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# KAIYO Cruise Report

KY09-09 Leg 1

Bathymetry Survey off northwest Sumatra

25 October - 20 November 2009

Benoa - Benoa

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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**Acknowledgements**

The scientific cruise, KY09-09 Leg.1 “Bathymetry Survey off northwest Sumatra Island, Indonesia”, was conducted by using the JAMSTEC R/V KAIYO. We would like to express our gratitude to the Captain Kohji Samejima and the crews of the R/V KAIYO for their cooperation and support during the cruise. We are deeply grateful to radio officers Tokinori Nasu, Hiroki Ishiwatari, and Mai Minamoto for their great efforts of collecting and processing the bathymetric data. We thank the JAMSTEC Ship Operation Department for their management of this cruise. We also thank to the JAMSTEC Research Support Department, Foreign Research Permit of Ristek and the BPPT to make all the necessary administration works to allow us the scientific investigation in Indonesian Exclusive Economic Zone.

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(4) The Basic Research Program “Study on high-precision forecast of tsunamis based on offshore and onshore tsunami observations as well as other seismological observations” (PI; Dr. Kenji Hirata) of the Meteorological Research Institute / Japan Meteorological Agency.

# 1. Introduction

## 1.1 Scientific Objectives

K. Hirata

### 1.1.1 Backgrounds

On the basis of various sets of far-field observations, researchers have proposed many fault models for the December 26, 2004 Sumatra-Andaman earthquake (Mw9.2). Almost all the models share a common character that a very large amount of slip was occurred co-seismically off northwest of Sumatra (Fig.1-1-1). The great earthquake generated a huge tsunami with averaged heights of more than 20 meters that struck the western coast of the northern tip of Sumatra [e.g., Tsunami field survey team, 2005; Jaffe et al., 2006] (Fig.1-1-2). The huge tsunami is considered to closely relate to the very large amount of slip off northwest Sumatra [e.g., Hirata et al.,2006; Tanioka et al.,2006]. However, the far-field observations are not able to resolve more detailed features for the tsunami generation mechanism. A problem which and how geological sections in the wide ocean floor off the northwest Sumatra were displaced co-seismically remains unresolved.

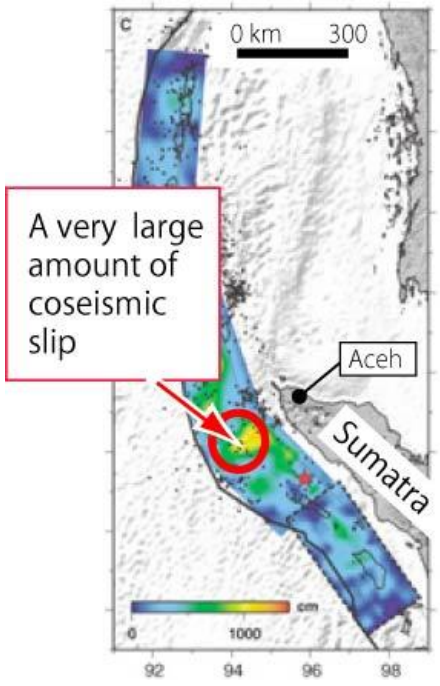


Fig.1-1-1 A typical fault model of the 25 December 2004 Sumatra-Andaman earthquake, estimated by analyzing far-field observations [modified from Ammon et al., 2005].

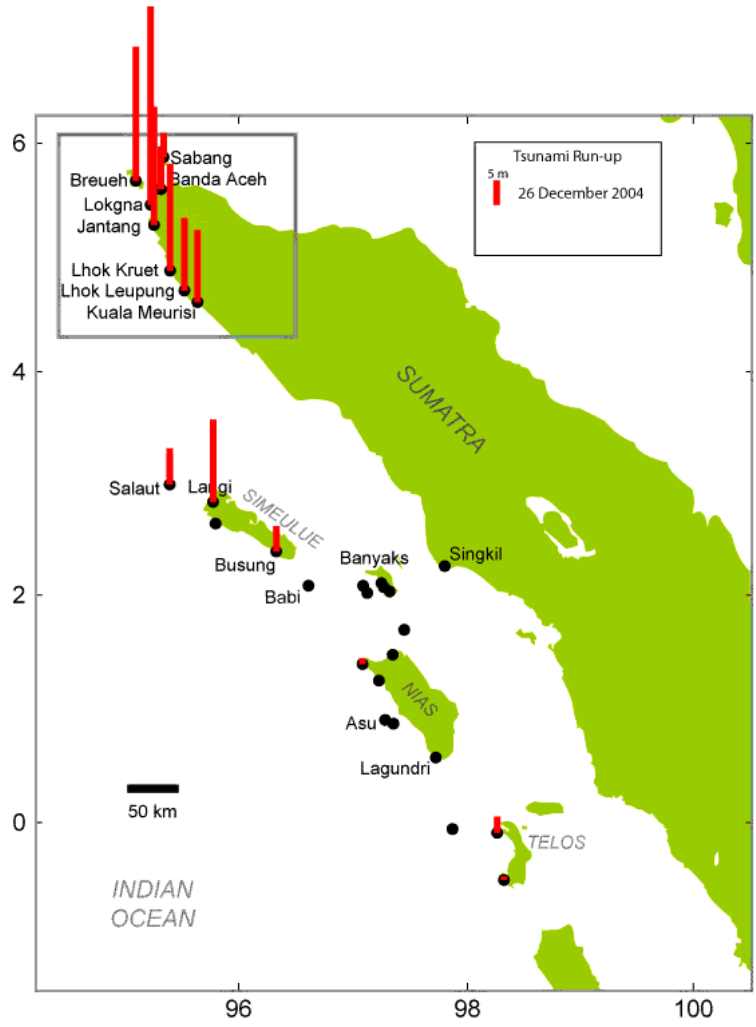


Fig.1-1-2 Tsunami run-up heights along the coasts of Sumatra and the Mentawai Islands [Jaff et al., 2006]

Five working hypotheses that are trying to resolve the problem are proposed based mainly on results of scientific research cruises as follows;

(1) The first hypothesis: only the plate interface, or megathrust, between the subducting Indo-Australia plate and the upper plate displaced coseismically [McNeill et al., 2005; Moran et al., 2005;Henstock et al.,2006]. In other words, the coesismic rupture propagated to the deformation front of the accreationary prism along the plate interface between (Fig.1-1-3a).

(2) The second hypothesis; the most oceanward splay fault, Main Thrust, within the outer-arc-high, defined as a broad, topographical high between the trench and forearc basin, displaced coseismically as well as the plate interface did [Soh et al.,

2005; Seeber et al., 2007] (Fig.1-1-3b).

(3) The third hypothesis; the most landward splay fault, Upper Thrust, within the outer-arc-high displaced coseismically [Sibuet et al., 2007] (Fig.1-1-3c).

(4) The forth hypothesis; the West Andaman Fault displaced coseismically as well as the plate interface did [Plafker et al., 2006] (Fig.1-1-3d).

(5) The fifth hypothesis: a splay fault, Middle Thrust, within the outer-arc high displaced coseismically as well as the plate interface and Main Thrust did [Hirata et al., 2008] (Fig.1-1-3e).

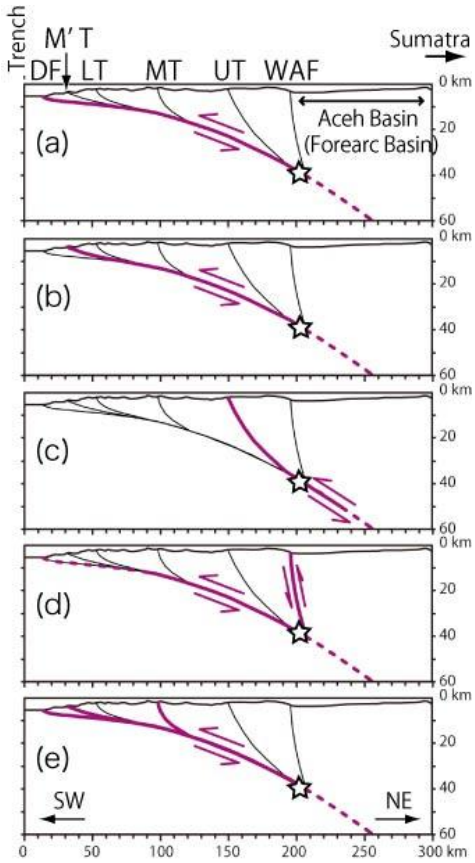


Fig.1-1-3 Five hypothetical models (a)-(e), proposed for the coseismic fault motion of the 25 December 2004 Sumatra-Andaman earthquake off northwest Sumatra. In each model, the coseismic fault rupture is depicted by red curves. DF= deformation front; M'T = Main Thrust; LT = Lower Thrust; MT = Middle Thrust; UT = Upper Thrust; WAF = West Andaman Fault. The hypocenter is indicated by a star.

A series of ROV diving surveys during the Japanese and English scientific cruises were conducted in several sites along the West Andaman Fault [NT05-02 scientific party, 2005; SETOS scientific party, 2005]. But the surveys found no indication suggesting that the West Andaman Fault displaced very recently.

There are three important tsunami observations; (A) tsunami spatial distribution across the Indian Ocean observed with satellites [Gower, 2005], (B) tsunami travel times at tide gauge stations along coasts of the Indian Ocean [Fine et al., 2005; Seno and Hirata, 2007], and (C) dispersed, short-period tsunami waves observed with hydrophone arrays deployed on the deep ocean floor of the Indian Ocean [Hanson et al., 2007].

The observation (A) shows that double peaks appeared in the tsunami spatial distribution, indicating that the tsunami generated off the northwest Sumatra in two regions almost simultaneously, one is around the front of the accretionary prism and the other is farther landward [Geist et al.,2007]. The observation (B) suggests that the oceanward side of the tsunami source off the northwest Sumatra was located near the trench or toe of the accretionary prism but the maximum uplift area was located between the Middle Thrust and the Upper Thrust [Fine et al., 2005]. The observation (C) suggests that the source of the dispersed, short-period tsunami waves, that is a relatively narrow area with a large vertical displacement of ocean floor, was located near the Middle Thrust. But it is possible that the source location is shifted a few tens of kilometers at maximum trenchward [Hanson, personal comm., 2008]. It is interesting that the Lower Thrust probably exists a few tens of kilometers trenchward of the Middle Thrust.

Only the fifth hypothetical model seems explain well all of the observations (A), (B), and (C). Recently, other study that supports the fifth hypothesis was just published [Lin et al., 2009]. However, investigation around the Middle Thrust, a key structure of the fifth hypothetical model, is still insufficient. Therefore, even exact surface trace of splay faults such as the Middle Thrust and Lower Thrust remains unclear.

### 1.1.2 Bathymetry study using R/V KAIYO

This scientific research cruise, Leg.1 of KY09-09, is planned by JAMSTEC, MRI, BPPT, and LIPI as a follow-up cruise of NT05-02. The Leg.1 is incorporated with Leg.2 in which m-TRITON buoys are recovered and deployed in the Indian Ocean to observe oceanographic data. The KY09-09 is port called in Tanjung Benoa, Bali, Indonesia for embarkation and disembarkation.

Our scientific objectives of this cruise are as follows;

(1) To investigate high-resolution geomorphologic features around the Middle Thrust in the outer-arc-high.
(2) To understand the regional tectonics of a middle part of the outer-arc-high.
(3) To understand where and how the huge tsunami was generated off northwest Sumatra in December 25, 2004.

An additional scientific cruise using R/V HAKUHO-MARU with a high-resolution MCS is planned to conduct in and around the area surveyed during this cruise in next year.

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## 1.2. Plate Tectonics

### 1.2.1 Geological setting

The western part of the southeast Asia region from Burma, Andaman-Nicobar and Sumatra is a product of an oblique subduction of the Indo-Australia Plate beneath the Eurasia Plate - Burma Micro-plate along the Sunda Trench or Sunda Megathrust [Dotsea, 2005] (Fig. 1-2-1). The plate convergence results an elongated trench, a dextral strike-slip fault, thrust fault zone or wrench fault system.

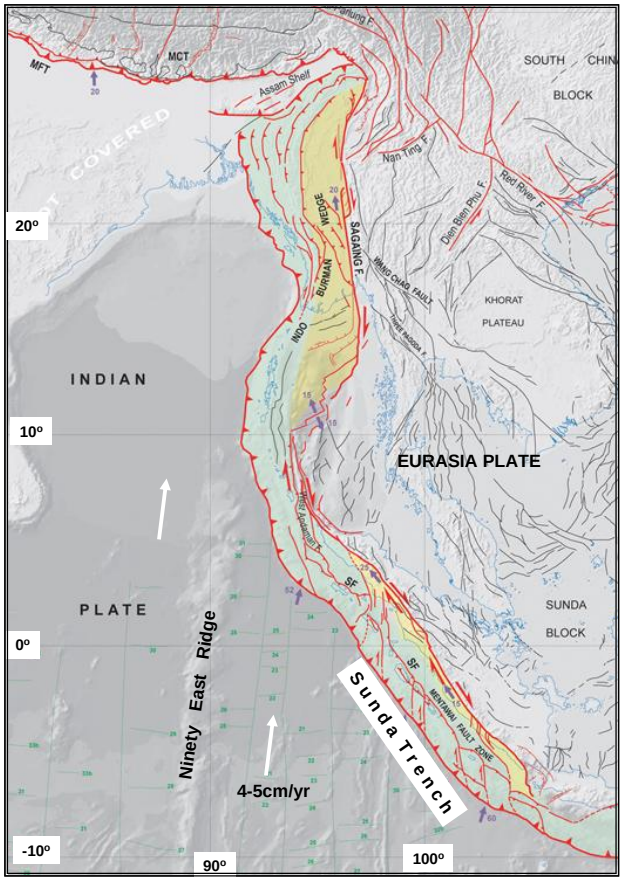


Fig. 1-2-1. Tectonic features of the Western of Southeast Asia and Sumatra, Indonesia related to oblique subduction of the Indo-Australia Plate beneath Eurasia Plate-Burma Micro-plate [Dotsea, 2005].

The main controll factor of plate subduction along the Sunda Trench is the Indian plate (oceanic crust) that started to be formed since the break-up of Indian, Australian and Africa at 60 Ma [Vine, 1970; Dienzt, 1970] . The Indian oceanic crust possibly started to be formed from 75 to 45 Ma based on magnetic anomaly analysis [Laughton, McKenzie and Sclater, 1973]. Magnetic anomaly lineations in the western part of North Sumatra ranges from 31–22 chrons or around 67-45 Ma. At this time, the

Indian Plate moved laterally to the north along Ninetyeast Ridge transform fault (Fig. 1-2-1). Sea floor spreading and movement of the Indian Plate to the north was followed by a collision and subduction beneath Eurasia Plate at Late Oligocene to Early Miocene (35Ma). Maximum rates in seafloor spreading of the Indian oceanic crust at Late Miocene are about 70 mm/year and 50 mm/year, respectively, in Early Oligocene and Early Miocene [Laughton, McKenzie and Sclater, 1973]. In actual condition, Indian oceanic crust around offshore of Sumatra is characterized by north-south trending ridges such as Ninetyeast Ridge, Wharton Ridge, Investigator Fracture Zone and sedimentary basin (Fig. 1-2-2 and 1-2-3) and east-west trending transform faults.

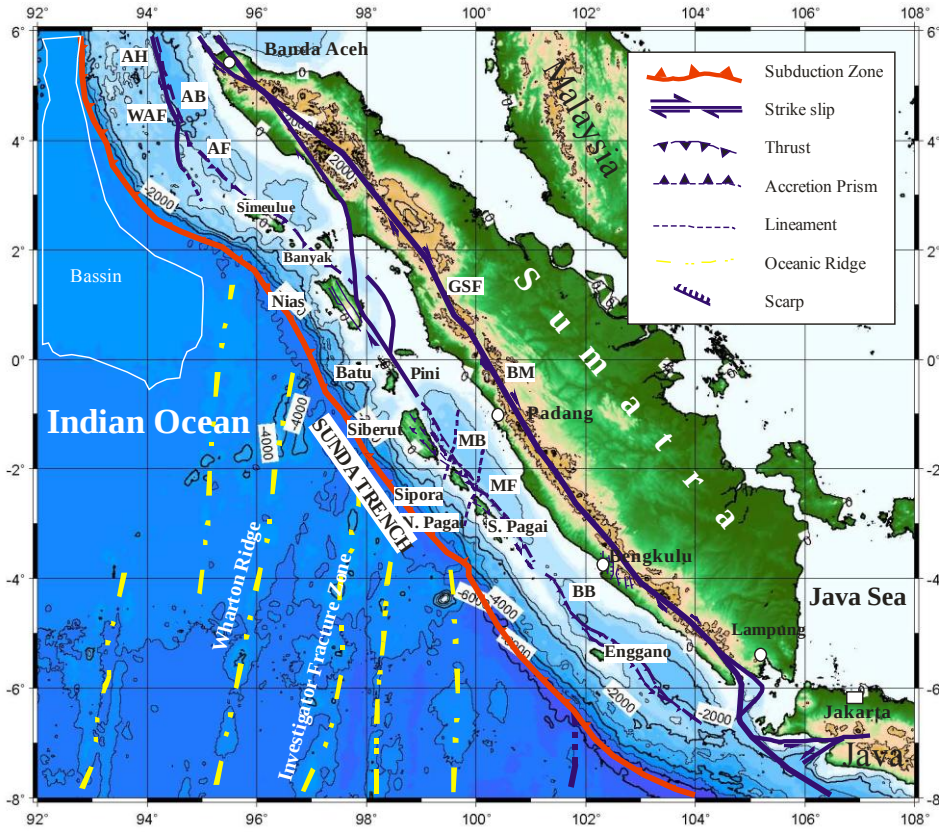


Fig. 1-2-2. Main structural feature offshore and on land of Sumatra Island, simplified from Sieh and Natawidjaja, [2000]; Dotsea, [2005], Singh et al., [2008]; The Great Sumatran Fault (GSF); Bukit Barisan Mountain (BM) a Tertiary-Quaternary volcanic product; the Mentawai Fault(MF); Mentawai fore-arc basin (MB); Bengkulu Basin(BB); Aceh back thrust Fault(AF); Aceh Basin(AB); West Andaman Fault(WAF); Aceh High(AH). Oceanic part: Sunda Trench or Sunda Megathrust; the basin (sedimentary); Wharton Ridge, and Investigator Fracture Zone. The Woyla terrain is not displayed in the figure but located from the Siberut Island to the southern Sumatra.

A thick sediment of Bengal abyssal fan [Hamilton, 1979] had filled and covered most of the oceanic crust of the Indo-Australian plate of north Sumatra, Simeulue and Nias Islands since Middle to Late Miocene [Karig et al., 1979]. The sediment covered a basin west of Sumatra and developed the Bengal fan. The sedimentary basin thins to the south and is limited by the Ninetyeast Ridge at the western side and the Wharton Ridge in the southeastern side (Fig. 1-2-2).

A GPS study at each boundary of transform faults [Avouac, 2005, unpublished] indicates that the oceanic crust west of Sumatra with ages of about 50-70 Ma has moved at convergence rates of around 37-41 mm/yrs (India relative to Sunda) or 50-57 mm/yr (Australia relative to Sunda) as shown in Fig. 1-2-3.

The Sunda Trench or Sunda Megathrust developed along the western coast of Sumatra, from Sunda strait continuous to the north Sumatra. The trench becomes gradually shallower from the south to the north, from 6000m to 5000m in water depth, while the trench becomes wider to the north. The convergent rate is about 50mm/year [Sieh & Natawidjaja 2000] since the Late Oligocene to the Early Miocene. Actually, the velocity of plate subduction along the Sunda Trench is about 70mm/year in the southern part of the Sunda Strait and about 68 mm/year in the western part of Aceh, northernmost Sumatra [Moore at al., 1980].

The plate convergent directly influenced a Neogene tectonic setting the fore-arc of west of Sumatra. It is indicated by accretional prism development that it composes Middle Miocene to the Present sedimentary rocks and, in some parts, by an slice of oceanic crust material [Ginco I, 1999 ] The tectonic uplifting, caused the outer arc high of western offshore of Sumatra exposing to the sea surface, formed a non-volcanic island arc, such as Simeulue, Nias, Siberut, Sipora, Pagai and Enggano islands. Morphology of the island arc is very rough due to wrench and thrust faults [Karig et al., 1980 or Hamilton, 1979]. This oblique convergence results the dextral strike-slip fault and thrust fault zone such as Sagaing Fault (Myanmar) and 1900 km length of the Great Sumatran Fault (GSF) (Fig. 1-2-1 and 1-2-2). The GSF cuts the Sumatra mainland from the southern part (Lampung) to the northern part (Banda Aceh) parallel with Bukit Barisan Mountain (BM) [Sieh and Natawidjaja, 2000] that has grown during the Late Miocene. The GSF is continuing to southern of the western part of West Java.

In the west of Sumatra, an active Mentawai outer arc ridge (Pagai, Sipora, Siberut Islands) and Mentawai fore-arc basin (Mentawai Basin(MB)) and Bengkulu Basin (BB) are occupied this area (Fig. 1-2-2). The basins are sliced by Mentawai strike-slip fault (MF) [Diament et al., 1992] or back-thrust fault [Dotsea, 2005; Singh et al, 2008 ], from Bengkulu Basin (BB) to Pini Island (Fig. 1-2-2). Farther north, the fault continues along Aceh back-thrust fault (AF) (Fig. 1-2-2). Parallel to this fault, the West Andaman strike-slip Fault (WAF), as prolongation of WAF from Andaman-

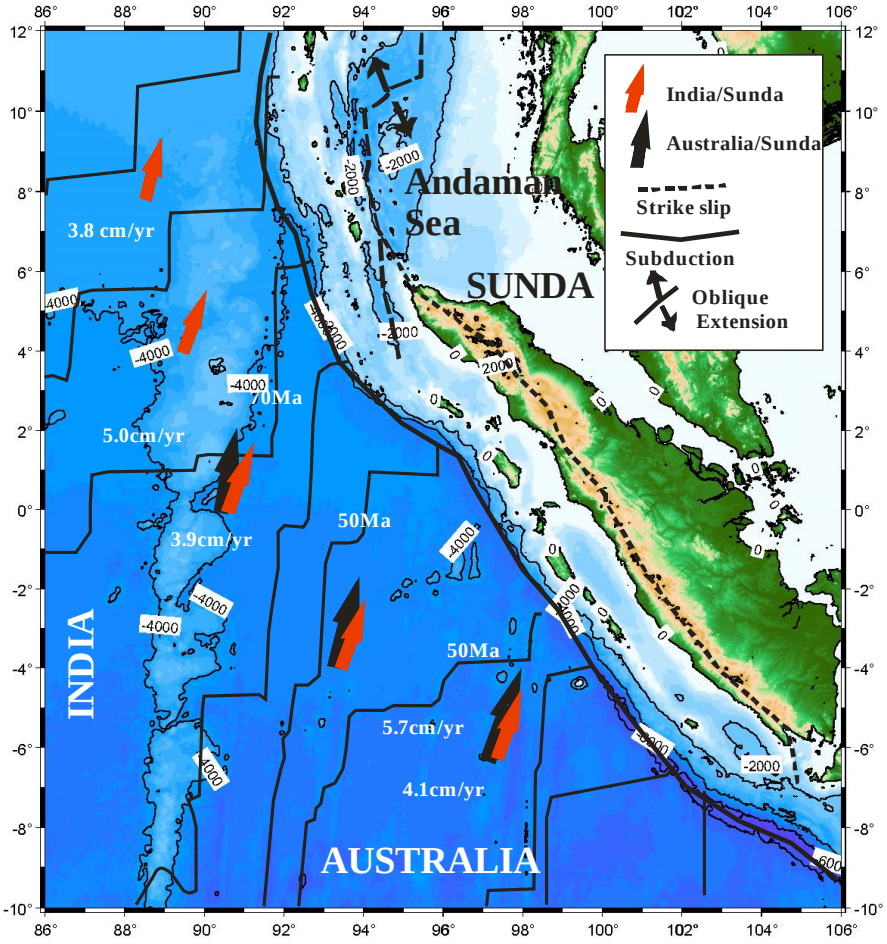


Fig. 1-2-3 Age variation and rate convergence of Indian plate beneath western of Sumatra (re-drawing from Avouac, [2005]).

Nicobar area. was presented between the western margin of Aceh Basin (AB) and Aceh High or Aceh rise (AH) as shown in Fig. 1-2-2.

### 1.2.2. Plate Subduction: earthquake, tsunami and mitigation

For hundreds of years before the 2004 giant Sumatra-Andaman earthquake, the southern parts of the Andaman-Nicobar-Sumatran subduction zone had repeatedly broken through big earthquakes (Fig. 1-2-4). The oldest is happen in 1797 (*M*w8.4) around Siberut Island, in 1861 (*M*w8.5) close to Nias Island [Natawidjaja et al., 2006], and in 1833 of estimated *M*w of 8.6–8.9 [Newcomb & McCann 1987; Natawidjaja et al., 2006] around Sipora-Pagai Islands. Farther north, earthquakes recorded in the Andaman-Nicobar-Sumatran subduction zone had attained *M*w 8 [Bilham et al. 2005]. The oldest shock is estimated magnitudes 7.5–7.9 in 1847, then 7.9 in 1881, and 7.7 in

1941 as shown in Fig. 1-2-1. These are about 50-150 years ago of the 2004 Mw9.2 earthquake whereas the tsunamis of 1847 and 1941 are poorly known [Murty & Rafiq 1991, Ortiz & Bilham 2003, Bilham et al. 2005] and the maximum amplitude of the 1881 tsunami is estimated to be less than 1 m in Myanmar [Ortiz & Bilham 2003]. Regarding these facts, the understanding of tsunami generation mechanism is very important beyond to coastal management and community resilience for this region.

