4-30-2004

Acquisition of Digitial Geophysical Equipment for University of Maine Sea-Level, Coastal and Lacustrine Research

Daniel Belknap
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Joseph Kelley
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Final Report for Period: 08/1999 - 07/2002 **Submitted on:** 04/30/2004

Principal Investigator: Belknap, Daniel F. **Award ID:** 9977367

Organization: University of Maine

Title:

Acquisition of Digitial Geophysical Equipment for University of Maine Sea-Level, Coastal and Lacustrine Research

Project Participants

Senior Personnel

Name: Belknap, Daniel
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kelley, Joseph
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

See list of papers and abstract co-authors:
J. Andrew Cooper - University of Ulster, Coleraine
Rick Wahle - Bigelow Laboratory for Ocean Sciences
Steve Dickson - Maine Geological Survey
Duncan FitzGerald - Boston University
Michael Fenster - Randolph-Macon College

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:

4 contracts and 4 funded grants arising from the NSF-MRI equipment capabilities
Published papers and abstracts listed above
6 student theses completed and underway
Usage of equipment in teaching marine geophysics, examples from the data in numerous other classes.

Ph.D. Candidate Allen Gontz has gained intensive and extensive experience with the entire suite of equipment, resulting in numerous contracts and other external projects (including invitations from NOAA-NURP to lead sidescan sonar investigations in Stellwagen Bank National Marine Sanctuary, and in an upcoming benthic oceanographic cruise). Other students are in the process of developing experience with the gear.

Outreach Activities:

Presentation to the Geological Society of Maine, a Short Course lecture in 2003 to laypersons, professionals, and students.
Presentation in Searsport to a town meeting of citizens concerned about a potential Liquified Natural Gas terminal in Penobscot Bay.
Continuing development of links with Maine Geological Survey scientists on projects of practical interest to coastal landuse, sand and gravel resources, conflicting uses of the nearshore environment.
Continuing development of links with scientific colleagues in Northern Ireland for comparison of the two similar paraglacial shelf systems.

Journal Publications

Gontz, A.M., Belknap, D.F. and Kelley, J.T., "Seafloor features and characteristics of the Black Ledges area, Penobscot Bay, Maine, USA", Journal of Coastal Research, p. 333, vol. SI-36, (2002). Published

Belknap, D.F., Kelley, J.T. and Gontz, A.M.,, "Evolution of the glaciated shelf and coastline of the northern Gulf of Maine, USA,", Journal of Coastal Research, p. 37, vol. SI-36, (2002). Published

Kelley, J.T., Dickson, S.M., Belknap, D.F., Barnhardt, W.A. and Barber, D.C, "Sand volume and distribution on the paraglacial inner continental shelf of the northwestern Gulf of Maine", Journal of Coastal Research, p. 41, vol. 19, (2003). Published

Books or Other One-time Publications

Belknap, D.F., Gontz A.M., and Kelley, "Paleodeltas and preservation potential on a paraglacial coast ? evolution of eastern Penobscot Bay, Maine", (2004). Book, Accepted
Editor(s): D.M. FitzGerald and J. Knight, eds.,
Collection: D.M. FitzGerald and J. Knight, eds.,
Bibliography: Kluwer Academic Publishing

Gontz, Allen M., "Evolution of seabed pockmarks in Penobscot Bay, Maine", (2002). Thesis, Published
Bibliography: Unpub. MS Thesis, Dept. Geological Sciences, University of Maine, Orono, 118 pp.

Gontz, Allen M., 2004, "Sources and implications of shallow subsurface methane on the Maine inner continental shelf", (2004). Thesis, In progress
Bibliography: Ph.D. Dissertation, Dept. Earth Sci., Univ. Maine, Orono, pp.

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Discussed above in results

Contributions to Other Disciplines:

Interdisciplinary collaboration with benthic oceanographers - critical lobster habitat, and with maritime arcaheologists - wreck of 'The Portland.'

Contributions to Human Resource Development:

Listed above - students and technical training

Contributions to Resources for Research and Education:

Major resources for continuing research and education at the University of Maine - marine geophysics, offshore vibracoring, intergration of digital data in GIS contexts.

Contributions Beyond Science and Engineering:

List above in outreach

Categories for which nothing is reported:

Organizational Partners

Any Web/Internet Site

Any Product

OCE-9977367
NSF-MRI 1999-2002 Final Report

Daniel F. Belknap and Joseph T. Kelley

NSF Funding: $200,000

UMaine match: $165,661

Rossfelder Electric Vibracorer - We purchased the Rossfelder P-3, electric vibracorer, a powerful, flexibile, and portable unit. This system is deployed without anchoring in most settings, takes cores up to 6.5 m in length in mud, while 3 m is a good penetration in sand. A float and weight-stand system keeps the corer vertical, while the light electrical cable allows work in shelf water depths (the head is rated to 600 m working depth). The vibracorer includes the power head, core clamp, weight chest, and float package. We purchased cable for working in up to 200 m water depth, and a generator (10 kW 3-Phase 230 V) for maximum flexibility in ship selection. In addition, there are a number of ancillary tools and attachments (core nose and core catchers) required.

