SANITATION DISTRICTS OF LOS ANGELES COUNTY

Development of a Modern Sampling Device to Assess DDT Contamination on the Palos Verdes Shelf Superfund Site, California, USA

Chi-Li Tang, Chase McDonald, Terra Petry, Joseph Gully (Sanitation Districts of Los Angeles County, California, USA)

Background/Objective

Since 1981, the Sanitation Districts of Los Angeles County (Sanitation Districts) have voluntarily collected, processed, and analyzed sediment cores to assess DDT contamination near the Joint Water Pollution Control Plant deep-ocean outfalls on the Palos Verdes Shelf (Figure 1). This long-term sediment monitoring program has helped the United States Environmental Protection Agency (EPA) to characterize the DDT-contaminated deposit at Palos Verdes Shelf and to evaluate potential remediation options. The research has indicated that DDT has degraded to less-chlorinated forms including DDE and DDMU, and suggests that DDT degradation rates may be increasing over time. However, PCBs have not degraded significantly.

As a part of the implementation of EPA's Interim Record of Decision Remedy (IROD, Figure 2), the Sanitation Districts collaborated with EPA Region 9 on a new round of Palos Verdes Shelf sediment core sampling in October 2013, to provide important data for the monitored natural recovery and sediment capping components of the IROD. One of the objectives of this sampling program was to more fully evaluate the coring process (Figure 3). This poster details the equipment added to the coring device to improve the process and the results of the evaluation.

