Geophysical Research Abstracts
Vol. 16, EGU2014-10059-1, 2014
EGU General Assembly 2014

Neotectonic formation of drainage patterns and their palaeohydrological implications for the Okwa River catchment, Botswana

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Large inter- and intramontane endorheic basins provide long term archives of environmental change, often integrating regional to continental climate driven process dynamics of huge drainage systems. On one hand the large-scale integration can be regarded as an advantage by averaging small-scale variations of either local hydrological peculiarities or random triggered drainage behaviour (e.g. internal thresholds, tectonics, etc.) and thus just recording atmospheric circulation pattern up to hemispherical scales with millennial resolution. Otherwise, with increasing basin size the process dynamic and their response system along one or more sediment cascades often become a complexity resulting in crucial problems of sedimentological archive interpretations by e.g. signal interference, equifinality or even multiple reworking. Therefore, studies of geomorphological or hydrological response processes and ecological adaption can only be undertaken on sub-catchment scale considering process dynamics along pathways.

For southern-hemispheric palaeoclimate reconstruction of land-ocean linkages, Makgadikgadi Basin - as the largest (c. 37,000 km2) and deepest depression in the middle Kalahari - provides a fluvio-lacustrine archive in high-continental position since at least 300 kyr BP. Recent studies suggest a mega-lake high-stand within the basin for the Last Glacial Maximum (LGM) For the hydrological persistence of the lake for about 6 kyrs, the since Heinrich Event 1 (17-16 ka) inactive Okwa River seems to play a key role indicating a northward-shift of the winter rainfall zone. However, beside some dating of exposed shell bearing sediments at the river mouth, a thorough investigation of the c. 129,000 km2 drainage system is missing.

Our presentation aims to point out the linkages between neotectonic activity and sediment transport. The combination of adaptive DEM-filter and multispectral remote sensing data reveals obvious traps (of neotectonic origin) of small temporary sinks filled partly with still-water sediments along the W-E-striking main course of Okwa. First two radiocarbon-dating of fossil shells within a c. 1.50m outcrop in a small basin of the upper reaches suggest an age of about 20-22 kyr cal. BP of the basin fill. To some extent, the related faults can clearly be traced by perpendicular river courses or vegetation changes related to wetness changes of the soils. In contrast, the influence of tectonics affecting the river courses become increasingly fuzzy until the immediate final gorge of the river mouth. A DGPS-profile exhibits an asymmetric cross-profile with two terraces at the southern slope and an additional terrace at the opposite slope. The asymmetric terrace-setting can apparently be attributed to the twin-featured Gidikwe-fault to the north and its single featured continuation to the south. Thus, the terraces within the gorge can obviously be related to intersecting faults. The eastward propagating delta consists of four generation of sub-fans. Morpho-stratigraphic analyses show that two of them can be directly attributed to young faulting dynamics with short-distance sediment transportation. However, the oldest fan is obviously developed by fluvial sedimentation during the last high-stand and conserved by a fast decreasing erosion base.