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R/V Kairei Cruise Report

KR09-14

Seismic study off Shikoku and off Kii Peninsula areas

Sep. 30, 2009 – Oct. 20, 2009

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents:

1．Cruise Information：

（1）Cruise number, Ship name: KR09-14, R/V Kairei

（2）Title of the cruise:

2009FY “Seismic study and earthquake observation study off Shikoku and off Kii Peninsula areas”

（3）Title of proposal:

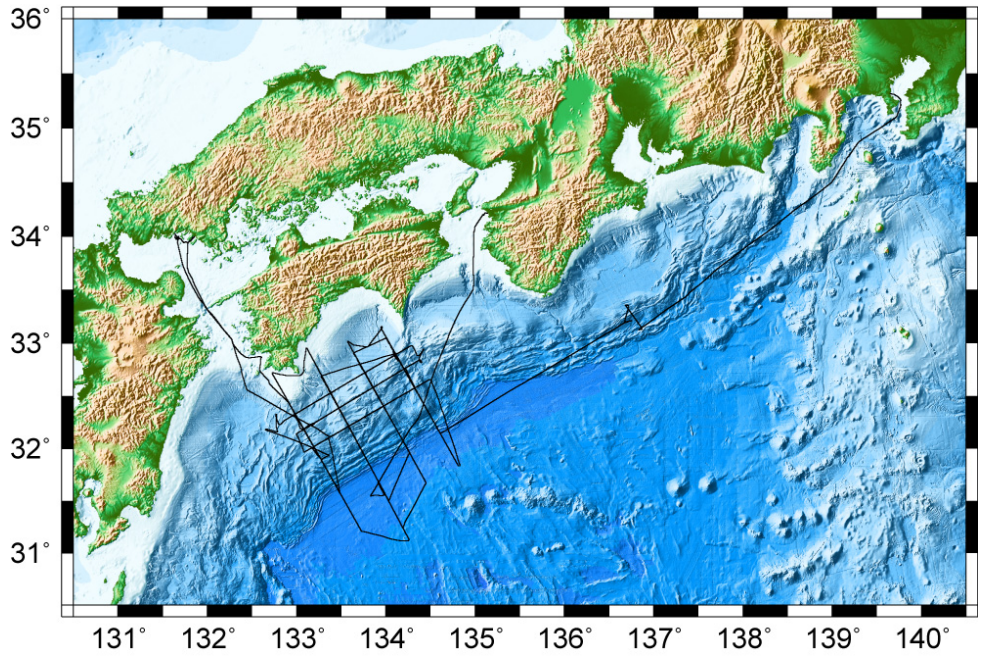
Seismic survey and observation study of evaluation for large earthquake synchronization in the Nankai Trough

（4）Cruise period, Port call:

2009/9/30-10/20, JAMSTEC (Yokosuka) to Wakayama Port

（5）Research Area: off Shikoku and off Kii Peninsula areas

（6）Research Map:



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３．Overview of Observation：

（１）Objectives：

This research cruise was conducted as a part of the study of “Research program concerning interaction between the Tokai, Tonankai, and Nankai Earthquakes” funded by the Ministry of Education, Culture, Sports, Science, and Technology of Japan.

In the Nankai Trough seismic subduction zone, a number of great earthquakes (M>8), such as 1944 Tonankai and 1946 Nankai earthqukaes, have been repeatedly occurred. Notable features in this region are the segmentation of the rupture zones and synchronization of these segments. To understand the structure factors controlling the segmentation and the synchronization of rupture zones, it is necessary to reveal the detailed structure variations and seismic activities in this subduction zone. The objectives of this cruise are to reveal detailed seismic structure and seismic activity off Shikoku, Nankai trough, and the activity of the low frequency tremors off Kii Peninsula.

（２）List of observation instruments：

１）Recovery and deployment of broad-band ocean bottom seismometers（BBOBSs）

3 BBOBSs were recovered and 2 BBOBSs were deployed off Kii Peninsula area.

２）Deployment of ocean bottom seismometers (OBSs)

201 OBSs were deployed on 7 survey lines (SK01-07) off Shikoku area.

３）Seismic refraction/reflection survey

A seismic refraction/reflection survey using a tuned air-gun array of 7,800 cubic inch and OBSs were conducted on 7 survey lines (SK01-07) off Shikoku area. However, on a part of SK05 line, a volume of a tuned air-gun array is 7,200 cubic inch because of an air-gun system trouble.