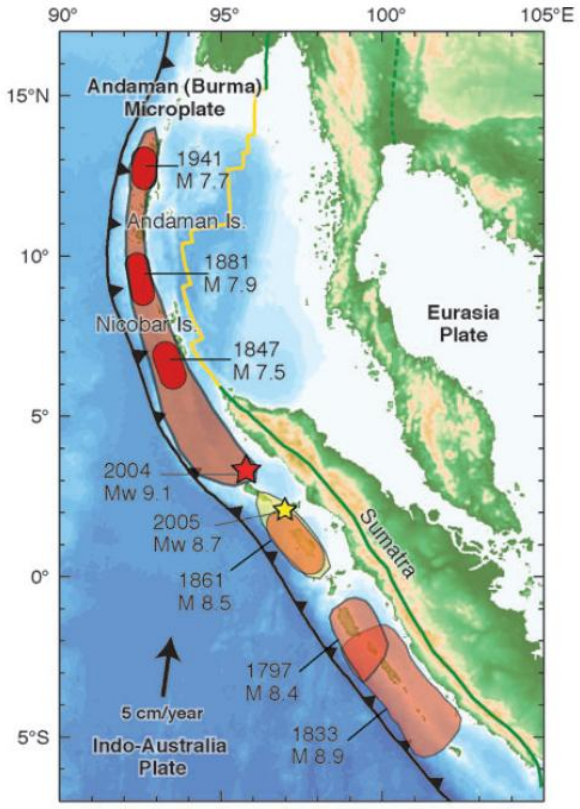


Fig. 1-2-4. Spatial distribution of Recent and past rupture areas of Sumatra-Andaman (adopted from Satake and Atwater, [2007]).

Since 17$^{th}$ century, rupture zones of all the big earthquakes along the Sunda Trench (Sumatra-Andaman Megathrust) in the same earthquake cycle do not overlap as shown in Fig. 1-2-4. Two hypothesis arises to explain that geological phenomena. First hypothesis is the idea that the subducting Indo-Australia oceanic plate is divided into several different segments, possibly by faults, beneath the Eurasia Plate. Each segment independently may subduct. Second hypothesis is that the upper plate consists of many micro-continental blocks along the fore arc of Sumatra, as reported by Pulunggono and Cameron [1984] based on well data of Oil Company. There are four micro-continental blocks ; (1) Sikuleh continental fragment distributed from the northern Sumatra to the Banyak Island (Fig. 1-2-2), (2) Sibolga granite in the eastern side of the Nias Island, (3) Natal continental fragment found around the Batu Islands

(Pini Island), and (4) the Woyla terrain that contains old volcanic material and ophiolite, exposed in the Siberut Island and distributed in the Southern Sumatra (Fig. 1-2-2). A seismic study indicates the presence of a continental basement material from the southern Sumatra to the western Java [Schluter et al., 2002], suggesting a heterogeneity in the fore arc basement west of Sumatra.

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## 2. Cruise Narrative (Dr. Udrekh)

| Date | Time (loc. time GMT +6) | Activity | Note |
|---|---|---|---|
| 25/10/2009 | 18:00 | Benoa Port. All Scientists arrive at Kaiyo. | Scientists: Hirata, Fujiwara, Kawano, Haryadi, Gaffar & Udrekh |
| 26/10/2009 | 10:00 | Meeting on life aboard with Chief Officer and Radio Officer. | |
| | 13:00 | Fire drill | |
| | 17:00 | Kaiyo Depart from Benoa Port | |
| | 19:00 | Science meeting for planning bathymetry survey track lines | |
| 27/10/2009 | | Revising the plan of bathymetry survey track lines. | |
| | | Praying KONPIRA-SAN (Japanese God of Ocean) | |
| 28/10/2009 | 19:00 | Finalizing the plan of bathymetry survey track lines. | |
| | 24:00 | Ship Mean Time (SMT) was shifted to delay one hour (SMT = GMT + 7) | |
| 29/10/2009 | 19:00 | Science meeting for discussion of watch system. | Watching schedule :<br>0 - 4 : Kawano & Udrekh,<br>4 - 8 : Hirata & Gaffar,<br>8 – 12: Haryadi & Fujiwara |
| 30/10/2009 | 19:00 | Determination of additional bathymetry survey track lines because the ship is expected to arrive to the survey area off NW Sumatra about one day earlier than scheduled. | |
| | 24:00 | Ship Mean Time (SMT) was shifted to delay one hour (SMT = GMT + 6) | |
| 31/10/2009 | 19:47 – 19:50 | First XBT measurement is carried out at $03^{o}$ 07.52'N $94^{o}$ 53.23'E. Depth is :1505m with water temperature $29.6^{o}$ C | |
| 1/11/2009 | 0:00 | Beginning of watching time. First turn is Kawano and Udrekh. Average | |

| | | | |
|---|---|---|---|
| | | ground speed is 12 Knot. | |
| | 1:30 | Arrived at the beginning of line #1 (waypoints 1 (WP 1)) at 03°58.49'N 94°7.50'E. Ground speed is changed to 10 knot. | Please see fig 2-1 for reference. |
| | 8:03 | End of line #1 (EOL #1,WP 2) at 04° 57.06'N 93° 35.16'E | |
| | 8:16 | Begin of line #2 (BOL #2,WP 3) at 04°56.42N 93°34.35'E | |
| | 14:52 | EOL #2 (WP 4) at 03° 58.13'N 94°6.5'E | |
| | 15:01 | BOL #3 (WP 5) at 3° 57.19'N 94° 5.46' | |
| | 21:32 | EOL #3 (WP 6) at 4° 55.80'N 93°33.53'E | |
| | 21:40 | BOL #4 (WP 7) at 4° 55.18'N 93°32.72E | |
| 2/11/2009 | 04:08 | EOL #4 (WP 8) at 3° 57.40'N 94°4.70'E | |
| | 04:20 | BOL #5 (WP 9) at 3°57.02'N 94° 3.71'E | |
| | 10:48 | EOL #5 (WP 10) at 93° 31.80'N 4°54.76'E | |
| | 10:57 | BOL #6 (WP 11) at 4°53.96'N 93° 31.10'E | |
| | 11:30 | Survey is carried out under high wind speed (11.4 m/s) with wind direction N55° | |
| | 16:00 | Wind speed is back to normal 3.5m/s | |
| | 17:12 | EOL #6 (WP12) at 3°56.69'N 94°2.83'E | |
| | 17:23 | BOL #7 (WP13) at 94°1.89'N 3°56.30'E | |
| | 23:52 | EOL #7 (WP14) at 4°53.35'N 93°30.30'E | |
| 3/11/2009 | 00:04 | BOL #8 (WP15) at 4°52.95'N 93°29,56'E | |
| | 03:07 | EOL #8 (WP16) at 4°24.94'N 93° 44.96'E | |
| | 03:18 | BOL #9 (WP17) at 4°24.52'N | |

| | | | |
|---|---|---|---|
| | | 93°43.97'E | |
| | 06:20 | EOL #9 (WP18) at 4°52.19'N 93°28.69'E | |
| | 06:33 | BOL #10 (WP19) at 4°51.48'N 93°27.89'E | |
| | 09:00 | EOL #10 (WP20) at 4°29.37'N 93°40.16'E | |
| | 09:11 | BOL #11 (WP21) at 4°28.77'N 93°39.33'E | |
| | 11:40 | EOL #11 (WP22) at 4°50.60'N 93°27.23'E | |
| | 11:52 | BOL #12 (WP23) at 4°49.83'N 93°26.53'E | |
| | 14:18 | EOL #12 (WP24) at 4°28.16'N 93°38.61'E | |
| | 14:28 | BOL #13 (WP25) at 4°27.62'N 93°37.75'E | |
| | 16:48 | EOL #13 (WP26) at 4°49.17'N 93°25.76'E | |
| | 17:01 | BOL #14 (WP27) at 4°48.47'N 93°25.02'E | |
| | 18:30 – 19:00 | Wind speed is increasing to around 6m/s, it may caused ship speed increase to 10.5 | |
| | 19:25 | EOL #14 (WP28) at 4°27.01'N 93°36.98'E | |
| | 19:35 | BOL #15 (WP29) at 4°26.45'N 93°36.09'E | |
| | 22:00 | EOL #15 (WP30) at 4°47.66'N 93°324.33'E | |
| | 22:13 | BOL #16 (WP31) at 4°47.07'N 93°23.50'E | |
| 04/11/2009 | 0:36 | EOL #16 (WP32) at 4°25.80'N 93°35.39'E | |
| | 0:57 | BOL #17 (WP33) at 4°25.36'N 93°35.39'E | |
| | 3:18 | EOL #17 (WP34) at 4°46.39'N 93°22.83'E | |
| | 3:33 | BOL #18 (WP35) at 4°45.57'N 93°22.13'E | |
| | 5:51 | EOL #18 (WP36) at 4°24.76'N 93°33.71'E | |

| | | | |
|---|---|---|---|
| | 06:03 | BOL #19 (WP37) at 4°24.20'N 93°32.90'E | |
| | 08:25 | EOL #19 (WP38) at 4°45.05'N 93°21.26'E | |
| | 08:38 | BOL #20 (WP39) at 4°44.25'N 93°20.57'E | |
| | 10:26 | EOL #20 (WP40) at 4°28.21'N 93°29.46'E | |
| | 10:37 | BOL #21 (WP41) at 4°27.81'N 93°28.56'E | |
| | 12:25 | EOL #21 (WP42) at 4°43.59'N 93°19.78'E | |
| | 12:37 | BOL #22 (WP43) at 4°42.82'N 93°19.08'E | |
| | 14:22 | EOL #22 (WP44) at 4°27.17'N 93°27.84'E | |
| | 14:32 | BOL #23 (WP45) at 4°26.80'N 93°26.93'E | |
| | 16:14 | EOL #23 (WP46) at 4°42.14'N 93°18.28'E | |
| | 16:27 | BOL #24 (WP47) at 4°41.43'N 93°17.51'E | |
| | 18:09 | EOL #24 (WP48) at 4°26.24'N 93°26.14'E | |
| | 18:21 | BOL #25 (WP49) at 4°25.75'N 93°25.33'E | |
| | 20:02 | EOL #25 (WP50) at 4°40.70'N 93°16.76'E | |
| | 20:15 | BOL #26 (WP51) at 4°40.02'N 93°16:00'E | |
| | 21:55 | EOL #26 (WP52) at 4°25.15'N 93°24.56'E | |
| | 22:00 | BOL #27 (WP52) at 4°24.88'N 93°25.13'E | |
| 05/11/2009 | 01:00 | EOL #27 (WP53) at 4°10.31'N 93°52.44'E | |
| | 01:07 | BOL #28 (WP53) at 4°9.57'N 93°53.30'E | |
| | 02:40 | EOL #28 (WP54) at 3°55.57'N 94°1.03'E | |
| | 02:51 | BOL #29 (WP55) at 3°55.44'N 94°0.09'E | |

| | | | |
|---|---|---|---|
| | 04:24 | EOL #29 (WP56) at 4°26.24'N 93°26.14'E | |
| | 04:38 | BOL #30 (WP57) at 4°8.18'N 93°51.30'E | |
| | 06:06 | EOL #30 (WP58) at 3°54.89'N 93°58.86'E | |
| | 06:22 | BOL #31 (WP59) at 3°54.34'N 93°57.61'E | |
| | 07:50 | EOL #31 (WP60) at 4°7.38'N 93°50.15'E | |
| | 08:03 | BOL #32 (WP61) at 4°6.60'N 93°49.11'E | |
| | 09:30 | EOL #32 (WP62) at 3°53.98'N 93°56.35'E | |
| | 09:45 | BOL #33 (WP63) at 3°53.62'N 93°55.45'E | |
| | 11:10 | EOL #33 (WP64) at 4°6.04'N 93°49.16'E | |
| | 11:23 | BOL #34 (WP65) at 4°5.42'N 93°47.47'E | |
| | 12:47 | EOL #34 (WP66) at 3°53.03'N 93°54.69'E | |
| | 12:59 | BOL #35 (WP67) at 3°52.68'N 93°53.78'E | |
| | 13:09 | Second XBT measurement is carried out at 03 07.5235N 94 53.234E. Depth is :1505m with water temperature 29.6°C | |
| | 14:30 | EOL #35 (WP68) at 4°4.87'N 93°46.63'E | |
| | 14:41 | BOL #36 (WP69) at 4°4.25'N 93°45.85'E | |
| | 16:03 | EOL #36 (WP70) at 3°52.25'N 93°52.88'E | |
| | 16:17 | BOL #37 (WP71) at 3°51.89'N 93°51.89'E | |
| | 17:39 | EOL #37 (WP66) at 4°3.69'N 93°45.02'E | |
| | 17:52 | BOL #38 (WP67) at 4°3.10'N 93°44.21'E | |
| | 19:10 | EOL #38 (WP68) at 3°51.50'N | |

| | | | |
|---|---|---|---|
| | | 93°51.09'E | |
| | 19:23 | BOL #39 (WP69) at 3°51.10'N 93°50.22'E | |
| | 20:43 | EOL #39 (WP70) at 4°2.51'N 93°43.36'E | |
| | 20:53 | BOL #40 (WP71) at 4°1.90'N 93°42.58'E. This is the last track of bathymetry survey in KY0909. | |
| | 22:07 | EOL #40 (WP72) at 3°50.73'N 93°49.33'E. End of bathymetry survey. Ship move to the WP73 for ADCP deployment. | |
| 6/11/2009 | - | Preparing cruise report. Responsible person to write every chapter/sub chapter is decided. | |
| 8/11/2009 | 19:00 | Scientific meeting to discuss data processing result and cruise report progress. The preliminary result of bathymetry data processing is used for discussion and QC. | |
| 9/11/2009 | 19:00 | Discussion of cruise report progress and presentation by Dr. Haryadi Permana ". 2 set definitions of lineament are decided. | Two set definition are : Direction based lineament and topography based lineament |
| 10/11/2009 | 14:00 | Drawing line of every lineament in two sets of A0 printed sized of new bathymetry map processed by Dr. Fujiwara. | 2 sets for direction based lineament and topography base lineament. |
| | 18:00 | Redraw the result in Adobe Illustrator. | |
| 12/11/2009 | 14:00 | Discussion on the result of direction based lineament drawing. | |
| | 19:00 | Discussion on the result of topography based lineament drawing. | |
| 13/11/2009 | 10:00 | Discussion on the result of topography based lineament is continued. | |
| 14/11/2009 | | Every scientist works on finalization of cruise report. Discussion is continued through e-mail. | |

| | | | |
|---|---|---|---|
| 15/11/2009 | 24:00 | Ship Mean Time (SMT) was shifted to be one hour earlier (SMT = GMT + 6). | |
| 16/11/2009 | 14:00 | Scientific meeting: discusson about the progress of Cruise Report. | |
| 19/11/2009 | | Cruise report has been complitely revised. The final version of cruise report was saved in pdf format. | |
| 20/11/2009 | | Arrived at Benoa Port – Bali. | |

Please refer of log book in Appendix A for detail information of acquisition progress.

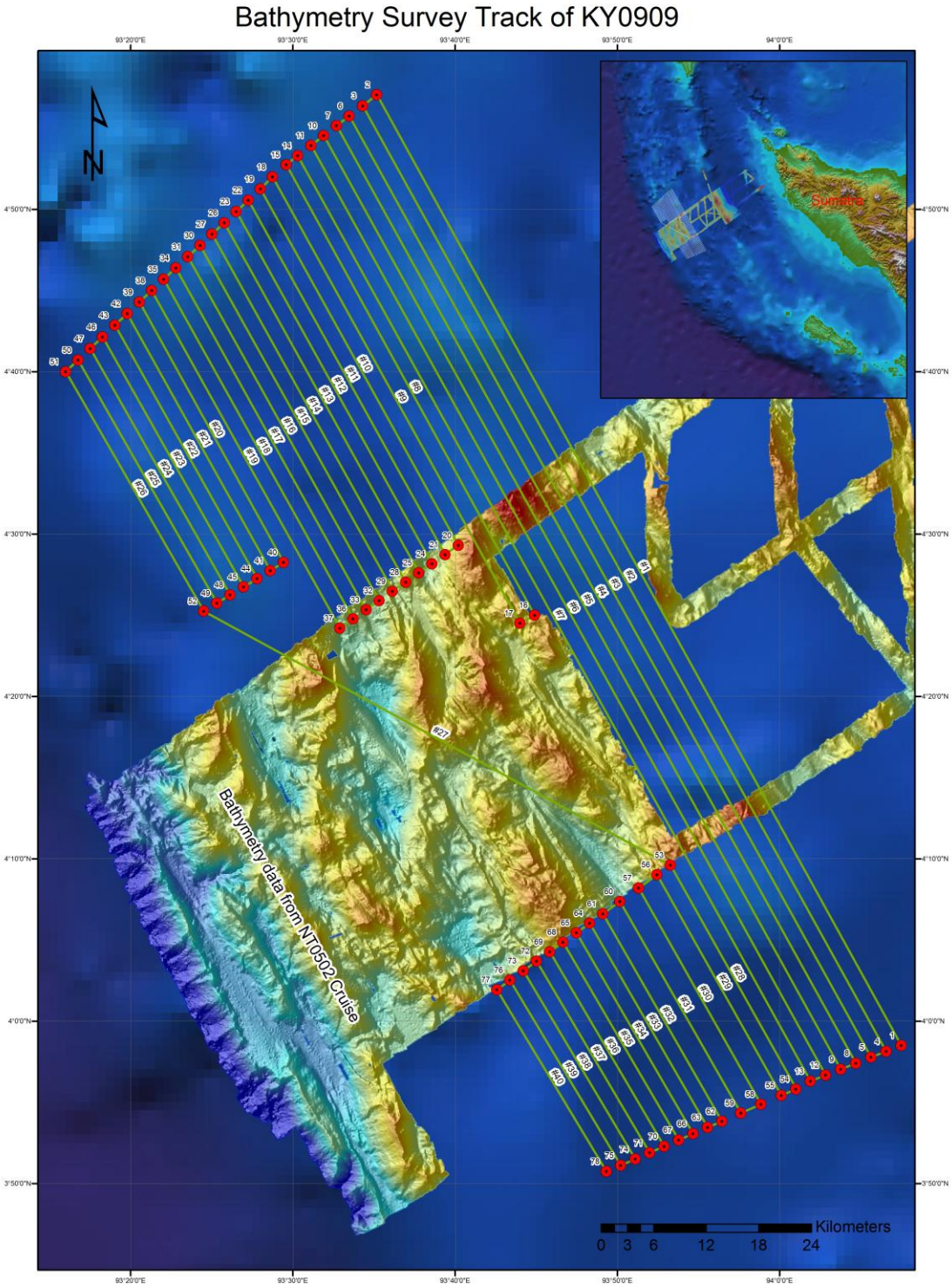


Figure 2-1. Bathymetry track of KY0909.

## 3. List of participants

***Co-chief Scientist***

Kenji HIRATA (Representative of Science Party)
Seismology & Volcanology Res. Dept. /JMA

(Guest Senior Scientist)
Institute for Research on Earth Evolution/JAMSTEC
2-15 Natsushima-cho, Yokosuka, 237-0061 - JAPAN

Haryadi PERMANA
Research Center for Geotechnology,
Indonesian Institute of Sciences (LIPI)

***Researcher***

Eddy Zulkarnaen GAFFAR
Research Center for Geotechnology,
Indonesian Institute of Sciences (LIPI)

Toshiya FUJIWARA
Institute for Research on Earth Evolution
Japan Agency for Marine-Earth Science and Technology
2-15 Natsushima-cho, Yokosuka, 237-0061 - JAPAN

Udrekh
BPPT Teknologi
NEONET - BPPT 1st building 20th floors

Masahiro KAWANO
Institute for Research on Earth Evolution
Japan Agency for Marine-Earth Science and Technology
2-15 Natsushima-cho, Yokosuka, 237-0061 - JAPAN

***Security officer***


KAPTEN Hardenan NURSYAHID
DISHIDROS
Jl. Pantai Kuta V/I Ancol Timur, Jakarta -
INDONESIA

## 4. Scientific Equipment

Kenji Hirata

### 4.1 Multi-beam bathymetry system

The R/V KAIYO equips the SEA BEAM 2100 multi-beam bathymetric system that uses sonar acoustic arrays placed in a Mils Cross arrangement to form the beams. The crossed arrangement of hydrophone and projector arrays enables SEA BEAM 2100 to process up to 81 soundings spaced at angles of one degree in an athwartship accurate pattern.

The SEA BEAM 2100 of R/V KAIYO operates at a primary frequency of 12 kHz. At 12 kHz, the system can function at depths ranging from 100 to 11,000 meters with a swath width of 80 degrees, in the presence of up to ± 7.5 degree of pitch. Because of the broad athwartship beam pattern of the projector, the system can achieve a wide swath in intermediate depths, depending on array size, sea state, and bottom backscatter. In addition to bathymetric data, the system processes backscatter signals from the ensonified seafloor crosstrack swath for Side Scan presentation [Seeber et al., 2007]. Table 4-1 lists general hardware performance specifications for the SEA BEAM 2100 of R/V KAIYO [SeaBeam Instruments, Inc., 1997, 1999].

Table 4-1 Hardware Specifications

| | |
|---|---|
| Beam Frequency | 12 kHz |
| Depth Range | 100 to 11,000 meters |
| Beam Spacing | 1° athwartship |
| Available Swath width | 80 ° |
| Transmit Beam (width) | 2° at -3 dB (fore and aft) |
| Receive Beam (width) | 2° at -3 dB (athwartship) |
| Pulse Width | 3 to 20 msec |
| Allowable Pitch | ±7.5 ° |
| Allowable Roll | ±20 ° (±5 ° in the case of maximum swath width) |
| Source Level at maximum response axis | 234 dB $\mu$Pa/m |
| RMS depth precision | Smaller value of either 0.5 % of water depth or ±1 meters, over all the swath widths |

References

SeaBeam Instruments, Inc., Sea Beam 2100 Manual Supplement (RV-08AGS), Sea Beam 2100 Operator's Manual, No. 2125-8004, Revision A, 5-6, 1997.

SeaBeam Instruments, Inc., Sea Beam 2100 Factory Acceptance Test, Sea Beam 2100 Series Multibeam Bathymetric Survey System, No.2101-8237, Revision G, p.1-1, 1999.

## 5. Preliminary Results:
## Multi-Beam Bathymetry off the Northwestern Sumatra Island

Toshiya Fujiwara, Haryadi Permana, Kenji Hirata, Eddy Gaffar,
Udrekh, and Masahiro Kawano

### 5.1. Data Collection

During the R/V Kaiyo KY09-09 cruise, bathymetry survey was conducted in the vicinity of outer-arc-high in the Indonesian rupture zone of the Great Sumatra-Andaman Earthquake of 26 December 2004. The purpose is to investigate seafloor morphology, possible fault activity, and evidences of mass wasting.

The bathymetric data were collected using a SeaBeam 2100 multi-narrow beam echo-sounder system, which has a frequency of 12 kHz, 2°×2° beam widths, 81 beams, and a swath width of 80° (Detailed description of the equipment is in Chapter 4).

Measurements of expendable bathythermograph (XBT) for the sound velocity profile in water column were carried out at 3°07'N, 94°54'E (1505 m in water depth, 29.6°C in surface temperature, 13:50 (UT: Local Time 19:50 (+6 hrs)), October 31st, 2009) and at 3°54'N, 93°52'E (2455 m in water depth, 29.7°C in surface temperature, 7:09 (UT), November 5th, 2009) (Fig. 5-1-1). The bathymetry survey started at 19:29 (UT) on October 31st, 2009, and ended at 16:07 (UT) on November 5th, 2009 (Detailed log of the survey and XBT records are in Chapter 2 and Appendix). Thanks to good weather condition, quality of the data was good!

Survey tracks were designed to orient sub-parallel to the along-arc direction (Fig. 5-1-1). Track spacing was 1.3-1.4 nautical mile (2.4-2.6 km) in areas that water depth is deeper than ~2000 m, and track spacing in other areas was 1 nautical mile (1.85 km) to get complete bathymetric coverage. However, there are gaps of the beam coverage in the portions where the water depths are shallower than 800 m. Survey ship speed was set to be 10 knot (18.5 km/h). As the result of our survey, total of approximately 3500 $km^2$ areal coverage was obtained.

The survey area extended from ~3°50'N, 93°10'E to ~5°00'N, 94°10'E adjacent to the R/V Natsushima NT05-02 survey conducted in 2005. The area elongates a length of 70 km in the along-arc direction, and a width of 40 km in the across-arc direction over the outer-arc-high. The area is situated off the northwestern Sumatra Island, ~200 km northwestward from the epicenter on December 26, 2004, and is one of the regions of highest vertical displacement predicted from the modeling (See Chapter 1).

Spurious depth readings in the data were edited out using ping-edit of MB-System software. The bathymetric data were girded at ~37 m (0.02 arc-minutes) cell size in order to filter out the beam artifact while preserving the characteristic high resolution of the multi-beam data. GMT software was used for data processing, and commands and parameters are shown in Table 1.

**Table 5.1** GMT commands and parameters.

| |
|---|
| *blockmedian: grid size = 0.025 arcmin* |
| *surface: grid size = 0.020 arcmin, tension to the gridding = 0.35* |
| *grdmask: search radius = 0.050 arcmin* |

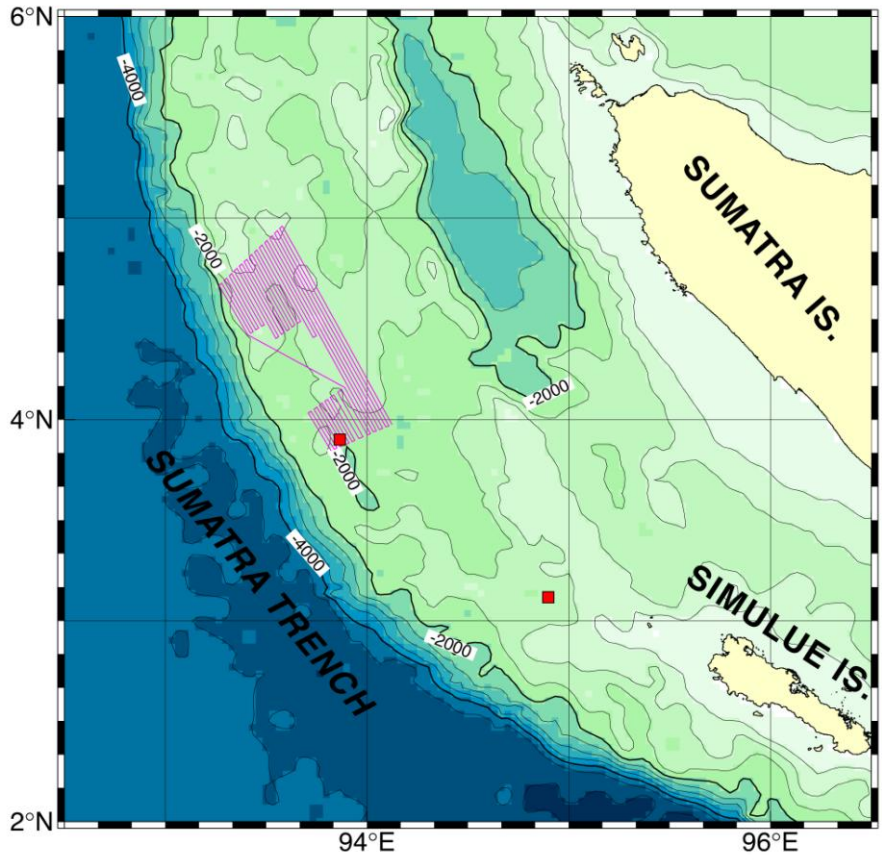


Fig. 5-1-1 Index of the survey area of the KY09-09 cruise. Survey tracks are shown as purple lines. Squares show the XBT stations.

