A chronology of fluvial dynamics of the Hoanib River, NW-Namibia, based on optically stimulated luminescence dating.

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Introduction

In the context of climatic change monsoon-affected desert-margin areas belong to the geomorphologically most sensitive environments on earth. The eastern margin of the Namib Desert, Northwestern Namibia, is characterized by the Great Escarpment with rivers draining the semi-arid highlands to the east, across the hyper-arid Namib Desert down to the Atlantic Ocean in the west (fig. 1). In the same direction a prominent hydraulic gradient of ~20 mm annual precipitation per 10 km decreases from the semi-arid highlands (~250 mm/a) to the hyperarid northern Namib Desert.

Fine-grained, predominantly silty sediments covering large areas of the valleys and basins along the river courses are excellent archives storing information on past environmental changes (fig. 2). Even though the sediments may possess loessic features they are waterlain. Apart from this, their genesis is still controversially debated.

Sediments and stratigraphy

The well laminated fine-grained structure of the deposits indicates low-energy runoff of the rivers during sedimentation. Complete covering of the basin and valley bottoms excludes repeated high-energy slackwater-deposition, which would be confined to distinct backflood positions. Typically, the sediments are divided into a basal light grey to greyish colour complex-I (silt member 1, Heine 2004), and a younger brownish complex-II, with an ‘intermediate complex’ sometimes intercalated between the two (fig. 3, fig. 4).

Hydromorphic bleaching of complex-I sediments (see fig. 2), indicating a high groundwater table, apparently occurred before complex-II was deposited. A pedogenetic calcrete on top of complex-I (fig. 5) reveals that fluvial aggradation was succeeded by a period of soil formation with subsoil carbonate precipitation and a subsequent period of aridification leading to the exhumation of the subsoil horizon so that a hardpan could evolve. Gullying of complex-I points to a following period of fluvial erosion under more humid conditions. The intermediate complex is made up from repeatedly reworked material of complex-I, more variable runoff than during the deposition of complex-I is likely. After the deposition of complex-II palaeoenvironmental conditions changed completely and the Hoanib River deeply eroded the formerly deposited river-end deposits along its thalweg. Intermediate, coarse grain, sandy and gravelly material forming a prominent 4–m terrace along the river course was deposited (fig. 6). At present the conditions in the highlands east of the Namib Desert are too humid for significant fluvial sediment accumulation. Erosions processes prevail resulting in progressive terrace consumption.

Conclusions for the palaeoenvironment

Drier conditions for river-end sedimentation in the upper Hoanib valley prevailed ~60–40 ka and ~34–24 ka. During the Last Glacial Maximum (LGM) fluvial dynamics apparently ceased completely due to arid conditions. River-end deposits are documented from the latest Pleistocene to the mid-LGM, when the climate was more humid than before the LGM but drier than at present. Due to increased runoff after ~ 3 ka the Hoanib River re-eroded older deposits forming deep channels. During the Little Ice Age (LIA), coarse-grain material was deposited along the upper Hoanib, while river-end sedimentation produced the Amspoort Silt formation further downstream, pointing to slightly drier conditions than at present.

Funding from DFG is gratefully acknowledged.

References:


Murray, A.S. & C. Wintle (2000): Sedimentology of the Hoarusib, Khumib and Kuiseb River drainages of the Khowarib Gorge. The sampling locations are indicated with fig. 1). Note the greyish deposits of complex-I below the brownish load to their outlets at the Atlantic coast but terminating in progressive terrace formation. 2) Areas of the valleys and basins along the river courses are covered with fine-grained, predominantly silty sediments. Apart from this, their like the Hoarusib, Khumib and Kuiseb River drainages are a consequence of increased monsoonal rainfall and severe flooding, river-end deposits point to increased aridity with 2) Areas of the valleys and basins along the river courses are covered with fine-grained, predominantly silty sediments. Apart from this, their like the Hoarusib, Khumib and Kuiseb River drainages are a consequence of increased monsoonal rainfall and severe flooding, river-end deposits point to increased aridity with