４）Multi-channel seismic (MCS) reflection survey

MCS survey using a tuned air-gun array of 7,800 cubic inch and a 444 channel hydrophone streamer with a 12.5 m group interval was planned to conduct off Shikoku area. However, this survey could not be conducted because of typhoon and some air-gun system troubles.

５）Bathymetry, Gravity and Geomagnetic observation

During this cruise, bathymetry, gravity and geomagnetic data have been recorded continuously by SEABEAM2112, gravity meter (KSS-31) and three-component magnetometer (SFG1214), respectively.

６）Temperature and Conductivity observation for the correction of sonic speed

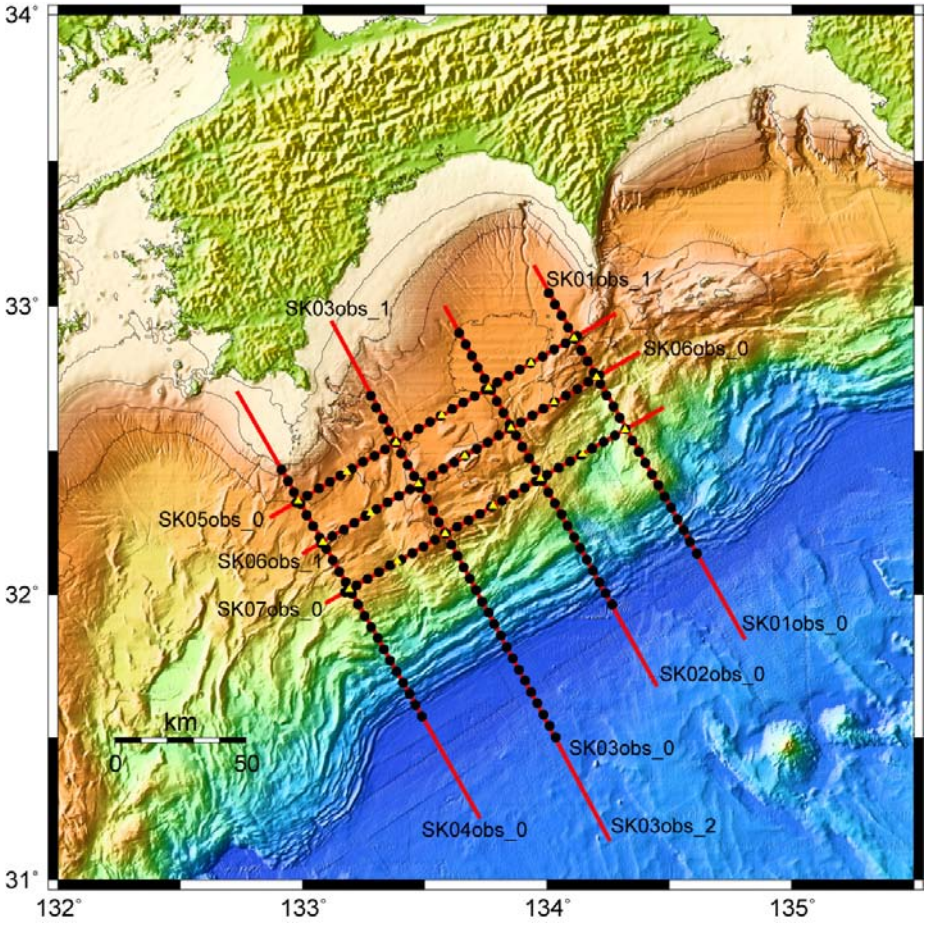
Expendable-Bathy Thermograph (XBT) has been conducted to correct the sonic speed for the bathymetry survey.

