Seabed Characterization and Physical Oceanography Overview of Candidate Sites

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Austin, TX
April 5-6, 2011

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

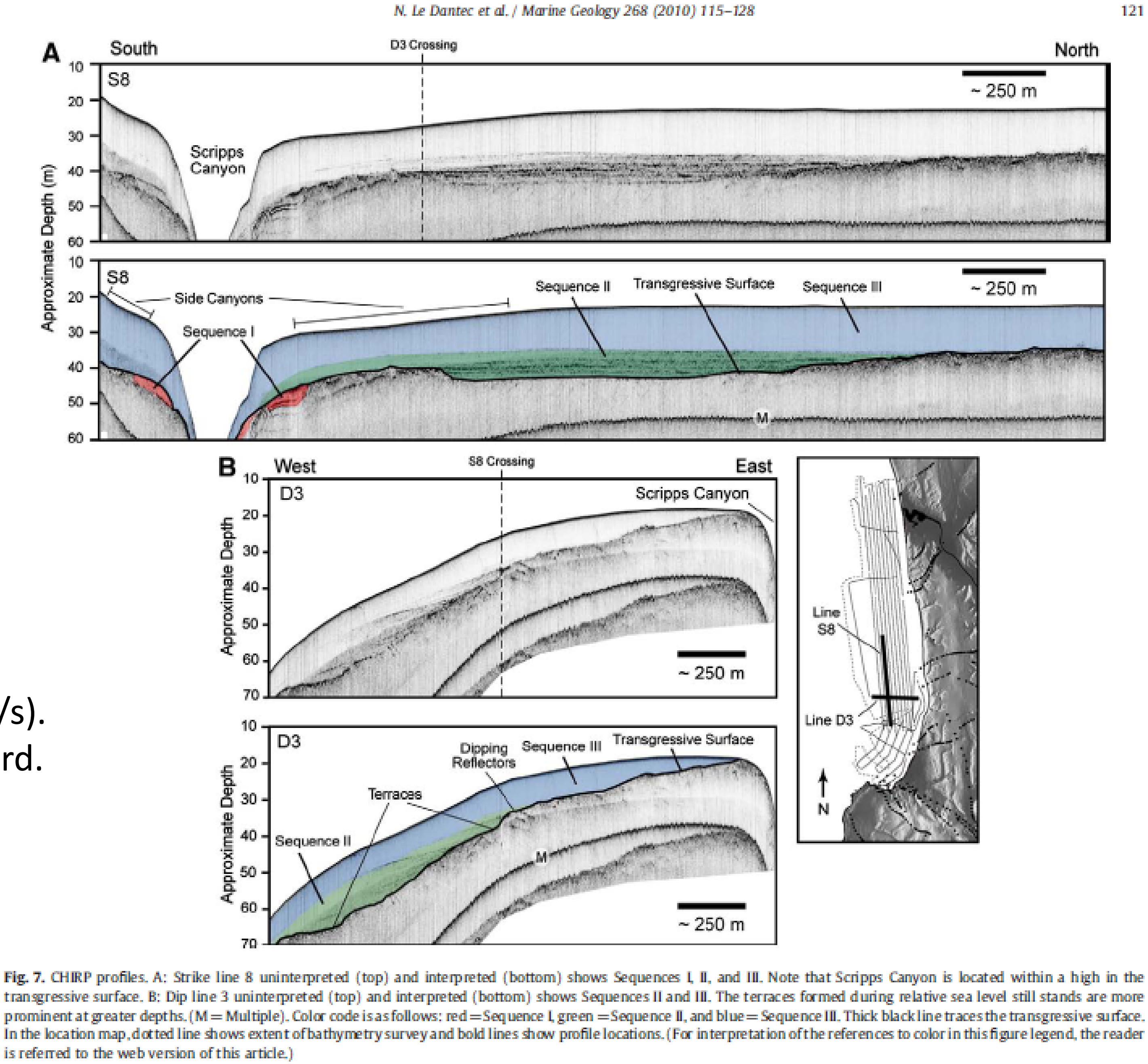

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Fig. 7. CHIRP profiles. A: Strike line 8 uninterpreted (top) and interpreted (bottom) shows Sequences I, II, and III. Note that Scripps Canyon is located within a high in the transgressive surface. B: Dip line 3 uninterpreted (top) and interpreted (bottom) shows Sequences II and III. The terraces formed during relative sea level still stands are more prominent at greater depths. (M = Multiple). Color code is as follows: red = Sequence I, green = Sequence II, and blue = Sequence III. Thick black line traces the transgressive surface. In the location map, dotted line shows extent of bathymetry survey and bold lines show profile locations. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

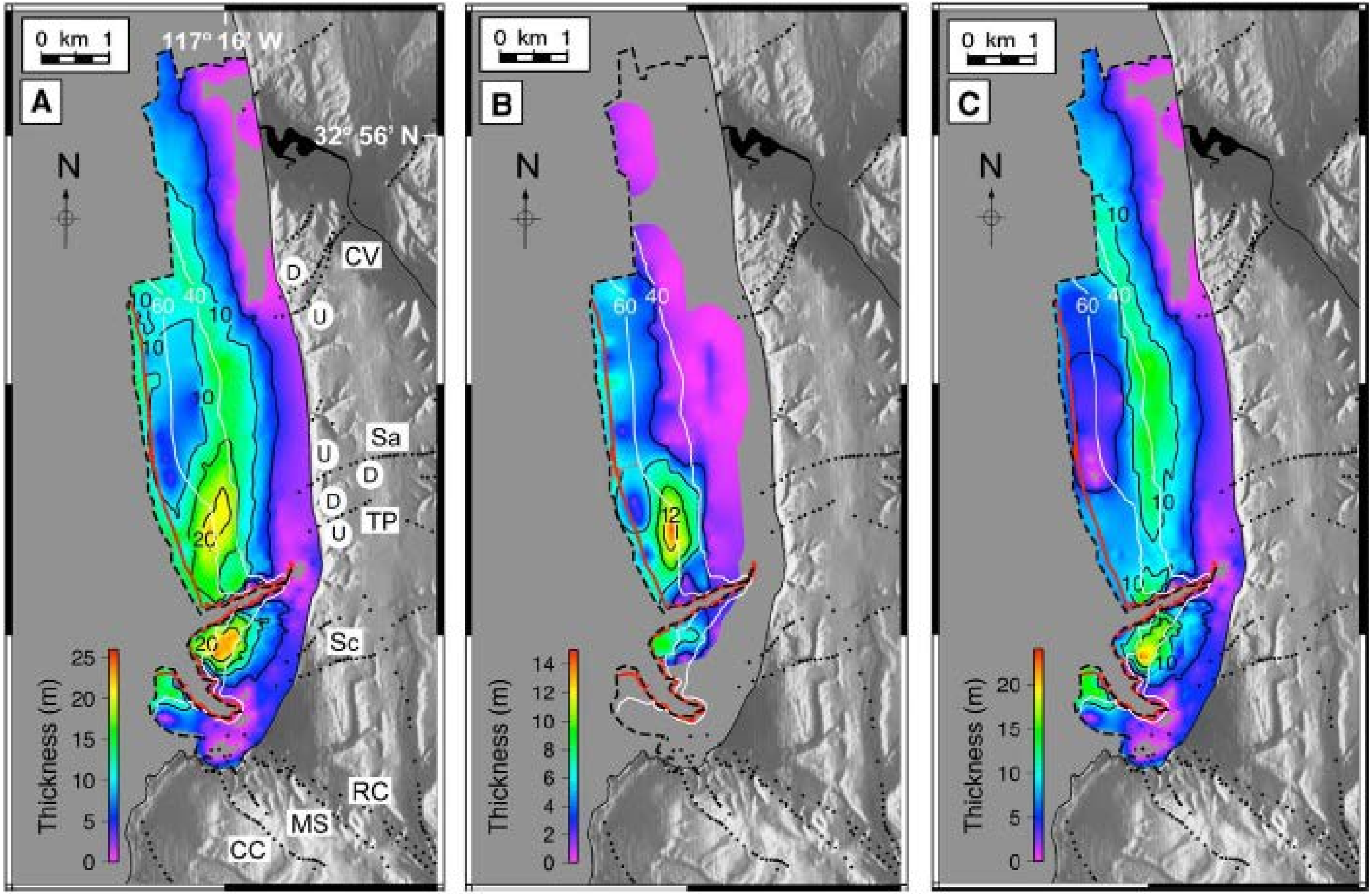
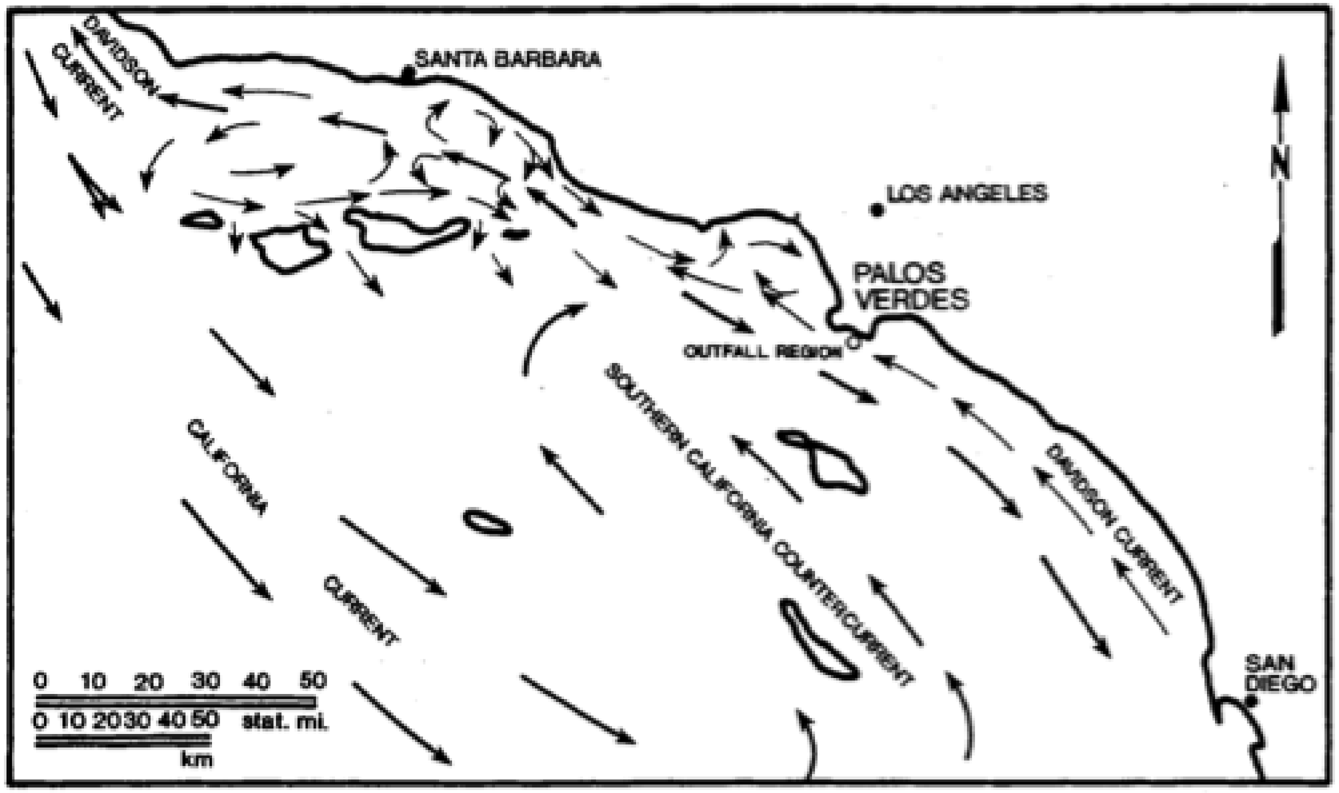


Fig. 10. A: Isopach map of Sequences II and III. B: Isopach map of Sequence II. C: Isopach map of Sequence III. Note that Sequence II makes up most of the northern depocenter observed in A, whereas the inter-canyon depocenter is predominantly Sequence III. Isopach thicknesses are shown in black. For 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.)

