Sedimentology and Hydrodynamics of Strait-Margin Beach/Shoreface Complexes, Strait of Juan de Fuca, British Columbia

Shannon E. Frey
Shahin E. Dashtgard

ARISE, Department of Earth Sciences, Simon Fraser University, 8888 University Drive, Burnaby, British Columbia V5A 1S6
sfa21@sfu.ca

The relative influence of tides and waves on the sedimentological and ichnological character of strait-margin beach-shoreface complexes is poorly defined. Strait-margin shorefaces differ from wave-dominated (open ocean) shorefaces in that strong tidal currents are common due to the exchange of water though the strait with the rising and falling tide. As well, strait-margins tend to be protected from full ocean swells by the landmasses restricting the waterway. The strong tidal currents and relatively weak wave activity can significantly influence the sedimentological character of the shoreface and the infauna that colonize the seafloor. To assess the character of strait-margin beach-shorefaces, the backshore, foreshore, and shoreface of three composite sand-and-gravel beaches (upper mesotidal to lower macrotidal range; Fig. 1) on the margin of the Strait of Juan de Fuca, British Columbia were considered.

Sediments constituting these strait-margin beaches/shorefaces reflect the interplay of strong tidal currents and moderate (fair-weather) and strong (storm) wave processes that influence the coast. Tidal currents dominate offshore (below 18 m water depth; Fig. 2a), while wave processes dominate sediment deposition in the nearshore (intertidal zone to 5 m water depth; Fig. 2b). Between the tide-dominated offshore and wave-dominated nearshore is a gradient of increasing relative wave influence from the offshore to the nearshore. Tidal currents operating in the strait transport sand-sized sediment at depths below fair weather wave base. As a result, there is a dominance of medium-grained sand (of a similar sediment caliber to the upper shoreface; Fig. 2c) in the offshore and lower shoreface, which is consistent for all shorefaces within the strait. These offshore and lower shoreface sandy sediments are mainly deposited as current-generated structures oriented parallel to the shoreline (Fig. 2d).

Wave processes dominate in the upper shoreface and foreshore. Sedimentary structures in these two environments share similarities with both wave-dominated beach/shorefaces and tidally-modulated beach/shorefaces. The upper mesotidal to lower macrotidal tides within the Strait of Juan de Fuca modulate wave activity in the foreshore, resulting in interbedding of sedimentary structures produced by a range of wave processes (e.g., swash-backwash, surf, breaker, and shoaling wave zones).

Comparison of these strait-margin beaches with their wholly wave-dominated (open-coast) counterparts, reveals that strong tidal currents active in the strait significantly alter the character

of the beach and shoreface. The lower shoreface and offshore are dominated by sand deposited by energetic unidirectional tidal currents. This differs from wave-dominated settings, where the lower shoreface and offshore are normally dominated by mud deposition in a low-energy setting. As well, the upper shoreface and foreshore are influenced by the large tidal range; mainly through tidal modulation of wave regimes. Although this is a common phenomenon in beach-shorefaces developed in mesotidal to megatidal settings, the reservation of interbedding is more likely in settings with reduced wave-energy, such as along strait margins.

Figure 1: Location map of the study area. a) Vancouver Island, Canada b) The three beaches included in this study; French Beach, Sandcut Beach, China Beach c) Sattelite image of Sandcut Beach d) Ground images of Sandcut Beach.

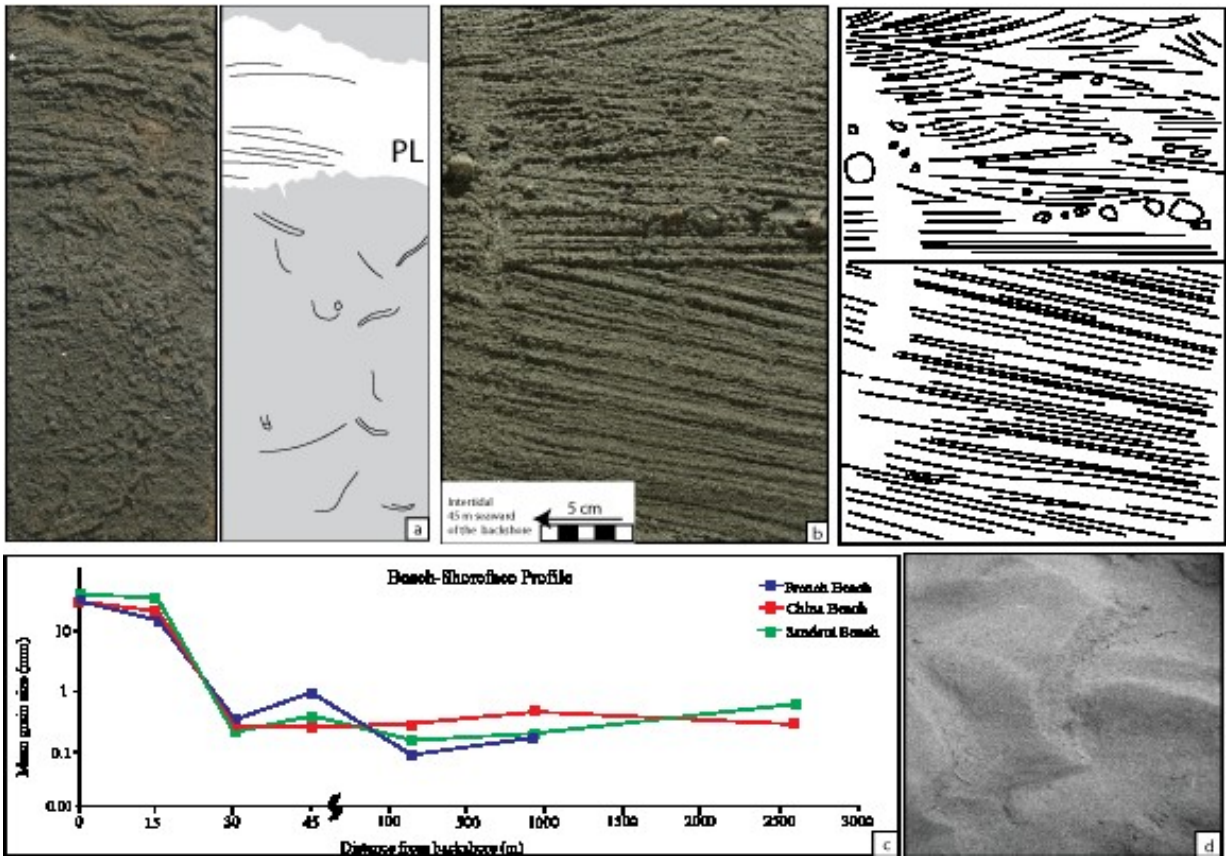

Figure 2: a) Sediment peel and corresponding line diagram of sedimentary structures and ichnology (PL = planar lamination) from 13 m water depth, Sancut Beach. b) Sediment peel and corresponding line diagram of sedimentary structures from the intertidal of Sandcut Beach. c) Cross-shore diagram of sediment calibre for each beach. d) Current ripples oreinted parallel to shoreline,18 m water depth, French Beach.