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Spatial and seasonal variability of thermal stratification in Lake Nam Co, central Tibetan Plateau

Junbo Wang (1,2), Jianting Ju (1), Gerhard Daut (2), Lei Huang (1), Yong Wang (1), Qingfeng Ma (1), Torsten Haberzettl (2), Jussi Baade (2), Roland Mäusbacher (2), and Liping Zhu (1)

(1) Institute of Tibetan Plateau Research, CAS, Beijing, China (wangjb@itpcas.ac.cn), (2) Institut für Geographie, Friedrich-Schiller-Universität Jena, Germany

As a big and deep lake in high altitude environment, Lake Nam Co, located in central Tibetan Plateau with an altitude of 4730m and a maximum depth of ∼98m, has played an important role in the past decade concerning paleoenvironmental change studies. However, some aspects related to the lake itself remained still unclear, for example, how the water quality of lake water varies in different seasons and how the thermal stratification develops within a year. As basic and important limnological issues, such kinds of questions need to be addressed to better understand modern process within the lake. Based on in situ monitoring by using a multi-probe water quality sonde (Hydrolab DS5, Hach, USA) and deployed water temperature data logger (VEMCO Minilog, Canada), we present preliminary results focusing on the seasonal variations of thermal stratification in Nam Co and their different temporal behaviors at different monitoring stations.

The regular water quality profiling was conducted at two stations located in two sub-basins of the lake, one in the eastern area (T1, ∼57m depth) and the other in the main western basin (T2, ∼93m depth), respectively. The monitoring campaigns were carried out from mid-May to late November, covering almost the whole open lake period, and the data logger were deployed throughout the whole year.

Nam Co usually has a frozen season from late January to mid-May, during which the water body shows isothermal status vertically. After that, the increasing air temperature causes a rapid lake ice melt and a short spring overturn of the lake's water body. Then the water temperature begins to rise from lake surface and thermal stratification forms gradually and enhances until late October (T1 station) and late November (T2 station). This thermal stratification will be destroyed then and autumn overturn occurs, after mixing the lake enters a winter stagnation period. Based on the annual circulation pattern, Nam Co can be classified as a dimictic lake which is typically distributed in temperate zones.

Although the thermal stratification patterns are rather consistent throughout the year at both T1 and T2 stations, they still show remarkable variations concerning the timing, intensity and disappearance of thermocline as well as the absolute temperature in different periods. In late May, only T1 station show obvious temperature rising (∼8° at surface and <4° at bottom). In mid June, thermal stratification completely forms at T1 station while no visible temperature changes at T2 station. In mid July, both stations show typical thermal stratification, but the thickness of the epilimnion of T1 is deeper than that of T2; moreover, the surface temperature and gradient within thermocline between two stations are different. In late October, water body of T1 station shows homogeneous temperature vertically (∼8°) indicating the thermal stratification has been destroyed, however there is still a typical thermocline layer between 52-60m depth at T2 station, indicating a very thick epilimnion layer which is more than 50m. For frozen season, the eastern area is ice covered earlier than the western lake area. As a result, T1 station shows earlier temperature rising and thermal stratification forming than T2 station as well as higher surface temperature; and accordingly, the disappearance of thermal stratification at T1 station is also earlier than that of T2 station in autumn, causing different timing of overturn in these two lake areas.

Geomorphologically, the two sub-basins of Nam Co are relatively separated. They show quite different characteristics of size, water depth, thereafter water volume and thermal capacity. Compared with the open lake area, the eastern small basin where T1 station locates is easier and faster to response to heating in spring, but the capacity of keeping heat is poorer therefore losing heat in autumn must be earlier. Consequently, these two sub-basins are supposed to be relatively thermally isolated, they have their own thermal circulations within each water body. This may significantly influence both autochthonous sediment productions and allochthonous sedimentary input with their related processes and has to be considered when interpreting proxies of paleoenvironmental records.