Hawaii OTEC Pilot Plant Site Assessment and Survey

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Project Overview

- Funded by ONR Alternate Energy Program.
- Objectives, Goals, and Tasking
  - Conduct engineering technical assessment of three candidate Navy sites.
  - Collect high-resolution survey data to support technical assessment.
  - Provide technical site data to LMCO for preliminary design of Pilot Plant.
  - Collaborate with NOAA to collect data to help define environmental baseline.
  - Provide Navy with technical assessment and supporting information for Hawaiian OTEC way forward discussion.

Project Methodology

Three Navy sites to be assessed.

- Pacific Missile Range Facility (PMRF), Kaua‘i
- Joint Base Pearl Harbor – Hickam, Oahu
- Marine Corps Base Hawai?i, Kaneohe Bay, Oahu

Process

- Compile existing data of areas of interest into a comprehensive Desktop Study (DTS).
- Conduct assessment and select the best technical site from DTS data.
- Conduct ocean survey of the identified best site.
- Provide data to and assist Navy Region Hawaii in selecting pilot plant location.

Navy Sites Considered

PMRF, Kaua‘i

MCBH, Oa‘hu

JBPHH, Oa‘hu

OTEC Hawaii – Site Assessment Process

- Developed Site Evaluation Matrix to establish criteria and weights for evaluation
- Grouped factors for evaluation into categories
- Vetted the matrix and criteria with Navy, OTEC-LM Team
- Selected six sites for evaluation
  - Two each at PMRF, Kaneohe, and Pearl Harbor
  - Deepwater Site (1100m) and preferred anchoring site at each location
  - Criteria at all sites was min 20 Deg C Temp Differential)

OTEC Hawaii – Site Assessment Matrix

Factor Category	Description	Overall Net Weights
Platform Siting Factors	Mooring and anchoring, thermal resource depth, metocean conditions, currents, proximity to support base, compatibility with local commercial and military operations, etc	65%
Shore-landing Factors	Shore-landing sites, length of HDD drill, proximity to grid, hazards , environmental permitting, etc	9%
Cable Routing	Cable route length, cost, permitting, cable route hazards, environmental permitting, etc	12%
General Factors	Historical and cultural considerations, NAVFAC project requirements compatibility, baseload, electrical infrastructure compatibility, etc	14%

