



## From megaslides to mass flows: using seismic geomorphology to unveil gravity-driven deformation at continental margins.

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Modern seismic geomorphology techniques are implemented to infer modes of emplacement of a wide range of products derived by gravity-driven deformation in continental margins and to discuss the implications of these for exploration of georesources in offshore basins.

High-quality 3D seismic data from the Namibian margin (West Africa) show how margin-scale, extensional-contractional gravity-driven linked systems deformed at least 2 km of Cretaceous post-rift strata. The systems are laterally segmented into a series of scoop-shaped megaslides ~30 km long by ~20 km wide, which are formed by listric headwall fault systems with associated 3D rollover structures and thrust imbricates at their toes. Lateral segmentation occurs along sidewall fault systems that display oblique extensional motion and define horst structures up to 6 km wide between individual slides.

Key examples are shown of slope failures offshore North West Shelf of Australia that affected Jurassic rift strata as well as near seabed, Late Oligocene to Recent, post-rift sediments. The seabed collapse systems originated at water depths of ~1000 m and extended downdip to depths well in excess of 1500 m. These are shallow failures that exhibit width ranging 1-5 km and run out of ~15 km, with estimated volumes of sediments in excess of ~10 km<sup>3</sup>. A number of these failures are characterised by disrupted, slump-like facies which progressively pass downslope into packages of high amplitude, continuous reflections. This facies transition represents a downslope rheological transformation from slump to mass-flow as evidenced by prominent canyons that link the updip failures to well-developed, downdip fan systems several kilometres across.

In the rift section, slope failures affected domino extensional fault systems in the form of well-imaged footwall degradation complexes. These complexes exhibit overlapping, scoop-shaped scars up to 10 km in length that deteriorated the exposed footwall breakaways. Debris from footwall collapse was resedimented in the hanging wall basins, forming talus wedges up to 300 m thick that taper away from adjacent fault planes for distances of several kilometres. These deposits are characterised by sheeted to contorted seismic facies, indicating a variety of mass-wasting processes accompanying footwall collapse.

This research demonstrates that a broad spectrum of slope instability processes can ensue during the evolution of rift systems to passive margins. Margin-scale megaslides emplace through processes of complex lateral segmentation which can create a variety of trapping mechanisms in the post-rift section of unstable margins. Downslope transformation of deepwater slumps into sediment flows may explain the occurrence of sandy deposits in offshore basins, hundreds of

kilometres away from coastlines and river inputs.

On the other hand, fault degradation complexes, which are relevant slope instability processes in rift systems, can redistribute and accumulate footwall reservoirs into hanging-wall basins, increasing the diversity of play types in rifted margins.