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LINKING CRUSTAL TECTONICS WITH EARTH SURFACE PROCESSES: EVIDENCES FROM AN ANCIENT ROCK AVALANCHE-DAMMED LAKE (BASPA VALLEY, HIGHER HIMALAYA)

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Of the three major rivers originating from the Mount Kailash area in Tibet, the Brahmaputra and the Indus rivers overcome the Himalaya at its syntaxes (the former at the Namche Barwa in the East, the latter at the Nanga Parbat in the West), only the Sutlej river cross-cuts the Himalaya in its central part. As a result, the Sutlej valley forms a natural cross-section perpendicular to the general trend of the Himalayas exposing all tectonic units of the orogen and thus represents an ideal place for studying geodynamic processes at different levels of the orogen (e.g. Vannay et al., 2004 and references cited therein). In this natural laboratory, the investigation of the tectonic processes (viscous as well as brittle deformation) combined with studies on the climate and geomorphology (e.g. Thiede et al., 2004) gives a respectable data base for the interpretation of the interaction and interdependence of endogenetic *versus* exogenetic processes.

The Main Central Thrust (MCT) is the most prominent tectonic feature in the Indian part of the Valley. It separates the Lesser Himalaya (LH) tectonic unit in the footwall from the Higher Himalaya (HH) in the hanging wall. This thrust was active during the Early Miocene. Subsequently, thrusting activity propagated in sequence towards the south (towards the foreland of the orogen) and the MCT became inactive and was folded in a prominent antiform-synform foldtrain typical for the whole Himalayan orogen. In this way Lesser Himalaya rocks are exposed in large windows (e.g. Shali half-window, Larji-Kullu-Rampur window). Based on geochronological data and the fact that the MCT is folded, it is obvious that the thrust is inactive today and therefore cannot be responsible for the common indications of active tectonics in the Sutlej area (e.g. seismicity, thermal springs, steep near-surface thermal gradients and deformed Quaternary sediments).

A probable candidate for triggering active tectonics in the Sutlej Valley is the still on-going extrusion of a wedge-shaped metamorphic massif, the Lesser Himalayan Crystalline Sequence, between a thrust at the base, the Munsiari Thrust (MT), and a concurrent normal fault on the top, the Karcham Normal Fault (KNF) (Grasemann & Vannay, 1998; Janda et al., 2001). Pleistocene fission track cooling ages (Jain et al., 2000; Vannay et al., 2004; Thiede et al., 2004) in the hanging wall of the MT and Pliocene ages from the MCT are interpreted to indicate that the MT represents an out-of-sequence thrust at the position of the inactive MCT. The extensional deformation is not restricted to the horizon of the KNF, but is typical for the whole area east of Karcham (i.e. hanging wall above the KNF). Brittle faults in the Baspa Valley indicate an overall NE-SW to W-E extensional regime (Janda et al., 2001; Hager, 2003).

In the Baspa Valley, near village Sangla, in a tectonic position in the hanging wall above the KNF, more than 90 m of sandy, silty and clayly lake sediments have been accumulated behind a Quaternary rock-avalanche. ^{14}C data of organic remains demonstrate a late Holocene age of the lake. The lake sediments are covered by a thin layer of fluvial gravel, evidencing that the lake was filled completely with sediments before the subsequent incision of the Baspa River by backward erosion. Pollen from clay samples in the lowermost part of the lake, close to the dam, show a relatively diverse flora (65 taxa) indicating considerable warmer and more humid climate (e.g. 25 taxa of ferns and fern allies) close to the time, when the rock-avalanche occurred, than a less diverse flora (23 taxa) in a sample from clays directly above the lake sediments.

Abundant deformation structures have been found in the lake sediments; they mainly consist of water-escape-structures, soft sediment folding and brittle normal faults. The orientation of the brittle normal faults in the lake sediments indicate a NE-SW to W-E extensional regime, consistent with the orientation of normal faults found in the surrounding crystalline rocks in the hanging wall of the KNF (Janda et al., 2001; Hager, 2003). The normal faults in the lake sediments are interpreted to relate to the regional extensional kinematics in the hanging wall of the KNF, supporting the young age of the fault.

Our observations indicate the importance of both tectonics and precipitation as key factors in controlling the landscape evolution of this area. On a regional scale, we suggest, climate probably exerts positive feedback to tectonic processes, but does not control or even trigger them. On a local scale, whether the rock-avalanche that formed the natural dam of the lake has possibly been triggered by seismic activity at the KNF and/or by the humid climate during the time of its formation cannot be answered unequivocally.

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