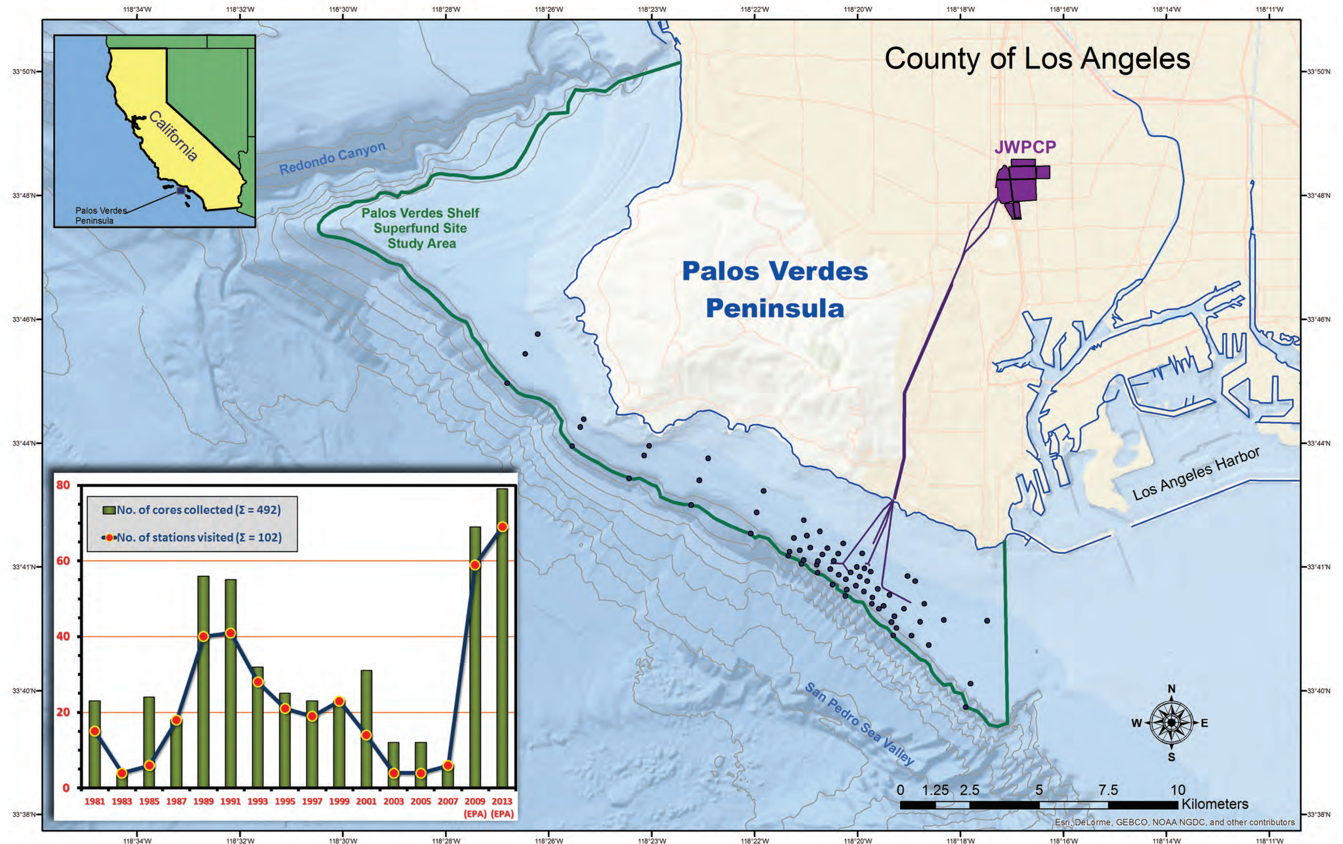


Figure 1 Sediment coring program conducted on the Palos Verdes shelf by the Sanitation Districts of Los Angeles County, 1981-2013.

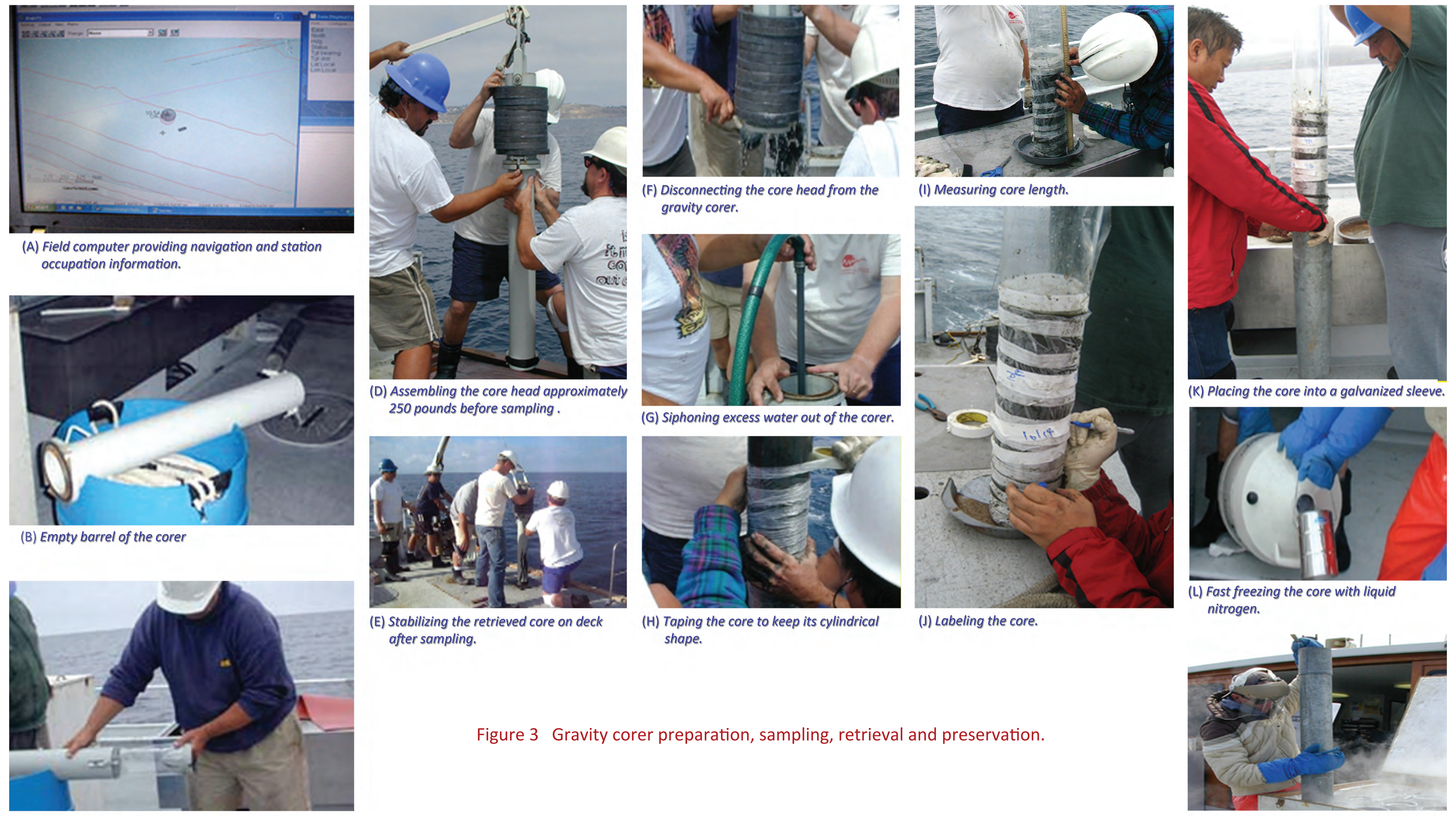
Palos Verdes Shelf Superfund Site Interim Record of Decision (IROD)

