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Cruise Report for the 2007-2008 Palos Verdes Moored Measurement Program Field Deployment

Prepared for
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1 Introduction

The Palos Verdes Shelf (PVS) project team identified in mid-2007 the need for additional data on the sediment properties and oceanographic conditions at the Palos Verdes Superfund Site for continued support of ongoing modeling and feasibility studies. It was determined that more detailed data on the degree and spatial variability of resuspension of the effluent affected (EA) deposit during multiple winter storms was necessary to adequately model the fate of the deposit over time. Multiple objectives were identified for the 2007-2008 field program.

- Measure sediment transport events at several locations on the EA deposit. Specifically, measure the sediment response (threshold of resuspension, suspended-sediment concentrations, and suspended-sediment transport rates) to bed stresses associated with waves and currents. Pursue the joint hypothesis that net erosion or deposition of the deposit is related to alongshore gradients in sediment transport caused primarily by gradients in sediment erodibility, and by alongshelf gradients in forcing, particularly that of internal tides. Multiple heavily-instrumented tripods that measure physical oceanographic processes in the bottom boundary layer (BBL) are necessary to accomplish this goal.
- Determine the structure of the bottom boundary layer and relate near-bed currents with those measured ~10 meters above bottom (mab). This will allow us to relate the valuable long-term data on currents collected by the Los Angeles County Sanitation District (LACSD) acoustic Doppler current profiler (ADCP) deployments to near-bed current speed and direction. Low-profile tripods with high-frequency ADCPs co-located with two of the large tripods were selected for this goal.
- Measure nearshore circulation and sediment fluxes on the inner and mid shelf, near the Portuguese Bend landslide, in an attempt to understand the dispersal and pathways of landslide material over the EA deposit. Two tripods with ADCPs and near-bottom current and suspended-sediment sensors were deployed in a cross-shore array to fulfill this need. In addition, one tripod is equipped with a sediment trap to sample for later analysis of size and mineralogy of suspended sediment.
- Evaluate the cross-shelf evolution of internal motions. Thermistor strings at 60-m and 30-m sites (B6 and B7, respectively), will observe changes in internal wave character as they propagate onshore. An additional thermistor string deployed by U.S. Geological Survey (USGS), and thermistor arrays deployed by LACSD will provide additional data on the alongshelf variability of internal motions.
- Obtain field measurements to assess the temporal and spatial variation in the potential erodability of PVS sediments (co-located with current meter measurements) via sediment coring and on-board erodibility measurements on cores obtained.

- Support deployment of EPA/URI polyethylene sheets passive DDT samplers (for absorbing DDT from the water column).

Implementation of these field measurements during the winter of 2007-2008 was deemed necessary to meet EPA timetables for input to the feasibility study. This was also a time in which USGS scientists and instrumentation were available for this extensive program. As in the 2004 program, Dr. Patricia Wiberg from the Virginia Institute of Marine Science (VIMS) was contracted to conduct the on-board erodibility measurements with the Gust chamber. This cruise report details the activities of the USGS and VIMS to complete the instrument deployment and first round of sediment coring.

2 Mobilization and Deployment of Moored Oceanographic Equipment

The U.S. Geological Survey (USGS) began mobilization of equipment and purchasing of consumables as soon as the decision to proceed was finalized. No additional purchasing of oceanographic instrumentation was necessary. The USGS Eastern Coastal and Marine Geology team (ECMG) in Woods Hole, MA prepared the hydraulically damped piston corer (to collect undisturbed samples of the seabed for erodability measurements) and shipped it and other equipment to be deployed to the Scripps Marine Facility (MarFac) in San Diego in advance of personnel arrival. The Western Coastal and Marine Geology team (WCMG) meanwhile loaded equipment on government owned and leased trucks, and drove equipment to MarFac to begin preparation of equipment on Tuesday, November 27th. The vessel left the Scripps Marine Facility on the evening of December 3 to arrive on site at first light. Deployment operations were performed during the day, and coring operations at night. An overview of the schedule of events is provided in Table 1.

Date	Activity	Comments
11/26/2007	Travel Day	
11/27/2007	Build Day	Unpack gear and begin tripod construction
11/28/2007	Build Day	Continue tripod construction and instrument testing
11/29/2007	Build Day	Continue tripod construction and instrument testing
11/30/2007	Build Day	Continue instrument testing and mounting
12/1/2007	Build Day	Continue instrument testing and mounting
12/2/2007	Build Day	Finalize instrument testing and mounting
12/3/2007	Vessel Mob	Pack and load R/V Robert Gordon Sproul
12/3/2007	Transit	Leave San Diego 18:00, transit overnight
12/4/2007	Deployment	Arrive onsite 06:00, deploy tripods/moorings until 18:00
12/4/2007	Coring	Perform night coring operations until 06:00
12/5/2007	Deployment	Deploy tripods/moorings, 06:00-18:00
12/5/2007	Coring	Perform night coring operations until 06:00
12/6/2007	Transit	Depart site 06:00, arrive San Diego 17:30
12/7/2007	Vessel Demob	Demobilize vessel, pack gear into storage van and trucks
12/8/2007	Travel Day	

Table 1 – Overview of instrument deployment and coring operations schedule.

