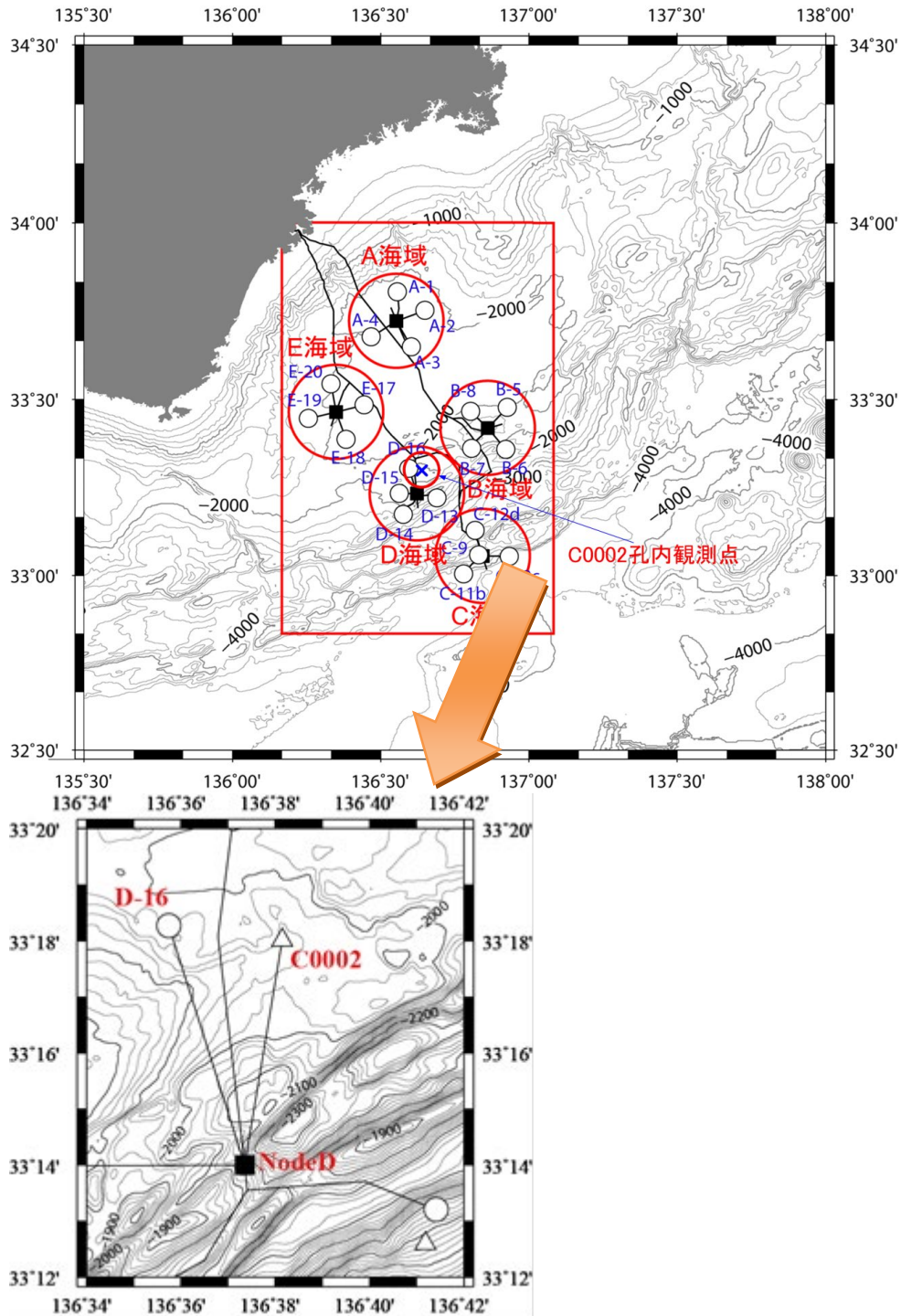
Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

