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Active tectonics and Holocene versus modern catchment erosion rates at 300 MW Baspa II hydroelectric power plant (NW Himalaya, India)

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The Baspa River is one of the most important tributaries to the Sutlej River in the NW Himalaya (India). Its catchment is 1116 km2 in size, ranges from c. 6400 m asl to 1770 m asl and contains India's largest private hydroelectric facility, the 300 MW Baspa II. Geologically, the hydroelectric installation is located in the Higher Himalayan Crystalline, just above the active Karcham Normal Fault, which is reactivating the Early Miocene Main Central Thrust, one of the principal Himalayan faults. The area is seismically active and mass-movements are common.

Around 8200 yrs BP the Baspa was dammed by a rock-avalanche dam, leading to the formation of the originally c. 260 m deep palaeo-lake Sangla palaeo-lake. Detailed sedimentological investigations and radiocarbon dating indicate that the palaeo-lake was completely filled with sediments until c. 5100 yrs BP. This makes the Sangla palaeo-lake to a very rare example of a mass-movement dam with very long duration and its lacustrine sediments represent a valuable archive for geological processes and environmental proxies within the Baspa catchment during the c. 3100 years of its existence – which are the aim of our study.

At least 5 levels of soft-sediment deformation have been recorded in the exposed part of the lacustrine sediments of Sangla palaeo-lake, including brecciated laminae, overturned laminae, folds, faults and deformation bands, separated by undeformed deposits. They are interpreted as seismites, indicating at least 5 earthquakes within 2500 years strong enough to cause liquefaction.

The 300 MW Baspa II hydro-electric power plant has been built exactly on top of this palaeo-lake. This special location represents a very rare possibility to evaluate the short-term, river load and hydrological parameters measured during the planning and operational stages of Baspa II with the long-term parameters gained from the palaeo-lake sediments from the catchment. This data show that the Mid-Holocene erosion rates of the Baspa catchment estimated from the volume and duration of deposition of the exposed lake sediments are at 0.7-1.0 mm yr-1, almost identical with the modern erosion rates calculated from river gauge data from Baspa II.

Several charcoal layers and charcoal pieces from the uppermost palaeo-lake levels around 5000 cal yr BP might be related to woodland clearance and they possibly represent one of the oldest evidences for human presence and environmental impact in the Baspa Valley during Neolithic time.