R/V New Horizon Cruise NH1111
September 7-16, 2011

ALBACORE OBS Recovery Cruise Report

(September 30, 2011 DRAFT)

Science Party

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Brian Clements	Undergrad	CSU Northridge
Lennin Escobar	Graduate Student	CSU Northridge
Paige Logan	Undergrad	Caltech
Teodor Sotirov	Graduate Student	CSU Northridge
Jennifer Zhu	Undergrad	Caltech
Ronald Lambert	Engineer-observer	Johns Hopkins University
Seth Mogk	Engineer	Science Applications International Corporation
Ernie Aaron	OBS Technician	UCSD
Mark Gibaud	OBS Technician	UCSD
Phil Thai	OBS Engineer	UCSD
Dave Anderson	Student Technician	UCSD
Meghan Donohue	Resident Technician	UCSD

R/V New Horizon's Ship's Crew

Deck Department	
Richard Vullo	Captain
Rene Buck	Chief Mate
Kirstin Capaccioli	Third Mate
Dave Weaver	Bosun
Richard Posthuma	AB
Tony Chi	AB
Engine Department	
Mike Breen	Chief Engineer
Willie Brown	Assistant Engineer
William Bouvier	Oiler
Tony Porcioncula	Wiper
Galley	
Mark Smith	Senior Cook
Oscar Buan	Second Cook

Introduction

The primary goal of the 2011 ALBACORE (Asthenosphere and Lithosphere Broadband Architecture from the California Offshore Region Experiment) cruise was to recover 34 ocean bottom seismometers (OBSs) in a 150 km (north-south) by 400 km (east-west) region off the coast of Southern California (Fig. 1). The cruise took place on R/V New Horizon, departing out of San Diego on Sept 7, 2011 and arriving back in San Diego on Sept 16, 2011 with no port stops in between.

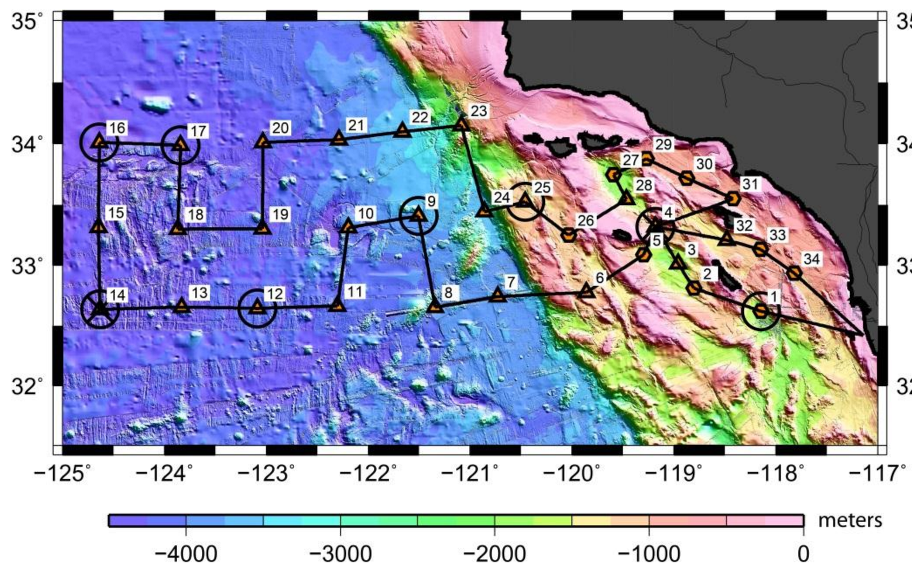

Figure 1. ALBACORE OBS deployment area with bathymetry compiled by N. Shintaku. Ship tracks shown for Sept. 7-16, 2011 recovery cruise on the R/V New Horizon. Bathymetry is compilation of ship track data sets from the NGDC, USGS, 2010 ALBACORE deployment cruise, and Smith & Sandwell global data. Circles indicate stations with limited or no seismometer data.

Two Navy-contracted personnel accompanied us on our cruise as part of the science party. The purpose of their involvement was to low-pass filter (4 Hz) the entire dataset for 16 out of the 34 stations. These 16 stations included every station in the Inner and Outer Borderland: stations #1-6, and #25-34. This was in preparation for screening of those data for signals of national security interest at Science Applications International Corporation (SAIC) and Johns Hopkins Applied Physics Lab during the next three months (September-December, 2011). General interaction with the two engineers who were from SAIC and Johns Hopkins University Applied Physics Lab, but who will not do the subsequent screening, was good. Data processing operations involving them were smooth and efficient. They were helpful during the data copy and raw-data-to-mseed format conversion process because they had brought additional fast 64-bit computers on board with them which dramatically sped up the process. They met with OBSIP staff about a week before the cruise to prepare for handling the data during the cruise. Before the cruise, Phil Thai spent time modifying conversion code, originally designed for 32-bit systems, to run on the Navy-contracted engineers' 64-bit systems.

Scientific Motivation

The overall objective of the ALBACORE project is to understand the tectonic interaction at the Pacific-North America plate boundary by identifying the physical properties and deformation styles of the Pacific plate and transition to continental lithosphere. The results will be used to distinguish among contrasting upper mantle geodynamic scenarios that predict large-scale mantle flow patterns beneath western North America. Seismic studies using broadband ocean bottom seismometer (OBS) data will characterize the driving plate motion consequences of collision between the rift system, a fragmented subducted plate, the geometry of the San Andreas transform fault system, and block rotations. The boundaries for the seismic array overlap the region of complex breakup and fracture of the Pacific plate nearshore where several microplates are observed. The array extends far to the west to provide comparison with oceanic lithosphere that is not fractured.

Studies using seismic anisotropy and plate motion GPS data in western North America infer SW-NE plate motion over uniformly EW mantle flow. Some predict eastward passive drag with little or no mechanical coupling between lithosphere and asthenosphere, while others predict westward active drag. In addition, a compelling new study based on a compilation of plate velocity and anisotropy results suggests that toroidal flow occurs in the asthenosphere beneath much of the western U.S. to accommodate mantle flow around the subducted Juan de Fuca plate. If this is the case, then toroidal mantle motions also occur below the Pacific-North American plate boundary in southern California. If coupling with the lithosphere is occurring, this could be contributing significant driving forces for plate motions and fault loading. These different scenarios have implications for whether lithospheric deformation occurs passively with little or no mechanical coupling with the deep mantle, or actively with the primary source of plate motion coming from the deep mantle.

A combined study of azimuthal and polarization anisotropy from dispersive Rayleigh wave and SKS splitting studies recorded on the OBSs will distinguish the lithospheric and asthenospheric components of anisotropy from which to infer lithospheric-asthenospheric coupling. If splitting reflects the shear strain field related to deeper mantle flow, possibly only weakly coupled to surface plate motions across the plate boundary, no change in fast directions or amplitude would be expected in and west of the southern California Borderland.

The widely observed uppermost mantle high-velocity anomaly beneath the Transverse Ranges exhibits an apparent rotation with decreasing depth in the uppermost mantle. The western boundary of the Transverse Ranges high-velocity anomaly appears to terminate at the coastline, but its western lateral extent is not imaged due to lack of offshore data. The high-velocity seismic anomaly and adjacent low-velocity anomalies may be the result of asthenospheric flow processes such as small-scale upwellings and downwellings. A combined tomographic study using onshore and offshore seismic stations, with sufficiently long-period data, will provide estimates of lithospheric thickness across this plate boundary to test these various model predictions.

The recorded local earthquake data will be used to map offshore fault and seismicity features, and to compile phase arrival times for crustal velocity modeling. The local offshore seismicity recorded by the OBS array is expected to produce a more accurate offshore hypocenter catalog which will be examined for seismicity. Unresolved features of offshore earthquakes are that offshore hypocenters do not always closely correlate with mapped fault locations indicating either the existence of unmapped faults or errors that are too large in the hypocenters to associate them with mapped faults, local magnitudes are almost always smaller than moment magnitudes, and aftershock sequences are smaller than those of onshore earthquakes, suggesting differences in strain release styles and geometries between onshore and offshore faults. Wherever possible, focal mechanisms will be computed for the offshore earthquakes; the California Integrated Seismic Network will help with this task. Of additional interest are tsunami implications from reverse/thrust faulting mechanisms. Focal mechanism analysis will help identify the potential for faulting necessary in evaluating the tsunami risk.

During the OBS deployment the devastating M_w=9.0 Tohoku, Japan earthquake and subsequent tsunami occurred and were recorded on our OBS network (Fig. 2). The earthquake's exact date-time was March 11, 2011 (Julian day 70) at 05:46:24 UTC, and the location was 38.297° N and 142.372° E. Depth was 30 km. The majority of casualties and damage occurred in Iwate, Miyagi and Fukushima from a Pacific-wide tsunami that had a maximum runup height of 38 m. The earthquake, which occurred near the northeast coast of Honshu, was the result of thrust faulting on or near the subduction zone plate boundary between the Pacific and North America plates at the Japan Trench subduction zone. Body waves and surface waves were well-recorded on every functioning OBS in our network, and the tsunami was clearly recorded on the differential pressure gauge (DPG) instruments that accompanied each long-period OBS.

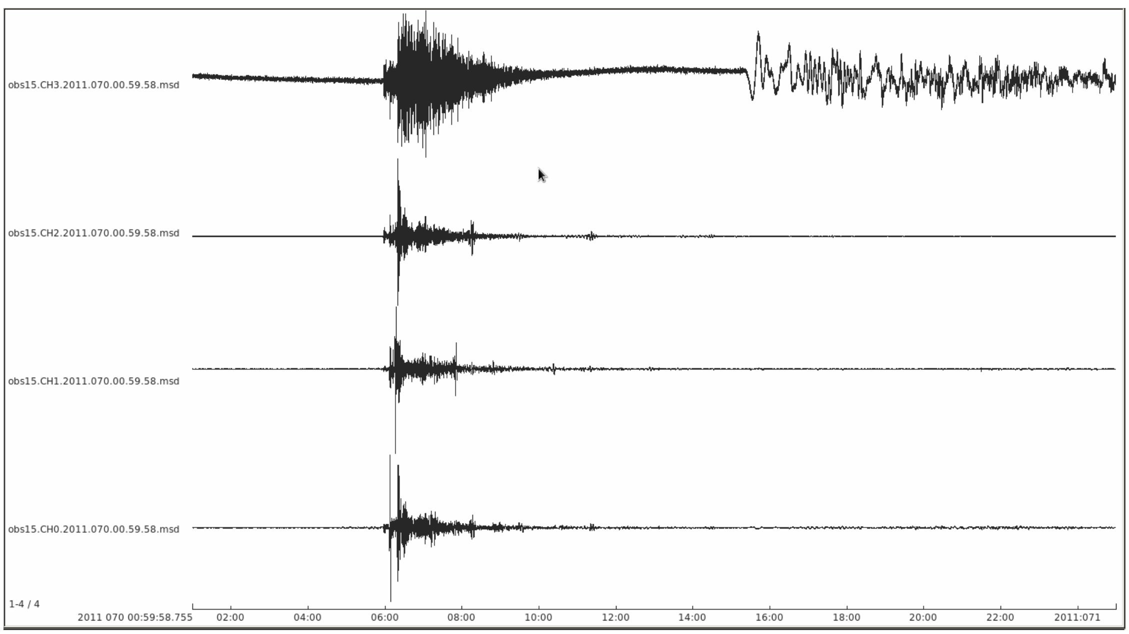

Figure 2. March 11, 2011 M_w=9.0 Tohoku, Japan earthquake recorded on OBS15. Channel channels 0 and 1=horizontals, 2=vertical, and channel 3=DPG.

Recovery and instrumentation logistics

The OBSs sat on the seafloor for 12 months before recovery during this cruise. The OBSs were set to record earth vibration data continuously at a sample rate of 50 samples per second. The OBS locations were chosen such that approximately uniform station spacing could be achieved, taking advantage of existing California Integrated Seismic Network stations installed on Catalina, San Clemente, San Nicolas, Santa Barbara, Santa Rosa, and San Miguel Islands. In the shallow-water Continental Borderland region, station spacing was approximately 50 km, and in the deep-water oceanic plate region, station spacing was approximately 75 km. The OBSs consist of three types: 21 three-component long-period Trillium 240 sensors with differential pressure gauges (DPGs), 3 three-component long-period Trillium T-40 sensors with DPGs, and 10 three-component short-period Sercel L-28 sensors with hydrophones. Each long-period OBS weighs approximately 1000 lbs (according to Ernie Aaron: 911 lbs) in air with the anchor. Without the anchor, each weighs 850 lbs. Negative buoyancy in water as the OBS is sinking adds 50 lbs, and positive buoyancy as the OBS is rising without anchor subtracts 50 lbs. Each short-period OBS weighs approximately 400 lbs (according to Ernie: 427 lbs) in air with the anchor. Without the anchor, each weighs 300 lbs. Negative buoyancy in water adds 40 lbs and positive buoyancy subtracts 40 lbs. The loaded short-period rack (with 3 SP OBSs) is 1018 lbs and the loaded 24-transducer rosette rack is 1091 lbs.

