OFFSHORE SAND PROSPECTING IN HAWAII

James H. Barry
Sea Engineering, Inc.
Waimanalo, HI
SEA ENGINEERING, INC. WAS FOUNDED IN 1973 BY UNIVERSITY OF HAWAII GRADUATE STUDENTS TO PROVIDE MARINE-RELATED ENGINEERING, CONSTRUCTION AND DIVING SERVICES.

TODAY, WE HAVE FOUR OFFICE LOCATIONS IN HAWAII AND CALIFORNIA AND OVER 80 EMPLOYEES.

OUR CLIENTS INCLUDE PROFESSIONAL, BUSINESS AND INDUSTRIAL FIRMS; MARINE CONTRACTORS; GOVERNMENT AGENCIES (STATE, FEDERAL, COUNTY) AND RESEARCH INSTITUTIONS.
Why Offshore Sand Prospecting?

- Hawaii beach sand is virtually all carbonate – derived from offshore sources.
- On-land sources exist, but are limited or not available.
- Coastal erosion is a growing concern and certain areas have critical needs.

Ka`anapali, Maui 2003

Kuhio Beach, Waikiki
### EARLY RESEARCH OVERVIEW: Involved Organizations

<table>
<thead>
<tr>
<th>Period</th>
<th>Organization</th>
<th>Activities</th>
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<tbody>
<tr>
<td>1968-1978</td>
<td>University of Hawaii (HIG)</td>
<td>Reconnaissance Sand Surveying and Sampling</td>
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<td>State of Hawaii, Marine Affairs Coordinator</td>
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<td>Sea Grant (NOAA)</td>
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<td>USACE</td>
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<td>Pacific Concrete and Rock Company, Ltd.</td>
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<td>Ocean Innovators (Fred Casciano)</td>
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<td>Edward K. Noda &amp; Associates (State Department of Transportation)</td>
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<td>1993-1994</td>
<td>Sea Engineering /Precision Signal (CEROS)</td>
<td>Instrument Development</td>
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<td>MMTC</td>
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<td>1996-2000</td>
<td>USGS/Sea Engineering</td>
<td>Deposit Mapping and Characterization (Oahu)</td>
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<td>2000 - Present</td>
<td>Sea Engineering</td>
<td>Deposit Mapping and Characterization (Oahu and Outer Islands)</td>
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<td>UH Coastal Geology Group</td>
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<td>USACE</td>
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EARLY RESEARCH: Offshore Sand Mapped Around Oahu

GENERAL CONCLUSIONS:

- SAND DEPOSITS OCCUR IN ALLUVIAL CHANNELS AND WAVE-CUT TERRACES
- GROUND-TRUTH JET PROBES REVEALED THAT DEPOSITS ARE OFTEN THINNER THAN SHOWN BY GEOPHYSICS
- OFFSHORE SAND IS GENERALLY TOO FINE FOR BEACH NOURISHMENT, BUT SELECT LOCATIONS HAVE REASONABLE GRAIN SIZE CHARACTERISTICS
- OFFSHORE SAND IS GENERALLY GRAY IN COLOR

PROSPECTING:

1. LOCATE SAND: SIDE SCAN AND MULTIBEAM SONAR, GEOLOGICAL INSIGHT, DIRECT OBSERVATION
2. DETERMINE SAND THICKNESS: SUB-BOTTOM PROFILING AND PROBING
3. DETERMINE GRAIN SIZE CHARACTERISTICS: VIBRACORE SAMPLING
EARLY RESEARCH: POOR QUALITY DATA
1993 - 1995: SEI & PRECISION SIGNAL

