CRUISE REPORT FM3507

STUDENT CRUISE XI / BONIN ARC II

BRIEF CHRONOLOGICAL NARRATIVE

30 JULY 1987 Depart Austin 0930 L* *L - all times are local
31 July Arrive Osaka 1840
3 Aug 0600 Cruise departure
4 Aug 2107 Deployed HIG OBS-1
2131 Deployed HIG OBS-2
2245 Deployed HIG OBS-3
5 Aug 0033 Deployed HIG OBS-4
0245 Deployed HIG OBS-6
0350 Deployed HIG OBS-5
0400-0930 Transit to streamer deployment site
0954-2245 Deployed streamer; checked a few boots for causes of bad channels and replaced section 31
2300-
6 Aug
7 Aug 1340 Compressors (final stage exit air) running too hot to use. Called Galveston for advice and altered plans - to shoot lines 9 & 8 before deploying UT OBSs so that we could be sure that we could shoot to them at all.
1341-
8 Aug 0114 Shot Line 9 with one 2000 cu. in. air gun at 20sec.rep rate with two compressors.
0114-0328 transitted to Line 8
0328-1407 Shot Line 8 with two 2000 in guns at 20 sec., maintaining 1960 psi. Compressors ran at marginally high temperatures. This mode of operation continued throughout the cruise.
1410-1920 Retrieved air guns & transitted to UT OBS-A site.
1922 Deployed UT OBS-A
1930-2313 Transitted to and deployed UT OBS-B
2313-
9 Aug 0400 Transitted to and deployed UT OBS-C
0400-0730 Transitted to and deployed UT OBS-D
0730-1120 Transitted to and deployed UT OBS-E
1120-1329 Transitted to Line 1
1329-2155 Shot Line 1 with one 2000 in gun starting at a rep rate of 14 sec. maintaining 1980 - 2000 psi. Increased rep rate to 18 sec. incrementally with deep water delay increase to 8 sec. Obtained 48 to 43 fold.
1838 Main coupling on port compressor failed; compressor lost for the rest of the cruise.

2200-2400 Transitted to Line 2
10 Aug 0000-
11 Aug 0146 Shot Line 2 with one 2000 in gun at 20 sec rep rate maintaining > 1900 psi.
0146-1628 Shot Line 3; same parameters as Line 2.
1630-2107 Transitted to Line 4. Retrieved 2000 in gun and deployed two arrays (2130 cu. in. total). Two more hours for gun repairs than for transit.
2107-
12 Aug 0951 Shot Line 4 with two arrays at 20 sec. rep rate maintaining 1900 - 2000 psi.
1000-1323 Transitted to Line 5 retrieving arrays and redeploying one array and one 2000 in gun. Test fired 3000 cu. in. at 30, 28, 26, & 25 sec. rep rates.
1323-
13 Aug 0238 Shot Line 5 with 3000 cu. in. at 25 sec. maintaining 1920 - 1930 psi. Second array and second 2000 in gun deployed as backup; switched two guns during line.
0240-1057 Transitted to Line 6 pulling all guns and making repairs - 5 hours more than the transit alone.
1057-2353 Shot Line 6 with 3000 cu. in. at 24 sec. maintaining 1910 - 1920 psi.
1402 Deployed sonobuoy #1
1728 Deployed sonobuoy #2
1958 Deployed sonobuoy #3
14 Aug 0000-0030 Air guns retrieved.
0030-0625 Streamer retrieved; a couple of boots opened and checked, two patches made, five leads removed and some oil added to heavy sections (10, 11, & 12).
0630-1610 Transitted to UT OBS-E site and awaited surfacing.
1611 UT OBS-E retrieved
1831 UT OBS-D retrieved
2122 UT OBS-C retrieved
2343 UT OBS-B retrieved
15 Aug 0246 UT OBS-A retrieved; HIG OBS-6 did not surface
0500-0747 HIG OBS-5 did not surface
0830-1000 HIG OBS-4 did not surface
1100-1330 HIG OBS-3 did not surface
1430-1630 HIG OBS-2 did not surface
1830-2000 HIG OBS-1 did not surface; returned to HIG OBS-6 site to await possibility that times were programmed 24 hours late.
16 Aug 0230-0400 HIG OBS-6 did not surface
0530-0600 HIG OBS-5 did not surface; retrieval abandoned; began transit to Osaka.
17 Aug 2015 Arrived Osaka

DISCUSSION AND COMMENT.

