Seabed Characterization and Physical Oceanography Overview of Candidate Sites

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Candidate Sites (West to East)

• 1) Southern California Bight - La Jolla
• 2) Gulf of Mexico - Central Texas shelf
• 3) Gulf of Mexico - NW Florida shelf
• 4) Middle Atlantic Bight - New England shelf Mud Patch/Georges Bank
• 5) NJ Shelf
• 6) Gulf of Maine - Georges Bank
• 7) Barents Sea - Bear Island Trough
• 8) Malta Plateau
2) Gulf of Mexico - Central Texas shelf

Pros: close logistics, good prior knowledge, simple stratiography, weak tides, good weather, good water depth, lateral size good, no large scale fishing, not much Of a shelf break,

Cons: lack of diversity, high noise from oil industry surveys and rigs, effect of shear? loop current eddies but avoidable, some dolphin presence, whale activity?
3) Gulf of Mexico - NW Florida shelf

Pros: close logistics, some prior knowledge, simple stratiography, weak tides, good weather, good water depth, lateral size good, no large scale fishing, not much of a shelf break, good diversity, gas seeps, ray-like propagation interpretation (long-range prop), effect of shear greater than site 2)?:, low noise from oil industry surveys and rigs.

Cons: loop current eddies but avoidable, some dolphin presence, whale activity? Level of range dependence higher than 2),
4) Middle Atlantic Bight- New England shelf Mud Patch/Georges Bank

Pros: close logistics, lots prior knowledge, diverse stratiography, weak tides in mud Patch, good water depth, lateral size good, can easily avoid shelf break, good diversity, expect to find effect of shear, little effect of currents in Mud Patch, + [future OOI data & site characterization (<2012) oceanography, etc. in mud patc],

Cons: some dolphin presence, strong currents on G. Bank, Strong range dependence may be a possible?, variable weather, lots of fishing, shipping noise?, large presence of herring seasonally, lots of whales and their sanctuary but avoidable,
5) NJ Shelf

Pros: close logistics, lots prior data + [future OOI data & site characterization (<2012) oceanography, etc. in mud patch], weak tides away from shelf?, good water depth, lateral size good, can easily avoid shelf break, good diversity if you include mud patch, expect to find effect of shear? Ok currents

Cons:
range dependence may be a possible?, variable weather, lots of fishing, shipping noise?, large presence of bladder fish seasonally, marine mammals, no thick sand layers in deep water, seasonal internal waves & eddies, Areas of thick sand in 45-60m water (depth already surveyed), complicated stratiography?

Note: can also go to mud patch from this site.
7) Barents Sea

Pros: avoidable coastal currents?, lateral size good, can easily avoid shelf break, no past problems with marine mammals, water depth 150-300m, diversity is present 30x30 km flat sites available, shear properties favorable, sites with lots of volume scattering, localized and extensive gas seeps, good deal of prior info in literature and more recent bathymetric surveys, arctic button pressed, weak internal waves & eddies

Cons: logistics for US participants, outside of May through Sept = bad weather Oil exploration seasonal and site-specific, lots of fishing, shipping noise along coast, large presence of bladder fish seasonally,

? need to learn about stratiography?
8) Malta Plateau

Pros: modest coastal currents, good weather, lateral size ok, best site for NURC Involvement, can easily avoid shelf break, no past problems with marine mammals, water depth 80-200m, diversity is present, shear properties favorable, some evidence of gas seeps? good deal of prior info in literature and lots of surveys, weak internal waves, currents & tides, little fishing, can find areas of strong range dependence or avoid it, stratigraphy is well understood, Long tracks of range independence,

Cons: logistics for US participants, lots of shipping noise at times,
La Jolla Shelf

Holocene section composed of a basal, laminated unit and a thick transparent unit (sand, silt; 1640 m/s). Underlain by lithified hardgrounds (2200 m/s). Section thins northward.

Velocities from M. Buckingham
Fig. 10. A: Isopach map of Sequences II and III. B: Isopach map of Sequence II. C: Isopach map of Sequence III. Note that Sequence II makes up most of the northern depocenter observed in A, whereas the inter-canyon depocenter is predominantly Sequence III. Isopach thicknesses are shown in black. For reference, the 40 m and 60 m structure contours to the top of the transgressive surface (white) and the outline of canyon (red) are superimposed. Note thickness scales vary for the different panels and were selected to highlight along-strike variability. Survey area is shown by dashed line, and gray regions within survey area are regions with zero sediment thickness. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Southern California- La Jolla

Very narrow shelf
Canyon nearby
Mild weather
Urban environment- very aggressive surfers
Pacific coast core locations

NGDC: yellow dots
usSEABED: none
Central Texas Shelf

Shideler, 1978

Eckles et al., 2004
Gulf of Mexico- Central Texas shelf

Figure 4. Mean surface salinity from the model output for: (a) May to August and (b) October to February. Vectors represent the main currents for the period with the same scale as in Figure 3. Shown are the 200 m and 1000 m isobaths.

