R/V Marcus Langseth Cruise to the Mariana Trench: February 2-29, 2012 Large Scale Active/Passive Source Seismic Experiment

John Lundquist (WHOI), Foreword by Doug Wiens (Washington University at St. Louis)

How much water is transported deep into the Earth at subduction zones, locked away as hydrous minerals in the downgoing oceanic mantle? This question is vital for understanding the source of water erupted at island arc volcanoes as well as determining whether significant water is carried deeper to the transition zone.

A pair of cruises sailed in early 2012 near the Mariana trench to help provide answers to these questions. The project, under the direction of Doug Wiens (Washington University in Saint Louis) and Dan Lizarralde (Woods Hole Oceanographic Institution), involved deploying 85 ocean bottom seismographs (OBS) from the R/V Thompson and seismic refraction and reflection imaging work carried out using the R/V Langseth airgun array.

The active source results will constrain the seismic velocity, and thus the degree of serpentinization, of the uppermost mantle thought to be occurring at faults associated with the bending of the Pacific plate near the trench. 25 OBSs remain deployed and will provide constraints on the maximum depth of serpentinization and catalog microearthquake activity on the bending faults. These OBSs will be recovered by the R/V Oceanus in January, 2013.

Seven graduate students participated in the two cruises. What is it like to go to sea on a seismic cruise for the first time? John Lundquist's blog, from the Langseth cruise, provides some insight.

Figure 1. The two ships used for the Mariana seismic experiement: (left) R/V Thomas G. Thompson, operated by the University of Washington; (above) R/V Marcus Langseth, operated by Columbia University.

Life at Sea: 8,653 miles, 4 airports, 3 inflight meals, and 34 hours later, I'm standing in the Hagåtña, Guam Airport. In my post trans world flight delirium "What the hell have I gotten myself into this time?" pops into my mind. I collect myself and step outside into the warm Pacific night air. A stark contrast from the artic chill I left in Maine. I arrive at the hotel…sweet, sweet sleep.

I wake up suddenly, unaware of where I am. A few hours of fitful rest hasn't revived my senses or my mind. I look out the window and see surf breaking and the world starts to come back into focus. I'm John Lundquist….I know this….my next thought……go find someone in your group. I'm slightly anxious, as I'm about to rendezvous with a group of highly intellectual geophysicists, Ph.D. candidates, and graduate students. Having studied geology in

college I should have felt prepared to meet these great minds. I walk down stairs and arrive at the breakfast buffet. As I scan the restaurant area, my gaze immediately rests on “the science” party….not too hard to pick out of a crowd. Nathan Miller, one of the chief scientists, walks up to me, “you must be John.” Apparently I wasn’t too hard to spot either. Introductions were made and the trip was underway.

We all piled into the rented mini-van for the Naval Base, where the ship was docked. We boarded the ship, were assigned our rooms, and then set free. We headed out for a few libations and our last taste of land before the 9AM departure time. The next day, as the ship cast off its lines, we all walked out to the Observation Deck. Pulling out of the harbor was beautiful. Guam’s mountainous landscape is breathtaking from the water. As we reach the end of the channel and transition into the open ocean, I quickly realized the ship is not stationary. Five minutes later…. seasickness…this is going to be a long month.

I begin my first shift as a watchstander by making my way down to the lab. I had briefly seen this area earlier, my first thought was “you could control the space shuttle from in here.” The lab is a complete floating technology hub, with about 40 computer monitors, countless processers, and Internet. From here everything science related is controlled and monitored. I was glad to finally get down there. As I sat down that first day, it was overwhelming to say the least. I had never been in a room with so many screens, let alone been put in charge of some of them. As a watchstander, we were basically assigned to monitor several scientific instruments. Every half hour, we entered data into a thirty-minute log. The function was to insure that all the instruments were still recording and running properly.

