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Basin morphology of Lake Donggi Cona, north-eastern Tibetan Plateau, as a combined result of tectonic and climatic forcing

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The Tibetan Plateau provides a unique setting to study both active tectonic forces and environmental changes related to monsoon dynamics with its feedback impacts on the global climate system. Tectonic and climatic processes in particular affect the geomorphological system in different, but not always specifiable ways, requiring multi-disciplinary methodical approaches for their differentiation.

This contribution is dedicated to the area of Lake Donggi Cona (also called Dongxi Co or Tuosuo), which is a 230 km^2 open lake system located in the north-eastern part of the Tibetan Plateau. The catchment area is about 3200 km^2 in size. Tectonically, the lake basin belongs to a series of pull-apart basins associated with the left-lateral Kunlun fault, one of the major suture zones accommodating convergence of the ongoing Indo-Asian collision. Climatically, it is located at the boundary between the East Asian monsoon and Westerlies influence, which is supposed to have shifted repeatedly between higher and lower latitudes during Quaternary time, in concert with global climate fluctuations. These shifts altered the local humidity balance as well as temperature and the glaciation regime and thus, controlled lake level fluctuations and associated sedimentation patterns.
During a limno-geological survey, echo depth sounding and shallow seismic sub-bottom profiling were performed to investigate basin morphology below the present lake surface and sediment architecture up to 50 m beneath the lake bottom. A sediment core, which penetrated the uppermost 6 m of the sediment infill, was dated to a basal age of 18 kyr BP by AMS radiocarbon techniques, yielding a record of postglacial environmental history. A supplementary approach of lineation analysis on the base of Landsat7 ETM+ multispectral images, Shuttle Radar Topography Mission (SRTM) elevation model and geostatistics helped to define regional tectonic activity at high spatial resolution.
In the bathymetric model, a relatively shallow sub-basin and an up to -90 m deep graben structure are shaped by dominant morphological levels. They seem to have formed primarily by vertical displacements as part of the tectonic background movements, as also suggested by the configuration of tectonic lineations. However, lowering of the lake level and the respective accumulation of thick delta sediments along the lake margins indicate strong glaciofluvial impact during a substantial lowstand of the lake at Late Glacial times, preceding a Holocene lake level rise. Furthermore, an older lowstand of unknown age has also been observed in the graben structure. This suggests a morpho-tectonic evolution of sub-aqueous terrace systems was also linked to changes in the hydrological balance of the lake basin.
The project is part of the DFG priority program 1372 (Tibetan Plateau: Formation - Climate – Ecosystems) and is contributing to the topic of reconstruction of the Late Cenozoic climate evolution and environmental response.