EXAMINING AND TESTING PREHISTORIC ARCHAEOLOGICAL FEATURES ON THE OCS

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Project abstract: This funded project addresses methodologies for accurately locating and identifying submerged prehistoric archaeological sites on the outer continental shelf. Three (3) areas tentatively identified as high probability areas for site occurrence and preservation will be tested to determine if they actually represent archaeological deposits.

PROGRESS TO DATE

- Background investigation included review of 204 industry reports

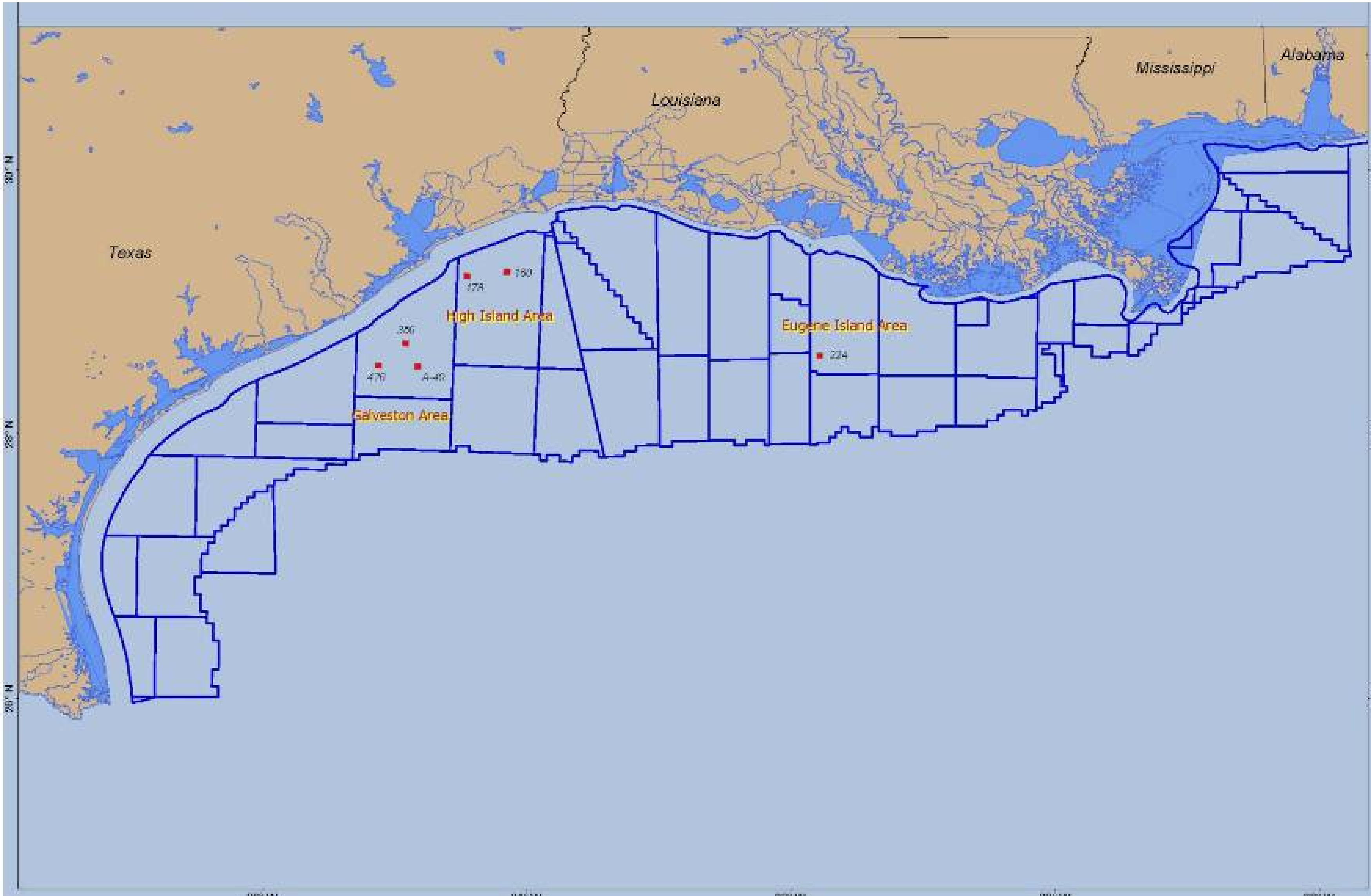
- Remote Sensing Cruise (July 2008) resulted in geophysical survey (subbottom profiler) of 6 targeted areas of interest, and surface sediment sampling. Data interpretation and mapping and sediment analyses are currently ongoing.

- Ongoing literature review related to
    - Gulf of Mexico sedimentary history
    - Storm and hurricane history
    - Wave impacts and related potential site impacts
    - Archaeological settlement patterns

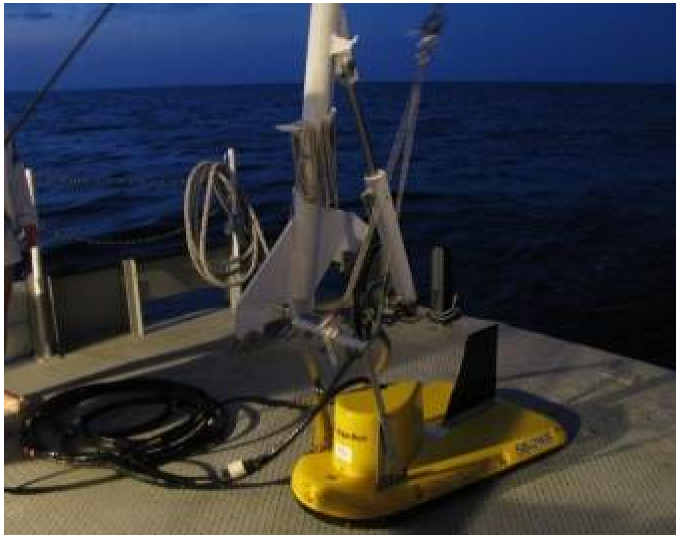
- Analysis of sea level change and rate and impacts to potential sites.

- Collaboration with colleagues at Rice University integrate their large-scale seafloor mapping and seismic work which identifies former river valleys and terraces with our detailed site-specific surveys.

SURVEY AREAS



REMOTE SENSING



- July 2008
- 6 targeted areas surveyed at 25m intervals
- Edgetech SB216 with DGPS navigation input
- Digital data interpretation and contouring

SEDIMENT SAMPLING

A total of 13 sea-floor sediment samples were collected using a ponar dredge.

Samples were collected within each survey grid, based on observationof the real time seismic data

The main goal of this sediment sampling was to determine the grain size on the surface of the sea floor on sites that may be drilled in the next phase.

