Carbon Isotopes Provide Distinctive Signatures for Tracking Tectonic Forcing and Sea Level Changes on an Active Margin

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Stable carbon isotopes and grain-size analyses from a suite of 4 giant piston cores retrieved from a high-yield active margin (Poverty Margin, North Island, New Zealand) reveal dramatic stepwise changes across the shelf and slope in response to sediment supply from marine and terrestrial sources, tectonics and sea-level rise. Two cores were from tectonically-controlled mid-shelf basins located north and south of the Waipaoa River mouth, landward of actively emerging shelfbreak anticlines, a third from near the modern shelf break at 122m water depth and the fourth from a mid-slope plateau at 1450m. Numerous tephra horizons and over 200 ^{14}C dates from shells within these cores afford detailed chronostratigraphic control. Elemental and isotopic carbon signatures were used to elucidate the relative autochthonous and allochthonous inputs of sediment, and coherent shifts in $\delta^{13}C$ signatures between cores allowed for their use as markers of progressive shelf inundation, tracking sea level rise throughout the Holocene. Prior to 12ka, the Waipaoa River directly discharged to the slope, evidenced by terrestrial $\delta^{13}C$ signatures in the slope cores. All cores show progressively more enriched (marine) $\delta^{13}C$ values upcore, as terrestrial input to the slope waned with sea level rise. An abrupt shift in mean grain size from coarse (~5 phi) to fine (~8 phi) in the slope cores corroborates this interpretation, marking a reduction in riverine bedload and an increase in suspended load components as the Waipaoa mouth became more distal. Bulk sediment $\delta^{13}C$ from the shelf cores display shifts from terrestrial to marine after 12ka, when sea-level abruptly rose, causing shoreline retreat landward of the emergent anticlines. Contemporaneous fining in sediment texture confirms these interpretations, reaching a peak ~8 ka, after which the isotopic trend reverses and textures become progressively coarser, attributed to maximum transgression (and trapping of coarse fluvial material in estuaries) and subsequent progressive bypassing of coarser sediment from the coastal region seaward. The two shelf basins show a temporal offset in the textural transition from fining to coarsening upward, reflecting differential tectonic control on accommodation. Combined high-resolution bulk carbon and textural analyses provide a powerful tool to unravel the controls of sea level, tectonics and varying sediment supply and dispersal on the development of active continental margins.