Did incision of the Three Gorges begin in the Eocene?

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Richardson et al. (2010) analyzed apatite fission-track (AFT) and U-Th/He low-temperature thermochronology of the Three Gorges area of the Yangtze River, indentified an enhanced cooling event at 40–45 Ma, and therefore proposed that the incision of the gorges began in the Eocene. This time inference is comparable with the age of widespread denudation of the Sichuan Basin, just upstream of the Three Gorges, as suggested by Richardson et al. (2008). The immediate consequence of the incision is the outflow of the Sichuan Basin to the east, which would have resulted in changes in the sedimentary environments and associated facies of the basin infill in the Jinaghan Basin, just downstream of the Three Gorges.

Jinaghan Basin began rifting in the late Cretaceous, and became a graben-type basin during the Paleogene, with vast deposition of lacustrine and evaporitic sequences (Fig. 1). The lithology of the Yuyang Formation (late Cretaceous) includes redbed sandstone and mudstone with minor gypsum mudstone. Shashi Formation, of the Paleogene, is similar in lithology to the Yuyang Formation. Eocene strata is the major hydrocarbon-bearing strata basin-wide, and is divided into three formations that contain various proportions of oil shale and evaporate. Late Eocene Qianjiang Formation is ~3000 m thick, and is dominated with hundreds of halite beds with various thicknesses, ranging from a few centimeters to 2 m. The Jinghezhen Formation of the Oligocene is composed of gray mudstone, with minor hydrocarbon-bearing strata in the lower part. Facies analysis of Paleogene sediments does not show any major trunk streams with a comparable size of the Yangtze River running through the Jinaghan Basin.

At the end of the Paleogene, the basin went through a period of adjustment, characterized by uplift, folding, and erosion, and eventually turned into a generally subsiding system (Dai, 1997), Guanghuasi Formation (Miocene and Pliocene) and Pingyuan Formation (Quaternary), characterized by uplift, folding, and erosion, and eventually turned into a generally subsiding system. Had the Sichuan Basin been denuded in the Eocene, the first place to collect the sediments would be the Jinaghan Basin, which does not seem to be the case in the stratigraphic record.

In summary, our studies of stratigraphy and sedimentology of Sichuan and Jinaghan Basins do not support claims that the Three Gorges were incised during the Pleistocene (e.g., Li et al., 2001), nor the Eocene. Most likely, the incision occurred as part of the process of regional tectonic adjustment around the Oligocene–Miocene boundary, during which basin development over eastern China went through an important evolution, from graben-type to general subsiding, and associated drainage networks would also be adapted to a new tectonic regime.

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REFERENCES CITED