## 5.2. Morphology of the Outer-Arc-High

Multi-beam bathymetry obtained during the KY09-09 cruise is shown in Fig. 5-2-1b. In the survey area, the water depth ranges from 300 m to 2500 m. The shallowest depth is 300 m in the northeastern area, whereas the deepest depth is in the southwestern area, rising above the Sumatra Trench (depth of approx. 4500 m). An integrated multi-beam bathymetry with the NT05-02 cruise data [NT05-02 scientific party, 2005] is shown in Fig. 5-2-2b.

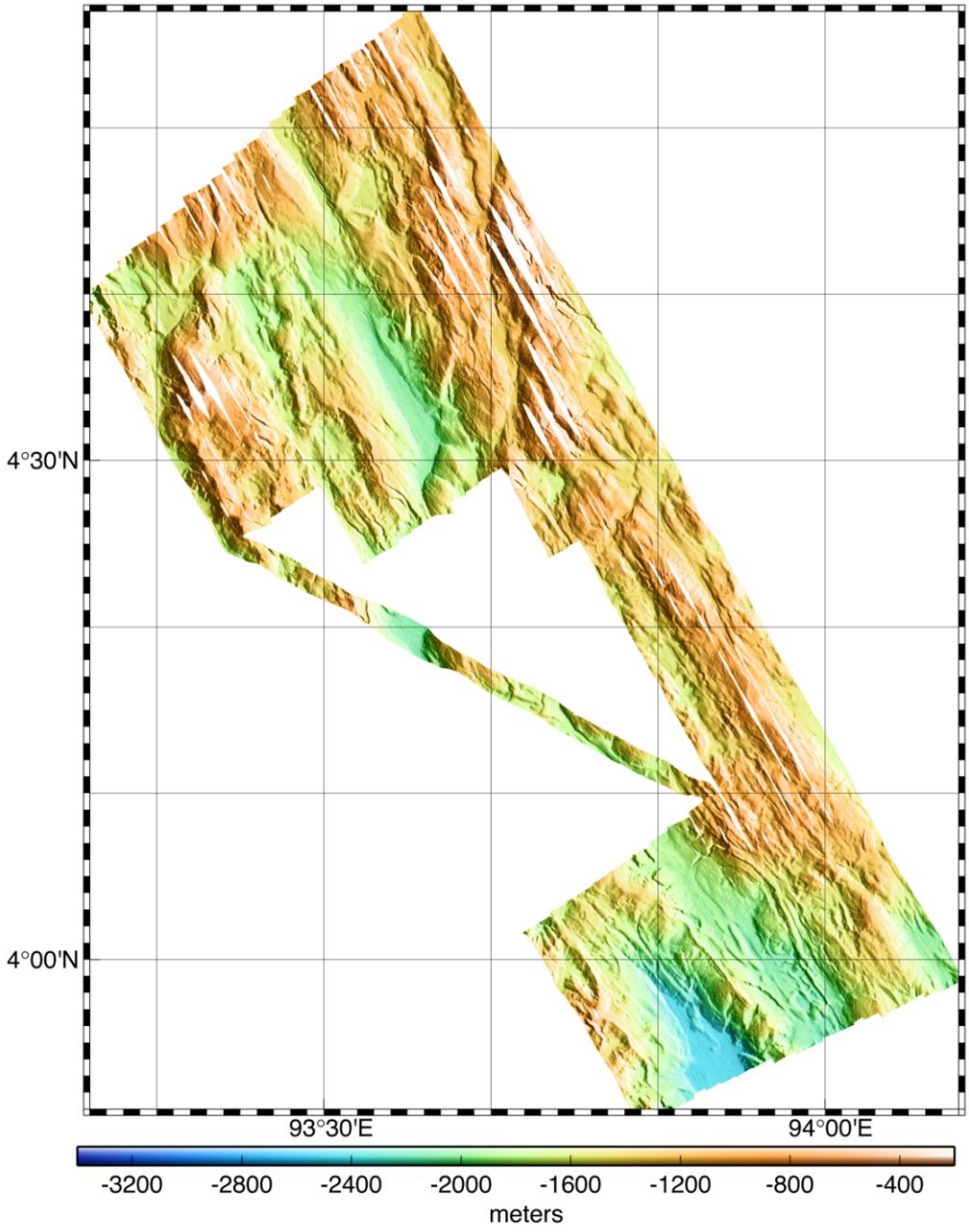


Fig. 5-2-1 (a) Multi-beam bathymetry illuminated from northeast.

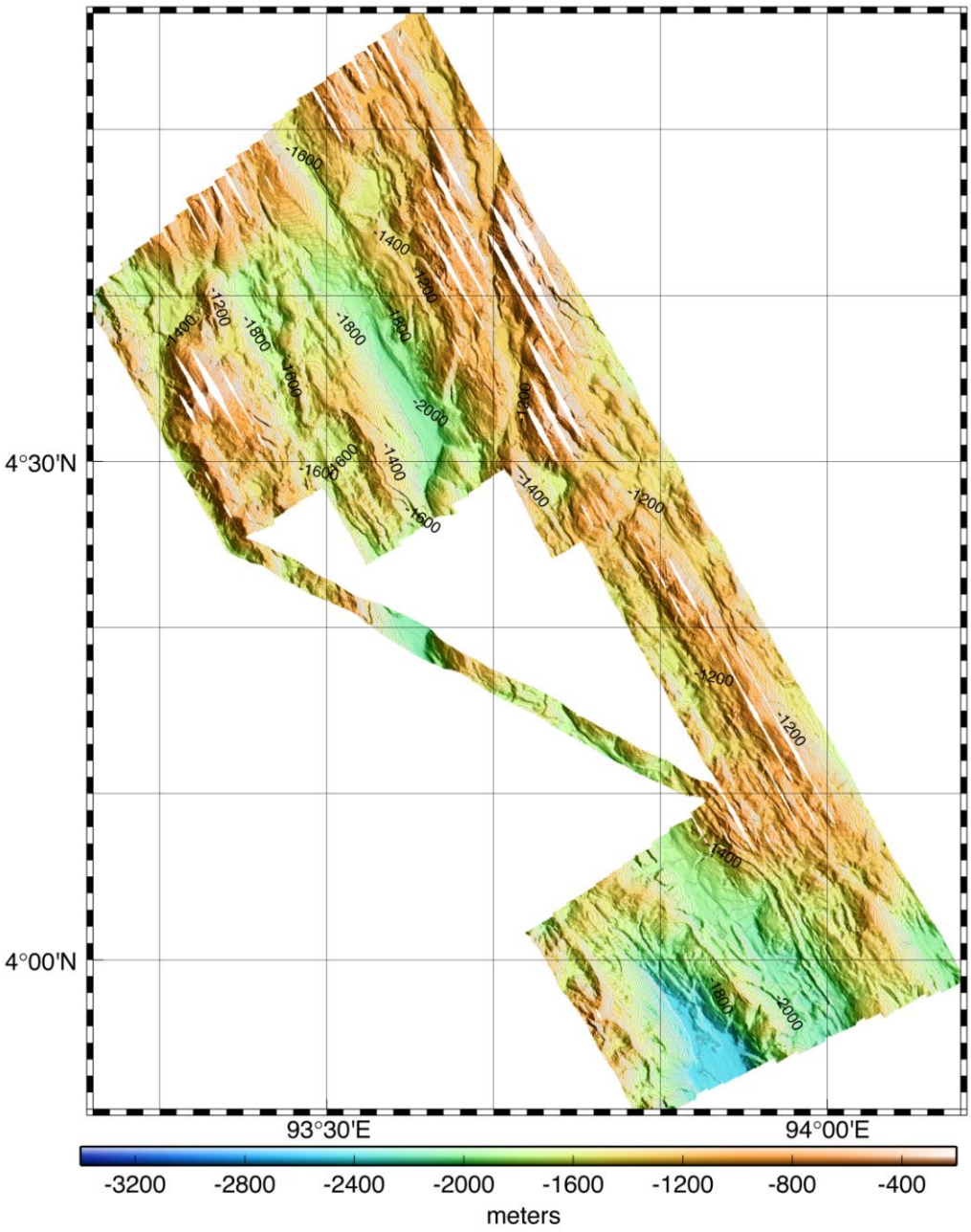


Fig. 5-2-1 (b) Multi-beam bathymetry illuminated from northeast. Contours are at 50 m intervals.

A prominent feature in the bathymetry is a series of ridge and trough structure trending along the arc in the direction of NNW-SSE, parallel to the strike of the Sumatra Trench (Fig. 5-2-2b). Relative height of this rugged topography, from bottoms of troughs to crests of ridges, is roughly 1000 m. A characteristic distance between bottoms of troughs or crests of ridges is 5-6 km. The prominent feature is

possibly controlled by imbricate thrust faults [Seeber et al., 2007]. Landward facing slopes of the ridges are generally linear and steep.

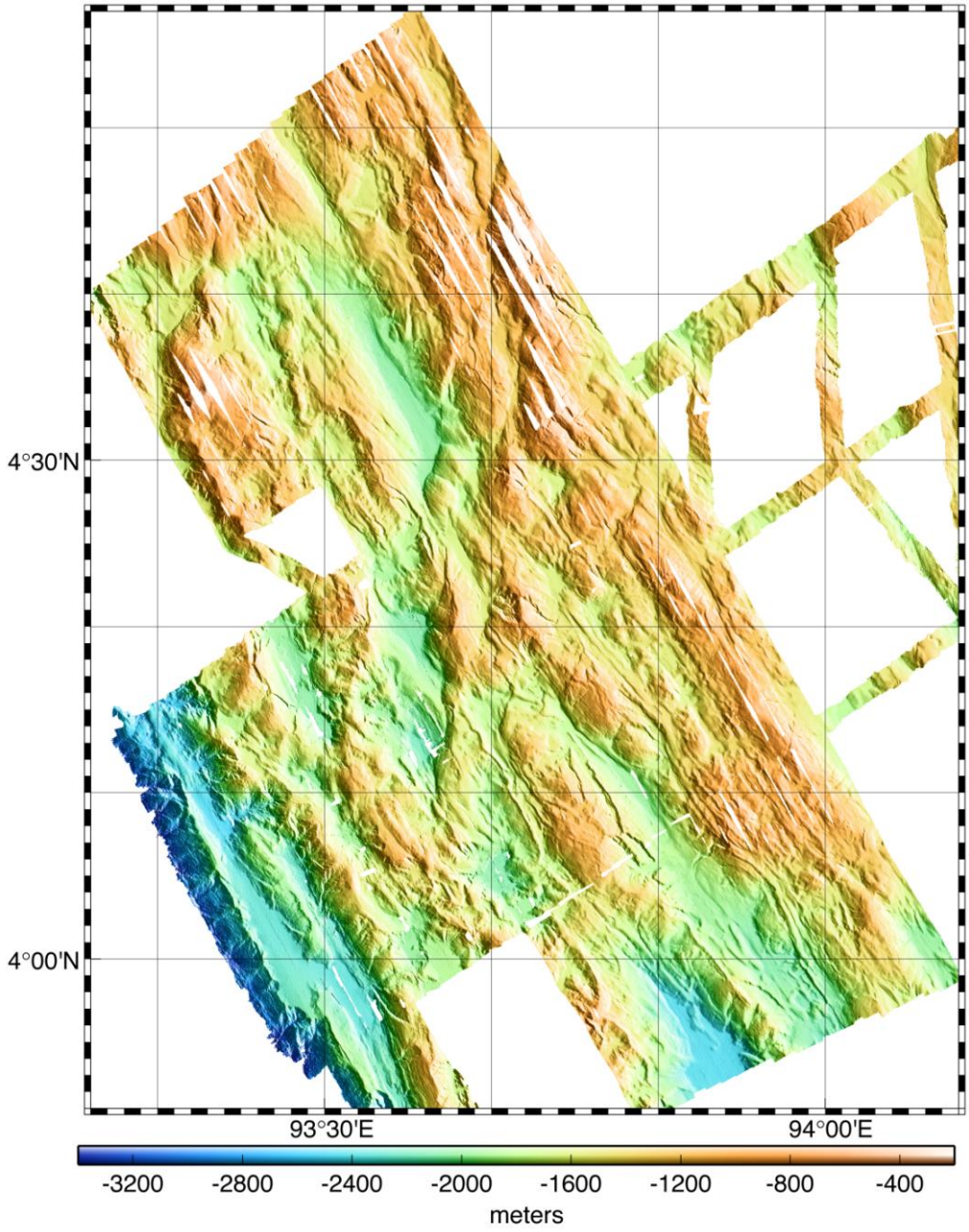


Fig. 5-2-2 (a) Multi-beam bathymetry illuminated from northeast. The NT05-02 cruise data are merged with the data obtained during this cruise.

The ridge and trough structure is occasionally offset in the normal direction to the trench or the N-S direction. These offset structures are possibly due to oblique

subduction of the Indo-Australia plate. Detailed description of morphological lineaments is discussed in the following chapters 5.3 and 5.4.

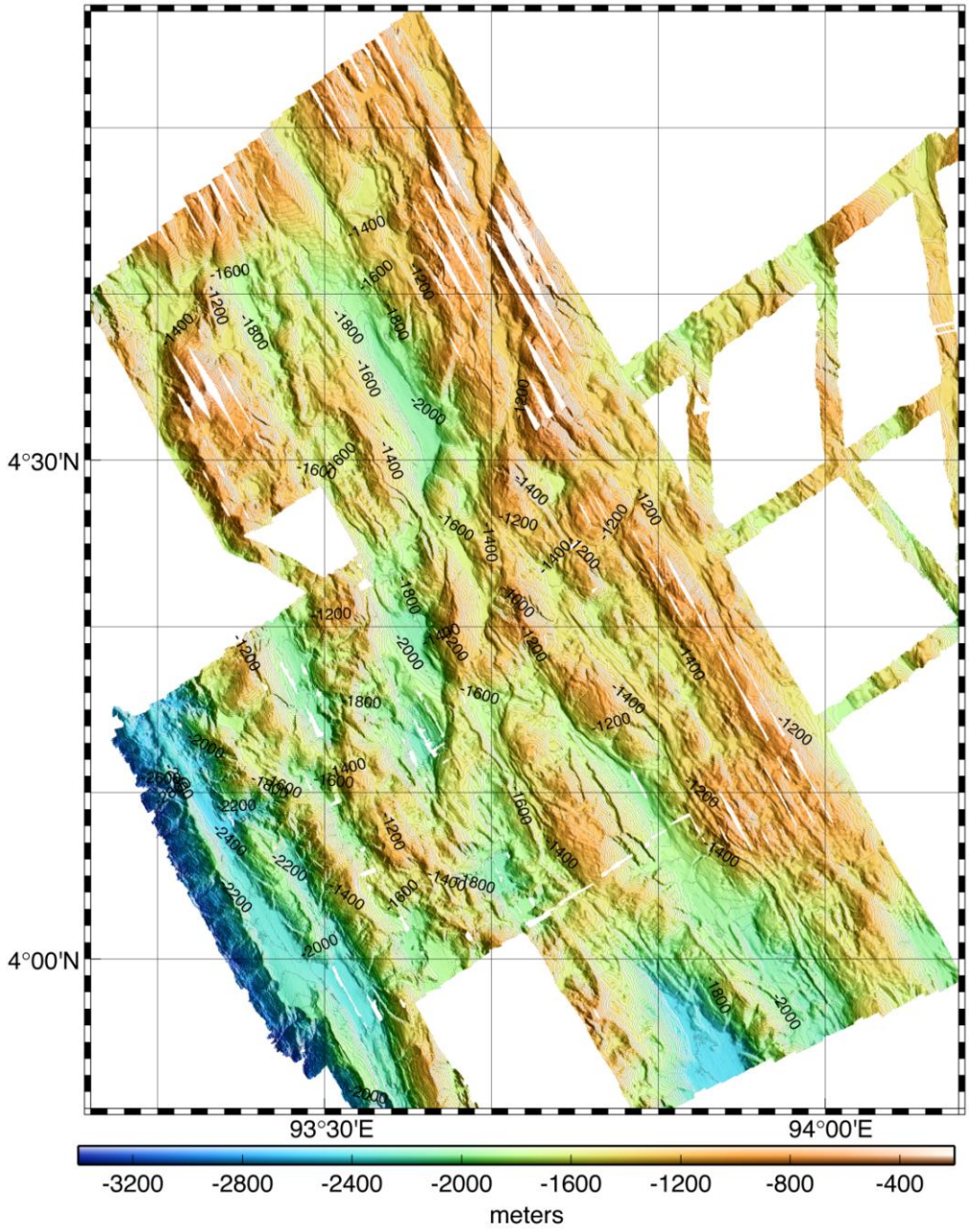


Fig. 5-2-2 (b) Multi-beam bathymetry illuminated from northeast. Contours are at 50 m intervals.

The morphology feature could be divided into 3 different blocks in general, named Block A, Block B, and Block C (Fig. 5-2-2c). The NW direction of ridge, scarp and valley dominates morphology of the study area. The shallowest area up to

300 m water depth occupies the NE part of the area (or the northern part of Block C) while the deepest area up to 3200 m water depth is commonly observed in the southwestern part of the study area (Block A) and southern part of the area (or the southern part of Block B). Ridges morphology generally show gentle slopes in the southwestern side. An well-developed, a set of NS trending ridge and valley is commonly observed in the middle of the study area along the meridian of 93º38'E.

NW trending ridges in Block A which are mostly narrow with widths of 4 km to 8 km shows very rough morphology indicated by dissected and narrow V-shape valleys. In the surveyed area, the shallowest ridge is 1000 m water depth and the deepest valley is 2200 m water depth. Land sliding traces can be clearly observed at almost all the SW facing scarps of the western side of the ridge, located in the western side of Block A and is featured by irregular circular failures. Isolated circular morphology features are commonly observed in the northeastern part of Block A, for examples at 4º14'N-93º24', 4º12.5'N-93º25', 4º11'N-93º29.5', and 4º02.5'N-93º36', and those are limited by very steep hill walls. Isolated, cubic to irregular shape depressions at 1600 to 1800 m water depth are also commonly observed in the middle part of Block A around at 4º14'N- 93º25'E or 4º11'N-93º29'E.. A wide (4 km to 8 km) and long (several tens of km up to 60 km) valley is parallel to the ridge occupying the southwestern side of block A. The valley surface is flat, smooth and bordered by steep scarp on both sides. Another valley observed in the northeastern side of Block A shows an irregular shape with undulating surface.

NW trending ridges in Block B are mostly wider than block A and varies its width from 8 km to 15 km in the north and 6 km to 8 km in the northeast. The shallowest area is located in the northern part of Block B, up to 700 m water depth (around 4º35'N-93º23'E) and the deepest area is located in the southern part of Block B (around 3º54'N-93º54'E) around 2450 m water depth. Morphology of Block B shows very rough topography, dissected by V- to U-shaped valley. In the middle part of Block B, the NS trending ridges and V shaped valley are observed, as well as isolated hills or depressions, located at 4º03'N-93º42', 4º05'N-93º40.5', 4º13'N-93º35', 4º19'N-93º35', bounded by steep scarps. Another isolated depression morphology is found at 4º28'N-93º26'E. An steep and long wall valley is observed to be centered at 4º34'N-93º35'E of Block B with depths from 1800 m to 2200 m. An well-developed valley with dimensions of at least 20 km long and 12 km wide, and with depths from 2200 m to 2400 m, are found in the southern part of Block B, centered at 3º54'N-93º54'E. The surface of another valley, centered at and 3º58'N-93º58'E, is not very smooth but undulating.

A NW-trending, wide ridge with lengths up to 30 km occupies Block C. The shallowest part reaches at 600 m water depth at around 4º32'N-93º42'E and the deepest part is 1650 m water depth in the southeastern corner of Block C. Many isolated hills, bordered by steep slopes, are commonly located along the NW-trending wide ridge. ,Isolated and irregular depressions in between 1700m and 1600 m water depth are observed at 4º47'N-93º33'E, 4º29'N-93º43'E. 4º18'N-93º51'E, and 4º17'N-93º52'E.

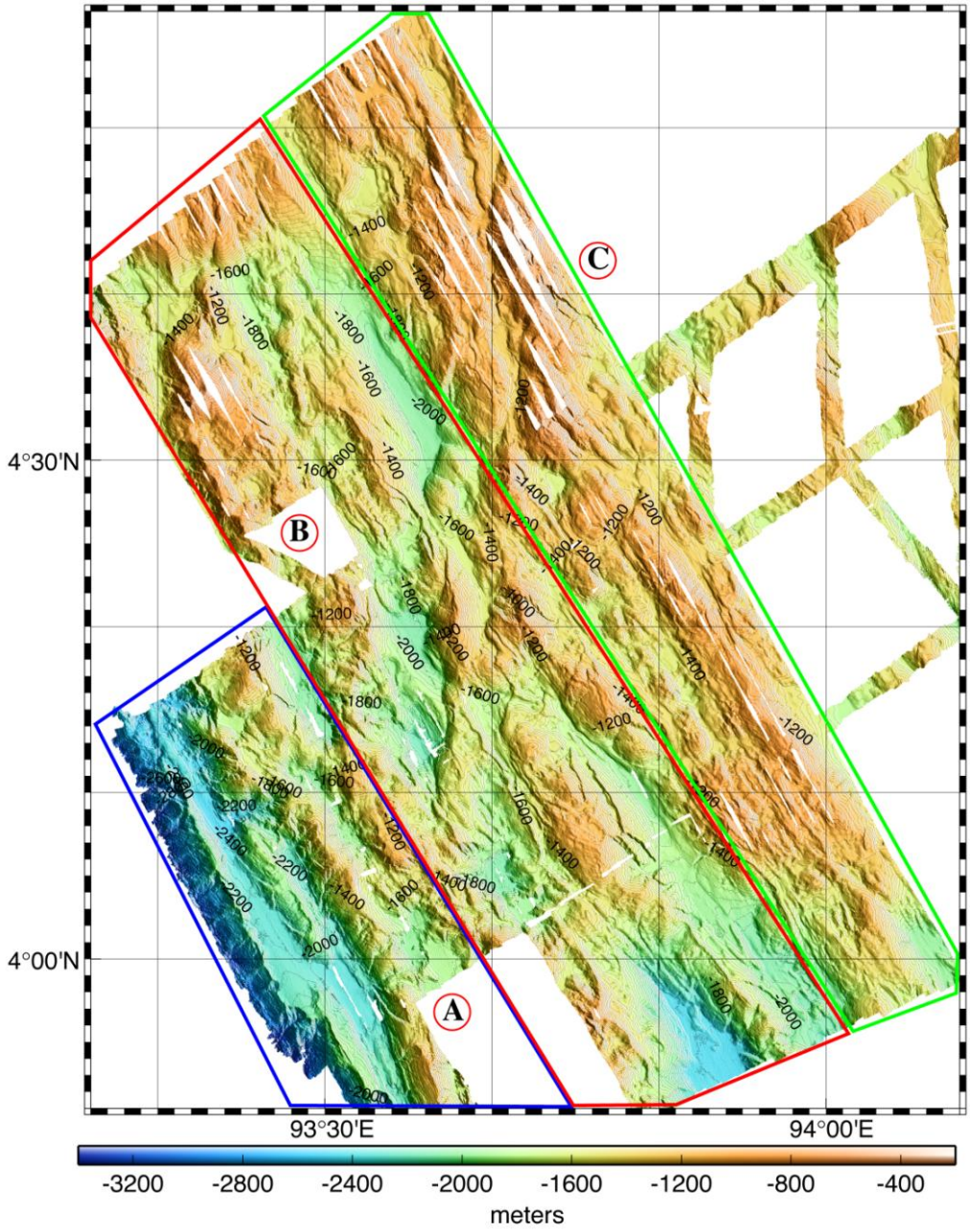

Fig. 5-2-2 (c) Multi-beam bathymetry illuminated from northeast. Contours are at 50 m intervals. Blocks A, B, and C are morphological grouping as discussed in Chapter 5.2.

References

NT05-02 scientific party, http://www.jamstec.go.jp/jamstec-e/sumatra/natsushima/bm/contents.html

Seeber, N., et al., Earth Planet. Sci. Lett., doi: 10.1016/j.epsl.2007.07.057, 2007.

### 5.3. Lineament Pattern

The two sets of lineament patterns were analyzed. The first lineament set is based on direction (Fig. 5-3-1) and the second one is based on topography such as ridge, scarp and valley lineament (Fig. 5-3-2).

The directional lineament could be re-grouped into three (3) unit lineaments. The first unit is NW direction shown in green color in the figure, the second is NS direction in red, and the last is NE direction in blue color. The NW direction lineament is the major lineament in the study area because the length of lineament varies 10-20 km and up to 40 km. Exception is the SW part of the area. There are very short NW lineaments, 1-3 km in length. This lineament commonly exists at the NW side and SE side of the study area (Fig. 5-3-1).

