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Evolution of the western Namibian drainage systems since Eocene times – a multi-methodical approach

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The recent stream network of western Namibia is characterised by numerous non-perennial rivers with relatively small catchment areas, framed by the perennial Kunene and Orange Rivers. Most of them originate in the hinterland of the Great Escarpment. Studies based on terrestrial cosmogenic nuclides (TCN) revealed very low erosion rates of 3-16 m/Ma since the end of the Eocene within the proposed field area, which is consistent with the estimated long-term exhumation rates of 2 to 14 m/Ma derived by fission track studies [1,2]. Rates of ca. 10 m/Ma are also supposed for the escarpment retreat [1,3]. Thus, the relief of this region is inferred to have changed little since the Eocene [4]. Such low erosion provided excellent conditions for the preservation of fluvial sedimentary records derived by older river systems. They occur mostly as terrace conglomerates in higher positions of recent valleys. The river incision into the subjacent rocks was likely caused by recurrent tectonic events along the Etosha-Griqualand-Transvaal axis, which resulted in the uplift of the Great Escarpment [e.g. 5, 6]. But the uplift possibly also caused changes of the atmospheric circulation and the hydrologic cycle [7]. Tectonic events and climate changes are supposed to be responsible for several variations in the direction of flow and dimension of the catchment areas, e.g. for the Kunene and Orange Rivers, since Palaeogene times.

The present study aims to constrain the evolution of the western Namibian drainages since the Eocene. Therefore, fluvial sediments of the Kunene, Ugab, Swakop, Kuiseb, Tsondab, and Orange Rivers, as well as their precursors were sampled. In order to obtain precise surface exposure ages of the various terrace levels the routinely used TCN ^{10}Be, ^{21}Ne and ^{26}Al from quartz were applied either on surface samples or on depth-profiles consisting of 3 to 5 depth sample spots. Additionally, first results of ^{36}Cl in calcite and U-Pb SSI (small scale isochrones) ages of calcareous matrices from pedogenic calcretes will be presented.

The provenance of the sediments was studied by detrital zircon geochronology using U-Th-Pb and Lu-Hf isotope systematics as well as single grain morphometrics. Preliminary results from several river terraces indicate differences in the detrital zircon pattern through time. This combination of methods facilitates the recognition of potential changes in the fluvial sediment provenance of a catchment area at certain points in time with high resolution. Thus, this combined approach has huge potential for revealing the palaeohydrological history. All this information can be used to estimate amplitudes and processing speeds of past events like incision rates, changing sizes of catchment areas or discharge, which is of particular interest for modelling the palaeoclimate and palaeogeography.

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