Geologic Hazards Associated With a Proposed Dam on the Yarlung-Tsangpo River in SE Tibet

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#1 - Background

For over a decade anecdotes and media reports have been circulating about a proposed dam on the Yarlung-Tsangpo River in SE Tibet. The proposed site is in the deep canyon of the Yarlung Tso-Gang, where the river emerges from the Tibetan Plateau to flow into the lowlands of southern China. Naeke Dam is intended to create an artificial lake 125 km long and 15 km wide at an elevation of 850 m above sea level. The reservoir will provide hydroelectric power for the development of northern China (for comparison, the Three Gorges project is rated as one of the top 10 in the world in terms of energy output).Despite the allure of its vast hydropower potential, the Big Bend knickzone is developed across an active thrust zone. This is in active planning, and officials have downplayed stories about the pressing water-resources issues in China as well as the environmental concerns associated with a dam located in such a geologically active area. With potential environmental impact being substantial, the dam would break sharply across what appear to steep massif-boundary (Figures 6a and 6b). These do not represent shallow earthquakes and landslides, and the dam would dramatically increase the frequency of landslide and extreme local bedrock erosion rates that would lead to rapid sedimentation. This work was funded by the Continental Dynamics Program at the U.S. National Science Foundation, and was also supported by IRIS-PASSCAL.

#2 - Geodynamic Context

The proposed dam site at the great Tsangpo gorge is located at the far eastern end of the Himalayan arc, where it terminates in the active Namche Barwa-Gyala Peri massif. At a more regional scale, GPS results show that steep three-dimensional velocity gradients exist across the region, and the eastern Antillides-Himalaya near Namche Barwa (~50% of the Indian-Eurasia discrepancy is accommodated within the high-latitude wedge massif and the core India massif, and only ~20% is attributed to the southern edge of the proposed site). The 1938 Assam earthquake (M8.6) was one expression of the high local strain rates, and caused considerable damage within the canyon area.

#3 - Active Tectonics: Structure and Antiform Evolution

The Big Bend knickzone is developed across an active antiform metamorphic massif that exposes Indian plate basement (Figure 3) as a result of a recent and probably ongoing tectono-metamorphic episode. granite dikes and migmatites give Ar-Ar ages from 8 to 10 Ma, and metamorphic geochronology and PT trends show that the massif has experienced ~400 Ma of exhumation dating back to 15.0 20.0 Myr ago. Our studies suggest that the knickzone is likely pinned at the growing antiform in its present position and that in the next few million years it will be pinned at an antiform in a coupled system in which erosion-localizes and enhances deformation. This work was funded by the Continental Dynamics Program at the U.S. National Science Foundation, and was also supported by IRIS-PASSCAL.

#5 - Sediment Fluxes and Geomorphology

Around the Yarlung-Tsangpo canyon, slopes are very steep, and a number of hydropower schemes have been proposed in the area. The proposed Naeke Dam is in active planning, and officials have downplayed stories about the pressing water-resources issues in China as well as the environmental concerns associated with a dam located in such a geologically active area. With potential environmental impact being substantial, the dam would break sharply across what appear to steep massif-boundary (Figures 6a and 6b). These do not represent shallow earthquakes and landslides, and the dam would dramatically increase the frequency of landslide and extreme local bedrock erosion rates that would lead to rapid sedimentation. This work was funded by the Continental Dynamics Program at the U.S. National Science Foundation, and was also supported by IRIS-PASSCAL.

References

More Information: http://www.ees.lehigh.edu/groups/corners

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#6 - Implications for Dam Siting and Hazards

Our data indicates that no dam placed within the Yarlung-Tsangpo canyon would be at risk, with the dam and adverse being prone to failure due to increased seismic hazards and focused deformation. As it is highly localized along shallow earthquakes and landslides, and the dam would be difficult to maintain given the high frequency of landslide and extreme local bedrock erosion rates that would lead to rapid sedimentation. This work was funded by the Continental Dynamics Program at the U.S. National Science Foundation, and was also supported by IRIS-PASSCAL.