Geophysical Research Abstracts
Vol. 18, EGU2016-14441, 2016
EGU General Assembly 2016

Environmental change at the southern Cape coast of South Africa as inferred from a high-resolution Holocene sediment record from Eilandvlei

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The RAIN project (Regional Archives for Integrated iNvestigations), funded by the German Federal Ministry of Education and Research (BMBF), focuses on closely integrated investigations of terrestrial and marine geoarchives from southern Africa in order to assess environmental changes during the late Quaternary. For this purpose, various marine and terrestrial sediment records from the three major rainfall zones of South Africa (winter-, summer- and year-round rainfall zone) were recovered and analysed applying a wide range of methods (e.g., sedimentology, seismic stratigraphy, geochronology, organic and inorganic geochemistry, mineralogy, stable isotopes, micropalaeontology, palynology).

In this contribution, we present results and interpretations obtained from a 30.5 m sediment core retrieved from the coastal lake Eilandvlei located within the year-round rainfall zone. Geochemical investigations (Ca, Sr, total inorganic carbon) indicate major changes in the sediment carbonate contents which were linked to variations in the marine influence received at the site throughout the covered period. The interpretation of carbonates reflecting a varying marine influence is corroborated by micropalaeontological analyses (viz. ostracod and diatom assemblages) which reveal strong similarities with the geochemical data. In order to establish a reliable radiocarbon (^{14}C) chronology for this record, it is of particular importance to consider the impact of ^{14}C-depleted ("old") marine carbon contained in the measured samples causing reservoir effects. Therefore, two marine molluscan shells collected alive before AD 1950 ("pre-bomb") were analysed to determine the regional marine reservoir offset (ΔR). The obtained ΔR values of 134 $\pm$ 38 and 161 $\pm$ 38 ^{14}C yrs represent the first data available for the south coast of South Africa. However, the application of the resulting average ΔR = 148 $\pm$ 54 ^{14}C yrs for the calibration of the entire Eilandvlei record underestimates the reservoir effects for the older deposits. This indicates a temporal variability on the degree of old marine carbon affecting Eilandvlei during the Holocene, which was possibly caused by changes in the connectivity between the lake system and the ocean as well as changes in the extent of upwelling along the coast. To solve this problem, variable past reservoir effects were determined based on the dating of sample pairs which were assumingly deposited contemporaneously and are composed of different source material (marine/terrestrial). This approach provides the most reliable chronology revealing a median basal age of 8880 $^{+145}/_{220}$ cal BP. Thus, the Eilandvlei core represents an ultra-high-resolution record of environmental change during the Holocene, which is a unique discovery for entire southern Africa.

Palaeoenvironmental interpretations of the this record strongly suggest that sedimentation conditions at Eilandvlei were closely coupled to global sea level changes. Moreover, the multi-proxy approach provides great potential for palaeoclimatic interpretations of this record. For example, geochemical proxies reflecting the varying input of terrestrial material suggest changes in the discharge of inflowing rivers which, in turn, may be linked to variations in rainfall and hence climate within the year-round rainfall zone of South Africa.