Seismic System

Streamer: Two sections of streamer were skinned and boxed for shipment to Galveston and refurbishing. One had been removed prior to our arrival and section 31 was swapped out during streamer deployment. It had leaked almost dry through one of several old patches on the reel. A section in the same location (first or second wrap, starboard side) began leaking heavily during the latter part of the streamer retrieval. This section will need patching or replacement on the next streamer deployment. If the leaking section is on the innermost wrap, the leader on which it lies should be checked for anything sharp which may have caused the leak. The inner half of the streamer was well balanced; the outer half was heavy around sections eleven and one and light (or had an uncalibrated depth indicator) at section four. The area around section 11 was lightened during retrieval; the outermost section or two should be lightened by 3 or 4 leads upon the next deployment. Channels 12, 61, and 86 are dead or nearly so. Channel 12 is electrically open. Channels 25 and 67 appear noisy on the dot scope but look good on the QC plots. Overall, the streamer is a little heavy at a water temperature of 80 - 82 F. The tail buoy separated at the inboard end of its tow rope and was lost. This was presumably a shackle failure during calm seas.

The winch system worked entirely satisfactory. It has enough power to pull in the full streamer at slow ahead on two engines (about 4 knots) and can pull it in faster than it can be level wound at all stop. Backing down on the streamer was never necessary to maintain enough slack to have a catenary from the drum to the water that did not touch the deck. All work was done in calm seas.

Sources: The two large (2000 cubic inch) air guns worked satisfactorily throughout the cruise. However, on one line, the lifting wire rope on the starboard gun broke at the fitting - necessitating retrieving it with the chain and time-consuming jury rigging. Apparently this break was due to wire fatigue and suggests that fittings should be replaced at regular intervals as preventative maintenance. As bad or worse was the detachment of the port gun from its tow chain. The gun was fired for an unknown time hanging on its retrieval wire. The entire chain attachment came off, apparently due to the working loose of the attachment bolts. One set of spare chain-holding blocks were aboard, but spare bolts were not. Several sets of such small spare parts should be carried.

The arrays also worked satisfactorily although at least one fitting was gone and one gun was 'dangling' on each retrieval. The system of deploying all guns and using only half with the other half as 100% backup for switch- ing when necessary, enabled us to complete 50 mile lines satisfactorily. Any lines shot with less than this configuration had holes in it or required circling while making gun repairs. Gun repairs made during interline transits (generally 2 to 4 hours) always took longer than the transits and thus necessitated additional circling. Part of the reason for this and the reason why arrays were not used until late in the cruise, was that the gun technician experienced with them was medically impaired until late in the cruise.

The array winches work slowly, but they have only a short distance to pull and seem to be satisfactory. Both umbilical and chain winches can be operated simultaneously, although the starboard winch controls are somewhat more difficult to operate. One balloon and rigging was lost after it was passed from the upper deck to the streamer deck but not secured there. Several small hydraulic leaks are scheduled to be repaired in Osaka.

Fold and source volume were significantly lower than desired, because only one compressor was available for most of the cruise. Furthermore, operation of both compressors was marginal due to overheating. Extensive repairs were started in Osaka to overcome the overheating. The coupling failure on the port compressor was apparently due to excessive wear when cycling between idle and fast with each shot. The compressors were run at constant rpm to try to overcome this. Compressor monitoring and maintenance seemed to be the bulk of the work of the engineering staff and thus obviously require more maintenance effort (personnel) than 'normal' ship's operations.

GUS: GUS itself worked very well. Watch standers were often able to give it minor instructions such as stop, start, and change deep water delay. Only rarely did a non-start require a complex set of high-tech button pushing; but in these situations, all action would stop indefinitely without the high-tech operator. A couple of short data gaps occurred because only two tape drives were kept on line. One drive was inoperative and one was 'uncertain'. Keeping more than two drives on line is a better mode of operation. Ken Griffiths intends to get all drives operational on the next transit.

