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

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AB For 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-Tsangpo where the river leaves the Tibetan Plateau across an immense knickpoint, falling ~2000 m along an irregular U-shaped reach ~100 km in length. The fundamental purpose of the dam is generation of ~40,000 MW of hydropower, to be used in diverting a portion of the impounded river to water-starved regions of northern China. Offsetting benefits that would accrue from improved water supply in the north, debate has centered on the water-flow and sediment-flux impacts that would be felt downstream in the Brahmaputra system in northeastern India and Bangladesh, as well as the impact of a dam and large lake on the pristine, ecologically and ethnographically diverse area around the Yarlung-Tsangpo canyon, an area of great significance to Tibetan Buddhists. We have been examining the geodynamic evolution of eastern Tibet, and have gathered considerable geophysical and geological data on the knickpoint region. The knickpoint traverses the

Namche Barwa-Gyala Peri massif, one of the most geologically active regions on Earth. In this region, very rapid bedrock exhumation at rates of 7 mm/yr or more has exposed granites as young as 1 Ma, and these rates have been ongoing for at least the past 3 m.y. Detrital-dating evidence shows that these high rates continue at present and that erosion within the massif contributes fully 50% of the suspended-sediment load in the Yarlung-Tsangpo at the point where it enters the Brahmaputra (this would be about 100 Mt/yr derived from the massif). The steep slopes in the massif fail by pervasive landsliding and suggest a steady-state topography where the high erosion rates are balanced by equivalent rates of rock uplift accommodated by numerous active structures. At a more regional scale, GPS results show that steep three-dimensional velocity gradients exist across the region, in the easternmost Himalaya near Namche Barwa >50% of the Indian – Eurasian plate convergence is accommodated within the high-strain zone that reaches to the southern edge of the proposed reservoir. The 1950 Assam earthquake (M8.6) was one expression of the high local strain rates, and caused considerable damage within the canyon area. Seismic results from our portable deployment show that the area beneath the massif and the Yarlung-Tsangpo canyon is exceptionally active, with over 1000 events ranging in magnitude from 1.0 to 5.6 (mb) taking place over a 15-month period. The events occur almost entirely in the mid to shallow crust and show a range of first motions. Together these data suggest that any dam placed within the Yarlung-Tsangpo canyon would be at high risk, with the dam being prone to failure due to pronounced seismic hazards and focused deformation. As it fills water pressure behind the dam could help trigger shallow earthquakes and landslides, and the dam would be difficult to maintain given the high frequency of landsliding and extreme local bedrock exhumation rates that would lead to rapid siltation at the dam site. Further, this impoundment of the Yarlung-Tsangpo would greatly starve the sediment flux downstream in the Brahmaputra and ultimately Bay of Bengal systems.

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