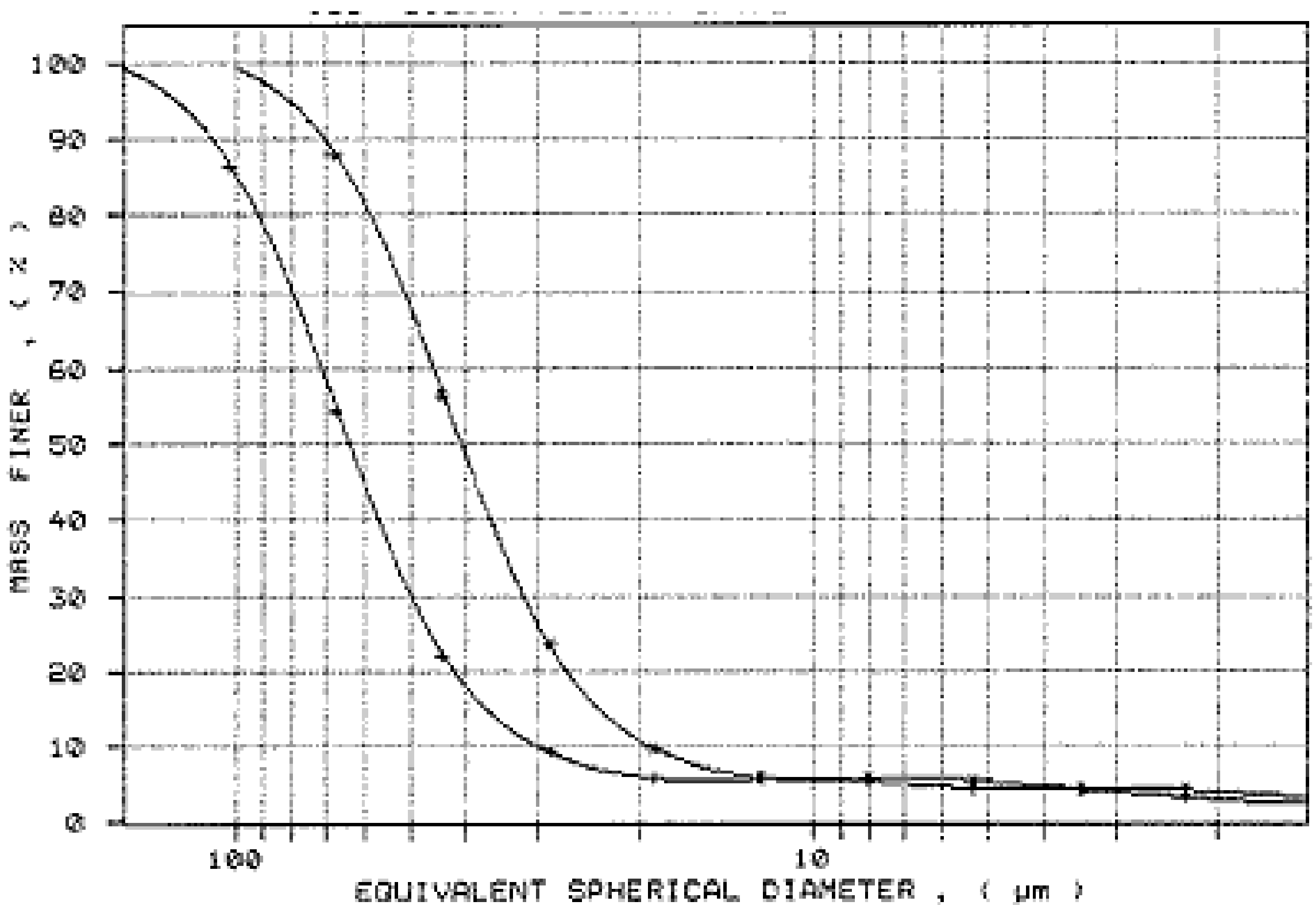
SEDIMENT GRAIN SIZE ANALYSES

<u>Lab Methodology:</u> Soluble salts in the samples were removed by washing in the laboratry. The samples were then dried in a Yamato DVS 600 oven and split into four sub-samples of 30 to 40 grams. One sample was placed in a Vulcan A-550 muffle furnace to remove organics and determine the organic fraction. Another sample was sieved to separate the sand and mud. The sand was sieved for approximately 20 minutes using a battery of ¼ phi (ϕ) sieves in order to obtain the grain size frequency distribution. The weight of each grain size class was obtained and a software utilizing the equations proposed by Folk and Ward (1957) was used to determine grain size statistical parameters. The mud fraction was then analyzed utilizing a Micrometrics Sedigraph 5100 and a grain size distribution was obtained.

SEDIMENT GRAIN SIZE ANALYSES

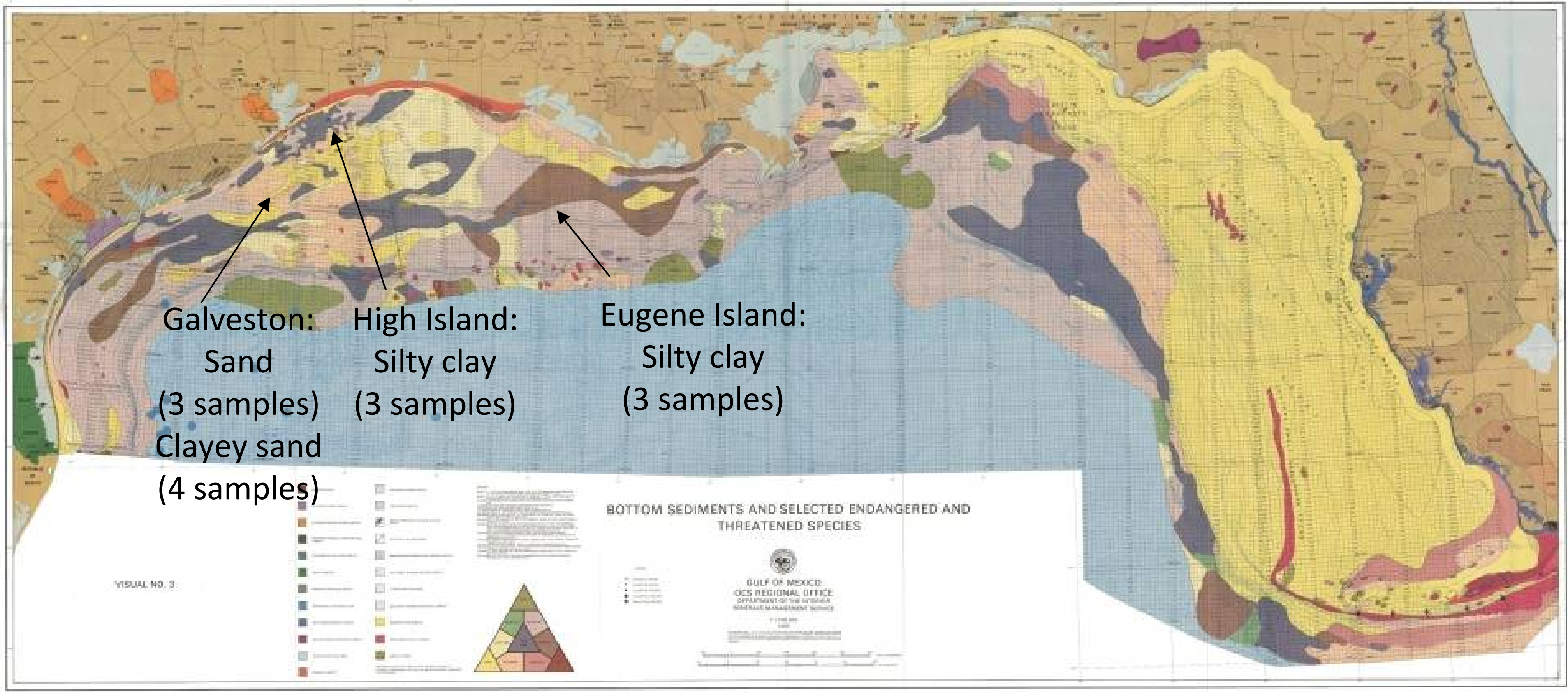
The Sedigraph employs x-ray attenuation technology to determine the particle-size distribution of an aqueous suspension of material finer than 0.063 mm (mud). Particle size analysis is determined in terms of equivalent spherical settling velocity. The SediGraph method assumes that the particles are dispersed in a fluid and settle in accordance to Stokes' Law. The SediGraph monitors the rate at which particles settle, and it determines the concentration of particles remaining at specific depths and times in a suspension-filled cell. The SediGraph measures the amount of x-ray attenuation that occurs in clear water and compares that to the x-ray attenuation in a sediment suspension. An accurate measure of the cumulative size distribution of the settling particles is determined.

PRELIMINARY RESULTS



This particular graph show a particle size distribution produced by the SediGraph. In this case, the percentage of smaller grain sizes decreases while the bigger grain sizes (within the mud fraction) are more abundant.