（３） Cruise log:

Date		Remarks
2009/9/30	Wed	Departure from JAMSTEC (Yokosuka), and transit to survey area (off Kii Peninsula area)
2009/10/1	Thu	Recovery of BBOBSs and deployment of BBOBSs off Kii Peninsula area, and transit to survey area (off Shikoku area)
2009/10/2	Fri	Deployment OBSs off Shikoku area
2009/10/3	Sat	Deployment OBSs off Shikoku area
2009/10/4	Sun	Deployment OBSs off Shikoku area
2009/10/5	Mon	Deployment OBSs off Shikoku area, and transit to Tokuyama-Kasado Bay to escape typhoon
2009/10/6	Tue	Transit to Tokuyama-Kasado Bay, and stay at there to escape typhoon
2009/10/7	Wed	Stay at Tokuyama Bay to escape typhoon
2009/10/8	Thu	Stay at Tokuyama Bay and Sukumo Bay to escape typhoon, and transit to survey area (off Shikoku area)
2009/10/9	Fri	Deployment OBSs off Shikoku area
2009/10/10	Sat	Air-gun shooting on SK05 line
2009/10/11	Sun	Air-gun shooting on SK05 and SK06 lines
2009/10/12	Mon	Air-gun shooting on SK06 and SK07 lines
2009/10/13	Tue	Air-gun shooting on SK07 line
2009/10/14	Wed	Air-gun shooting on SK01 line
2009/10/15	Thu	Air-gun shooting on SK02 line
2009/10/16	Fri	Air-gun shooting on SK02 and SK03 lines
2009/10/17	Sat	Air-gun shooting on SK03 and SK04 lines
2009/10/18	Sun	Air-gun shooting on SK04 line
2009/10/19	Mon	Air-gun shooting on SK04 and SK03 lines transit to Wakayama Port
2009/10/20	Tue	Arrive at Wakayama Port

（4） Seismic lines

1） Refraction/Reflection seismic survey



Black circles and yellow triangles show locations of deployed OBSs for a long-term observation and them for short-term observation, respectively. Red lines are seismic refraction/reflection survey lines conducted in this cruise using a tuned air-gun array and OBSs.

SK05obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/10 9:00	32° 16.13613’	132° 52.00483’	1230	990
First good shot	2009/10/10 9:03	32° 16.25526’	132° 52.00483’	1223	992
Last good shot	2009/10/10 19:37	32° 58.47122’	134° 16.82416’	1002	1760
Last shot	2009/10/10 19:37	32° 58.47122’	134° 16.82416’	1002	1760

SK06obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/11 1:05	32° 50.50015’	134° 22.65330’	1654	997
First good shot	2009/10/11 1:15	32° 50.22994’	134° 22.09782’	1653	1002
Last good shot	2009/10/11 23:57	32° 12.25608’	133° 07.23696’	1064	1685
Last shot	2009/10/12 0:21	32° 11.58517’	133° 05.92941’	1072	1697

SK06obs_1	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/12 6:49	32° 12.53603’	133° 07.78155’	1013	1680
First good shot	2009/10/12 6:51	32° 12.53603’	133° 07.67224’	1023	1681
Last good shot	2009/10/12 8:46	32° 08.49150’	132° 59.95161’	1306	1752
Last shot	2009/10/12 8:46	32° 08.49150’	132° 59.95161’	1306	1752

SK07obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/12 11:48	31° 58.17858’	133° 05.52933’	2065	997
First good shot	2009/10/12 11:51	31° 58.29706’	133° 05.74238’	2067	999
Last good shot	2009/10/13 4:08	32° 38.98140’	134° 28.60905’	2374	1750
Last shot	2009/10/13 4:08	32° 38.98140’	134° 28.60905’	2374	1750

SK01obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/13 15:30	31° 50.58109’	134° 48.52865’	4514	995
First good shot	2009/10/13 15:33	31° 50.77386’	134° 48.41284’	4513	997
Last good shot	2009/10/14 6:47	32° 53.15230’	134° 07.10578’	882	1658
Last shot	2009/10/14 6:52	32° 53.52999’	134° 06.85516’	933	1662

SK01obs_1	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/14 10:19	32° 52.68051’	134° 07.42006’	1004	1653
First good shot	2009/10/14 10:20	32° 52.77384’	134° 07.35496’	968	1654
Last good shot	2009/10/14 14:45	33° 08.49511’	133° 56.76922’	795	1821
Last shot	2009/10/14 14:45	33° 08.49511’	133° 56.76922’	795	1821

SK02obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/14 22:11	33° 00.12689’	133° 34.77389’	699	1190
First good shot	2009/10/14 22:13	32° 59.94173’	133° 34.90735’	727	1192
Last good shot	2009/10/15 18:05	31° 40.71967’	133° 26.95002’	4534	2030
Last shot	2009/10/15 18:05	31° 40.71967’	133° 26.95002’	4534	2030