Rossfelder Vibracorer:	
P-3 Underwater Vibracoring System	$ 24,500
Bouyant Frame System	3,500
2 - 100 m Kevlar jacketed underwater cables	12,000
Set of 5 stainless corenoses w. catchers	1,495
Jig for hole alignment	140
Spare Terminal power cable	840
Total:	$ 42,475
Gillette 10 KW 3-Phase 230V generator	$ 4,135

Side-scan sonar (SSS) - We replaced our existing sidescan with a newer Edgetech DTS1000 digital system with a dual-frequency fish (105 and 500 kHz), monitor display, digital data recording, and a variety of digital and printer output capabilities. Side-scan sonar images are typically 100-200 m scale to either side of the track-line, with a third channel of depth under the towfish. Gray-scale patterns have allowed us to distinguish 16 categories of bottom type, as well as bedforms, bedrock fracture patterns, and human artifacts such as cables, shipwrecks and drag marks. Triton-Elics built-in mapping software allows mosaicking and export to GIS and other software. Digital recording and enhancement allows publication-quality images to be reproduced at will.

EdgeTech Digital Side-Scan Sonar	
DTS1000 System:	$ 36,000
DF-1000 Digital Towfish	
DF-1000 Digital Control Interface	
Topside Processor (Isis add-on)	20,000
100 m Kevlar reinforced Coaxial tow cable	3,250
DF-1000 Digital Towfish Accessories Kit	725
Complete DF-1000 Towfish Spare Parts Kit	15,000

Survey Office (Isis, DMAP, BathyPro)	9,800
Subtotal:	$ 84,775
EPC Recorder for side-scan printout	
GSP-1086-2 500 Series	12,100
Small Spares Kit 1086-2	1,160
Transport Case	800
Subtotal:	$ 14,060
SSS Total	$ 98,835

Seismic Reflection Profiler (SRP) - Our existing ORE Geopulse SRP system was purchased in 1985, and has experienced extensive, damaging field use. In order to achieve an integrated digital capability, we will purchase a completely new SRP, with digital recording capability, monitor display, and swell filter. This Sole Source Request does not apply to the SRP directly, but the Topside Processor is the control unit and integration unit - described below.

Applied Acoustics Seismic Reflection Profiler:	
CSP1000 Power Supply	$24,220
CAT200 Catamaran	2,840
AA200 Boomer Plate	8,970
Remote Control Box	900
Field Spares kit	3,380
Transit Case	1,190
50 m Boomer Cable	2,550
AAE 20-Element Hydrophone	8,210
AAE 8-Element Hydrophone	4,970
Subtotal:	$ 57,230
EPC Recorder for seismic printout	
GSP-1086-0	9,450
Small Spares Kit 1086-0	1,075
Transport Case	800
Subtotal:	$ 11,325
SRP Gross	$ 68,555

Digital data processing software and hardware (DDPS) - The Triton-Elics integrated system for post-processing, allows us to enhance data, remove artifacts, produce mosaics and interpretive diagrams, and enter information into a GIS domain, compatible with our existing Arc-Info-based GIS laboratory. A high-quality thermal printer allows us to produce raw or interpreted copies of our data equivalent to the original data, greatly improving our information transfer capabilities, and, as noted previously, providing more stable archives.
The suite of products is integrated by Triton-Elics into a system that can operate either seismic or side-scan system, or both simultaneously, in an asynchronous mode (that is: independently controlled and displayed, but linked to a time and navigation signal).

Triton-Elics Seismic Topside Processer/Control Unit	
Delph Seismic Data Acquisition and Processing hardware, 17î color monitor, mass data storage, software, transit case	$ 31,900
Delph Seismic Option Package software	6,500
SGIS Suite (Delph Seismic Office and SGIS)	19,800
Additional Monitor and Graphics (for simultaneous asynchronous seismic and side-scan collection)	1,560
TEI CPU and Monitor Cases	730
Topside Processor/Control Subtotal:	$ 60,490

Publications Resulting FROM USE OF NSF-MRI 1999 funds

Fenster, M.S., FitzGerald, D.M., Kelley, J.T., Belknap, D.F., Buynevich, I.V. and Dickson, S.M., 2001, Net ebb sediment transport in a rockbound, mesotidal estuary during spring freshet conditions: Kennebec River Estuary, Maine, USA: Geological Society of America Bulletin. v. 113, p. 1522-1531. December.

