Interior Mud Flats of Florida Bay Islands: Records of Sea Level Rise, Storm History, and Island Formation

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Staff at Mariners Hospital, Key Largo, for CAT scans
Projected Future Change
Projected Future Change

Image from http://coast.noaa.gov/slr/
1. What is the fate of the islands and mudbanks as sea level rises and climate changes?

2. Will the character of Florida Bay change completely and become a more open water estuary, similar to Biscayne Bay?

3. Will this mean the loss of the unique habitats on the interior of these islands?
Project Goals

Use the relatively complete sedimentary record preserved in the island interiors to determine:

• Sea level rise history
• Storm history
• Role of SLR and storms in the geologic and ecologic history of the islands
• Role of the islands in carbon sequestration
Why core on the islands?

- Interior of the islands are basins that entrap sediment and debris
- Sparse plants and organisms means better preservation of layers
- Most complete record in Florida Bay (Enos, 1989; Swart and Kramer 1997)

Storm surge + 6 feet at Vaca Key

October 24, 2005
Hurricane Wilma

Images from http://www.srh.noaa.gov
April 2014 Coring Locations

- Jim Foot Key
- Buttonwood Key #7
- Russell Key
- Bob Allen Key
Coring Methods: Russian Cores
Coring Methods: Piston Cores

Collected:
- 2-3 Russian cores/island
- 1 4.5” piston core /island
- 1 2” piston core/island
- Elevation data each site
Planned Analyses

**Russian Cores:**
- C accumulation rates
- Peats – macro-plants
- Isotopic ratios
- % Carbon
- % Nitrogen
- C/N
- Stratigraphy and sediment description
- C-14 dating
- Pollen
- Loss on Ignition
- Bulk density

**4.5” Piston Cores:**
- Grain size
- Pb-210
- Mollusks
- Ostracodes & Forams
- Diatoms
- CAT scans

**2” Piston Cores:**
- XRF analysis
- Photo scans
• Reached Plio-Pleistocene bedrock in all cores so captured entire record available
• Good agreement between piston & Russian cores at each site (note compression of piston cores)
• C-14 ages for the bottom of three basal peats = ~4500-4900 BP
• C-14 ages for top of basal peats = ~3185-3820 BP
• Consistent with previously published ages of ~5500 for onset of flooding of deepest parts of Bay (eg. Enos 1989)
Overview

C-14 ages for upper peats / organic layers = ~725-1610 BP

955-1065 BP
725-900 BP
1610-1525 BP
1410-1560 BP
Preliminary Interpretation

Depth in cm

Russell 3 (A&C)

- **firm carbonate clay**
- Carbonate clay / mud
- Carbonate mud
- Peat
- Carbonate mud w/ large plant frags
- Carbonate mud w/ organics
- Shell layer
- Peat

**Preliminary Environment based on mollusks**

- Interior mud flats / island edge
- Occasional freshwater
- Shallow nearshore or washover
- Estuarine

**Calibrated Radiocarbon Age**

- 1383 ± 42 BP
- 1484 ± 72 BP
- 3364 ± 45 BP
- 4528 ± 98 BP

USGS
Preliminary Interpretation

Transgression - Rising Sea Level

Island Formation

Preliminary Environment based on mollusks

Interior mud flats / island edge

Occasional freshwater

Shallow nearshore or washover

Estuarine

Calibrated Radiocarbon Age

1383 ± 42 BP

1484 ± 72 BP

3364 ± 45 BP

4528 ± 98 BP
Patterns very similar to Enos & Perkins (1979) idealized sequence.
Incorporating Historical Data

Whipray / Buttonwood #7 - 1870

US Coast & Geodetic Survey 1870 Map
Incorporating Historical Data

Whipray / Buttonwood #7 - 1935
Incorporating Historical Data

Elevation at center of island = -0.17 m MSL
Incorporating Historical Data

Whipray / Buttonwood #7 – 1935 overlay on satellite

Reduction of mangroves, and increase in size of mudflats between 1935 and present
Incorporating Historical Data

Jim Foot - Today

Today - Jim Foot has open tidal exchange in SE section of island

Elevation on edge of island = -0.47 m MSL - lowest recorded
Incorporating Historical Data

Jim Foot - 1935 overlay on satellite

Today - Jim Foot has open tidal exchange in SE section of island. Mangroves shown in 1935 map - dead stumps present today.
Incorporating Historical Data

Russell Key - Today

Elevation on NE side of island = -0.35 m MSL

Today – Russell has open tidal exchange in SE section of island

ESRI World Imagery - April 2015 from http://www.arcgis.com
Incorporating Historical Data

Russell Key - Today

Today – Russell has open tidal exchange in SE section of island
What we know so far . . .

- Ages of basal peats are consistent with initial flooding of Florida Bay approximately 5500 years ago
- Similar sequences of basal peat, followed by estuarine sediments and island formation in all the cores
- Elevation of basins is below sea level
- Indication from examination of historical imagery that sea level rise is already affecting islands

Stay tuned for more as we continue with our analyses!
For more information on research visit: http://sofia.usgs.gov/

Related Presentations:
B. Stackhouse – Wed. Poster Session # 76 – Extreme Environments
M. Jones – Thurs. 3:30, Great Cypress Room – Patterns of Change & Carbon Storage

Thank you!