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Characteristics and seasonal variation of hydrochemistry in the Tangra Yumco basin, central Tibetan Plateau, and its response to Indian summer monsoon

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Lake Tangra Yumco, located in central Tibetan Plateau, is the deepest lake recorded on the Plateau with a maximum water depth of 230m. Several studies have been conducted focused on paleoenvironmental changes utilizing lake sediemts cores and high lake terraces. The results revealed a significant lake level decreasing up to 180m from early Holocene and Tangra Yumco was separated from two other adjacent lakes since then. A high resolution continuous lake sediment record covering the past 17.4 cal ka has been established. However, compared with the high lake level and paleoenvironmental studies, modern investigations on the water in this basin are still lack.

A comprehensive investigation of hydrochemistry is helpful to understand the modern environment and its response to climate change. This study focuses on the characteristics, seasonal variation and controlling mechanism of hydrochemistry in Tangra Yumco basin, including lake water, river water and rainfall water. Lake water, river water and rainfall water were collected for analyzing major ionic composition in Tangra Yumco basin during 2013-2014. The results showed that Na+ is the major cation of lake water; Ca2+ is the major cation of river and rainfall water, whereas the major anion of all samples is HCO_3-. Comparison of the concentration of calcium in river water, lake water and surface sediments reveals a significant carbonate precipitation process within the lake. The chemical composition of lake is mainly controlled by evaporation and crystallization, whereas river water and rainfall water are mainly controlled by carbonate weathering. Among all rivers, DR10 and DR1 locate in the north and west part of Tangra Yumco where dense local populations live nearby show the highest and second highest total dissolved solid (TDS) with a small catchment and a high content of SO42-, indicating that anthropogenic input and planting have likely a strong influence on chemical compositions of both rivers. The TDS of lake water and river water is much higher during Indian summer monsoon (ISM) period than the pre-monsoon period. The TDS concentration of lake water shows a rapid increase from early August and reaches 2.5 times of pre-monsoon period within one month indicating that due to the rise of temperature and increase of rainfall, rock weathering is enhanced, thus the runoff could take much more chemical composition into the river and the lake. During the post-monsoon period, the TDS of lake water is still keeping in a high level as in monsoon period, probably resulting from the balance between concentration of ions due to lake water loss and decrease of terrestrial ion input. K+ and Cl- of rainfall may originate from evaporation of lake water and mineral aerosols, and the dissolved carbonates are responsible for the chemical composition of rainfall water.