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In total, 7 bottom platforms (three large tripods and 4 smaller tripods), three subsurface moorings, and 3 surface moorings were successfully deployed, with over 100 sensors attached. A map detailing the position of each platform deployed is shown in Figure 1. Following is a detailed description of platforms deployed at each site. Table 2 lists the personnel involved in the coring and deployment operations.

Name	Agency	Tasks
Marinna Martini	USGS ECMG	Shore/Vessel Mooring preparation/deployment
Jonathan Borden	USGS ECMG	Shore/Vessel Mooring preparation/deployment
Rick Rendigs	USGS ECMG	Shore/Vessel Mooring preparation/deployment
Joanne Ferreira	USGS WCMG	Shore/Vessel Mooring preparation/deployment
David Gonzales	USGS WCMG	Shore/Vessel Mooring preparation/deployment
Kevin O'Toole	USGS WCMG	Shore Mooring preparation
Jamie Grover	USGS WCMG	Shore/Vessel Mooring preparation/deployment
Kurt Rosenberger	USGS WCMG	Shore/Vessel Mooring preparation/deployment
Marlene Noble	USGS WCMG	Vessel Mooring deployment
Patricia Wiberg	VIMS	Vessel Sediment Coring and Erosion Testing
Sarah Lawson	VIMS	Vessel Sediment Coring and Erosion Testing

Table 2 – Personnel involved in 2007-2008 instrument deployment and sediment coring operations, November 2008.

Site B1

This site contains a single small tripod, with no surface expression, intended to measure near-shore currents, waves and near-bottom suspended sediment load (Figure 2). The deployment spot is slightly southeast and offshore of target location, due to topography and presence of fishing gear.

Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Small Tripod	851	Upward- facing current profiler Single-Point current meter with 1 optics Temperature logger Two Passive DDT samplers	33° 43.254'	118° 20.681'	18.7	Dec 5 2007, 13:10

Site B2

This site contains a medium sized tripod, with no surface expression, also intended to measure mid-shelf currents, waves and suspended sediment load (Figure 3). The single point current meter measures near-bottom orbital wave velocities, and logs two types of optical sensors. There is a sediment trap and a Temperature/Salinity (T/S) sensor as well.

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Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Medium Tripod	852	Upward- facing current profiler Single-Point Current meter with 2 optics channels T/S Logger	33° 43.007’	-118° 20.851’	28.7	Dec 4 2007, 10:21

Site B3

This site is one of two heavily instrumented sites, with four platforms (Figure 4). A large tripod houses multiple near-bottom current meters, both for redundancy, and for stress measurements, as well as multiple optical sensors, temperature sensors, and a T/S logger. A smaller tripod houses a single high-frequency upward facing current profiler to profile the gap in currents from ~1.5mab to 10 mab. A subsurface taut-wire mooring houses multiple temperature,T/S sensors to monitor internal motions and one optical sensor to monitor suspended sediment. A surface buoy acts as a guard buoy protecting the equipment, and houses temperature and salinity sensors near the surface. This site was occupied in 2004, in 60m water depth, however, there were no water column measurements, and the large tripod tipped over on deployment. Due to limitations in the maximum deployment depth for two instruments, this site was relocated to 55m water depth.

Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Surface Buoy	840	Two Temperature loggers One T/S logger	33° 42.585’	118° 21.208’	52	Dec 5 2007, 14:38
Sub-Surface Mooring	841	Four T/S Loggers Three Temperature loggers One T/S Logger with optics	33° 42.626’	118° 21.299’	54	Dec 5 2007, 17:28
Large Tripod	842	Upward- facing current profiler Two Single-point current meters with 2 optics channels each Downward- facing current profiler with 2 optics channels Downward-facing acoustic backscatter profiler T/S Logger Temperature sensor Four Passive DDT samplers	33° 42.598’	118° 21.250’	54	Dec 4 2007, 15:54
Small Tripod	843	ADCP Two Passive DDT samplers	33° 42.658’	118° 21.378’	55.1	Dec 5 2007, 9:54

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Site B5

This site has one large heavily instrumented platform and is located near LACSD Site A5 (Figure 5). Instrumentation mounted on this platform is intended to make measurements of near-bottom orbital wave velocities and stresses near a site that has long-term current profile measurements (but no near-bottom measurements) such that the long-term measurements can be utilized to assess the long-term stress history in the near-bottom.

Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Large Tripod	844	Upward- facing current profiler Two Single-point current meters with 2 optics channels each Downward- facing current profiler with 2 optics channels Downward-facing acoustic backscatter profiler T/S Logger Temperature sensor Four Passive DDT samplers	33° 41.652’	118° 19.793’	65	Dec 4 2007, 8:20

Site B6

This site is the second of the two heavily instrumented sites with four platforms (Figure 6), and is essentially identical to Site B3, however, two differences exist; the surface buoy is larger and houses a meteorological station, and the small tripod also houses a LISST suspended sediment concentration sensor. This site was also occupied in 2004.

Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Surface Buoy	845	Two Temperature loggers One T/S logger Meteorological station	33° 41.070’	118° 18.677’	57	Dec 4 2007, 12:34
Sub-Surface Mooring	846	Four T/S Loggers Four Temperature loggers One T/S Logger with optics	33° 41.062’	118° 18.554’	57	Dec 5 2007, 19:17
Large Tripod	847	Upward- facing current profiler Two Single-point current meters with 2 optics channels each Downward- facing current profiler with 2 optics channels Downward-facing acoustic backscatter profiler T/S Logger Temperature sensor Four Passive DDT samplers	33° 41.03’	118° 18.529’	57	Dec 4 2007, 14:10
Small Tripod	848	Upward- facing current profiler Two Passive DDT samplers Suspended sediment sensor	33° 41.135’	118° 18.763’	60	Dec 5 2007, 11:54

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Site B7

This site was occupied in 2004, however no water-column temperature measurements were made at that time (Figure 7). Thus, this site consists of a sub-surface taut-wire mooring with temperature and salinity sensors, and a surface mooring with additional temperature sensors. There is also a near-bottom optical sensor logged by one of the T/S loggers, and a pressure wave gauge on the anchor.

Platform	Mooring Number	Instruments	Latitude (North)	Longitude (West)	Depth (m)	Deployment Time (PST)
Surface Buoy	849	Three Temperature loggers	33° 41.759'	118° 18.258'	32.5	Dec 5 2007, 20:20
Sub-Surface Mooring	850	Two T/S Loggers Three Temperature loggers One T/S Logger with optics Wave gauge	33° 41.740'	118° 18.203'	32.4	Dec 4 2007, 19:01

Note that all tripods are equipped with a tilt sensor that can be checked remotely from the surface. Each tripod was found to be in an upright orientation on deployment. All but one of the deep-water tripods have redundant recovery systems. Each tripod has at least one acoustic locator beacon (the acoustic recovery release being a secondary), and the shallow tripods have recovery beacons that can be located by hand-held SCUBA diver units.

3 Sediment Coring and Gust Chamber Erosion Testing

A hydraulically damped piston corer was used to obtain sediment cores at several of the deployment sites. Coring operations were performed at night, as it was more critical to have daylight for mooring deployments. Hydrocasts with the rosette water sampler and Conductivity Temperature Depth (CTD) were performed at the beginning of each night to obtain measurements of water column properties as well as to collect near-bottom water samples necessary for erosion testing.

The first night of coring at sites B6 and B7 was unsuccessful. Although a similar coring device had been used in 2004 at similar sites, the core barrel was entirely empty on each attempt. Many adjustments were made to the coring device, as well as the deployment technique, to no avail. Nevertheless, coring operations continued until dawn, stopping to allow continued tripod deployment.

However, on the second night, 3 quality cores were obtained at site B3 and one at site B5. Erosion testing commenced as soon as a quality core was obtained, and continued on the return transit until all cores had been sampled. It is not entirely clear why there was so much difficulty on the first attempt, but it could be that a higher swell

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on the first night was causing the coring device to tip over or prematurely trip the sediment catching mechanism.

4 Instrument recovery

The instrument deployment is planned to last 4 months, and thus recovery will occur at the beginning of April. Another round of sediment coring will also be performed soon after recovery of all instruments. Instruments will be cleaned and the data downloaded once on board. Final breakdown and cleaning of tripods will occur at MarFac upon return.