INSTRUMENT DEVELOPMENT: CHIRP SUB-BOTTOM SONAR

- FUNDED BY CEROS (CENTER OF EXCELLENCE FOR RESEARCH IN OCEAN SCIENCES)
- DESIGNED BY STEVE SCHOCK AND LESTER LEBLANC – PRECISION SIGNAL, INC. (NOW PART OF EDGETECH) SPECIFICALLY FOR HAWAIIAN SAND DEPOSITS
- 0.4-10 kHz VARIABLE PULSE
- ACOUSTIC BAFFLING TO REDUCE NOISE
- WIDE 2-CHANNEL RECEIVE ARRAY
1996 - 2001: USGS OAHU SURVEYS

U.S. Geological Survey
Open-File Report 03-441

Geology of Reef-Front Carbonate Sediment Deposits around Oahu, Hawaii

by

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²TEOK Investigations, Poipu, HI
³Battelle Pacific Northwest National Laboratory, Richland, WA
⁴University of Hawaii, Honolulu

- COMPREHENSIVE GEOPHYSICAL SURVEYING AND VIBRACORE SAMPLING AROUND OAHU

Mokuleia 4
Massive-appearing (bioturbated), pebbly, medium- to very coarse-grained, 
algal/coral/foraminiferal carbonate sand: grayish orange (10YR7/4); very poor sorting; sand and 
pebble size clasts rounded to well rounded; composed mainly of a mix of calcareous algae (47.5%), 
coral fragments (15.5%) and foraminifera (11.0%); common carbonate rock fragments (8.5%) and 
mollusks (11.0%); light olive gray (5Y6/1); composed mainly of a mix of coral fragments (38.5%), 
calcareous algae (28.5%) and foraminifera (16.0%); common carbonate rock fragments (6.0%), 
minor echinoid fragments (3.0%), mollusks (2.0%) and *Halimeda* (2.0%).
REEF TOP SAND: WAIKIKI

- MAPPED BY UH COASTAL GEOLOGY GROUP (UHCGG) AND SEI USING AERIAL PHOTOGRAPHS, JET PROBES, AND GEOPHYSICS
- TYPICALLY 4-6 FT IN THICKNESS
- BEING USED FOR 24,000 CY NOURISHMENT OF KUHIO BEACH (JANUARY 2012)

DRAWING AND NOTES FROM CONSTRUCTION PLANS

TOYO PUMP FOR SAND RECOVERY
SEI SURVEYS: RECENT WORK

- KA`ANAPALI SURVEYS FOR KA`ANAPALI OPERATIONS ASSOCIATION (2008)
- KAHULUI FOR MOFFETT & NICHOL / COUNTY OF MAUI (2008)
- POIPU / KAPA`A FOR COUNTY OF KAUAI (2011)
- WINDWARD AND NORTH SHORE OAHU NEARSHORE REEF CHANNEL DEPOSITS (2013)
SEI SURVEYS: KA`ANAPALI (2008)

- COMPREHENSIVE SONAR SURVEYS, PROBING, AND VIBRACORE SAMPLING
- FOUND EXTENSIVE DEPOSITS SUITABLE FOR BEACH NOURISHMENT
- MOST SAND COMPOSED OF HALIMEDA – CALCAREOUS GREEN ALGAE

HALIMEDA MEADOW
SEI SURVEYS: KAHULUI (2008)

- SURVEY CONDUCTED TO PROSPECT FOR SAND SOURCE FOR NORTH SHORE OF MAUI

TYPICAL SUB-BOTTOM IMAGE

EMERGENCE OF LIMESTONE SUBSTRATE
SEI SURVEYS: POIPU (2011)

- SURVEY CONDUCTED AS PART OF ON-GOING COMPREHENSIVE STUDY OF POIPU BEACH: POIPU BEACH PARK RESTORATION STUDY (COUNTY OF KAUA'I)
- VIBRACORING CONDUCTED IN NOVEMBER, 2011
SEI SURVEYS: POIPU (2011)
Figure 5-3: Kaanapali Beach Sand vs Vibracore Samples
Note: Green = Halimeda sand, Blue = Kekaa Point sand, Red = Sand Wave area sand
ALOHA