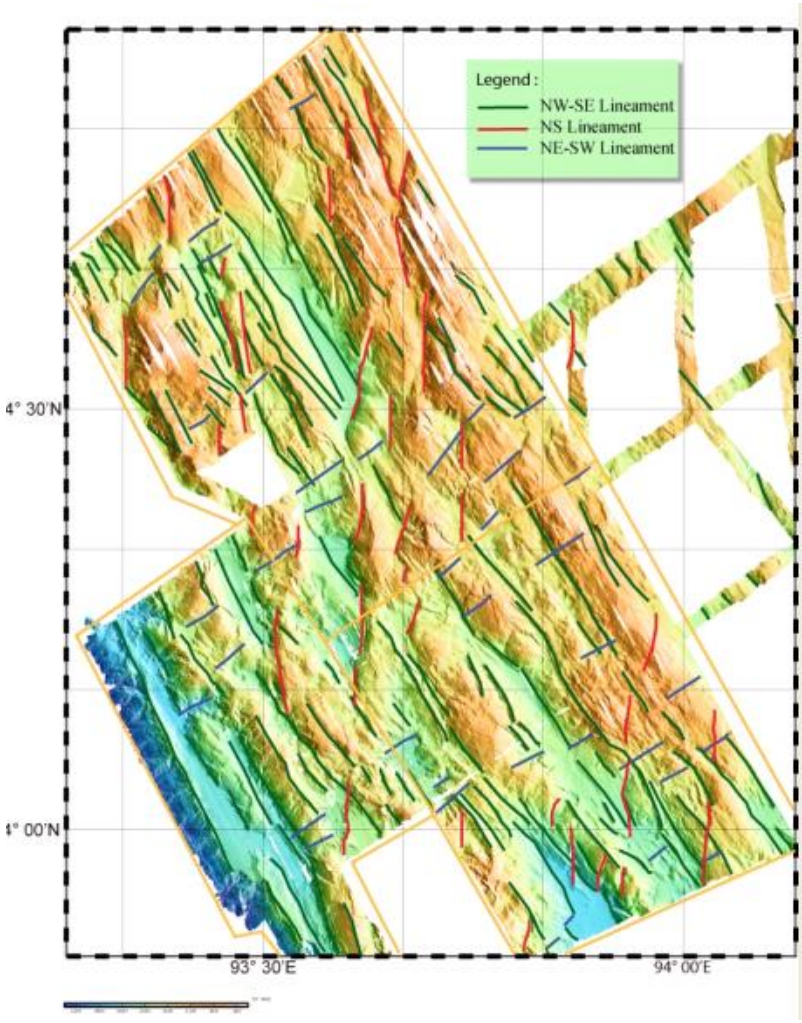


Fig. 5-3-1 Distribution of lineaments based on directional analysis.

The NS lineament exists commonly in between 93°30'E to 93°50'E and minor appearance at NW and SE part of the area. The lineaments have medium length from 8-12 km up to 20 km. The NS lineament usually crosses cut the NW lineament or in some cases cut the NE lineament.

The NE lineament often appears as a short lineament varies 2 km to 4 km in length. The NE lineaments are widely distributing in the area and very significant in middle part of the study area. The NE lineament commonly crosscuts the NW and NS lineaments.

The second set of lineaments has been defined based on ridge, scarp, and valley tracing (Fig. 5-3-2). The ridge, valley and scarp lineaments are mostly in NW direction (red, brown and blue colors in the figure) are dominant in the study area. They are the major lineament in the area and the length varies from 2 km, 4 km to 10 km and up to 60 km.

The other lineament tracing along scarp and ridge exist in the limited area between 93°30'E and 93°50'E. These lineaments are mostly in NS and few in NNE direction (green color) crosscutting other lineaments. The length of the lineament mostly varies 20-50 km and minor number of lineament has 2-6 km length.

The last pattern lineament is identified as scarps (yellow color). They appear as short length lineaments, with length of 2-6 km and rarely 10-15 km. This type of lineament is commonly extending in NE direction but also in ESE direction and those are mostly distributed in the middle and SE of the study area.

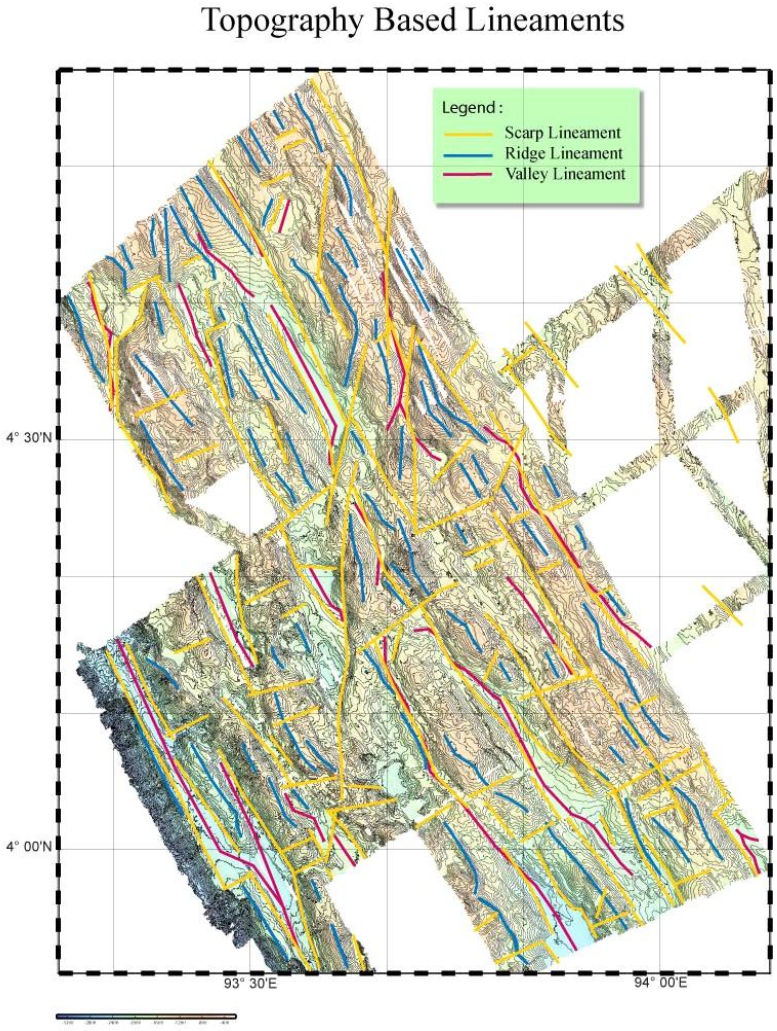


Fig. 5-3-2 Distribution of lineaments based on topographic analysis (ridge, scarp, and valley).

## 5.4. Interpretation

Haryadi Permana

The high-resolution bathymetry map acquired in the KY0909 cruise has resulted in identification of three (3) different units in both of categories of direction lineament and topographic lineament. In general, lineaments could represent structural features as fault (thrust, normal or strike slip), fold (anticlinal, synclinal), fracture or bedding plan or bedding strike. In the surveyed area, they are Northwest-to-southeast (NW-SE), Northeast-to-southwest (NE-SW) and North-to-south (N-S) lineaments, although a few of lineaments have directions to NNE-to-SSW or ENE-WSW. From the viewpoint of length of the lineaments, the NW-SE lineament is considered as major lineaments and then the N-S lineaments as the second major lineaments. The NE-SW lineaments are mostly minor and appear as short lineaments but are distributed very densely in the entire study area. Using a conventional cross-cutting law that a younger lineament cuts off an older one, the NW-SE lineaments can be classified as the oldest or the first stage lineament. But it is very difficult to determine whether the N-S lineaments was formed earlier (or later) than the NE-SW lineaments. In this cruise report, we suppose that the NE-SW lineaments have occurred before the N-S lineament appears.

The study area is located in the transition zone of relatively ESE (south of Simeulue Island) to NNW subduction trend and is affected by the present relatively N-S subduction direction (P in Fig. 5-4-1). The subduction itself has occurred since Late Oligocene – Early Miocene and is continuing until now (Laughton, McKenzie and Sclater, 1973). It is believed the oblique subduction in the present stage but it is unclear when the oblique subduction component appeared (Hamilton, 1979; Hall, 1996 and Hall and Wilson, 2000). It assumes or hypotheses, the compressional stress (P in Fig. 5-4-1) is decreasing while the shear stress (S, in Fig. 5-4-3) is increasing in undefined time during subduction took place. At the first stage, the compressional stress across the subduction zone is dominant to develop the NW lineaments as undistinguished thrust faults, thrust folds and fold systems in the outer-arc-high as shown in a cartoon of Fig. 5-4-1. The NW lineaments become major (structural features) in the area.

The second stage is under the condition where the shear stress component appears in subduction system. The NE to ENE lineaments occur during extension or stretching of the outer-arc high due to the shear stress component, as undistinguished lineaments, possibly they are normal fault or strike-slip fault that cross-cut the previous NW lineaments as shown in Fig. 5-4-2. Such a kind of U-shape valley is growing up during this stage.

Assume that the shear stress component has increased comparing with compressional stress component at the third stage causing the oblique subduction. In this stage, undistinguished N-S to NNE-SSW lineaments occurred in the area. The N-S lineaments possibly represent strike slip or normal fault. The N-S lineaments cross-cut the previous NW-SE and NE-SW lineaments as shown in Fig. 5-4-3. Basin or U-shape valley is expanding during this stage.

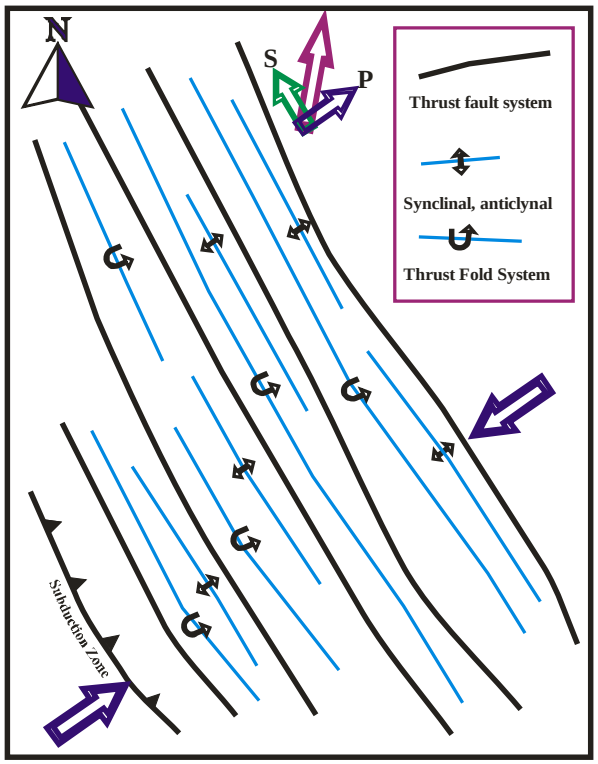


Fig. 5-4-1. Cartoon scenario of NW lineament formation at the first stage related to subduction system.

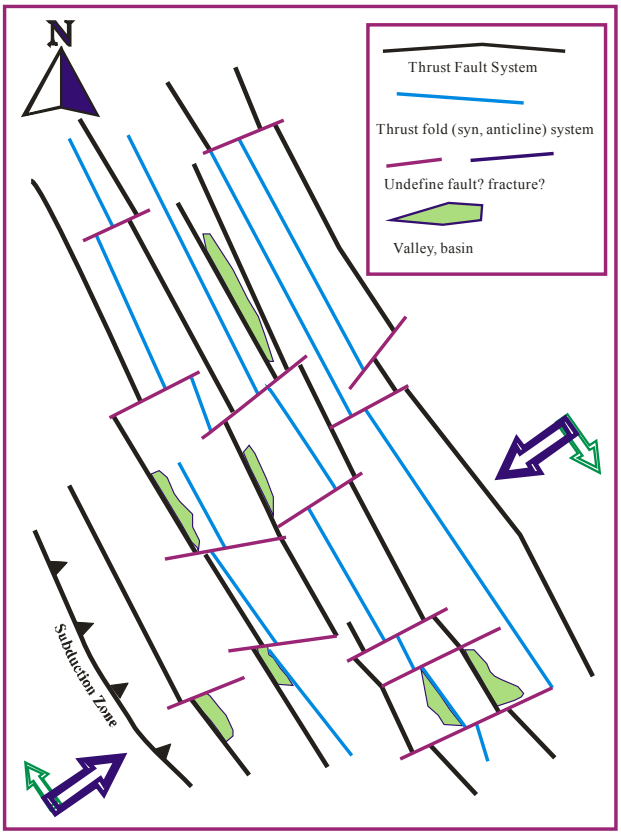


Fig. 5-4-2. Cartoon scenario of NE-NEE lineament formation related to present shear stress component in subduction system.

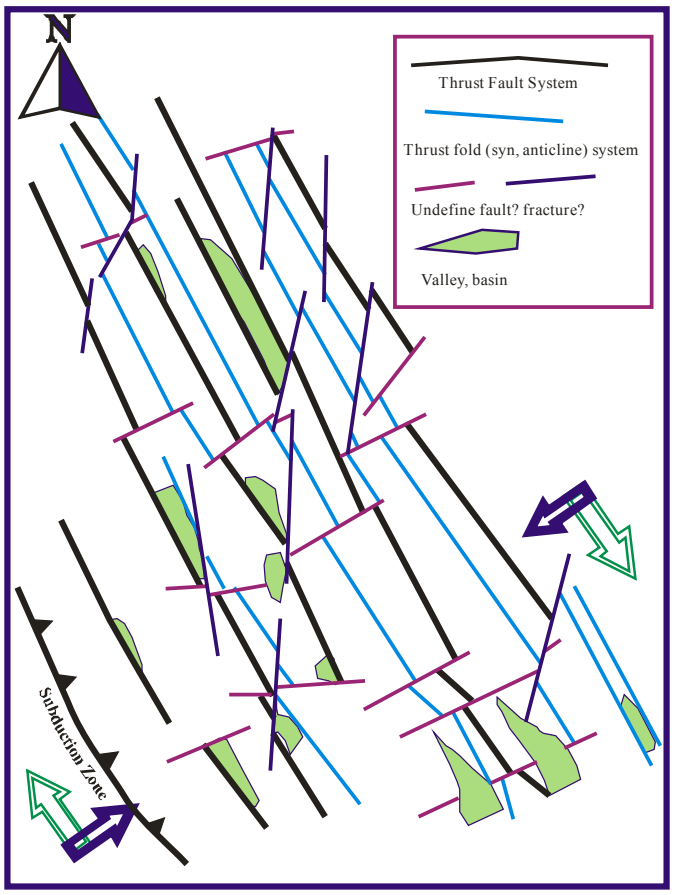


Fig. 5-4-3. Cartoon scenario of NS-NNE lineament formation related to oblique subduction.

Reference.

Hamilton, W. Tectonics of the Indonesian region, US Government Printing Office, Washington, DC, 1979.

Hall, R., Reconstructing Cenozoic SE Asia. Geological Society Special Publication, v. no. 106, p. p. 153 – 184. 1996.

Hall, R., and Wilson, M.E.J.. Neogene sutures in eastern Indonesia. Journal of Asian Earth Sciences 18 (2000) 781–808. 2000

Laughton, A.S ; J.G Sclater, & D.P McKenzie. The Structure and Evolution of the Indian Ocean, Implication of Continental Drift to The Earth Sciences, Vol 1, Academic Press, London and New York. 1973.

KY09-09 Leg.1 Log Sheet No. 1

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 01/11/2009 | 0 | 0 | 3 | 45,59 | 94 | 18,29 | 11,9 | 320,6 | 1798 | |
| 01/11/2009 | 0 | 15 | 3 | 48,10 | 94 | 16,40 | 11,8 | 320,6 | 1944 | |
| 01/11/2009 | 0 | 30 | 3 | 50,49 | 94 | 14,56 | 12,1 | | 1928 | I found that a parameter of SOG should be measured on the PC monitor of SAINS HYB-CPU. |
| 01/11/2009 | 0 | 45 | 3 | 52,70 | 94 | 12,63 | 11,4 | 321,4 | 1852 | |
| 01/11/2009 | 1 | 0 | 3 | 54,73 | 94 | 10,80 | 10,1 | 316,7 | 1760 | |
| 01/11/2009 | 1 | 15 | 3 | 56,52 | 94 | 8,99 | 10,4 | 317,6 | 1859 | |
| 01/11/2009 | 1 | 30 | 3 | 58,49 | 94 | 7,50 | 10,1 | 331,5 | 1952 | survey line #1 (original waypts 1 to 2) is started at 1:29 am |
| 01/11/2009 | 1 | 45 | 4 | 0,71 | 94 | 6,27 | 10,4 | 331,7 | 1987 | |
| 01/11/2009 | 2 | 0 | 4 | 2,97 | 94 | 5,02 | 10,2 | 331,7 | 1705 | |
| 01/11/2009 | 2 | 15 | 4 | 5,20 | 94 | 3,01 | 9,9 | 332,2 | 1349 | |
| 01/11/2009 | 2 | 30 | 4 | 7,43 | 94 | 2,56 | 10,5 | 334,8 | 1196 | |
| 01/11/2009 | 2 | 45 | 4 | 9,71 | 94 | 1,31 | 10,6 | 330,3 | 1324 | |
| 01/11/2009 | 3 | 0 | 4 | 11,99 | 94 | 0,04 | 10,6 | 331,3 | 1504 | |
| 01/11/2009 | 3 | 15 | 4 | 14,28 | 93 | 58,81 | 10,2 | 327,5 | 1485 | |
| 01/11/2009 | 3 | 30 | 4 | 16,56 | 93 | 57,54 | 10,0 | 328,9 | 1398 | |
| 01/11/2009 | 3 | 45 | 4 | 18,79 | 93 | 56,31 | 10,0 | 328,2 | 1209 | |
| 01/11/2009 | 4 | 0 | 4 | 20,03 | 93 | 55,04 | 10,2 | 328,5 | 1250 | |
| 01/11/2009 | 4 | 15 | 4 | 23,25 | 93 | 53,80 | 10,2 | 328,0 | 1215 | |
| 01/11/2009 | 4 | 30 | 4 | 25,71 | 93 | 52,45 | 10,1 | 327,5 | 1146 | |
| 01/11/2009 | 4 | 45 | 4 | 27,68 | 93 | 51,35 | 10,3 | 327,7 | 1333 | |
| 01/11/2009 | 5 | 0 | 4 | 29,89 | 93 | 50,16 | 10,3 | 329,4 | 1473 | |
| 01/11/2009 | 5 | 15 | 4 | 32,13 | 93 | 48,94 | 10,4 | 328,5 | 1347 | Newly formatted log sheet is used from this time. |
| 01/11/2009 | 5 | 30 | 4 | 34,34 | 93 | 47,70 | 10,2 | 328,5 | 1420 | |
| 01/11/2009 | 5 | 45 | 4 | 36,59 | 93 | 46,45 | 10,4 | 330,2 | 1509 | |
| 01/11/2009 | 6 | 0 | 4 | 38,81 | 93 | 45,22 | 10,2 | 330,0 | 1396 | |
| 01/11/2009 | 6 | 15 | 4 | 40,98 | 93 | 44,00 | 10,1 | 329,1 | 1056 | |

KY09-09 Leg.1 Log Sheet No. 2

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 01/11/2009 | 6 | 30 | 4 | 43,31 | 93 | 42,73 | 9,6 | 332,0 | 577 | |
| 01/11/2009 | 6 | 45 | 4 | 45,37 | 93 | 41,70 | 10,3 | 330,1 | 778 | |
| 01/11/2009 | 7 | 0 | 4 | 47,62 | 93 | 40,33 | 9,8 | 332,8 | 1272 | |
| 01/11/2009 | 7 | 15 | 4 | 49,84 | 93 | 39,13 | 10,2 | 331,4 | 956 | |
| 01/11/2009 | 7 | 30 | 4 | 52,09 | 93 | 37,88 | 10,3 | 332,8 | 1208 | |
| 01/11/2009 | 7 | 45 | 4 | 54,44 | 93 | 36,57 | 10,4 | 331,9 | 1208 | |
| 01/11/2009 | 8 | 0 | 4 | 56,45 | 93 | 35,47 | 10,3 | 332,9 | 1263 | |
| 01/11/2009 | 8 | 3 | 4 | 57,06 | 93 | 35,16 | | | | Survey line #1 (original waypoints 1 to 2) is completed. |
| 01/11/2009 | 8 | 15 | 4 | 56,51 | 93 | 34,32 | 10,3 | 152,0 | 1209 | |
| 01/11/2009 | 8 | 16 | 4 | 56,42 | 93 | 34,35 | | | | Survey line #2 (original waypoints 3 to 4) is started. |
| 01/11/2009 | 8 | 30 | 4 | 54,49 | 93 | 35,42 | 9,8 | 151,4 | 1208 | |
| 01/11/2009 | 8 | 45 | 4 | 52,38 | 93 | 36,59 | 10,3 | 151,1 | 1400 | |
| 01/11/2009 | 9 | 0 | 4 | 50,18 | 93 | 37,82 | 10,0 | 151,8 | 1290 | |
| 01/11/2009 | 9 | 15 | 4 | 47,95 | 93 | 39,06 | 10,3 | 149,9 | 1156 | |
| 01/11/2009 | 9 | 30 | 4 | 45,75 | 93 | 40,25 | 9,7 | 150,5 | 852 | |
| 01/11/2009 | 9 | 45 | 4 | 46,59 | 93 | 41,45 | 10,1 | 149,8 | 302 | |
| 01/11/2009 | 10 | 0 | 4 | 41,33 | 93 | 42,71 | 10,2 | 150,5 | 797 | |
| 01/11/2009 | 10 | 15 | 4 | 39,01 | 93 | 43,98 | 10,3 | 150,7 | 1109 | |
| 01/11/2009 | 10 | 30 | 4 | 36,82 | 93 | 45,20 | 10,6 | 150,7 | 1235 | |
| 01/11/2009 | 10 | 45 | 4 | 34,67 | 93 | 46,38 | 10,0 | 150,7 | 1236 | |
| 01/11/2009 | 11 | 0 | 4 | 32,48 | 93 | 47,60 | 9,8 | 150,3 | 1382 | |
| 01/11/2009 | 11 | 15 | 4 | 30,29 | 93 | 48,81 | 9,9 | 150,7 | 1390 | |
| 01/11/2009 | 11 | 30 | 4 | 28,09 | 93 | 50,02 | 10,0 | 151,1 | 1410 | |
| 01/11/2009 | 11 | 45 | 4 | 25,89 | 93 | 51,24 | 10,1 | 151,3 | 1190 | |
| 01/11/2009 | 12 | 0 | 4 | 23,68 | 93 | 52,46 | 10,3 | 150,1 | 1334 | |
| 01/11/2009 | 12 | 15 | 4 | 21,40 | 93 | 53,72 | 10,7 | 151,9 | 1144 | |
| 01/11/2009 | 12 | 30 | 4 | 19,28 | 93 | 54,89 | 9,6 | 151,6 | 1202 | |

KY09-09 Leg.1 Log Sheet No. 3

| Date (UTC+6) | Time (UTC+6) (h) | (m) | Latitude (ºN) (deg) | (min) | Longitude (ºE) (deg) | (min) | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 01/11/2009 | 12 | 45 | 4 | 17,05 | 93 | 56,13 | 10,5 | 152,2 | 1168 | |
| 01/11/2009 | 13 | 0 | 4 | 14,82 | 93 | 57,35 | 10,4 | 150,3 | 1230 | |
| 01/11/2009 | 13 | 15 | 4 | 12,56 | 93 | 58,61 | 10,6 | 151,5 | 987 | |
| 01/11/2009 | 13 | 30 | 4 | 10,24 | 93 | 59,89 | 10,6 | 149,7 | 1095 | |
| 01/11/2009 | 13 | 45 | 4 | 7,87 | 94 | 1,20 | 11,0 | 150,6 | 1087 | |
| 01/11/2009 | 14 | 0 | 4 | 5,63 | 94 | 2,43 | 9,5 | 152,9 | 1306 | |
| 01/11/2009 | 14 | 15 | 4 | 3,49 | 94 | 3,62 | 9,8 | 152,4 | 1472 | |
| 01/11/2009 | 14 | 30 | 4 | 1,34 | 94 | 4,80 | 10,0 | 151,7 | 1871 | |
| 01/11/2009 | 14 | 45 | 3 | 59,15 | 94 | 6,01 | 10,6 | 151,4 | 1861 | |
| 01/11/2009 | 14 | 52 | 3 | 58,42 | 94 | 9,50 | | | | Survey line #2 (original waypoints 3 to 4) is completed. |
| 01/11/2009 | 15 | 0 | 3 | 57,53 | 94 | 5,77 | 10,4 | 333,0 | 1661 | $3^{o}$ 57.19'N $94^{o}$ 5.46' |
| 01/11/2009 | 15 | 1 | 3 | 57,19 | 94 | 5,46 | | | | Surevy line #3 (original waypoints 5 to 6) is started. |
| 01/11/2009 | 15 | 15 | 3 | 59,84 | 94 | 4,48 | 10,3 | 329,6 | 1629 | |
| 01/11/2009 | 15 | 30 | 4 | 2,08 | 94 | 3,27 | 10,2 | 328,9 | 1249 | |
| 01/11/2009 | 15 | 45 | 4 | 4,50 | 94 | 1,91 | 10,4 | 329,2 | 1366 | |
| 01/11/2009 | 16 | 0 | 4 | 6,59 | 94 | 0,75 | 10,6 | 329,5 | 1260 | |
| 01/11/2009 | 16 | 15 | 4 | 8,88 | 93 | 59,45 | 10,4 | 329,0 | 958 | |
| 01/11/2009 | 16 | 30 | 4 | 11,08 | 93 | 58,27 | 10,0 | 329,0 | 900 | |
| 01/11/2009 | 16 | 45 | 4 | 13,30 | 93 | 57,04 | 10,2 | 332,5 | 842 | |
| 01/11/2009 | 17 | 0 | 4 | 15,39 | 93 | 55,88 | 10,1 | 325,6 | 864 | |
| 01/11/2009 | 17 | 19 | 4 | 18,33 | 93 | 54,25 | 10,0 | 329,8 | 953 | a record of four minutes after the regular watch time at every 15 minutes. |
| 01/11/2009 | 17 | 30 | 4 | 19,96 | 93 | 53,36 | 10,2 | 326,1 | 984 | |
| 01/11/2009 | 17 | 45 | 4 | 22,29 | 93 | 52,07 | 10,7 | 327,9 | 1098 | |
| 01/11/2009 | 18 | 0 | 4 | 24,56 | 93 | 50,82 | 10,0 | 327,0 | 1232 | |
| 01/11/2009 | 18 | 15 | 4 | 26,84 | 93 | 49,55 | 10,5 | 328,0 | 1196 | |
| 01/11/2009 | 18 | 30 | 4 | 29,12 | 93 | 48,29 | 10,5 | 328,3 | 1396 | |
| 01/11/2009 | 19 | 0 | 4 | 33,69 | 93 | 45,76 | 10,7 | 330,0 | 1302 | |