1. Cruise Information

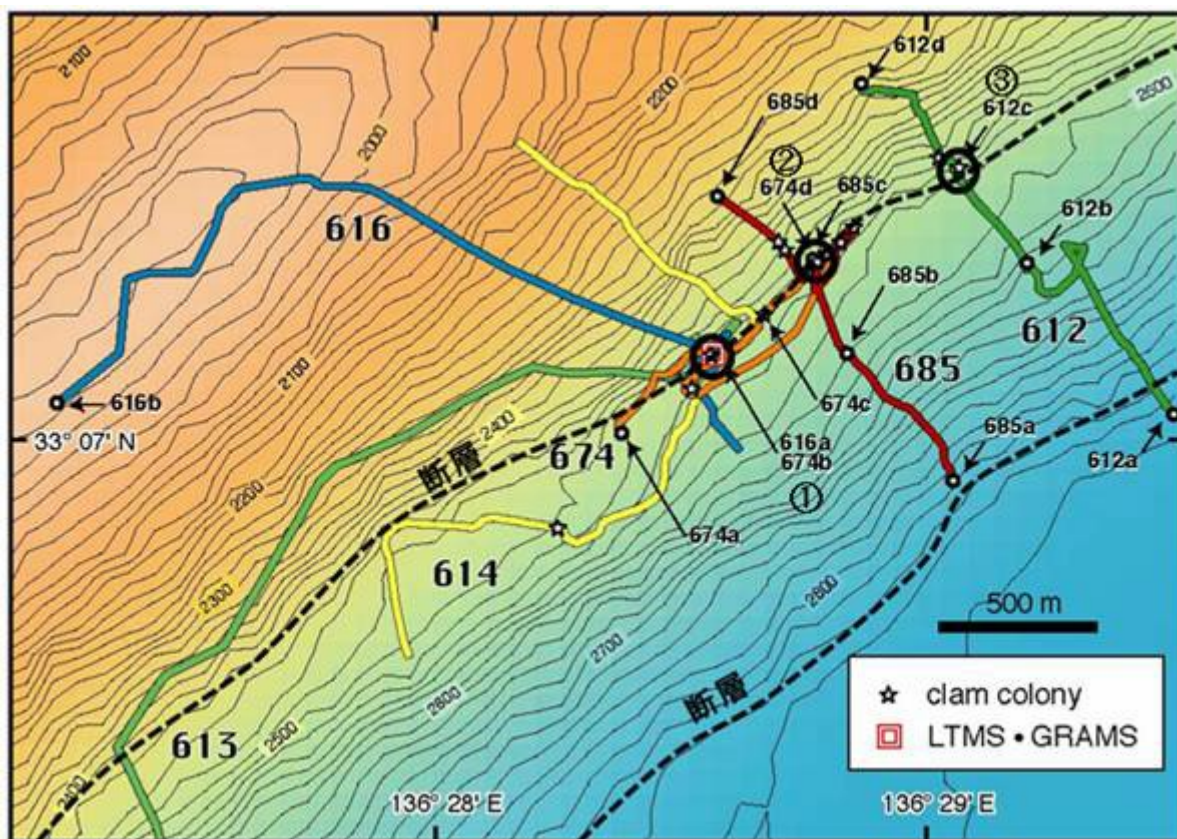
- Cruise ID: NT14-13
- Name of vessel: Natsushima
- Title of the cruise:
 1. On site calibration of pressure gage on using mobile pressure sensor
 2. Temporal variation of Rn emanation at faults
- Cruise period: Aug.2nd.2014 – Aug.6th.2014
- Ports of departure, call and arrival: Shimizu ~ Wakayama
- Research area: Kumano-nada
- Research Map:



Theme1: In side of 8 [nm] circle center on 33-13.998'N, 136-37.350'E



Theme2: The rectangle area 33-00.0'N, 136-25.0'E and 33-10.0N, 136-30.0E



2. Researchers

- Chief scientist [Affiliation]: Shuhei Nishida [JAMSTEC]
- Representative of the science party [Affiliation]
 - > Shuhei Nishida, On site calibration of pressure sensor using mobile pressure sensor
 - > Shin Toyoda, Temporal variation of Rn emanation at faults

3. Theme 1: On site calibration of pressure gage using mobile pressure sensor

3.1 Objectives

The observation with high reliability crustal deformation amount of long-term (1-10 years) of cm order per year, we aim to provide important data for the evaluation of the huge earthquake before the preparatory process of the Nankai Trough by DONET1. To do so, the level measurement accuracy of the order cm is required. However, about 10cm/year drift caused by long-term operation is a precision pressure gauge was deployed DONET1 observation points have been identified, in order to measure the pressure variations due to diastrophism by precision pressure meter, it is necessary to compensate for the error due to drift. For that and knows each drift by performing repeated measurements in the vicinity of the pressure gauge was installed to implement the calibration. Also, it can be expected to improve the relative accuracy of the observation network to grasp the amount of change relative between observation points by calibrating the pressure gauge at the same dive.

3.2 Instruments

We were developed a mobile pressure sensor which has two pressure hulls.

#1 pressure hull has a recorder, power and external communication boards. #2 pressure hull has pressure sensor, electric valve and heater. #3 is pressure sensor in a cylinder.

3.3 Method and results

The purpose of this cruise are (1) repeat measurement using a mobile pressure sensor near pressure gauge on seafloor (2) to measure the difference of pressure mobile pressure sensor between two observatories.