Belknap, D.F., Kelley, J.T. and Gontz, A.M., 2002, Evolution of the glaciated shelf and coastline of the northern Gulf of Maine, USA, Journal of Coastal Research Special Issue 36, p. 37-55.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2002, Seafloor features and characteristics of the Black Ledges area, Penobscot Bay, Maine, USA: Journal of Coastal Research Special Issue 36, p. 333-339.

Kelley, J.T., Dickson, S.M., Belknap, D.F., Barnhardt, W.A. and Barber, D.C., 2003, Sand volume and distribution on the paraglacial inner continental shelf of the northwestern Gulf of Maine: Journal of Coastal Research, v. 19, p. 41-56.

Belknap, D.F., Gontz A.M., and Kelley, J.T., 2004 in press, Paleodeltas and preservation potential on a paraglacial coast ñ evolution of eastern Penobscot Bay, Maine. In: D.M. FitzGerald and J. Knight, eds., High Resolution Morphodynamics and Sedimentary Evolution of Estuaries. Kluwer Academic Publishing.

Fenster, M.S., Knisley, B.A., FitzGerald, D.M., Belknap, D.F., Buynevich, I.V., Gontz, A.M. and Kelley, J.T., 2004 in press, Controls on estuarine morphodynamics: a case study on Merrymeeting Bay, Kennebec River estuary, Maine. In: D.M. FitzGerald and J. Knight, eds., High Resolution Morphodynamics and Sedimentary Evolution of Estuaries. Kluwer Academic Publishing

Published Abstracts:

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2001, Evidence for changes in the Belfast Bay pockmark field, Maine: Geological Society of America Abstracts with Programs, v. 33, no. 1, p. A2.

Belknap, D.F., Gontz, A.M., and Kelley, J.T., 2001, Evolution of Holocene tidal channels and the tidal ravinement surface in Penobscot Bay, Maine: Geological Society of America Abstracts with Programs, v. 33, no. 1, p. A2.

Belknap, D.F., Gontz, A.M. and Kelley, J.T., 2001, Rapid sea-level changes controlling late Quaternary valley incision, estuarine backfill, and tidal ravinement in the coastal Gulf of Maine: Geological Society of Canada/Mineralogical Society of Canada Joint Annual Meeting Abstracts, May 27-30, St. Johnís, Newfoundland, v. 26, p. 11-12.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2001, An evolutionary model for biogenic methane sourced pockmark field based on Penobscot Bay, Maine: Geological Society of Canada/Mineralogical Society of Canada Joint Annual Meeting Abstracts, May 27-30, St. Johnís, Newfoundland, v. 26, p. 52.

Belknap, D.F. and Kelley, J.T., 2001, Sedimentary strata of the inner shelf of the northern Gulf of Maine: glacial, deglacial and sea-level controls: American Geophysical Union Chapman Conference, Ponce, Puerto Rico, June 16-20.

Heinze, H. Dickson, S.M., Belknap, D.F. and Kelley, J.T., 2001, The effects of storm-generated currents on the sand beaches in southern Maine: American Geophysical Union Transactions, v.

Gontz, A.M., Kelley, J.T.; and Belknap, D.F., 2001, The use of sidescan sonar, shallow seismic reflection profiling, and GIS to assess the coastal zone: examples from Penobscot Bay, Maine. CoastGIS 2001, Halifax, NS, June, 2001.

Knisley, B.A., Fenster, M.S., FitzGerald, D.M., Belknap, D.F., Buynevich, I.V., Gontz, A.M. and Kelley, J.T., 2001, Controls on estuarine morpholodynamics: a case study on Merrymeeting Bay, Kennebec River estuary, Maine: Geological Society of America Abstracts with Programs, v. 33, no. 6, p. A273-A274.

Belknap, D.F., Kelley, J.T. and Gontz, A.M., 2001, Paleodeltas and preservation potential ñ Holocene evolution of the Maine shelf: Geological Society of America Abstracts with Programs, v. 33, no. 6, p. A275.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2001, Current and proposed pockmark research in coastal Maine: life cycles and fluid origins: Geological Society of America Abstracts with Programs, v. 33, no. 6, p. A455.