Selected Remedy ($57.2M)

1. Continue and strengthen the existing Institutional Controls (ICs) program.
2. Monitor natural recovery (MNR) to achieve specific Remedial Action Objectives.
3. Placement of an in situ isolation cap (Small Cap) over the erosive edge of the deposit that also contains the most highly contaminated sediments.

Five-Year Review Component for the Selected Remedy is Required

Figure 2 Interim Record of Decision (IROD) for Palos Verdes Shelf Superfund Site published by EPA. Region 9.



(A) Field computer providing navigation and station occupation information.
(B) Empty barrel of the corer
(C) Inserting the acetate liner into the barrel.
(D) Assembling the core head approximately 250 pounds before sampling .
(E) Stabilizing the retrieved core on deck after sampling.
(F) Disconnecting the core head from the gravity corer.
(G) Siphoning excess water out of the corer.
(H) Taping the core to keep its cylindrical shape.
(I) Measuring core length.
(J) Labeling the core.
(K) Placing the core into a galvanized sleeve.
(L) Fast freezing the core with liquid nitrogen.
(M) Placing the core into a cold box with dry ice for preservation.

Figure 3 Gravity corer preparation, sampling, retrieval and preservation.

Approach

To address questions raised during the 2009 survey regarding whether the gravity coring device was performing as intended, the Sanitation Districts' staff designed and fabricated a protective camera mount and placed a Data Storage Tag (DST) on the gravity coring device (Figure 4). These modifications allowed for visual and empirical confirmation that the gravity corer was entering the sediment on a vertical plane and that no significant disturbance or loss of the surface sediment layer was occurring. The video camera and light source were attached to a custom-built aluminum protective mount that fastened around the lead weight system of the top assembly. The barrel was marked and wrapped with colored electrical tape in 10-cm increments. The DST tilt sensor was attached to the uppermost lead weight. During deployment, the tilt sensor measured tilt in the X-axis, Y-axis, and Z-axis, as well as temperature and depth. The gravity corer mounted with the Data Storage Tag and a underwater video camera with housing was used to take the deep sediment cores at 34 stations where the water was no deeper than 60 meters. A total of 79 sediment cores (including replicates) were collected from 69 sites; stations were resampled when the tilt exceeded 20 degrees along the Z-axis.