The galvo-camera still awaits fixing.

The single channel monitor was of poor quality but by no means useless - remaining much as it was.

Gun Control: This system apparently operated fully but is another area that relies almost exclusively on a high-tech operator.

Magnetometer

Only the starboard magnetometer was tried briefly (part of Line 2). The signal level was low and erratic. Ken Griffiths intends to check the systems further on the next transit.

3.5 Bathymetry

Good records were obtained to the maximum depths encountered - 9,300 meters. Several variations on programming were used with various advantages and disadvantages to each. Two second sweeps simplified operation of the system and is recommended in areas such as this where surficial sedimentary stratigraphy is not a primary objective and bathymetric relief is high. The outgoing pulse apparently bounces around inside the new transducer housing quite a bit. This effects much ringing noise in the first 0.05 to 0.125 seconds of record wherein the bottom may be quite difficult to discern. Poor (no) records in deep water on previous legs may have been due to ambiguous (or even incorrect) programming and/or bad weather (6-8 ft seas or worse).

Sonobuoys

Three sonobuoys were deployed on the last MCS line. More were not deployed earlier, because refraction data was anticipated from OBSs on almost all of the preceding lines. Ken set up the radio receiver, a flatbed monitor, and recording on GUS auxiliary channel 1. The analog monitor records were excellent for all three sonobuoys. 1600 bpi tapes of the records were provided to Dr. Patricia Cooper of the Hawaii Institute of Geophysics as were copies of all hand written logs and processed navigation at five minute intervals.

OBSs

Five UT OBSs were deployed and recovered. One had blank tape; one had data on only one of four tape tracks; and three had excellent records of reflections, refractions, and volcanic tremors. A separate supplemental report by Dr. Yosio Nakamura, on the OBS work, is included.

Six HIG OBSs were deployed but none resurfaced. Whereas 24-hour errors have been made on OBS release times in the past, we extended the cruise to cover at least two release times 24 hours later than scheduled. Unfortunately neither OBS surfaced then either, and the search was abandoned. No cause for the release failures is known except that it was obviously systematic to all instruments. As with ours, the HIG OBSs had no provision for acoustic releasing.

Navigation

Navigation in real time was done with Loran-C which was calibrated with both transit and GPS satellite fixes. Both satellite systems worked routinely. After installing a new preamp and 'going over' all connections (especially tightening up the antenna connection), the bridge Loran worked as well as or better than the lab Loran. Yosio performed the calibrations. All programs for this are aboard but are probably unusable by others. The crux of the system is to deduce the secondary correction factors for the chain used by the Loran set from comparison of time differences (TDs) with observed latitudes and longitudes, and to determine 'correct' secondary correction factors from satellite fix calibration. With these data, the program NSTOTRU (in NAV/NAV) will calculate corrected (true) from observed Loran coordinates <u>or</u> provide you with coordinates to navigate by ('predicted observations') from true coordinates (e.g., obtained from a map). These predicted coordinates may then be plotted (as PLOT program 'notes') on the plotter and used for course guidance. Programs are also aboard for reading logger tapes, applying these corrections to Loran data, and for smoothing Loran data and applying the corrections (for fixes as- or more frequent than one minute). These programs can do post-cruise navigation processing, but they are not documented for general use (i.e., by anyone other than Yosio). A short introduction to the possible navigation processing and a user guide for NSTOTRU are available.

The program NAV ran unattended throughout the cruise. Use of PLOT and the Calcomp plotter made hand plotting for course maintenance and guidance almost obsolete. PLOT is a friendly, interactive program with only a few hangups. The first data or note plotted on a grid should be checked, because plotting coordinates sometimes differ from grid coordinates (that is, after the border is drawn, data gets plotted on a different grid). Also, starting a new plot sometimes requires a couple of tries. Once a grid was started, the only program failure (a complete crash) occurred as the result of very fast scrolling (pushing NEXT or BACK) through the available entry lines.

