

DEPOSITIONAL ENVIRONMENTS AND SEDIMENT TRANSPORT ON A MICROTIDAL, WAVE DOMINATED SHOREFACE

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The south shore of Rhode Island (RI) is a 33 km, microtidal, wave dominated coastline, consisting of alternating barrier spits and headlands comprised primarily of late Pleistocene glacial deposits (till and stratified sand and gravel) (Boothroyd et al., 1985; Boothroyd et al., 1998). Both the barrier and headland shorelines are moderately to heavily developed and managed for human use. The entire shoreline is transgressive, and is erosional on a decadal time-scale (Hehre and Boothroyd, 2007).

High-resolution side-scan sonar, underwater video imagery, surface sediment samples and diver surveys have been used to map the distribution and characteristics of depositional environments on portions of the RI shoreface over the last 20 years. These surveys have identified four main depositional environments: 1) Dp ss - depositional platform; a sand sheet immediately seaward of the intertidal beach comprised of medium to fine sand; 2) CSS sd - cross-shore swaths of coarse sand and gravel that contain small two-dimensional bedforms with roughly shore parallel crests (large ripples to small dunes); 3) DPv cg - depositional gravel pavement comprised primarily of cobbles (10 – 15 cm intermediate axis); and 4) GO bgc - concentrations of 1-3+ m boulders, deposited during the last glaciation, that crop out within other depositional environments (Klinger, 1996; Boothroyd and Klinger, 1998 ;Brenner, 1998; Zitello, 2002; Oakley et al., 2007).

Longshore sediment transport is predominantly to the east, as indicated by records of past dredging in the Point Judith Harbor of Refuge (Boothroyd et al, 1985). Onshore sediment transport occurs predominantly by wave orbital motion generated by southwest wind-waves. Sediment is transported offshore by combined flows during storm events, when asymmetric wave-orbital motion suspends sand-sized sediment. The suspended sediment is transported offshore by a downwelling return flow generated by set-up along the shoreline (Clifton, 2006; Suter, 2006). The downwelling flow seems to follow topographic lows in the cross-shore swaths, which are aligned perpendicular to the trend of the shoreline and extend offshore to at least 20 m water depth. The bedforms mapped in the cross-shore swaths would need a current speed of 0.5 -1.0 m/s to form (Clifton, 1976). Limited current meter data from the RI shoreface, collected during an extra-tropical storm recorded a velocity of 0.8 m s^{-1} (Griscom, 1978). Similar bedforms and current speeds have been reported for other shoreface localities (Hequette and Hill,

1993). We believe that sediment transported offshore to a depth greater than 12 m is not returned to the intertidal beach. While the cobble pavement is likely a depositional feature, transport and movement of these clasts only occurs during significant storm events, as a velocity of $2\text{--}4\text{ m s}^{-1}$ is needed to transport cobbles. It is unlikely that there is any significant transport of the boulders.