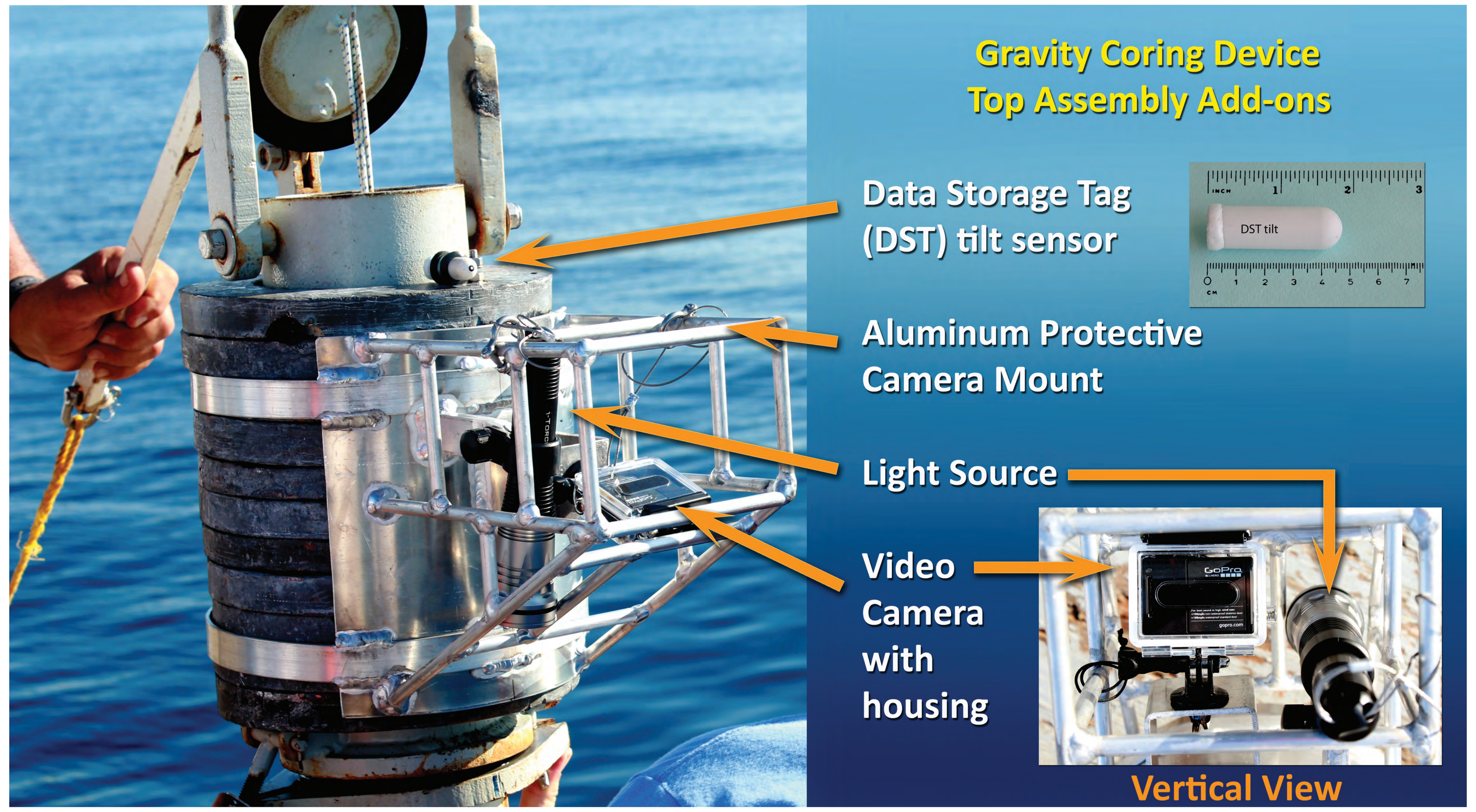


Figure 4 Close-up view of the modifications to the gravity coring device used in sediment core sampling in 2013. Preliminary field testing in shallow water on October 4, 2013, confirmed that the inclinometer and underwater video camera could be utilized to assess the acceptability of the sediment cores collected. Due to limitations of the underwater camera housing, the video setup was limited to water depths shallower than 60 meters.

Results/Lessons Learned

Screen captures from the video camera and tilt sensor results during a successful coring process at station 3C (60-meter water depth) on October 22, 2013, are illustrated in Figure 5 and Figure 6, respectively.