Day two, I walk down to my post in the lab only to find that nobody is there. Odd, I say to myself. I see on one of the remote cameras that everyone is outside working on the deck. I make my way aft and I’m instructed to put on a life jacket and “get to work.” The task at hand is to get the seismic streamer into the water. At this point, the streamer’s technicians, watchstanders, and ship’s crew were all working together. We were in charge of the streamer length number, the spacing of weights that need to be on the streamer, the spacing of acoustics, and position of birds. On this cruise (MGL1204) the streamer length was 8000 m. Along with the OBSs (ocean bottom seismometers), the streamer was used to record data in the active source survey. Hydrophones were strategically placed along the entire streamer. Because of the precise spacing of all the elements of the streamer, and the long length, it took about 12 hours to put it all in the water. It was great to be able to work with the ship’s crew and aid in the technical aspect of the mission. As a watchstander, they pretty much let you participate as much as you want to. I was carrying birds, putting them on the streamer, coupling streamer lengths, and adding weights, all while the sun was rising. It was fun, and exciting to be part of such a technical aspect of the project. Once the streamer was fully out, the gunners began the process of putting out the guns. Once the guns were in place, they began firing and we started collecting our active source data. After each “shot” from the air guns, the acoustic echo from the ocean floor was picked up by the hydrophones on the streamer and the OBS’s on the ocean floor. The data was then used to create bathymetric profiles of the sea floor around the trench.

Figure 2. Protected Species Observers watching for marine wildlife.

Once the streamer and guns were in place, it was smooth sailing in terms of the instruments; the seas, on the other hand, were the contrary. The wind increased to 30 knots and the seas grew to 4-6 meters. Large seas, as you can imagine, change life aboard a ship. Everything is in constant motion. Sleeping was another story. Imagine sleeping in a moving bed…not conducive to quality rest. The way I solved that problem was by stuffing a bunch of blankets under one side of my mattress. This in effect created a v-notch that basically held me in one spot.

Life on a ship during a research mission is a lot of work. But nobody can work 24 hours a day. There was plenty to do on the ship during down time. After a few days, everyone began to fall into their own routine. There was a full theater, complete with big screen TV, PlayStation 3, and a hard drive filled with movies and TV shows. This was a good place

to go and unwind after a long shift, or if the boat was pitching too much to sleep. At any given time, there was bound to be someone there to share a laugh with.

For exercise, the ship had a nice gym. A month is a long time to go without working up a sweat, the gym was a good place to get the heart rate up. There was a treadmill, elliptical, erg, and bike. The gym was also home to some dumbbells and homemade equipment, rendered by the engineers and ship's crew over the years. A descent swell made working out quite interesting. With any pitch or roll of the ship, you could be sent flying. After a couple minutes of practice, though, you could get the hang of it.


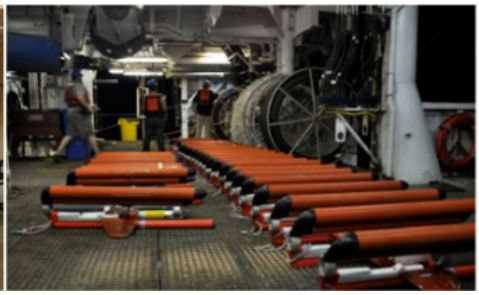


Figure 3 (left). The main lab. Figure 4 (middle). A line-up of birds for the streamer. Watchstanders Matt Hughes and Martina Coccia assisting the ship's crew. Figure 5 (right). Guns discharging.

As for meals, the ship is equipped with a full galley and mess hall. Meals were served three times a day, but there was always food available. Dinnertime was especially good to relax and chat with other people on the ship. Sometimes, if it was nice, we would take our food up to the deck and eat outside under the Pacific sky. Sunset and sunrise were two of my favorite times on the ship. Its funny how on a ship, watching the sun go down or come up becomes another part of the routine. It was like a morning and afternoon break from the fast-paced research.

One of my favorite sky-watching spots was on the PSO bridge. Every seismic ship now has a crew of PSO's or Protected Species Observers. These people spend their day watching the water. Their job is to make sure the seismic survey does not disturb or injure any marine life. They are on the lookout for whales, dolphins, seals, and other large marine mammals. If they see one too close to the ship, we stop firing the guns until the marine life has been deemed out of the danger zone.

In the end, I was happy to be part of such an interesting experiment. I arrived with no idea what to expect. By the end of the cruise, I was comfortable with technical equipment and data analysis in the lab. I got to meet several geophysicists and the whole ship's crew. If you have any interest in how active source reflection seismology is carried out, get on a research cruise. You will learn about geophysics as well as about yourself. Thanks to the R/V Marcus Langseth MGL 1204 crew!

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Reference information
R/V Marcus Langseth Cruise to the Mariana Trench: February 2-29, 2012 Large Scale Active/Passive Source Seismic Experiment Lundquist J., Wiens D.; GeoPRISMS Newsletter, Issue No. 29, Fall 2012. Retrieved from http://geoprisms.org