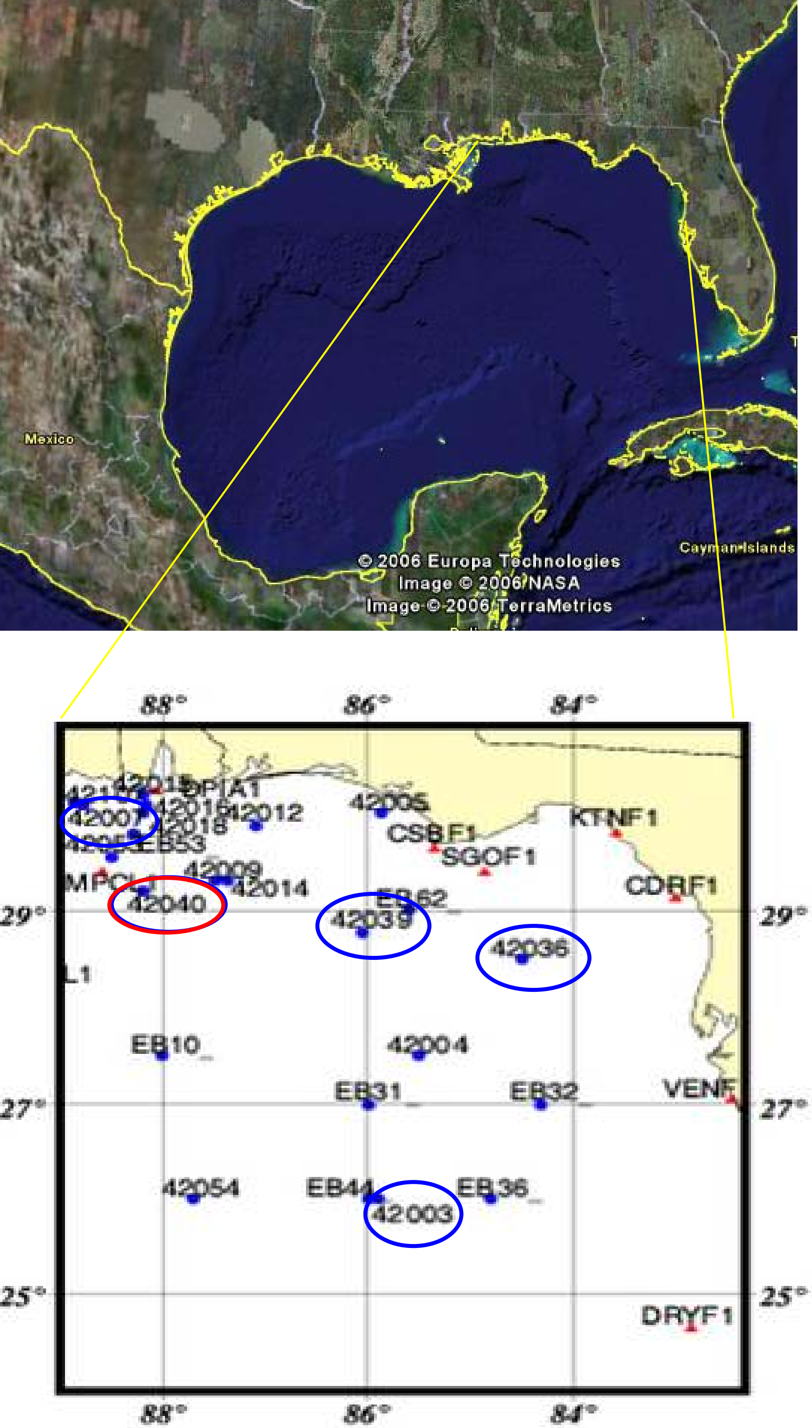
PRELIMINARY RESULTS



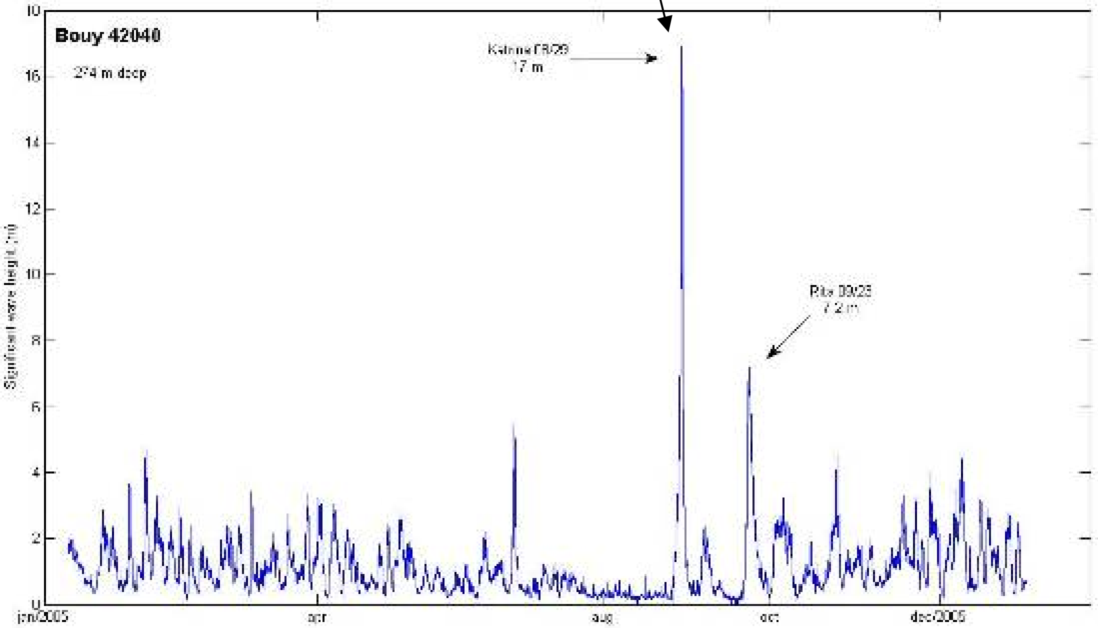
Preliminary results show that the grain size on the OCS increases towards Galveston, as also determined by previous works (e.g. MMS 1983)

Wave data acquisition

Eastern Gulf of Mexico

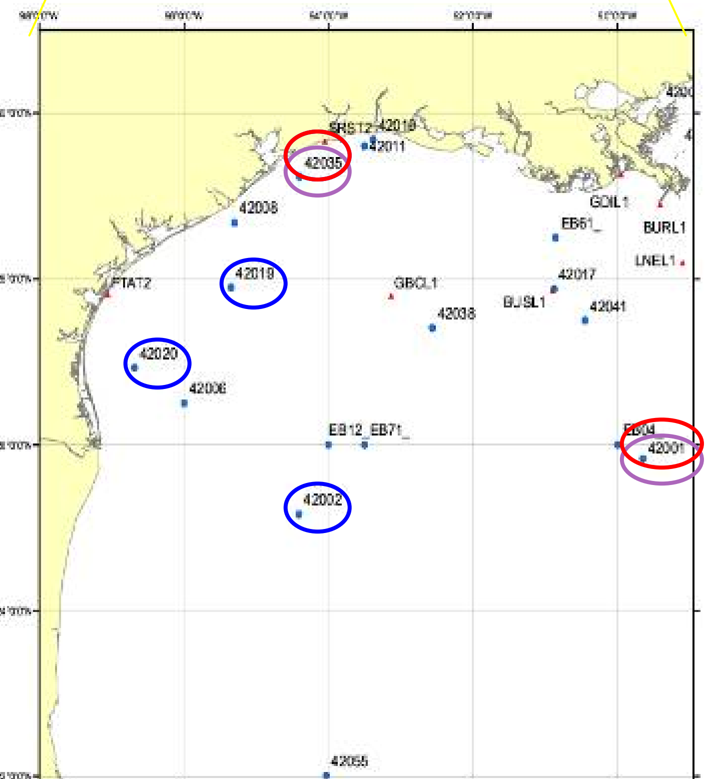


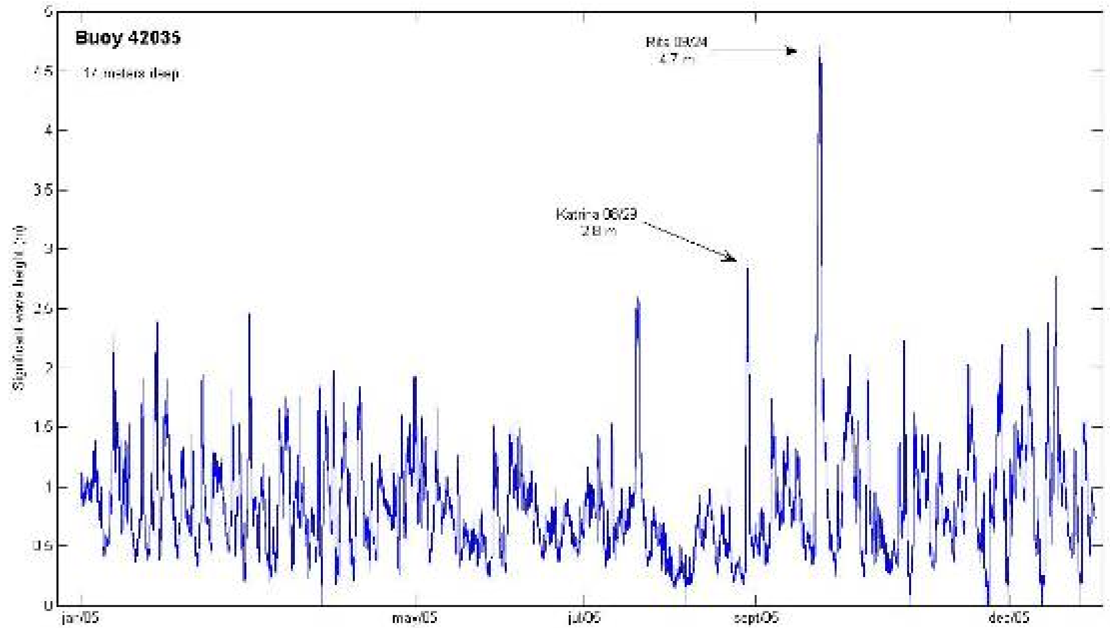
This wave can start moving sediments ~ 160 meters deep