SK03obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2009/10/16 0:32	31° 15.45928’	134° 10.94141’	4504	1073
First good shot	2009/10/16 0:35	31° 15.65559’	134° 10.83448’	4521	1075
Last good shot	2009/10/16 5:57	31° 38.51141’	133° 56.68731’	4893	1314
Last shot	2009/10/16 6:02	31° 38.89146’	133° 56.44461’	4893	1318

SK03obs_1	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP

First shot	2009/10/16 10:55	31°	37.84011’	133°	57.09814’	4875	1307
First good shot	2009/10/16 10:58	31°	38.03224’	133°	56.98152’	4881	1309
Last good shot	2009/10/17 6:39	32°	56.97866’	133°	07.05409’	89	2137
Last shot	2009/10/17 6:39	32°	56.97866’	133°	07.05409’	89	2137

SK04obs_0	Time (UTC)	Latitude (N)		Longitude (E)		Depth (m)	SP
First shot	2009/10/17 14:33	32°	42.41709’	132°	43.88797’	145	1030
First good shot	2009/10/17 14:36	32°	42.23484’	132°	44.02709’	145	1032
Last good shot	2009/10/18 16:14	31°	13.02236’	133°	43.46325’	4619	1980
Last shot	2009/10/18 16:14	31°	13.02236’	133°	43.46325’	4619	1980

SK02obs_0	Time (UTC)	Latitude (N)		Longitude (E)		Depth (m)	SP
First shot	2009/10/18 22:01	31°	08.18952’	134°	15.42548’	4394	997
First good shot	2009/10/18 22:07	31°	08.57536’	134°	15.19677’	4398	1001
Last good shot	2009/10/19 3:59	31°	33.06284’	134°	00.07113’	4745	1257
Last shot	2009/10/19 3:59	31°	33.06284’	134°	00.07113’	4745	1257

2） OBSs locations

（1） OBS list

Site	OBS Calibration position					Remarks
	Latitude(N)	Longitude(E)	Depth(m)	x	y	
1	33_02.7685	134_00.3382	881	-	-	1
2	33_00.3603	134_01.8310	895	-	-	1
3	32_58.0623	134_03.4527	896	-	-	1
4	32_55.6509	134_05.1182	907	-	-	1
5	32_53.2765	134_06.6905	956	-	-	1
6	32_50.9072	134_08.2589	1013	-	-	1
7	32_48.5891	134_09.9267	1198	-	-	1
8	32_46.2343	134_11.3984	1511	-	-	1
9	32_43.9140	134_13.0314	1707	-	-	1
10	32_41.5383	134_14.5359	2146	-	-	1
11	32_39.2156	134_16.1953	1785	-	-	1
12	32_36.8378	134_17.7537	2135	-	-	1
13	32_34.5009	134_19.2899	1998	-	-	1
14	32_32.1559	134_20.8956	2146	-	-	1
15	32_29.8232	134_22.4509	2267	-	-	1
16	32_27.4847	134_24.0880	2200	-	-	1
17	32_25.1482	134_25.6522	2081	-	-	1

18	32_22.8044	134_27.2489	2380	-	-	1
19	32_20.4663	134_28.8267	3342	-	-	1
20	32_18.1079	134_30.3975	4122	-	-	1
21	32_15.7740	134_31.9534	4002	-	-	1
22	32_13.4400	134_33.5171	4313	-	-	1
23	32_11.0295	134_35.0541	4603	-	-	1
24	32_08.6178	134_36.6806	4797	-	-	1
25	32_54.4320	133_38.3726	1035	-	-	1
26	32_52.0814	133_40.0077	1046	-	-	1
27	32_49.7013	133_41.5119	1053	-	-	1
28	32_47.2848	133_42.9384	1052	-	-	1
29	32_44.9494	133_44.5727	1051	-	-	1
30	32_42.6298	133_46.1757	1052	-	-	1
31	32_40.2295	133_47.6739	1063	-	-	1
32	32_37.8822	133_49.2302	1135	-	-	1
33	32_35.5310	133_50.7420	1159	-	-	1
34	32_33.1820	133_52.3249	1177	-	-	1
35	32_30.8121	133_53.8942	1187	-	-	1
36	32_28.4707	133_55.5175	1509	-	-	1
37	32_26.1120	133_57.1264	1657			1
38	32_23.7458	133_58.6841	1630			1
39	32_21.3725	134_00.2512	1795			1
40	32_19.0928	134_01.8482	1977			1
41	32_16.7552	134_03.4461	2446	-	-	1
42	32_14.4056	134_05.0208	2868	-	-	1
43	32_12.0367	134_06.5736	3022	-	-	1
44	32_09.6886	134_08.1141	3322	-	-	1
45	32_07.3318	134_09.7061	3809	-	-	1
46	32_04.9718	134_11.2261	4203	-	-	1
47	32_02.6256	134_12.8173	4390	-	-	1
48	32_00.3056	134_14.3768	4716	-	-	1
49	31_57.9361	134_15.8977	4887	-	-	1
50	32_41.4990	133_16.7107	665	-	-	1
51	32_39.0239	133_18.0487	780	-	-	1
52	32_36.6295	133_19.6777	898	-	-	1
53	32_34.1876	133_21.1122	970	-	-	1
54	32_31.7899	133_22.6714	1033	-	-	1