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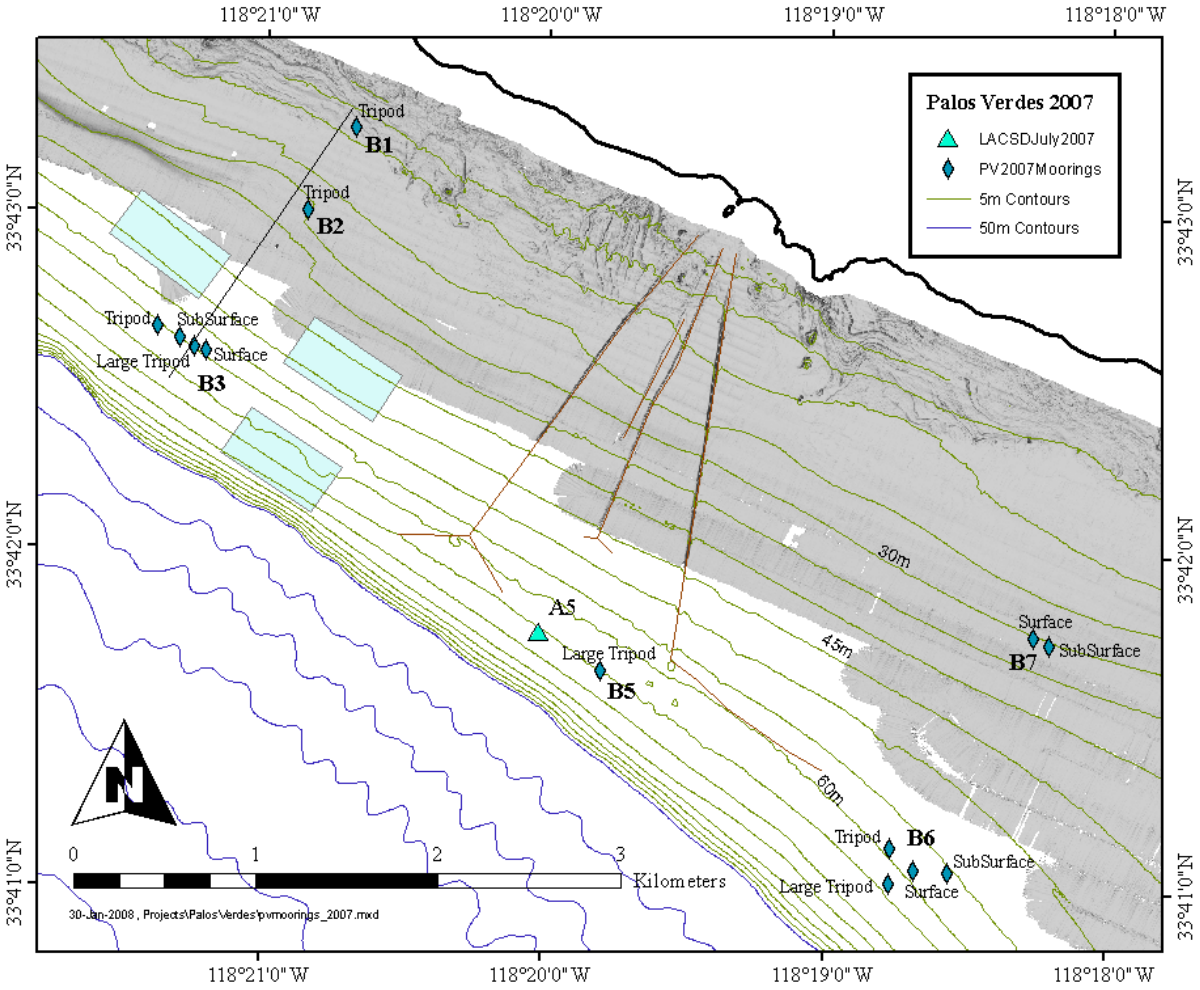

Figure 1 – Map depicting the deployment locations of individual instrument platforms.

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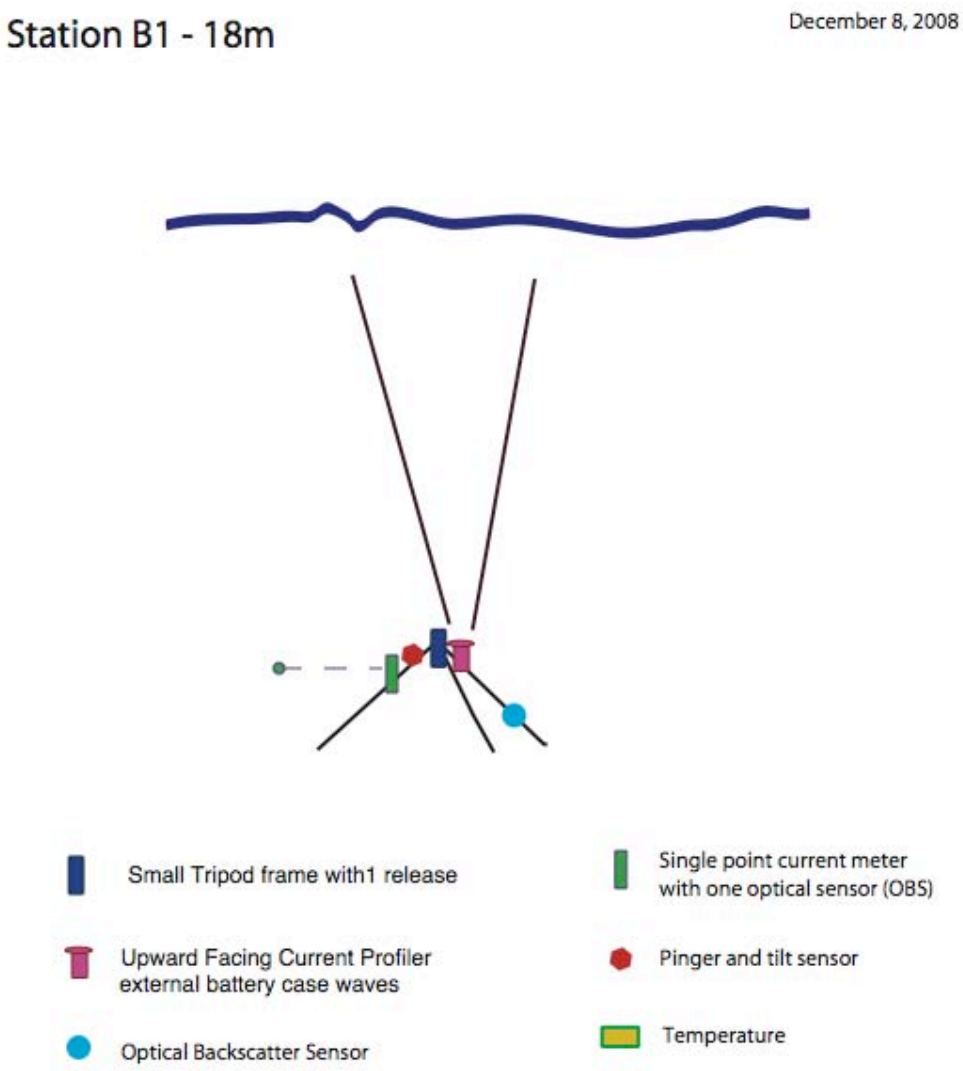