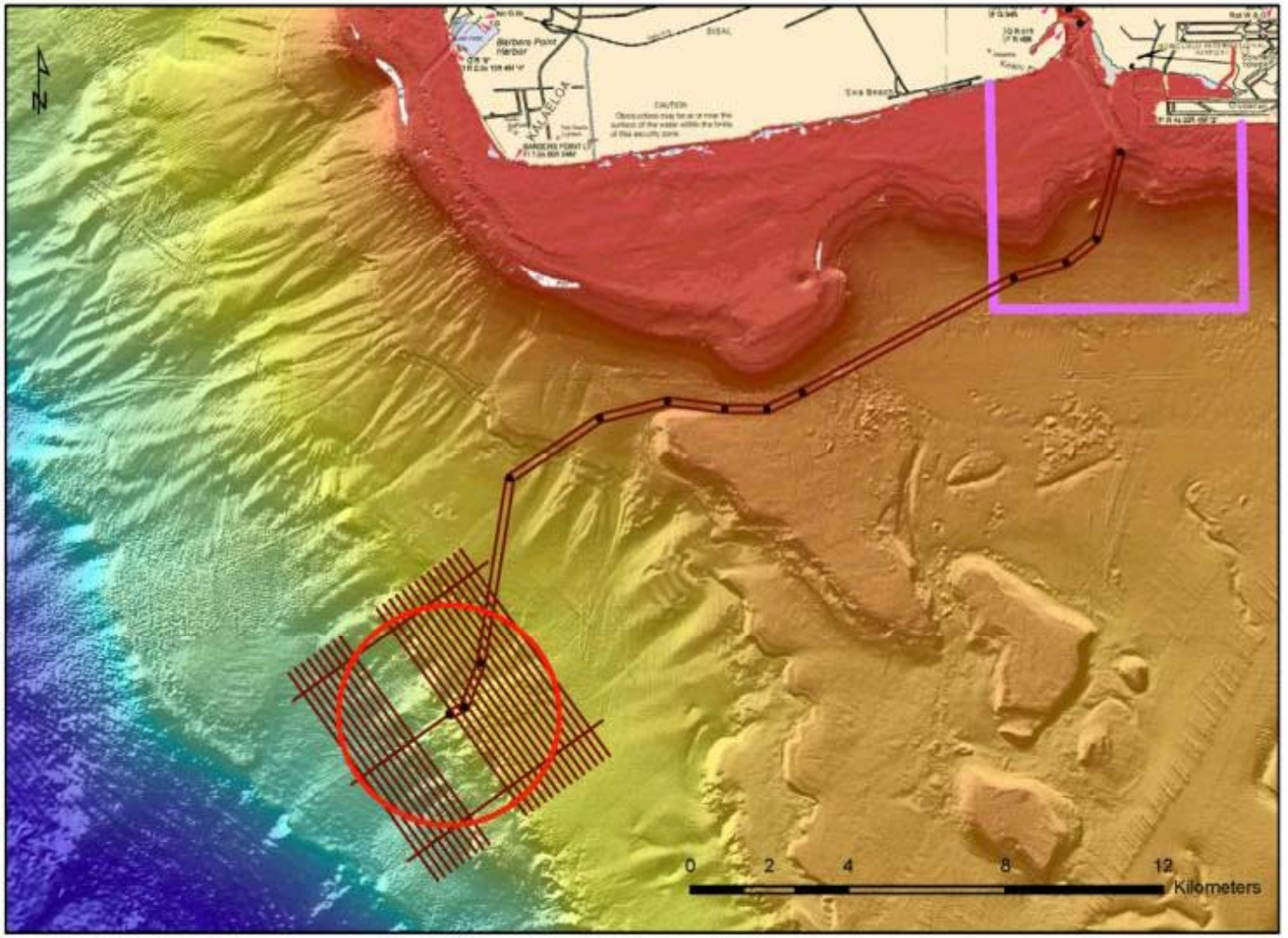
Evaluation Summary

	PH - A	PH-B	MCBH-A	MCBH-B	PMRF-A	PMRF-B
Platform Siting	3900	3859	3690	3662	3410	3357
Shore-landing	528	528	392	392	409	409
Cable Routing	500	500	619	590	639	730
General Factors	900	780	740	710	500	470
Total Points	**5828**	**5667**	**5441**	**5354**	**4958**	**4966**
Total %	**92.5%**	**90.0%**	**86.4%**	**85%**	**78.7%**	**78.8%**