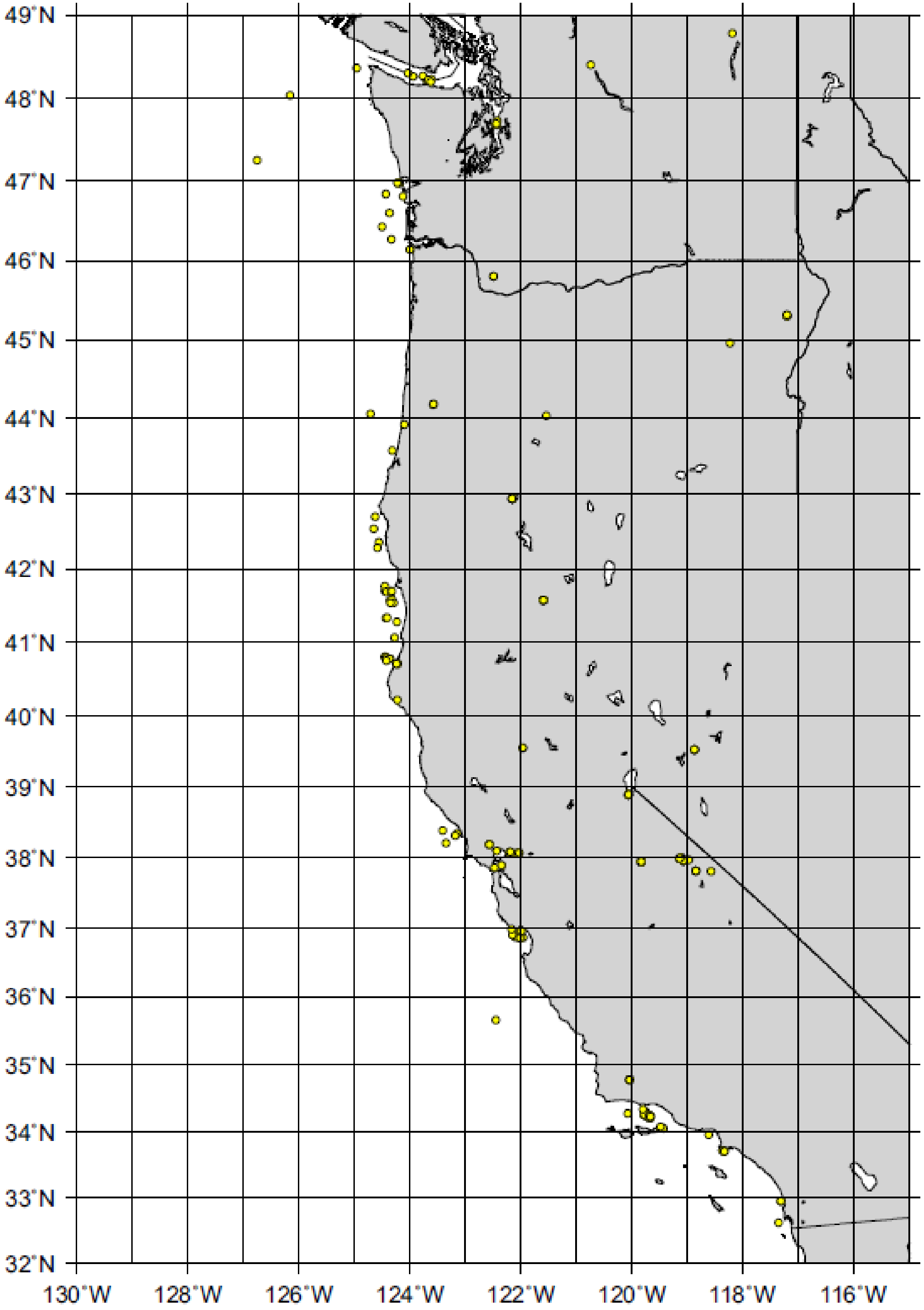
Southern California- La Jolla



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

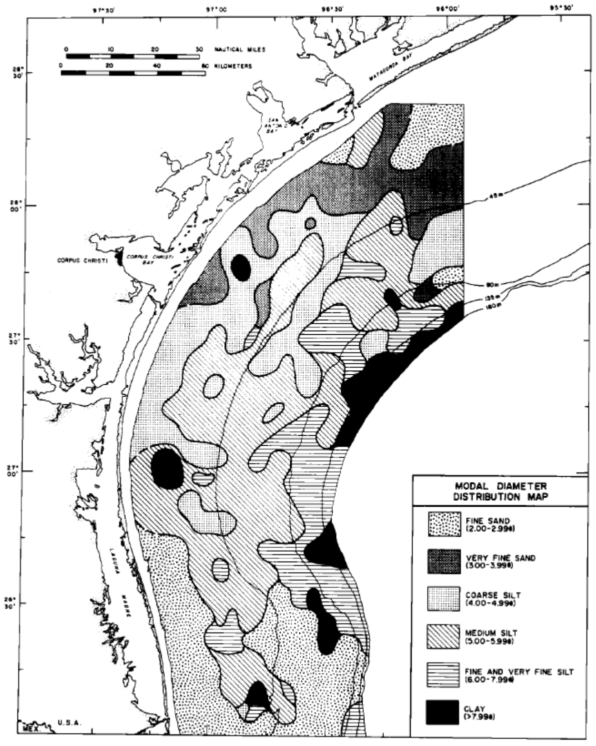


Fig.3. Distribution map of principal modal diameters in surficial sea-floor sediments.

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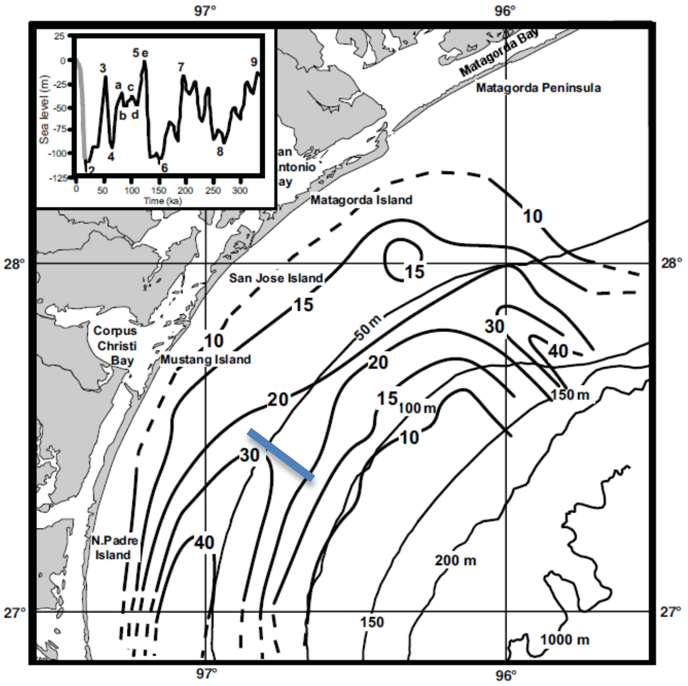


FIG. 16.—Isopach map of Stages 2 to 1 transgressive muds of the Texas Mud Blanket. Two potential source areas, the ancestral Rio Grande Delta to the south and the ancestral Colorado Delta to the north, are shown. Contour interval in meters.

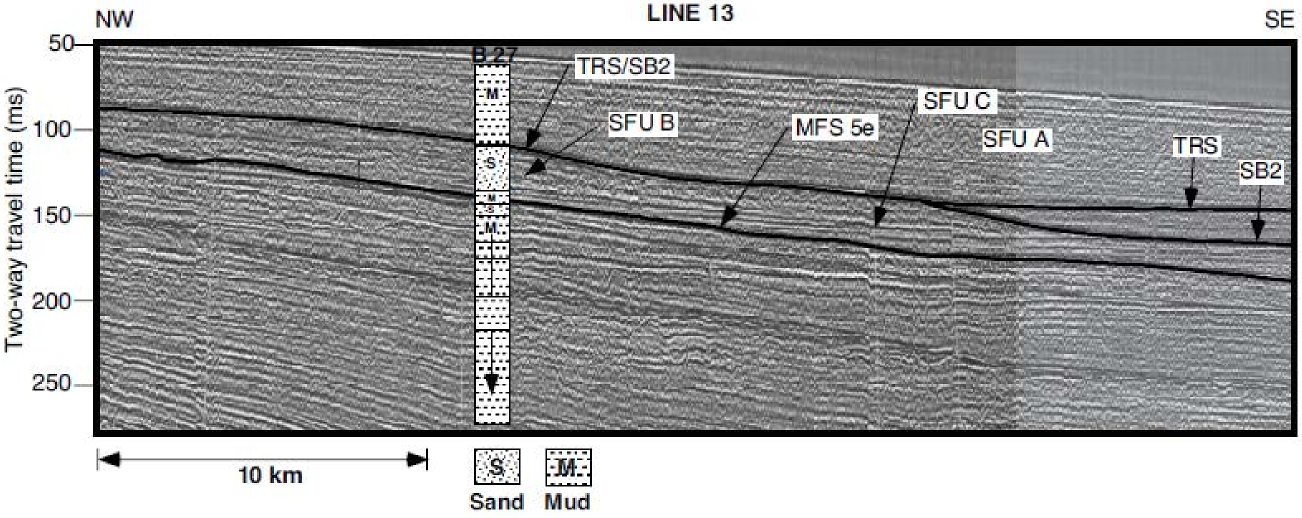


FIG. 6.—Dip-oriented seismic profile (Line 13) illustrating character of seismic facies SFU A, SFU B, and SFU C. Platform boring B-27 illustrates the muddy nature of SFU A and the sandy nature of the SFU B facies. See Figure 3 for location. MFS 5e = Stage 5e maximum flooding surface.

Eckles et al., 2004

Gulf of Mexico- Central Texas shelf

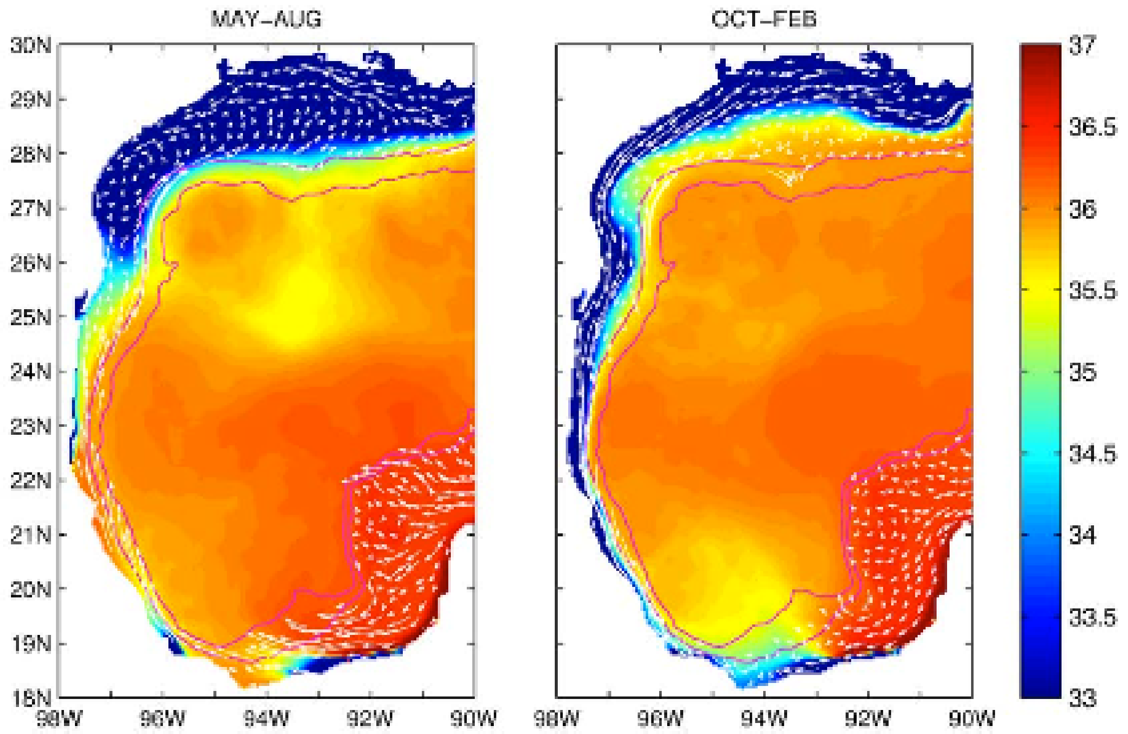


Figure 4. Mean surface salinity from the model output for: (a) May to August and (b) October to February. Vectors represent the main currents for the period with the same scale as in Figure 3. Shown are the 200 m and 1000 m isobaths.

