

# Evolution of a Mixed Bedrock-Alluvial Canyon Incising into an Uplifting Plateau and Debouching into a Subsiding Valley: Linked Knickpoint Migration and Valley Fill

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Arid, tectonically active regions such as the Basin and Range Province of the western United States are often riddled with normal faults. These normal faults are associated with tablelands undergoing (relative) uplift, adjacent to valleys undergoing (relative) subsidence. These conditions in turn foster the formation of canyons incising into the tablelands. These canyons receive some of their sediment from the tableland upstream of a well-defined knickpoint, and some from the collapse of the canyon walls themselves. Here we treat canyon-valley evolution using a formulation that can smoothly handle transitions between purely alluvial reaches and bedrock-alluvial reaches. We model bedrock incision in terms of wear due to collision of bedrock particles, and capture knickpoint migration using a moving-boundary formulation. Our model captures tableland uplift, canyon incision, failure of canyon walls, and the transition to pure deposition in the downstream subsiding basin, in a symphonic interaction of different parts of the landscape.

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