Belknap, D.F., Kelley, J.T. and Gontz, A.M., 2002, Evolution of the glaciated shelf and coastline of the northern Gulf of Maine, USA: International Coastal Symposium, 25-29 March 2002, Templepatrick, Northern Ireland, p. 5. Journal of Coastal Research SI-36 Proceedings of ISC 2002.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2002, Seafloor features and characteristics of the Black Ledges area, Penobscot Bay, Maine, USA: International Coastal Symposium, 25-29 March 2002, Templepatrick, Northern Ireland., p.19-20. Journal of Coastal Research SI-36 Proceedings of ISC 2002.

Belknap, D.F., Gontz, A.M. and Kelley, J.T., 2003, Pockmarks and natural gas in coastal Maine ñ the search for sources: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

Ferland, K.A., Kelley, J.T., Belknap, D.F., Dickson, S.M. and Gontz, A.M., 2003, An investigation of Glacioisostatic lake-level changes in Rangeley Lake, Maine: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 26.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2003, The Relationship Between Pockmarks, Gas-Enhanced Reflectors and Acoustic Wipeout in an Active Estuarine Pockmark Field, Penobscot Bay, Maine: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

Kelley, J.T., Belknap, D.F. and Gontz, A.M., 2003, A review of shallow-water pockmark distribution and origins in the northwestern Gulf of Maine: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2003, Pockmarks in Penobscot Bay: an overview of morphology, associations, and activity: Canadian Quaternary Association-Canadian Geomorphological Research Group, Program and Abstracts, Halifax, N.S., June 8-12, 2003, p. A40.

Gontz, A.M., Johnson, B.J., and Belknap, D.F., 2003, The Organic geochemistry of sediments recovered from an active estuarine pockmark field, Black Ledges, Penobscot Bay, Maine ñ Initial Results: Eos: Transaction of the American Geophysical Union, v. 84, no. 52, Ocean Sciences Meeting Supplement, Abstract OS21D-13, p. OS24. (January 26-30, 2004).

Gontz, A.M., Belknap, D.F., Wahle, R.A., Babb, I.G., Terrell, B. and Cowie-Haskell, B., 2003, Remotely operated vehicles and sidescan sonar ñ an integration of technology for investigation of benthic habitat and submerged cultural resources: Eos: Transaction of the American Geophysical Union, v. 84, no. 52, Ocean Sciences Meeting Supplement, Abstract OS22D-10, p. OS49. (January 26-30, 2004).

Belknap, D.F., Gontz, A.M., Wahle, R.A., and Hovel, K., 2004, Mapping lobster habitat with sidescan sonar and ROV - a geologic and benthic oceanographic collaboration: Geological Society of America Abstracts with Programs, v. 36, no. 2, p. 137.

Brothers, L., Kelley, J.T., Belknap, D.F., and Gontz, A.M., 2004, Construction of a baseline dataset for Saco Bay shoreface, Saco Bay, ME: Geological Society of America Abstracts with Programs, v. 36, n. 2, p. 46.

Gontz, A.M., Belknap, D.F., Johnson, B.J., and Kelley, J.T., 2004, Paleogeographic reconstructions of the Black Ledges pockmark field, Penobscot Bay, Maine from 13 ka to present: Geological Society of America Abstracts with Programs, v. 36, no. 2, p. 45.

Lee, K.M., Belknap, D.F., Kelley, J.T., and Gontz, Allen M., 2004, Submerged environments of Saco Bay, Maine: Geological Society of America Abstracts with Programs, v. 36, no. 2, p. 45.

Grants and Contracts Utlilizing NSF-MRI 1999 Equipment

[Contract] ñ MER Assessment Corporation: Sidescan Sonar survey of Portland Harbor drydock dredge and restoration area - D.F. Belknap, January-May 2001, $1420. 1 MS student supported

[Contract] ñ Science Applications International Corporation (SAIC): Sidescan sonar survey of Rockland Harbor dredge spoil disposal area - D.F. Belknap, March-June, 2001, $2728. 1 MS student supported

[Contract] ñ Science Applications International Corporation (SAIC): Seismic profiling survey of harbor, New London, CT - D.F. Belknap, May-June, 2002, $7448. 1 MS student supported

NOAA-NURP: Cobble **n**ursery **l**andscapes and the **r**egional **a**bundance of the **A**merican **l**obster**:** D.F. Belknap, $21,795. Collaborative project with R.A.Wahle, Bigelow Laboratory for Ocean Sciences and K. Hovel, San Diego State University, 2003-2004. National Undersea Research Center - Univ. Connecticut, Avery Point. NAGL-03-01A

NOAA-Maine Sea Grant: Monitoring of Coastal Dynamics at the Saco River Mouth Near Jetty Modification and Beach Nourishment Projects**:** D.F. Belknap, J.T. Kelley and S.M. Dickson, $141,040. 2003-2005.