In this cruise, it is insidious in C0002 Long Term Borehole observatory, we tried to pressure measurement in ROV platform, but the measurement of pressure on site could not be realized by a malfunction of the electric valve of mobile pressure sensor, which was developed. However, we found that the outside environment changes due to transport to the seabed from shipboard mobile pressure sensor can affect the measurement data of the mobile pressure sensor. There is sufficient coercive pressure capability, but the data shows that the effect of the temperature change of the mobile pressure sensor inside by water temperature change is not negligible. Based on these experiments, in the future, it is planned the function improvement of mobile water pressure gauge.

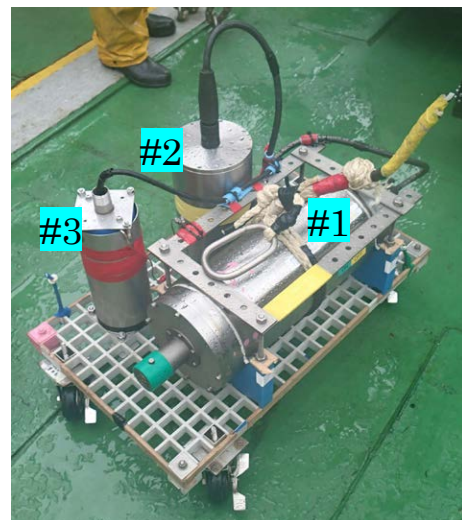
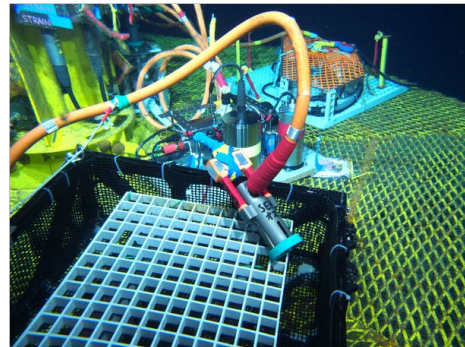
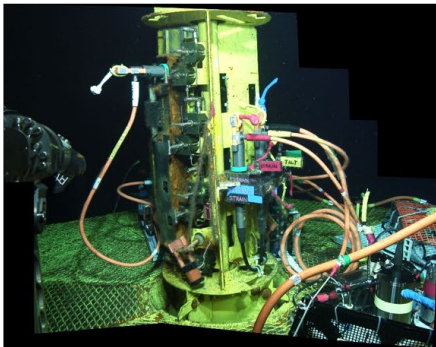
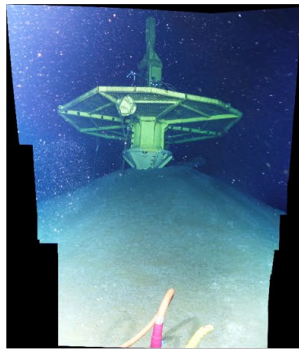


Fig.3.1 a mobile pressure sensor

3.4 dive Digest Photo

2014/08/03

Dive Digest Photo HPD#1689@C0002G



4. Theme 2: Temporal variation of Rn emanation at faults

4.1 Introduction

The mechanism of inter-plate earthquakes and the physico-chemical processes associated with those earthquakes are the critical scientific issues in Japan where large and fierce earthquakes are expected in Tokai and Tonankai within several ten years. The temporal variation in Rn in cold seeps, indicating the variation in the formation fluid emanating from the sea floor, may be a key to investigate such processes associated with the crustal deformations.

4.2 Background

The increase of Rn concentrations in air and in well water samples was once observed at the time of the Southern Hyogo prefecture earthquake in 1995. This phenomenon has been interpreted so that Rn, produced by decay of U (and Th) and accumulated in the crust, was released from the minerals, and through the fissures created by the foreshock and main shock, emanated to the air and water in the wells. Unlike Rn in the air, which will soon diffuse away, Rn emanated into the sea water would more easily be detected when the emanation of formation fluid is appropriately detected.

Kumano-nada is a seismic source region for the expected Tonankai earthquake where cold seeps have been observed. This region would be appropriate for investigating the temporal change of Rn concentration in emanating formation fluid in correlation with small earthquakes in this region.

4.3 Objectives

The group of present researchers has developed a stand-alone automatic recording gamma ray spectrometer to which the electricity is supplied from another pressure proof vessel containing batteries. With also a newly developed software which enables episodic measurements, instead of continuous measurements, it is possible that the measurements of gamma ray spectrometry are done up to several months. The aim of the present proposal of the cruise was to retrieve this stand-alone automatic gamma ray spectrometer system which had been installed in the sea floor during the dive #1654 in April, 2014. In the present research, the radioactivity in the sea water is of interest. The contribution of gamma ray from the sea bottom to the measurement of gamma ray of sea water was quantitatively estimated.