KY09-09 Leg.1 Log Sheet No. 4

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 01/11/2009 | 19 | 15 | 4 | 35,94 | 93 | 44,52 | 9,6 | 330,6 | 1014 | |
| 01/11/2009 | 19 | 30 | 4 | 38,13 | 93 | 43,30 | 10,1 | 331,2 | 814 | |
| 01/11/2009 | 19 | 45 | 4 | 40,31 | 93 | 42,07 | 10,3 | 331,5 | 621 | |
| 01/11/2009 | 20 | 0 | 4 | 42,42 | 93 | 40,91 | 10,2 | 331,0 | 454 | Along Waypoint 8 (original waypoint 6) |
| 01/11/2009 | 20 | 15 | 4 | 44,79 | 93 | 39,61 | 10,3 | 333,4 | 1147 | SST: 30deg C |
| 01/11/2009 | 20 | 30 | 4 | 47,03 | 93 | 38,39 | 9,8 | 333,8 | 1225 | |
| 01/11/2009 | 20 | 45 | 4 | 49,28 | 93 | 37,13 | 10,3 | 331,7 | 980 | |
| 01/11/2009 | 21 | 0 | 4 | 51,49 | 93 | 35,91 | 10,3 | 333,6 | 964 | |
| 01/11/2009 | 21 | 15 | 4 | 53,69 | 93 | 34,70 | 9,9 | 332,0 | 856 | |
| 01/11/2009 | 21 | 30 | 4 | 55,82 | 93 | 33,52 | 9,6 | 332,2 | 826 | |
| 01/11/2009 | 21 | 32 | 4 | 55,80 | 93 | 33,53 | | | | Survey line #3 (original waypoints 5 to 6) is completed. |
| 01/11/2009 | 21 | 34 | 4 | 56,19 | 93 | 33,07 | 9,5 | 220,5 | 756 | |
| 01/11/2009 | 21 | 39 | 4 | 55,54 | 93 | 32,62 | 9,5 | 166,6 | 837 | |
| 01/11/2009 | 21 | 40 | 4 | 55,18 | 93 | 32,72 | | | | Survey line #4 (original waypoints 7 to 8) is started. |
| 01/11/2009 | 21 | 45 | 4 | 54,67 | 93 | 33,02 | 9,9 | 150,7 | 847 | |
| 01/11/2009 | 22 | 0 | 4 | 52,45 | 93 | 34,25 | 10,2 | 150,2 | 1040 | |
| 01/11/2009 | 22 | 15 | 4 | 50,23 | 93 | 35,48 | 9,8 | 147,8 | 1150 | |
| 01/11/2009 | 22 | 30 | 4 | 48,01 | 93 | 36,71 | 10,4 | 150,7 | 812 | |
| 01/11/2009 | 22 | 45 | 4 | 45,79 | 93 | 37,94 | 10,4 | 150,4 | 767 | |
| 01/11/2009 | 23 | 0 | 4 | 43,56 | 93 | 39,18 | 10,3 | 149,9 | 1073 | |
| 01/11/2009 | 23 | 15 | 4 | 41,31 | 93 | 40,42 | 9,9 | 148,9 | 1031 | |
| 01/11/2009 | 23 | 30 | 4 | 39,07 | 93 | 41,66 | 10,2 | 146,2 | 827 | |
| 01/11/2009 | 23 | 45 | 4 | 36,88 | 93 | 42,87 | 10,4 | 146,6 | 798 | |
| 01/11/2009 | 0 | 0 | 4 | 34,58 | 93 | 44,15 | 10,5 | 148,4 | 1040 | |
| 02/11/2009 | 0 | 15 | 4 | 32,34 | 93 | 45,38 | 10,3 | 148,9 | 961 | |
| 02/11/2009 | 0 | 30 | 4 | 30,08 | 93 | 46,64 | 9,7 | 149,5 | 1276 | |
| 02/11/2009 | 0 | 45 | 4 | 27,90 | 93 | 47,64 | 10,1 | 150,6 | 1210 | |
| 02/11/2009 | 1 | 0 | 4 | 25,73 | 93 | 49,04 | 10,0 | 149,8 | 1105 | |
| 02/11/2009 | 1 | 15 | 4 | 23,58 | 93 | 50,24 | 10,2 | 150,2 | 845 | |
| 02/11/2009 | 1 | 30 | 4 | 21,38 | 93 | 51,44 | 10,0 | 150,5 | 865 | |
| 02/11/2009 | 1 | 45 | 4 | 19,16 | 93 | 52,68 | 10,0 | 151,5 | 1057 | |
| 02/11/2009 | 2 | 0 | 4 | 16,93 | 93 | 53,90 | 10,0 | 151,5 | 1124 | |

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) | Heading (GYRO) | Depth | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | (knots) | (deg) | (-m) | |
| 02/11/2009 | 2 | 15 | 4 | 14,60 | 93 | 55,22 | 10,8 | 152,7 | 930 | |
| 02/11/2009 | 2 | 30 | 4 | 12,42 | 93 | 56,47 | 9,9 | 152,2 | 1082 | |
| 02/11/2009 | 2 | 45 | 4 | 10,12 | 93 | 57,68 | 10,9 | 153,6 | 989 | |
| 02/11/2009 | 3 | 0 | 4 | 7,78 | 93 | 58,97 | 10,5 | 151,6 | 1090 | |
| 02/11/2009 | 3 | 15 | 4 | 5,42 | 94 | 0,28 | 10,8 | 151,9 | 1178 | |
| 02/11/2009 | 3 | 30 | 4 | 3,09 | 94 | 1,56 | 10,5 | 152,2 | 1454 | |
| 02/11/2009 | 3 | 45 | 4 | 0,83 | 94 | 2,82 | 9,9 | 151,1 | 1329 | |
| 02/11/2009 | 4 | 0 | 3 | 58,56 | 94 | 4,07 | 10,0 | 151,6 | 1543 | |
| 02/11/2009 | 4 | 8 | 3 | 57,40 | 94 | 4,70 | | | | Survey line #4 (original waypoints 7 to 8) is completed. |
| | | | | | | | | | | turning point to original waypoint 9 |
| 02/11/2009 | 4 | 16 | 3 | 56,62 | 94 | 4,10 | 7,9 | 310,0 | 1575 | Turning point to way point # 9 |
| 02/11/2009 | 4 | 20 | 3 | 57,02 | 94 | 3,76 | 9,3 | 331,5 | 1517 | Survey line #5 (original waypoints 9 to 10) is started. |
| 02/11/2009 | 4 | 30 | 3 | 58,41 | 94 | 3,00 | 9,8 | 329,4 | 1542 | |
| 02/11/2009 | 4 | 45 | 4 | 0,59 | 94 | 1,76 | 10,1 | 330,0 | 1538 | |
| 02/11/2009 | 5 | 0 | 4 | 2,79 | 94 | 0,57 | 10,1 | 329,1 | 1542 | |
| 02/11/2009 | 5 | 15 | 4 | 4,98 | 93 | 59,35 | 10,5 | 392,3 | 1263 | |
| 02/11/2009 | 5 | 30 | 4 | 7,21 | 93 | 58,13 | 9,9 | 328,9 | 1093 | |
| 02/11/2009 | 5 | 45 | 4 | 9,38 | 93 | 56,93 | 10,4 | 328,3 | 1050 | |
| 02/11/2009 | 6 | 0 | 4 | 11,63 | 93 | 55,78 | 10,0 | 327,9 | 1219 | |
| 02/11/2009 | 6 | 19 | 4 | 14,53 | 93 | 54,08 | 10,3 | 326,9 | 1162 | Description is delayed by 4 minutes. |
| 02/11/2009 | 6 | 30 | 4 | 16,00 | 93 | 53,25 | 9,9 | 329,6 | 1315 | Wind becomes strong slightly ; 4.7 m/s in a direction of N 12 degE. |
| 02/11/2009 | 6 | 45 | 4 | 18,23 | 93 | 52,02 | 10,0 | 328,4 | 1294 | |
| 02/11/2009 | 7 | 0 | 4 | 20,45 | 93 | 50,80 | 9,9 | 328,8 | 1162 | |
| 02/11/2009 | 7 | 15 | 4 | 22,63 | 93 | 49,59 | 9,7 | 330,0 | 1102 | Wind speed is 6.0 m/s in N 18 deg-E. |
| 02/11/2009 | 7 | 30 | 4 | 24,84 | 93 | 48,37 | 10,6 | 331,9 | 1135 | Wind speed is 6.6 m/s in N 16 deg-E. |
| 02/11/2009 | 7 | 45 | 4 | 27,21 | 93 | 47,05 | 10,5 | 331,4 | 1038 | |
| 02/11/2009 | 8 | 0 | 4 | 29,46 | 93 | 45,81 | 10,6 | 331,6 | 1282 | |
| 02/11/2009 | 8 | 15 | 4 | 31,73 | 93 | 44,56 | 10,1 | 333,0 | 970 | |
| 02/11/2009 | 8 | 30 | 4 | 34,02 | 93 | 43,30 | 10,1 | 331,1 | 864 | |
| 02/11/2009 | 8 | 45 | 4 | 36,24 | 93 | 42,06 | 10,2 | 332,0 | 972 | |
| 02/11/2009 | 9 | 0 | 4 | 38,45 | 93 | 40,83 | 9,8 | 336,2 | 1244 | |
| 02/11/2009 | 9 | 15 | 4 | 40,67 | 93 | 39,61 | 10,3 | 334,1 | 1030 | |

KY09-09 Leg.1 Log Sheet No. 6

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 02/11/2009 | 9 | 30 | 4 | 42,88 | 93 | 38,38 | 10,6 | 334,9 | 762 | |
| 02/11/2009 | 9 | 45 | 4 | 45,19 | 93 | 37,09 | 10,5 | 336,2 | 899 | |
| 02/11/2009 | 10 | 0 | 4 | 47,48 | 93 | 35,83 | 10,6 | 334,2 | 1053 | |
| 02/11/2009 | 10 | 15 | 4 | 49,74 | 93 | 34,59 | 9,7 | 336,5 | 1078 | |
| 02/11/2009 | 10 | 30 | 4 | 51,90 | 93 | 33,39 | 10,3 | 335,9 | 1128 | |
| 02/11/2009 | 10 | 45 | 4 | 54,18 | 93 | 32,13 | 10,4 | 332,1 | 901 | |
| 02/11/2009 | 10 | 48 | 4 | 54,76 | 93 | 31,81 | 10,3 | | 871 | Survey line #5 (original waypoints 9 to 10) is completed. |
| 02/11/2009 | 10 | 57 | 4 | 53,81 | 93 | 31,18 | 10,1 | | 857 | Surevy line #6 (original waypoints 11 to 12) is started. |
| 02/11/2009 | 11 | 0 | 4 | 53,50 | 93 | 31,36 | 10,2 | 144,9 | 904 | |
| 02/11/2009 | 11 | 15 | 4 | 51,25 | 93 | 32,61 | 10,4 | 148,6 | 1044 | |
| 02/11/2009 | 11 | 30 | 4 | 49,01 | 93 | 33,85 | 10,3 | 149,4 | 1166 | Wind speed 11.4m/s in a direction of N 55.0-deg E. |
| 02/11/2009 | 11 | 45 | 4 | 46,80 | 93 | 35,07 | 10,2 | 147,9 | 1194 | |
| 02/11/2009 | 12 | 0 | 4 | 44,60 | 93 | 36,39 | 10,3 | 148,3 | 984 | |
| 02/11/2009 | 12 | 45 | 4 | 37,69 | 93 | 40,13 | 10,5 | 146,7 | 1309 | |
| 02/11/2009 | 13 | 0 | 4 | 35,31 | 93 | 41,44 | 11,1 | 146,3 | 1330 | |
| 02/11/2009 | 13 | 15 | 4 | 32,94 | 93 | 42,76 | 10,5 | 147,3 | 631 | |
| 02/11/2009 | 13 | 30 | 4 | 30,60 | 93 | 44,06 | 10,7 | 149,1 | 866 | |
| 02/11/2009 | 13 | 45 | 4 | 28,20 | 93 | 45,38 | 10,9 | 149,5 | 1163 | Wind speed 7.7m/s in direction of N 55.0-deg E. |
| 02/11/2009 | 14 | 0 | 4 | 25,94 | 93 | 46,63 | 10,4 | 146,6 | 1092 | |
| 02/11/2009 | 14 | 15 | 4 | 23,59 | 93 | 47,94 | 10,9 | 149,6 | 1253 | |
| 02/11/2009 | 14 | 30 | 4 | 21,24 | 93 | 49,23 | 10,5 | 150,0 | 1391 | |
| 02/11/2009 | 14 | 45 | 4 | 18,89 | 93 | 50,54 | 10,6 | 148,7 | 1552 | |
| 02/11/2009 | 15 | 0 | 4 | 16,53 | 93 | 51,84 | 10,8 | 152,2 | 1602 | |
| 02/11/2009 | 15 | 15 | 4 | 14,18 | 93 | 53,14 | 10,4 | 151,0 | 1375 | |
| 02/11/2009 | 15 | 30 | 4 | 11,84 | 93 | 54,44 | 10,5 | 152,7 | 1225 | |
| 02/11/2009 | 15 | 45 | 4 | 9,46 | 93 | 55,75 | 10,4 | 151,6 | 988 | |
| 02/11/2009 | 16 | 0 | 4 | 7,24 | 93 | 56,98 | 10,5 | 153,6 | 1085 | Wind speed 3.3m/s in direction of N 116.0-deg E. |
| 02/11/2009 | 16 | 15 | 4 | 4,97 | 93 | 58,24 | 9,9 | 153,1 | 1418 | |
| 02/11/2009 | 16 | 30 | 4 | 2,79 | 93 | 59,45 | 9,9 | 151,9 | 1612 | |
| 02/11/2009 | 16 | 45 | 4 | 0,57 | 94 | 0,69 | 10,2 | 150,9 | 1579 | |
| 02/11/2009 | 17 | 0 | 3 | 58,38 | 94 | 1,88 | 10,2 | 151,6 | 1665 | Wind speed 3.5m/s in direction of N 162.0-deg E. |
| 02/11/2009 | 17 | 12 | 3 | 56,69 | 94 | 2,83 | 10,2 | 151,6 | 1453 | Survey line #6 (original waypoints 11 to 12) is completed. |

KY09-09 Leg.1 Log Sheet No. 7

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 02/11/2009 | 17 | 23 | 3 | 56,30 | 94 | 1,89 | 9,1 | 330,7 | 1710 | Surevy line #7 (original waypoints 13 to 14) is started. |
| 02/11/2009 | 17 | 30 | 3 | 57,27 | 94 | 1,34 | 10,0 | 333,0 | 1941 | |
| 02/11/2009 | 17 | 45 | 3 | 59,42 | 94 | 0,17 | 10,0 | 328,0 | 1858 | |
| 02/11/2009 | 18 | 0 | 4 | 1,56 | 93 | 58,98 | 9,5 | 332,0 | 1802 | Wind speed 2.1m/s in direction of N 182.0-deg E. |
| 02/11/2009 | 18 | 15 | 4 | 3,80 | 93 | 57,73 | 10,3 | 329,6 | 1570 | |
| 02/11/2009 | 18 | 30 | 4 | 5,93 | 93 | 56,56 | 10,2 | 329,2 | 1300 | |
| 02/11/2009 | 18 | 45 | 4 | 8,13 | 93 | 55,33 | 9,8 | 332,0 | 954 | |
| 02/11/2009 | 19 | 0 | 4 | 10,30 | 93 | 54,14 | 9,7 | 328,0 | 1045 | Wind speed 4.5m/s in direction of N 175.0-deg E. |
| 02/11/2009 | 19 | 15 | 4 | 12,45 | 93 | 52,94 | 10,0 | 328,8 | 1397 | |
| 02/11/2009 | 19 | 30 | 4 | 14,63 | 93 | 51,74 | 10,1 | 330,1 | 1297 | |
| 02/11/2009 | 19 | 45 | 4 | 16,83 | 93 | 50,51 | 10,2 | 332,8 | 1349 | |
| 02/11/2009 | 20 | 0 | 4 | 19,06 | 93 | 49,27 | 10,5 | 331,9 | 1503 | wind calm less than 2m/s, dir. N154deg |
| 02/11/2009 | 20 | 15 | 4 | 21,33 | 93 | 48,02 | 10,1 | 332,5 | 1511 | |
| 02/11/2009 | 20 | 30 | 4 | 23,54 | 93 | 46,80 | 10,2 | 334,2 | 1247 | |
| 02/11/2009 | 20 | 45 | 4 | 25,74 | 93 | 45,59 | 10,1 | 334,3 | 1078 | |
| 02/11/2009 | 21 | 0 | 4 | 27,95 | 93 | 44,34 | 10,4 | 334,1 | 1479 | |
| 02/11/2009 | 21 | 15 | 4 | 30,19 | 93 | 43,12 | 10,4 | 334,7 | 1118 | |
| 02/11/2009 | 21 | 30 | 4 | 32,41 | 93 | 41,88 | 10,0 | 337,7 | 1073 | |
| 02/11/2009 | 21 | 45 | 4 | 34,58 | 93 | 40,68 | 10,0 | 332,1 | 1075 | |
| 02/11/2009 | 22 | 0 | 4 | 36,75 | 93 | 39,47 | 9,7 | 334,2 | 1136 | |
| 02/11/2009 | 22 | 15 | 4 | 38,91 | 93 | 38,28 | 10,1 | 334,5 | 1016 | |
| 02/11/2009 | 22 | 30 | 4 | 41,14 | 93 | 37,05 | 10,3 | 335,9 | 821 | |
| 02/11/2009 | 22 | 45 | 4 | 43,34 | 93 | 35,82 | 10,4 | 333,4 | 926 | |
| 02/11/2009 | 23 | 0 | 4 | 45,61 | 93 | 34,57 | 10,3 | 335,5 | 1260 | |
| 02/11/2009 | 23 | 15 | 4 | 47,81 | 93 | 33,35 | 10,0 | 334,1 | 1383 | wind 3,8m/s, dir. 78deg |
| 02/11/2009 | 23 | 30 | 4 | 50,09 | 93 | 32,09 | 10,8 | 333,8 | 1069 | wind 4,7m/s, dir. 74deg |
| 02/11/2009 | 23 | 45 | 4 | 52,40 | 93 | 30,83 | 9,7 | 332,4 | 862 | |
| 02/11/2009 | 23 | 52 | 4 | 53,39 | 93 | 30.25 | 10,1 | | 843 | Survey line #7 (original waypoints 13 to 14) is completed. |
| 03/11/2009 | 0 | 0 | 4 | 53,36 | 93 | 29.25 | 9,0 | 167,0 | 956 | |
| 03/11/2009 | 0 | 4 | 4 | 52,82 | 93 | 44,96 | | | | Survey line #8 (original waypoints 15 to 16) is started. |
| 03/11/2009 | 0 | 15 | 4 | 51,26 | 93 | 30,42 | 10,1 | 149,7 | 862 | |
| 03/11/2009 | 0 | 30 | 4 | 49,03 | 93 | 31,65 | 9,9 | 147,8 | 1071 | |

KY09-09 Leg.1 Log Sheet No. 8

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 03/11/2009 | 0 | 45 | 4 | 46,80 | 93 | 32,90 | 9,9 | 149,1 | 1574 | |
| 03/11/2009 | 1 | 0 | 4 | 44,54 | 93 | 34,13 | 9,3 | 151,7 | 1247 | |
| 03/11/2009 | 1 | 15 | 4 | 42,27 | 93 | 35,37 | 10,5 | 147,0 | 1306 | |
| 03/11/2009 | 1 | 30 | 4 | 39,97 | 93 | 36,66 | 10,4 | 149,4 | 999 | |
| 03/11/2009 | 1 | 45 | 4 | 37,64 | 93 | 37,93 | 10,3 | 144,6 | 1095 | |
| 03/11/2009 | 2 | 0 | 4 | 35,34 | 93 | 39,22 | 10,3 | 150,2 | 1058 | |
| 03/11/2009 | 2 | 15 | 4 | 32,92 | 93 | 40,54 | 10,3 | 151,2 | 1211 | |
| 03/11/2009 | 2 | 30 | 4 | 30,71 | 93 | 41,76 | 10,6 | 150,7 | 1214 | |
| 03/11/2009 | 2 | 45 | 4 | 28,22 | 93 | 43,17 | 10,4 | 151,8 | 1465 | |
| 03/11/2009 | 3 | 0 | 4 | 26,14 | 93 | 44,28 | 10,6 | 150,1 | 1214 | |
| 03/11/2009 | 3 | 7 | 4 | 24,93 | 93 | 44,96 | 10,3 | 151,6 | 1206 | Survey line #8 (original waypoints 15 to 16) is completed. |
| 03/11/2009 | 3 | 15 | 4 | 24,09 | 93 | 44,35 | 10,3 | 272,0 | 1429 | |
| 03/11/2009 | 3 | 18 | 4 | 24,52 | 93 | 43,97 | 10,2 | 332,7 | 1355 | Survey line #9 (original waypoints 17 to 18) is started. |
| 03/11/2009 | 3 | 30 | 4 | 26,23 | 93 | 43,04 | 10,7 | 331,1 | 1328 | |
| 03/11/2009 | 3 | 45 | 4 | 28,49 | 93 | 41,79 | 10,1 | 332,1 | 1217 | |
| 03/11/2009 | 4 | 0 | 4 | 30,74 | 93 | 40,55 | 10,2 | 331,7 | 1322 | Wind speed 2.2m/s in direction of N 159.0 deg E. |
| 03/11/2009 | 4 | 15 | 4 | 32,98 | 93 | 39,28 | 9,9 | 331,0 | 1286 | |
| 03/11/2009 | 4 | 30 | 4 | 35,22 | 93 | 38,04 | 10,5 | 332,0 | 1264 | |
| 03/11/2009 | 4 | 45 | 4 | 37,54 | 93 | 36,75 | 10,4 | 334,2 | 1351 | |
| 03/11/2009 | 5 | 0 | 4 | 39,86 | 93 | 35,47 | 10,3 | 332,2 | 1218 | |
| 03/11/2009 | 5 | 15 | 4 | 42,15 | 93 | 34,16 | 10,1 | 331,7 | 1340 | |
| 03/11/2009 | 5 | 30 | 4 | 44,41 | 93 | 32,95 | 10,2 | 333,6 | 1427 | |
| 03/11/2009 | 5 | 45 | 4 | 46,65 | 93 | 31,70 | 10,0 | 335,0 | 1403 | |
| 03/11/2009 | 6 | 0 | 4 | 48,93 | 93 | 30,44 | 10,1 | 333,8 | 1244 | Wind speed 3.3 m/s in direction of N 113.0 deg E. |
| 03/11/2009 | 6 | 15 | 4 | 51,18 | 93 | 29,18 | 10,5 | 334,6 | 1202 | |
| 03/11/2009 | 6 | 20 | 4 | 52,01 | 93 | 28,73 | 10,6 | 334,3 | 1194 | Survey line #9 (original waypoints 17 to 18) is completed. |
| 03/11/2009 | 6 | 30 | 4 | 51,61 | 93 | 27,86 | 9,4 | 162,3 | 1354 | |
| 03/11/2009 | 6 | 33 | 4 | 51,24 | 93 | 28,00 | 10,1 | 148,8 | 1437 | Surevy line #10 (original waypoints 19 to 20) is started. |
| 03/11/2009 | 6 | 45 | 4 | 49,55 | 93 | 28,95 | 9,8 | 148,4 | 1405 | |
| 03/11/2009 | 7 | 0 | 4 | 47,34 | 93 | 30,17 | 10,4 | 149,4 | 1344 | |
| 03/11/2009 | 7 | 15 | 4 | 45,09 | 93 | 31,44 | 10,5 | 148,7 | 1519 | |
| 03/11/2009 | 7 | 30 | 4 | 42,87 | 93 | 32,63 | 9,9 | 149,1 | 1313 | |

KY09-09 Leg.1 Log Sheet No. 9

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 03/11/2009 | 7 | 45 | 4 | 40,55 | 93 | 33,96 | 10,2 | 149,8 | 1395 | |
| 03/11/2009 | 8 | 0 | 4 | 38,43 | 93 | 35,11 | 10,2 | 146,7 | 1585 | Wind speed 4.8 m/s in direction of N 133.0 deg E. |
| 03/11/2009 | 8 | 15 | 4 | 36,21 | 93 | 36,35 | 10,0 | 147,4 | 1406 | |
| 03/11/2009 | 8 | 30 | 4 | 33,95 | 93 | 37,62 | 10,8 | 149,9 | 1745 | |
| 03/11/2009 | 8 | 45 | 4 | 31,58 | 93 | 38,95 | 10,2 | 150,1 | 1489 | |
| 03/11/2009 | 9 | 0 | 4 | 29,37 | 93 | 40,16 | 10,0 | 150,5 | 1255 | Survey line #10 (original waypoints 19 to 20) is completed. |
| 03/11/2009 | 9 | 11 | 4 | 28,77 | 93 | 39,33 | 10,2 | 329,1 | 1576 | Survey line #11 (original waypoints 21 to 22) is started. |
| 03/11/2009 | 9 | 15 | 4 | 29,41 | 93 | 39,00 | 10,2 | 334,4 | 1731 | |
| 03/11/2009 | 9 | 30 | 4 | 31,50 | 93 | 37,84 | 10,1 | 333,2 | 1724 | |
| 03/11/2009 | 9 | 45 | 4 | 33,69 | 93 | 36,62 | 9,8 | 332,7 | 1804 | |
| 03/11/2009 | 10 | 0 | 4 | 35,91 | 93 | 35,38 | 10,2 | 331,3 | 1883 | Wind speed 2.1 m/s in direction of N 80.0 deg E. |
| 03/11/2009 | 10 | 15 | 4 | 38,15 | 93 | 34,12 | 9,7 | 335,9 | 1855 | |
| 03/11/2009 | 10 | 30 | 4 | 40,32 | 93 | 32,94 | 10,3 | 333,9 | 1753 | |
| 03/11/2009 | 10 | 45 | 4 | 42,43 | 93 | 31,76 | 10,0 | 332,0 | 1575 | |
| 03/11/2009 | 11 | 0 | 4 | 44,68 | 93 | 30,51 | 10,3 | 334,2 | 1688 | Wind speed 1.4 m/s in direction of N 99.0 deg E. |
| 03/11/2009 | 11 | 15 | 4 | 46,99 | 93 | 29,23 | 10,1 | 332,0 | 1653 | |
| 03/11/2009 | 11 | 30 | 4 | 49,13 | 93 | 28,04 | 9,6 | 335,0 | 1571 | |
| 03/11/2009 | 11 | 40 | 4 | 50,60 | 93 | 27,23 | 10,1 | 331,8 | 1498 | Survey line #11 (original waypoints 21 to 22) is completed. |
| 03/11/2009 | 11 | 45 | 4 | 50,74 | 93 | 26,58 | 9,8 | 230,3 | 1298 | |
| 03/11/2009 | 11 | 52 | 4 | 49,83 | 93 | 26,53 | 9,6 | 146,9 | 1176 | Survey line #12 (original waypoints 23 to 24) is started. |
| 03/11/2009 | 12 | 0 | 4 | 48,70 | 93 | 27,16 | 9,2 | 148,5 | 1282 | |
| 03/11/2009 | 12 | 15 | 4 | 46,57 | 93 | 28,35 | 10,1 | 150,1 | 1251 | |
| 03/11/2009 | 12 | 30 | 4 | 44,38 | 93 | 29,57 | 10,0 | 152,2 | 1465 | |
| 03/11/2009 | 12 | 45 | 4 | 42,20 | 93 | 30,79 | 10,7 | 151,1 | 1684 | |
| 03/11/2009 | 13 | 0 | 4 | 39,97 | 93 | 32,02 | 10,1 | 150,6 | 1908 | |
| 03/11/2009 | 13 | 15 | 4 | 37,78 | 93 | 33,24 | 9,9 | 149,2 | 1945 | |
| 03/11/2009 | 13 | 30 | 4 | 35,47 | 93 | 34,53 | 10,3 | 149,5 | 1992 | |
| 03/11/2009 | 13 | 45 | 4 | 33,27 | 93 | 35,75 | 10,8 | 150,6 | 2033 | |
| 03/11/2009 | 14 | 0 | 4 | 31,01 | 93 | 37,01 | 10,3 | 150,8 | 1978 | |
| 03/11/2009 | 14 | 15 | 4 | 28,71 | 93 | 38,29 | 10,2 | 152,1 | 1670 | |
| 03/11/2009 | 14 | 18 | 4 | 28,16 | 93 | 38,61 | 10,5 | 149,1 | 1683 | Survey line #12 (original waypoints 23 to 24) is completed. |
| 03/11/2009 | 14 | 28 | 4 | 27,62 | 93 | 37,75 | 9,6 | 334,8 | 1552 | Survey line #13 (original waypoints 25 to 26) is started. |