SUMMARY

The cruise had both significant accomplishments and failures. The MCS lines include both in that about 3/4 of the line milage (> 400 n.mi.) was accomplished; but both the unfinished lines and the less than desired sources were due almost entirely to compressor failure. Other accomplishments include establishment of full depth range capability of the 3.5 system, reestablishment of duplicate LORAN-C acquisition, and establishment of sonobuoy data acquisition capability. Remaining to be done are galvo-camera repair, single channel monitor improvement, and air gun hardware improvement. UT OBS data acquisition was 65% of total possible, but loss of the HIG OBSs reduced total OBS acquisition to < 30%.

The ship's operations were at thier usual high standards and not only made possible the successes we had but also made all of our work pursuable with pleasure and safety.

This cruise was accomplished with funding from the University of Texas at Austin.

Respectfully submitted,

E. William Behrens,
Chief Scientist

FM35-07 Cruise Report Supplement (OBS)

We conducted a small-scale ocean-bottom seismograph (OBS) experiment during the student training cruise, FM35-07, in the Bonin arc area. We deployed five OBS units along multichannel lines 2 and 3, which ran perpendicular to the trench axis, and recovered all of them. Three of the units recorded full data, one recorded partial data, and one recorded none.

Paul McPherson and I were in charge of the OBS operation, and we were fortunate to have Dr. Toru Ouchi of Kobe University, a veteran Japanese OBS seismologist, on board to participated in the experiment. Also on board were Dr. Patricia Cooper and Mr. David Barrett of Hawaii Institute of Geophysics with their ocean-bottom seismographs.

In the following chronological list of events, the indicated times are in local Japanese standard time (JST). Additional pertinent data are given in Table 1.

<u>August 8</u>

10:00:00 Started main clocks on all five OBS's.

19:22:15 Deployed OBS unit 81-4 at site A. The deployment was delayed from the originally planned date of August 6 because of the bad weather and also of compressor problem.

23:13:00 Deployed OBS unit 81-2 at site B.

<u>August 9</u>

04:00:20 Deployed OBS unit 84-1 at site C after a delay of about 30 minutes caused by a failure of the deployment gig. Since we deployed our OBS's with the full streamer out, and thus were unable to stop or to make a quick turn, the delay caused the mislocation of the OBS by about 2 nautical miles from the planned site.

07:30:20 Deployed OBS unit 83-4 at site D.

11:19:55 Deployed OBS unit 81-3 at site E.

<u>August 10</u>

07:45 While shooting line 2 at 20 second rep. rate with a single 2000 in^3 gun, started recording on OBS at site D, followed by one at site E at 08:00, one at site B at 17:15 and one at site A at 20:02. Shooting continued on line 3 at the same rate with the same gun.

<u>August 11</u>

07:37 Completed recording on OBS at site A. Other OBS's completed recording earlier: E at 12:19, D at 21:26 on August 10, and B at 06:30 on August 11.

<u>August 14</u>

16:00	OBS at site E surfaced after being released from the sea floor at 14:55.
16:11	OBS at site E recovered on board. The tape was found to have run past the end-of-tape mark and completely been wound on the take-up reel, thus restricting the recorded data only to the first track of the tape. A failure of the sensing of the end-of-tape mark appears to be responsible for the problem.
18:26	OBS at site D surfaced after being released from the sea floor at 17:40.
18:31	OBS at site D recovered on board. The tape contained full data.
21:03	OBS at site C surfaced after being released from the sea floor at 20:15.
21:22	OBS at site C recovered on board. The tape did not run beyond the initial test recordings before deployment, and thus contained no useful data.
23:28	OBS at site B surfaced after being released from the sea floor at 22:50.
23:43	OBS at site B recovered on board. The tape contained full data.

<u>August 15</u>

01:58	OBS at site A surfaced after being released from the sea floor at 01:25.
02:06	OBS at site A recovered on board. The tape contained full data.

We processed the acquired data on board and plotted preliminary record sections. The OBS's at sites B and D recorded clear refraction arrivals up to the limit of the recording at about 50 km of distance in both directions. The OBS at site E, because of the failure of the tape drive, recorded good arrivals but only to a distance of about 19 km. The OBS at site A, which was located in the rift zone of the Bonin arc, recorded nearly continuous but intermittent, high background noise, which has all characteristics of being of natural origin. These signals may represent recordings of deep-sea volcanic activities near by.