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

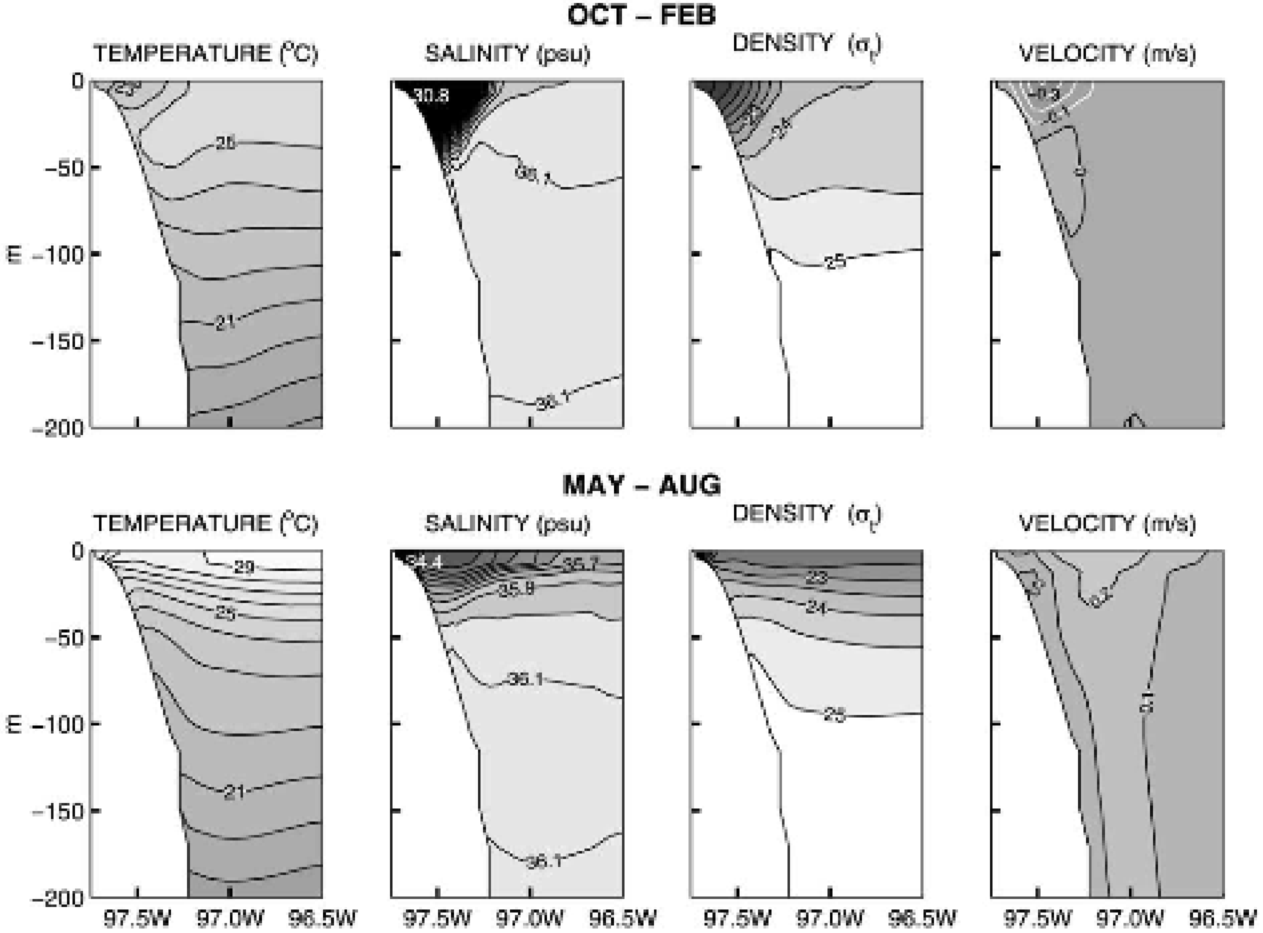
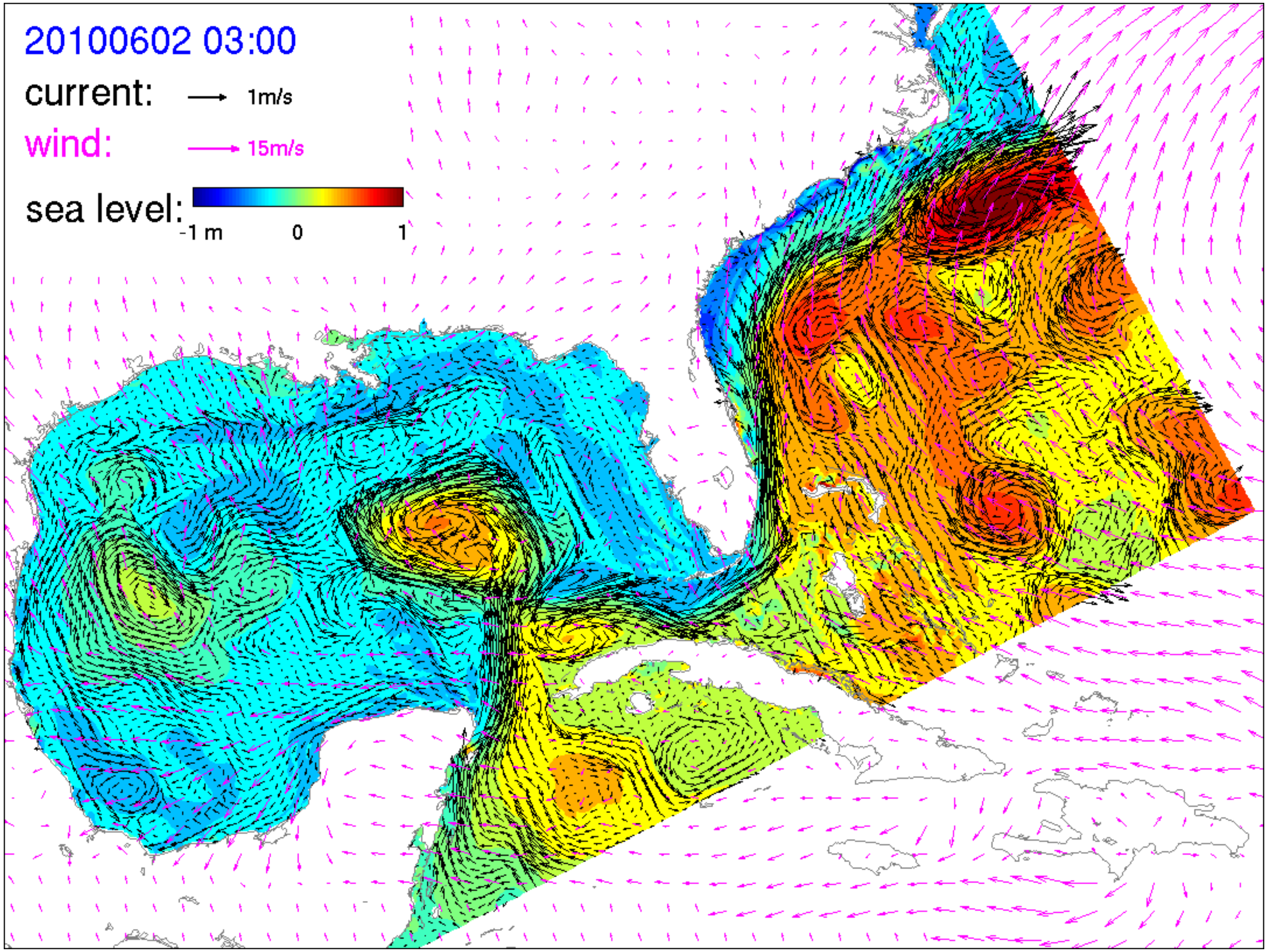


Figure 7. Monthly mean vertical structure from model output in section E of Figure 1, averaged from (top) October to February and (bottom) May to August of 1 year.

Zavala-Hidalgo et al., 2006

Gulf of Mexico- Loop Current and eddies



Ruoying He, NC State

NW Florida Shelf

Doyle and Sparks, 1980

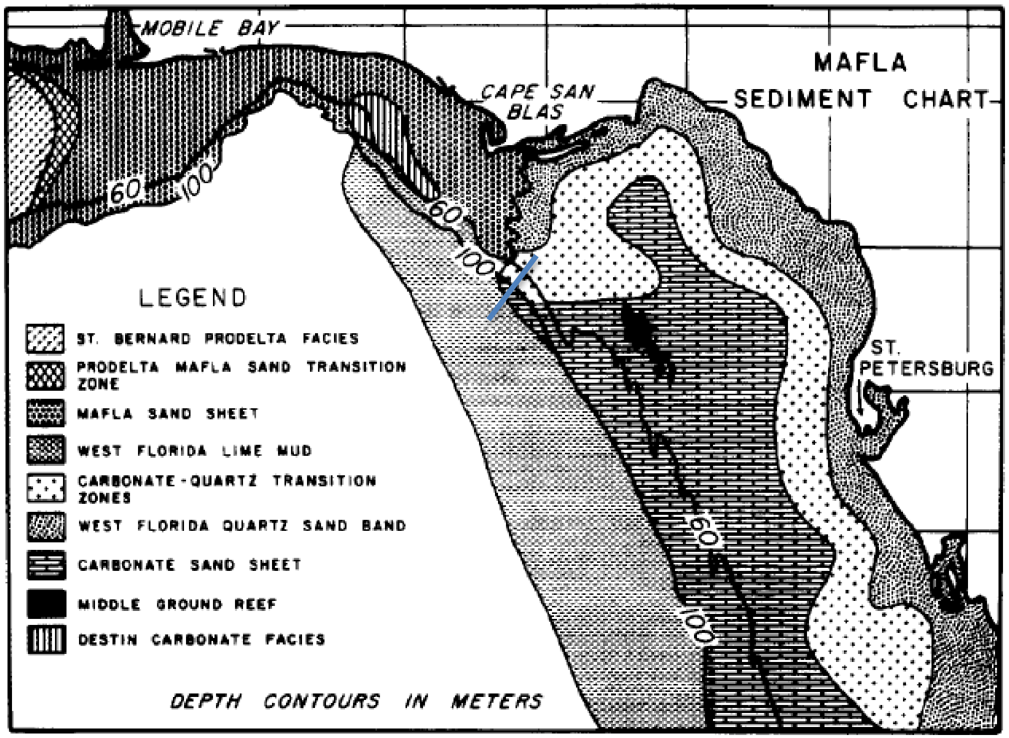


FIG. 9.—Sedimentary facies of the MAFLA margin.

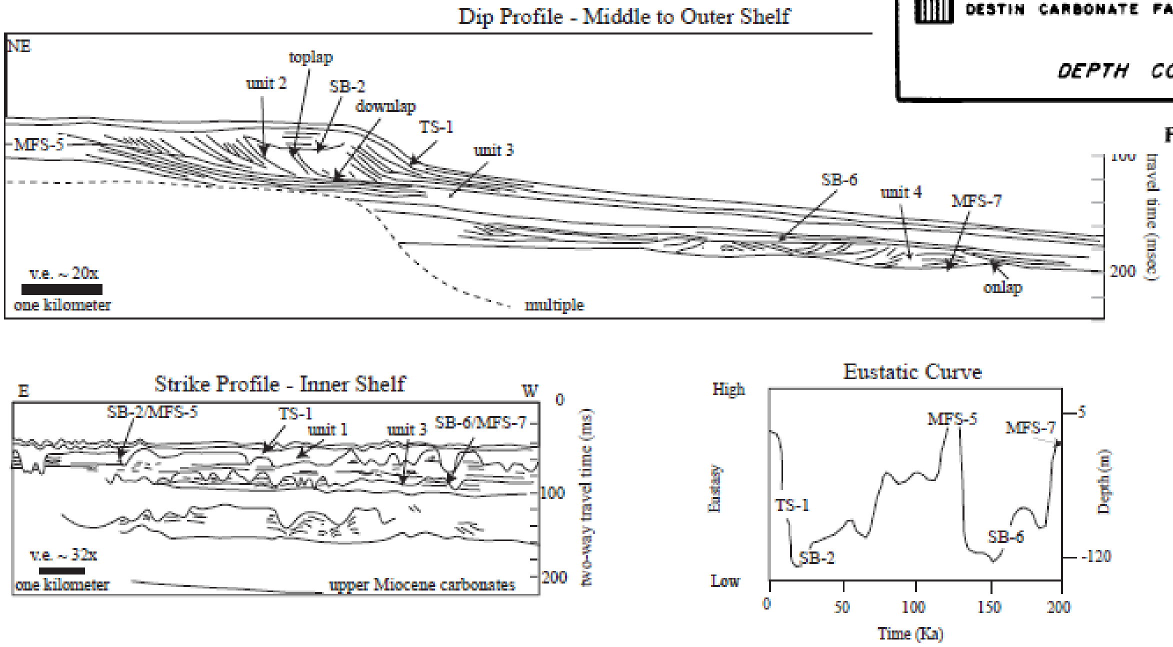


FIG. 3.—Line drawings of dip (APL 08) and strike (APL 04) seismic profiles to illustrate ages of seismic stratigraphic boundaries. The dip-oriented profile best illustrates the generalized stratigraphic architecture and flooding (downlap) surfaces, whereas strike-oriented profiles best image sequence boundaries (fluvial incision). Surfaces are also indicated on the eustatic curve showing their approximate time of formation. Ages are inferred from the relative positioning of surfaces beneath the sea floor, with TS-1 being the upper transgressive surface, SB-2 being the upper sequence boundary, and MFS-5 being the upper maximum flooding surface.