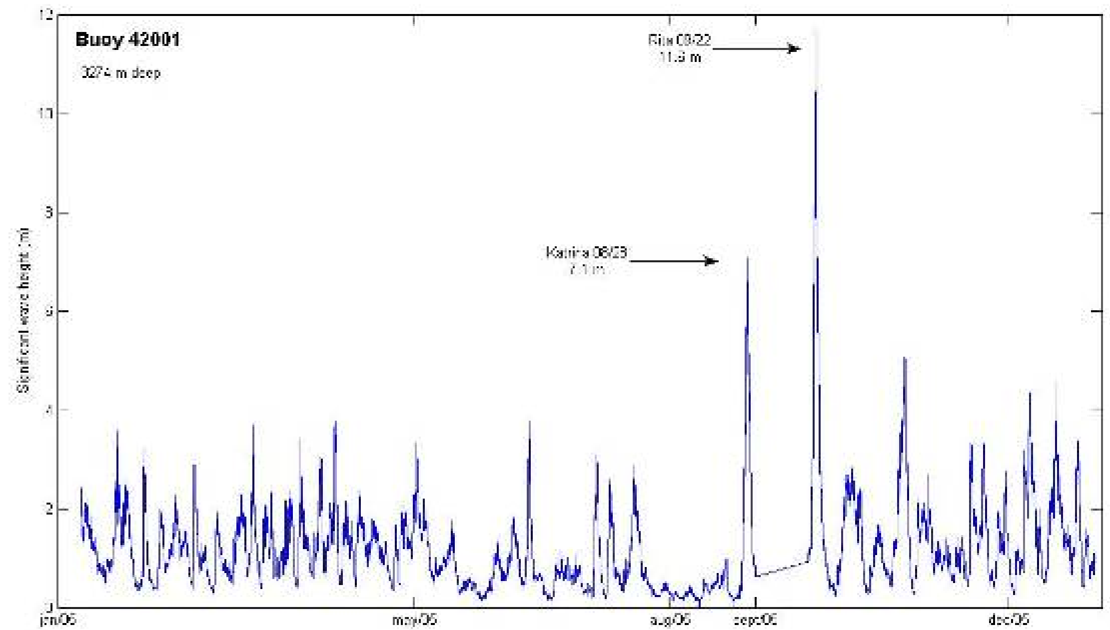


http://www.nodc.noaa.gov/BUOY/bwgm.html

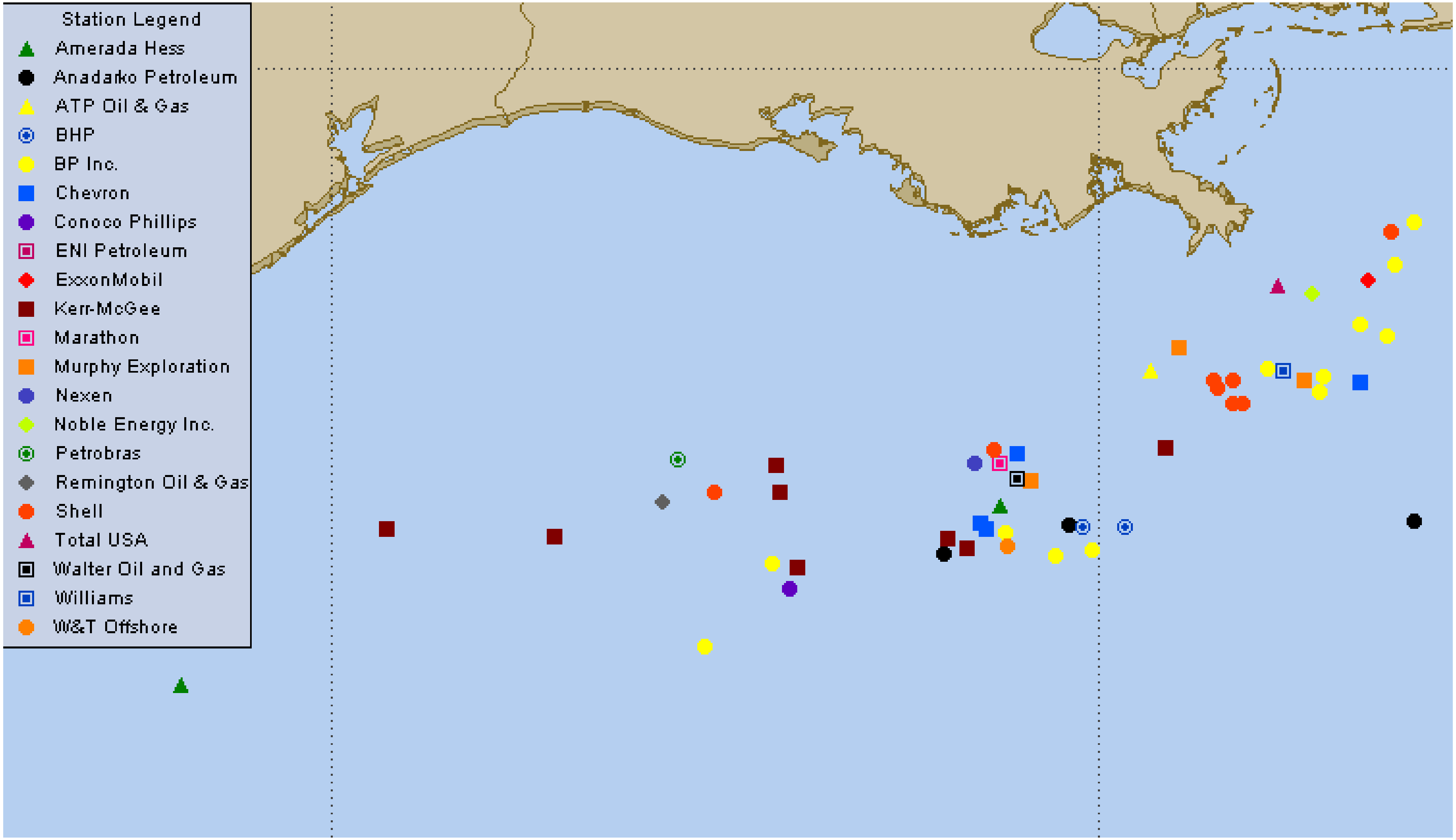
Western Gulf of Mexico



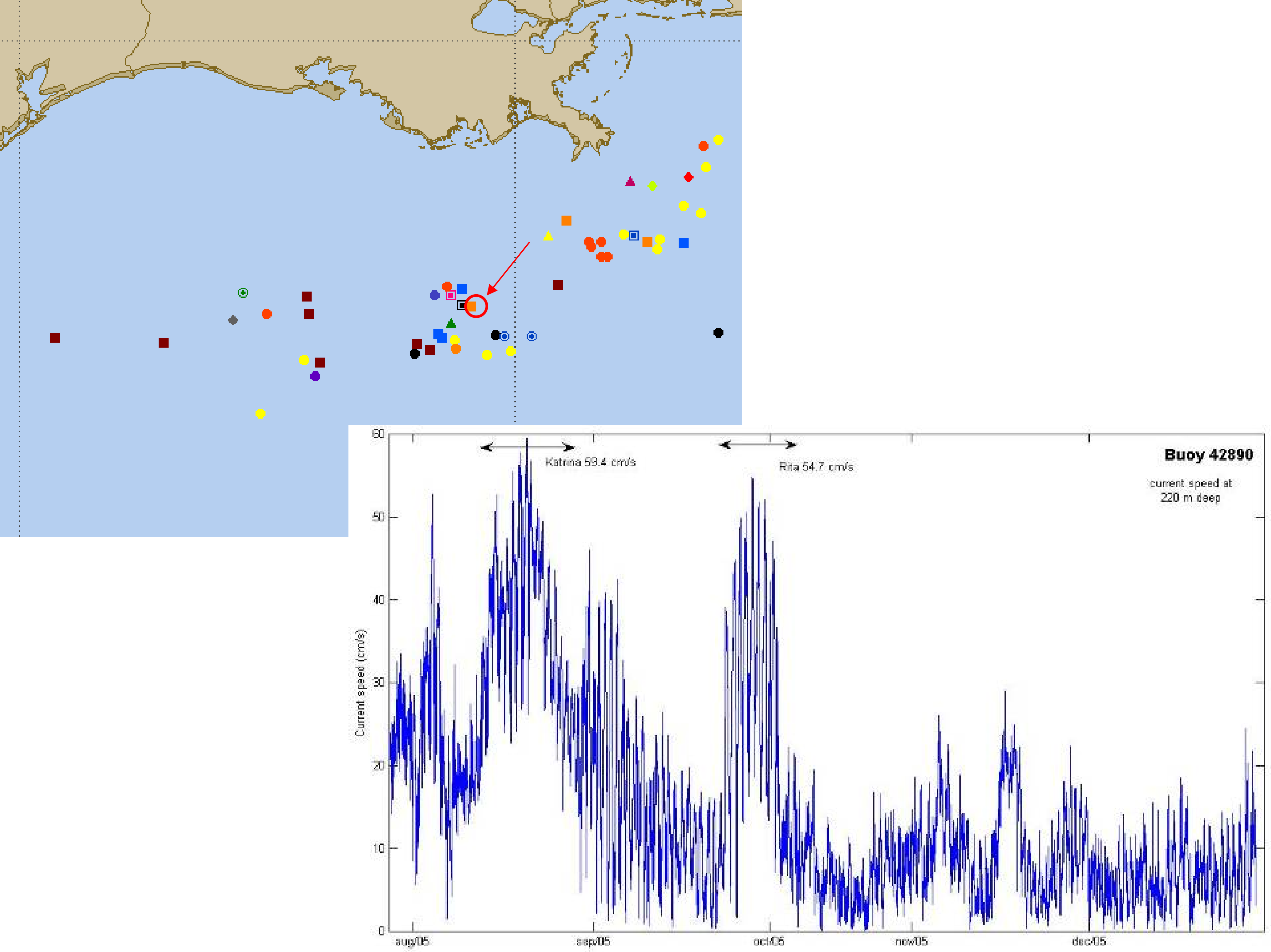




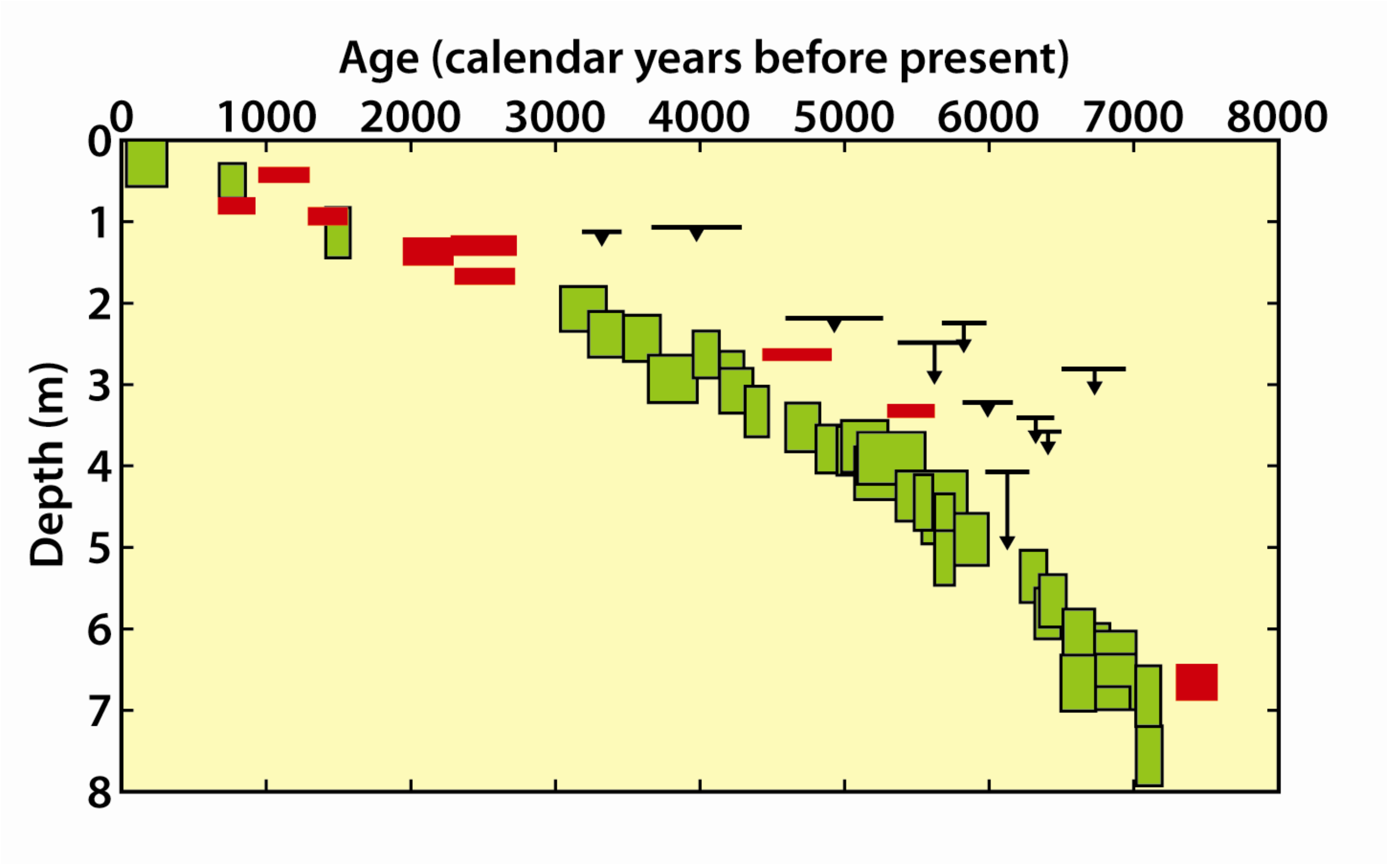
Current data acquisition – ADCP data (MMS)



http://www.ndbc.noaa.gov/maps/ADCP_WestGulf.shtml

