Late Cenozoic Response of the Susquehanna **RIVER** to Climatic and Base Level Forcing

Milan Pavich, Joanna Reuter, Luke Reusser and Paul Bierman

The Susquehanna, the largest river basin draining the Appalachians, has been studied geomorphically since the 19th century and has been the subject of major geomorphic models. New cosmogenic ^{10}Be exposure data and model erosion rates raise important challenges to both the geomorphic cycle and dynamic equilibrium models, and provide constraints important to future modeling efforts. The Susquehanna River basin exhibits rapid erosion rates at a variety of timescales. Cosmogenic ^{10}Be exposure ages and model erosion rates provide evidence that:

- Bedrock gorge incision approached 1m/ky during the last glacial maximum, probably due to periods of high discharge and lowered base level relative to the Holocene. Total incision of >20m occurred in a geologically short interval.
- Hill slope response to channel incision following Miocene uplift, base level fall and/or stream capture is a continuing process in all three major physiographic provinces (the Plateau, Valley and Ridge and Piedmont). Erosion delivers sediment from slopes irrespective of lithology at rates proportional to relief.
- Climate-related slope deposits, such as fans and debris flows, do not store sediment in sufficient quantities at the 100 ky timescale to mask the isotopic signal of the delivery from slopes to channels.

It is unlikely that the bedrock gorge incision in the Piedmont during the most recent glacial maximum (~30 ka to 10 ka) was a unique Pleistocene event. Thus the disturbance of stream profiles by headcutting has probably proceeded continuously or in climate-related intervals over at least the last 2 Ma. The disturbance and on-going adjustment of stream profiles may have a much longer history in this basin. Data from the terrace deposits and offshore stratigraphy show that the river has responded to forcing at a range of timescales. Sediment discharge increased dramatically during the Miocene, possibly in association with major stream capture and divide migration north and west of the Piedmont.

Taken together, these results show that various disequilibrium processes have affected this passive margin river over the past 20 Ma. Relief has probably increased over this time. Thus **COMMA** dynamic equilibrium is not a valid explanation for the geomorphic relations of valleys and ridges over this time interval. While it is possible that the pre-Miocene landscape had more subdued relief due to a long decay following the late Paleozoic orogenic climax, the rapid response of the present river to Pleistocene forcing raises doubts about the concept of a geomorphic decay cycle lasting tens of millions of years. As shown by the Susquehanna data, geomorphic investigations using cosmogenic isotopes can provide important constraints on processes operating at the **MILLENIAL TO** million year timescale.