[Contract] ñ Atlantic Testing Laboratories, Ltd. Vibracore rental and training, Hudson River contaminated sediments assessment. Sept. ñ Oct. 2002. $15,685. Support for 1 graduate student.

Minerals Management Service: Multi-year cooperative assessment of sand and gravel resources along the inner continental shelf of Maine: J.T. Kelley, D.F. Belknap, and S.M. Dickson, (Maine Geological Survey), $ 97,066, 2003-2004. Support for 1 graduate student.

University of Ulster: Sabbatical research project, J.T. Kelley with D.F. Belknap and J.A.G. Cooper, University of Ulster, Coleraine, Northern Ireland. Vibracoring lowstand shoreline deposits.

Student Theses using NSF-MRI Equipment

Brothers, Laura L., 2004 in progress, Nearshore sedimentary environments of the mouth of the Saco River, Maine, in relationship to proposed jetty modifications: Unpub. M.S. Thesis, Dept. Earth Sciences, Univ. Maine, Orono, pp.

Ferland, Kristie M., 2004 in progress, Geology of Rangeley Lake from seismic reflection profiling and sidescan sonar mapping. Unpub. M.S. Thesis, Dept. Earth Sciences, Univ. Maine, Orono, pp.

Gontz, Allen M., 2002, Evolution of seabed pockmarks in Penobscot Bay, Maine: Unpub. MS Thesis, Dept. Geological Sciences, University of Maine, Orono, 118 pp.

Gontz, Allen M., 2004 in progress, Sources and implications of shallow subsurface methane on the Maine inner continental shelf: Ph.D. Dissertation, Dept. Earth Sci., Univ. Maine, Orono, pp.

Heinze, H.W., 2001, Anthropogenic influences and meteorological effects: how they are changing the sand beaches in southern Maine: Department of Geological Sciences, Unpub. MS Thesis, University of Maine, Orono, 380 pp.

Lee, Kristen M., 2004 in progress, Relationship of lowstand shoreline and offshore sand resources in Outer Saco Bay, Maine to postglacial sea-level changes. Unpub. M.S. Thesis, Dept. Earth Sciences, Univ. Maine, Orono, pp.

Leach, Peter, A., in progress, 2004, Geoarchaeological modeling of potential Archaic oyster exploitation in central coastal Maine. Unpub. M.S. Thesis, Climate Change Institute, Univ. Maine, Orono, pp.

Undergraduate classes utilizing NSF-MRI Equipment

GES-417 Introduction to Geophysics ñ Assistant Professor Peter O. Koons. Belknap and Gontz participated in field trip demonstration and practical exercises using Triton-Elics digital system, boomer and sidescan, Spring 2003 and 2004.

Some Major Findings:

1. **Discovery of Penobscot Paleodelta, continuing development of evolutionary models for the paraglacial shelf of New England, evaluation of evidence for sea-level change control on offshore sand bodies:**

Belknap, D.F., Kelley, J.T. and Gontz, A.M., 2002, Evolution of the glaciated shelf and coastline of the northern Gulf of Maine, USA, Journal of Coastal Research Special Issue 36, p. 37-55.

Evolution of the Glaciated Shelf and Coastline of the Northern Gulf of Maine, USA
Daniel F. Belknap, Joseph T. Kelley and Allen M. Gontz

ABSTRACT

The Gulf of Maine, (northeast US coast) records shelf evolution since deglaciation ca. 15 ka. Glacial erosion of bedrock left a complex coastline of bays, peninsulas and islands. Till and outwash provided coarse sediment for reworking in littoral systems throughout the Holocene transgression. Glaciomarine mud, the Presumpscot Formation, was an abundant source of fine sediments that were reworked in estuaries, embayments and back-barrier systems. Relative sea-level change was driven by both isostatic and eustatic components. Initial submergence by 70-130 m above present sea level was contemporaneous with marine-based ice-sheet retreat 15-13 ka. Rapid emergence followed to 60 m below present, during continuing isostatic rebound 13-11 ka. Finally, submergence and transgression occurred 10.8 ka to present as isostatic rebound was overtaken by eustatic sea-level rise. Reworking during emergence and lowstand brought sand and gravel to the present coast and inner shelf, building paleodeltas at the mouths of the Merrimack River and Kennebec River. Other rivers, such as the Penobscot, drained landscapes with fewer coarse-grained sources, and have primarily mud-filled estuaries, such as Penobscot Bay.

