Geophysical Research Abstracts, Vol. 7, 00182, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00182

Form of submarine erosion from confluences in Atlantic USA continental slope canyons

Neil C. Mitchell

School of Earth, Ocean and Planetary Sciences, Cardiff University, Cardiff CF10 3YE, Wales, U.K. (E-mail: neil@ocean.cardiff.ac.uk).

Submarine canyons of the Atlantic continental slope are found to have some remarkably analogous morphological properties to river networks, such as inverse power-law relations between channel gradient S and contributing area A (S proportional to Aˆ-a). Such relationships for bedrock-incising rivers have been interpreted using models in which bed erosion rates (E) depend on A and S according to E proportional to AˆmSˆn, where the Aˆm term represents the effect of discharge increasing down-stream. For areas of spatially balanced erosion, the model predicts the inverse relation S proportional to Aˆ-a. It is argued here that erosion of canyon floors by turbidity currents involves similar processes to river bed erosion so that a similar model could be used to help interpret aspects of canyon morphology and differences between canyon systems. Discharge and flow power, however, do not vary down-stream in submarine canyons in the same way as in fluvial networks because tributaries are not usually active simultaneously. As turbidity currents and other sedimentary flows originate from failure of over-steepened deposits in canyon walls, the frequency of erosive flows experienced by the channel increases with A. This produces a down-stream erosive effect analogous to that of discharge in river networks.

The model's applicability is explored here by comparing the ratio of gradients and areas at confluences where erosion rates of the converging branches must be equal (Seidl and Dietrich, 1992). The data show significant scatter due to canyon floor irregularities, but they suggest on average m/n=0.2-0.3 if E is proportional to AˆmSˆn. Gradient-area graphs of canyons heading at the shelf break and of those heading within the slope are identical. Therefore, although the classical sequence stratigraphic model predicts that shelf spillover during glacial lowstands is important for incising continental slopes, there is little evidence that it occurred by direct supply of sediment to

canyon heads as this would have modified their gradient-area relationships differently. The model has the potential to explain morphological differences between canyons, for example such as caused by differences in bed erodibility, turbidity current properties and the spatial distribution of initiating slope failures. Modelling channel-bed erosion is also an important aspect of slope development that could be incorporated into numerical stratigraphic simulations and reservoir modelling.

References: Mitchell, N.C., Form of submarine erosion from confluences in Atlantic USA continental slope canyons, Am. J. Science, 304, 590-611, 2004. Seidl, M., and Dietrich, W. E., 1992, The problem of channel erosion into bedrock: Catena Suppl., v. 23, p. 101-124.