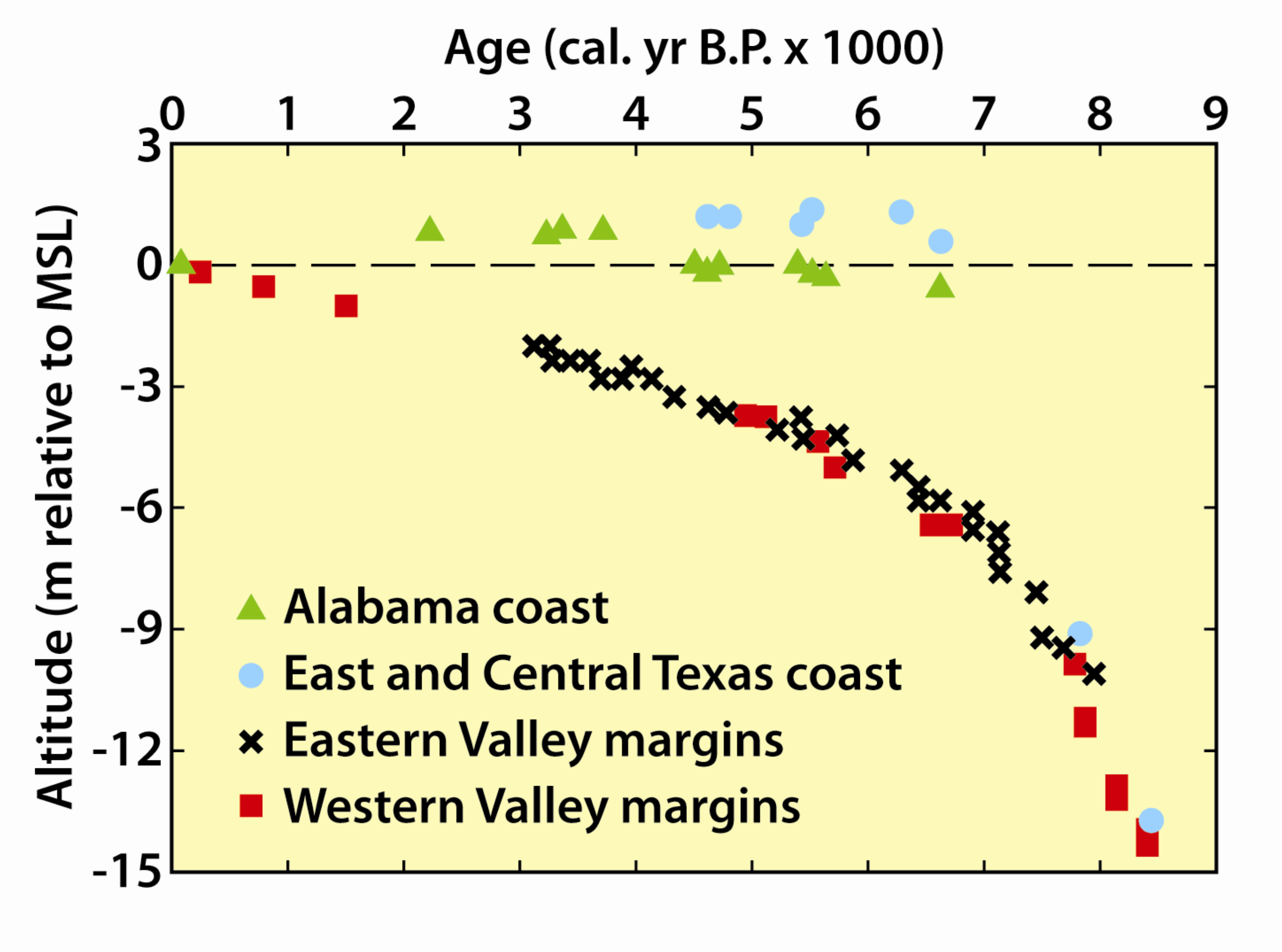

Buoy 42890
current speed at
220 m deep
Katrina 59.4 cm/s
Rita 54.7 cm/s
Current speed (cm/s)
0
10
20
30
40
50
60
aug/05
sep/05
oct/05
nov/05
dec/05

The “standard” sea-level curve for the Gulf of Mexico indicates sea level slowly rising throughout the mid to late Holocene reaching the present level only 500 or so years ago.