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 03/11/2009 | 14 | 30 | 4 | 27,87 | 93 | 37,62 | 10,2 | 328,9 | 1544 | |
| 03/11/2009 | 14 | 45 | 4 | 30,15 | 93 | 36,34 | 11,0 | 330,9 | 2005 | |
| 03/11/2009 | 15 | 0 | 4 | 32,47 | 93 | 35,05 | 10,2 | 331,2 | 2014 | |
| 03/11/2009 | 15 | 15 | 4 | 34,76 | 93 | 33,78 | 10,2 | 332,4 | 2023 | Wind speed 1.9 m/s in direction of N 319.0 deg E. |
| 03/11/2009 | 15 | 30 | 4 | 37,03 | 93 | 32,51 | 10,6 | 331,2 | 1956 | |
| 03/11/2009 | 15 | 45 | 4 | 39,33 | 93 | 31,24 | 10,3 | 331,7 | 1910 | |
| 03/11/2009 | 16 | 0 | 4 | 41,63 | 93 | 29,95 | 10,9 | 330,2 | 1770 | Wind speed 1.9 m/s in direction of N 268 deg E. |
| 03/11/2009 | 16 | 15 | 4 | 43,91 | 93 | 28,68 | 10,1 | 330,2 | 1462 | Wind speed 7.5 m/s in direction of N 326 deg E. |
| 03/11/2009 | 16 | 30 | 4 | 45,21 | 93 | 27,40 | 10,8 | 331,6 | 1041 | Wind speed 3.3 m/s in direction of N 280 deg E. |
| 03/11/2009 | 16 | 45 | 4 | 48,60 | 93 | 26,08 | 11,1 | 331,6 | 1017 | Wind speed 2.1 m/s in direction of N 225 deg E. |
| 03/11/2009 | 16 | 48 | 4 | 49,17 | 93 | 25,76 | 11,2 | 332,6 | 933 | Survey line #13 (original waypoints 25 to 26; S->N) is completed. |
| 03/11/2009 | 17 | 0 | | | | | | | | Wind speed 1.9 m/s in direction of N 175 deg E. |
| 03/11/2009 | 17 | 1 | 4 | 48,47 | 93 | 25,02 | 9,5 | 151,0 | 1082 | Survey line #14 (original waypoints 27 to 28;N->S) is started. |
| 03/11/2009 | 17 | 15 | 4 | 45,81 | 93 | 26,51 | 10,1 | 150,9 | 1149 | |
| 03/11/2009 | 17 | 30 | 4 | 44,26 | 93 | 27,36 | 10,1 | 152,2 | 1398 | |
| 03/11/2009 | 17 | 45 | 4 | 42,05 | 93 | 28,60 | 10,4 | 150,8 | 1675 | Wind speed 1.4 m/s in direction of N 339 deg E. |
| 03/11/2009 | 18 | 0 | 4 | 39,74 | 93 | 29,88 | 9,6 | 152,3 | 1688 | Wind speed 1.6 m/s |
| 03/11/2009 | 18 | 15 | 4 | 37,64 | 93 | 31,06 | 10,2 | 152,7 | 1663 | Wind speed 6.0 m/s in direction of N 225 deg E. |
| 03/11/2009 | 18 | 30 | 4 | 35,37 | 93 | 32,32 | 10,5 | 154,1 | 1562 | Wind speed 6.2 m/s in direction of N 261 deg E. |
| 03/11/2009 | 18 | 45 | 4 | 33,10 | 93 | 33,58 | 10,5 | 154,7 | 1552 | Wind speed 5.6m/s . |
| 03/11/2009 | 19 | 0 | 4 | 30,84 | 93 | 34,84 | 10,4 | 154,7 | 1726 | Wind speed 5.5 m/s in direction of N 331 deg E. |
| 03/11/2009 | 19 | 15 | 4 | 28,58 | 93 | 36,10 | 9,9 | 153,3 | 1881 | |
| 03/11/2009 | 19 | 25 | 4 | 27,01 | 93 | 36,98 | 10,0 | 152,7 | 1476 | Survey line #14 (original waypoints 27 to 28; N->S) is completed. |
| 03/11/2009 | | | | | | | | | | Wind speed 3.2 m/s in direction of N 345 deg E. |
| 03/11/2009 | 19 | 35 | 4 | 26,45 | 93 | 36,09 | 10,3 | 339,8 | 1658 | Survey line #15 (original waypoints 29 to 30 ;S->N) is started. |
| 03/11/2009 | | | | | | | | | | Wind speed 5.0 m/s in direction of N 335 deg E. |
| 03/11/2009 | 19 | 45 | 4 | 27,85 | 93 | 35,36 | 9,9 | 329,4 | 1707 | |
| 03/11/2009 | 20 | 0 | 4 | 29,94 | 93 | 34,18 | 9,9 | 331,9 | 1443 | Wind speed 5.7 m/s in direction of N 343 deg E. |
| 03/11/2009 | 20 | 15 | 4 | 32,26 | 93 | 32,91 | 10,1 | 330,9 | 1369 | |
| 03/11/2009 | 20 | 30 | 4 | 34,58 | 93 | 31,62 | 10,9 | 331,8 | 1341 | |
| 03/11/2009 | 20 | 45 | 4 | 36,77 | 93 | 30,40 | 10,2 | 330,3 | 1552 | |
| 03/11/2009 | 21 | 0 | 4 | 38,99 | 93 | 29,15 | 9,7 | 329,7 | 1729 | |

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 03/11/2009 | 21 | 15 | 4 | 41,21 | 93 | 27,92 | 10,4 | 334,6 | 1644 | |
| 03/11/2009 | 21 | 30 | 4 | 43,44 | 93 | 26,68 | 9,2 | 335,1 | 1415 | |
| 03/11/2009 | 21 | 45 | 4 | 45,48 | 93 | 25,54 | 9,7 | 333,2 | 1074 | |
| 03/11/2009 | 22 | 0 | 4 | 47,66 | 93 | 24,33 | 9,4 | 332,2 | 911 | we finish in line # 15, going to line # 16, turning |
| 03/11/2009 | 22 | 13 | | | | | | | | starting in line # 16 (original waypoints 31 to 32) |
| 03/11/2009 | 22 | 15 | 4 | 46,85 | 93 | 23,66 | 9,7 | 150,0 | 710 | |
| 03/11/2009 | 22 | 30 | 4 | 44,68 | 93 | 24,85 | 10,6 | 149,1 | 1109 | |
| 03/11/2009 | 22 | 45 | 4 | 42,43 | 93 | 26,10 | 10,4 | 148,8 | 1617 | |
| 03/11/2009 | 23 | 0 | 4 | 40,25 | 93 | 27,33 | 10,7 | 147,6 | 1603 | |
| 03/11/2009 | 23 | 15 | 4 | 38,00 | 93 | 28,59 | 10,2 | 148,6 | 1643 | |
| 03/11/2009 | 23 | 30 | 4 | 35,73 | 93 | 29,86 | 10,2 | 150,6 | 1515 | |
| 03/11/2009 | 23 | 45 | 4 | 33,54 | 93 | 31,08 | 10,1 | 148,5 | 1285 | |
| 04/11/2009 | 0 | 0 | 4 | 31,27 | 93 | 32,34 | 10,4 | 149,4 | 1261 | Along line # 16 |
| 04/11/2009 | 0 | 15 | 4 | 28,98 | 93 | 33,62 | 10,6 | 149,2 | 1227 | |
| 04/11/2009 | 0 | 30 | 4 | 26,75 | 93 | 34,86 | 9,5 | 149,3 | 1609 | Wind speed 4.5m/s in direction of N 246.0 deg E. |
| 04/11/2009 | 0 | 36 | 4 | 25,80 | 93 | 35,39 | 9,6 | 149,4 | 1761 | Survey line #16 (original waypoints 31 to 32) is completed. |
| 04/11/2009 | 0 | 45 | | | | | | | | irregular course out between lines #16 and #17 to avoid collision with another ship. |
| 04/11/2009 | 0 | 57 | 4 | 25,36 | 93 | 34,50 | 10,3 | 333,9 | 1796 | Survey line #17 (original waypoints 33 to 34) is started. |
| 04/11/2009 | 1 | 0 | 4 | 25,77 | 93 | 34,27 | 10,4 | 332,6 | 1664 | |
| 04/11/2009 | 1 | 15 | 4 | 27,94 | 93 | 33,06 | 9,7 | 333,6 | 1368 | |
| 04/11/2009 | 1 | 30 | 4 | 30,17 | 93 | 31,82 | 10,1 | 332,6 | 1576 | Wind speed 6.4m/s in direction of N 333.0 deg E. |
| 04/11/2009 | 1 | 45 | 4 | 32,41 | 93 | 30,57 | 10,0 | 332,5 | 1527 | |
| 04/11/2009 | 2 | 0 | 4 | 34,60 | 93 | 29,36 | 9,9 | 331,1 | 1323 | |
| 04/11/2009 | 2 | 15 | 4 | 36,79 | 93 | 28,12 | 10,4 | 331,5 | 1511 | |
| 04/11/2009 | 2 | 30 | 4 | 39,05 | 93 | 26,87 | 10,7 | 330,6 | 1784 | Wind speed 5.6m/s in direction of N 230.0 deg E. |
| 04/11/2009 | 2 | 45 | 4 | 41,34 | 93 | 25,60 | 10,6 | 331,4 | 1772 | |
| 04/11/2009 | 3 | 0 | 4 | 43,55 | 93 | 24,37 | 10,0 | 329,7 | 1064 | |
| 04/11/2009 | 3 | 15 | 4 | 45,75 | 93 | 23,15 | 10,1 | 330,6 | 905 | |
| 04/11/2009 | 3 | 18 | 4 | 46,39 | 93 | 22,83 | 9,9 | 328,6 | 893 | Survey line #17 (original waypoints 33 to 34) is completed. |
| 04/11/2009 | 3 | 30 | 4 | 46,01 | 93 | 21,92 | 9,1 | 158,6 | 867 | Wind speed 5.1m/s in direction of N 212.0 deg E. |
| 04/11/2009 | 3 | 33 | 4 | 45,57 | 93 | 22,13 | 9,6 | 151,8 | 869 | Survey line #18 (original waypoints 35 to 36) is started. |
| 04/11/2009 | 3 | 45 | 4 | 43,96 | 93 | 23,01 | 9,3 | 155,5 | 909 | |

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 04/11/2009 | 4 | 0 | 4 | 41,82 | 93 | 24,20 | 10,3 | 153,6 | 1394 | |
| 04/11/2009 | 4 | 15 | 4 | 39,57 | 93 | 25,47 | 10,4 | 156,9 | 1832 | |
| 04/11/2009 | 4 | 30 | 4 | 37,15 | 93 | 26,82 | 10,9 | 156,4 | 1683 | Wind speed 2.9 m/s in direction of N 159.0 deg E. |
| 04/11/2009 | 4 | 45 | 4 | 34,92 | 93 | 28,05 | 10,7 | 155,1 | 1439 | Wind speed 1.5 m/s in direction of N 125 deg E. |
| 04/11/2009 | 5 | 0 | 4 | 32,59 | 93 | 29,35 | 10,6 | 155,1 | 1527 | Wind speed 1.6 m/s in direction of N 50 deg E. |
| 04/11/2009 | 5 | 15 | 4 | 30,22 | 93 | 30,66 | 10,8 | 154,1 | 1646 | Wind speed 2.1 m/s in direction of N 345 deg E. |
| 04/11/2009 | 5 | 30 | 4 | 27,98 | 93 | 31,92 | 10,1 | 156,3 | 1444 | Wind speed 3.0 m/s in direction of N 328 deg E. |
| 04/11/2009 | 5 | 45 | 4 | 25,72 | 93 | 33,18 | 10,4 | 153,3 | 1456 | Wind speed 3.0 m/s in direction of N 347 deg E. |
| 04/11/2009 | 5 | 51 | 4 | 24,76 | 93 | 33,71 | 10,5 | 153,7 | 1699 | Survey line #18 (original waypoints 35 to 36) is completed. W.S=3.2m/s,329deg |
| 04/11/2009 | 6 | 0 | 4 | | 93 | | | | | |
| 04/11/2009 | 6 | 3 | 4 | 24,20 | 93 | 32,90 | 9,5 | 330,1 | 1818 | Survey line #19 (o.waypoints 37 to 38) is started. W.S=5.7m/s, 320 deg |
| 04/11/2009 | 6 | 15 | 4 | 35,87 | 93 | 31,96 | 9,5 | 327,7 | 1562 | Wind speed 5.0 m/s in direction of N 330 deg E. |
| 04/11/2009 | 6 | 30 | 4 | 28,09 | 93 | 30,72 | 10,3 | 327,3 | 1597 | Wind speed 3.8 m/s in direction of N 318 deg E. |
| 04/11/2009 | 6 | 45 | 4 | 30,30 | 93 | 29,48 | 10,1 | 327,0 | 1595 | |
| 04/11/2009 | 7 | 0 | 4 | 32,54 | 93 | 28,24 | 10,2 | 327,4 | 1626 | Wind speed 4.5 m/s in direction of N 305 deg E. |
| 04/11/2009 | 7 | 15 | 4 | 34,96 | 93 | 26,88 | 10,1 | 327,4 | 1731 | Wind speed 2.9 m/s in direction of N 316 deg E. |
| 04/11/2009 | 7 | 30 | 4 | 36,75 | 93 | 25,89 | 10,3 | 327,7 | 1743 | |
| 04/11/2009 | 7 | 45 | 4 | 39,01 | 93 | 24,60 | 9,9 | 326,7 | 1556 | Wind speed 7.2 m/s in direction of N 26 deg E. |
| 04/11/2009 | 8 | 0 | 4 | 41,22 | 93 | 23,39 | 9,9 | 328,2 | 1455 | Wind speed 5.4 m/s in direction of N 41 deg E. |
| 04/11/2009 | 8 | 15 | 4 | 43,45 | 93 | 22,15 | 9,9 | 329,2 | 1085 | |
| 04/11/2009 | 8 | 25 | 4 | 45,05 | 93 | 21,26 | 10,0 | 327,7 | 995 | Survey line #19 (original waypoints 37 to 38) is completed. W.S=1.5m/s,73deg |
| 04/11/2009 | 8 | 30 | 4 | 45,29 | 93 | 20,74 | 8,9 | 240,6 | 990 | |
| 04/11/2009 | 8 | 38 | 4 | 44,25 | 93 | 20,57 | 9,6 | 153,4 | 905 | Survey line #20 (o.waypoints 39 to 40) is started. W.S=1.7m/s,123 deg |
| 04/11/2009 | 8 | 45 | 4 | 43,22 | 93 | 21,13 | 9,9 | 153,7 | 1059 | |
| 04/11/2009 | 9 | 0 | 4 | 40,99 | 93 | 22,77 | 10,0 | 155,6 | 1455 | |
| 04/11/2009 | 9 | 15 | 4 | 38,80 | 93 | 23,59 | 10,3 | 153,1 | 1280 | |
| 04/11/2009 | 9 | 30 | 4 | 36,61 | 93 | 24,80 | 9,9 | 153,0 | 1402 | |
| 04/11/2009 | 9 | 45 | 4 | 34,44 | 93 | 25,99 | 10,0 | 150,1 | 1437 | |
| 04/11/2009 | 10 | 0 | 4 | 32,16 | 93 | 27,26 | 10,5 | 150,5 | 1488 | |
| 04/11/2009 | 10 | 15 | 4 | 29,84 | 93 | 28,54 | 10,3 | 151,3 | 1444 | Wind speed 0.6 m/s in direction of N 262 deg E. |
| 04/11/2009 | 10 | 26 | 4 | 28,21 | 93 | 29,46 | 10,2 | 151,2 | 1380 | Survey line #20 (original waypoints 39 to 40) is completed. W.S=0.7m/s,164deg |
| 04/11/2009 | 10 | 30 | 4 | 27,61 | 93 | 29,37 | 9,5 | 230,4 | 1313 | |

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| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 04/11/2009 | 10 | 37 | 4 | 27,81 | 93 | 28,56 | 9,9 | 334,1 | 1283 | Survey line #21 (o.waypoints 41 to 42) is started. |
| 04/11/2009 | 10 | 45 | 4 | 28,89 | 93 | 27,95 | 10,2 | 332,0 | 1241 | |
| 04/11/2009 | 11 | 0 | 4 | 31,06 | 93 | 26,75 | 10,0 | 334,8 | 1123 | |
| 04/11/2009 | 11 | 15 | 4 | 33,28 | 93 | 25,52 | 10,3 | 333,3 | 1086 | |
| 04/11/2009 | 11 | 30 | 4 | 35,44 | 93 | 24,30 | 10,0 | 332,4 | 1084 | |
| 04/11/2009 | 11 | 45 | 4 | 37,63 | 93 | 23,09 | 10,3 | 334,3 | 1319 | Wind speed 8.4 m/s in direction of N 36 deg E. |
| 04/11/2009 | 12 | 0 | 4 | 39,84 | 93 | 21,86 | 10,2 | 336,1 | 1521 | |
| 04/11/2009 | 15 | 45 | 4 | 37,59 | 93 | 20,83 | 10,2 | 332,6 | 1496 | |
| 04/11/2009 | 16 | 0 | 4 | 40,00 | 93 | 19,48 | 10,7 | 331,5 | 1657 | |
| 04/11/2009 | 16 | 14 | 4 | 42,14 | 93 | 18,28 | 10,9 | 329,0 | 1560 | Survey line #23 (original waypoints 45 to 46) is completed. |
| 04/11/2009 | 16 | 27 | 4 | 41,43 | 93 | 17,51 | 9,4 | 150,3 | 1597 | Survey line #24 (original waypoints 47 to 48) is started. |
| 04/11/2009 | 16 | 30 | 4 | 40,98 | 93 | 17,77 | 9,7 | 149,3 | 1621 | Wind speed 2.3 m/s in direction of N 105 deg E. |
| 04/11/2009 | 16 | 45 | 4 | 38,80 | 93 | 18,99 | 9,8 | 150,2 | 1606 | |
| 04/11/2009 | 17 | 0 | 4 | 36,67 | 93 | 20,24 | 10,3 | 151,9 | 1489 | Wind speed 0.9 m/s in direction of N 310 deg E. |
| 04/11/2009 | 17 | 15 | 4 | 34,52 | 93 | 21,44 | 9,9 | 152,6 | 956 | |
| 04/11/2009 | 17 | 30 | 4 | 32,20 | 93 | 22,75 | 10,6 | 153,6 | 1171 | Wind speed 0.4 m/s in direction of N 225 deg E. |
| 04/11/2009 | 17 | 45 | 4 | 29,97 | 93 | 24,03 | 10,6 | 152,0 | 1243 | |
| 04/11/2009 | 18 | 0 | 4 | 27,70 | 93 | 25,32 | 10,6 | 154,9 | 1283 | Wind speed 1.9 m/s in direction of N 172 deg E. |
| 04/11/2009 | 18 | 9 | 4 | 26,24 | 93 | 26,14 | 10,5 | 154,9 | 1257 | Survey line #24 (original waypoints 47 to 48) is completed. |
| 04/11/2009 | | | | | | | | | | Wind speed 1.3 m/s in direction of N 207 deg E. |
| 04/11/2009 | 18 | 21 | 4 | 25,75 | 93 | 25,33 | 10,1 | 329,0 | 1006 | Survey line #25 (original waypoints 49 to 50) is started. |
| 04/11/2009 | 18 | 30 | 4 | 26,99 | 93 | 24,61 | 10,4 | 327,1 | 1031 | Wind speed 1.7 m/s in direction of N 254 deg E. |
| 04/11/2009 | 18 | 45 | 4 | 29,26 | 93 | 23,29 | 10,2 | 329,4 | 854 | |
| 04/11/2009 | 19 | 0 | 4 | 31,53 | 93 | 21,99 | 10,7 | 327,8 | 1028 | Wind speed 1.7 m/s in direction of N 202 deg E. |
| 04/11/2009 | 19 | 15 | 4 | 33,90 | 93 | 20,63 | 10,9 | 326,7 | 1373 | |
| 04/11/2009 | 19 | 30 | 4 | 36,08 | 93 | 19,40 | 9,8 | 325,7 | 1494 | Wind speed 2.9 m/s in direction of N 183 deg E. |
| 04/11/2009 | 19 | 45 | 4 | 38,24 | 93 | 18,16 | 9,8 | 326,4 | 1399 | |
| 04/11/2009 | 20 | 0 | 4 | 40,38 | 93 | 16,94 | 9,7 | 327,4 | 1524 | Wind speed 2.9 m/s in direction of N 183 deg E. |
| 04/11/2009 | 20 | 2 | 4 | 40,70 | 93 | 16,76 | 9,7 | 327,8 | 1454 | Survey line #25 (original waypoints 49 to 50) is completed |
| 04/11/2009 | 20 | 15 | 4 | 40,02 | 93 | 16,00 | 10,2 | 153,8 | 1942 | in line # 26(o.wp 51 to 52) is started; wind 8,9m/s, dir. 82 deg; |
| 04/11/2009 | 20 | 30 | 4 | 37,84 | 93 | 17,25 | 10,8 | 154,0 | 1386 | |
| 04/11/2009 | 20 | 45 | 4 | 35,60 | 93 | 18,54 | 10,5 | 154,2 | 1086 | |

| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 04/11/2009 | 21 | 0 | 4 | 33,42 | 93 | 19,79 | 10,2 | 153,2 | 1458 | |
| 04/11/2009 | 21 | 15 | 4 | 31,15 | 93 | 21,10 | 9,9 | 152,6 | 1345 | |
| 04/11/2009 | 21 | 30 | 4 | 28,95 | 93 | 22,36 | 10,2 | 154,5 | 1179 | |
| 04/11/2009 | 21 | 45 | 4 | 26,68 | 93 | 23,68 | 9,6 | 153,9 | 1217 | |
| 04/11/2009 | 21 | 55 | 4 | 25,15 | 93 | 24,56 | 9,8 | 131,2 | 1390 | The line # 26 (51 to 52) is completed. Turning to SW block |
| 04/11/2009 | 22 | 0 | 4 | 24,88 | 93 | 25,13 | 9,7 | 117,3 | 1330 | The line # 27(52 to 53) is started |
| 04/11/2009 | 22 | 15 | 4 | 23,66 | 93 | 27,43 | 10,0 | 122,2 | 1651 | |
| 04/11/2009 | 22 | 30 | 4 | 22,41 | 93 | 29,71 | 10,2 | 119,3 | 1402 | |
| 04/11/2009 | 22 | 45 | 4 | 21,19 | 93 | 31,98 | 10,5 | 120,0 | 1112 | |
| 04/11/2009 | 23 | 0 | 4 | 19,93 | 93 | 34,26 | 10,5 | 118,8 | 2050 | |
| 04/11/2009 | 23 | 15 | 4 | 18,71 | 93 | 36,55 | 10,6 | 117,7 | 1742 | |
| 04/11/2009 | 23 | 30 | 4 | 17,43 | 93 | 38,89 | 10,9 | 120,3 | 1310 | |
| 04/11/2009 | 23 | 45 | 4 | 16,19 | 93 | 41,16 | 9,8 | 116,7 | 1620 | |
| 05/11/2009 | 0 | 0 | 4 | 15,02 | 93 | 43,40 | 10,7 | 120,7 | 1595 | |
| 05/11/2009 | 0 | 15 | 4 | 13,75 | 93 | 45,67 | 10,1 | 119,7 | 1652 | |
| 05/11/2009 | 0 | 30 | 4 | 12,55 | 93 | 47,87 | 10,3 | 118,5 | 1535 | Wind speed 5.2m/s in direction of N 204 deg E. |
| 05/11/2009 | 0 | 45 | 4 | 11,30 | 93 | 50,18 | 9,6 | 120,1 | 1670 | |
| 05/11/2009 | 1 | 0 | 4 | 10,31 | 93 | 52,44 | 9,9 | 100,9 | 1196 | Survey line #27 (original waypoints 52 to 53) is completed.. |
| 05/11/2009 | 1 | 7 | 4 | 9,57 | 93 | 53,30 | 9,9 | 151,7 | 1106 | Survey line #28 (original waypoints 53 to 54) is started. |
| 05/11/2009 | 1 | 15 | 4 | 8,41 | 93 | 53,95 | 9,5 | 150,2 | 886 | |
| 05/11/2009 | 1 | 30 | 4 | 6,22 | 93 | 55,17 | 10,0 | 152,0 | 1250 | Wind speed 10.6m/s in direction of N 189 deg E. |
| 05/11/2009 | 1 | 45 | 4 | 4,02 | 93 | 56,41 | 10,8 | 152,7 | 1791 | |
| 05/11/2009 | 2 | 0 | 4 | 1,68 | 93 | 57,71 | 10,2 | 154,2 | 1800 | |
| 05/11/2009 | 2 | 15 | 3 | 59,45 | 93 | 58,97 | 9,9 | 154,8 | 1977 | |
| 05/11/2009 | 2 | 30 | 3 | 57,08 | 94 | 0,21 | 10,1 | 155,0 | 2090 | Wind speed 6.0m/s in direction of N 247 deg E. |
| 05/11/2009 | 2 | 40 | 3 | 55,77 | 94 | 1,03 | 10,2 | 157,1 | 2114 | Survey line #28 (original waypoints 53 to 54) is completed. |
| 05/11/2009 | 2 | 45 | 3 | 55,22 | 94 | 0,82 | 8,2 | 240,7 | 2186 | |
| 05/11/2009 | 2 | 51 | 3 | 55,44 | 94 | 0,09 | 10,3 | 329,1 | 2132 | Survey line #29 (original waypoints 55 to 56) is started. |
| 05/11/2009 | 3 | 0 | 3 | 56,60 | 93 | 59,42 | 9,9 | 329,4 | 1986 | |
| 05/11/2009 | 3 | 15 | 3 | 58,79 | 93 | 58,20 | 10,1 | 327,7 | 2063 | |
| 05/11/2009 | 3 | 30 | 4 | 0,97 | 93 | 56,97 | 10,0 | 328,1 | 1943 | Wind speed 6.7m/s in direction of N 244 deg E. |
| 05/11/2009 | 3 | 45 | 4 | 3,16 | 93 | 55,73 | 10,1 | 327,2 | 1952 | |