Detailed seismic reflection profiling and sidescan sonar mapping provide data for a model of inner-shelf evolution based on principles of sequence stratigraphy. The lower sequence boundary is the unconformity created on top of the Presumpscot Fm. and other glacial sediments during emergence. Lowstand systems tracts are best recognized in paleodeltas. Transgressive systems tracts are thin, but interrupted by parasequences of prograding deltaic and estuarine facies in some estuaries. Significant examples such as the newly discovered Penobscot Paleodelta (8-9 ka, 30 m below present sea-level) may relate to a slowing of relative sea-level rise. Highstand systems tracts formed in the late Holocene as the rate of sea-level rise slowed and the rate of sediment supply allowed stabilization and progradation of barriers and tidal deltas. Preservation potential of these features is controlled by the open coast ravinement unconformity, and by the tidal ravinement unconformity and bluff ravinement unconformity in embayments. Variability in preservation potential results both from paleotopography and differing energy of modern processes.

NOAA-Maine Sea Grant: Monitoring of Coastal Dynamics at the Saco River Mouth Near Jetty Modification and Beach Nourishment Projects**:** D.F. Belknap, J.T. Kelley and S.M. Dickson, $141,040. 2003-2005.

Minerals Management Service: Multi-year cooperative assessment of sand and gravel resources along the inner continental shelf of Maine: J.T. Kelley, D.F. Belknap, and S.M.

Dickson, (Maine Geological Survey), $ 97,066, 2003-2004. Support for 1 graduate student.

Brothers, Laura L., 2004 in progress, Nearshore sedimentary environments of the mouth of the Saco River, Maine, in relationship to proposed jetty modifications: Unpub. M.S. Thesis, Dept. Earth Sciences, Univ. Maine, Orono, pp.

Lee, Kristen M., 2004 in progress, Relationship of lowstand shoreline and offshore sand resources in Outer Saco Bay, Maine to postglacial sea-level changes. Unpub. M.S. Thesis, Dept. Earth Sciences, Univ. Maine, Orono, pp.

Brothers, L., Kelley, J.T., Belknap, D.F., and Gontz, A.M., 2004, Construction of a baseline dataset for Saco Bay shoreface, Saco Bay, ME: Geological Society of America Abstracts with Programs, v. 36, n. 2, p. 46.

CONSTRUCTION OF A BASELINE DATASET FOR SACO BAY SHOREFACE, SACO BAY, ME

BROTHERS, Laura[1], KELLEY, Joseph T.[2], BELKNAP, Daniel F.[2], and GONTZ, Allen M.[2], (1) School of Marine Sciences, Univ of Maine, Bryand Global Science Center, Orono, ME 04469, Laura.Brothers@umit.maine.edu, (2) Department of Earth Sciences, Univ of Maine, Bryand Global Sciences Center, Orono, ME 04469-5790

Begun in 1867, the paired jetty system at the mouth of the Saco River was intended to stabilize the river mouth tidal deltas to facilitate commercial navigation. The North Jetty was sequentially enlarged over 100 years to permit deeper draft vessels to enter the estuary and to create an anchorage at the site of the former tidal deltas. Presently 2032 m in length, the North Jetty is one of the largest along the US East Coast. Its enlargement was erroneously predicated on the belief that sand was moving into the estuary from beaches in the north, when in fact sand moves from the Saco River as a source toward the north. The North Jetty is believed by local property owners to cause erosion of the adjacent beach by reflecting waves onto the shoreline; 33 properties have been lost between 1968 and 1998. To remedy this, the Army COE is considering altering the North Jetty to increase sand retention on the beach at Camp Ellis. We are testing the hypothesis that the alteration will improve conditions on the beach by measuring river and nearshore sand movement pre- and post-alteration, and by evaluating shoreline and bathymetric changes following alteration.

We collected approximately 25 km^2 of new multibeam bathymetry, 45 km^2 of sidescan sonar imagery and 35 km of seismic reflection profiles of the shoreface immediately adjacent to the jetties during the summer of 2003. During this initial phase, we mapped a series of sediment bodies and erosional features including sand waves, bars, rippled scour depressions, and scour pits. These features were correlated with sediment textures, thicknesses, bathymetry, wave patterns, currents and proximity to the jetties. These new data were compared to sidescan sonar imagery acquired in 1995 for evidence of changes in sediment texture and evolution of rippled scour depressions. In general, the sediment texture patterns observed on the sidescan imagery show little change. General, large-scale bathymetric evolution of the region is under evaluation by comparison of time series bathymetry. A repeat survey of the area is planned for the summer of 2004, post nourishment and summer 2005.

Lee, K.M., Belknap, D.F., Kelley, J.T., and Gontz, Allen M., 2004, Submerged environments of Saco Bay, Maine: Geological Society of America Abstracts with Programs, v. 36, no. 2, p. 45.