McKeown et al., 2004

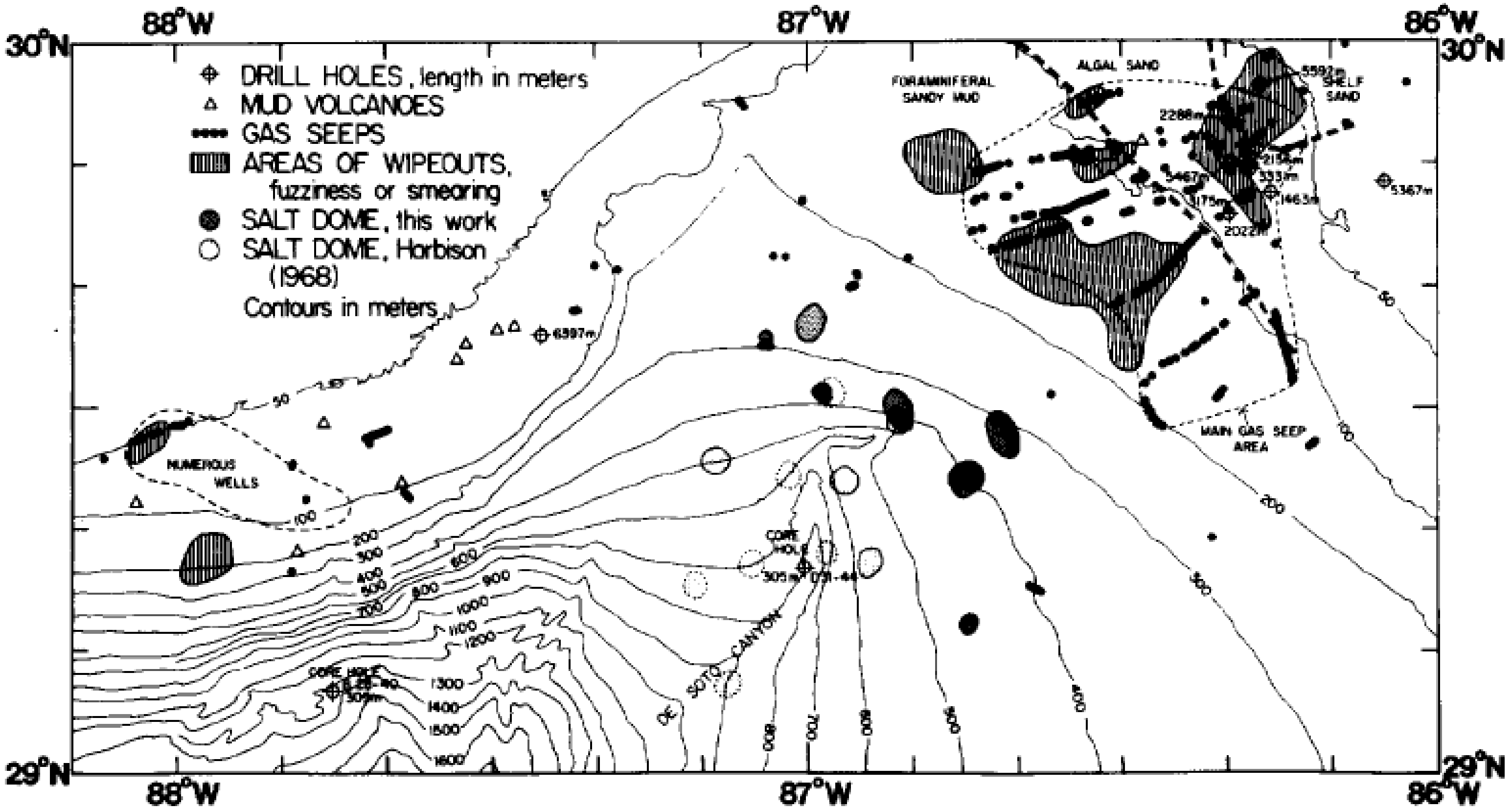
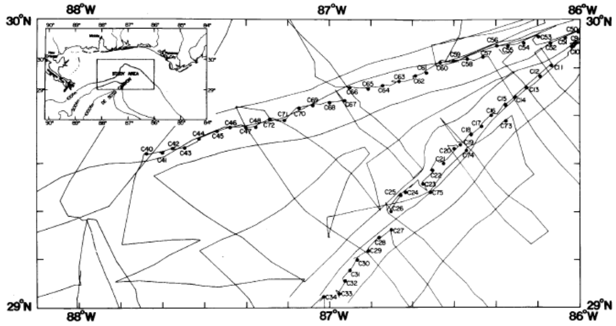


FIG. 3—Map showing distribution of gas seeps, wipeouts, fuzziness, smearing, and sediment type. Each solid circle shown represents one identifiable gas seep. Main gas-seep area is shown by dashed line. Types of surface sediment in main gas-seep area are separated by heavy double-dashed lines. Information 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

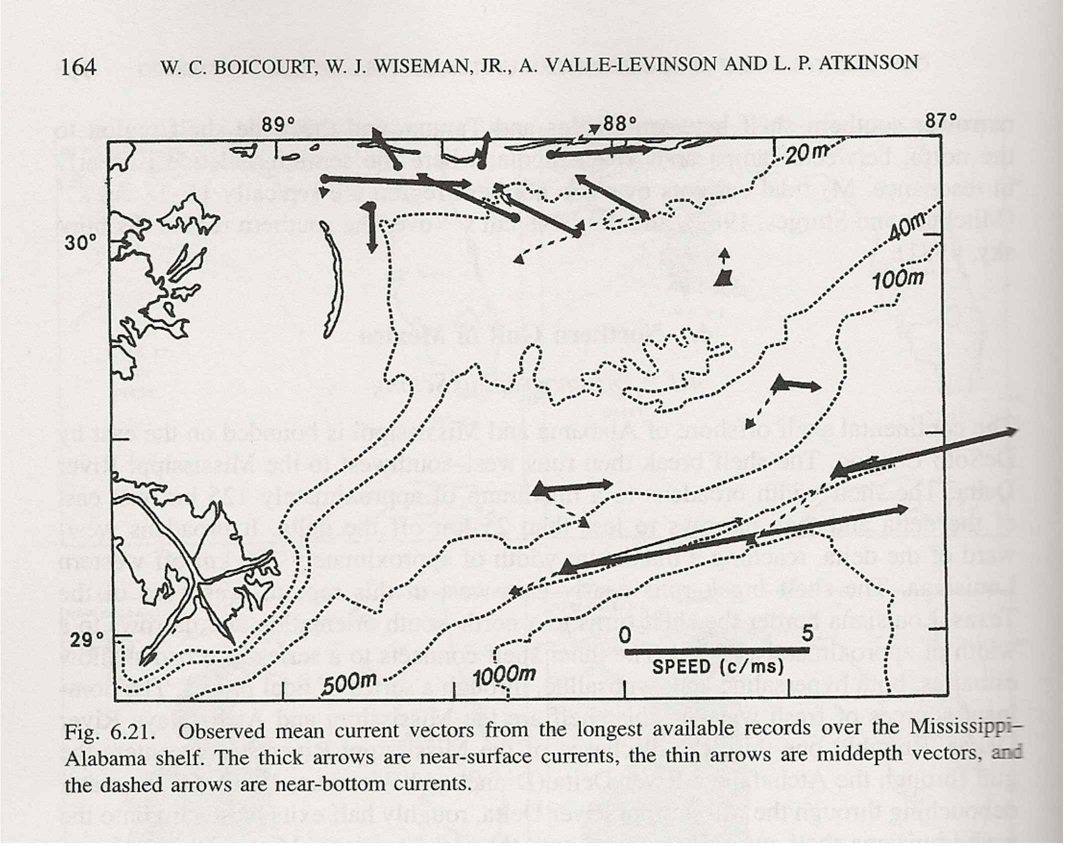


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Fig. 6.21. Observed mean current vectors from the longest available records over the Mississippi–Alabama shelf. The thick arrows are near-surface currents, the thin arrows are middepth vectors, and the dashed arrows are near-bottom currents.

Gulf of Mexico- NW Florida shelf

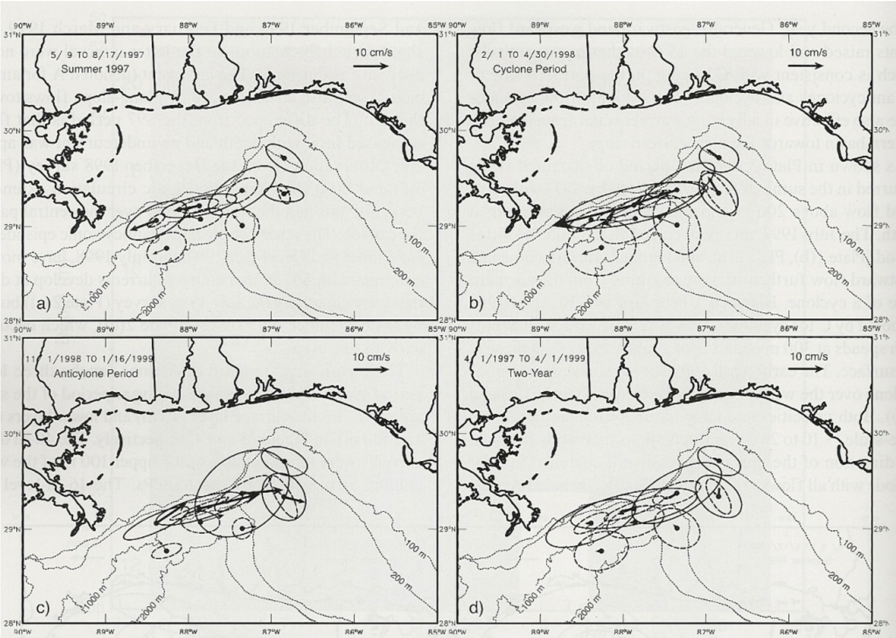


Figure 4. Mean currents and standard deviation ellipses at 200-m (thick arrows and solid ellipses) and 500-m (thin arrows and dashed ellipses) depths, from 40-HLP data, for the periods: (a) Summer 1997 (S97); (b) Cyclonic flow (C); (c) Anticyclonic flow (A); and (d) Complete two-year records.

Current ellipses- continental slope

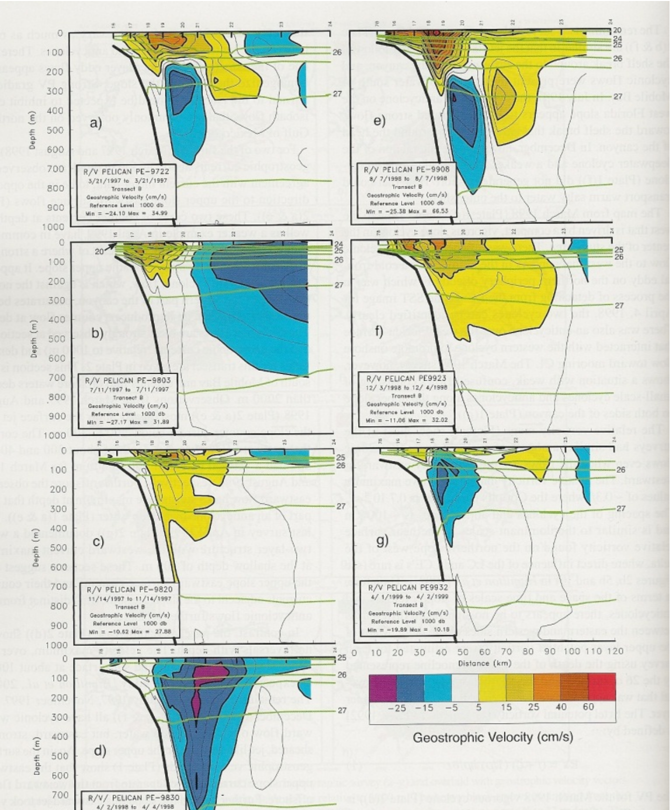
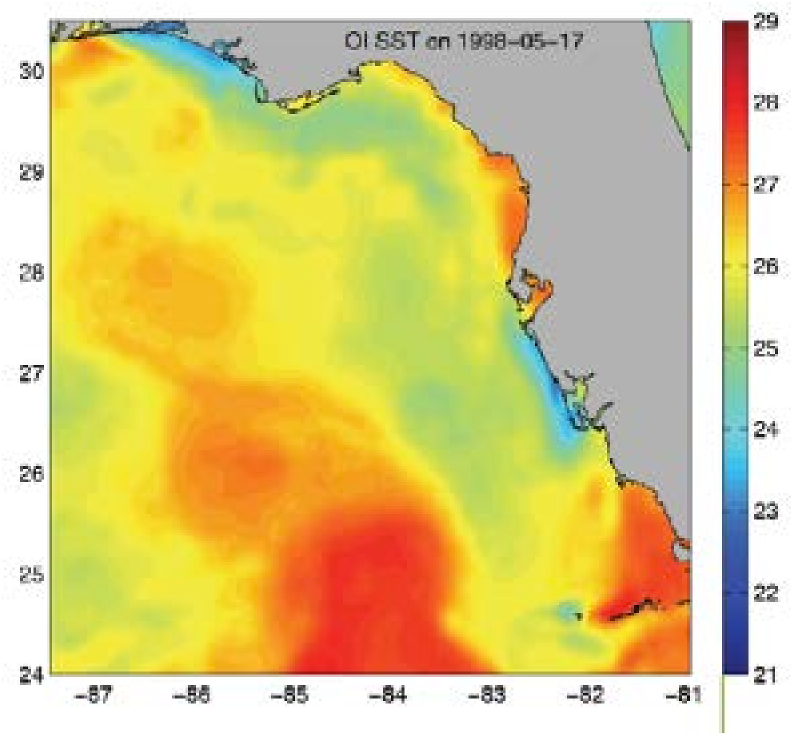


Plate 2. Geostrophic velocities on transect B for the indicated surveys. Positive velocities are eastward and normal to the section. Isopycnals (green lines) are overlaid at intervals of 0.5 σ_t.

