AAPG Datapages/Search and Discovery Article #90235 © 2015 AAPG Asia Pacific Region, Geoscience Technology Workshop, Modern Depositional Systems as Analogues for Petroleum Reservoirs, April 21-22, 2015, Wellington, New Zealand

The Role of Longshore Drift in Sand Accumulation on the Sedimentary Shelf

Christine McLachlan[1], Gary Wilson[1], Andrew Gorman[1], and Lionel Carter[2]

[1]University of Otago, Dunedin 9016, New Zealand
[2]Victoria University of Wellington

Abstract

Current sequence stratigraphic models deal with the factors of eustasy, subsidence and sediment supply. However, these models do not always account for other imprints on the system, which also affects the stacking pattern of sedimentary sequences, such as the coast parallel re-distribution of sediment by longshore drift.

Here, we compare a new seismic profile taken ~30 km to the south off the coast of Dunedin with a previously interpreted high-resolution seismic profile (Osterberg, 2006) to the north. Osterberg's (2006) seismic profile was acquired offshore from the Miocene volcanic Otago Peninsula where the continental shelf steepens and thins to ~12 km. Our new seismic profile (Dunedin profile) was taken ~10 km off the Dunedin coast on a wider, ~40 km, lower gradient region of the continental shelf and covers the inner-middle shelf. The two lines are proximal enough (Figure 1) to be able to discount subsidence and relative sea level variations as factors in sedimentation patterns.

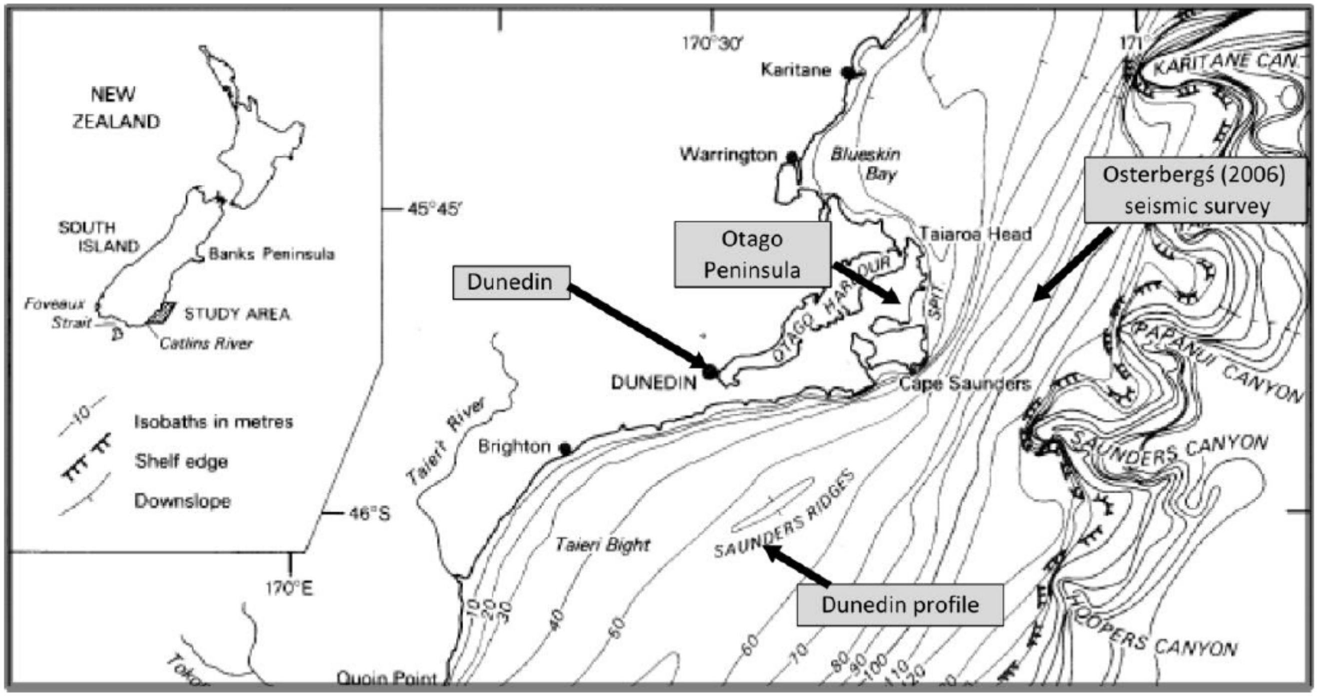

Figure 1. Location map for seismic profiles (modified from Carter et al, 1985).

The two profiles show different stratigraphic stacking patterns with Osterberg's (2006) profile dominated by deposits accumulated during the highstand and regressive phases of the sea level cycle while the Dunedin profile is dominated by deposits accumulated during transgressive phases (Figure 2).