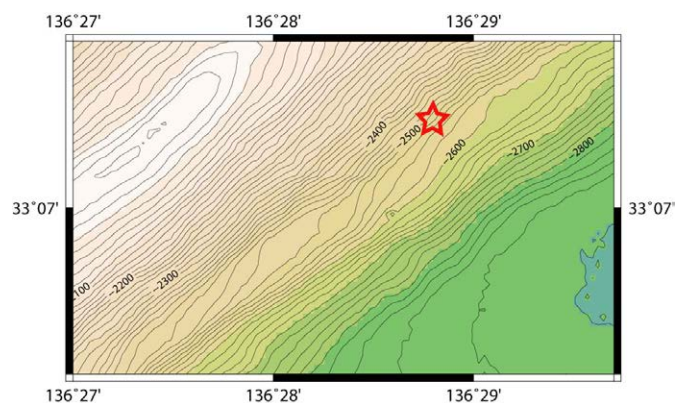


Fig. 4.1 Location of the site in Kumanonada at which the automatic gamma ray measurement system was placed on the sea floor (33°7.3584'N, 136°28.8014'E).

4.4 Study Area

The automatic gamma ray measurement system was retrieved from the location in Kumano-nada shown in Fig. 4-1.

4.5 Methods and Instruments

The automatic gamma ray spectrometry system as shown in Fig. 4-2 together with two stand-alone heat flow meters (SAHF) and a sea floor thermometer, which had been installed at one of the bacteria mats ($33^{\circ}7.3584'N$, $136^{\circ}28.8014'E$), were retrieved during the dive #1690 on Aug. 4, 2014.

The automatic gamma ray spectrometer system was installed on the location during the dive #1654 in NT14-07 on April 24, where episodic gamma ray measurements of 5 minutes with 55 minutes interval had continued for 102 days.

The contribution of the gamma rays from the radioactive elements contained in the sediments of the sea floor was measured by measuring the gamma ray with changing the interval between the sea bottom and the detector as shown in Fig. 4-3.

4.6 Results and Future plan

The gamma ray spectra measured in every minute stored in the memory will be read out and temporal change will be analyzed together with those of the heat flow and the sea floor temperature in order to examine the correlation with the tide and the micro earthquakes off-Kumano region. The radioactive elements in sulfide mineral and in the



Fig. 4-2 The automatic gamma ray spectrometry system developed for the present study.

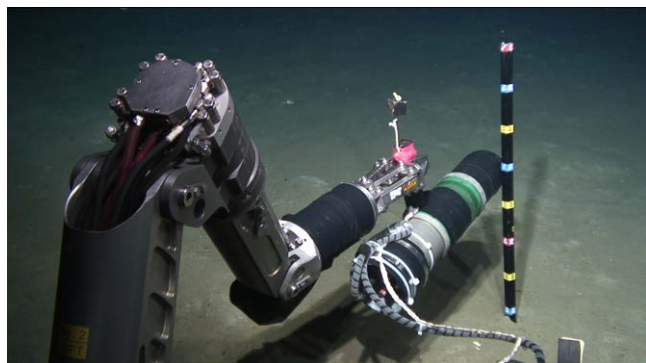


Fig. 4-3 The contribution of the gamma ray from the sea floor was estimated by measuring the gamma ray with changing the interval from the sea floor

sediments in the present bacteria mat will also be analyzed and the relation with the emanating radioactivity will be discussed.

The gamma ray counts per minute (cpm) was obtained as a function of the interval from the sea floor as shown in Fig. 4-4. As the background level of the gamma ray activity in the sea water (100 m above the sea floor) was about 400 cpm, corresponding to the counts at 70 cm, the contribution from the sea floor can be seen when the distance is 60 cm or less.

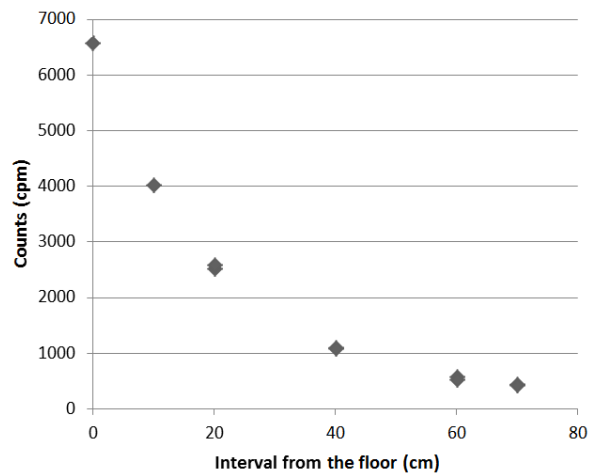


Fig. 4-4 Gamma ray counts as a function of the distance from the sea floor. The background level was about 400 cpm.

4.7 Data and Sample lists

Gamma ray spectra: every minute during Dive #1690 (Aug. 4, 2014)

Temporal change of Gamma ray spectra, heat flow, and sea floor temperature at the location, 33°7.3584'N, 136°28.8014'E, between April 24, 2014 and Aug. 4, 2014.