Figure 5 Screen captures for deep sediment coring conducted at station 3C on October 22, 2013

Results/Lessons Learned (Continued)

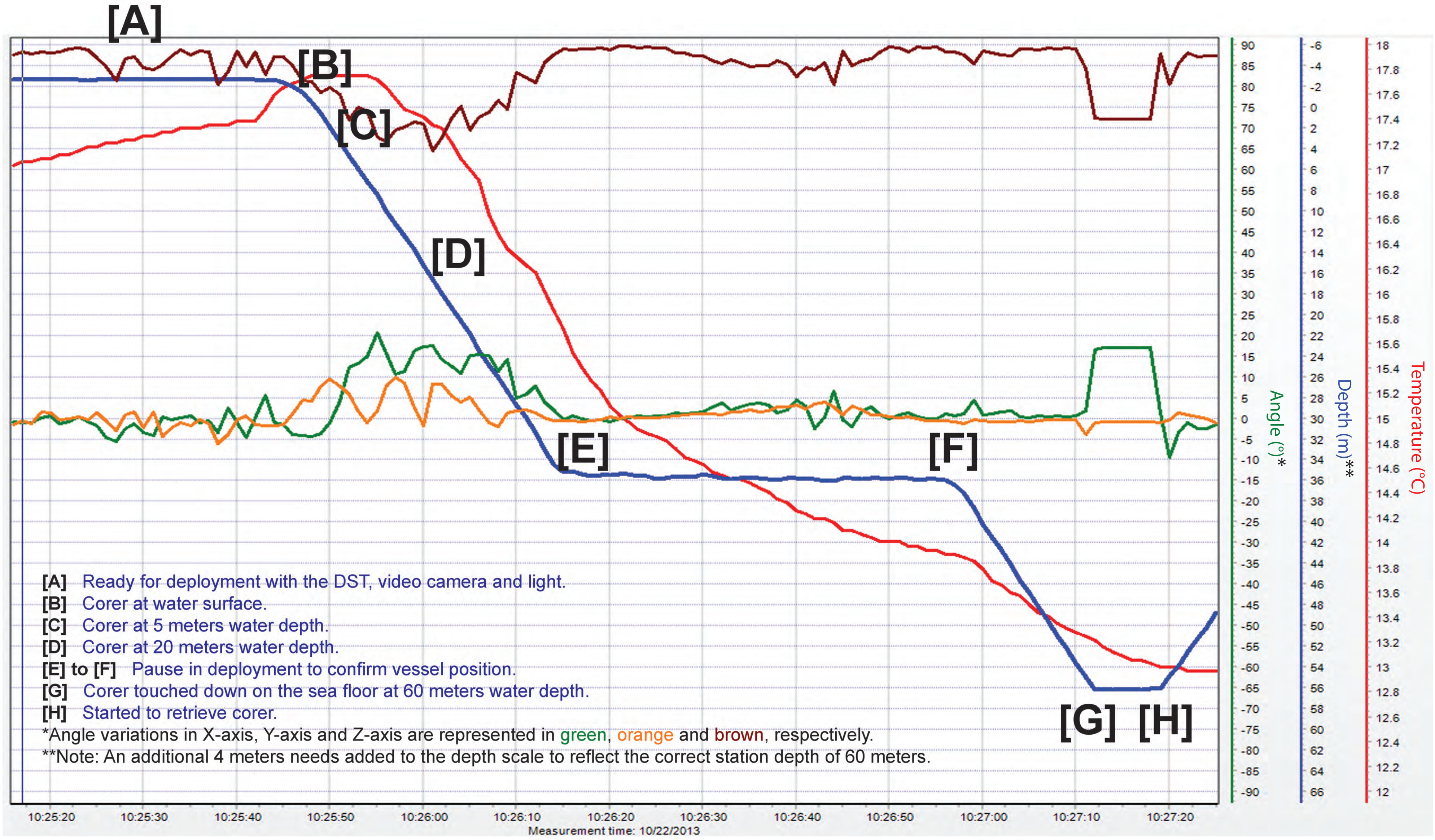


Figure 6 Tilt sensor results from the deep sediment coring conducted at Station 3C on October 22, 2013. Angle variations along the X-axis and Y-axis were within 20 degrees of the stable position (0 degrees) approximately 90% of the time, but were impacted by the current and gravity during the first 40-m of deployment from [B] to [E]. After stabilizing the corer for nearly 40 seconds between [E] and [F], the X-axis and Y-axis variations were significantly reduced before the gravity corer touched the sea floor [G]. Due to the DST orientation, the stable Z-axis position was 90 degrees, with a range of 65 to 90 degrees from [B] to [H].

