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The Role of Groundwater in the Salt Lakes in the Badain Jaran Desert, China

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The Badain Jaran Desert is the second largest desert in China with tallest sand dunes on the earth. In contrast to the extremely dry climate, there are about 100 lakes spreading regularly over the depressions among high dunes. Most of the lakes have high salinity and more than 50% are salt lakes. Dominant chemical components in the lakes are Na and Cl. The concentration of CO₃ is less than Cl. Fresh groundwater is an essential source of water supply for the lakes which contributes more than 90% of evaporation loss. In this study, we investigate the role of groundwater with respect to three aspects.

Firstly, the way groundwater discharges into the lakes is not in a uniform pattern but frequently concentrates in some places, forming springs. Different types of springs were found. In particular, sub-lake springs were found in some lakes with typical characteristics. Profile distribution of salinity in a salt lake named Sumu Barun Jaran reveals a sub-lake spring about 10-m-depth below water table which causes a low salinity zone near lake-bed. It is a new evidence showing that the groundwater can discharge upward through the bottom of deep lakes in the desert.

Secondly, groundwater discharge maintains the stability of water balance in the salt lakes. Evaporation rate of lake

water is more than 1000 mm per year, about 10 times of the annual precipitation and exhibits a strong seasonal fluctuation. A monthly water balance model is developed to investigate the variability in stage of a lake. It is found that the discharge rate of groundwater changes little in different seasons in comparison with lake water evaporation. This is the reason why the observed amplitude of lake-stage fluctuation is less than 15 cm.

Finally, groundwater discharge and evaporation of lake water control the accumulative process of salt in the lakes. A simplified annual salt balance model is developed to analyze the accumulation rate of salinity in the lakes. It is found that the increase in salinity of a lake is inversely proportional to the area and depth of the lake. Some of the biggest salt lakes have TDS higher than 100 g/L. It is preliminarily estimated from the salt accumulation that the lakes have been there for a long period between 2000 and 5000 years. Most of the other lakes will become salt lakes in the next 2000 years if they will not dry.

Key words: Badain Jaran Desert salt lakes groundwater springs lake-stage salinity

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