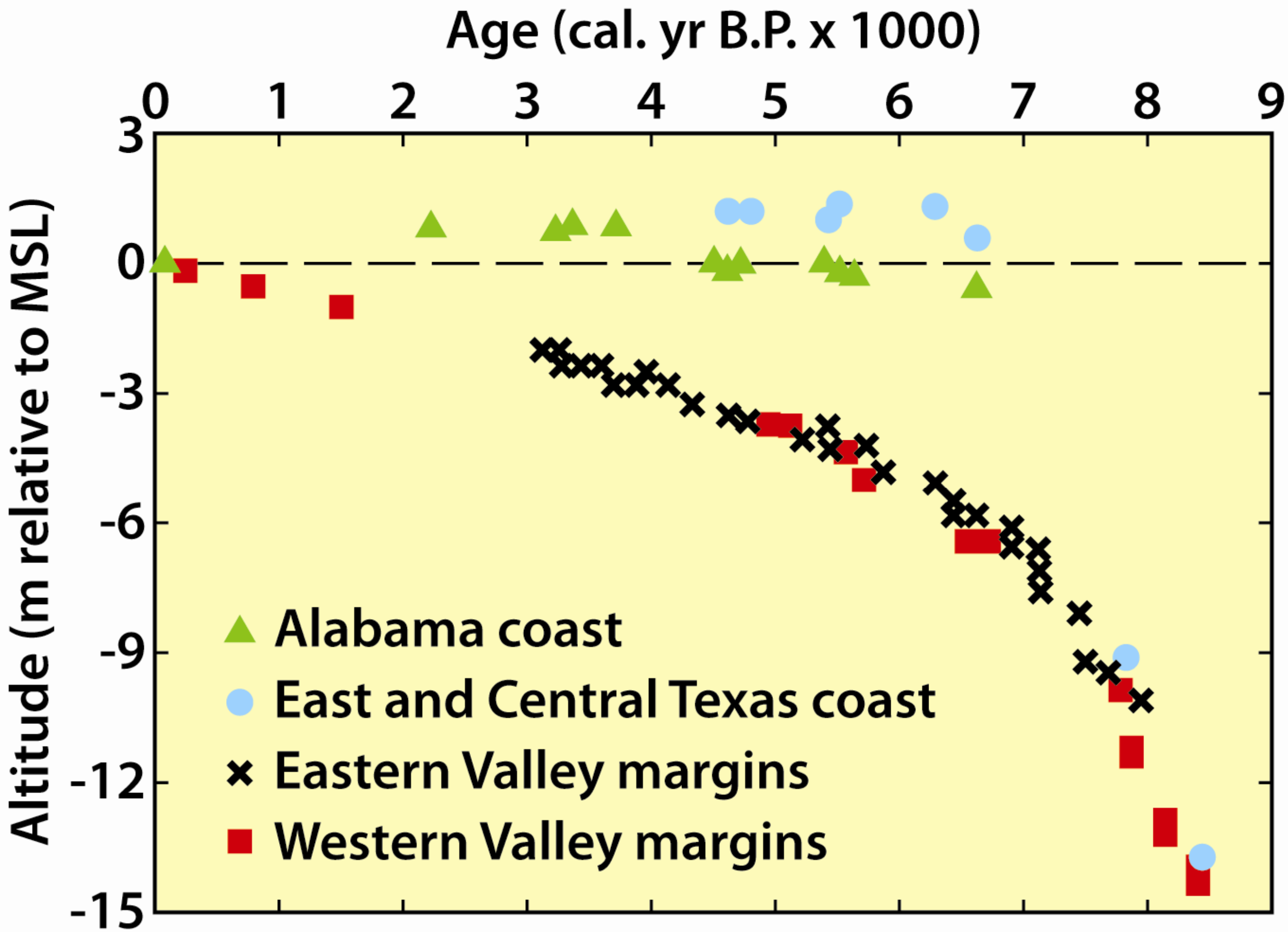


Sea-level data from the Mississippi delta (boxes) and NW Florida (bars with arrows) (Donnelly and Giosan 2008)

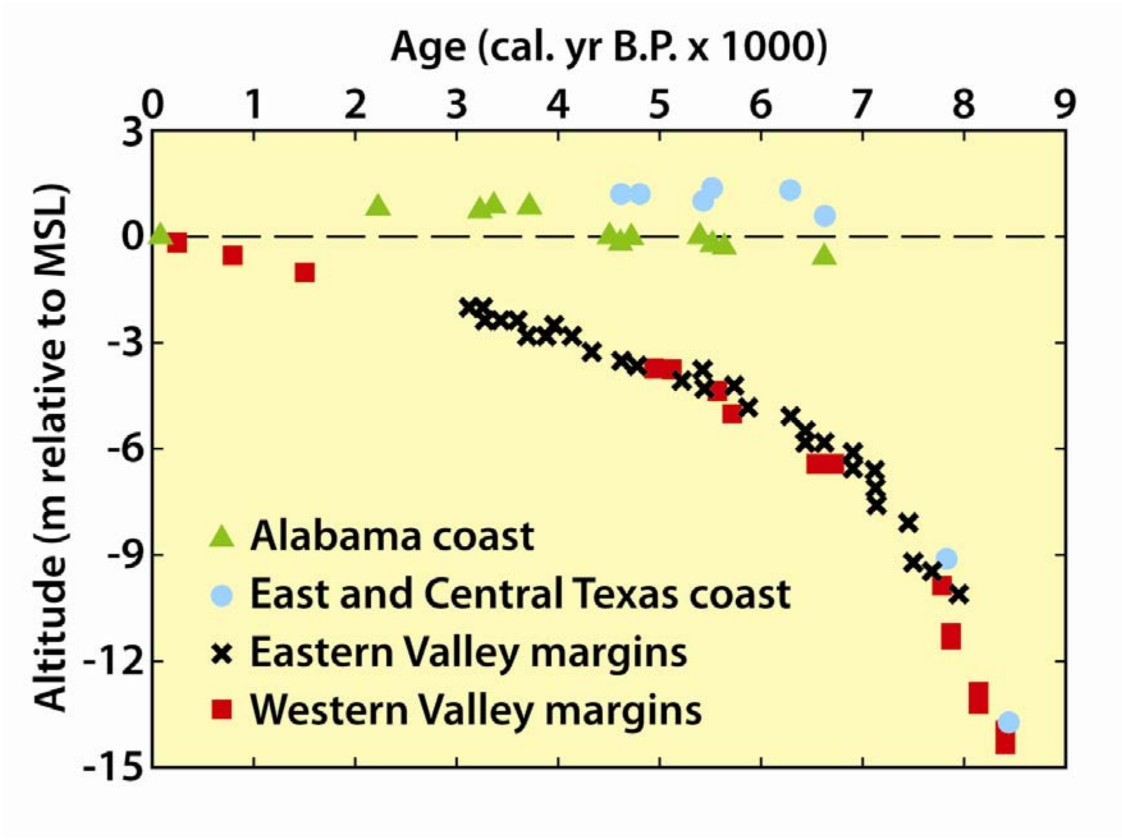
However, recent work elsewhere in the Gulf indicates a very different curve …



Sea-level data from the Mississippi delta (Tornqvist et al. 2006), and Texas and Alabama (Blum et al. 2008)