Based on video footage, the camera brace appeared to add drag to the coring device, causing an angled entry into the sediments (Figure 7). The tilt sensor confirmed the video interpretations: 38% of the cores needed resampling when the video camera brace was attached, compared to 8% of the cores that needed resampling without the brace.

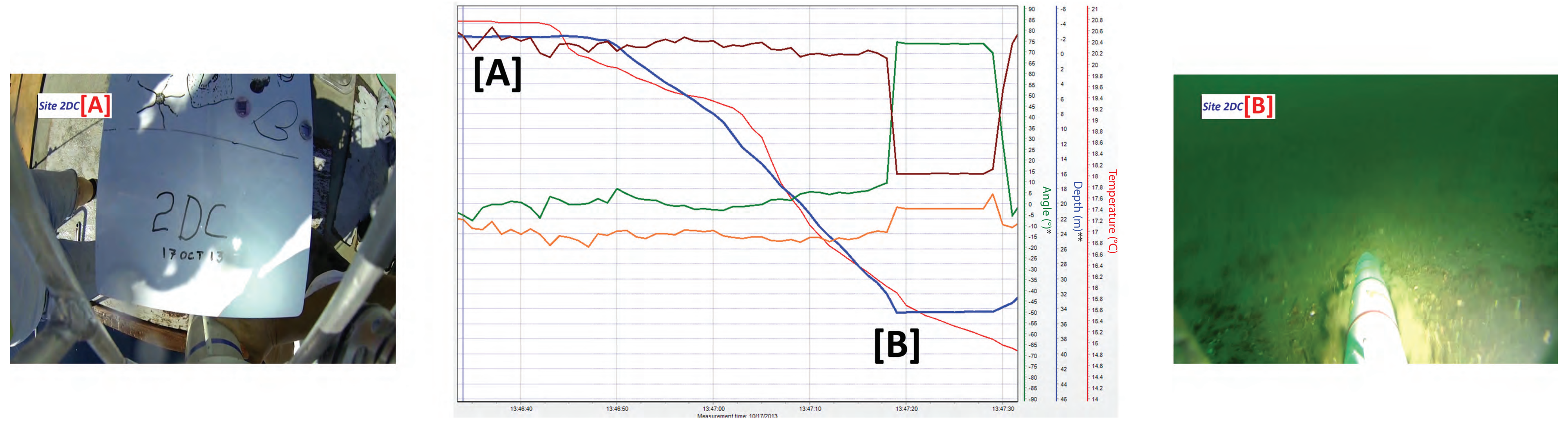


Figure 7 Deep Sediment Coring Conducted at Station 2DC on October 17, 2013. Core sampling event was rejected at station 2DC due to improper of angle penetration: the DST tag recorded 75 degree and 15 degree tilts on the X-axis and Z-axis respectively. These measurements were confirmed by the video footage of the slanted gravity corer (B).

Summary and Future Work

Sediment coring off the PVS Superfund site with the underwater video camera and DST tilt sensor increased the fidelity of the deep sea sediment sample collection process. While the video camera provided useful visual information about the coring process, it increased the probability of angled entry into the sediment bed. To minimize angled entry issues during future sampling rounds, improvements being considered include: (1) using only the DST tilt sensor without the brace and video camera; or (2) modifying the aluminum brace to balance two underwater cameras installed 180 degrees apart, or alternatively, three underwater cameras installed 120 degrees apart. The Sanitation District's will continue to implement and improve its monitoring program as a vital component of EPA's PVS site remediation.

Acknowledgement

The authors would like to thank Judy Huang (United States Environmental Protection Agency Region IX, Palos Verdes Shelf Superfund Site Remedial Manager) and Robert Lindfors (Gilbane) for their support, as well as the field operation team members of the Sanitation Districts: Bill Power (Supervising Scientist), Fred Stern (Senior Biologist, retired), Steve Gregson (Senior Boat Captain) and Robert Harper (Boat Deck Hand).