Taicrust onshore-offshore USA-Taiwan Cruise

Student Training Cruise Report

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Introduction

Taiwan was created as a result of the impingement of an island arc on the edge of the Asian continent. Due to this arc-continent collision, it contains one of the youngest mountain ranges in the world. To study the progression of this collision and the tectonics northeast of Taiwan, UT Institute for Geophysics collaborated with San Jose State University, University of Hawaii, Florida State University, State University of New York at Binghamton, National Taiwan University, and National Taiwan Ocean University in an onshore-offshore experiment during the month of August-September in 1995. We used Ocean Bottom Seismographs (OBS) and a 240-channel Multi-channel Seismic (MCS) streamer to record seismic refraction and reflection data around latitude 20.6°N to 26°N, longitude 118.5°E to 123.75°E. I participated in OBS seismic data acquisition working on the R/V Ocean Researcher I. The R/V Maurice Ewing provided seismic energy with its airgun array and recorded the MCS data.

We recorded large offset seismic signals from a large air-gun array of R/V Maurice Ewing at 39 OBS stations along 6 seismic lines. Each UTIG OBS station recorded 4-channel data (vertical, horizontal (H1), (H2), hydrophone), and Taiwanese OBS stations recorded 3-channel data. This experiment area covers the arc-continent collision zones in southern and eastern Taiwan. We expect to image the deep crustal structure and plate boundary, and to provide a velocity structure.

Pre-Cruise preparation

Prior to the cruise, I worked with Dr. Nakamura to assemble the Ocean-Bottom instruments. This included the replacement of all batteries, building and installing battery packs, measuring resistance of the disk drives, installation of geophones, hydrophones, and strobes, and system testing. My participation also included helping Dr. Nakamura and Glen Caglarcan in preparing the OBS chassis, which includes checking the CPU board, memory board, A/D converter board, SCSI interface, preamplifier/filter, data recorder and power relay board. Also I helped to check all ribbon-cable connections, power cable connections and battery connections. For the recording schedule, we created a shot table on a Macintosh computer, then wrote to each OBS CPU through a communication software. The procedure was developed by Dr. Nakamura. For this Taicrust Cruise, all the UTIG OBS instruments were installed with 500 Mbytes disk drives. We also communicated with the OBS instruments to identify faulty parts, which we then repaired or replaced.

During the Cruise

All the OBS spheres and chassis along with other equipment arrived in Keelung, Taiwan on August 16th. On August 20th, the preparation of OBSs for deployment started, and we also set up ship board laboratories for instrument operation, data processing (computer lab), and equipment storage. For all instruments, the OBS chassis were installed in the bottom of glass hemispheres with rubber pads and secured with screws. We checked the connections and set up an oscilloscope to observe sensor outputs. My participation also included helping Glen Caglarcan to connect hydrophone preamplifiers and release wire. During the deployment and recovery operation, I also participated in routine watch standing, and checking the OBS clocks.

A pre-cruise meeting was held on August 21st. Due to an approaching typhoon, Janis, the first deployment of OBSs on line 1 was postponed to the next day, August 24th. In the first experiment (line 1), we started at station 5, and deployed 8 OBSs between 8/24 14:17 and 8/25 17:14. The 7th and 14th instruments were not deployed due to the time constrains. The water depth at these deployments varied from 442 m to 5560 m. We recovered these instruments between 8/26 14:54 and 8/27 23:32. Due to the bad weather conditions, we went back to Keelung to avoid the next approaching typhoon. On August 31st we left from the Keelung and arrived at station 20 at around midnight.

The second experiment (lines 14 and 16) started on September 1st, at station 20 on line 14. We deployed 7 UTIG OBSs (stations 20 to 26) on line 14 between 9/1 00:01 and 9/1 10:09. We arrived at station 15 and deployed 5 NTOU OBSs (stations 15 to 19) on line 16 between 9/2 08:00 and 9/2 16:55. We recovered stations 20 to 26 on line 14 between 9/3 05:03 and 9/3 19:48 and recovered stations 15 to 19 between 9/4 01:35 and 9/4 13:13.

On September 1st, we approached the R/V Ewing, and got their navigation data for line 1. In the third experiment, we deployed 7 OBSs on line 23 between 9/5 18:24 and 9/ 6 03:40, and recovered OBSs between 9/7 21:58 and 9/8 09:12.

On September 7th, we met the Ewing again to get navigation data for lines 14 and 16. In the fourth experiment, we deployed 6 OBSs (one NTOU unit and 5 UTIG unit) on line 29 between 9/8 15:15 and 9/8 20:33, and deployed 6 OBSs (one NTOU unit and 5 UTIG unit) on line 33 between 9/9 02:35 and 9/9 08:26. All 12 instruments were recovered between 9/11 18:13 and 9/13 00:46.

Due to another typhoon approaching (Ryan), we didn't have a chance to finish the original plan. The experiments of line 45, 47 and 49 were canceled. All the preparation was stopped and we started to pack the equipment on September 21st.

Post cruise

(OBS data processing using OBSTOOL software)

Currently, I am processing OBS data from line 29 using the OBSTOOL software written by Gail Christeson. Given each OBS location (deployment and recovery), depth information, clock correction information and navigation data collected from the Ewing, we use a series of programs in OBSTOOL to produce SEG-Y files. After SEG-Y files are generated, I will pick and identify the arrivals on plots of the data. Additional processing, especially filtering and trace mixing may be used to aid picking. Interpretation will involve a combination of forward and inverse modeling using ray theory methods. The results of this work will be crustal scale velocity structure along each of the transects.

Conclusion

During this cruise, I learned about the operation and mechanical aspects of seismic cruise preparation . I realized the importance of navigation, scheduling and many other logistical aspects. It is clear that large, complex field experiments require team work and good weather conditions.

The opportunity for me to participate in this experiment helps me in understanding the real problems which may happen in seismic data acquisition. And it helped me to understand the importance of good instrumentation in the acquisition of good quality data.