Our Science Party arrived at the UCSD Scripps Institute of Technology (SIO) Nimitz Marine Facility (MarFac) on September 6, 2011. We departed onboard from MarFac on September 7 at 08:00 and arrived back at MarFac on September 16 at noon.

Weather during the cruise was mostly cloudy, windy, and cold, resulting in mild to choppy seas with nearly continuously swells during transit and deployment. We did not encounter any serious storm or sea state conditions that hampered the OBS deployments.

Members of the science party, including senior scientists, acted as observers or loggers ("watchstanders") during predetermined shift hours. Three student volunteers were assigned to shifts that mirrored the bridge officer shifts: i) 12 a.m. - 4 a.m. and 12 p.m. - 4 p.m. (Curie and Teodor), ii) 4 a.m. - 8 a.m. and 4 p.m. - 8 p.m. (Brian and Kelsey), and iii) 8 a.m. - 12 p.m. and 8 p.m. – 12 a.m. (Jennifer, Paige, and Lennin). Monica and Dayanthie rotated as necessary so that at least one was on call during every OBS deployment.

SIO Instruments

Each OBS datalogger is a Scripps-developed instrument that consists of four channels recording waveform data at 4000 sps. The datalogger contains solid state memory (CF) cards and a temperature-compensated oscillator. Power consumption is 350 mW and rated to 6000 m water depth where pressure is approximately 10,000 psi.

The long-period (LP) sensors are three-component Nanometrics Trillium 240s ("T-240") and Trillium 40s ("T-40"). The response of the T-240 is flat in velocity from 240 seconds to 35 Hz. The measured self-noise is below the NLNM (Peterson New Low Noise Model) from 100 seconds to 10 seconds. The clip level is 15 mm/s up to 1.5 Hz. Power consumption is 800 mW nominal and the sensor has 20 g shock resistance. The T-240s have motorized mass centering; no mass lock is required. The short-period (SP) sensors are three-component Sercel L-28 ("L-28") passive velocity transducers.

Each LP OBS contains a Differential Pressure Gauge (DPG), and either a T-240 (for 21 of our LP OBS sites) or a T-40 (for three of our LP OBS sites). They each also have a battery bottle to power the Trillium sensor and two mechanical release mechanisms. Each SP contains a hydrophone, an L-28, and one mechanical release mechanism. The DPGs measure differential pressure between 100 s and a few Hz, and the hydrophones measure pressure between 1 Hz and several thousand Hz. All sensors recorded waveform data downsampled to 50 samples per second.

The seismometers can level themselves (up to 120 degrees correction by the LPs and up to 45 degrees by the SPs) using a gimbal system. The LP gimbal system contains two-axis active leveling and a three-point coupling lock. It is low-power but the more often leveling is required, the more battery power will be required. It is rated to 6000 m water depth. Sensor ball leveling occurred once an hour for the first 24 hours, then once per day for the first seven days, then a level check once per week for the rest of the deployment period.

The acoustic release system has an 18-V release pack for disconnecting the OBS from the metal grate ("anchor") that keeps it on the seafloor. It operates by frequency shift key operation and there are unique codes for each serial number. It contains two redundant release circuits and is rated to 6000 m water depth. The flotation system consists of 2 components. Each seismometer has 88 lbs of glass buoyancy and 12 lbs of syntactic foam buoyancy. The net buoyancy of the entire system is 46 lbs.

Acoustic Transponders

Communication with the OBSs was made possible by acoustic pings using acoustic communication boxes ("deck units") provided by OBSIP. All acoustic signal pings to the OBSs were made in the 9-13 kHz range. More specifically, the acoustic units were interrogated with 11 kHz pings and we received confirmation pings from the OBS at 13 kHz. In order to enable or release one of the OBSs, we interrogated it with a specific code which was unique for every command type and for every individual acoustic unit. These codes were preset (hardcoded) and the OBS acoustic code depended on the specific acoustic unit selected for the site. All communication with the OBSs used OBS station-specific identifier code as well as additional codes to identify the OBS's operational status (e.g., "enable" to wake the station up and "disable" to put the station to sleep). The acoustic codes are transmitted on a frequency shift key principle. In order to initiate the release sequence, one needs the same set of topside gear as well as our particular codes. When we left each site, the units were disabled. It would be nearly impossible for someone to intentionally or accidentally trigger a release (i.e., the Navy during an exercise) without knowledge of our specific codes.

Both OBSIP acoustic communication boxes developed problems during the cruise. The first, newer orange box stopped communicating via the hull transducer. Either there was a bad transducer connector or the electronics inside the deck box went bad. The OBS techs were unable to repair this box during the cruise. The second, older yellow box developed a power-related problem below the main panel. It was fixed the same day by removing the battery and running it solely on A/C power.

Also as part of the communication system, each OBS was equipped with a radio beacon (an Edgetech acoustic transponder system). The Edgetech transponder hardware consists of off-the-shelf equipment, commonly used by fishermen, and for Acoustic Doppler Current Profiling and moorings measurements. The radio beacon emits acoustic signals which were tested individually before each OBS drop using a Radio Direction Finder (RDF) receiver in New Horizon's bridge as well as a portable RDF receiver carried by OBS techs. The RDF receiver uses a directional antenna arrangement to determine the direction of arrival of the OBS's radio signal. The RDF was used to identify when the OBS was on the surface of the water, and which direction relative to the ship it was in while floating on the sea surface

In addition, each OBS was equipped with a strobe light. The strobe light has a photo cell (light-sensitive switch) so that it will only go off between dusk and dawn during the recovery process.

OBS Recovery Details

OBS Station 1

OBS station 1 was an SP L-28. Curie Ahn was the Watchstander for OBS #1 SP, the very first recovery, with a local date and time of 09/07/11 13:23 and Beaufort Sea State 3. On JD 250 20:23 UTC, New Horizon was approximately 1km away from the OBS drop site. Both 3.5kHz and 12.0kHz Knudsen Echosounder were kept on since they did not conflict with the signals sent from the Acoustic box. The first enable code was sent at 20:23 UTC via seven pings, and OBS#1 was enabled right away at 20:23 UTC. Thus, a burn code was sent at 20:26 UTC and the OBS responded right away at 20:27 UTC that the burn code was successful. At 20:41 UTC, OBS#1 was confirmed to be off the seafloor with an estimated UTC arrival time on surface of 21:20. This rise time was calculated based on the depth at recovery site of approximately 2062.38m. At 21:18 UTC OBS#1 was sighted from ship; radio was supposedly heard on Bridge prior to this time. At 21:48 UTC, OBS#1 was safely recovered on deck with a surface location of 32 37.31N and 118 08.59 W. The OBS time tag displayed 21:58:005020528. The true wind speed was 8.6 m/s with a true wind direction of 291.1. Calculated rise speed: 53 m/min.

WATCHSTANDER LOG

On JD 250 15:00 UTC, New Horizon departed from dock and headed for OBS#1. The first few hours on board were spent adjusting ADCP and fine tuning the Knudsen Echosounder with the help of Resident Technician, Meghan. She noted that the watchstanders would have to adjust the phases accordingly with the changing water depths. The echo sounder acted especially strange when the vessel was going over a ridge or with sharp changes in water depth. At 20:15 UTC, Meghan increased the Echosounder gain value to 5dB and process shift to 4. At 20:23 UTC, the vessel was 1km away from OBS#1 and the Echosounder was kept on. At 21:49 UTC, OBS #1 was on deck and at 21:49 the resident technician radioed that the crane is secure, and bridge responded that we are heading off to OBS#2. By 22:00 UTC, everything was secure on deck.

OBS Station 2

OBS station 2 was an SP L-28. Kelsey Brunner was the watchstander for OBS #2 SP and pick-up#2 with a local date and time of 09/07/11 08:32. On JD 251 01:33 UTC, New Horizon was approximately 2km away from the OBS drop site. This time, the 12.0kHz Knudsen Echosounder was turned off at 01:32 UTC while the 3.5kHz was kept on. A series of enable code were sent at the following times: 01:33 UTC, 01:34 UTC, 01:35 UTC, 01:36 UTC, 01:37 UTC, 01:38 UTC, 01:39 UTC, 01:40 UTC and the OBS #2 was finally enabled at 01:40 UTC. It appears that many dolphins in the area were attracted by the enable code and had sent false signals to the acoustic box; this could explain the multiple enable codes sent. At 01:42 UTC the burn code was sent and was successful right away. By 02:00 UTC the crew was confident that the OBS was off the seafloor with an estimated UTC arrival time on surface of 02:25 UTC. This rise time was calculated based on the depth at recovery site of approximately 1450m. At 02:25:30 UTC, bridge confirmed visual and radio at surface location 32 48.794 N and 118 48.368 W. When OBS#2 was on deck at 02:36:47 UTC, one of the technicians noted that strobe light on the OBS was malfunctioning. The OBS time tag displayed 02:46:005390425. The true wind speed was 6.0m/s and true wind direction 269.1. Calculated rise speed: 58 m/min.

OBS Station 3

OBS station 3 was an LP T-240. The watchstander for the recovery of OBS #3 was Paige Logan. The local date and time was 09/07/11, 22:30. AT UTC 251:04:05 the vessel was 2000 m away from site. The OBS crew sent the enable code at UTC 251:04:05. Several pings were sent between the distance of 1000 m and 2000 m away from the site. OBS #3 was finally enabled at approximately 1200 m away from site at UTC 251:04:13. The estimated surface arrival time was not recorded. As this was only the 3rd OBS pickup, there was confusion as to recording the arrival time on surface. Burn2 was sent at UTC 251:04:15 and was confirmed unsuccessful at UTC 251:04:30. Burn2 was sent again at UTC 251:04:32 and was confirmed as unsuccessful at UTC 251:04:52. Later, through back calculating from the surface time and depth, Burn2 was later found to be successful. At UTC 251:04:52, Burn1 was sent and confirmed unsuccessful at UTC 251:05:08. Burn1 was sent again at UTC 251:05:09 with OBS #3 reaching the surface before success could be confirmed. OBS #3 was sighted by the Bridge and the RDF was heard at UTC 251:05:20. Back calculation reveals that OBS #3 released from bottom at approximately UTC 251:04:40. OBS #3 was recovered safely on deck at UTC 251:05:42. The surface latitude and longitude of recovery was 33 00.636 N and 118 57.291 W respectively. GPS time synchronization was carried out at UTC 251:05:49:57.9972527 which is also referred to as the 'time tag.' The recovery depth was 1746.46 m with a wind speed and direction of 5.4 m/s and 269.2 respectively. The Beaufort Sea State was a 3 at the time of recovery. Calculated rise speed: 44 m/min.

OBS Station 4

OBS station 4 was an LP T-240. The first attempt to pick up OBS 04 occurred on Julian day 251 at 08:20 (local time September 8, 2011). The hull transducer was turned on at 08:20 when the ship was approx.. 2000 m from the OBS seafloor site. On day 251 at 08:20, the first of several enable codes was sent. At 08:26, the OBS was enabled successfully. At 08:27, the first of several burn codes was sent, which was not deemed successful. Seven more burn codes were sent between 08:27 and 10:58. The echosounder was turned off at 10:26. Between the 5th and 6th burn code, the OBS techs swapped out transducer communication boxes. Although the second older box also worked well, the 8th burn code was still not successful. We couldn't hear clear double pings even after the 3rd burn, so at 09:04, the ship was moved right over the seafloor site, without success. At 11:14, after 8th burn code was sent, OBS tech confirmed that OBS is still on the bottom; this was determined while ship hovered directly over seafloor location. OBS04 was disabled and echsounder was turned back on. At 11:24, possible strobe was sighted off the aft bearing (bearing 135 deg relative to vessel). Lab asked Bridge to slow down to determine if OBS had surfaced after all. Nothing was found and Bridge reported that only aircraft were in the vicinity. At 500 m from the site, a slant range of 1159 m confirms that OBS 04 is still on the bottom. Captain confirmed slant range hypothesis. Vessel was turned into direction of next OBS.