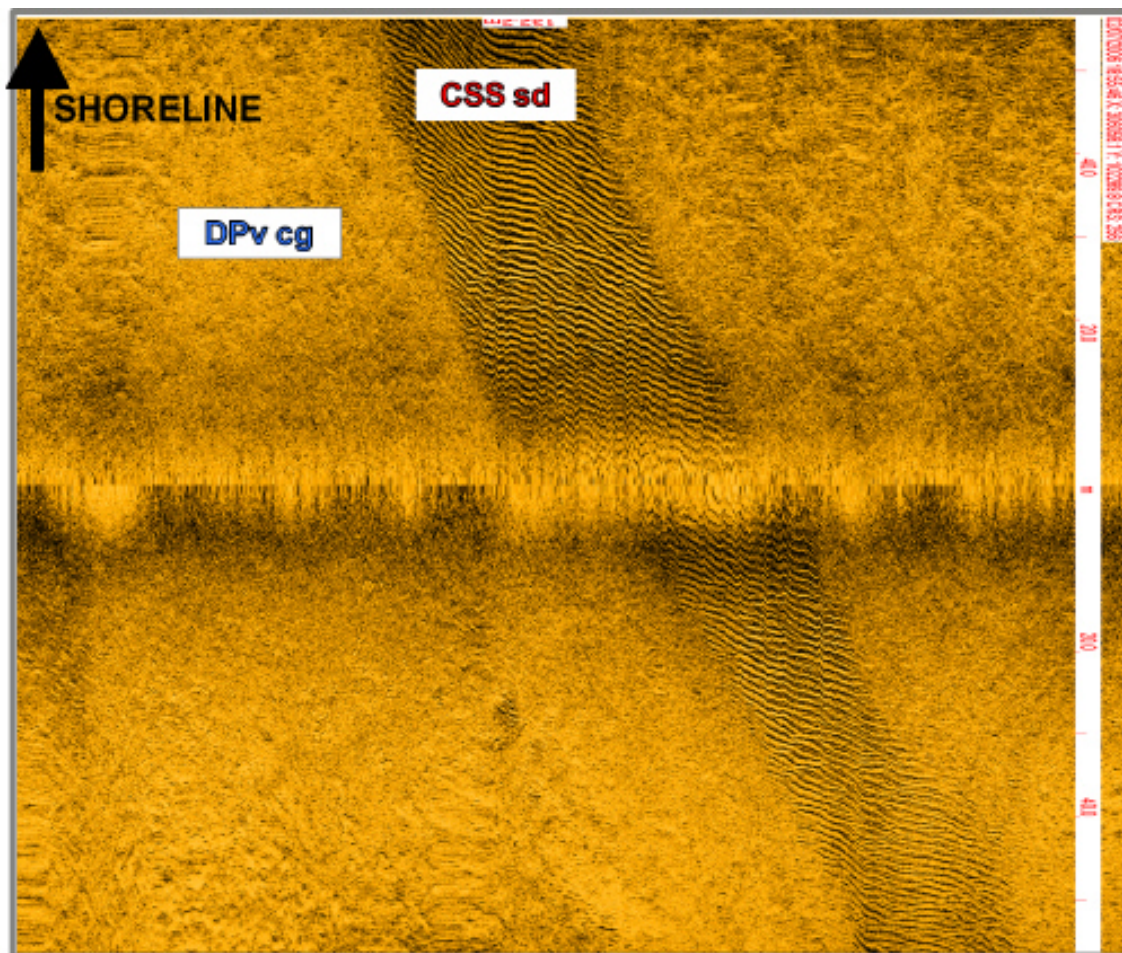
While this work has expanded our knowledge of shoreface sediment transport, additional benefits include locating suitable placement sites for the beneficial use of dredged material and mapping the distribution of essential habitat for commercial and recreational fish and shellfish.

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FIGURES:



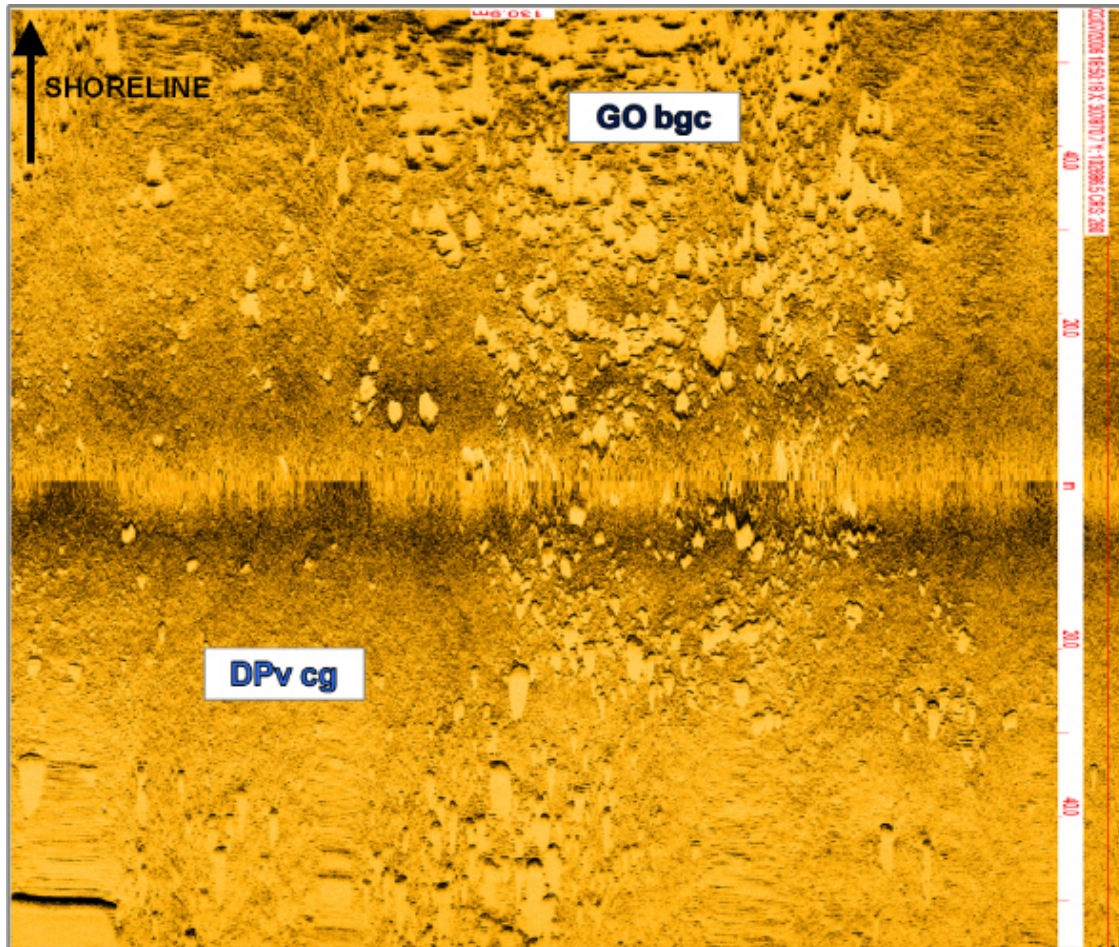


Figure 1. High resolution side-scan sonar images of the Rhode Island shoreface. See abstract for details.

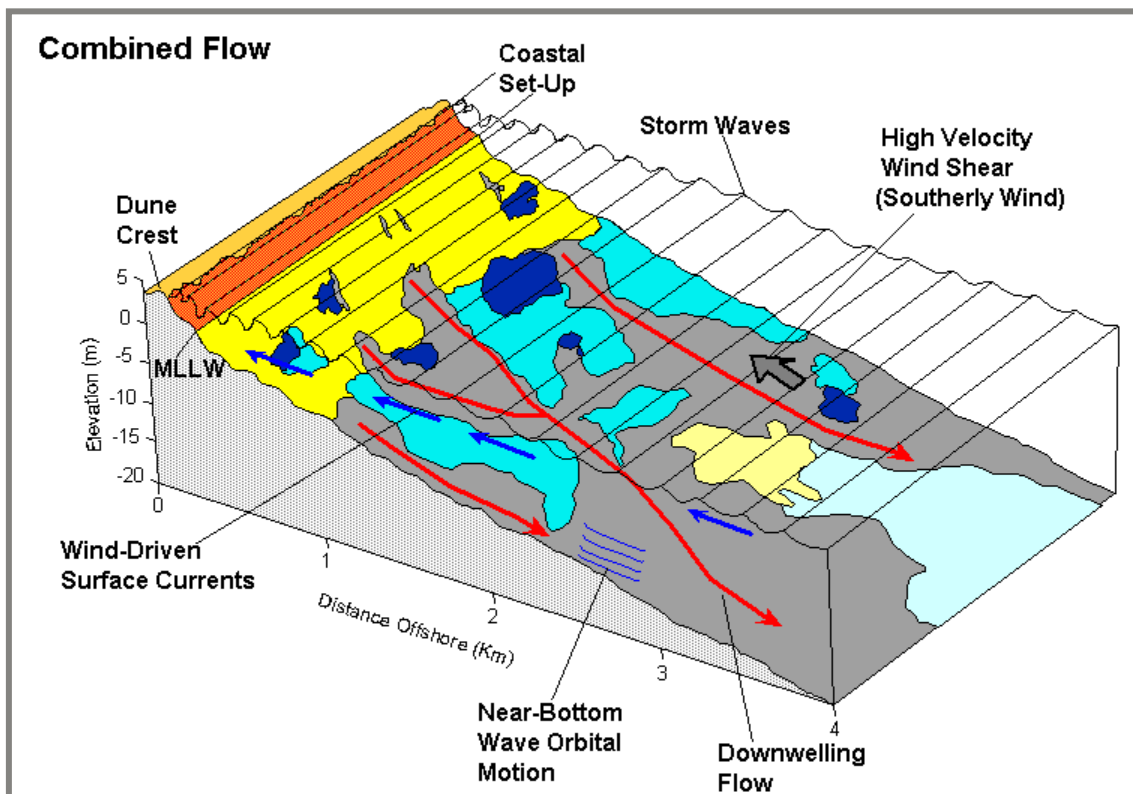


Figure 2. Downwelling combined flow on the Rhode Island shoreface/inner shelf of Block Island Sound. Gray areas are cross-shore swaths inset into a depositional pavement of cobble gravel (light blue).

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