55	32_29.4555	133_24.1637	1050	-	-	1
56	32_27.1056	133_25.7775	981	-	-	1
57	32_24.6941	133_27.2979	908	-	-	1
58	32_22.2661	133_28.7861	872	-	-	1
59	32_19.9828	133_30.3897	862	-	-	1
60	32_17.5785	133_31.9225	1067	-	-	1
61	32_15.1847	133_33.3883	1057	-	-	1
62	32_12.8678	133_34.8941	1244	-	-	1
63	32_10.4209	133_36.4394	1858	-	-	1
64	32_08.0842	133_37.9692	2031	-	-	1
65	32_05.6867	133_39.5089	2277	-	-	1
66	32_03.3409	133_41.0165	2385	-	-	1
67	32_00.9661	133_42.5258	2794	-	-	1
68	31_58.5856	133_44.0593	2901	-	-	1
69	31_56.2105	133_45.5744	3827	-	-	1
70	31_53.7923	133_47.0626	4025	-	-	1
71	31_51.4155	133_48.6230	4193	-	-	1
72	31_49.0289	133_50.0833	4687	-	-	1
73	31_46.6498	133_51.5379	4890	-	-	1
74	31_44.2721	133_53.0740	4901			1
75	31_41.9197	133_54.5567	4893			1
76	31_39.5481	133_56.0754	4891			1
77	31_37.2222	133_57.5715	4851			1
78	31_34.8699	133_59.0989	4799			1
79	31_32.5104	134_00.5848	4731			1
80	31_30.0751	134_02.1030	4692			1
81	32_26.1068	132_54.8299	339	-	-	1
82	32_23.6672	132_56.3755	601	-	-	1
83	32_21.3476	132_57.8713	766	-	-	1
84	32_18.9939	132_59.4176	1069	-	-	1
85	32_16.6379	133_00.9643	1154	-	-	1
86	32_14.2787	133_02.5645	1223	-	-	1
87	32_11.9123	133_04.1474	1188	-	-	1
88	32_09.5871	133_05.8022	1197	-	-	1
89	32_07.2044	133_07.3936	1318	-	-	1
90	32_04.8447	133_08.9255	1483	-	-	1
91	32_02.6195	133_10.5530	1560	-	-	1