Figure 2 – Diagram of platform deployed at Site B1 in 18m water depth.

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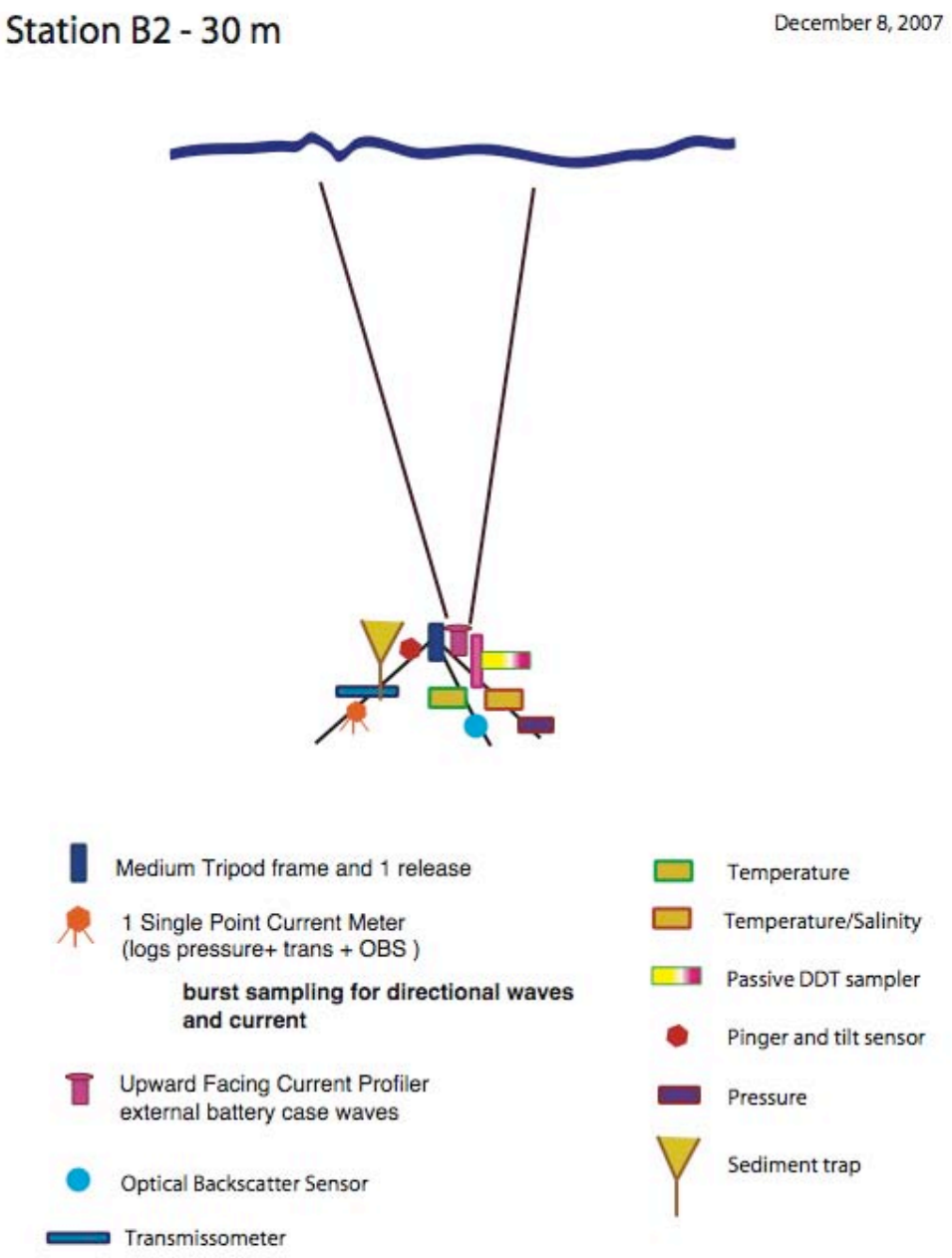

Figure 3 – Diagram of platform deployed at Site B2 in 30m water depth.