Alongshelf currents over slope

NW Florida-Coastal upwelling



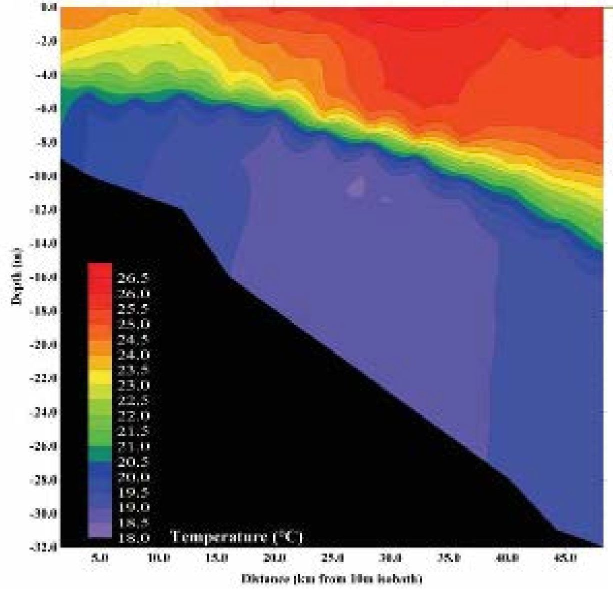
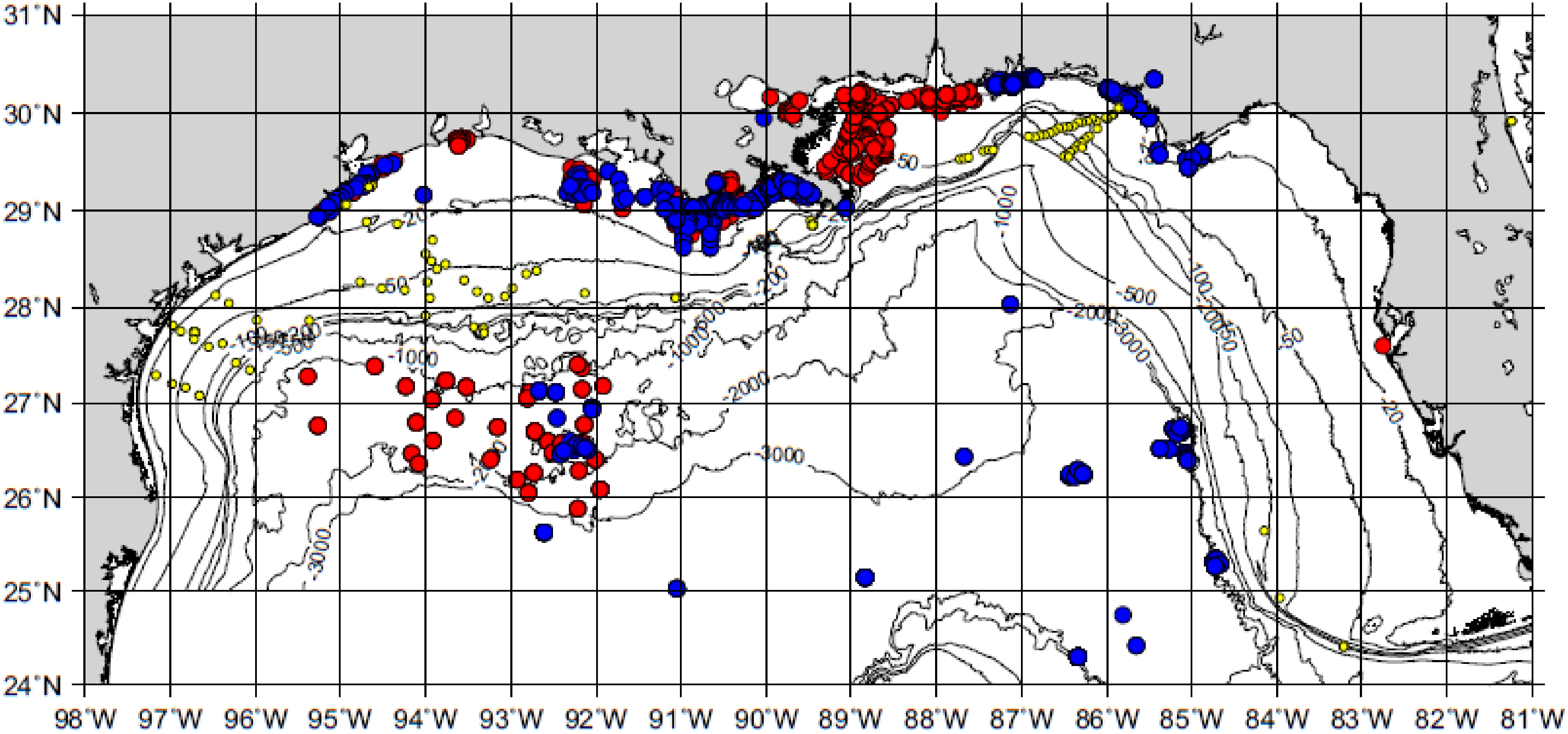


Figure 3. A temperature cross section sampled offshore of Sarasota, Florida on May 18, 1998. It is believed that the cold-water core originated a few hundred kilometers to the northwest by upwelling across the shelf break in the Florida Big Bend region (Figure 1; Weisberg and He, 2003; Walsh et al., 2003).

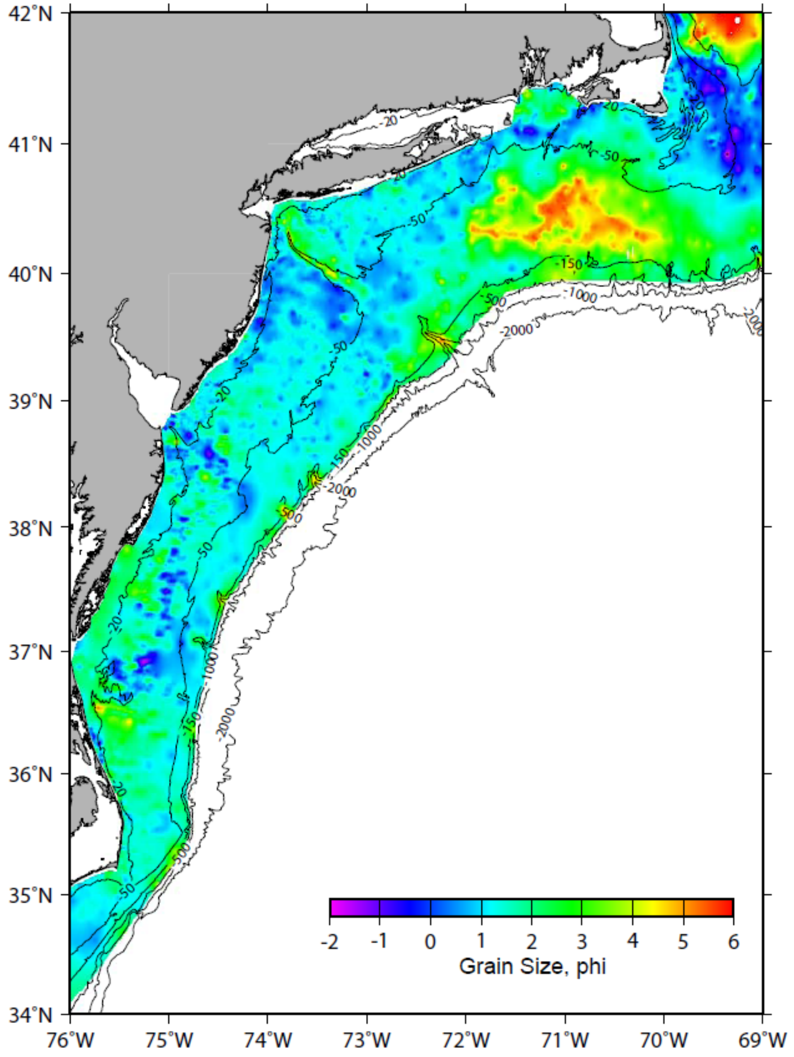
Weisberg et al., 2004

Gulf of Mexico Core Locations

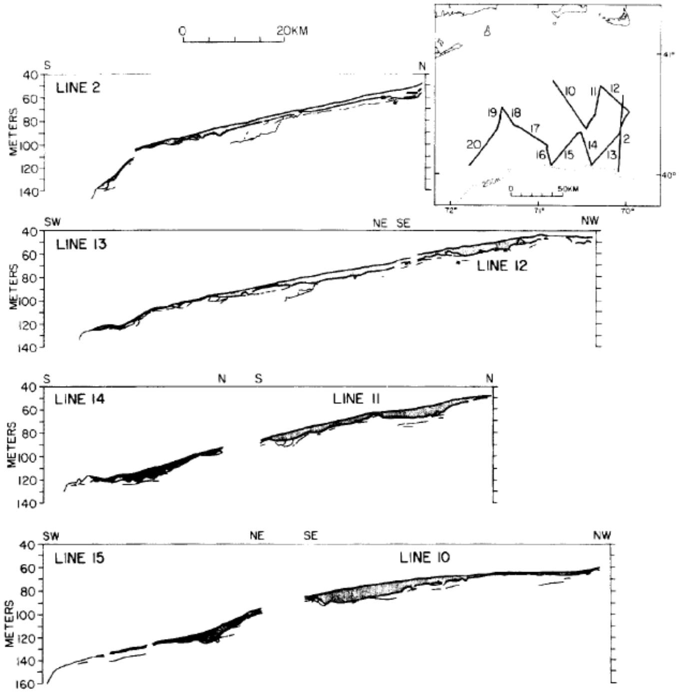
NGDC: yellow dots
usSEABED visual: red dots
usSEABED analytic: blue dots



Mid-Atlantic Bight
Mud Patch



Palamara et al., in prep



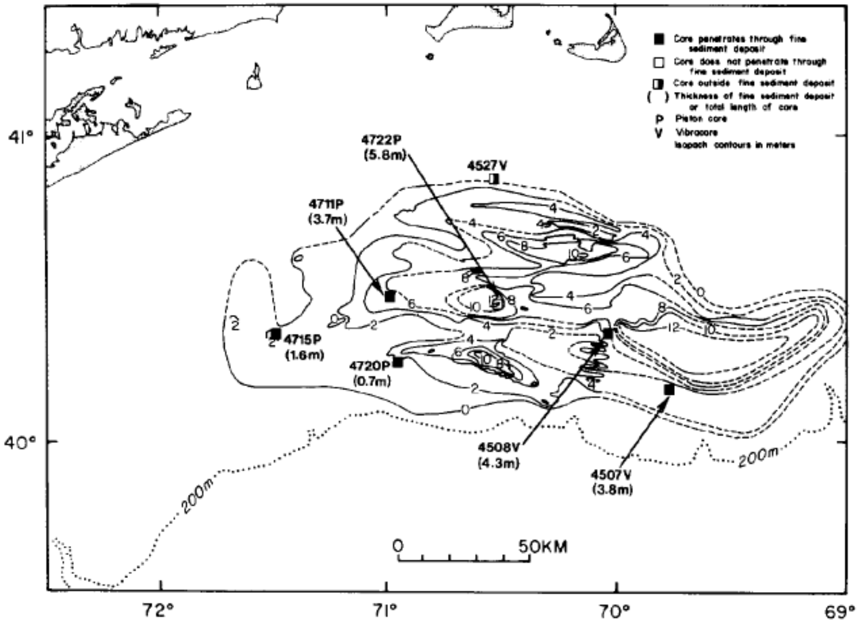


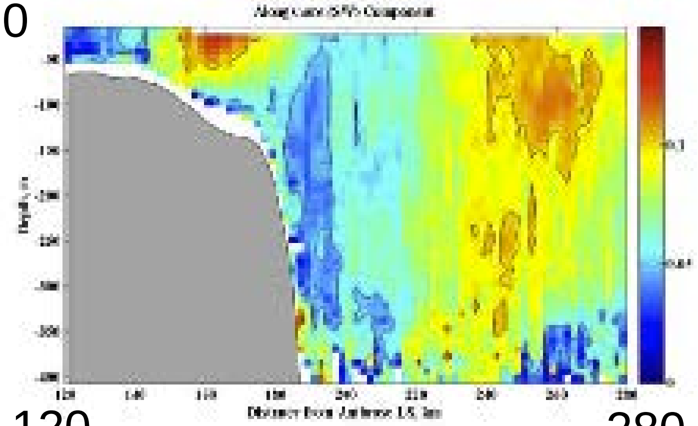
FIG. 4.—Isopach map of the acoustically transparent sediment lens. Contours in meters. Core locations and information from Bothner et al. (1979b).