OBS Station 5

OBS station 5 was an SP L-28. Kelsey Brunner was the watchstander for the recovery of OBS #5, pick-up #5. The local date and time for the recovery was 09/08/11 and 05:04 respectively. The hull transducer was turned on at UTC 251:13:04. The 12 kHz channel of the Knudsen Echosounder was off prior to recovery site proximity. The enable code was sent at UTC 251:13:04 and enabled at UTC 251:13:05. The burn code was sent at UTC 251:13:07 and was considered successful at UTC 251:13:08. OBS #5 was confirmed to be off the seafloor at UTC 251:13:22 with the ETA to surface being UTC 251:13:46. AT UTC 251:13:52:33, OBS #5 was sighted from the ship with the RDF heard 'loud and clear.' OBS #5 was successfully recovered and on deck at UTC 251:14:06 with a surface latitude and longitude of 33 05.180 N and 119 17.859 W respectively. The depth of the recovery site was 1630 m with a wind speed and direction of 4.0 m/s and 301.4 respectively. The beaufort Sea State was 2 during the recovery. The 'time tag' was 2011:251:14:27:00.7627667. Calculated rise rate: 37 m/min.

OBS Station 6

OBS station 6 was an LP T-240. Paige Logan was the watch stander for the recovery of OBS06, the sixth recovery, at 10:24 local on 9/8/11 (Jday 251). An Enable Code was sent at 17:25 UTC. The instrument was enabled at 17:29 at a distance of ~1000 m from the drop site. The first Burn Code was sent at 17:33. This Burn was checked at 17:48 and we were not able to to get a good enough signal from the OBS to determine if it was off the seafloor. The Bridge was then asked to move in closer. A second Burn was sent at 17:57 from a closer range, but we were still unable to communicate with the OBS. Passing directly over the instrument at 17:59 and sending another Burn Code was successful and it was positively determined to be off the bottom. Based on a depth of 1180 m, the estimated time of arrival was 26 min after the last Burn command was sent. Its radio signal was heard by the Bridge at 18:17 and was spotted shortly thereafter at 18:18. OBS06 was safely placed on the deck at 18:35 from 32 46.669 N, 119 51.238 W, and a depth of 1180.79 m. Calculated rise rate: 54 m/min.

OBS Station 7

OBS station7 was an LP T-240. Kelsey was the watchstander for the seventh recovery (OBS07). The local date was 09/08/11 with the local time of 16:13 at the time of initializing communication with the instrument. The 12 kHz channel of the echo sounder was off during this recovery and will remain turned off for the remainder of the cruise unless noted otherwise. The Enable Code was sent to OBS07 at UTC 23:13, 23:15 and 23:17. The Enable Code sent at 23:17 was successful. This allowed Ernie to send Burn Codes to the OBS at 23:19 when we were 3.7 km away, at 23:27 when we were 2 km away, at 23:29 when we were 1.35 km away, and at 23:30 at the same distance. This last Burn Code was successful and we were able to verify that OBS07 was off the seafloor at 23:49. The ship had to be repositioned directly over the site due to poor communication with the instrument, but repositioning the ship fixed the communication issues. A survey from last year's deployment indicates that the southwest quadrant of this particular site has known communication "blind spots." Based on the depth of about 3800 m of the recovery site, we were able to estimate that the OBS would take approximately 85 min to reach the surface. This gave an estimated arrival time of 01:15 UTC in Jday 252 or 18:15 local time. The OBS was sighted from the ship off the starboard side at 2:01 UTC, well after the estimated arrival time. This may be because range signals were not conclusive as to whether the instrument was still rising or if we were moving away from it. The Bridge also did not hear the radio to give an indication as to where to look for it. However, once it was spotted, the rest of the procedure went by smoothly and quickly. The OBS was recovered from 32 44.521 N, 120 43.316 W and safely placed on deck at 2:15 UTC. The OBS appeared to be sitting low in the water, but there was no apparent damage to the instrument that may have caused it. Although, there was green mud caked on to the bottom which may have caused it to rise more slowly than anticipated. Calculated rise rate: 29 m/min.

WATCHLOG.

OBS crew attempting to communicate with OBS#7 at UTC23:13. At UTC23:18 the enable code was sent successfully with an attempt to send the first burn cycle while approximately 3700 m away from site. Bridge informed the Lab that the vessel was approximately 2000 m away from site at UTC23:27. OBS crew informed the Bridge that communication was established and that the burn cycle was sent. OBS crew asked the Bridge to maintain a distance of 1000m from the site at UTC23:34. Shortly after this, OBS crew asked the Bridge to change position and travel over the site as communication became poor. Bridge confirmed that the vessel would head over the site with an approximate heading of 225. It’s important to note that communication with the OBS during survey from this position was poor as well. Survey shows that constant communication occurred on southwest quadrant of the site. Lab asked the Bridge to reduce speed once over the site. OBS #7 was confirmed to be off the bottom at UTC 23:54 with an ETA of UTC01:15. Bridge holding the vessel steady during rise time. Ranges are decreasing but unable to confirm whether OBS #7 is at the surface or still rising. At UTC01:53 the Bridge confirmed faint RDF signals off of the starboard beam. Range is slowly decreasing as the Bridge brings the vessel towards the signal. At UTC02:01, OBS #7 was visually located. OBS #7 was safely placed on deck at UTC02:15. Bridge standing by for the deck to be secured before departing towards the next site.

OBS Station 8

OBS station 8 was an LP T-240. Paige Logan was the Watchstander for OBS #8 recovery. OBS #8 was also pick-up #8 with a local time and date of 23:07 09/08/11. The vessel was approximately 2000 m away from site at UTC 06:07. The enable code was sent at UTC 06:12 252. There were reply pings, but it was unsure if the instrument was enabled at first. The Bridge was instructed to move west to attempt to get better communication. The first burn code was unsuccessful. The second burn code was sent at UTC 06:20. OBS crew member was unable to verify success. Informed Bridge to move closer to site at UTC 06:25 where success was finally verified. OBS #8 confirmed off the sea floor at UTC 06:38 with an 87 minute rise time, making the ETA UTC 08:00 (01:00 local). At UTC 08:17, OBS #8 was sighted from ship. OBS #8 was recovered safely on deck at UTC 08:44 with a surface latitude and longitude of 32 39.07N and 121 20.34W respectively. The UTC GPS time was synchronized and carried out at 2011:252:08:57:53585463084. The recovery depth was 3900 m, with a wind speed of 8.1, wind direction of 312.8, and a beaufort sea state of 5. Calculated rise rate: 39 m/min.

WATCHSTANDER LOG

At UTC 03:30, the echo sounder was identified as acting strange. An attempt was made to correct it by adjusting the phase to the next highest range. The phase was changed back to 3700-3900. With a sea state of 4 at UTC 03:45, the echo sounder was still acting strange (it is of the belief of this recorder that ‘strange’ should be interpreted as the echo sounder not presenting a clean profile, but a profile that is convoluted by vertical line debris). At UTC 04:00, with the wind picking up, the echo sounder was changed. Throughout the travel to OBS #8 site, the echo sounder was recording artifacts over the entire depth range on the screen. The resident technician attempted to correct the profile to no avail. AT UTC 06:07, the Bridge informed the lab that the vessel was 2000 m away from the site. The echo sounder was recording very thick sediments. At UTC 06:12, the enable code was sent. At UTC 06:14, the vessel was 1000 m away from the site. At UTC 06:25, the Bridge called to notify the Lab that we were heading west and that we were south of the site. Ernie asked the Bridge to direct the vessel towards the OBS site for better communication as he thought the burn command was successful, but was unable to verify. Ernie thought that the 23:20 local time burn command was successful but (missing entry). At UTC 06:40, the burn code was successfully verified with a surface rise of 01:00hr. The Bridge watch was changing shortly, so the Captain will notify the new watch on the Bridge. The echo sounder is profiling thick sediments. OBS #8 was recovered onto the deck at UTC 08:30. Shortly after the recovery, the echo sounder depth was lost in the profile artifacts. Meghan attempted to rectify the situation but was unsure if the echo sounder was giving true values. At UTC 10:15, it was decided that the echo sounder could not be fixed at the moment.

OBS Station 9

OBS station 9 was an LP T-240. Kelsey was originally the watchstander for the OBS #9 recovery but then Paige took over at the shift change. OBS #9 was also pick-up #9 with a local time and date of 07:45 09/09/11. The vessel was approximately 2000 m away from the site at UTC 252:14:45. The vessel was approximately 1000 m away from the site at UTC 14:50. The enable code was sent at UTC 14:46 and the OBS was enabled on the first ping. The first burn code was sent at UTC 14:51. Mark was unsure if the first burn command worked so he sent a second burn code at UTC 14:53. The OBS didn't catch the second burn command because it was in fact already in the burn sequence from the first burn command. At UTC 15:08, Mark called the bridge and asked them to drive over the drop site in order to get a better signal to see if the burn code was successful. At UTC 15:14, we started getting some good responses from the OBS that indicated movement but Mark wanted to wait and get several consistent responses before declaring that it had released from the seafloor. At 15:20, Mark was relatively sure the OBS was off the bottom but asked the bridge to maneuver the ship directly of the drop site. He sent out a third burn command at UTC 15:23 just in case the pings he was getting were false. At UTC 15:48, we started getting some better pings and the OBS seemed to be at a depth of approximately 2000m. Note that all three burn commands were sent to wire 2. We back-calculated to estimate that OBS #9 came off of the sea floor at approximately UTC 15:06 with an 85 minute rise time, making the ETA UTC 16:40 (09:40 local). At UTC 16:48, OBS #9 was sighted from ship but the bridge never said anything about hearing the radio so we're unsure if they heard it. OBS #9 was recovered safely on deck at approximately UTC 16:57 with a surface latitude and longitude of 33 24.147N and 121 30.364W respectively. The UTC GPS time was synchronized and carried out at 2011:252:17:02:59.8691500. The recovery depth was approximately 3810m, with a wind speed of 12.4 m/s, wind direction of 330.1, and a Beaufort sea state of a high 4. Calculated rise rate: 37 m/min.

WATCHSTANDER LOG

At UTC 14:45, the Bridge informed the lab that the vessel was 2000 m away from the site. The echo sounder was recording very thick, dense sediments. At UTC 14:46, the enable code was sent. At UTC 14:50, the vessel was 1000 m away from the site. The first burn code was sent at UTC 14:51; a second was sent at 14:54 as a precaution, with the bridge standing by to wait for the conformation of the release and rise of the OBS. At UTC 15:08, Mark asked the bridge to drive over the drop site to get a better signal, and by UTC 15:14, we were getting some good responses from the OBS, but are waiting to get several good responses in a row. At UTC 15:20, mark was relatively sure that the OBS is off the bottom, so we changed course to sit directly over the drop site. At this time, the wind picked up a bit. By UTC 15:48, we started getting some better pings, and by UTC 16:00, we were sure that the OBS was rising, with an ETA on surface of 16:40 UTC. At UTC 16:45, the ranges from the OBS were all over the place, but the bridge called at 16:48, saying that the OBS was found on the surface, very close to the ship. Watchstander missed when the OBS was brought on deck, but the time sync was done at UTC 17:03.

OBS Station 10

OBS station 10 was an LP T-240. Teodor was the watchstander for the tenth recovery, that of OBS10, on September 9, 2011. Once the ship was in range of the instrument at 20:38 UTC (approximately 2km), the first Enable Code was sent and was seemed successful. A Burn Code was then sent at 20:39, 20:46, 20:52, and 21:01. The box was then switched to the yellow one at 21:08 and another Burn Code was sent at 21:10 and 21:20. Communication with the OBS indicated that it was still on the seafloor and none of the previous Burn Codes had been successful. Even more Burn Codes were sent at 21:28, 21:35, and 21:43. At 21:53, we could tell that the instrument was off the bottom, so one of the last Burns was successful. Based on a water depth of approximately 3700 m, we estimated that it would take about 85 min to surface. Ranges sent indicated that the OBS reached the surface at 23:38 and it was spotted from the Bridge 20 min later at 23:58. It was recovered from 33 18.763 N, 122 11.708 W and a depth of 3708 m. It was placed on the deck at 00:16 and GPS synchronization occurred at 00:20. This particular OBS took much longer to reach the surface than anticipated. Calculated rise rate: 29 m/min.