Highest Scoring Site

Results presented to Commander Navy Region Hawaii, December 2009

Pearl Harbor – Site "A" Survey Plan

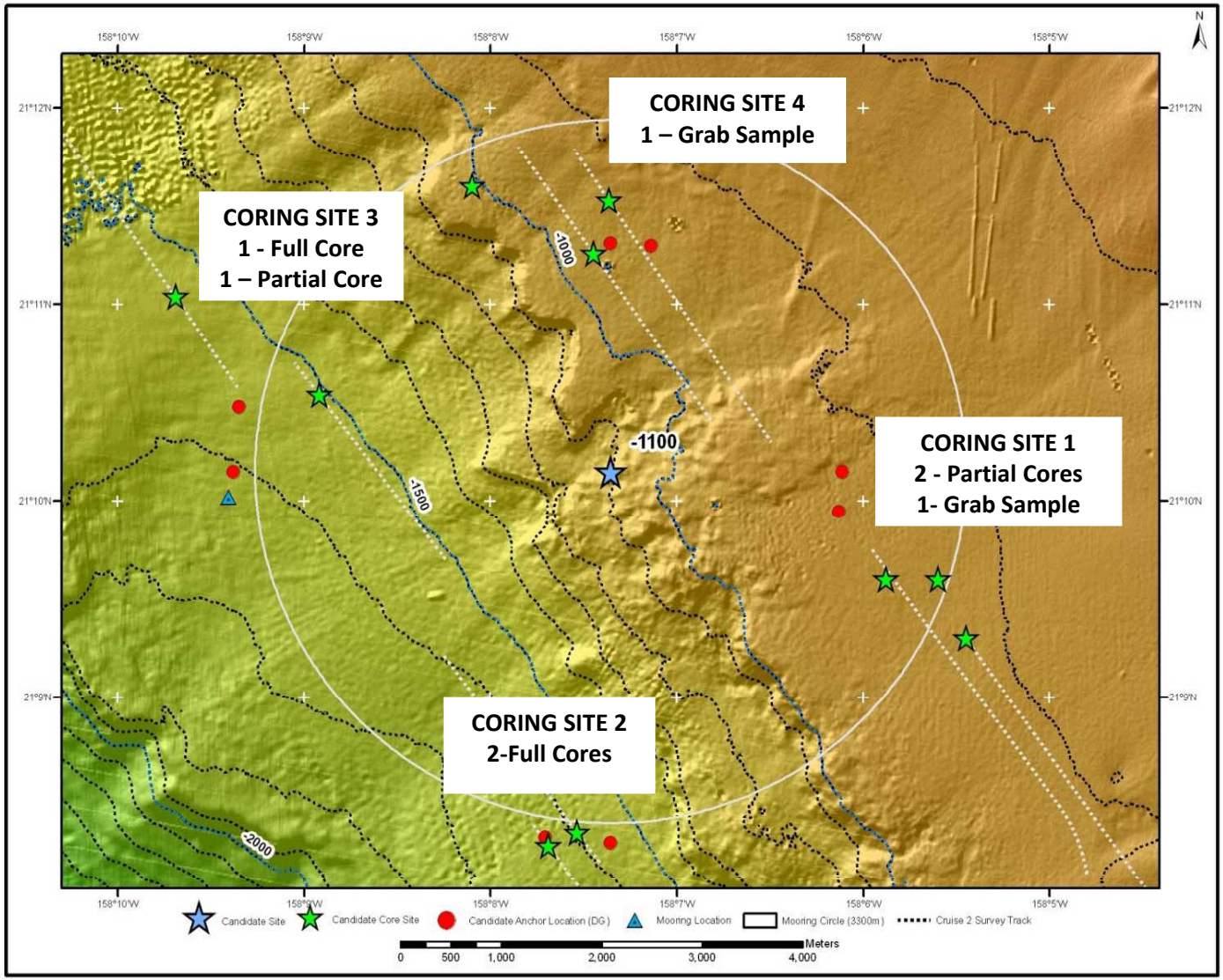


Acquired Data Summary

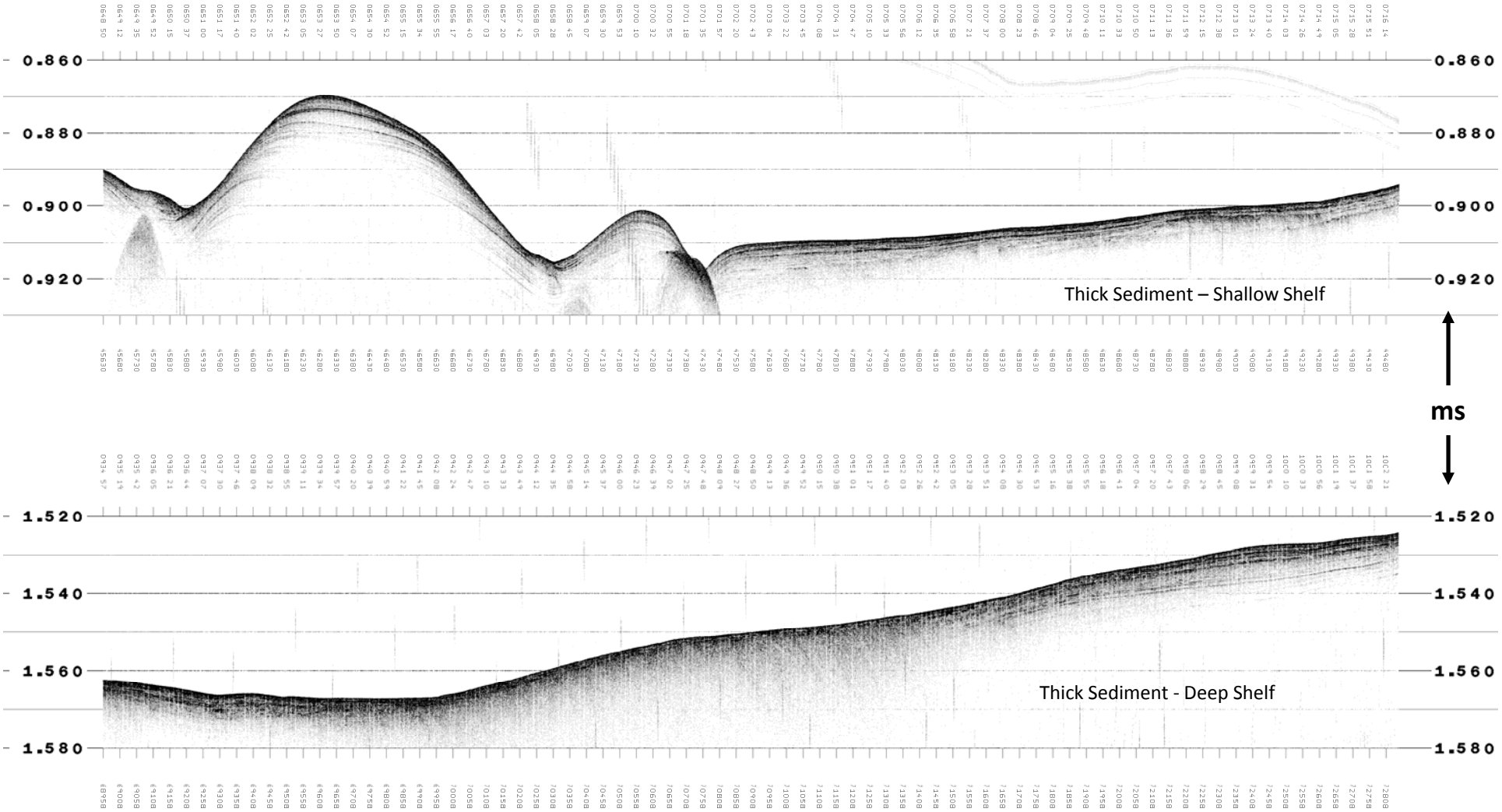
- Sea Floor Mapping:
  - Mulitbeam Sonar System (MBSS) Bathymetry
  - Side-scan Sonar
  - Sub-bottom profiles
- Sediments Core Samples – Coring
  - Gravity Core Attempts: 10 attempts at four site locations
  - Successful core samples: 3 Full Cores (10 ft) ; 3 Partial Cores (2-3 ft)
  - Harpoon Cone Penetrometer (CPT):
    - Equipment Failure – No Samples Obtained