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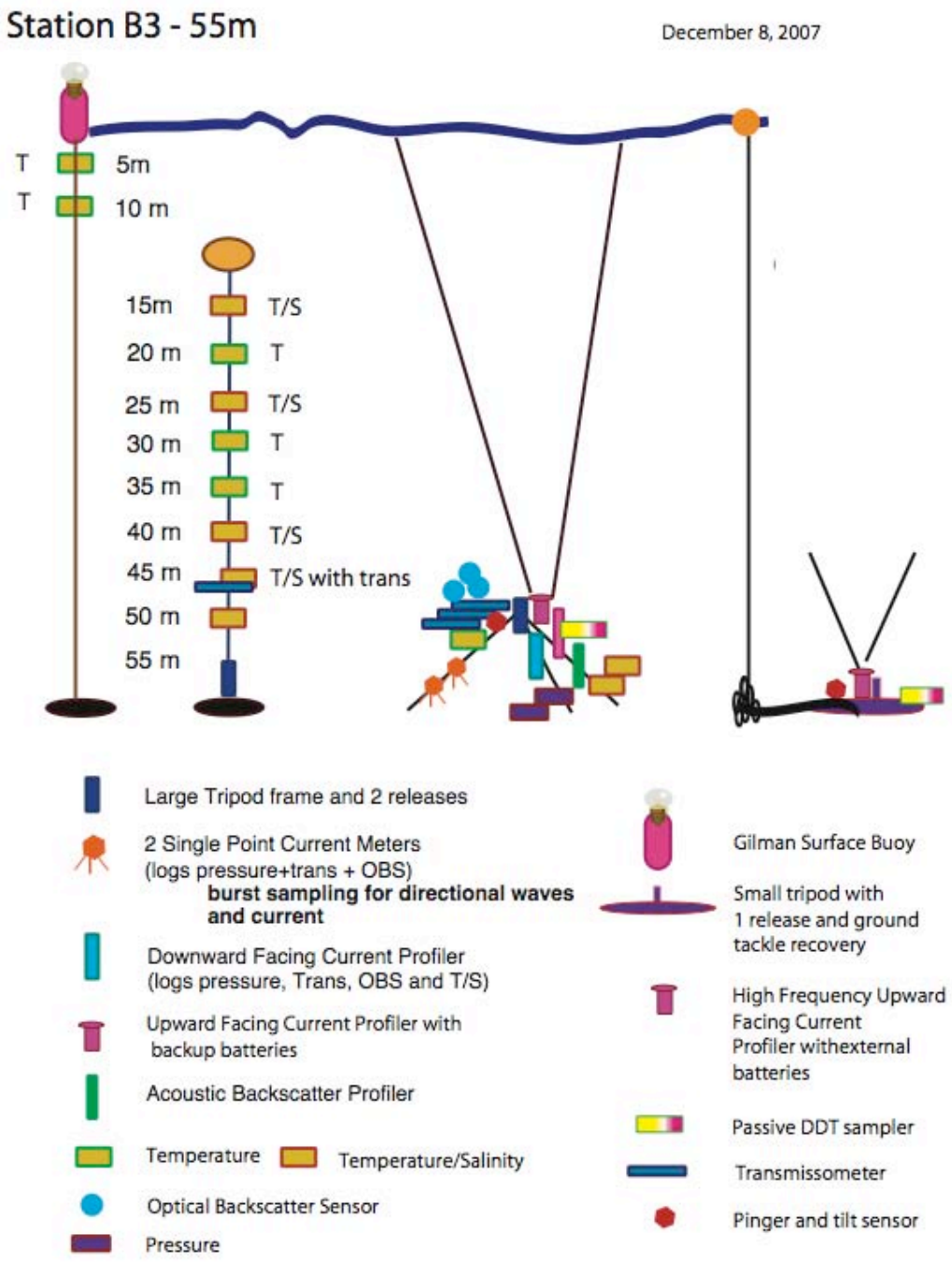

Figure 4 – Diagram of platforms deployed at Site B3 in 55m water depth.

