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TECTONIC OVERSTEEPENING: AN ALTERNATIVE TO SEA-LEVEL LOWSTANDS AS A CONTROL ON SUBMARINE CANYON AND FAN DEVELOPMENT

Subsurface and outcrop data, combined with numerical simulations, support an alternative model for the formation of submarine canyons and fans. Falling sea level does not have to be invoked. Instead, changes in basin physiography, often due to tectonic oversteepening, lead to erosion of continental slopes, sediment bypass, and development of submarine fans.

Two kinds of basin margins are recognized. (1) Progradational margins represent the basinward advance of graded depositional profiles when sediment supply, basin subsidence, and basin physiography are in equilibrium. (2) Erosional margins result when upper-slope gradients exceed an equilibrium profile. Progradational margins can develop bathymetric escarpments and become erosional due to rapid sea-level rise, a transition from carbonate to siliciclastic deposition, and/or tectonic deformation (e.g., faulting, diapirism).

Falling sea level has played a major role in the formation of submarine canyons and fans along many basin margins, by forcing sediment input to the shelf edge. Basinward shifts in facies and subaerial-exposure surfaces that continue basinward as submarine unconformities result. However, many other margins display regional surfaces of slope truncation that do not extend updip into subaerial unconformities. Such margins also exhibit abrupt landward shifts in facies, with canyon and fan deposits unconformably overlying shallow-water to nonmarine facies.

Examples include the Eocene of San Diego, California, and numerous Tertiary systems of the northern Gulf of Mexico. In these cases, changes in basin physiography due to tectonic oversteepening triggered slope erosion and submarine-fan deposition. Thus, every submarine-fan system does not reflect a drop in sea level.