OBS Station 11

OBS station 11 was an LP T-240. Paige was the watchstander for OBS station #11, pick-up #11. The local date and time was 09/09/11 and 21:16 respectively. The vessel was 2000 m from the OBS station at UTC 253:04:16. The 12.0 kHz channel of the Knudsen Echosounder was off prior to the pickup. The first ping was sent unsuccessfully at UTC 253:04:00, prior to the 2000 m proximity. At UTC 253:04:02, 253:04:08, 253:04:11, and 253:04:13, pings were unsuccessfully sent. OBS crew holds the belief that the 5th ping was actually successful, but has requested from the Bridge to hover the vessel over the site to confirm. At UTC 253:04:27, the vessel was hovering approximately 40 m east of the original drop site. At UTC 253:04:29, the burn code was sent successfully with a confirmation that the instrument was off the sea floor and rising. The estimated time to surface was UTC 253:06:16, 23:16 local. The instrument was sighted and RDF heard from the ship at UTC 253:06:36. OBS #11 was recovered safely on deck at UTC 253:06:50 with a surface latitude and longitude of 32 39.619 N and 122 18.372 W respectively. GPS time synchronization, the 'time tag,' was carried out at UTC 253:06:58:00.8943059. The depth of the recovered OBS was approximately 4196.2 m, with a wind speed and direction of 8.4 m/s and 301.6 respectively. The Beaufort Sea State was recorded as a 4, but the wind speed noted places it more towards a 3. Calculated rise rate: 33 m/min.

OBS Station 12

OBS station 12 was an LP T-40. Kelsey was the watch stander for the twelfth recovery, that of OBS #12, on September 10, 2011. At 11:06 UTC, the ship was 2000 m from the drop site. An Enable Code was then sent at 11:06, 11:07, 11:08, and 11:09. This last Enable Code was successful, so the OBS was enabled at 11:09. A Burn Code was sent shortly thereafter at 11:10 and was deemed successful on the first try. At 11:28, we determined that the OBS was off the sea floor, but was rising very slowly. We used the normal 45 m/min to estimate that it would arrive on the surface at 13:30, or 6:30 local time, but would likely appear sometime later because it was rising so slowly. This hypothesis was indeed correct, as it was spotted and heard as soon as it surfaced at 14:03 – a full half hour after the estimated arrival time. It was safely placed on the deck at 14:15 at 32 38.657 N, 123 05.127 W, and a depth of 4124 m. When it was placed on the deck, we observed that there was mud caked on the bottom of the OBS, which probably contributed to its slow rise time of approximately 25 m/min. Calculated rise rate: 27 m/min.

OBS Station 13

OBS station 13 was an LP T-240. Paige Logan and Teodor Sotirov were the watchstanders for OBS #13 LP and pick-up #13 with a local date and time of 09/10/11 11:18 and Beaufort sea state 2. On JD 253 18:18 UTC, the vessel was approximately 2km away from the OBS#13 drop site. An enable code was sent at 18:18 UTC and was confirmed successful at 18:21 UTC. Thus, a burn code was sent at 18:21 UTC to release the OBS#13 and 15 minutes later at 18:36 UTC, the first burn was confirmed to be successful. By 18:28 UTC, the crew noted that the OBS was already off the seafloor and its expected UTC arrival time on surface 21:15 UTC. This particular rise time was calculated based on water depth of 4281m and with consideration of previously seen fine mud or dirt on the bottom of the OBS. Indeed, at 21:11 UTC both visual and radio of OBS#13 was confirmed at surface location of 32 39.36 N and 123 49.427 W. The OBS time tag indicated 21:28:595998144. The true wind speed was 1.6m/s and true wind direction 305. Calculated rise rate: 26 m/min.

OBS Station 14

OBS station 14 consisted of an LP T-240. Kelsey was the watchstander for the recovery of OBS #14 up to 20:00 local and then replaced by Paige. OBS crew on duty was Ernie and David. At the beginning of the recovery of OBS #14, the local date and time was 09/10/11 and 18:40. At UTC 254:01:43, the vessel was 2000m from OBS station #14. OBS crew, Ernie, attempted to make contact with OBS #14 approximately 3000m away. At this time, the 12 kHz channel of the Knudsen Echosounder was off. At UTC 254:02:12 the 3 kHz channel of the Knudsen Echosounder was turned off. At UTC 254:02:13, the ADCP was turned off in attempt to create complete frequency silence.

Multiple enable and burn codes were sent approximately every 1-2 minutes, beginning at UTC 254:01:51. There was no communication with OBS #14. At this time, OBS crew instructed the Bridge to have the vessel circle the site with a distance of 500 m in an attempt to find a location with good communication. The Echosounder had profiled a 50 m high ‘hump’ or ‘dome’ almost exactly over the site, and it was a belief that this feature may be blocking communication. It is important to note a comparison with the deployment report for this site. The deployment log noted this particular site as being a ‘flat plateau’ with deep sediment without mention of the ‘dome.’

At UTC 254:02:29, OBS crew contacted the Bridge and requested the vessel to cut south from the 500 m circle, passing directly over the site, and pick up circling the site again from the south with a distance of 1000m. At UTC 254:02:34, the vessel passed directly over the site and reached the southernmost point to begin the 1000 m survey at UTC 254:02:41. At UTC 254:02:50, a ranging signal was sent to determine if the OBS was receiving signals but was simply not responding. At UTC 254:02:55, it was determined that no response was being received. Bridge was informed to continue heading south and begin the 1000 m clockwise survey.

At UTC 254:03:37, a second OBS IP communication box was set up. OBS crew called the Bridge at UTC 254:03:37 and asked for the vessel to be positioned directly over the drop location due to issues with the communication boxes. Also, it was decided to lower a recue beacon down to the instrument for approximately 20 minutes of communication time. At UTC 254:04:25, the beacon was deployed. A bag full of decorated Styrofoam cups was attached to the beacon. At UTC 254:04:30, burn2 command was programmed to be sent every 2 minutes and the depth to which the beacon will be lowered was established to be 4200 m. There were issues with the 8011M box. Apparently, even though the box’s power was being supplied directly through a

110v outlet, the battery was still in and faulty, causing issues. OBS crew removed the battery, thus removing the issue.

At UTC 254:04:42, with the beacon being lowered by winch, the winch readout was not working. The Bridge, as well as Megan, were troubleshooting the issue. The beacon reached a depth of 1500 m at UTC 254:04:42, yet the screen display was still not working. At UTC 254:04:58, the wind shifted direction causing the vessel to roll more than usual. 2000 m was reached at UTC 254:05:05 with the speed of the winch payout calculated to be 59 m/min, set at 60 m/min. The beacon reached a depth of 2500 m at UTC 254:05:14. At UTC 254:05:16, the 3.5 kHz channel of the Knudsen Echosounder was turned back on. The beacon reached a depth of 3000 m at UTC 254:05:23 and 3500 m at UTC 254:05:33. OBS crew went to the Bridge and returned with settings from the winch display, attempting to troubleshoot the display in the Lab. The beacon reached a depth of 4000 m at UTC 254:05:48. Megan requested the payout to be reduced to 30 m/min until the beacon reaches a depth of 4150 m. The plan was to hold the beacon at a depth of 4150 m for approximately 20 minutes as the beacon sends a burn command every 2 minutes.

At UTC 254:06:16, Megan asked for the winch to be brought back up to 100 m at a rate of 60 m/min. The plan now is to wait for 2 hours as it would take this long for the instrument to reach the surface if the burn command was received by the instrument. At UTC 254:06:57, the beacon had reached 1000 m and was safely placed back on deck at UTC 254:07:34. After waiting the appropriate time for the instrument to rise it was decided that the instrument had failed to receive the burn command and the Bridge was notified to begin travel to OBS #15.

OBS Station 15

OBS station 15 consisted of an LP T-240 sensor. Kelsey was the watch stander for the recovery of OBS #15, also the fifteenth pick-up, until 08:00 local time on 9/11/11 at which time Paige took over. The first Enable Code was sent at 13:32 UTC when the ship was ~2.75 km from the drop site. Another Enable Code was sent at 13:34 UTC when the ship reached a distance of 2 km. This was determined to be successful at 13:35, so a Burn Code was sent (also at 13:35). This was successful on its first try. At 13:52, we were able to tell that the OBS was off the sea floor. Since several of the previous OBSs rose much more slowly than expected, a rise rate of 30 m/min and depth of ~4200 m was used to calculate to estimated arrival. Based on this calculation, we estimated that the instrument would arrive on the surface at 16:10 (9:10 local). This ended up being a fairly accurate assumption, as its radio was heard at 16:07 and was spotted at 16:08. The OBS was safely placed on deck at 16:18 from 33 18.789 N, 124 34.053 W, and a depth of 4260 m. The GPS was synchronized at 16:23. This was a very straight-forward recovery with no issues. Calculated rise rate: 32 m/min.

OBS Station 16

OBS station 16 consisted of an LP T-240 sensor. Curie Ahn was the watchstander for OBS #16 LP and pick-up#16 with a local date and time of 09/11/11 13:48 and Beaufort Sea State 2. The true wind speed was 2.2m/s and true wind direction 154.5. On JD 254 20:47 UTC, the vessel was approximately 2km away from the OBS drop site. Prior to this arrival, two enables codes were sent out around 20:35 UTC and 20:36 UTC and excellent communication with the OBS had already been established. Since these initial attempts were successful, the technicians attempted two burns at 20:37 UTC and 20:39 UTC. 15 minutes later at 20:55 UTC, OBS#16 was finally enabled and the second burn at 20:39 UTC was confirmed successful. By 20:57 UTC, the OBS was off the seafloor and its estimated arrival time on surface was 22:45 UTC.

This rise time was calculated based on the depth at recovery site of approximately 4565m. Around 22:42, we lost the ability to range to the instrument. However, we were able to regain this capability and got decreasing ranges starting from 22:54 that indicated that the instrument was still rising. The OBS made it to the surface at 23:30, where it was both sound and heard. It was safely placed on deck approximately ten minutes later around 23:40, at 34 00.982 N, 124 38.189 W, and a depth of 4565 m. There was some corrosion of small, exterior, metal pieces (such as nuts and bolts) on the OBS. GPS synchronization was carried out another ten minutes later at 23:50 (OBS Time Tag showed 23:45:56.3124593). Calculated rise rate: 39 m/min.

OBS Station 17

OBS station 17 was an LP T-240. Kelsey began the recovery watch for OBS#17 LP at 19:55 local time on 9/11/11. Paige then took over at 20:00. Enable Codes were sent at 02:55 and 03:01 UTC on Jday 255 from a distance of ~7.25 nautical miles (> 2.0 km). Enable and Burn Codes were sent at 03:07, 03:10, 03:12, 03:14, 03:17, 03:20, 03:23, 03:24, 03:28, and 03:30. At 03:31, we still could not confirm that it had been enabled. Two more Burn Codes were sent at 03:32 and 03:34 before starting a continuous Burn Code at 03:34 from 1000 m from the drop site. At 03:44, the ship was directly over the drop site. Then at 03:51, we were finally able to confirm that the OBS had been enabled and was off the sea floor. We estimated the instrument to arrive on the surface at 06:30 UTC, or 23:30 local. It actually arrived on the surface at 05:42 UTC, where it was seen and heard by the Bridge 1200 m SW of the survey site. It was placed safely on the deck at 05:56 from 33 58.805 N, 123 50.832 W, and a depth of 4454 m. GPS synchronization was carried out at 06:01 UTC. Calculated rise rate: 40 m/min.

OBS Station 18

OBS station 18 was an LP T-240. Curie Ahn was the watchstander for OBS #18 LP and pick-up #18 with a local date and time of 09/12/11 03:00 and Beaufort Sea State 1-2 (Kelsey took over at 04:00 local time). The true wind speed was 2.0 m/s and true wind direction 59.2. On JD 254 09:59 UTC, the vessel was approximately 2 km away from the OBS drop site. The first enable code sent at 09:59 UTC from a distance of 2.6 km was immediately successful and was followed by a burn code at 10:00 UTC. The Bridge was asked to move over the drop site at 10:15 UTC because the first burn code was not successful. A secondary burn command was then sent at 10:25 UTC and a third was sent at 10:40. At 10:59 UTC, we were able to determine that one of the burn codes was successful and the OBS was off the seafloor. Based on a depth of ~4700, we estimated that it would arrive on the surface at 13:00 (06:00 local). The OBS was heard and spotted from the ship at 13:08. It was placed safely on the deck at 13:24 from 33 167.764 N, 123 51.942 W, and a depth of 4463 m. GPS synchronization was carried out at 13:30 (OBS Time tag showed 13:30:57.4078700). Calculated rise rate: 35 m/min.