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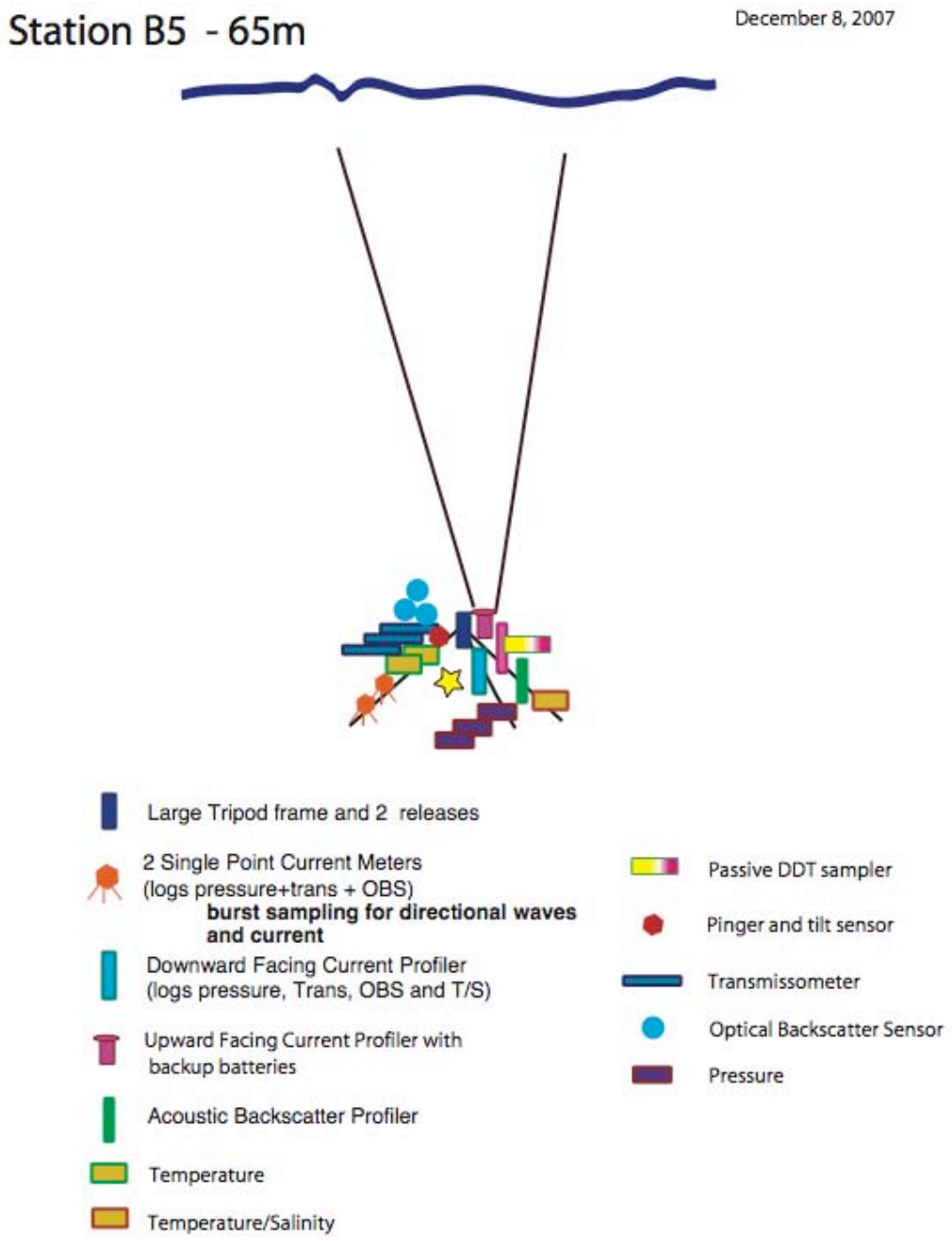

Figure 5 – Diagram of platform deployed at Site B5 in 65m water depth.

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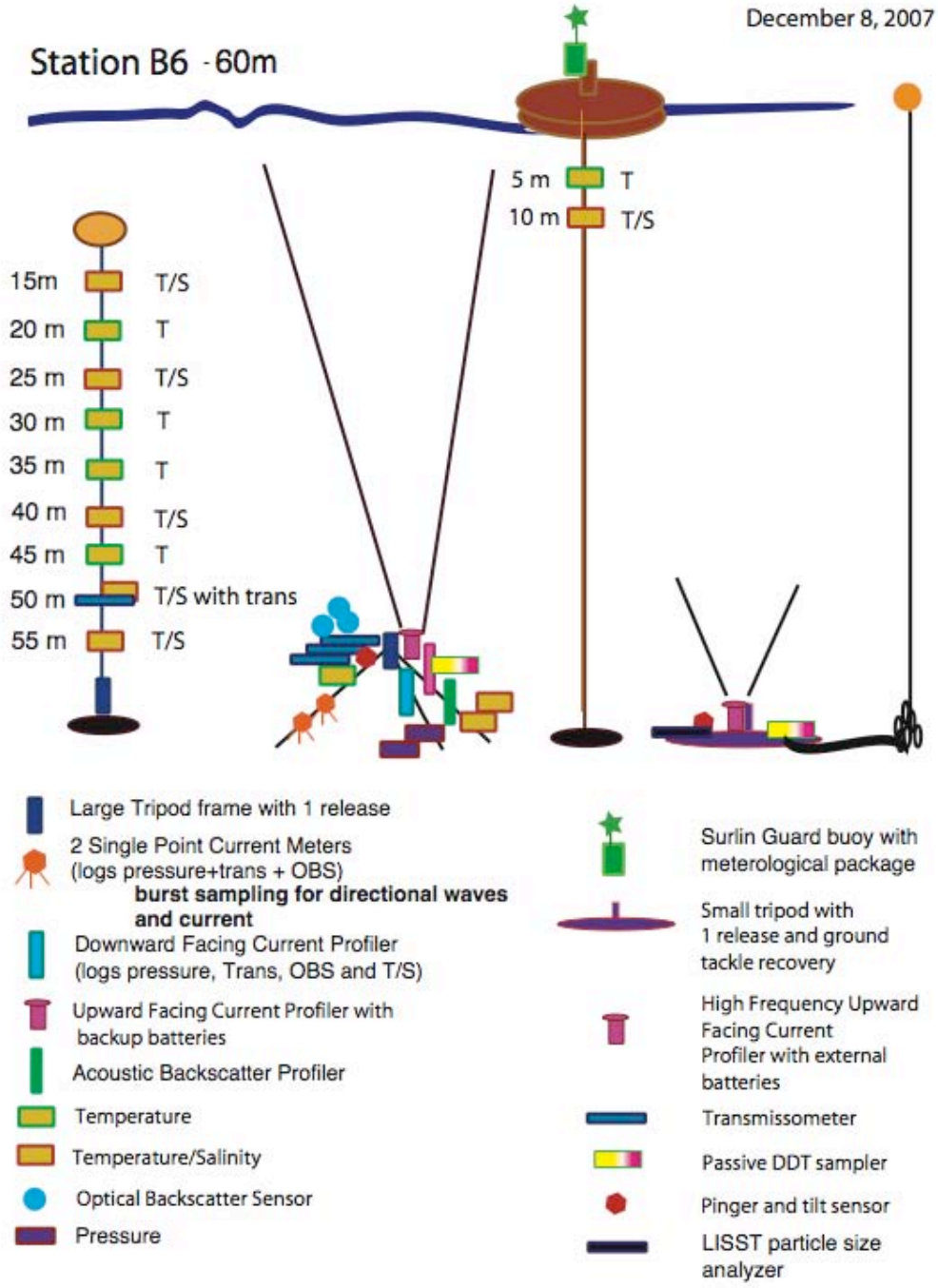

