Geophysical Research Abstracts
Vol. 16, EGU2014-12340, 2014
EGU General Assembly 2014

Shorelines in the Sahara desert: Archives of the hydrodynamics of Megalake Chad

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The African Humid Period corresponds to a major climate change event paced by the orbital parameters of Earth (precession of the equinoxes) with enhanced monsoon regime which has strongly modified the Holocene paleoenvironments of Africa. In sub-tropical north-Africa related reactivation of ancient river networks and the development of numerous lakes, have in turn temporarily favored human occupation of the Sahara. Megalake Chad, which extended over an area swept by the latitudinal fluctuations of the Intertropical convergence zone (ITCZ), represents one of the most emblematic case study of these climate-controlled environmental changes. This very large paleolake had a water-surface of more than 350000 sqkm (10°N–18°N, 12°E–19°E) and maximum depths of ∼150 m to the North and of ∼40 m in the area of the present-day Lake Chad. Satellite imagery (SRTM, Landsat, Pleiades) over the Chad basin reveals conspicuous clastic morphosedimentary structures which do not correspond to eolian or terrestrial landforms but that clearly correspond to typical coastal features. They include isolated ridges, Azov-type spits, beach ridges, wave-ravinement surface and wave-dominated deltas. These paleoshorelines provide firm outlines of the maximal extension of Megalake Chad and allow to track its size evolution which in turn informs about the precipitation/evaporation budget at basin-scale (∼2000000 sqkm). Moreover, the particular shape and distribution of coastal landforms are mostly controlled by the alongshore drift induced by the prevailing winds. Wind-driven hydrodynamics was the major process for clastic sediments redistribution at basin-scale in the nearshore zone and resulted in the building of prominent sedimentary bodies (up to hundreds of kilometer long and few tens of meter thick). As a consequence, paleoshorelines of Megalake Chad represent a record of the paleo-wind regime over the Sahara-Sahel zone which was apparently dominated by an Harmattan-like wind.