OBS Station 19

OBS station 19 was an LP T-240 sensor. Paige Logan was the watchstander for OBS station LP #19, pick-up #19. The local date and time was 09/12/11 and 10:21 respectively. At UTC 255:17:17, the vessel reached a distance of 1000 m. At UTC 255:17:28, the vessel passed the original drop location. At UTC 255:17:40, OBS crew called the Bridge and asked for the vessel to be positioned directly over the drop site due to the instrument not communicating. The enabled code was sent and the instrument was enabled at UTC 255:17:21. The burn code was set at UTC 255:17:24. At UTC 255:17:40, OBS crew was unable to confirm the success of the first burn code, so a second burn code was sent. At UTC 255:17:55, the OBS was still considered to be on the sea floor, so a third burn command was sent. At UTC 255:18:08, the burn code was confirmed successful and off the sea floor. The estimated time of arrival on the surface was UTC 255:20:15. At UTC 255:20:16, the OBS was sighted from the ship with the RDF heard before this time at approximately UTC 255:20:12. OBS #19 was safely recovered on deck at UTC 255:20:31 with a surface latitude and longitude of 33 18.396 N and 123 02.187 W respectively. The GPS time synchronization was carried out at UTC 255:20:36:06.2836346. The depth of recovery was 4356 m with a wind speed of 2.7 and wind direction of 4.9. The Beaufort Sea State was 3. Calculated rise rate: 35 m/min.

OBS Station 20

OBS station 20 was an LP T-240. Monica was the watchstander for OBS station LP #20, pick-up #20 on 9/12/11. On JD 255 00:17 UTC, a series of burn commands were sent out 4.2nm away from the original drop site. The final burn sent at 00:28 UTC was confirmed successful at 00:43 UTC. By 00:52 UTC, OBS#20 was off the seafloor and its estimated arrival time on surface was 03:00 UTC. Surprisingly, the OBS was sighted and heard 30 minutes earlier than expected at 34 00.690 N and 123 01.030 W. At 02:40 UTC OBS#20 was on deck and its time tag displayed 02:50:58.3237698. The depth at recovery site was 4297m; true wind speed was 6.2m/s and wind direction 317.5; Beaufort Sea State was 2. Calculated rise rate: 44 m/min.

OBS Station 21

OBS station 21 was an LP T-40 sensor. Paige Logan was the watchstander for OBS station LP-T-40 #21, pick-up #21. The local date and time was 09/12/11 and 22:59 respectively. On JD 256 06:17 UTC, the vessel reached a distance of 1000 m. Even before an enable code was sent out, a series of burn codes were sent out at the following times: 05:56 , 05:58, 06:02, 06:04, 06:06, 06:08, 06:11, and 06:14 UTC. These burn codes were purposely sent out earlier as we approached the drop site and at 06:29 UTC the burn was confirmed successful. At 06:32 UTC an enable code was sent out and OBS#21 enabled right away. Its estimated arrival time on surface was 08:45 UTC. At 08:25 UTC bridge confirmed both visual and radio at a surface location of 34 02.229 N and 122 17.126 W. By 08:47 UTC OBS#21 was safely on deck and its OBS time tag showed 08:55:55.705305. True wind speed was 4.8m/s and wind direction 353.4. The Beaufort Sea State was 3. Calculated rise rate: 23 m/min.

OBS Station 22

OBS station 22 was an LP T-240 sensor. Kelsey Brunner was the watchstander for OBS Station #22 LP, pick-up #22, with a local date and time of 09/13/11 and 05:04 respectively. At UTC 256:12:04, the vessel was 2000 m away from the OBS station. The 12.0 kHz channel of the Knudsen Echosounder was off prior to the approach. The enable code was sent successfully and enabled at UTC 256:12:05. At UTC 256:12:06 the burn code was sent with success confirmed at UTC 256:12:21. Confirmation that the instrument was off the seafloor and rising was at UTC 256:12:23 with a surface ETA of UTC 256:14:10, 07:10 local. AT UTC 256:14:02, the OBS was sighted from the ship, while the RDF was heard two minutes prior to sighting. The OBS was successfully and safely recovered onto the deck at UTC 256:14:23, with a surface latitude and longitude of 34 05.512 N and 121 39.323 W. The GPS time synchronization was carried out at UTC 256:14:36. The depth of recovery was 3565 m with a wind speed of 8.8 m/s and a wind direction 327.1. The Beaufort Sea State was definitely a 4**.** Calculated rise rate: 37 m/min.

OBS Station 23

OBS station 23 was an LP T-240 sensor. Paige Logan was the watchstander for OBS Station #23 LP, pick-up #23, with a local date and time of 09/13/11 and 10:28 respectively. On JD 256 17:28 UTC, the vessel was 2000 m away from the OBS station. The enable code was sent successfully and enabled at 17:28 ITC. At 17:30 UTC the burn code was sent with success confirmed at 17:45 UTC. Confirmation that the instrument was off the seafloor and rising was at 17:48 UTC with a surface ETA of 18:50 UTC. At 18:44 UTC, both visual and radio of OBS #23 was confirmed. The OBS was safely recovered onto the deck at 18:59 UTC, with a surface latitude and longitude of 34 08.938 N and 121 05.074 W. The OBS time tag showed 19:06:01.2910106. The depth of recovery was 2029 m with a wind speed of 9.2 m/s and a wind direction 330.7. The Beaufort Sea State was definitely a 4**.** Calculated rise rate: 36 m/min.

OBS Station 24

OBS station 24 was an LP T-40 sensor. Kelsey was the watchstander for the recovery of OBS24, the twenty-fourth pick-up, on September 13, 2011 at 16:25 local time. At 23:35 UTC on Jday 256, we were 2 km from the drop site. An Enable Code was sent at 23:27 from 1.5 km away and was successful on the first attempt. A Burn Code was then sent at 23:29 and it was also successful on the first try. We verified that the OBS was off the seafloor at 23:47. Based on a depth of ~3500 m, we estimated the surface arrival time to be at 01:30 or 18:30 local. It was spotted from the ship of the starboard side at 01:52. It was recovered and safely placed on deck at 02:07 from 33 26.346 N, 120 51.745 W, and a depth of 3587.2 m. The water was rather rough with a Beaufort sea state of 4-5 and winds of 11 m/s from 331.3. The GPS synchronization was then carried out 02:10. Calculated rise rate: 29 m/min.

OBS Station 25

OBS station 25 was an LP T-240. Jennifer/Paige was the watchstander for the recovery of OBS25, the twenty-fifth pick-up, on September 13, 2011 at 21:18 local time. At 04:27 UTC on Jday 257, we were 2 km from the drop site. An Enable Code was sent at 04:38 and was successful on the first attempt. A series of Burn Codes were then sent from 04:07 to 04:28 (roughly every two minutes). The successful one was sent at 04:22 and was successful at 04:37 (realized it was in the burn sequence at 04:31). We verified that the OBS was off the seafloor at 04:37. Based on a depth of ~1100 m, we estimated the surface arrival time to be at 05:05 or 22:05 local. It was spotted from the ship (and the radio was heard) at 05:02. It was recovered and safely placed on deck at 05:17 from 33 31.399 N, 120 27.833 W, and a depth of 1104.33 m. The water was rather rough with a Beaufort sea state of 4 and winds of 9.2 m/s from 310.2. The GPS synchronization was then carried out 05:24. Calculated rise rate: 44 m/min.

OBS Station 26

OBS station 26 was an SP L-28. Curie and Teddy were the watchstanders for OBS Station #26 SP, pick-up #26, with a local date and time of 09/14/11 and 1:08 respectively. On JD 256 08:03 UTC, the vessel was approximately 2000 m away from the OBS station. A series of burn commands were sent out at the following times: 07:59, 08:00, 08:01, 08:02, and 08:07 UTC and the 07:59 UTC burn command was confirmed successful at 08:13 UTC. At 08:13 UTC, OBS #26 was also enabled and was off the sea floor with its expected arrival time on surface 08:40 UTC. At 08:28 UTC, OBS#26 was sighted on deck and its radio heard from surface location 33 14.925 N and 120 02.057 W. At 08:45 UTC, OBS#26 was on deck and its time tag showed 08:5 31.294. The depth of recovery was 2029 m with a wind speed of 6.6 m/s and a wind direction 304.2. The Beaufort Sea State was a 4**.** Calculated rise rate: 62 m/min.

OBS Station 27

OBS station 27 consisted of an SP L-28. Kelsey/Jennifer/Paige was the watchstander for the recovery of OBS27, the 28th pick-up (switched order between OBS 27 and 28), on September 14, 2011 at 7:53 local time. At 14:56 UTC on Jday 257, we were 2 km from the drop site. Enable Codes were sent at 14:53, 14:55, and 14:56 (successful at 14:56). A Burn Code was then sent at 14:57, and successful at 15:13, which was also when we verified that the OBS was off the bottom. Based on a depth of ~1900 m, we estimated the surface arrival time to be at 15:45 (or 8:45 local). It was spotted from the ship (and the radio was heard) at 15:43. It was recovered and safely placed on deck at 05:51from 33 44.572 N, 119 35.674 W, and a depth of 1921.59 m. The Beaufort sea state was 2 and there were winds of 4.6 m/s from 294.5. The GPS synchronization was then carried out 16:05:02. Calculated rise rate: 48 m/min.

OBS Station 28

OBS station 28 consisted of an LP T-240 sensor. Kelsey was the watchstander for the recovery of OBS28, the twenty-seventh recovery since we are going slightly out of order, on September 14, 2011 at 05:22 local time. At 12:22 UTC on Jday 257, we were 2 km from the drop site. An Enable Code was sent at 12:23 and was successful on the first try. A Burn Code was then sent at 12:24 and was also successful on the first attempt as we determined that the instrument was off the sea floor at 12:40. We estimated that it would arrive on the surface at 13:35, or 6:35 local. It was spotted on the surface at 13:29 and heard shortly thereafter. OBS28 was safely placed on deck at 13:39 from 33 32.688 N, 119 27.716 W, and a depth of 1855.4 m. There was a very small amount of mud found of the feet of the instrument and there was a sea slug attached to the sensor ball. The Beaufort sea state was only a 2, with a wind speed of 4.3 m/s from 293.5 so this was a rather simple recovery. The GPS was synchronized at approximately 13:45. Calculated rise rate: 38 m/min.

OBS Station 29

OBS station 29 was an SP L-28. Jennifer/Paige was the watchstander for the recovery of OBS29, the 29th recovery, on September 14, 2011 at 10:41 local time. At 17:41 UTC on Jday 257, we were 2 km from the drop site. An Enable Code was sent at 17:44 and was successful on the first try. A Burn Code was then sent at 17:44 and was successful at 18:04 on the first attempt. We determined that the instrument was off the sea floor at 18:04. We estimated that it would arrive on the surface at 18:14, or 11:14 local. It was spotted on the surface at 18:13. OBS28 was safely placed on deck at 18:19 from 33 52.622 N, 119 16.303 W, and a depth of 827.6 m. The Beaufort sea state was only a 2, with a wind speed of 4.3 m/s from 293.5 so this was a rather simple recovery. The GPS was synchronized at approximately 13:45. Calculated rise rate: 38 m/min.

OBS Station 30

OBS station 30 was an SP L-28. Teodor was the watchstander for OBS Station #30 SP, pick-up #30, with a local date and time of 09/14/11 and 13:35 respectively. On JD 257 20:31 UTC, the vessel was approximately 2000 m away from the OBS station. A series of burn commands were sent out at the following times: 20:24, 20:26, 20:28, 20:31, 20:34 UTC and the first burn was confirmed successful at 20:39 UTC. At 20:41 UTC, an enable code was sent and OBS #30 was enabled right away. By 20:45 UTC, the OBS crew had confirmation that the OBS was off the seafloor with its estimated arrival time as 21:05 UTC. The actual OBS was seen and heard at 21:00 UTC and was safely recovered on deck at 21:04 UTC. Its surface location at recovery was

33 43.239 N/118 52.504 W and its depth 913m. The OBS time tag displayed 21:12:21.8146837. The Beaufort Sea state was only a 1; true wind speed was 0.7m/s and true wind direction 203.7. Calculated rise rate: 61m/min.

OBS Station 31

OBS station31 consisted of an SP L-28. Kelsey was the watchstander for the recovery of OBS31, the thirty-first recovery, on September 14, 2011 at 16:23 local time. At 23:23 UTC on Jday 257, an Enable Code was sent from 3.5 km. Burn Codes were then sent at 23:27 and 23:29. These were all deemed successful at 23:30 and we confirmed that the instrument was off the sea floor at 23:45. It was estimated to arrive on the surface between 23:55 and 00:00 on Jday 258. It was actually spotted from the ship at 23:51 and was on deck by 00:03. It was recovered from 33 33.107 N, 118 25.123 W, and a depth of 904.4. GPS synchronization was carried out at 00:05.