In the current interglacial highstand climate the seismic profiles have the same major sediment supply; the Clutha and Taieri rivers which deliver 3.14 Mt y^{-1} (pre-Clyde dam, construction started 1982) and 0.4 Mt y^{-1} respectively, the adjacent Southland continental shelf, 0.6 Mt y^{-1}, and biogenic debris, 0.25 Mt y^{-1} (Carter, 1986). This sediment is redistributed along the coast by longshore drift created by the southerly waves and tides and by the Southland Current, which flows over the continental shelf in a northerly direction at a mean speed of 8.3 Sv (Sutton, 2003) and is enhanced by storms. During glacial periods, however, with the lowering of sea level, the region is influenced by a different hydraulic regime with the Southland Current lessened or absent (Carter, 2001). A drier climate during glacial periods also meant that the volume of sediment delivered from the Clutha and Taieri Rivers was less. With a much reduced Southland Current, sediment from Otago Harbour may also have reached the area profiled by Osterberg (2006).

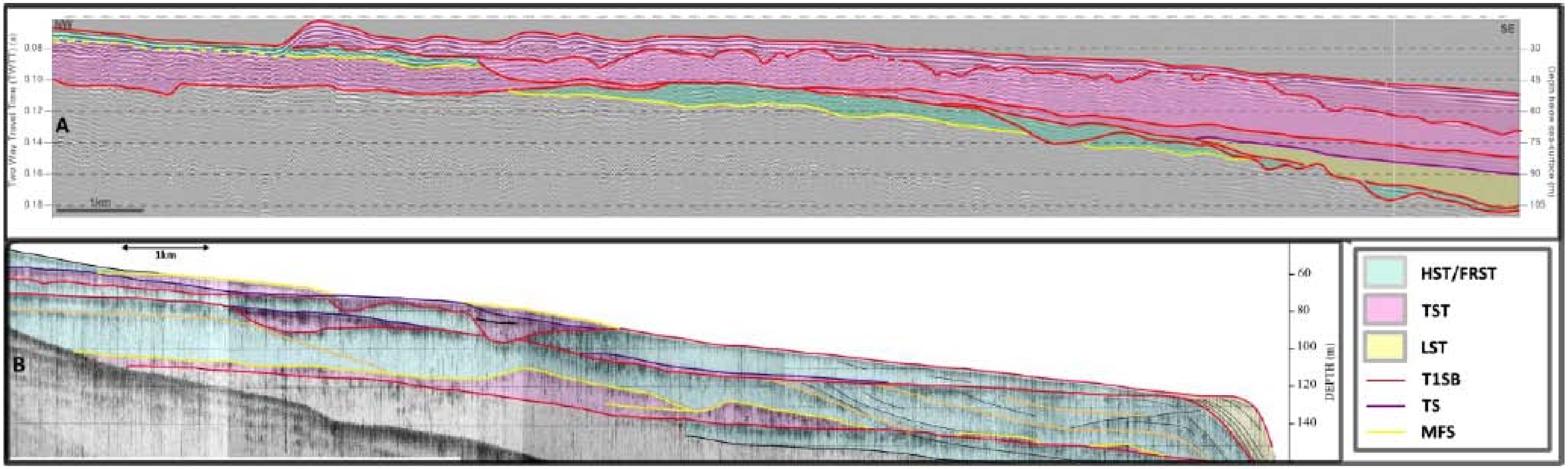

Figure 2. The top figure (A) is the Dunedin profile and the bottom figure (B) is Osterberg's seismic profile taken off the Otago Peninsula, showing the systems tracts and boundaries. T1SB – type 1 sequence boundary, TS – transgressive surface, MFS – maximum flooding surface.

Our observations highlight the importance of coast parallel sediment transport processes, which are not always considered in the interpretation of coast perpendicular seismic sequences. Furthermore, the effect may vary within the sea level cycle as coastal currents reorganise from rising and falling sea level that provides and removes accommodation space for coastal currents, respectively. The result is that sediment can be removed from the shelf during highstands when it might normally be expected to accumulate and then accumulate during regression and lowstand when reduced coastal currents no longer remove sediment. In addition, local point sources become more important in shaping regional and subregional sedimentary stacking patterns, when coastal currents are reduced and less important when currents increase again in the glacial, interglacial parts of the cycle, respectively.

References Cited

Carter, R.M., Carter, L., Williams, J.J., Landis, C.A., 1985. Modern and relict sedimentation on the South Otago continental shelf, New Zealand. New Zealand Oceanographic Memoir 93.

Carter, L. 1986. A budget for modern Holocene sediment on the South Otago continental shelf. New Zealand Journal of Marine and Freshwater Research. 20:665-676.

Carter, L. 2001. Currents of change: the ocean flow in a changing world. NIWA: Water and atmosphere. 9:4.

Osterberg, E.C. 2006. Late Quaternary (marine isotope stages 1-6) seismic sequence stratigraphic evolution of the Otago continental shelf, New Zealand. Marine Geology. 229:159-178.

Sutton, P.J.H. 203 The Southland Current: a subantarctic current. New Zealand Journal of Marine and Freshwater Research. 37:645-652.