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2D quantitative imaging from MCS data of the North Matakaoa (New Zealand)

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The Matakaoa re-entrant outlines the headwall of a large collapse of the New Zealand continental margin, north of East Cape. This region is a peculiar example of multiple avalanche and debris flows. Conventional processing of multi-channel seismic (MCS) reflection data have provided clues about the sedimentary history of the margin and slope instability mechanisms associated with these submarine avalanches and debris flows. However, the physical properties of seismic reflectors as possible indicators of the presence of fluids related to a possible slope destabilisation are still poorly known. In this work, we apply an integrated approach to obtain small scale physical properties (e.g. seismic velocities) along seismic reflectors. The integrated approach is based on 2 steps: (1) asymptotic waveform inversion to obtain a 2-D quantitative depth model for velocity; (2) an automated post-processing procedure on the migrated image, based on the very fast simulated annealing algorithm, to eliminate the source signature from the migrated image, and to estimate the absolute values of the velocity of seismic reflectors, and to obtain the correct geometry of seismic reflectors reachin the theoretical seismic resolution of the source wavelet. The integrated approach allows us to identify three seismic units on a profile (Line 5) located in the subsiding Raukumara fore-arc basin (North) that is the locus of debris flows and mass sediment remobilization. The first unit, between the sea bottom (S) and a strong reflector considered as a basal surface (B), has a thickness of ˜ 220 m, and has been interpreted as a stratified turbidite-tephra sequence possibly breaking off in km-wide blocks. The second unit, has a thickness of ˜ 250 m, and presents also a stratified seismic facies. Both of these units are characterized by velocity structures with of large wavelength. A negative velocity perturbation zone (˜50 m/s) appears in the lower part of the first unit and extends

all along the second unit. The third unit that is interpreted as a slumped mass, has a thickness of ˜ 600 m, is confined between a basal decollement (D) and a chaotic summit surface. This unit is a diffracting zone that exhibits low velocity perturbations. In addition to gravity, over-pressure fluids may be involved in the destabilisation process as suggested by possible dewatering conduits that could be associated with negative velocity perturbations. The reflector D, which presents a negative velocity perturbation, overlays a stratified seismic facies between 3500-3700 m in depth.