OBS Station 32

OBS station 32 consisted of an LP T-240 sensor. Curie and Teodor were the watchstanders for OBS #32 LP, the 32nd pick-up, on 9/16/11 at 1:20 AM. On JD 259 at 08:18 UTC, the vessel was approximately 2km away from the OBS station. At 08:20 UTC, an enable code was sent and OBS was enabled right away. The first burn command sent at 08:22 UTC was confirmed successful 15 minutes later at 08:38 UTC. By 08:38 UTC, OBS#32 was off the seafloor and its estimated time on surface was 08:47. At 09:09 UTC, OBS was sighted from ship and it was safely recovered on deck at 09:21 UTC from a surface location of 33 11.893 N and 118 25.957 W. OBS time tag showed 09:20:00.6923748 and depth at recovery site was 1268m. True wind speed was 4.3kts and wind direction 93; Beaufort Sea state was only a 1. Calculated rise rate: 40.9 m/min.

OBS Station 33

OBS station 33 was an SP L-28. Curie and Kelsey were the watchstanders for pick-up #33, OBS station #33. The local date and time was 09/16/11 and 03:38 respectively. The vessel was 2000m from OBS station #33 at UTC 259:11:00. The enable code was sent successfully at UTC 259:10:47 and was enabled at UTC 259:11:03. The burn code was sent twice, UTC 259:11:07 and 259:11:08, and was successfully confirmed at UTC 259:11:25, which is also the time the instrument began its rise from the seafloor. The ETA to the surface was UTC 259:11:45 but spotted from the ship at UTC 259:11:40. The gives a calculated rise rate of 70.5 m/min. The instrument was successfully and safely recovered and placed on deck at UTC 259:11:51. The OBS was recovered at a surface latitude and longitude of 33 08.004 N and 118 09.121 W respectively. The GPS time synchronization was carried out at UTC 259:11:57. The depth of recovery was 1057.7 m with a wind direction and speed of 2.8 kts and 262.3 respectively.

OBS Station 34

OBS station 34 consisted of an SP L-28. Kelsey was the watchstander for pick-up #34, OBS station #34. The local date and time was 09/16/11 and 06:54 respectively. At UTC 259:13:54, the vessel was 2000m away from the site. The enable code was sent at UTC 259:13:54. The instrument was enabled at UTC 259:13:58 with two burn codes sent at UTC 259:13:55 and UTC 259:13:58 with the last burn command proving successful. OBS #34 was confirmed to be rising from the seafloor at UTC 259:14:14 and reached the surface at UTC 259:14:34. establishing a calculated rise time 64.9 m/min as the Bridge spotted the instrument breaking surface at UTC

259:14:30. The instrument was safely recovered and placed on deck at UTC 259:14:40 with a surface latitude and longitude of 32 56.259 N and 117 49.217 W respectively. The depth of the recovery site was 1039.6 m. The GPS time synchronization was completed at UTC 259:14:45. The wind speed and direction during recovery was 172.3 and 4.6 kts. The Beaufort Sea State was a beautiful 1.

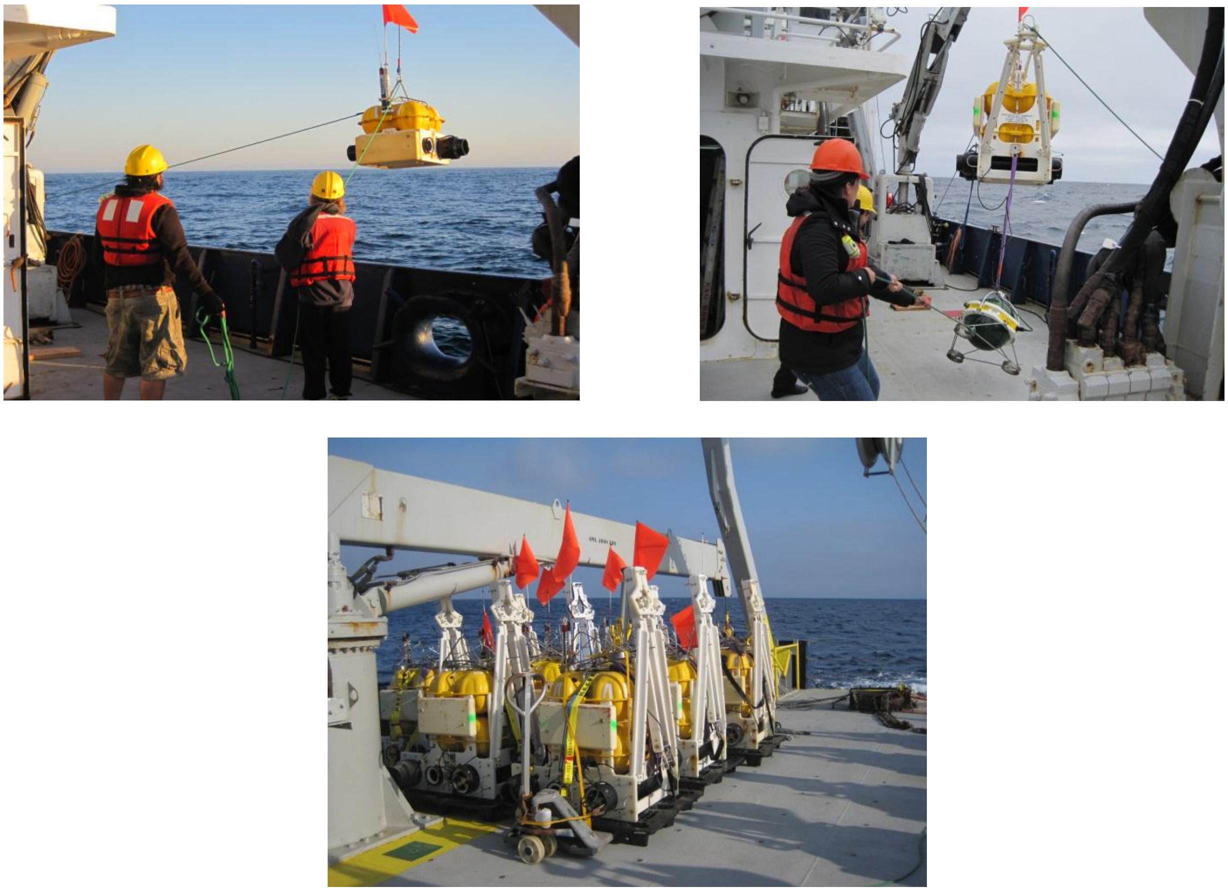

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

OBS Rise Rate plots

Rise rates for the instruments indicate that there is a dependence on the depth of the deployment. Greater depths show lower average rise rates (Fig. X).

OBS #	Depth (m)	Rise Rate (m/min)	Inst. Type		Short-periods only (OBS #)	Depth (m)	Rise Rate (m/min)		Long-periods only (OBS #)	Depth (m)	Rise Rate (m/min)
1	2062	53	S		1	2063	53		3	1746	44
2	1450	58	S		2	1450	58		6	1181	54
3	1746	44	L		5	1630	37		7	3773	29
5	1630	37	S		26	933	62		8	3900	39
6	1181	54	L		27	1922	48		9	3810	37
7	3773	29	L		29	828	92		10	3708	29
8	3900	39	L		30	913	70		11	4196	33
9	3810	37	L		31	904	150		12	4124	27
10	3708	29	L		33	1058	71		13	4281	26
11	4196	33	L		34	1070	65		15	4260	32
12	4124	27	L						16	4565	49
13	4281	26	L						17	4454	40
15	4260	32	L						18	4436	35
16	4565	49	L						19	4356	35
17	4454	40	L						20	4297	44
18	4436	35	L						21	2565	23
19	4356	35	L						22	3565	37
20	4297	44	L						23	2029	36
21	2565	23	L						24	3587	29
22	3565	37	L						25	1104	44
23	2029	36	L						28	1855	38
24	3587	29	L						32	1268	41
25	1104	44	L								
26	933	62	S								
28	1855	38	L								
27	1922	48	S								
29	828	92	S								
30	913	70	S								
31	904	150	S								
32	1268	41	L								
33	1058	71	S								
34	1070	65	S								

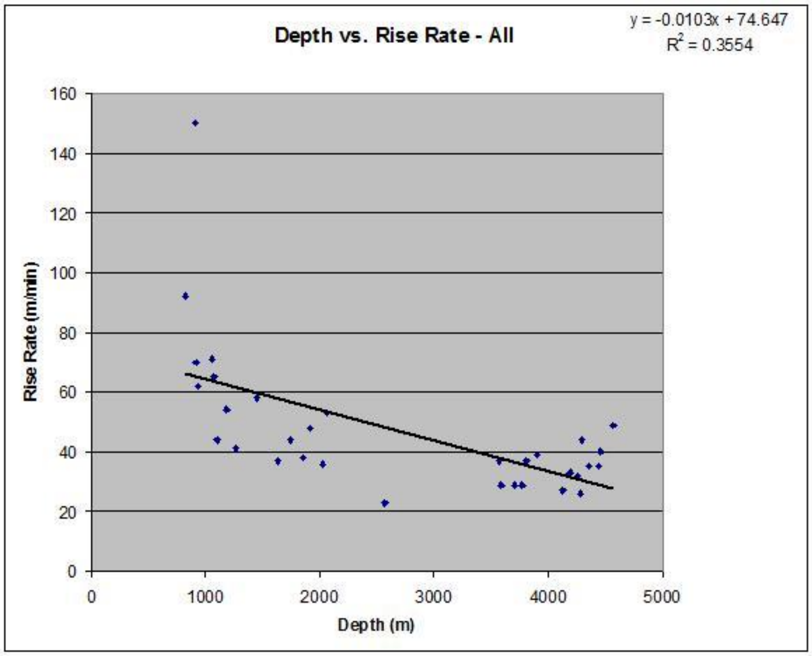

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

Short-period instruments have lower rise rates which average around 40 m/min (Fig. X). Long-period OBSs rose at an average of 60 m/min (Fig. X).

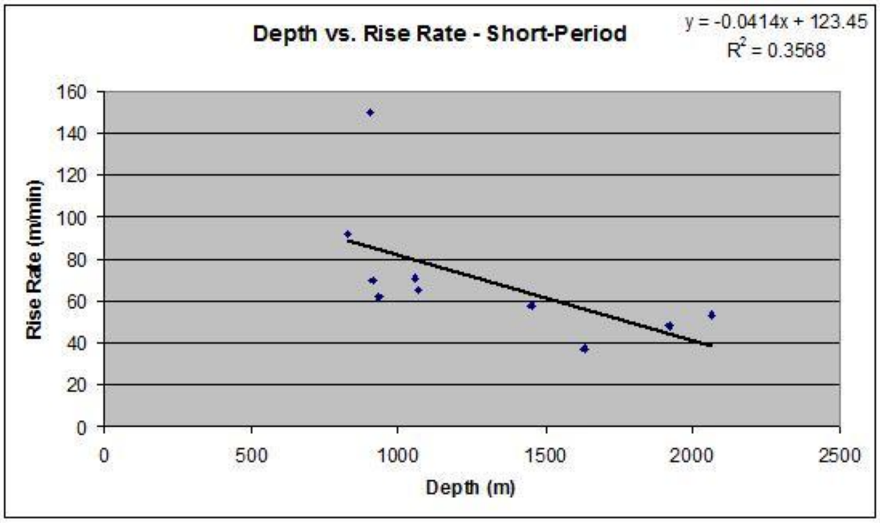

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

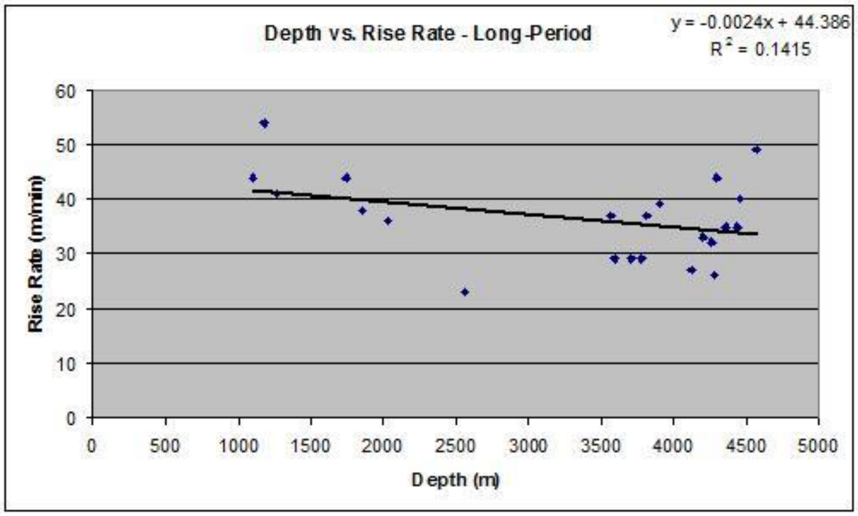

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

Data Quality Notes

General observations are that channel 2 appears to be vertical for all OBSs so far. The consistent presence of larger-amplitude low-frequency noise was used to distinguish horizontal channels from lower-amplitude vertical channel. Clock drifts vary between a fraction of a second to 4.3 seconds (Table 1). The hydrophones/DPGS appear to have recorded at all stations. Note that 16 Borderland stations (out of 34 stations total → 47%) were low-pass FIR filtered at 4 Hz by Navy during recovery cruise for immediate analysis. We will get redacted, full-band data set by December, 2011. The short-period L-28s exhibit well-known lack-of-shielding twisted pair cable noise problem at ~6.5 and 13 Hz; known from several days of data download from OBS #05 during last year's deployment cruise. Observations specific to individual OBSs are as follows.