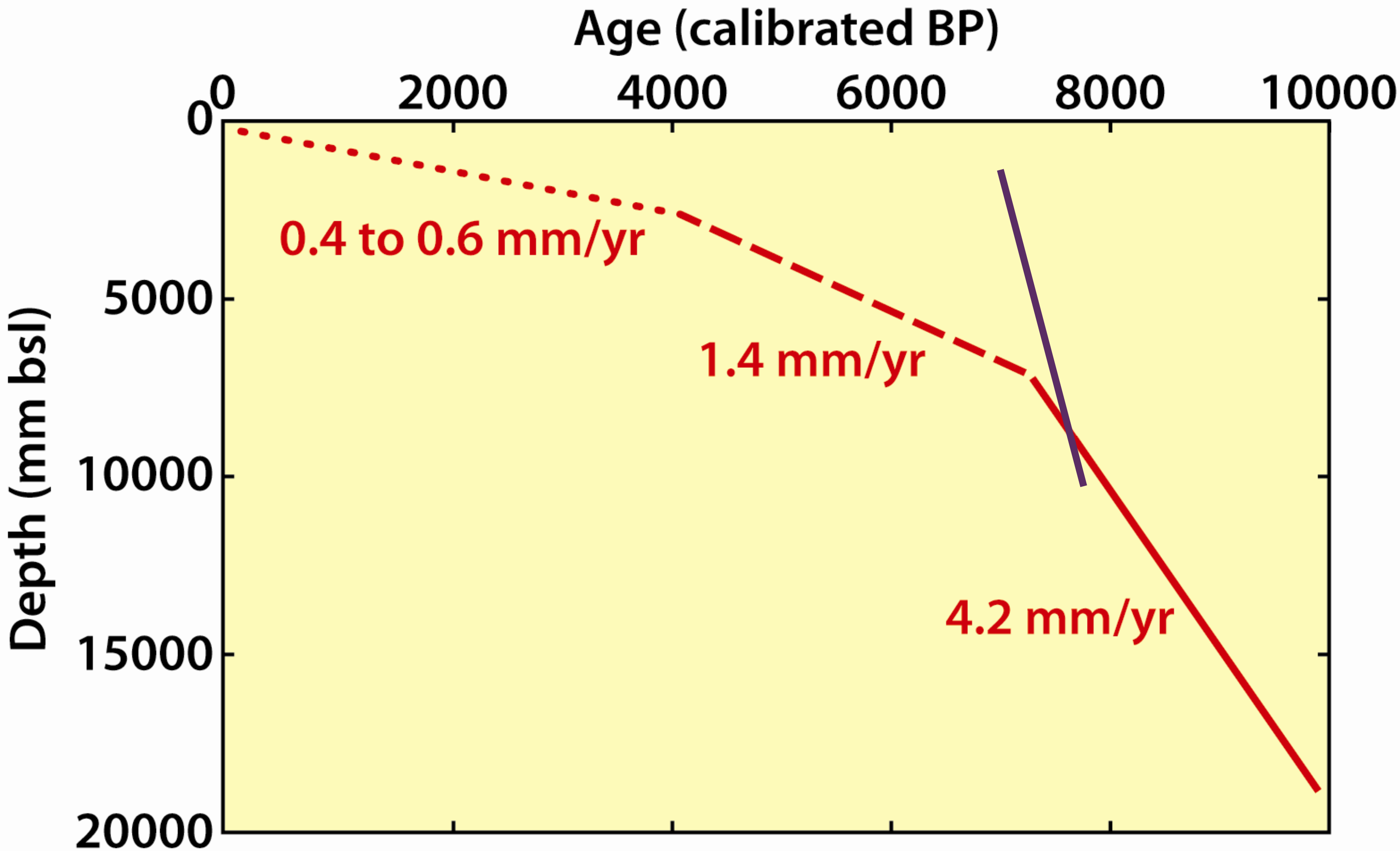
The differences in the sea-level data from the Mississippi delta versus Texas and Alabama can be explained by continued subsidence in the Mississippi valley due to vertical loading of 60+ meters of sediment in the mid to late Holocene.



The differences in the sea-level data from the Mississippi delta versus Texas and Alabama can be explained by continued subsidence in the Mississippi valley due to vertical loading of 60+ meters of sediment in the mid to late Holocene.

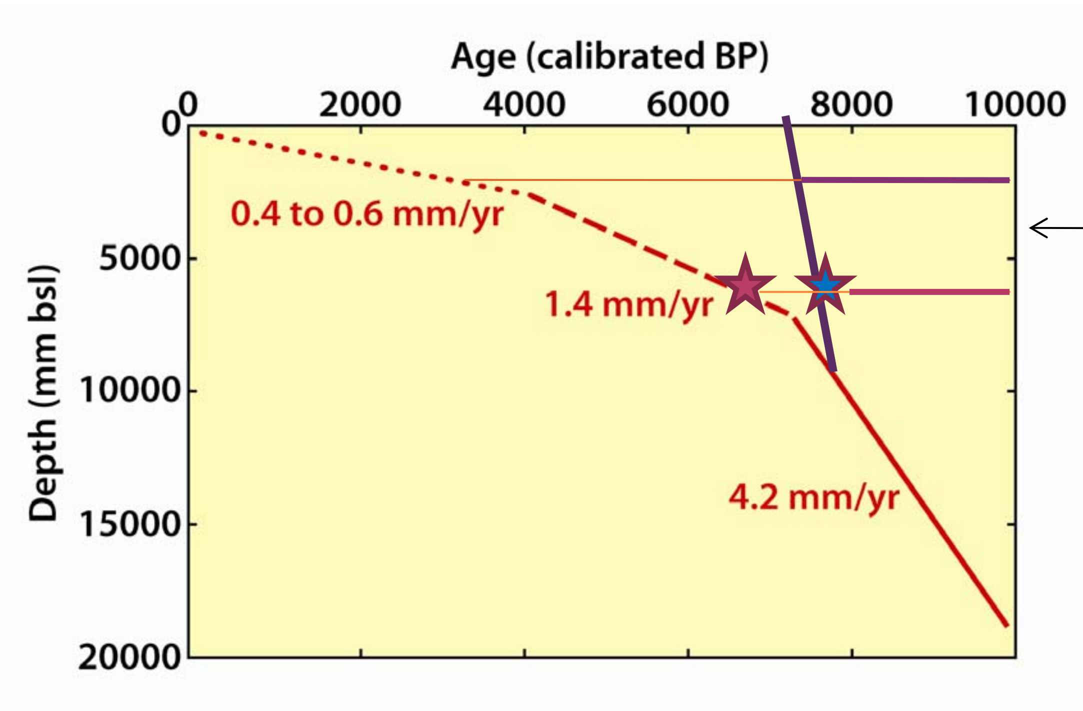
Detailed modeling (Blum et al. 2008) indicates that dates obtained on peat at say -6m depth and 6,000 years old, were actually deposited at modern sea level and subsided to -6m over that 6,000 year period.


So why should we care about the nature of sea level change and the rate of change in regard to this project?
The nature of change is critical because it can strongly affect the degree to which the site may be impacted …



This indicates the various rates of sea-level rise according to the “standard” sea-level curve …

