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Process and form in a developing channel

L M Reid (US Forest Service, Redwood Sciences
Lab, 1700 Bayview Dr., Arcata, CA 95521)

The topographic grain of a landscape is strongly influenced by the drainage density, and the drainage density reflects the balance between processes active on hillslopes and those in channels. This balance was explored by constructing sediment budgets for a sequence of stages in the development of a discontinuously incising channel. As the form develops, infilling processes shift from trampling alone to include creep, raveling, and block erosion; while simple tractive excavation is augmented by plungepool erosion. In addition, transport of hillslope-derived landslide debris is aided by increased incision, allowing delivery of the debris to more of the channel system. The evolution of processes active in the channel parallels an evolution of the form of the incision, both in its local and long-profile manifestations. Observations of channels at different stages of incision suggest that pool spacing converges upon that expected for established alluvial channels as the incision develops. The sediment-budgeting approach used in the analysis also allows inference of the effects of altered climate or vegetation on channel stability.