Twichell et al., 1981

Middle Atlantic Bight- Mud Patch

Alongshelf Velocity

20

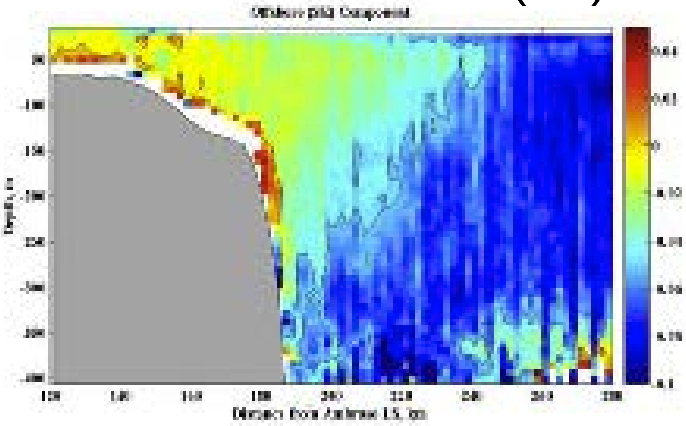


400

120

280

Cross-shelf Distance (km)

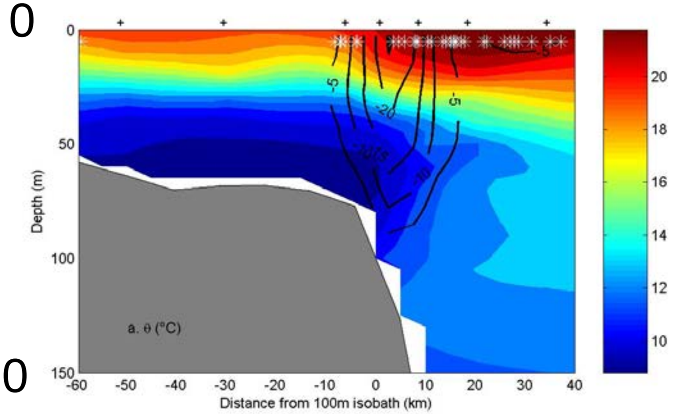


Cross-shelf Velocity

Flagg et al., 2006

Temperature

0

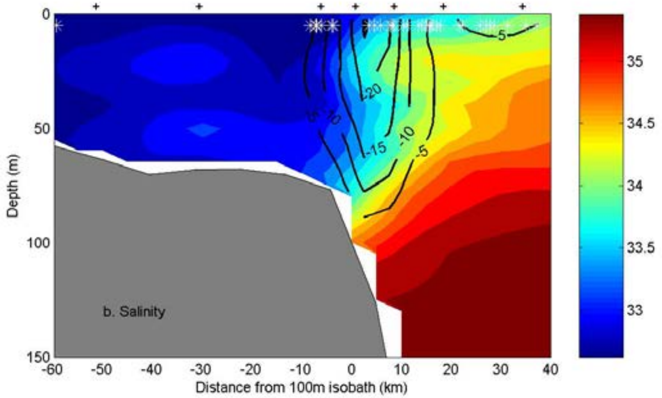


150

-80

40

Salinity



Cross-shelf Distance (km)

C. Linder

Mud Patch- Tides

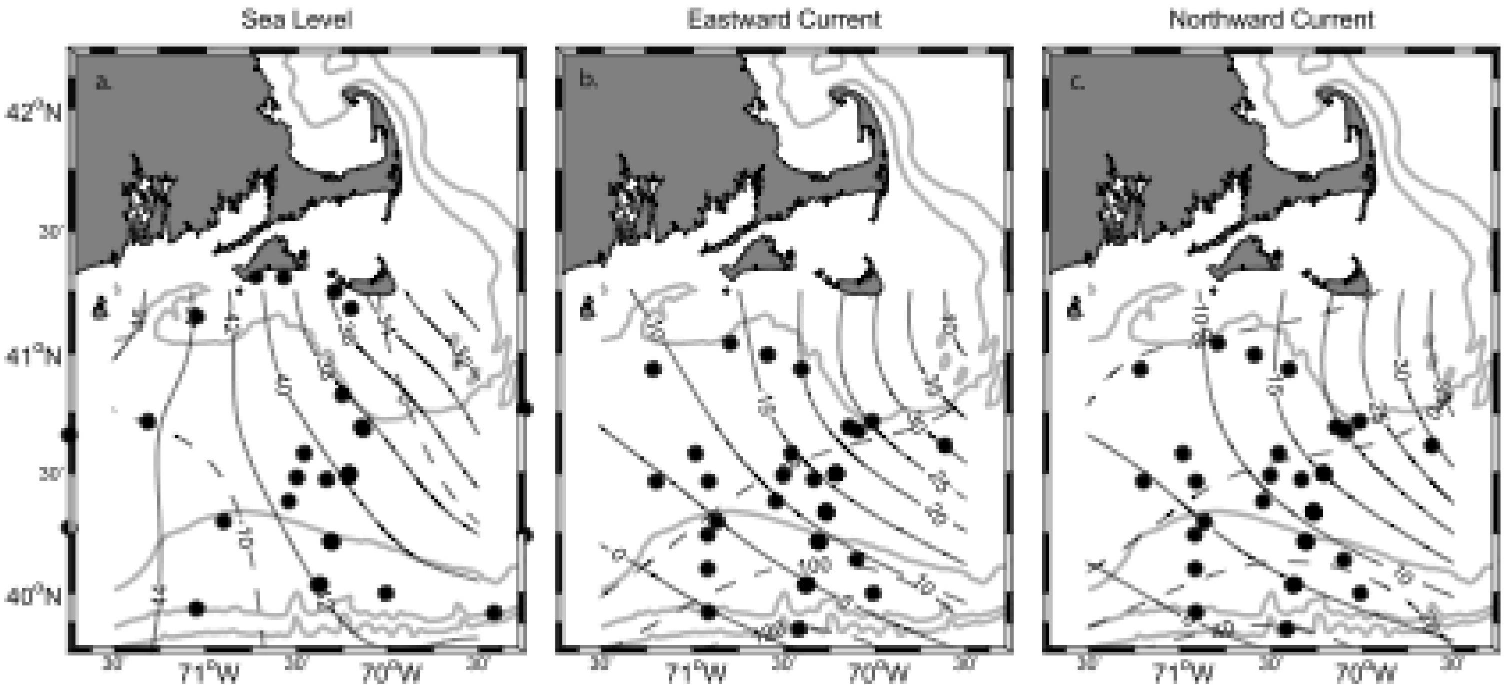


Figure 4. Maps of M_2 amplitude (solid line) and phase (dashed line) over the New England shelf for (a) sea level elevation, (b) eastward current, and (c) northward current. The location of amplitude and phase estimates are shown. The 40, 100, 500, and 1000 m isobaths are shown in gray.

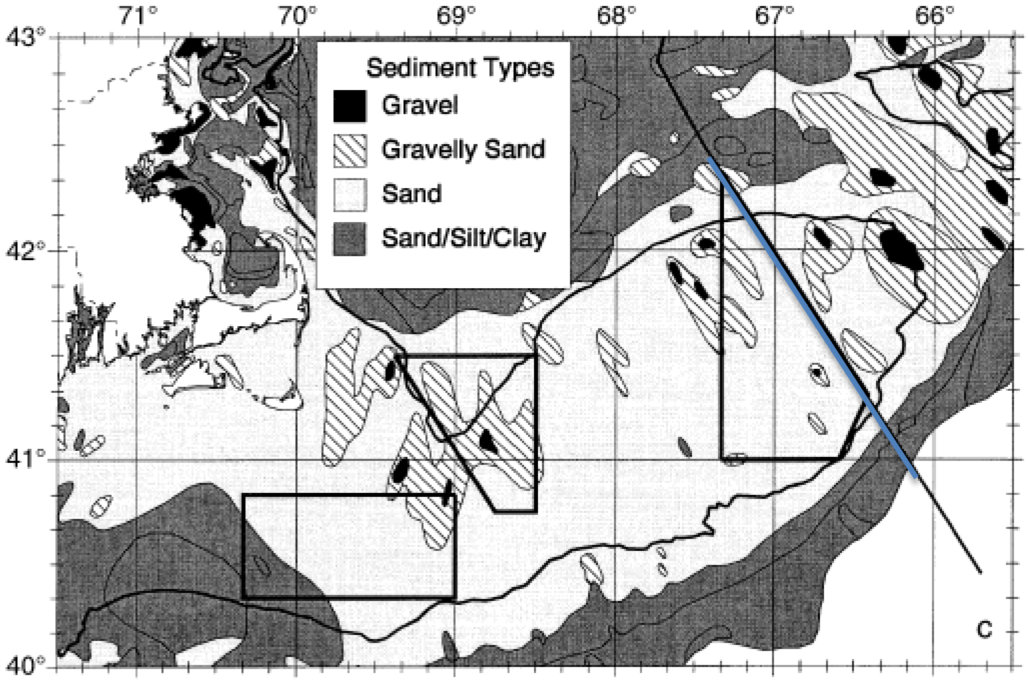
Shearman and Lentz, 2004

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

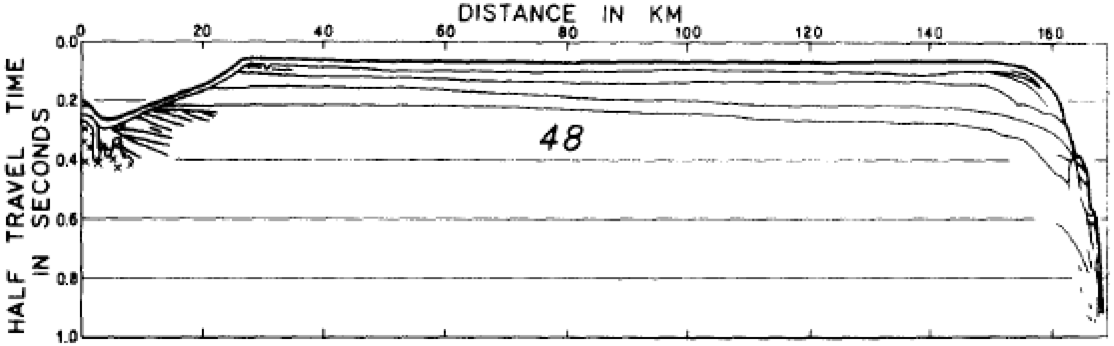


Fig.5. Continuous seismic profile across the top of Georges Bank. For position see Fig.2, and for symbols see Fig.3 and 4. The vertical exaggeration is 22.

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

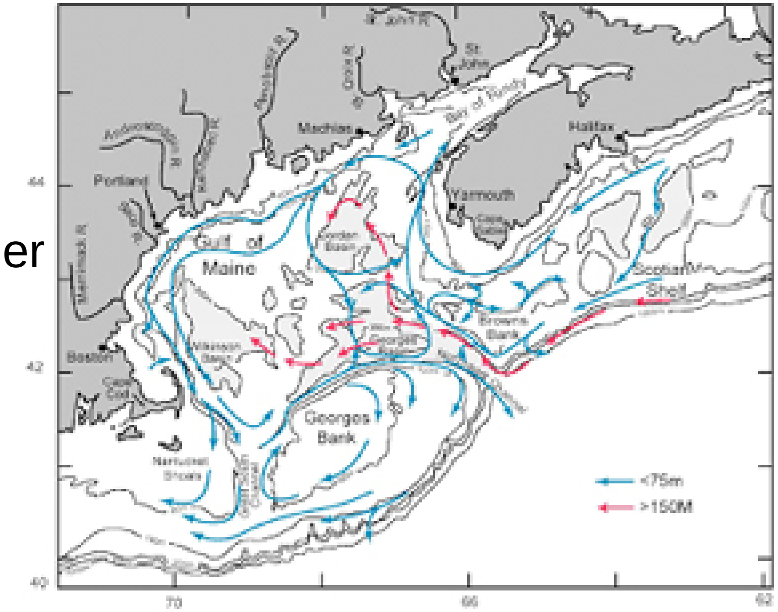
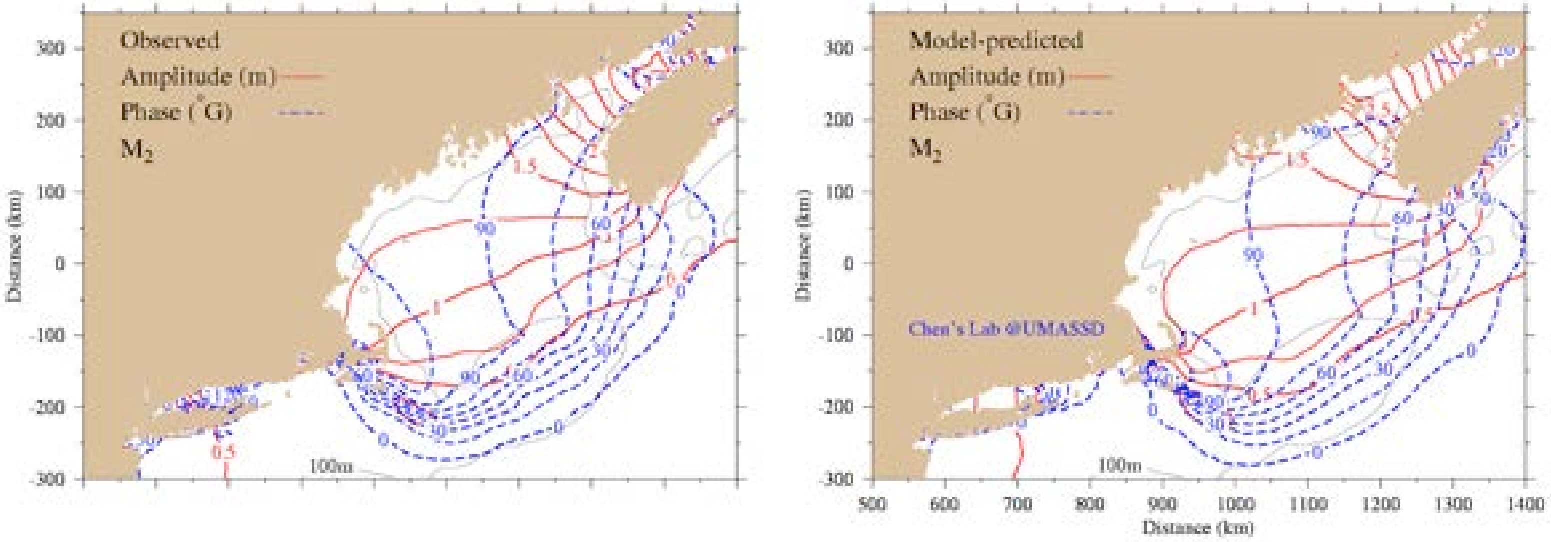
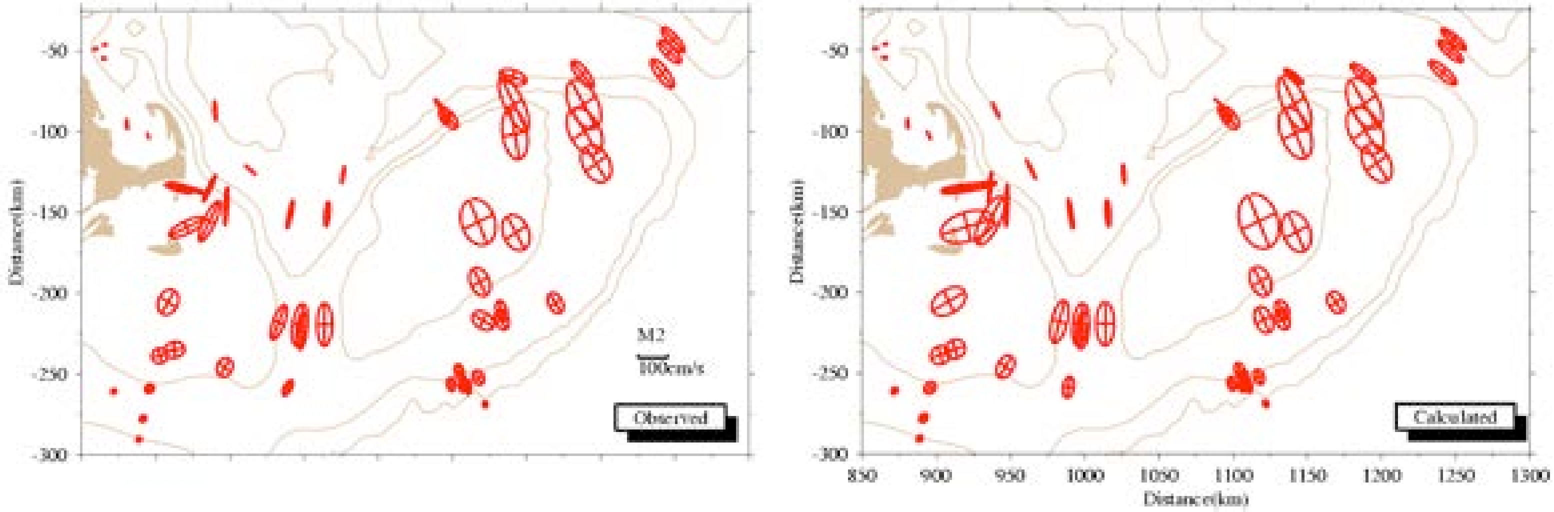