<u>OBS #01 SIO L-28</u>

Channel 1 flat-line dead for days 2010:227-257. Channel 1 zeroed at 8.8×10**6 counts. Square wave function before channel 1 kicks into life on day 257. Signal mean is 4×10**6.

Channel 2 has harmonic spikes (60-second intervals for each up spike, alternating with 60-second-interval down spikes that are 30 seconds out of phase with up spikes) on channel 2.

After 257, channel 1 has spikes at exactly the same times as, and exactly in phase with, channel 1.

Day 2011:014: square wave in channel 1. Channel 1 dies (zeroed at 8.8×10**6), then comes to life again later that same day.

Day 2011:046: square wave in channel 1. Channel 1 dies again (zeroed at 8.8×10**6), then comes to life again on day 051.

Channel 1 dead again on day 057 but exhibits random spikes. Back to life on 076.

Channel 0 seems to be OK entire 12 months.

OBS #02 SIO L-28
All channels OK overall, entire 12 months.

OBS #03 SIO T-240
All channels OK overall, entire 12 months.

OBS #04 SIO T-240
Not recovered. Successful enable but no successful burn/release. Went back to try to recover with two dredge/drag attempts, both of which were unsuccessful.

OBS #05 SIO L-28
All channels OK overall, entire 12 months.

OBS #06 SIO T-240
All channels OK overall, entire 12 months.

OBS #07 SIO T-240
All channels OK overall, entire 12 months.

OBS #08 SIO T-240
All channels OK overall, entire 12 months.

OBS #09 SIO T-240
Seismometer channels 0 and 2 are bad entire 12 months. Single-digit bit-level recordings. Bad channel 0 still shows larger-amplitude but contaminated response to 03/11/11 Honshu earthquake.

OBS #10 SIO T-240.
All channels OK overall, entire 12 months.

OBS #11 SIO T-240.
All channels OK overall, entire 12 months.

OBS #12 SIO T-40.
Seismometer channels 0-2 bad entire 12 months. Single-digit bit-level recording.

OBS #13 SIO T-240.
All channels OK overall, entire 12 months.

OBS #14 SIO T-240.
Never recovered.

OBS #15 SIO T-240.
All channels OK overall, entire 12 months.

OBS #16 SIO T-240.

Seismometer channels 0-2 bad entire 12 months. During some multi-day periods, channels 0-2 recorded at large count values (10**6) as if nearly clipped but within small range. Then during other multi-day periods, they recorded at single-digit bit-level recordings also within small range. Then went back again to large count values but within small range.

<u>OBS #17 SIO T-240</u>

All channels OK overall for first 4 months, except that seismometer channels 0-2 show short impulse-like peaks at around 79,000 seconds every 7 days. Releveling effects on vibration response?

All seismometer channels went bad on 2011:017. 3/11/11 Honshu eq. shows up weakly above low bit-level recording. Maybe gimbal clamps failed, OBS continued to rock back out of level. Maybe went into leveling loop where it slowly ate up battery and had only a little power left. Level enough to record something on 2 channels?

<u>OBS #18 SIO T-240</u>

All channels OK overall, entire 12 months.

<u>OBS #19 SIO T-240</u>

All channels OK overall, entire 12 months.

<u>OBS #20 SIO T-240</u>

All channels OK overall, entire 12 months.

<u>OBS #21 SIO T-40</u>

All channels OK overall, entire 12 months.

<u>OBS #22 SIO T-240</u>

All channels OK overall, entire 12 months.

<u>OBS #23 SIO T-240</u>

All channels OK overall, entire 12 months.

<u>OBS #24 SIO T-40</u>

All channels OK overall, entire 12 months.

<u>OBS #25 SIO T-240</u>

All seismometer channels 0-2 dead entire 12 months. Single-digit bit-level records.

<u>OBS #26 SIO L-28</u>

All channels OK overall, entire 12 months.

<u>OBS #27 SIO L-28</u>

All channels OK overall, entire 12 months.

<u>OBS #28 SIO T-240</u>

All channels OK overall, entire 12 months.

OBS #29 SIO L-28
All channels OK overall, entire 12 months.

OBS #30 SIO L-28
All channels OK overall, entire 12 months.

OBS #31 SIO L-28
All channels OK overall, entire 12 months.

OBS #32 SIO T-240
All channels OK overall, entire 12 months.

OBS #33 SIO L-28
All channels OK overall, entire 12 months.

OBS #34 SIO L-28
All channels OK overall, entire 12 month

Dredges

Only one dredge operation was attempted initially to recover OBS #4. This dredge activity, however, also returned a few rock samples. The dredge chain bag was nearly 50% full of a very thick mud (viscosity around 20K -50K Pas ?). We labeled this dredge #1 and saved a few rock samples which were recovered from the mud. One rock appears to be a basalt with fairly well edges that are fairly rounded. We saved some mud samples. A few samples appear to be other substances, perhaps petroleum, wood, metal, or other unidentified material.

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

Biological life

Some biological life was found on our instrumentation when we recovered the OBSs. We saw several varieties of tiny lobsters, crabs, and grass fibers. Most were small and the size of a thumb nail. One large crab was recovered from OBS #32 that was larger (see Mark's head for scale) and was returned to the sea.

  

Figure 3. Recovery of a short-period OBS (top left) and long-period OBS (top right). OBSs stored on main deck after recovery (bottom).

C. Underway Geophysical Data

Navigation Data

Cruise navigation data were acquired from the ship's Furuno GP150 GPS receiver at a rate of 1 sample/sec. The time series navigation data (“mv1010.gp150”) have the following format:

Data Column	Contents
1	UTC timestamp (yyyymmddhhmmss)
2	UTC timestamp (seconds since 1970-01-01 00:00:00)
3	Longitude East
4	Latitude North
5	Speed over ground (Knots)
6	Course over ground (Degrees)

ADCP Data

The ADCP (Acoustic Doppler Current Profiler) uses the Doppler frequency shift of an acoustic ping to infer water velocity. The ADCP is mounted on the ship’s hull.

Echosounder Sub-bottom Profiler

New Horizon’s echosounder system provided information about the depth and sediment conditions on the seafloor and consisted of a Knudsen3260 3.5kHz system. The echosounder was synchronized with the ship’s navigation system and was used throughout the entire cruise. Echosounder data was especially important when we had difficulty communicating with or recovering an OBS. It gave estimates of the gradient, sediment thickness, morphology, etc. of the original drop site which allowed us to infer why we may be having difficulty communicating with the instrument. For example, thick sediments imaged by the echosounder around an area where an OBS had trouble rising off the bottom suggested that the OBS may be stuck in those sediments. The echosounder was turned off during times we had issues communicating with the OBS in order to eliminate any possible noise interference.

The Knudsen system consists of 16 transducers placed in a grid pattern under the ship. It sends out sound waves and as the sound waves reflect off the ocean floor, it measures the returning waves as a function of time. It converts the time to depth in meters assuming that the speed of sound in water is 1500 m/s. When the echosounder is used over shallow waters, there is sometimes a second, artifact seafloor layer seen at twice the depth of the actual sea floor. This is due to the sound wave reflecting off the ship back down to the sea floor and then back up to the receivers. The parameters of the echosounder that the watchstanders and computer technician changed throughout the cruise were:

- Tx Pulse: Measured in milliseconds, the Tx pulse describes the length of the sound bit being transmitted by the transducers. The Tx pulse ranges from 0.0625 ms to 64 ms. A higher Tx pulse corresponds to a stronger return. For most of this cruise, the Tx pulse was under 10 ms.
- Tx Power: Tx power corresponds to the power level of the transmitted pulse. Tx power ranges from 1 to 4 with 4 being the maximum power and 1 being the minimum. A higher power also results in a stronger return.
- Gain Value: The gain value can only be controlled when the echosounder is set to the manual gain mode. The gain value controls the analog gain of the incoming data. The gain ranges from 0 dB to 96 dB, but on this cruise the gain was set to below 15 dB. A higher gain would create a darker echosounder image.
- Process Shift: The process shift controls the digital gain. It takes the data and amplifies it but it does not clip the analog data. It ranges from 0-13. For most of the cruise, the process shift was set below 5. A higher process shift also resulted in a darker echosounder image. Reducing the process shift often significantly reduced the noise in the image.
- Range: This is the length of the water column below the echosounder. For example, if the range is set to 500, the echosounder would only collect data for a select 500 meters. For this cruise, the maximum range is 1000 because the SEG-Y files cannot log for a higher range.
- Phase: The phase can be set to auto or manual mode. For most of the cruise, the phase was set to manual mode since the auto mode had not yet been fully tested. The phase value sets the minimum and maximum depths for the water column.
- Depth limits: The depth limits (minimum and maximum) are the limits in which the phase can be set.

Once completed files were stored to disk at a rate of approximately one per day, they could be viewed using the SounderSuite PostSurvey (v. 2.2) software. PostSurvey allows for the cutting of the file into time segments that correspond to regions of interest, such as the OBS locations. Additionally, a useful tool is the digitized curve display option. This option displays red dots that show the true depth recorded at each time point which allows us to more clearly distinguish true seafloor depth from artifacts in the echosounder data. Note that in order to make accurate depth measurements, a correction to speed of sound for average ocean profiles specific to our deployment region needs to be made. The values of these corrections can be found in the Matthews Tables.

Below are a few examples of Echosounder images from the cruise:

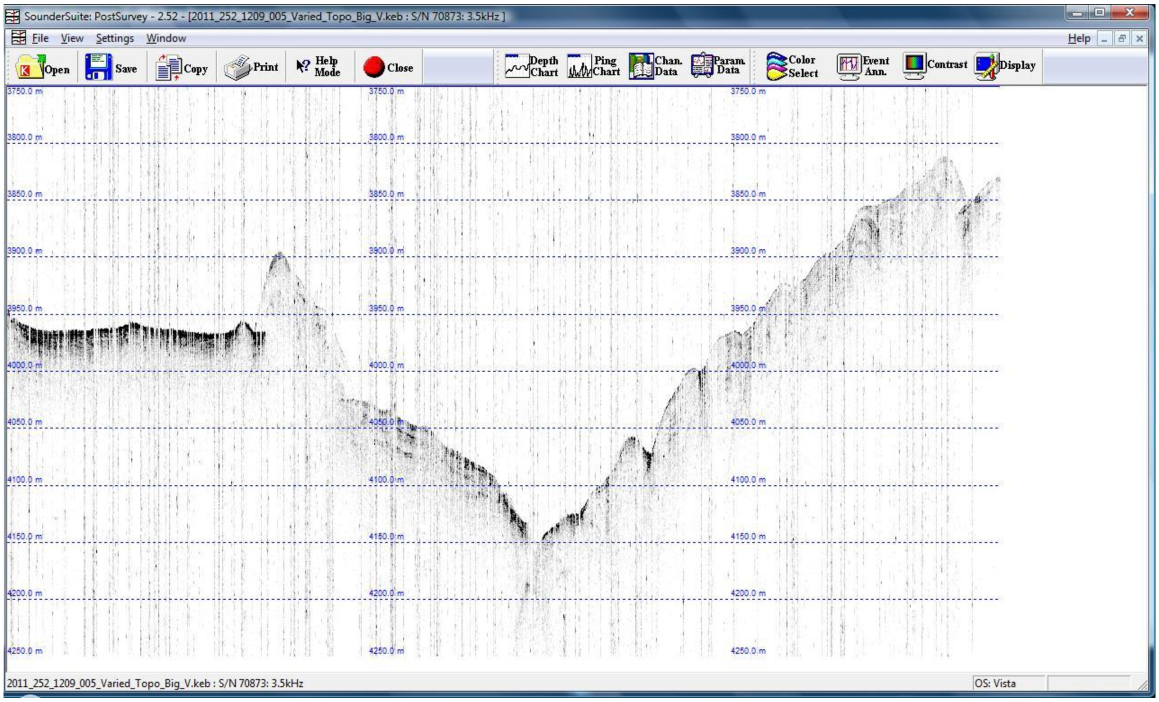

Figure X. This image shows thin sedimentary layers showing jagged features from Julian day 252 from 18:48:02 to 20:53:18 UTC time. It covers the area between 33 22.02095 N/121 47.82990 W and 33 18.37395 N/122 11.43997 W. This places it a little bit south of OBS #9, near some small seamounts and the Arguello Fracture Zone.