- CTD and Water Samples
  - Four CTD casts were conducted at three sites
    - OTEC site at 1100 meters;
    - Site 1 (2 casts)
    - Site 3, west of the OTEC site in 1500 meters of water
- Current Measurement Mooring
  - 6-7 month deployment
  - Full-depth ADCP and CTP measurements

OTEC Hawaii
Coring/CTD Sites and Buoy Location



Sub-bottom Examples
Thick Sediment
Site 1 / Site 2



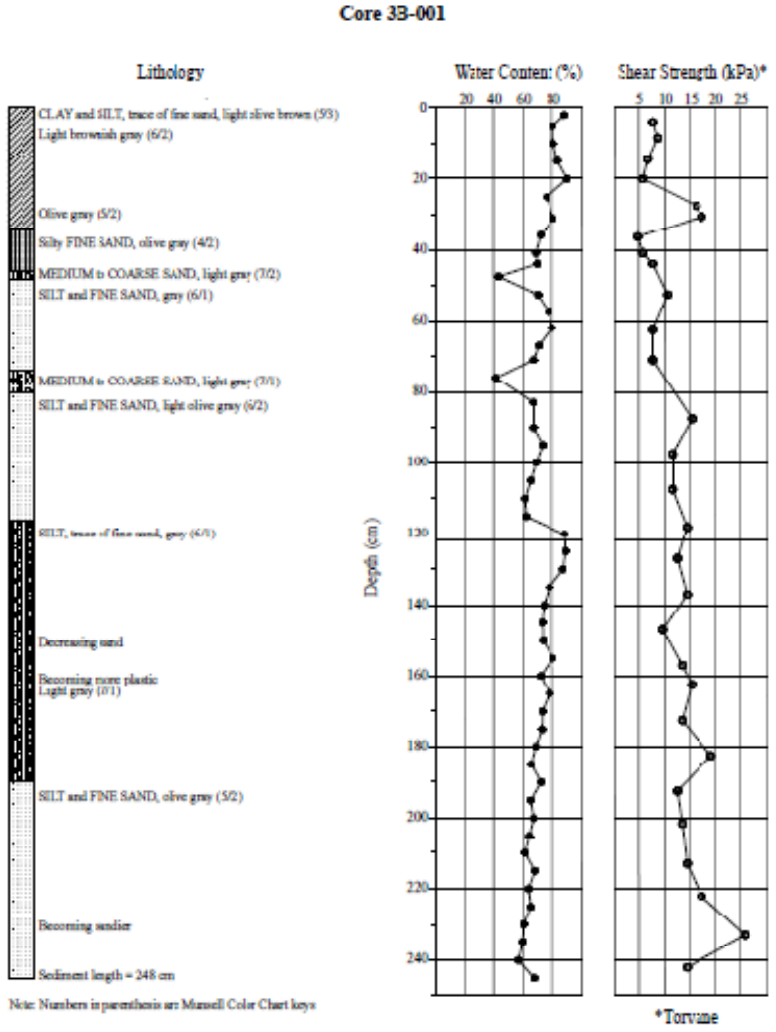
Preliminary Sediment Analysis

Example Core Results (preliminary):

- Site 3 - Lower Plateau
- Water Content and Shear Strength
- Sediment Characteristics:
  - Low-plasticity silt and fine sand
  - Shear strength increasing with depth
- Laboratory analysis of core in progress