Fig. 1: Bathymetry of the Gulf of Maine/Georges Bank region and schematic of the general subtidal circulation during stratified season. This picture was provided by R. C. Beardsley at Woods Hole Oceanographic Institution.

Georges Bank tides

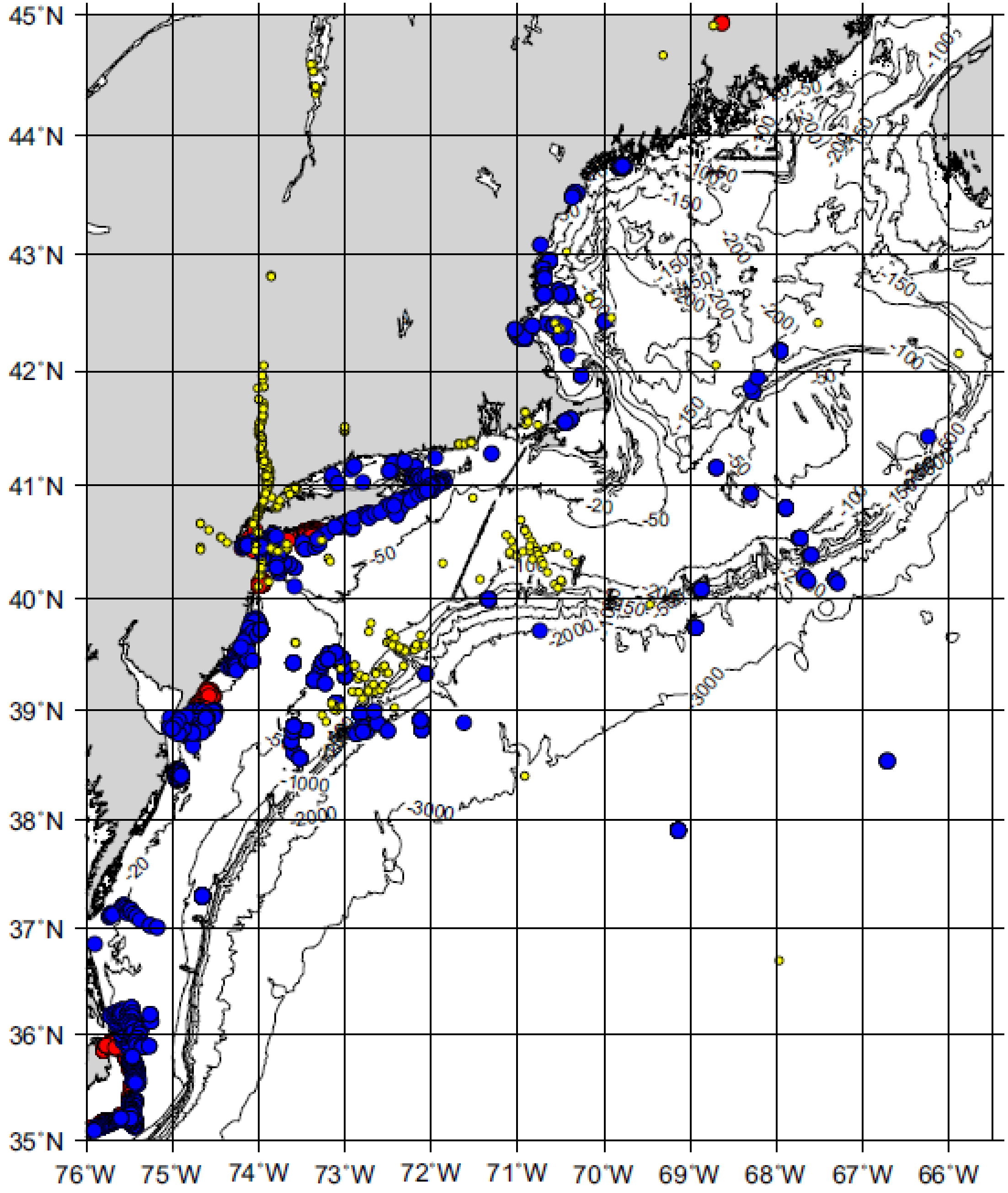




Chang-Sheng Chen, U. Mass.-Dartmouth

North Atlantic Shelf Core Locations

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

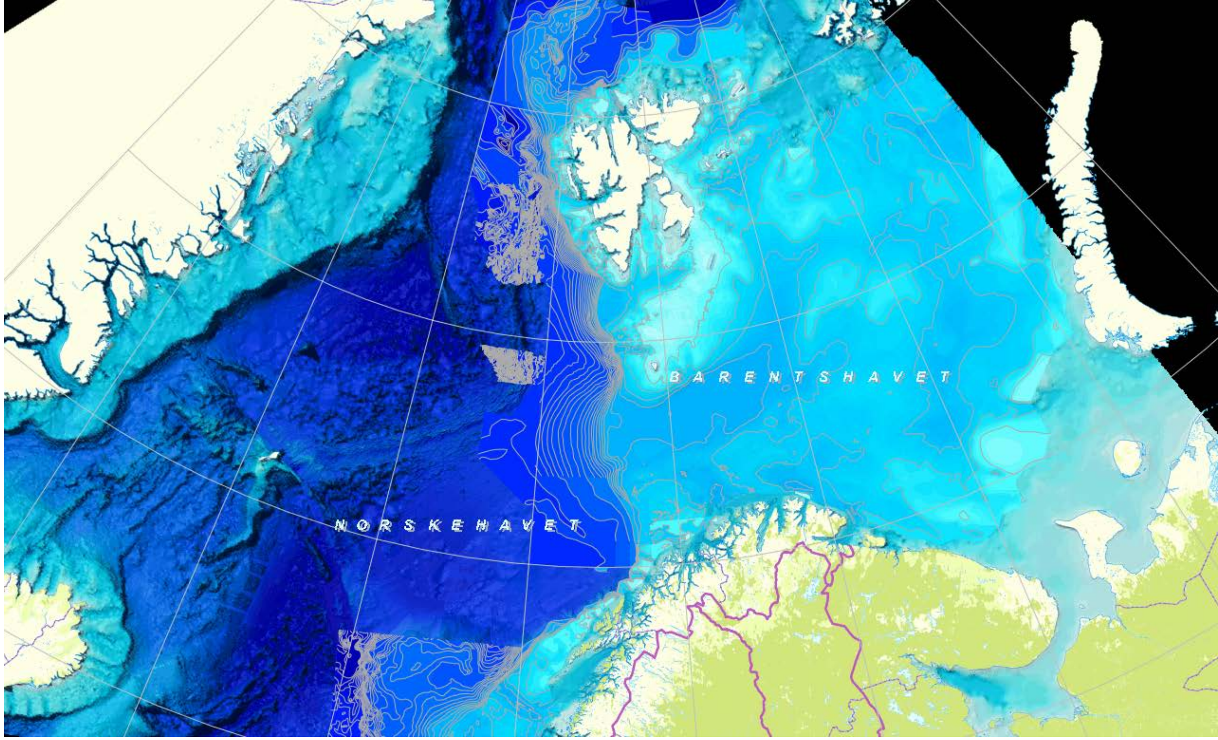


Barents Sea

Mud deeper than 200 m

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

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



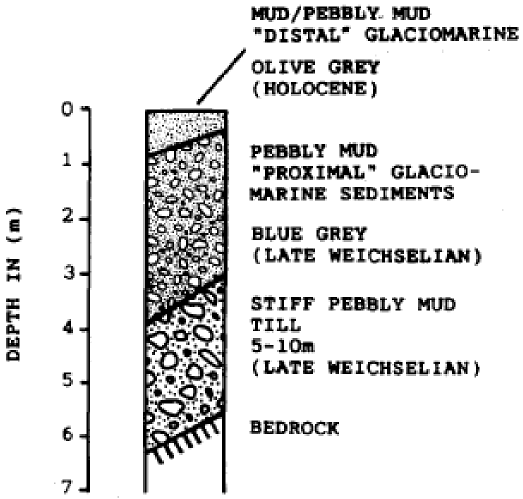
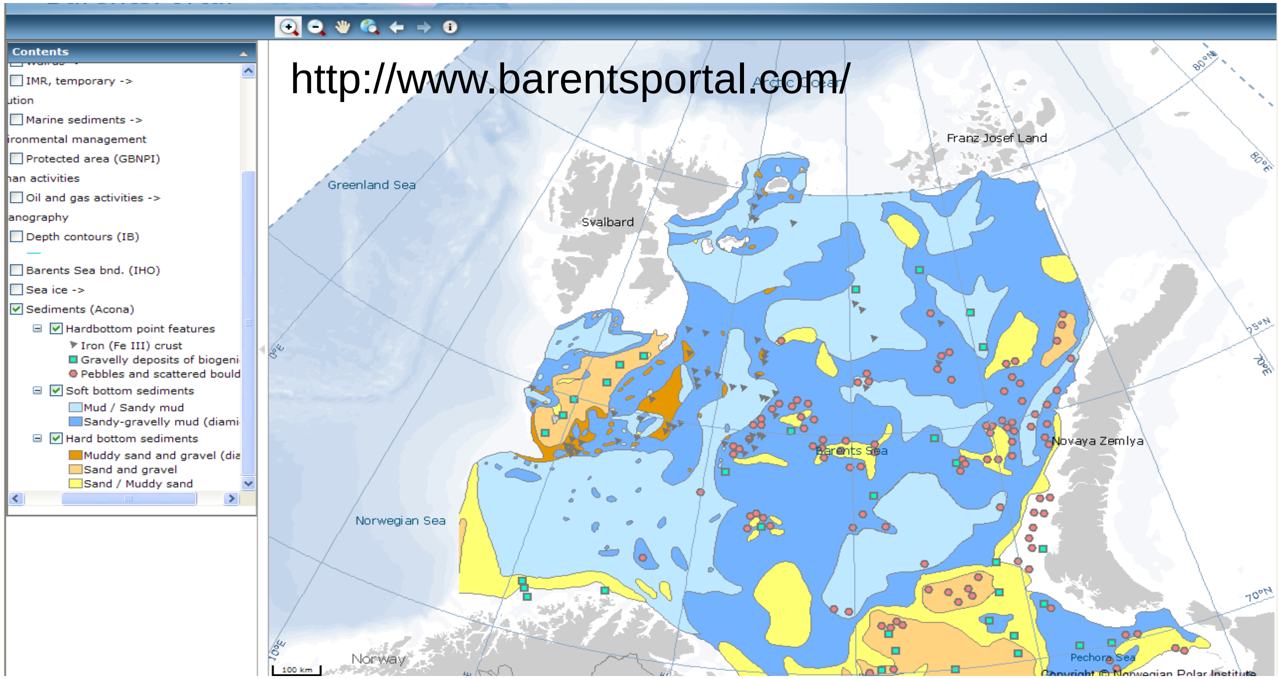


Fig.2. Schematic lithostratigraphic section of the unlithified sediments in the northern Barents Sea. The boundary between the upper mud and the underlying "proximal" glaciomarine sediments is tentatively dated at 10–12 ka B.P. (From Elverhøi and Solheim, 1987b.)