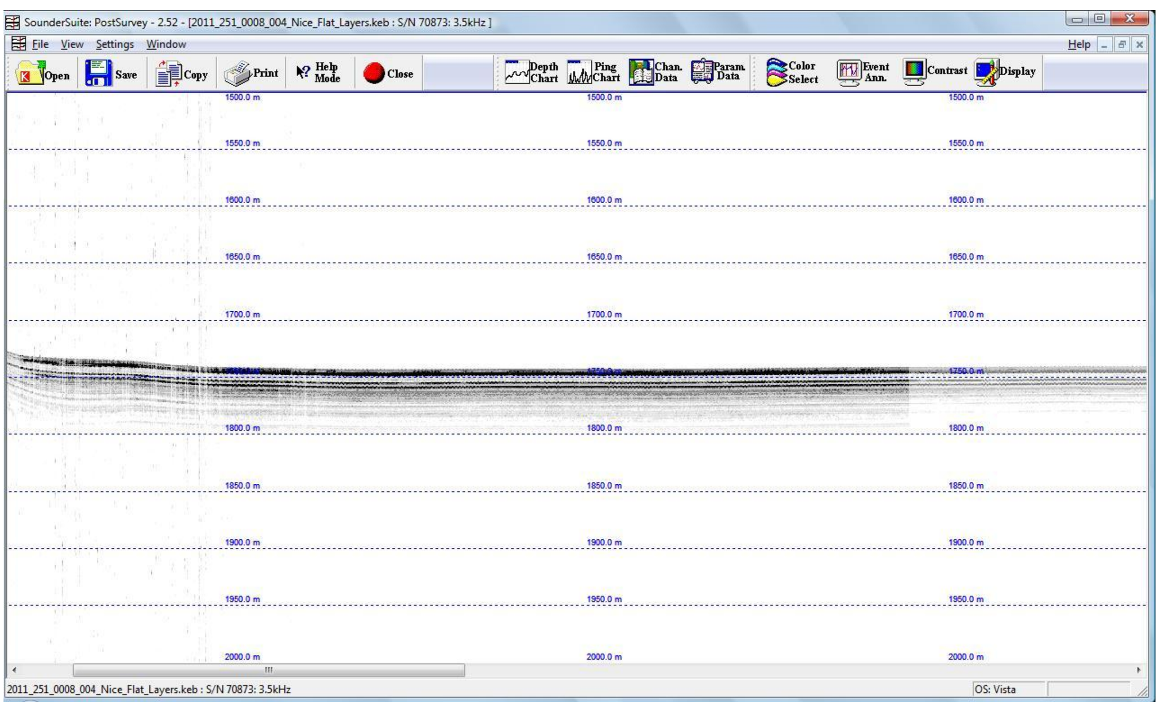

Figure X. This image shows thin sedimentary layers from Julian day 251 from 03:53:05 to 05:00:49 UTC time. It covers the area between 32 58.35480 N/ 118 55.56061 W and 33

00.25314 N/118 56.91193 W. This places it near OBS #3 in the inner borderland west of San Clemente Island and south of the San Nicolas Escarpment.

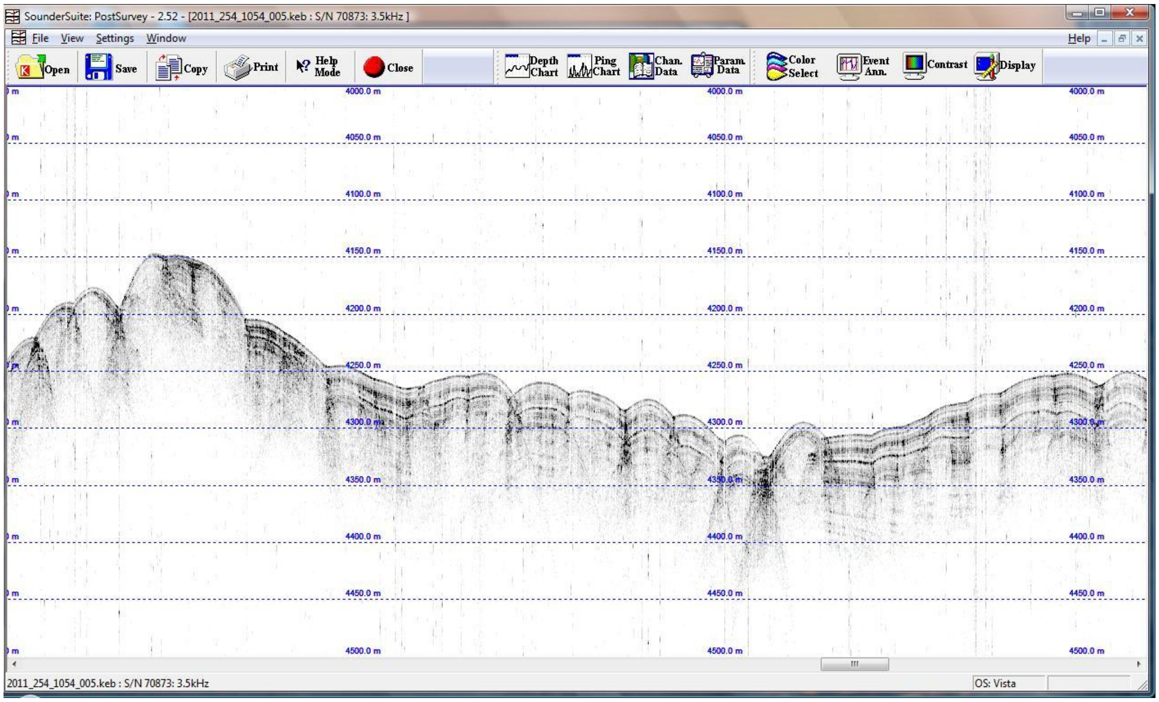

Figure X. This image shows moderately thick sedimentary layers in the rounded topography the data from Julian day 255 from 01:50:08 to 03:06:16 UTC time. It covers the area between 33 59.94965 N, 124 11.92520 W and 33 59.47952 N, 123 56.80618 W. This places it between OBS #16 and #17, and a little bit north of the Murray Fracture Zone.

OBS Drop #	**Instru-ment Type**	**LAT** Relocated	**LON** Relocated	**Depth** (m)	**Time in Water** UTC jday:hr:min	**Time on seafloor** UTC jday:hr:min	**GPS Synch Time at Deployment** UTC jday:hr:min:sec	**Wake Time** UTC jday:hr:min:sec	**GPS Synch Time at Recovery** UTC Jday:hr:min:sec	**Clock Drift over Total Recording Period** (seconds)
1	Sp	32 37.2761	-118 8.8229	2043	226:23:38	227:00:21	226:22:41:00	227:08:00:00	2011:250:21:58:00.5020528	0.5020528
2	Sp	32 48.7081	-118 48.2175	1451	227:04:52	227:05:22	227:00:07:00	227:20:00:00	2011:251:02:46:00.5390425	0.5390425
3	Lp	33 0.7726	-118 57.4432	1730	227:07:43	227:08:19	227:01:38:00	228:17:00:00	2011:251:05:49:57.9972527	-2.002748
4	Lp	33 19.1232	-119 10.9694	1051	227:11:10	227:11:31	227:06:21:00	228:22:00:00	Stuck-Responding	
5[1]	Sp	33 5.2220	-119 18.0102	1617	227:13:33	227:14:06	227:08:27:00	229:00:00:00	2010:238:17:15:00.0270108	0.0270108
5[2]	SP	33 5.2358	-119 17.8581	1616	238:17:41	238:18:14	238:17:24:00	239:00:00:00	2011:251:24:22:00.7627667	0.7627667
6	Lp	32 46.6192	-119 51.4677	1169	227:17:59	227:18:21	227:13:54:00	228:10:00:00	2011:251:18:39:58.9504275	-1.049573
7	Lp	32 44.5327	-120 43.5905	3769	228:11:19	228:12:35	228:03:10:00	230:05:00:00	2011:252:02:29:58.995202	-1.004798
8	Lp	32 39.2710	-121 20.5525	3888	228:16:55	228:18:17	228:11:37:00	229:21:00:00	2011:252:08:53:58.5463084	-1.453692
9	Lp	33 24.5183	-121 30.4322	3819	229:00:19	229:01:38	228:17:15:00	230:00:00:00	2011:252:17:02:59.8691500	-1.13085
10	Lp	33 18.6516	-122 11.7082	3777	229:05:54	229:07:10	229:00:07:00	230:11:00:00	2011:253:00:24:57.5186149	-2.481386
11	Lp	32 39.8715	-122 18.0960	4185	229:11:53	229:13:19	229:06:13:00	230:18:00:00	2011:253:06:58:00.8943059	0.8943059
12	Lp-T40	32 38.6871	-123 5.2956	4098	228:18:36	229:19:56	229:12:25:00	230:18:00:00	2011:253:14:21:00.6981427	0.6981427
13	Lp	32 39.3025	-123 49.7155	4281	230:01:08	230:02:31	221:19:51:00	230:21:00:00	2011:253:21:28:59.5998144	-0.400186
14	Lp	32 38.1503	-124 37.9369	4374	230:07:57	230:09:30	230:01:04:00	231:22:00:00	Not Responding	Abandon
15	Lp	33 18.9424	-124 38.8298	4248	230:15:18	230:16:44	230:08:14:00	231:18:00:00	2011:254:16:23:58.9461029	-1.053898
16	Lp	34 0.6851	-124 38.3059	4552	231:03:21	231:04:51	230:15:45:00	231:13:00:00	2011:254:23:45:56.3124593	-3.687541
17	Lp	33 59.2225	-123 50.4051	4426	231:10:15	231:11:48	231:03:37:00	232:03:00:00	2011:255:06:01:00.8788115	0.8788115
18	Lp	33 17.9964	-123 52.1074	4461	231:21:57	231:23:31	231:10:34:00	233:00:00:00	2011:255:13:30:57.4078700	-2.59213
19	Lp	33 18.1281	-123 2.2397	4374	232:04:53	232:06:25	231:22:21:00	233:03:00:00	2011:255:20:35:00.2836437	0.2836437
20	Lp	34 0.6596	-123 1.9558	4293	232:12:10	232:13:39	232:05:17:00	233:17:00:00	2011:256:02:50:58.3237690	-1.676231
21	Lp-T40	34 1.9705	-122 17.1759	3876	232:18:19	232:19:37	232:14:14:00	234:00:00:00	2011:256:08:55:55.705305	-4.294695
22	Lp	34 5.8675	-121 39.7047	3562	232:23:29	233:00:43	232:19:41:00	235:00:00:00	2011:256:14:30:55.7386586	-4.261342
23	Lp	34 8.9088	-121 5.1738	2010	233:04:19	233:05:00	232:23:51:00	234:00:00:00	2011:256:19:06:01.2910106	1.2910106
24	Lp-T40	33 26.5622	-120 51.5388	3571	233:09:46	233:10:58	233:04:43:00	234:10:00:00	2011:257:02:10:58.4028085	-1.597192
25	Lp	33 31.3971	-120 27.5800	1093	234:11:14	234:11:40	233:10:17:00	235:10:00:00	2011:257:05:24:57.9827078	-2.017293
26	Sp	33 15.0195	-120 1.9883	922	234:22:15	234:22:38	234:12:31:00	236:00:00:00	2011:257:08:53:59.2943082	-0.705692
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31	Sp	33 33.0174	-118 25.0643	896	237:01:30	237:01:50	236:21:54:00	237:01:00:00	2011:258:00:09:59.9953834	-0.004617
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