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The Pleistocene forearc basin of the Hikurangi subduction, eastern North Island, New Zealand: erosion, sedimentation and tectonic evolution

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Landscape evolution results from erosion, sediment transport and sedimentation controlled by tectonic and climatic variations. Active margin basin sedimentation during the Pleistocene provides excellent examples to illustrate the combined effects of these parameters and to quantify them. The present study concerns the last 1 Ma sedimentary architecture and erosion features of the forearc basin of the Hikurangui margin (Hawke's Bay basin, North Island of New Zealand)

The Hikurangi subduction margin accommodates the oblique convergence of Pacific and Australian plates since the Miocene. The forearc basin is bounded to the West by strike-slip faults at the foot of the axial ranges and to the East by the partly emerged accreting wedge. The forearc basin fill reaches a maximum of 1.5 km thick and is highly deformed by major NE trending thrusts and backthrusts. Results of interpretation of marine seismic data, geologic field mapping, sedimentologic sections and geomorphologic data from the axial ranges to the deep basin are presented below.

The axial ranges consist in highly deformed Mesozoic sediments consistently uplifting since the Mio-Pliocene. The elevated smoothed relief surfaces of the axial ranges comprise scarce patches of fluvial sediments of estimated Lower Pleistocene age. The foothills of the ranges are composed of non-marine, Lower to Middle Pleistocene deposits organised in a 400 m-thick, coarsening up section ending in nearly exclusive gravel deposits. The main part of the forearc basin fill was explored and mapped

through extensive suite of seismic surveys. It is made up of 12 depositional sequences (100 m thick in average) that comprises a complete suite of sediments deposited in fluvial (conglomerates) to offshore (marine silts and clays) environments. The seismic sequences tied to onshore exposures are correlated to oxygen isotopic stages and attributed to 40 to 100 ka climate variation cycles. Two major angular unconformities truncate the stack of sequences. They are dated at ca. 1 and 0.6 Ma. These unconformities characterise changes in deformation rates along growing faults and point out to variations in the progressive north-eastward shifting of depocenters in the inner shelf.

The volume of eroded material in the forearc from 1.0 Ma to Present is estimated at about 2200 km^3 (for a 21000 km^2 area).The erosion is characterised by (1) deep V shape valleys on the axial ranges that pass laterally towards the coastline to (2) broad U shape valleys with comprehensive flights of cut and fill terraces. Age controls on terrace fills correlate to cooling periods of isotopic stages 2, 3 and 4. Their formation can be therefore attributed to climate changes superimposed on the overall tectonic uplift.

These results tend to demonstrate that tectonic controls the broad spatial distribution of erosion and sedimentation areas within the forearc basin (eg. axial ranges uplift, depocenter shifts, and lateral extension of unconformities). The climate and its changes through time mostly control the frequency and the amplitude of erosion events as well as the amount of transported sediment. Tectonic and climate together determine the boundaries between erosion, transport and sedimentation domains and then, sediment partitioning in the active margin basin through time.