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

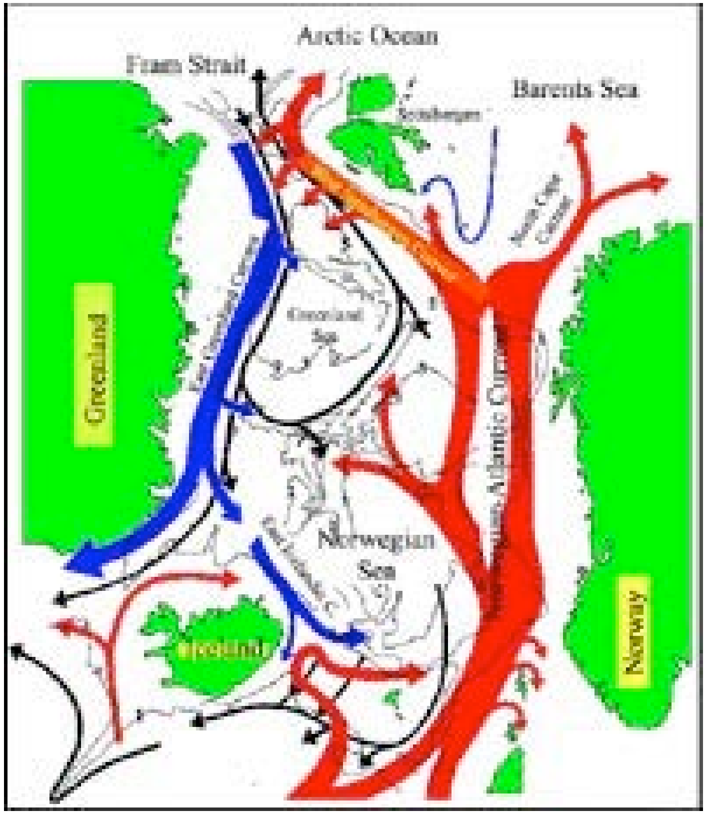
Northward flow west of Norway extends into Bear Island trough with one branch heading east through the central Barents Sea and one branch heading north past Spitsbergen

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

Large polynyas near Spitsbergen lead to strong gravity currents down canyons

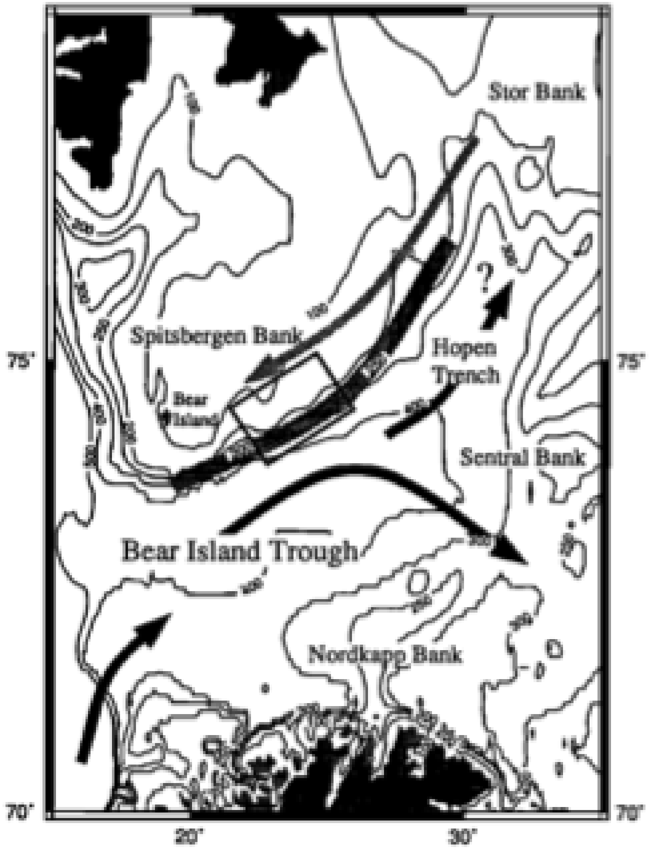
Local bathymetric depressions may trap dense water from previous winter

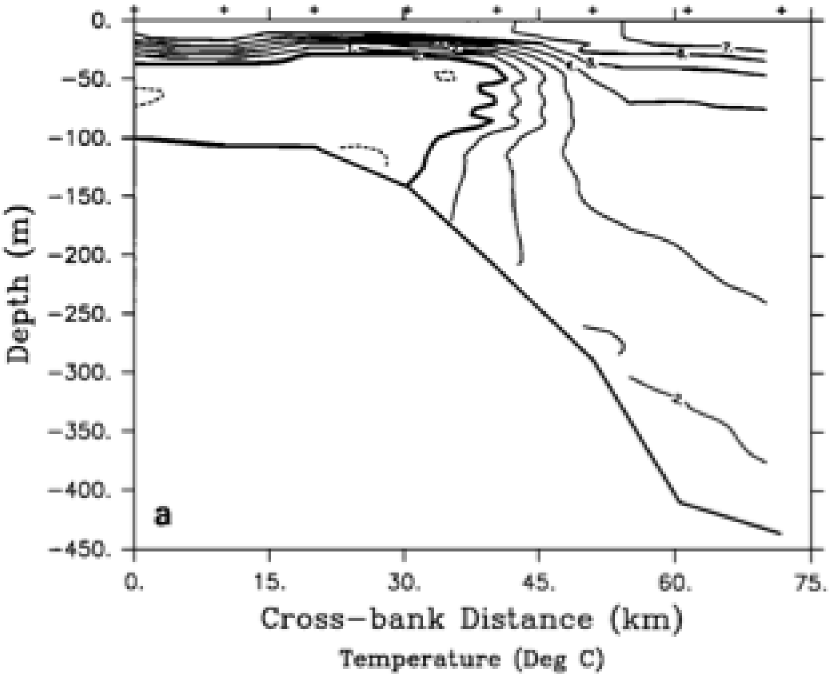
Strong storms and winds- challenging environment to work in



From UCSD Climate Change Earthguide

Barents Sea Polar Front

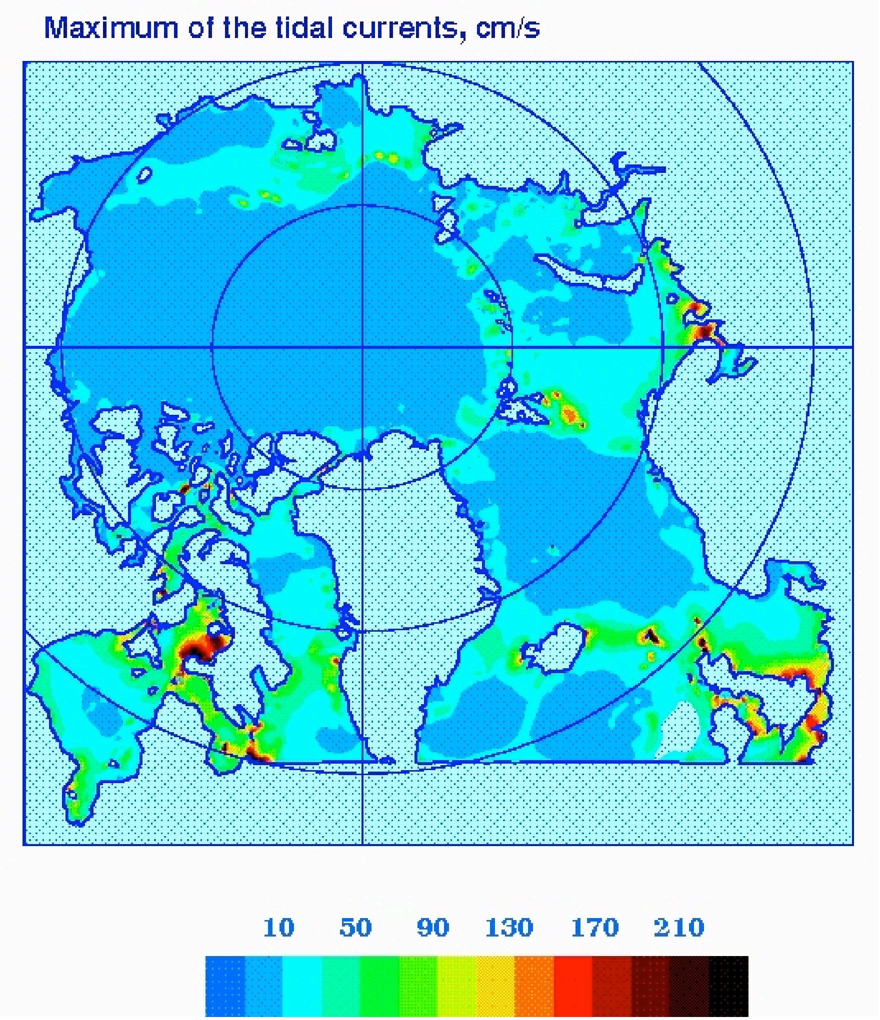




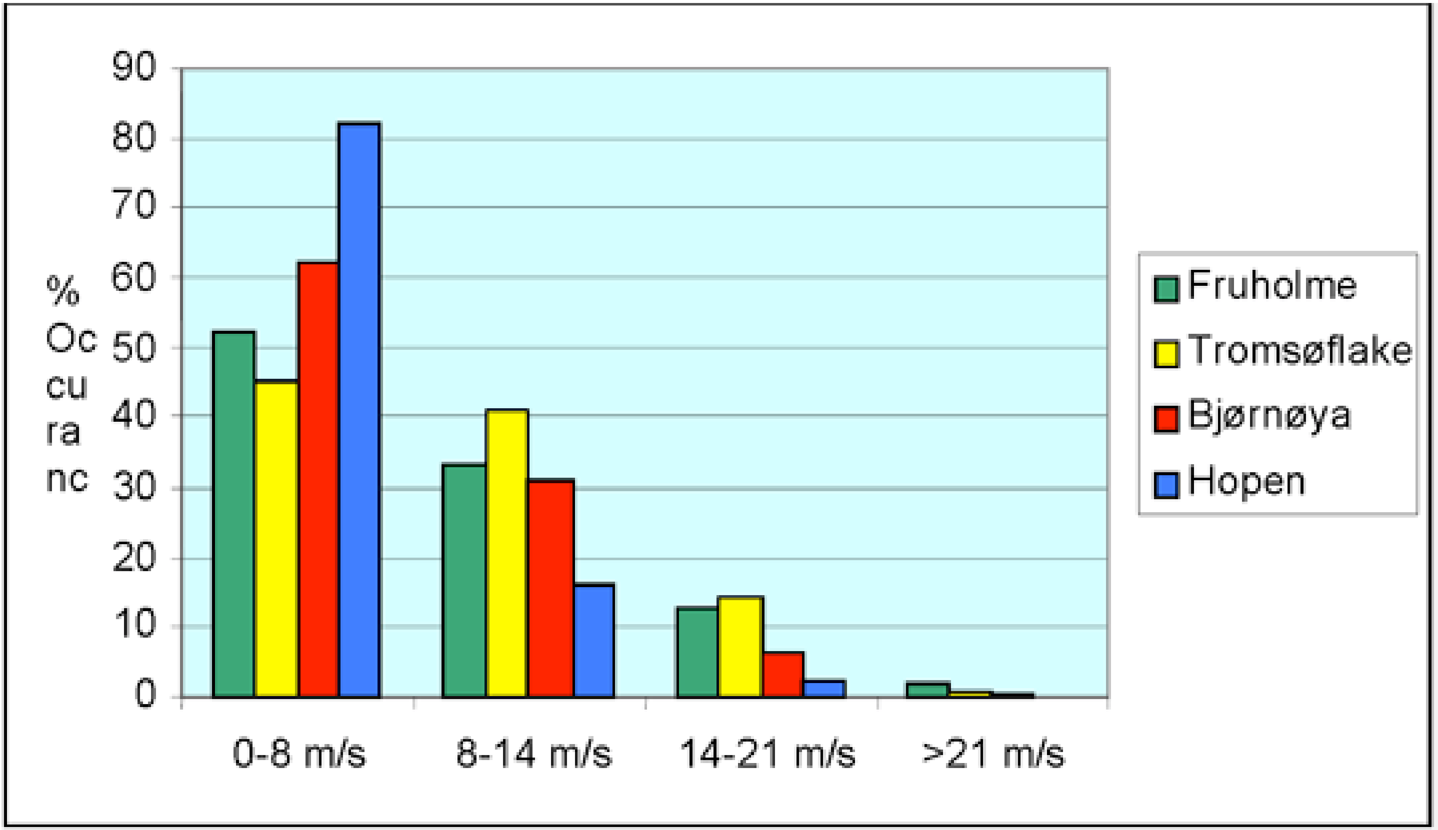
Gawarkiewicz and Plueddemann, 1994

Tides

Tides generally fairly weak, but some local enhancement near Bear Island



Winds



% Occurrence of Wind Speeds

Barentsweb, Norway