Geologic Evolution of Unstable, Unconfined Slopes

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Spectacular sequential images from a Miocene continental slope with limited sediment flux and syn-depositionally active salt diapirism illustrate key stages in the geologic evolution of unstable, unconfined slopes. The dominant processes observed are the entrenchment and subsequent fill of numerous canyon systems. Evolutionary changes in canyon development appear to be driven by sediment flux, rather than eustatic sea level change.

Canyons initially form by retrogradational failure, not progradational downcutting. Slumping off the tops of emergent salt diapirs appears to localize early stages of slope failure, effectively acting as 'nucleation' points for canyon formation. Mass-transport deposits and margin-failure complexes dominate the early depositional succession within the canyons.

As the 'nick points' at individual canyon heads migrate upslope, a preferred trunk system establishes itself. This system exploits areas of preferential failure upslope, such that canyons appear to 'seek' diapirs rather than avoid them. Subtle topographic relief on the seafloor causes local deflections in canyon orientations. When the features become buried, the canyons straighten their courses to re-assume a more slope-normal orientation.

Once the canyons breach the shelf break, sinuous channels fill and eventually overspill the confining banks of the canyons. The transition between fill and overspill is abrupt, usually occurring over a vertical interval of 10 meters or less. Once the channels are no longer confined by the canyons, they develop into a loosely amalgamated fan lobe with a characteristic elongate wedge shape. The apices of fan lobes coincide with abrupt changes in slope angle (hydraulic jumps or local toes-of-slope).

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