Shelf circulation- strong fresh water influence extends to southwest in fall, winter, spring
Also loop eddies impact continental slope

Zavala-Hidalgo et al., 2006
Texas shelf- Stratification

Figure 7. Monthly mean vertical structure from model output in section E of Figure 1, averaged from (top) October to February and (bottom) May to August of 1 year. Zavala-Hidalgo et al., 2006
Gulf of Mexico - Loop Current and eddies

20100602 03:00

current: → 1 m/s
wind: ← 15 m/s
sea level: -1 m 0 1

Ruoying He, NC State
NW Florida Shelf

McKeown et al., 2004

Doyle and Sparks, 1980
FIG. 3—Map showing distribution of gas seeps, wipeouts, fuzziness, smearing, and sediment type. Each solid circle shown represents one identifiable gas seep. Main gas-seep area is shown by dashed line. Types of surface sediment in main gas-seep area are separated by heavy double-dashed lines. Information on lithology of deeper sections has been obtained from two deep drill holes, 28-40 and 31-44, each 305 m deep. On northeastern flank of Destin dome, positions of nine exploratory holes and their depths are also shown. Of seven salt domes located by this survey, four are new findings. Bathymetry shown is from NOAA (1975).
Gulf of Mexico- NW Florida Shelf

Fig. 6.21. Observed mean current vectors from the longest available records over the Mississippi-Alabama shelf. The thick arrows are near-surface currents, the thin arrows are middepth vectors, and the dashed arrows are near-bottom currents.
Gulf of Mexico- NW Florida shelf

Current ellipses- continental slope

Alongshelf currents over slope
NW Florida-Coastal upwelling

Weisberg et al., 2004
Gulf of Mexico Core Locations

NGDC: yellow dots
usSEABED visual: red dots
usSEABED analytic: blue dots
Mid-Atlantic Bight
Mud Patch

Palamara et al., in prep

Twichell et al., 1981
Middle Atlantic Bight - Mud Patch

**Alongshelf Velocity**

Flagg et al., 2006

**Temperature**

C. Linder

**Salinity**

**Cross-shelf Distance (km)**
Mud Patch - Tides

Figure 4. Maps of $M_2$ amplitude (solid line) and phase (dashed line) over the New England shelf for (a) sea level elevation, (b) eastward current, and (c) northward current. The location of amplitude and phase estimates are shown. The 40, 100, 500, and 1000 m isobaths are shown in gray.

Shearman and Lentz, 2004
Georges Bank

Northern half: sand ridge morphology, well sorted coarse-grained sands and gravels. Gravel more common in swales.

Southern half: smooth morphology, silty sands.

10-30 m sand overlies stiff Pleistocene clay.

Fogarty and Murawski, 1998

Emery and Uchupi, 1965
Georges Bank

Clockwise circulation around bank

Tidal mixing front during summer

Very strong tides

Weather and sea states are bad even in summer

Fig. 1: Bathymetry of the Gulf of Maine/Georges Bank region and schematic of the general subtidal circulation during stratified season. This picture was provided by R. C. Beardsley at Woods Hole Oceanographic Institution.
Georges Bank tides

Chang-Sheng Chen, U. Mass.-Dartmouth
North Atlantic Shelf Core Locations

NGDC: yellow dots
usSEABED visual: red dots
usSEABED analytic: blue dots
Barents Sea

Mud deeper than 200 m

Diamicton/coarse grained clastics ~60-200 m water depth

Carbonate (shells, barnacles) 30-60 m water depth

Elverhoi et al., 1989

http://www.barentsportal.com/
Bear Island Trough

- Two major water masses- Norwegian Atlantic Water and Norwegian coastal water
- Norwegian Atlantic water- T~3.5 Deg C S~35 g/kg, Coastal water T~2-5 Deg C S~31-32 g/kg
- Currents range from 20-100 cm/s, typical velocities 30 cm/s
- Strong local topographic effects- may be pooling of winter water in isolated basins
Barents Sea Circulation

Northward flow west of Norway extends into Bear Island trough with one branch heading east through the central Barents Sea and one branch heading north past Spitsbergen.

Strong coastal current near North Cape—water is much fresher and generally colder.

Large polynyas near Spitsbergen lead to strong gravity currents down canyons.

Local bathymetric depressions may trap dense water from previous winter.

Strong storms and winds—challenging environment to work in.

From UCSD Climate Change Earthguide
Barents Sea Polar Front

Gawarkiewicz and Plueddemann, 1994
Tides generally fairly weak, but some local enhancement near Bear Island
Winds

% Occurrence of Wind Speeds

Barentsweb, Norway