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Geochemical and Isotope Tracers Reveal the Runoff Components Characteristics and the Ecohydrologic Influences at the Qinghai-Tibet Plateau

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The glacier recession and the runoff variation on the Qinghai-Tibet plateau conducted by the global warming is changing the regional hydrological and ecological processes. Although there is great need for the knowledge of the runoff evolution and biogenic substances migration and transformation for developing strategies for adaptive utilization of runoff, progress in study on these hydrological questions lags behind because of lack of observation dataset under harsh plateau cold conditions.

In order to understand the critical zone ecohydrological dynamics and evaluate the runoff components in the Qinghai-Tibet Plateau, a series of observation and research were carried out in the Niyang River watershed, a tributary of the Yarlung Zangbo River. Four basins embed in a larger basin (1500 km^2) were monitored and sampled at altitudes between 3667 to 6140 m. More than 500 samples from rain, snow, river water, spring water, glacier ice, vegetation stem, and soil were collected, with which theδ^2H, $\delta^{18}O$, K, Ca, Na, Mg, Sr, Si, F, Cl, N, and S in the water are examined. 5 automatic hydrometric stations were established, and the water level data was sent back by Beidou satellite. The 3D laser scanning and RTK technologies were used to obtain detailed geomorphological information near the 5 current measurement section, based on which a hydrodynamic model is able to be calibrated for the discharge estimation.

The δ^2H and $\delta^{18}O$ of the precipitation proposed a local meteoric water isotope line, which is parallel to the WMWL but higher in the δD~$\delta^{18}O$ graph. The river water isotopes suggest its source is the precipitation, which are similar to the spring ground water (but the geochemical elements are quite different between the surface and ground water). The vegetation stems water and soil water (by cryogenic vacuum extraction) isotope values suggest the attribute of the river/precipitation sources, but a few observation data appear different implying using water formed by the multiple precipitation events or supplied by the higher place under a significant evaporation influence.

The time series of the runoff and the snow cover and glacier variation results show that the base

flow is varied obviously relate to the temperature which influence the melting processes of the glacier and frozen earth from March to August, and the rain runoff events control the flood peek. It suggests that the concentration time should be less than 10 days in the interested watershed.

The tempo-spatial variation characteristics of the geochemical elements are analyzed and mapped in the interested area, which suggested relative steady water components signals contributing to the runoff. Based on which, a set of overdetermined equations are established to evaluate the quantities of different runoff components.

This study could help to evaluate runoff components quantitively in Tibet where lack of data. Monitoring and studing is still going on, which is included in the 2nd comprehensive scientific investigation into Qinghai-Tibet Plateau since 2019.

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