Geophysical Research Abstracts
Vol. 15, EGU2013-10922, 2013
EGU General Assembly 2013

Influence of permafrost on lake terraces of Lake Heihai (NE Tibetan Plateau)

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The Tibetan Plateau (TP) is one of the key regions for climatic global change. Besides the poles the TP is the third highest storage of frozen water in glaciers. Here global warming is three times higher than in the rest of the world. Additionally the TP provides water for billions of people and influences the moisture availability from the Indian and East Asian monsoon systems. During the Holocene extent and intensity of the monsoonal systems changed. Hence, in the last decades, a lot of work was done to reconstruct timing and frequency of monsoonal moisture, to understand the past and give a better forecast for the future. Comparative workings often show very heterogeneous patterns of timing and frequency of the Holocene precipitation and temperature maximum, emphasizing the local importance of catchment dynamics.

In this study we present first results of lake Heihai (36°N, 93°15'E, 4500m a.s.l.), situated at the north-eastern border of the TP. The lake is surrounded by a broad band of near-shore lake sediments, attesting a larger lake extent in the past. These sediments were uplifted by permafrost, reaching nowadays heights ca. +8 meters above present lake level. Due to the uplift one of the main inflows was blocked and the whole hydrology of the catchment changed.

To quantify the uplift of permafrost Hot Spot Analysis were accomplished at a DEM of the near-shore area. As a result regions of high permafrost uplift and those which mirror the original height of lake ground were revealed. The most obvious uplift took place in the northern and western part of the lake, where the four uplift centers are located. In contrast the southern and eastern areas show a rather degraded pattern (probably by fluvial erosion, thermokarst, etc.). The ancient lake bottom, without permafrost uplift was estimated to be 4-6 meters above the modern lake level.

For a better understanding of permafrost interaction inside the terrace bodies a 5m sediment profile was sampled and elements, minerals, grain size and isotopes were analyzed. Different factor and end-member analysis were applied on the data, resulting in a clear dichotomy between permafrost-influenced and uninfluenced layers. Hence a completely different process composition must be assumed.