Geophysical Research Abstracts
Vol. 20, EGU2018-11234, 2018
EGU General Assembly 2018

Development of cutoff-related knickpoints in submarine channels

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Sinuous, low-gradient submarine channels on continental slopes are often thought of as having relatively simple geometries, with significant along-channel morphologic and stratigraphic continuity and limited slope variability. However, there is increasing evidence that along many of these channels short segments with steep slopes, called knickpoints, are common. Avulsion- and deformation-related knickpoints have been documented before; here we focus on knickpoints that are the outcome of the meandering process itself. Using high-resolution seismic-reflection data from offshore Angola and a kinematic model of channel evolution, we present evidence that channels on the sea floor can develop slope variability as a result of meander cutoff events. When cutoffs develop, the shortened flow paths produce locally steep gradients, thus initiating knickpoints that are probably locations of supercritical flow and erosion. Waves of knickpoint retreat and the related channel incision explain the occurrence of terraces and associated remnant channel deposits above the youngest channel thalweg. The simple processes of meander cutoff followed by knickpoint retreat are intrinsic to submarine channels and result in significant morphologic variability, erosion, and stratigraphic complexity, without any external forcing. Cyclic steps are common geomorphologic features on the thalwegs on many steep submarine canyons and channels; it is unclear whether they are present in lower-gradient channels as well. More widely spaced knickpoints, of both allogenic and autogenic origin, might be the main morphologic and stratigraphic discontinuities in such systems.