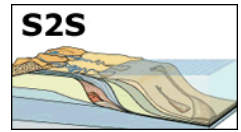


Waipaoa Sedimentary System illustrates tectonic and fluvial controls on shoreline migration



Award: 05-04719, 05-04690 (September 2005)

M. Wolinsky¹, J. Swenson¹, N. Litchfield², J. McNinch³

¹University of Minnesota Duluth; ²GNS Science, New Zealand; ³Virginia Institute of Marine Science, College of William and Mary

Shoreline dynamics strongly mediates land-sea sediment transfer in source-to-sink systems. Shoreline migration involves a complex coupling of terrestrial and marine processes, over a wide range of timescales, and requires an integrated interdisciplinary approach to unravel. The Waipaoa Focus Area of the MARGINS program is a tectonically active system which has undergone significant Holocene shoreline progradation at Poverty Bay, where the Waipaoa river enters the Pacific Ocean (Brown, 1995)*. Previous work has associated the systematic deceleration in Holocene shoreline migration (Figure, Top) with variability in upland erosion, inferring a decrease in sediment supply over the Holocene (e.g. Brown, 1995)*. However paleo-reconstructions (Wolinsky et al., in review) synthesizing existing onshore data with new off-shore data tell a different story. Planview patterns of shoreline migration record sediment storage due to coastal progradation, which dominates net storage in low-slope, sand-bed rivers with weak or no tectonics. By contrast, sediment storage in the Waipaoa river, a steep gravel-bed river with a rapidly subsiding alluvial plain, has significant components associated with tectonic accommodation and fluvial aggradation. Consequently, decelerating progradation over the Holocene has been offset by systematic increases in tectonic accommodation, resulting in approximately constant net storage rates through time (Figure, Bottom). These results demonstrate the importance of tectonic and fluvial processes, in addition to marine processes, in modulating shoreline migration and land-sea sediment partitioning in source to sink systems.

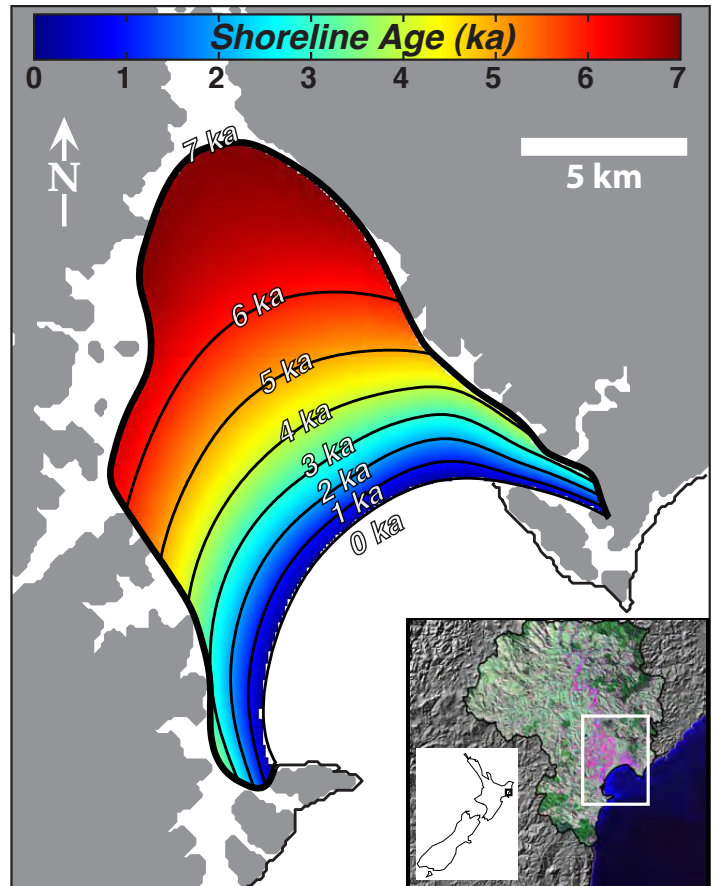
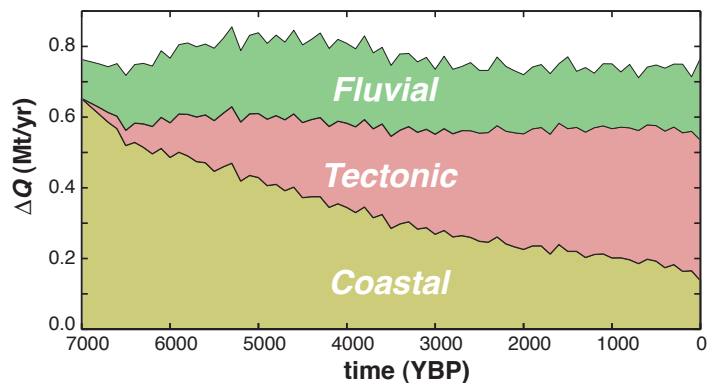


Figure: Top: Holocene progradation of the Poverty Bay shoreline, reconstructed from beach ridges, borehole stratigraphy, and carbonated shells (following Brown, 1995). Progradation rates decrease systematically through time, from ~10 m/yr ca. 7 ka to ~0.6 m/yr ca. 1800 A.D. (Inset: Watershed of the Waipaoa River, northeast North Island, New Zealand.) Bottom: Sediment storage during progradational infilling, reconstructed from shoreline age, tectonics, and paleo-bathymetry (Wolinsky et al., in review). Net storage is due to three processes: coastal progradation, tectonic accommodation, and fluvial aggradation. Decreasing coastal storage associated with decelerating progradation is compensated by increasing tectonic storage, resulting in a relatively constant 0.8 Mt/yr net storage rate.



Wolinsky, M.A., Swenson, J.B., Litchfield, N., McNinch, J.E. (in review). Late Holocene Shoreline Dynamics and Sediment Partitioning in the Waipaoa Sedimentary System, New Zealand. Marine Geology, Waipaoa Source to Sink Special Volume.

*References listed in appendix A.