Preliminary Conclusions:

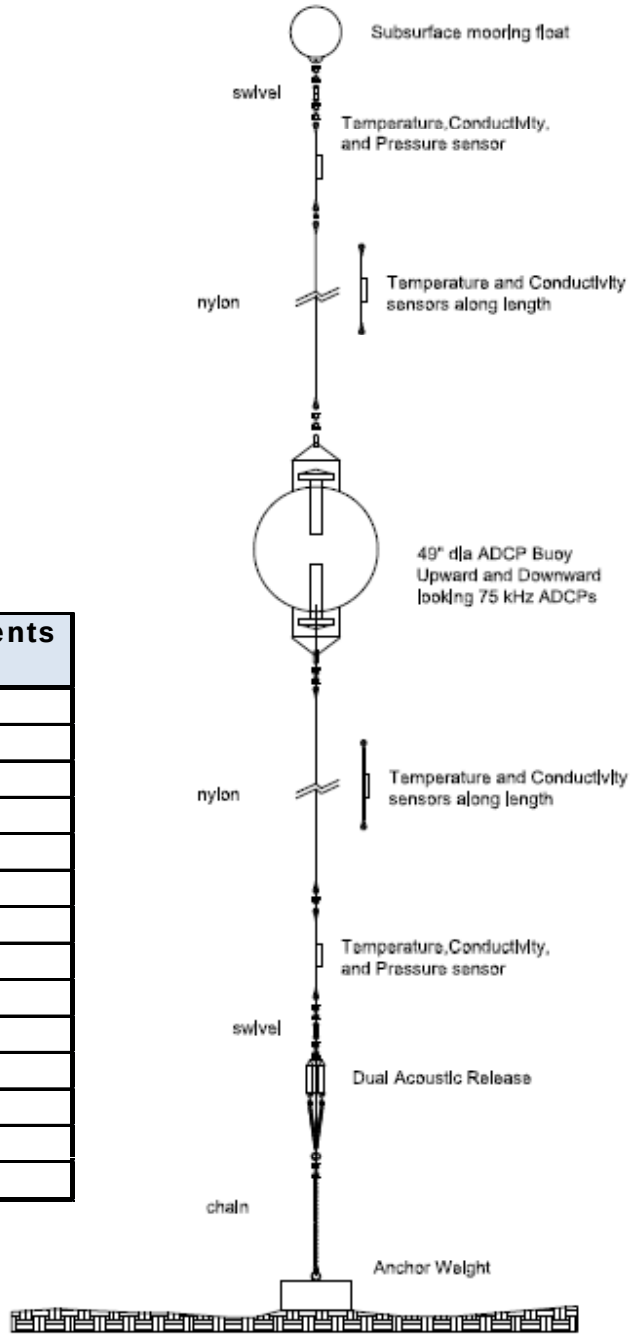
- Sediment recovered confirms significant regional presence of sediment as interpreted from sub-bottom profile data.
- Sediment characteristics compatible with conventional drag embedment anchors



Phase 2
ADCP Current Measurement String

Nominal 6-month measurement period

Depth (m)	Instrument	Sampling Rate	Measurements
20	37SM	30s	CTP
50	37SMP	150s	CT
80	37SMP	150s	CT
130	37SMP	150s	CTP
180			
230	37SMP	150s	CT
330			
450			
500	ADCP	20min	TP
650			
850	37SM	30s	CTP
1000	37SM	30s	CTP
1050			



RDI 75 kHz Workhorse Longrangers

600m Range

(LMCO/Makai)

ADCP Current Mooring Deployment

Survey Data Processing

- Core sediment samples
  - Field level analysis of selected cores (3) completed on deck
  - Soils lab analysis in process at UH
    - Soil strength, water content, and lithography completed on all samples.
    - Remaining soils analysis by 15 July
- By mid-July:
  - Integrated mosaic processing of high resolution bathymetry and sidescan data available
  - Updated sub-bottom sonar profiles geo-located
  - CTD and water sample reports
  - Evaluating options for generating sediment contour plots (Isopac)
- Survey Reports:
  - Towed Survey, sediment analysis, CTD, and water sample analysis – 15 July
  - Compilation of ADCP and CTD data (Mooring String) – 31 December

Next Steps

Additional Core Samples:

- Evaluating alternative coring approaches to secure sediment samples on upper plateau:
- Objective is to secure sediment samples in the upper plateau in a mid-summer cruise if feasible.
- Alternative is to combine additional sediment coring with mooring recovery in mid-November

Instrumentation Buoy Retrieval:

- Mid November planned retrieval

Final Report:

- September 2010