92	32_00.2406	133_12.0942	1647	-	-	1
93	31_57.8678	133_13.5859	1848	-	-	1
94	31_55.5442	133_15.2141	2131	-	-	1
95	31_53.2148	133_16.7730	2487	-	-	1
96	31_50.9465	133_18.3791	2607	-	-	1
97	31_48.5816	133_19.9446	3259	-	-	1
98	31_46.2280	133_21.4689	3267	-	-	1
99	31_43.8740	133_23.0604	3774	-	-	1
100	31_41.5223	133_24.6258	4102	-	-	1
101	31_39.2482	133_26.2087	4426	-	-	1
102	31_36.8889	133_27.6946	4742	-	-	1
103	31_34.4740	133_29.2074	4909	-	-	1
104	32_19.2713	132_58.4504	986	-	-	1
105	32_20.7063	133_01.1591	913	-	-	1
106	32_22.1481	133_03.9177	875	-	-	1
107	32_23.5199	133_06.6397	942	-	-	1
108	32_24.8626	133_09.2925	956	-	-	1
109	32_26.2700	133_12.0631	978	-	-	1
110	32_27.6508	133_14.8272	921	-	-	1
111	32_29.0077	133_17.5709	923	-	-	1
112	32_30.3218	133_20.2217	939	-	-	1
113	32_31.7473	133_23.0115	1024	-	-	1
114	32_33.1446	133_25.7789	987	-	-	1
115	32_34.5630	133_28.4983	960	-	-	1
116	32_35.9895	133_31.2662	984	-	-	1
117	32_37.2936	133_33.9035	984	-	-	1
118	32_38.6664	133_36.6631	972	-	-	1
119	32_40.0353	133_39.4309	993	-	-	1
120	32_41.4135	133_42.2299	1007	-	-	1
121	32_42.7498	133_44.9416	1040	-	-	1
122	32_44.1709	133_47.7309	1076	-	-	1
123	32_45.5607	133_50.5244	1108	-	-	1
124	32_46.9250	133_53.2939	1107	-	-	1
125	32_48.2090	133_55.9724	1079	-	-	1
126	32_49.6347	133_58.8284	1031	-	-	1
127	32_51.0391	134_01.6395	971	-	-	1
128	32_52.3241	134_04.4723	984	-	-	1

129	32_53.8025	134_07.2730	868	-	-	1
130	32_10.7890	133_04.5964	1175	-	-	1
131	32_12.2175	133_07.3046	1041	-	-	1
132	32_13.5768	133_10.0303	1079	-	-	1
133	32_14.9831	133_12.7355	1117	-	-	1
134	32_16.4249	133_15.4427	1178	-	-	1
135	32_17.8029	133_18.1319	1245	-	-	1
136	32_19.2360	133_20.8548	1276	-	-	1
137	32_20.6370	133_23.6073	1110			1
138	32_22.0089	133_26.3186	962			1
139	32_23.3875	133_29.0097	938			1
140	32_24.8107	133_31.7666	866			1
141	32_26.2235	133_34.4701	998	-	-	1
142	32_27.6035	133_37.2180	949	-	-	1
143	32_28.9652	133_39.8945	978	-	-	1
144	32_30.4168	133_42.6788	1024	-	-	1
145	32_31.8134	133_45.4227	1051	-	-	1
146	32_33.2031	133_48.1334	1101	-	-	1
147	32_34.5985	133_50.8589	1161	-	-	1
148	32_35.9669	133_53.5489	1290	-	-	1
149	32_37.3805	133_56.3120	1126	-	-	1
150	32_38.7597	133_59.0917	1092	-	-	1
151	32_40.1441	134_01.8149	940	-	-	1
152	32_41.5175	134_04.5985	949	-	-	1
153	32_42.9221	134_07.3650	1216	-	-	1
154	32_44.3085	134_10.1110	1419	-	-	1
155	32_45.6969	134_12.8504	1495	-	-	1
156	32_00.5509	133_10.3887	1717	-	-	1
157	32_01.9249	133_13.1777	1586	-	-	1
158	32_03.3071	133_15.8520	1520	-	-	1
159	32_04.7032	133_18.6718	1547	-	-	1
160	32_06.0873	133_21.4277	1799	-	-	1
161	32_07.3374	133_24.2099	1881	-	-	1
162	32_08.7082	133_26.9207	1513	-	-	1
163	32_10.0696	133_29.6867	1194	-	-	1
164	32_11.4570	133_32.4589	1036	-	-	1
165	32_12.8208	133_35.1905	1452	-	-	1

166	32_14.1230	133_37.8888	1242	-	-	1
167	32_15.5413	133_40.7122	1562	-	-	1
168	32_16.9047	133_43.4729	2250	-	-	1
169	32_18.3048	133_46.2183	1232	-	-	1
170	32_19.6191	133_48.9713	1548	-	-	1
171	32_20.9758	133_51.7404	1591	-	-	1
172	32_22.3411	133_54.4919	1518	-	-	1
173	32_23.6653	133_57.2460	1632	-	-	1
174	32_25.0448	134_00.0162	1714	-	-	1
175	32_26.3788	134_02.7594	1824	-	-	1
176	32_27.7682	134_05.5570	2127	-	-	1
177	32_29.1652	134_08.2668	2347	-	-	1
178	32_30.4922	134_11.0252	2333	-	-	1
179	32_31.8481	134_13.8109	2308	-	-	1
180	32_33.1921	134_16.6113	2519	-	-	1