Figure 6 – Diagram of platforms deployed at Site B6 in 60m water depth.

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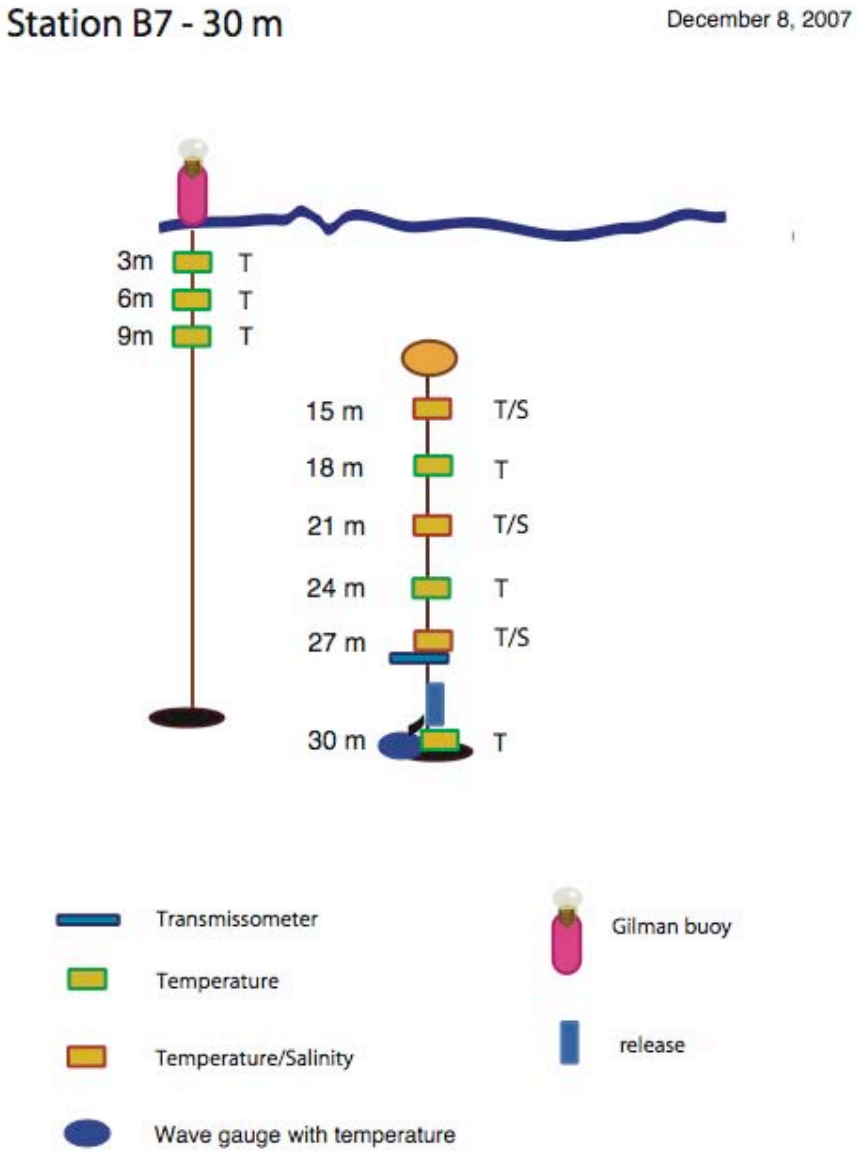

Figure 7 – Diagram of platforms deployed at Site B7 in 30m water depth.