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| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 05/11/2009 | 4 | 0 | 4 | 5,49 | 93 | 54,42 | 9,9 | 327,3 | 1498 | |
| 05/11/2009 | 4 | 15 | 4 | 7,57 | 93 | 53,25 | 10,3 | 328,3 | 1182 | |
| 05/11/2009 | 4 | 24 | 4 | 9,01 | 93 | 52,45 | 10,3 | 328,2 | 1225 | Survey line #29 (original waypoints 55 to 56) is completed. |
| | | | | | | | | | | Wind speed 6.4m/s in direction of N 239 deg E. |
| 05/11/2009 | 4 | 38 | 4 | 8,18 | 93 | 51,30 | 10,6 | 152,3 | 1652 | Survey line #30 (original waypoints 57 to 58) is started |
| 05/11/2009 | | | | | | | | | | Wind speed 6.7m/s in direction of N 222 deg E. |
| 05/11/2009 | 4 | 45 | 4 | 7,08 | 93 | 51,95 | 11,1 | 152,2 | 1670 | |
| 05/11/2009 | 5 | 0 | 4 | 4,73 | 93 | 53,27 | 11,0 | 155,2 | 1834 | Wind speed 5.8m/s in direction of N 226 deg E. |
| 05/11/2009 | 5 | 15 | 4 | 2,51 | 93 | 54,53 | 10,0 | 154,5 | 1988 | |
| 05/11/2009 | 5 | 30 | 4 | 0,33 | 93 | 55,77 | 10,0 | 152,9 | 2084 | Wind speed 4.9m/s in direction of N 230 deg E. |
| 05/11/2009 | 5 | 45 | 3 | 58,04 | 93 | 57,07 | 9,8 | 152,9 | 1976 | |
| 05/11/2009 | 6 | 0 | 3 | 55,83 | 93 | 58,31 | 10,5 | 152,4 | 2043 | Wind speed 5.1 m/s in direction of N 236 deg E. |
| 05/11/2009 | 6 | 6 | 3 | 54,89 | 93 | 58,86 | 10,9 | 152,8 | 2060 | Survey line #30 (original waypoints 57 to 58) is completed |
| 05/11/2009 | 6 | 22 | 3 | 54,34 | 93 | 57,61 | 9,8 | 328,0 | 1645 | Survey line #31 (original waypoints 59 to 60) is started |
| 05/11/2009 | 6 | 30 | 3 | 55,55 | 93 | 56,91 | 10,3 | 327,8 | 1602 | Wind speed 5.6 m/s in direction of N 220 deg E. |
| 05/11/2009 | 6 | 45 | 3 | 57,91 | 93 | 55,56 | 10,5 | 327,3 | 1702 | |
| 05/11/2009 | 7 | 0 | 3 | 59,97 | 93 | 54,38 | 10,1 | 328,2 | 1827 | Wind speed 6.5 m/s in direction of N 248 deg E. |
| 05/11/2009 | 7 | 15 | 4 | 2,19 | 93 | 53,12 | 10,3 | 326,3 | 1949 | |
| 05/11/2009 | 7 | 30 | 4 | 4,39 | 93 | 51,86 | 10,2 | 329,1 | 1909 | |
| 05/11/2009 | 7 | 45 | 4 | 6,62 | 93 | 50,57 | 10,1 | 328,0 | 1838 | Wind speed 6.3 m/s in direction of N 235 deg E. |
| 05/11/2009 | 7 | 50 | 4 | 7,38 | 93 | 50,15 | 10,3 | 328,2 | 32 | Survey line #31 (original waypoints 59 to 60) is completed |
| 05/11/2009 | | | | | | | | | | Wind speed 6.4 m/s in direction of N 321 deg E. |
| 05/11/2009 | 8 | 0 | 4 | 6,90 | 93 | 48,93 | 9,9 | 151,8 | 1687 | |
| 05/11/2009 | 8 | 3 | 4 | 6,60 | 93 | 49,11 | 10,4 | 154,4 | 1743 | Survey line #32 (original waypoints 61 to 62) is started |
| 05/11/2009 | 8 | 15 | 4 | 4,76 | 93 | 50,17 | 9,5 | 152,7 | 1626 | |
| 05/11/2009 | 8 | 30 | 4 | 2,63 | 93 | 51,39 | 9,9 | 153,6 | 1799 | |
| 05/11/2009 | 8 | 45 | 4 | 0,47 | 93 | 52,61 | 9,9 | 152,2 | 1796 | |
| 05/11/2009 | 9 | 0 | 3 | 58,34 | 93 | 53,86 | 10,1 | 152,9 | 1647 | |
| 05/11/2009 | 9 | 15 | 3 | 56,18 | 93 | 55,10 | 9,9 | 150,3 | 1812 | |
| 05/11/2009 | 9 | 30 | 3 | 53,98 | 93 | 56,35 | 10,4 | 151,7 | 1947 | Survey line #32 (original waypoints 61 to 62) is completed. |
| 05/11/2009 | 9 | 45 | 3 | 53,62 | 93 | 55,45 | 10,0 | 328,8 | 2281 | Survey line #33 (original waypoints 63 to 64) is started. Wind speed 7.4 m/s in direction of N209 deg E |

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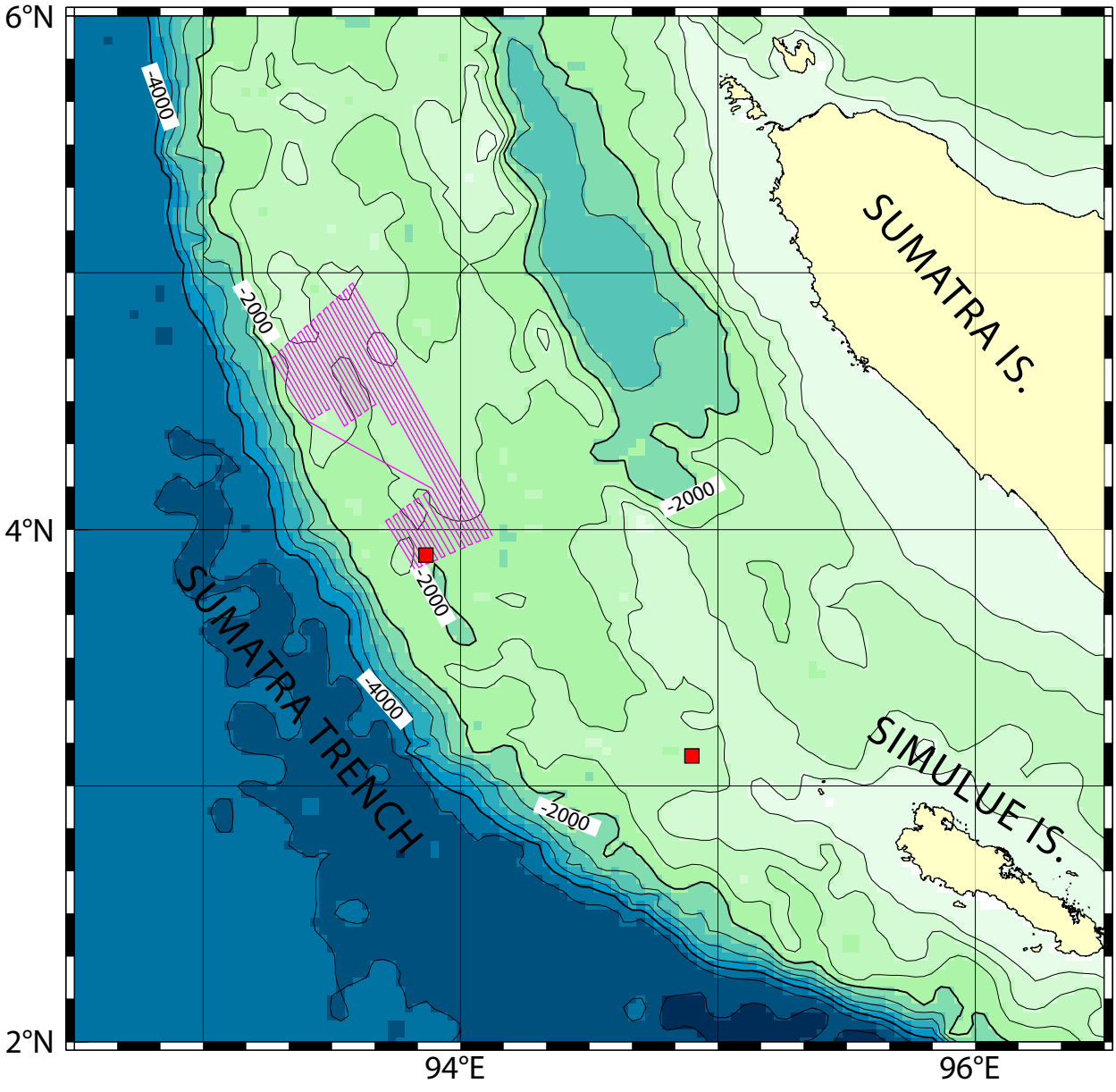
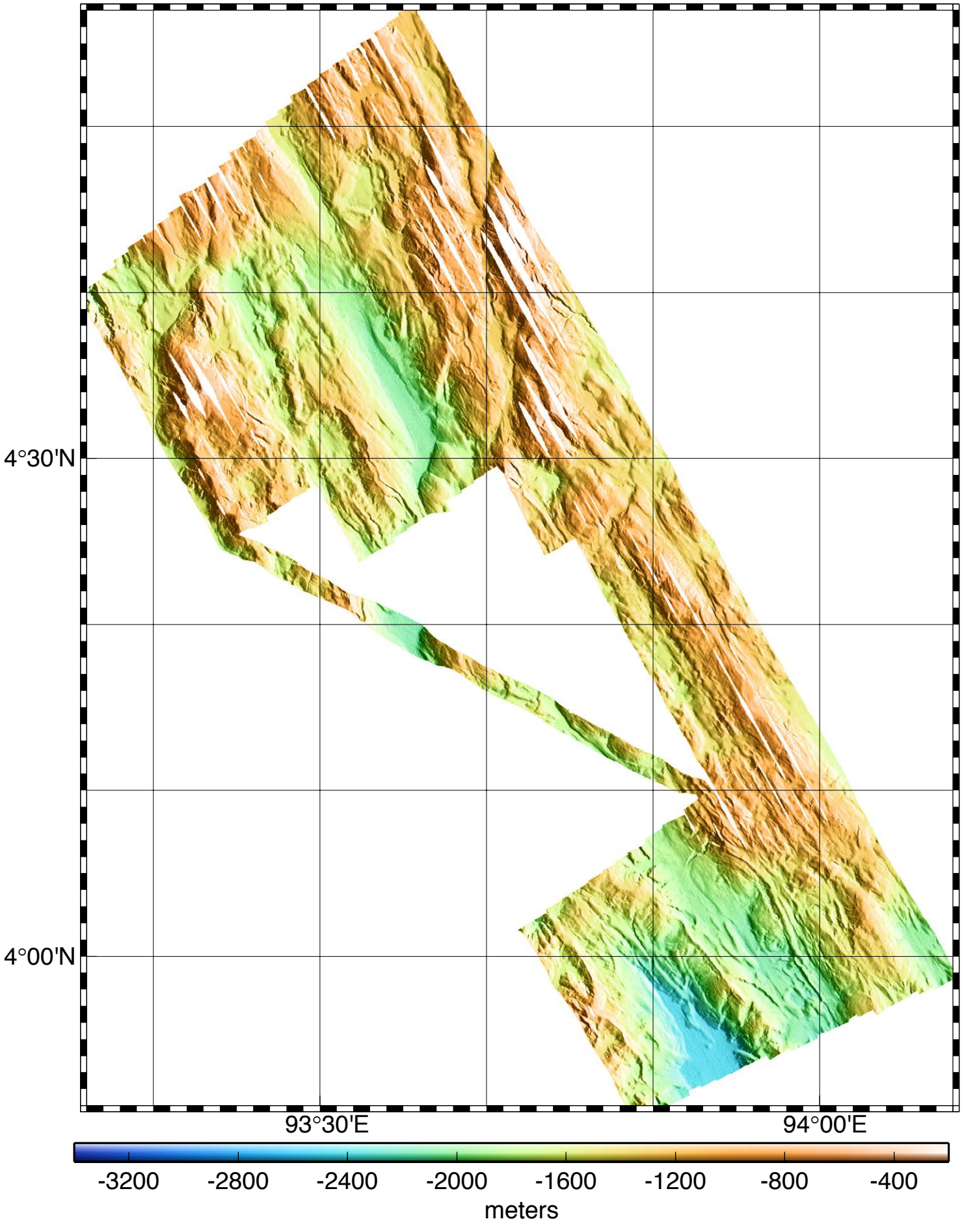
| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 05/11/2009 | 10 | 0 | 3 | 55,75 | 93 | 54,21 | 10,1 | 327,9 | 2281 | |
| 05/11/2009 | 10 | 15 | 3 | 57,95 | 93 | 52,95 | 9,8 | 326,5 | 2074 | |
| 05/11/2009 | 10 | 30 | 3 | 51,71 | 93 | 51,70 | 9,7 | 327,3 | 1830 | |
| 05/11/2009 | 10 | 45 | 4 | 2,25 | 93 | 50,46 | 10,0 | 325,0 | 1533 | Wind speed 6.5 m/s in direction of N 216 deg E. |
| 05/11/2009 | 11 | 0 | 4 | 4,80 | 93 | 49,16 | 10,9 | 327,2 | 1540 | |
| 05/11/2009 | 11 | 10 | 4 | 6,04 | 93 | 48,29 | 10,3 | 328,2 | 1747 | Survey line #33 (original waypoints 63 to 64) is completed. |
| 05/11/2009 | 11 | 15 | 4 | 6,42 | 93 | 47,73 | 9,0 | 241,5 | 1520 | |
| 05/11/2009 | 11 | 23 | 4 | 5,42 | 93 | 47,47 | 10,0 | 153,5 | 1387 | Survey line #34 (original waypoints 65 to 66) is started. |
| 05/11/2009 | 11 | 30 | 4 | 4,51 | 93 | 48,02 | 10,3 | 154,3 | 1438 | |
| 05/11/2009 | 11 | 45 | 4 | 2,10 | 93 | 49,43 | 11,0 | 153,1 | 1692 | Wind speed 8.2 m/s in direction of N 228 deg E. |
| 05/11/2009 | 12 | 0 | 4 | 0,57 | 93 | 50,60 | 10,5 | 152,3 | 1978 | |
| 05/11/2009 | 12 | 15 | 3 | 57,83 | 93 | 51,90 | 10,2 | 152,9 | 2294 | |
| 05/11/2009 | 12 | 30 | 3 | 55,66 | 93 | 53,16 | 10,0 | 152,9 | 2451 | Wind speed 7.1 m/s in direction of N 209 deg E. |
| 05/11/2009 | 12 | 45 | 3 | 53,46 | 93 | 54,44 | 10,1 | 151,3 | 2474 | |
| 05/11/2009 | 12 | 47 | 3 | 53,03 | 93 | 54,69 | 10,4 | 151,6 | 2467 | Survey line #34 (original waypoints 65 to 66) is completed. |
| 05/11/2009 | 12 | 59 | 3 | 52,68 | 93 | 53,78 | 10,4 | 328,0 | 2462 | Survey line #35 (original waypoints 67 to 68) is started. |
| 05/11/2009 | 13 | 0 | 3 | 52,51 | 93 | 53,72 | 10,2 | 326,3 | 2460 | |
| 05/11/2009 | 13 | 9 | | | | | | | | XBT |
| 05/11/2009 | 13 | 15 | 3 | 54,32 | 93 | 52,61 | 4,5 | 328,4 | 2457 | |
| 05/11/2009 | 13 | 30 | 3 | 56,11 | 93 | 51,76 | 10,2 | 328,0 | 2442 | Wind speed 5.5 m/s in direction of N 213 deg E. |
| 05/11/2009 | 13 | 45 | 3 | 58,35 | 93 | 50,45 | 10,2 | 329,1 | 2326 | |
| 05/11/2009 | 14 | 0 | 4 | 0,59 | 93 | 49,14 | 10,4 | 328,5 | 1894 | |
| 05/11/2009 | 14 | 15 | 4 | 2,78 | 93 | 47,86 | 10,1 | 328,5 | 1588 | |
| 05/11/2009 | 14 | 30 | 4 | 4,87 | 93 | 46,63 | 9,0 | 329,9 | 1239 | Wind speed 8.0 m/s in direction of N 10 deg E. Survey line #35 (original waypoints 67 to 68) is completed. |
| 05/11/2009 | 14 | 41 | 4 | 4,25 | 93 | 45,85 | 10,3 | 149,1 | 1456 | Survey line #36 (original waypoints 69 to 70) is started. |
| | | | | | | | | | | Wind speed 5.4 m/s in direction of N 340 deg E. |
| 05/11/2009 | 14 | 45 | 4 | 3,74 | 93 | 46,15 | 10,7 | 151,6 | 1508 | |
| 05/11/2009 | 15 | 0 | 4 | 1,51 | 93 | 47,46 | 9,9 | 151,3 | 1648 | |
| 05/11/2009 | 15 | 15 | 3 | 59,39 | 93 | 48,70 | 9,7 | 151,9 | 2025 | |
| 05/11/2009 | 15 | 30 | 3 | 57,28 | 93 | 49,95 | 10,1 | 154,3 | 2222 | Wind speed 7.1 m/s in direction of N 335 deg E. |
| 05/11/2009 | 15 | 45 | 3 | 55,04 | 93 | 51,26 | 10,6 | 152,7 | 2275 | |

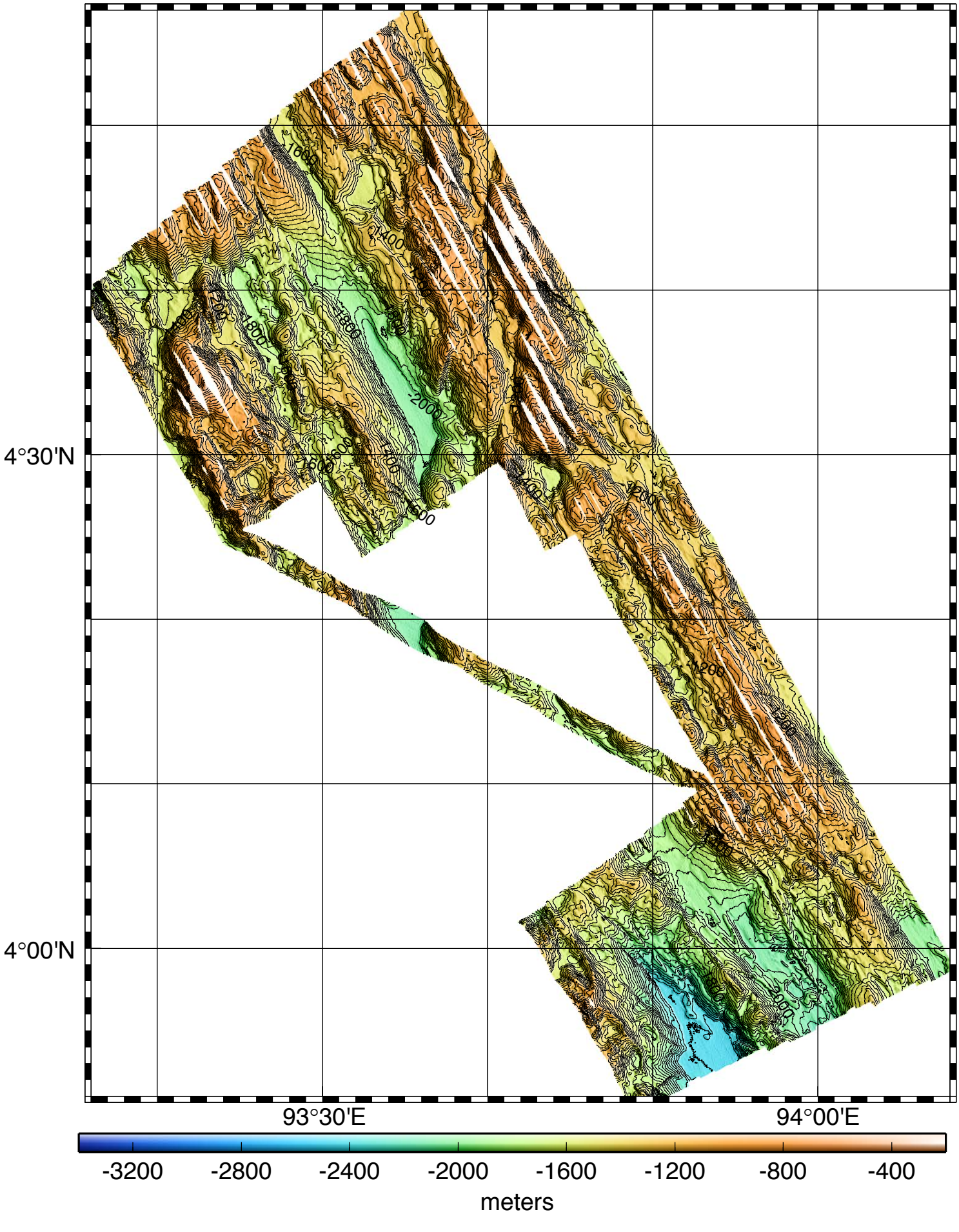
| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 05/11/2009 | 16 | 0 | 3 | 52,80 | 93 | 52,58 | 10,2 | 154,4 | 2441 | |
| 05/11/2009 | 16 | 3 | 3 | 52,25 | 93 | 52,88 | 10,3 | 153,8 | 2415 | Survey line #36 (original waypoints 69 to 70) is completed |
| 05/11/2009 | 16 | 17 | 3 | 51,89 | 93 | 51,98 | 10,1 | 324,9 | 2287 | Survey line #37 (original waypoints 71 to 72) is started |
| 05/11/2009 | | | | | | | | | | Wind speed 10.2 m/s in direction of N 333 deg E. |
| 05/11/2009 | 16 | 30 | 3 | 53,72 | 93 | 50,91 | 9,9 | 326,1 | 2041 | Wind speed 11.1 m/s in direction of N 329 deg E. |
| 05/11/2009 | 16 | 45 | 3 | 56,06 | 93 | 49,54 | 10,1 | 326,3 | 1734 | Wind speed 9.6 m/s in direction of N 334 deg E. |
| 05/11/2009 | 17 | 0 | 3 | 58,09 | 93 | 48,33 | 10,2 | 327,1 | 1724 | Wind speed 10.5 m/s in direction of N 335 deg E. |
| 05/11/2009 | 17 | 15 | 4 | 0,24 | 93 | 47,04 | 10,1 | 326,2 | 1760 | |
| 05/11/2009 | 17 | 30 | 4 | 2,41 | 93 | 45,76 | 10,2 | 329,1 | 1400 | Wind speed 10.5 m/s in direction of N 329 deg E. |
| 05/11/2009 | 17 | 39 | 4 | 3,69 | 93 | 45,02 | 10,3 | 329,0 | 1574 | Survey line #37 (original waypoints 71 to 72) is completed |
| 05/11/2009 | 17 | 45 | 4 | 10,00 | 93 | 44,15 | 10,1 | 242,5 | 1637 | |
| 05/11/2009 | 17 | 52 | 4 | 3,10 | 93 | 44,21 | 10,7 | 152,3 | 1649 | Survey line #38 (original waypoints 73 to 74) is started |
| 05/11/2009 | 18 | 0 | 4 | 1,85 | 93 | 44,95 | 10,1 | 152,4 | 1482 | |
| 05/11/2009 | 18 | 15 | 3 | 59,64 | 93 | 46,26 | 10,2 | 153,3 | 1600 | Wind speed 6.4 m/s in direction of N 342 deg E. |
| 05/11/2009 | 18 | 30 | 3 | 57,41 | 93 | 47,57 | 10,5 | 150,1 | 1543 | |
| 05/11/2009 | 18 | 45 | 3 | 55,16 | 93 | 48,91 | 10,4 | 153,4 | 1573 | |
| 05/11/2009 | 19 | 0 | 3 | 52,94 | 93 | 50,23 | 10,5 | 153,2 | 1948 | |
| 05/11/2009 | 19 | 10 | 3 | 51,50 | 93 | 51,09 | 10,5 | 153,8 | 2045 | Survey line #38 (original waypoints 73 to 74) is completed |
| 05/11/2009 | 19 | 15 | 3 | 50,71 | 93 | 51,17 | 8,9 | 244,6 | 2235 | |
| 05/11/2009 | 19 | 23 | 3 | 51,10 | 93 | 50,22 | 8,6 | 326,4 | 1944 | Survey line #39 (original waypoints 75 to 76) is started |
| 05/11/2009 | 19 | 30 | 3 | 51,96 | 93 | 49,70 | 9,4 | 326,8 | 1766 | Wind speed 7.0 m/s in direction of N 302 deg E. |
| 05/11/2009 | 19 | 45 | 3 | 54,21 | 93 | 48,34 | 9,7 | 327,7 | 1353 | |
| 05/11/2009 | 20 | 0 | 3 | 56,29 | 93 | 47,11 | 10,3 | 327,5 | 1130 | Wind speed 7.8 m/s in direction of N 313 deg E. |
| 05/11/2009 | 20 | 15 | 3 | 58,05 | 93 | 45,76 | 10,2 | 327,9 | 1542 | |
| 05/11/2009 | 20 | 30 | 4 | 0,69 | 93 | 44,46 | 10,4 | 328,4 | 1524 | |
| 05/11/2009 | 20 | 43 | 4 | 2,51 | 93 | 43,36 | 10,5 | 326,6 | 1683 | Survey line # 39 is completed; turning to the line # 40 |
| 05/11/2009 | 20 | 45 | 4 | 2,79 | 93 | 43,03 | 10,4 | 267,4 | 1681 | turning to line # 40, wind speed, 7,4 dir. 290 |
| 05/11/2009 | 20 | 53 | 4 | 1,90 | 93 | 42,58 | 11,6 | 152,2 | 1742 | Survey in line # 40 (original waypoints 77 to 78) is started |
| 05/11/2009 | 21 | 0 | 4 | 0,79 | 93 | 43,26 | 9,9 | 151,7 | 1369 | |
| 05/11/2009 | 21 | 15 | 3 | 58,56 | 93 | 44,60 | 10,3 | 151,7 | 1476 | |
| 05/11/2009 | 21 | 30 | 3 | 56,34 | 93 | 45,93 | 10,6 | 149,0 | 884 | |
| 05/11/2009 | 21 | 45 | 3 | 54,12 | 93 | 47,28 | 10,6 | 150,9 | 1267 | |