SUBMERGED ENVIRONMENTS OF SACO BAY, MAINE

LEE, Kristen M., BELKNAP, Daniel F., KELLEY, Joseph T., and GONTZ, Allen M., Department of Earth Sciences, Univ of Maine, Bryand Global Sciences Center, Orono, ME 04469-5790, kristen.lee@umit.maine.edu

Rapid relative sea-level change was the primary process forcing alteration in littoral environments in Saco Bay, Maine over the last 14,000 years. Bedrock geology, glacial deposits and postglacial deposits have constrained the morphology of Saco Bay through the last regression, with a lowstand at about 60 m below present sea level at approximately 10,500 years ago, and the subsequent transgression. To understand the environmental conditions present at the lowstand of sea level in Saco Bay, ME, we gathered multibeam bathymetric and sidescan backscatter data in August 2003 and coupled it with previously collected seismic reflection profiles and bottom samples. The new observations were collected in a narrow swath of data in 40 to 80 m water depth targeting presumed lowstand deposits. The pairing of bathymetric and surfical geology with stratigraphy has allowed the interpretation of ancient, submerged beach, river and tidal environments, which have undergone continued modification by modern processes. Placing these environments into a sequence stratigraphic framework and series of paleo-geographic reconstructions have aided in our knowledge of the evolution of the bay and locations of sand deposits. The reconstructions and framework will serve as a basis for future seismic and coring work planned for 2004. In this investigation of the influence of relative sea-level change on past environments in a sandy embayment, we seek to further the understanding role of isostasy in past depositional environments and subsequent modifications. This understanding of past sea-level change will also provide insight to the modern environmentís response to a changing sea level and consequent environmental stress.

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2. **Development of habitat assessment tools and models of lobster exploitation of cobble bottoms in New England ñ collaboration of marine geology/geophysics with benthic biological oceanographers.**

Belknap, D.F., Gontz, A.M., Wahle, R.A., and Hovel, K., 2004, Mapping lobster habitat with sidescan sonar and ROV - a geologic and benthic oceanographic collaboration: Geological Society of America Abstracts with Programs, v. 36, no. 2, p. 137.

MAPPING LOBSTER HABITAT WITH SIDESCAN SONAR AND ROV - A GEOLOGIC AND BENTHIC OCEANOGRAPHIC COLLABORATION

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Lobsters are a major fishery in much of the northeastern US. Benthic substrate is a critical control from settlement through juvenile stages and into adulthood. While adult lobsters can be

found on muddy and sandy bottoms during feeding and migration, cobble and boulder habitat provides critical shelter for many life stages. Cobble and boulder habitats are remnants of glacial deposition, modified by post-glacial marine reworking. The hypotheses tested center around the concept that regional settlement patterns are related to environmental controls: 1) oceanographic: current patterns and temperature, 2) biological: reproductive success, food sources, predation, competition, and disease, 3) habitat: shelter for early post-larval and juvenile phases. Our research plan involves scale-specific tests of habitat and lobster abundance: 1) regional scale: tests of oceanographic and biologic controls, 2) landscape scale: tests availability of habitat, especially pebble, cobble and boulder shelters, and edges adjoining mud bottoms; 3) patch scale: direct sampling and ROV observations of post-larval, juvenile and adult-phase lobsters. We conducted digital sidescan sonar surveys, totaling ca. 72 km^2, from the R/V Connecticut in July, 2003 at 7 nearshore regions (10-30 m depths): Newport, RI; Buzzards Bay, MA; Cape Cod Bay, MA; Cape Ann, MA; Rye, NH; Casco Bay, ME; Mt. Desert Island, ME; and an 8íth region, Muscongus Bay, ME in the fall, due to weather constraints. ROV dives followed immediately in 3-4 patches in each region to examine cobble-boulder habitats, using the sidescan mosaic as a detailed navigation guide. Preliminary results indicate that cobble habitats are available in all the nearshore regional sampling sites at 10-30 m depth. Buzzards Bay was essentially deserted - no lobsters were found. The peak adult lobster abundance occurred in Casco Bay. Sidescan sonar mapping in geo-referenced imagery allows precise navigation of the ROV, and direct linkage of landscape-scale mapping to in situ observations, enhancing geological and biological research collaboration. This study is funded by the NOAA-National Undersea Research Center, Univ. Connecticut, Avery Point.

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3. Development of models of evolution of methane gas fields and pockmarks in paraglacial shelves.

Gontz, Allen M., 2002, Evolution of seabed pockmarks in Penobscot Bay, Maine: Unpub. MS Thesis, Dept. Geological Sciences, University of Maine, Orono, 118 pp.