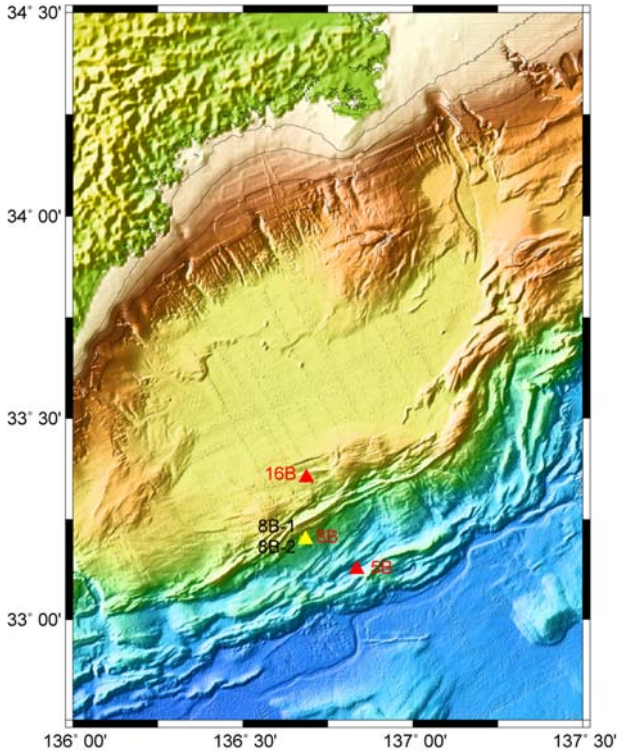
Site	OBS Calibration position					Remarks
	Latitude(N)	Longitude(E)	Depth(m)	x	y	
L1	32_53.4468	134_06.6147	954	-	-	1
L2	32_48.2484	133_56.0500	1078	-	-	1
L3	32_43.1085	133_45.6448	1049	-	-	1
L4	32_37.3997	133_34.1647	982	-	-	1
L5	32_31.7239	133_22.9030	1032	-	-	1
L6	32_25.6660	133_10.8656	839	-	-	1
L7	32_19.6165	132_59.0026	961	-	-	1
L8	32_45.2712	134_12.1693	1497	-	-	1
L9	32_40.0613	134_01.6908	960	-	-	1
L10	32_34.7824	133_51.2025	1174	-	-	1
L11	32_28.9345	133_39.7905	976	-	-	1
L12	32_23.0922	133_28.4215	937	-	-	1
L13	32_17.0009	133_16.6811	1215	-	-	1
L14	32_10.9478	133_04.9552	1166	-	-	1
L15	32_34.4411	134_19.2203	1998	-	-	1
L16	32_29.3760	134_08.7595	2318	-	-	1
L17	32_24.2451	133_58.3988	1608	-	-	1
L18	32_18.5344	133_46.7084	1234	-	-	1
L19	32_12.7261	133_34.9615	1268	-	-	1

L20	32_06.9358	133_23.3153	1950	-	-	1
L21	32_01.1155	133_11.5318	1613	-	-	1

Remarks:

1: OBS deployment location because of no OBS calibration.

3） BBOBSs locations



Red and yellow triangles show calibration positions of recovered BBOBSs and of deployed them, respectively.

Recovery

Site	BBOBS Calibration position					Remarks
	Latitude(N)	Longitude(E)	Depth(m)	x	y	
5B	33_07.5394	136_50.0757	3835	-	-	
8B	33_11.9767	136_41.0898	2648	-	-	
16B	33_21.2082	136_41.1877	2034	-	-	

Deployment

Site	BBOBS Calibration position					Remarks
	Latitude(N)	Longitude(E)	Depth(m)	x	y	
8B-1	33_11.9769	136_41.0706	2661	-	-	
8B-2	33_11.9932	136_41.0689	2653	-	-	

4. Notice on using:

This cruise report is a preliminary documentation as of the end of the cruise. It may not be corrected even if changes on content (i.e. taxonomic classifications) are found after publication. It may also be changed without notice. Data on the cruise report may be raw or not processed. Please ask the PI(s) for the latest information before using. Users of data or results of this cruise are requested to submit their results to Data Integration and Analysis Group (DIAG), JAMSTEC.