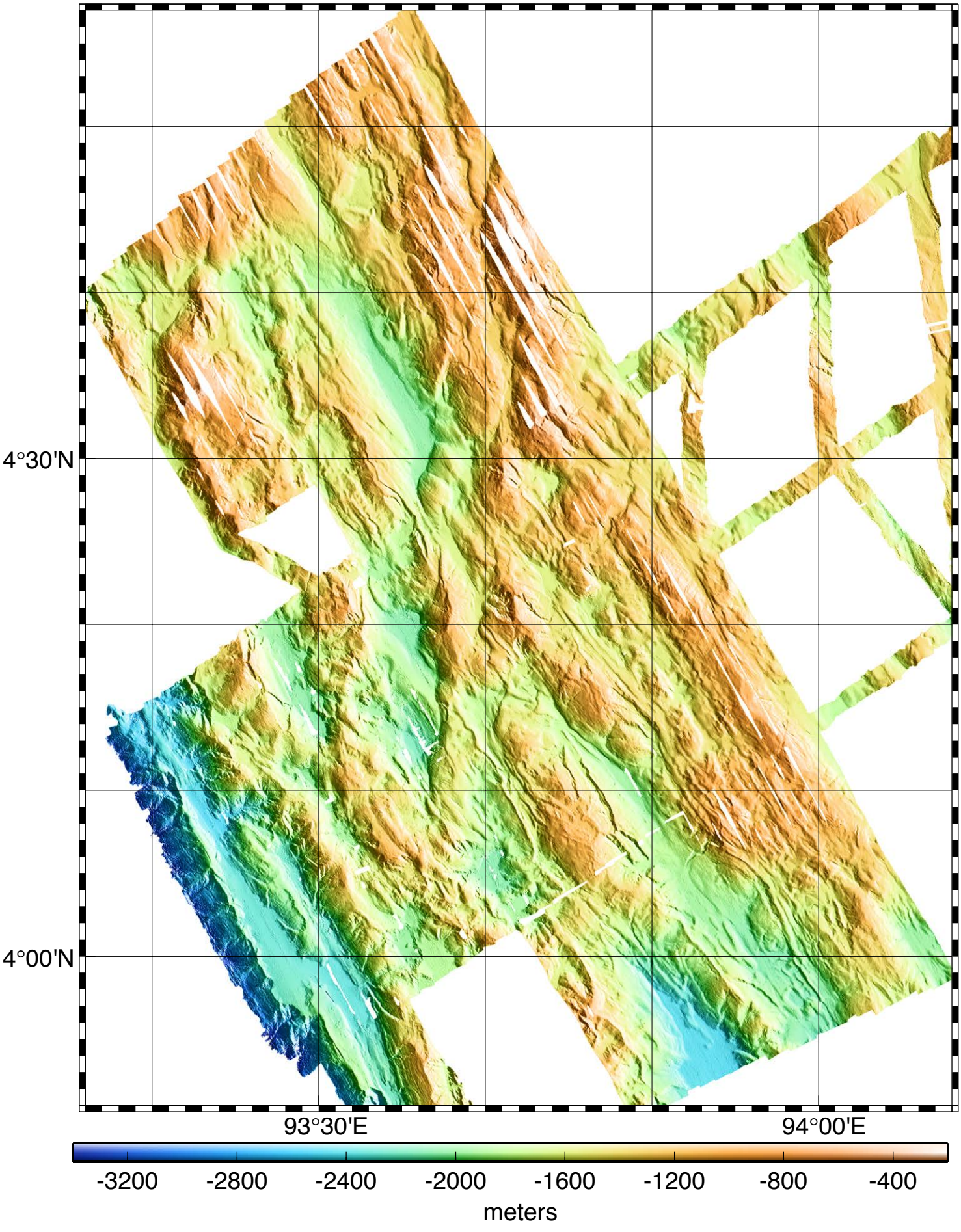
KY09-09 Leg.1 Log Sheet No. 18

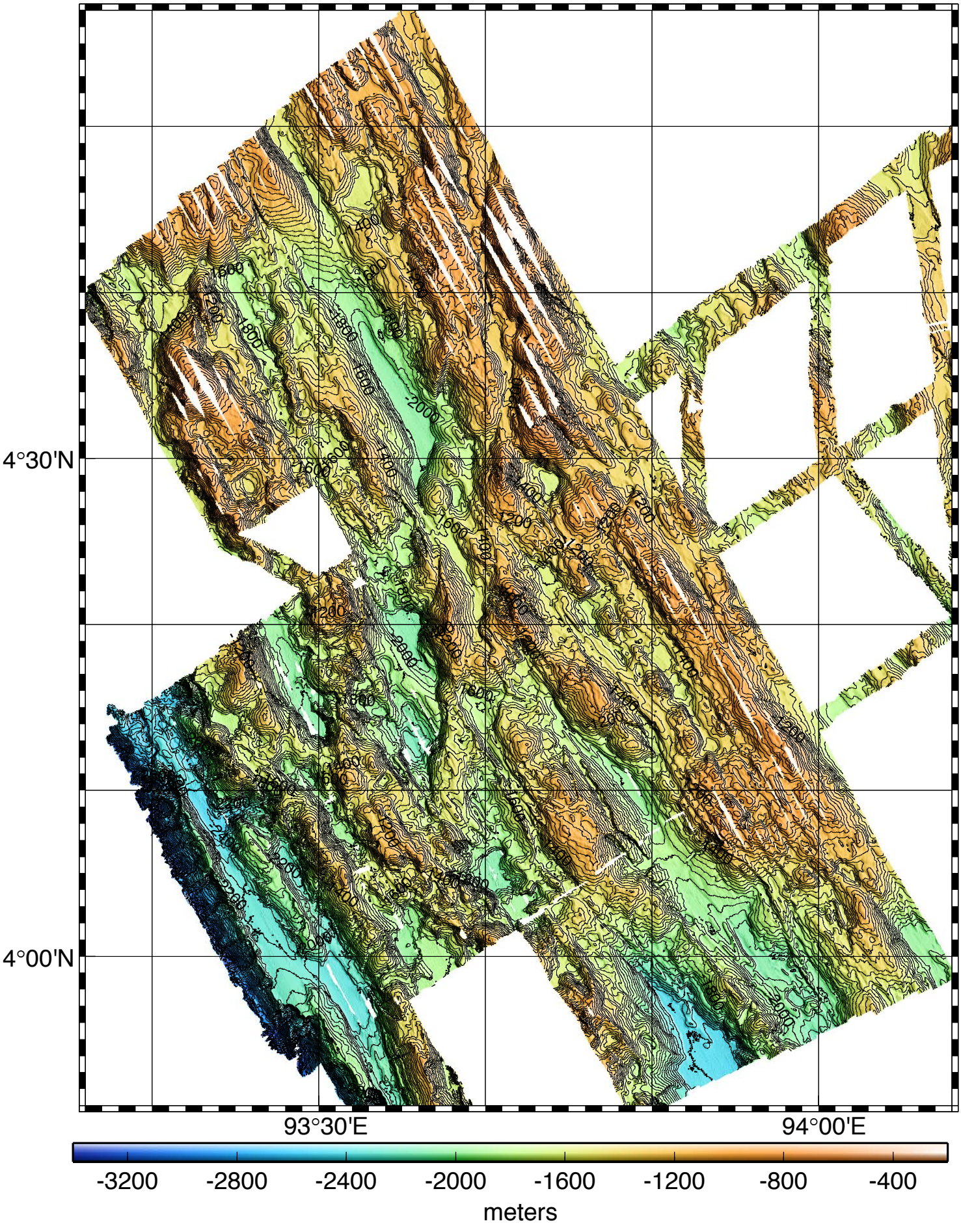
| Date (UTC+6) | Time (UTC+6) | | Latitude (ºN) | | Longitude (ºE) | | Speed (SOG) (knots) | Heading (GYRO) (deg) | Depth (-m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | (h) | (m) | (deg) | (min) | (deg) | (min) | | | | |
| 05/11/2009 | 22 | 0 | 3 | 51,84 | 93 | 48,65 | 10,6 | 148,8 | 1674 | |
| 05/11/2009 | 22 | 7 | 3 | 50,73 | 93 | 49,33 | 11,0 | 149,6 | 1575 | Survey line # 40 is completed |

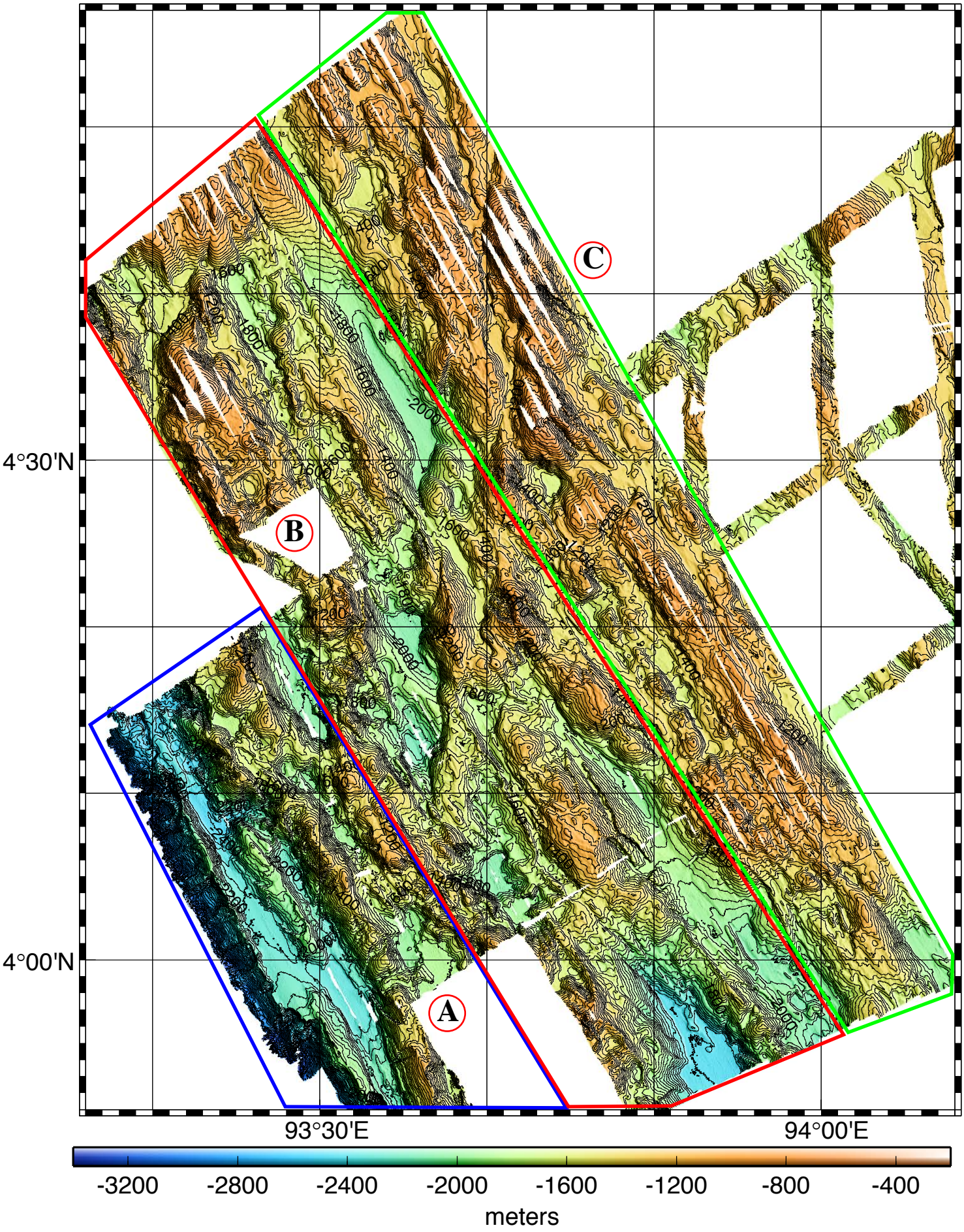

6°N
4°N
2°N
94°E
96°E
-4000
-2000
-2000
-2000
-4000
-2000
SUMATRA IS.
SIMULUE IS.
SUMATRA TRENCH


4°30'N
4°00'N
93°30'E
94°00'E
-3200
-2800
-2400
-2000
-1600
-1200
-800
-400
meters


4°30'N
4°00'N
93°30'E
94°00'E
-3200
-2800
-2400
-2000
-1600
-1200
-800
-400
meters


4°30'N
4°00'N
93°30'E
94°00'E
-3200
-2800
-2400
-2000
-1600
-1200
-800
-400
meters

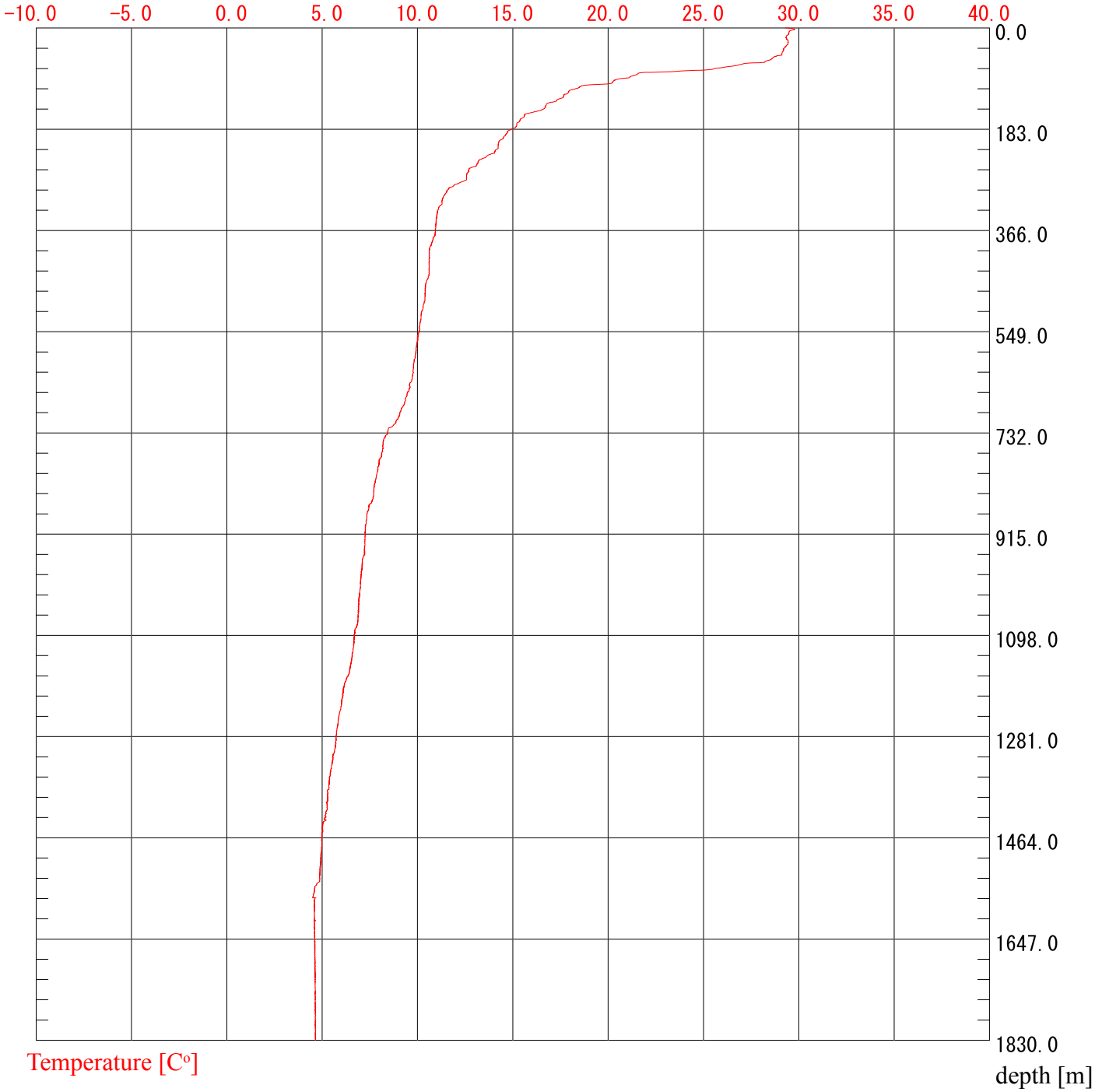

4°30'N
4°00'N
93°30'E
94°00'E
-3200
-2800
-2400
-2000
-1600
-1200
-800
-400
meters


A
B
C
4°30'N
4°00'N
93°30'E
94°00'E
-3200
-2800
-2400
-2000
-1600
-1200
-800
-400
meters

# XBT Profile

Data Name : BT-001220091031
Date : 2009/10/31
Time : 13:47:41
Lat : 03-07.5235N
Lon :094-53.2346E

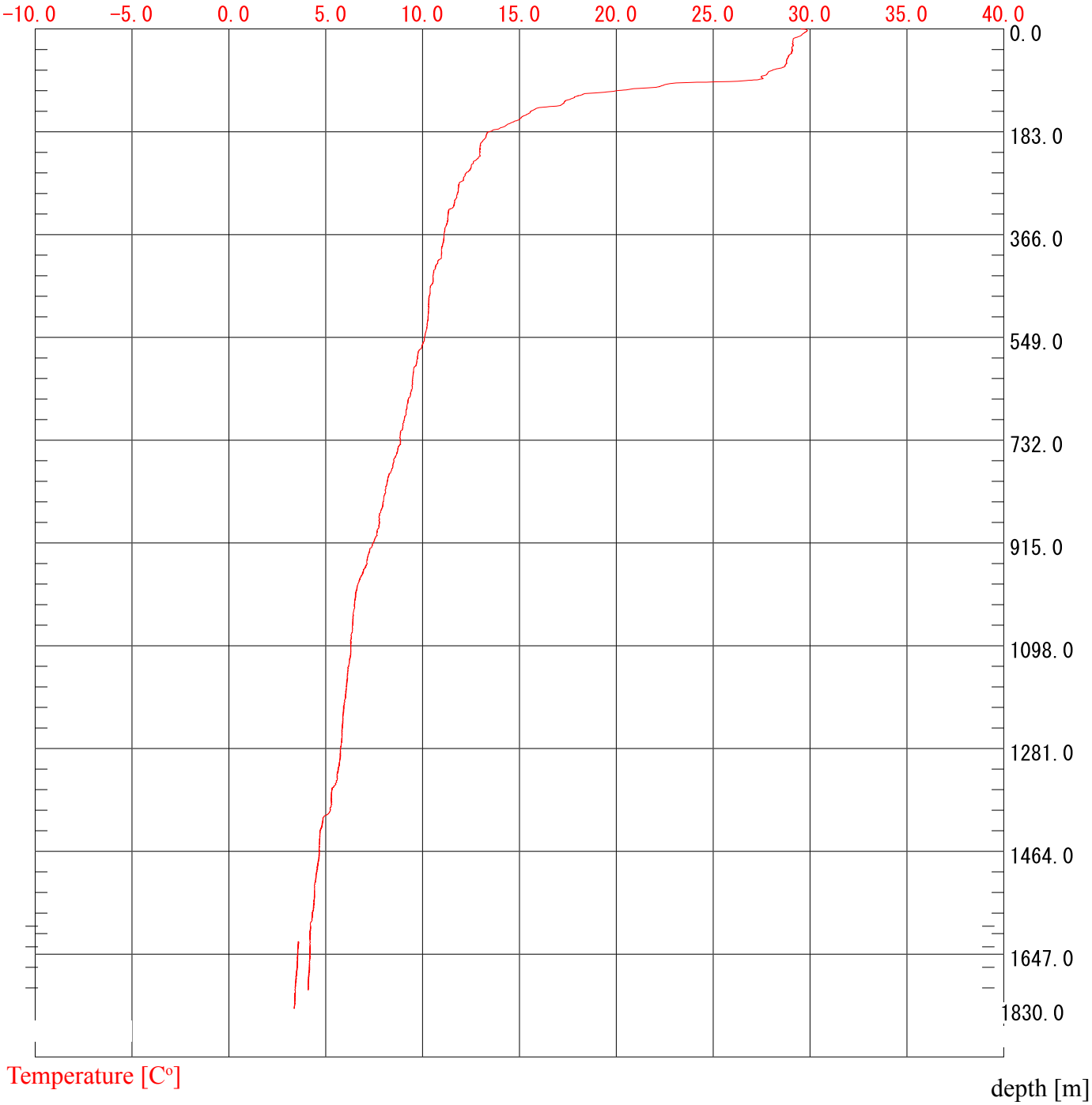
Device : XBT
Probe Type : T05
Coefficient of Depth (a) : 6.828
Coefficient of Depth (b) : -1.82
Maximum depth : 1830
Total Number of Data : 5821



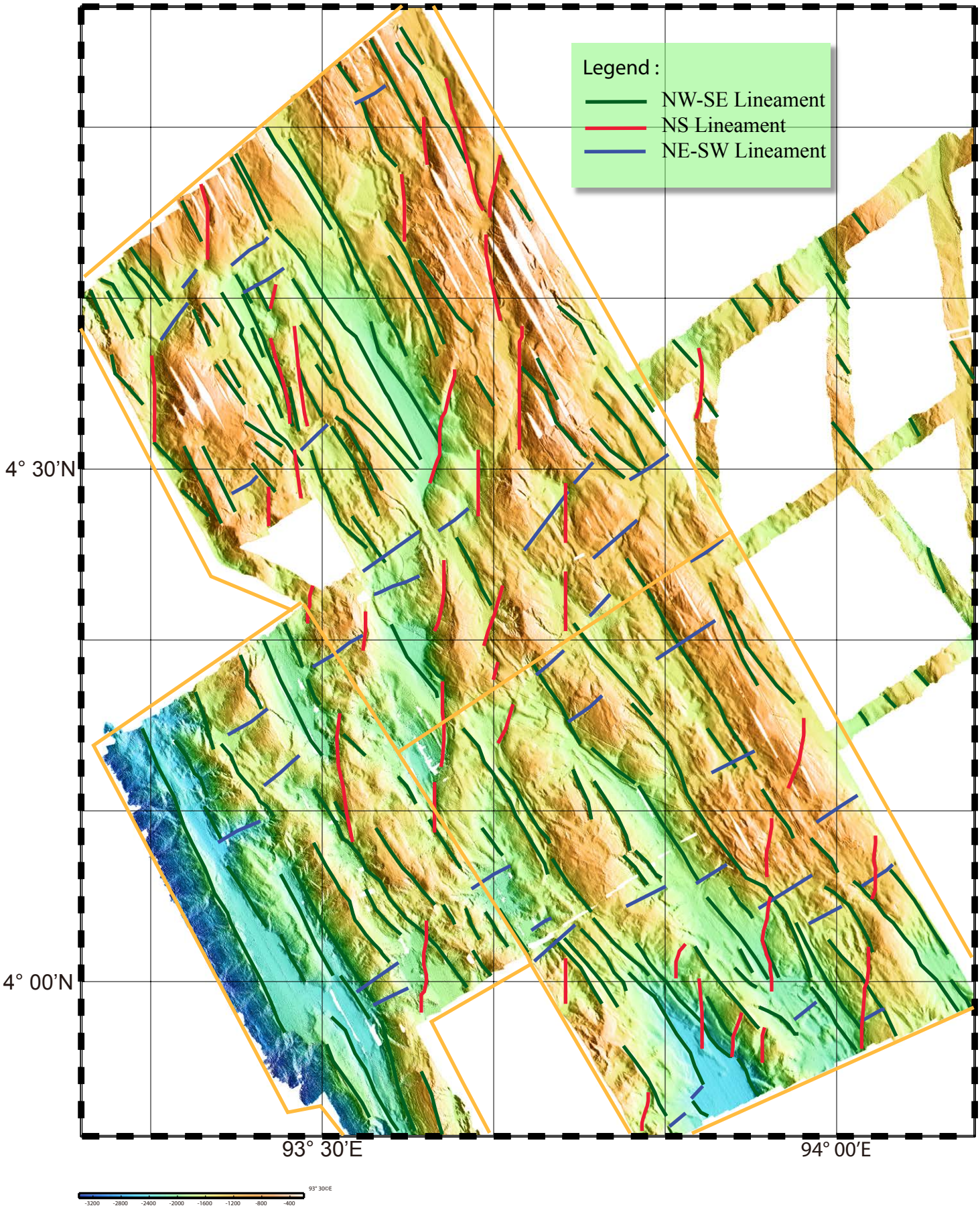
# XBT Profile

Data Name : BT-001220091105
Date : 2009/11/05
Time : 07:09:55
Lat : 03-53.9911N
Lon : 093-53.0094E

Device : XBT
Probe Type : T05
Coefficient of Depth (a) : 6.828
Coefficient of Depth (b) : -1.82
Maximum depth : 1830
Total Number of Data : 5821



# Direction Based Lineament



# Topography Based Lineaments