Gontz, Allen M., 2004 in progress, Sources and implications of shallow subsurface methane on the Maine inner continental shelf: Ph.D. Dissertation, Dept. Earth Sci., Univ. Maine, Orono, pp.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2002, Seafloor features and characteristics of the Black Ledges area, Penobscot Bay, Maine, USA: Journal of Coastal Research Special Issue 36, p. 333-339.

SEAFLOOR FEATURES AND CHARACTERISTICS OF THE BLACK LEDGES AREA, PENOBSCOT BAY, MAINE, USA

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Abstract

The Black Ledges, a series of islands, shoals, and ledges in East Penobscot Bay, Maine, was mapped with digital sidescan sonar and shallow marine seismic reflection equipment. We collected a total of 38 km^2 of sidescan and 600 km of seismic data during four cruises in 2000-2001. The sidescan sonar reveals a surficial geology dominated by muddy sediments, with

frequent, patchy outcrops of gravel and minor amounts of bedrock. There are seven large concentrations of pockmarks with populations totaling over 3500 in the areas of muddy sediments. Generally circular, pockmarks range in size from five to 75 meters in diameter and up to eight meters deep. Calculations show over 2 x 10^6 m^3 of muddy sediment and pore water were removed from the system. Seismic data reveal a simple stratigraphy of modern mud overlying late Pleistocene glaciomarine sediment, till and Paleozoic bedrock. Seismic data image areas of gas-rich sediments and gas-enhanced reflectors in close association with pockmarks, suggesting methane seepage as a cause. Pockmarks are recognized in areas lacking evidence of subsurface methane accumulations adding further validity to the late stage of development for the field. Elliptical pockmarks, found in nearly 40 m of water, show modification by currents and degradation of the pockmark form. This suggests depletion of methane and a late stage of development. A more intensive investigation of the area, including coring and high-resolution geophysics is currently in progress.

Gontz, A.M., Belknap, D.F. and Kelley, J.T., 2003, The Relationship Between Pockmarks, Gas-Enhanced Reflectors and Acoustic Wipeout in an Active Estuarine Pockmark Field, Penobscot Bay, Maine: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

Kelley, J.T., Belknap, D.F. and Gontz, A.M., 2003, A review of shallow-water pockmark distribution and origins in the northwestern Gulf of Maine: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

Belknap, D.F., Gontz, A.M. and Kelley, J.T., 2003, Pockmarks and natural gas in coastal Maine ñ the search for sources: Geological Society of America Abstracts with Programs, v. 35, no. 3, p. 7.

POCKMARKS AND NATURAL GAS IN COASTAL MAINE ñ THE SEARCH FOR SOURCES

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Coastal Maine contains estuarine and nearshore deposits of gas-charged Holocene sediments covering ca. 311 km2. Well-developed pockmark fields occur in Penobscot Bay, Passamaquoddy Bay, Blue Hill Bay, and in many smaller sites. In 2001-2002 we conducted sidescan sonar surveys, seismic reflection profiling, and vibracoring designed to elucidate origins and evolution of pockmark fields. We targeted well-developed pockmark fields in Penobscot Bay, a large estuary, and Muscongus Bay, a neutral embayment. Muscongus Bay contains large areas of abundantly gas-charged sediments, but with only one or two small pockmarks known. Our initial hypothesis for the Muscongus Bay target area, an area informally named Cranberry Basin, was that bedrock ridges may have contained an early Holocene lake and/or restricted estuary at times of sea level lower than ca. 30 m. We have recovered 46 vibracores in Penobscot Bay and 10 in Muscongus Bay, in addition to 5 and 9 vibracores, respectively, from earlier projects. The upper 3-4 m of the Holocene section in Penobscot Bay are typically olive-brown, relatively well oxidized mud with water content of 40-60%, and with abundant organic content (5-7% LOI) in

the form of fine detrital organic material. Near-surface shear strengths are generally 1.5-2 kg/cm2. The massive mud contains few intact mollusk fragments or foraminifera. Common zones with up to 4 cm diameter may be burrow traces, or possibly gas vent structures. Slightly indurated ì pipesî in cores and dredged from the seafloor resemble published examples from known gas venting regions. Cranberry Basin cores are distinctively darker grey, reduced muds with very high organic contents (10-12%) and water contents (60-70%). Near-surface shear strength is <1 kg/cm2. They contain abundant bivalves and gastropods, benthic foraminifera, with scattered sand lenses, shell hash lenses, and siliceous sponge spicules. They also contain abundant natural gas. At least one core contains detrital organic matter and abundant salt-marsh foraminifera. There is no evidence for lake sediments in the cores opened to date. The distinctly different sediments and degree of pockmark formation in the two embayments may be related to riverine inputs, paleogeography, or physical circulation. We rule out seismicity or groundwater as driving mechanisms.