The data recovery rate of 65% for this experiment was relatively low compared with our recent experiences. I might point out that, unlike most of our earlier experiments, this one was hampered by several activities that interfered with our fully preparing for the experiment before and during the cruise. Specifically, Paul McPherson was not available for preparation and testing of OBS's just before the cruise since he was assigned to be on board Tansei Maru. Also during the student cruise he, with Mark Wiederspahn, had to spend long hours servicing air guns, which deprived them of performing other important tasks.

It was very unfortunate that the Hawaii team did not recover any of their OBS's during this cruise. None of the OBS's now in existence, including ours, is completely foolproof. We must keep in mind that a minor neglect in preparation may quite easily lead to this kind of disaster. It may happen to us any time if we are not careful enough.

Dr. Ouchi told me that he was favorably impressed with our OBS operation, especially the high precision of our navigation (shot and OBS locations) and our ability to process the acquired data on board and to produce useful record sections in short time. However, when asked to do so, he also offered us the following critical evaluations: (1) We program our OBS's to record data within very tight time windows in order to conserve as much tape space as possible. This practice is acceptable so long as we can deploy the OBS's at correct locations and we can shoot to them following a pre-planned schedule. However, a significant dely in shooting can easily lead to a loss in recording of signals. (2) Our current OBS's do not have transponders installed, thus we must depend only on timers for their release from the sea floor. A transponder will add a flexibility in releasing of each OBS. I was told that one brand of Japanese transponder is quite dependable, though expensive, costing as much as our OBS. (3) The small orange flags we use to aid in day-light recovery may significantly increase the noise caused by bottom current.

Table 1 lists specifics of OBS recording. The locations and orientations of OBS's have been computed from the observed arrival times and polarizations of water-wave arrivals at near ranges. The various coordinates have been computed from Loran-C time difference (TD) values using additional secondary correction factors of XAFS = 0.00 μs and YAFS = 0.15 μs for the Northwestern Pacific chain [9970]. These correction factors had been determined from several GPS and Transit satellite fixes during the shooting of lines 2 and 3. The times given in this table are in GMT.

Prepared by Yosio Nakamura

Table 1. Bonin Arc Student Cruise OBS Data Summary (Preliminary)

Site	A	B	D	E
Geophones*	L-15B	L-15B	L-15B	L-1B/L-6A
Geophone mount	Gimbaled	Gimbaled	Gimbaled	Fixed
Deployment Coordinates				
Latitude	30°50.27'N	30°52.97'N	30°58.31'N	31°00.88'N
Longitude	140°01.76'E	140°24.16'E	141°07.91'E	141°29.81'E
Recovery Coordinates				
Latitude	30°50.28'N	30°53.06'N	30°58.37'N	31°00.79'N
Longitude	140°01.90'E	140°23.96'E	141°07.93'E	141°30.08'E
Computed Coordinates				
Latitude	30°50.177'N	30°52.967'N	30°58.440'N	31°00.574'N
Longitude	140°01.840'E	140°24.175'E	141°07.952'E	141°30.010'E
Depth	1355 m	2062 m	2541 m	3590 m
Orientation**	357.6°	270.5°	130.4°	206.9°
First record				
Time	222/11:02:09	222/08:15:49	221/22:45:09	221/23:00:22
Distance	65.511 km	49.879 km	49.775 km	12.429 km
Last record				
Time	222/22:36:25	222/21:30:09	222/12:26:09	222/03:18:43
Distance	20.165 km	48.086 km	51.303 km	19.263 km

All OBS's

Sampling interval 7.992 ms

Shot Distance	Recording Interval	Delay	Components	Duration
0.00 - 1.85 km (15 min)	60 s	0 s	3	10.76 s
1.85 - 16.67 km (2h:15m)	60 s	0-3 s	1	16.14 s
16.67 - 46.30 km (6h:15m)	40 s	3-9 s	1	16.14 s
46.30 km -	20 s	9 s	1	16.14 s

*L-15B geophones are 4.5 Hz vertical and horizontal
L-1B geophone is 4.5 Hz vertical
L-6A geophones are 10 Hz horizontal

**Direction of H_1 component measured clockwise from north.