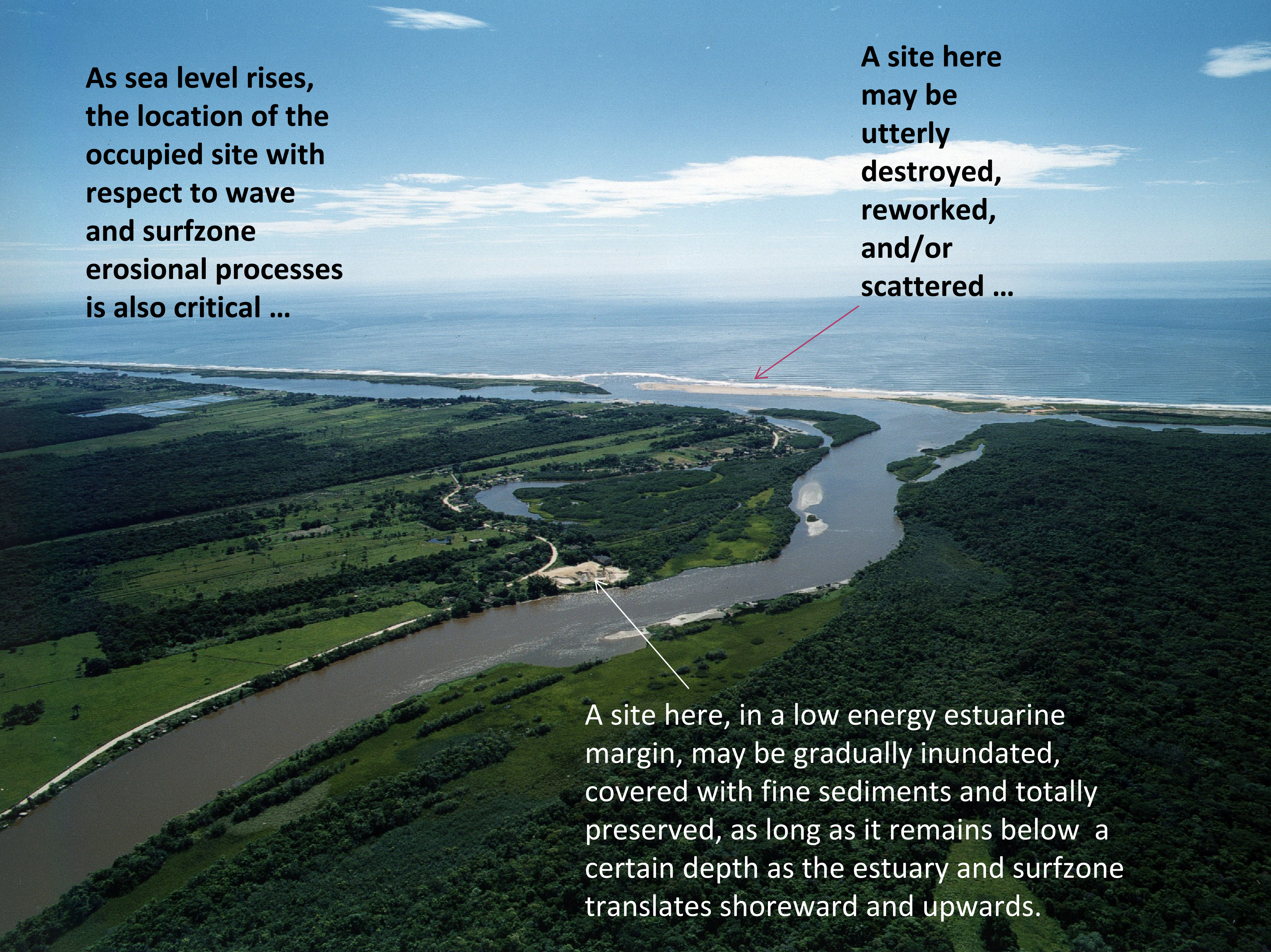
However, if the Blum et al. (2008) curve is correct, then the rate has been considerably different in the mid to late Holocene …

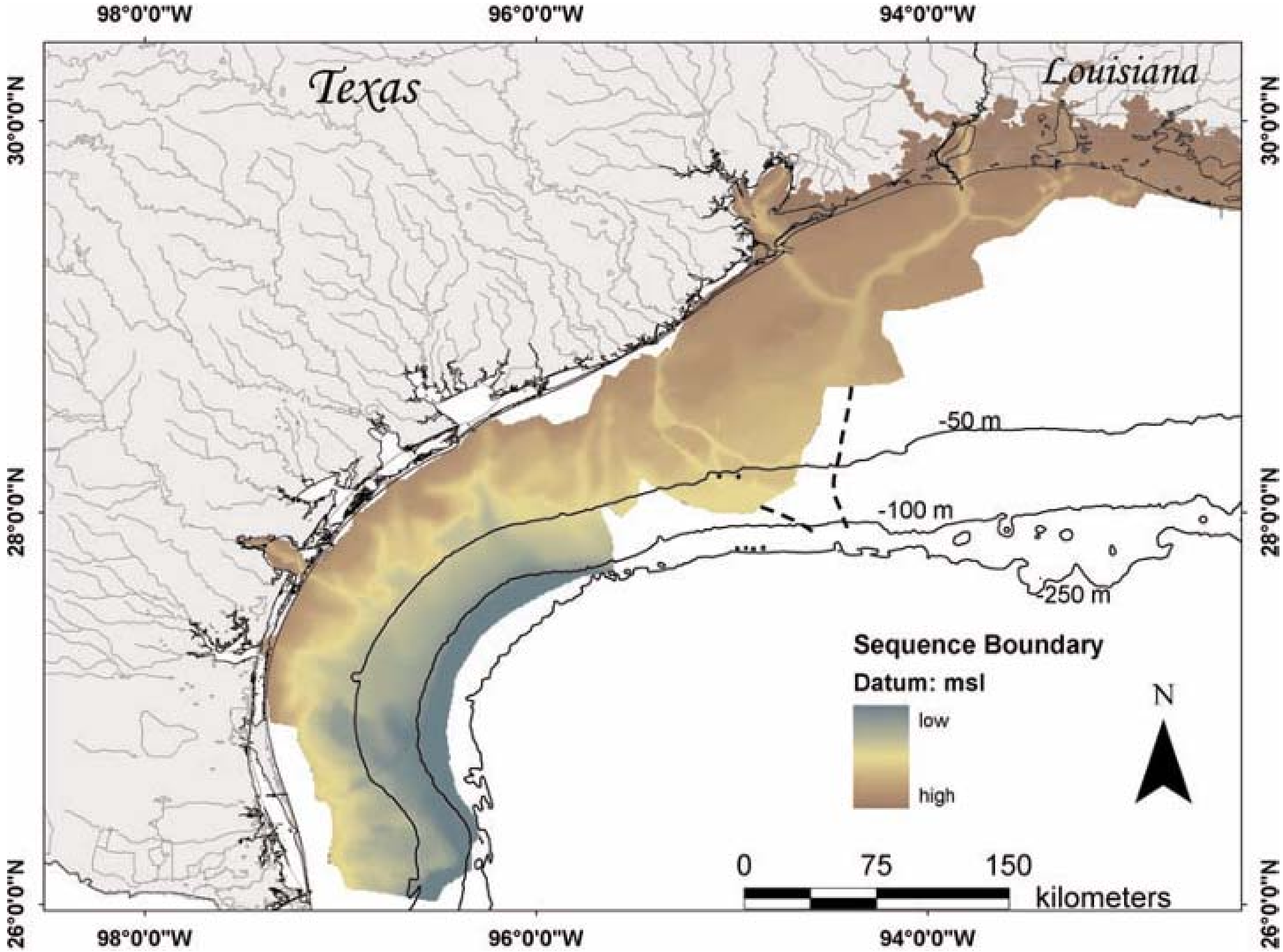


Primary surfzone processes operating in a 0 to -3m band

A 7,000 year old site located at -6m water depth would be sitting within the active surfzone for ~ 3,000 years if the "standard curve" is correct, meaning that the potential for site preservation is quite poor, as surfzone processes rework the site during storms and normal wave energy events.

A site located at the same depth on the "new" sea-level curve would be located within the active surfzone for ~ 300 years or less, meaning that potential site preservation could be considerably greater.


As sea level rises, the location of the occupied site with respect to wave and surfzone erosional processes is also critical …
A site here may be utterly destroyed, reworked, and/or scattered …
A site here, in a low energy estuarine margin, may be gradually inundated, covered with fine sediments and totally preserved, as long as it remains below a certain depth as the estuary and surfzone translates shoreward and upwards.



Locations of lowstand incised valleys based on the work of Simms et al. (2007).

We are collaborating with the Rice group to locate our very detailed site information on their broader seismic and geomorphological maps to expand our interpretations of potential site locations and landforms.

Evidence of Paleoindian and early Archaic cultures is limited due to the nature of these highly mobile hunter gatherers.

An essential component of this study includes an analysis and modeling of sea level change, site location, site formation processes and the impacts of sea level change and rate on site preservation and change.

Continued Fieldwork

- Sediment coring
- Data analyses
  - Chemical composition
  - Magnetic susceptibility
  - Pollen
  - Foraminifera
  - Grain size, distribution
  - Material culture

Forthcoming Results

- Final report of publications
  - Anticipated submission date Spring 2010
- Journal articles
  - Archaeology
  - Geology / geomorphology
  - Geography
- Doctoral dissertation
- Masters theses

- Funding for this research project is provided by the Minerals Management Service, Coastal Marine Institute.

- For more information, please contact project director Dr. Patrick Hesp,

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Blum, M.D., J.H. Tomkin, A. Purcell, and R.R Lancaster. 2008. Ups and downs of the Mississippi Delta. Geology 36:675–678.

Donnelly, J.P. and L. Giosan. 2008. Tempestuous highs and lows in the Gulf of Mexico. Geology 36(9):751–752.

Simms, A.R., J.B. Anderson, K.T. Milliken, Z.P. Taha, and J.S. Wellner. 2007. Geomorphology and age of the oxygen isotope stage 2 (last lowstand) sequence boundary on the northwestern Gulf of Mexico continental shelf. In: Davies, R.J., H.W. Posamentier, L.J. Wood, and J.A. Cartwright, eds. Seismic Geomorphology: Applications to Hydrocarbon Exploration and Production. Geological Society, London, Special Publications 277:29–46.

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