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Isotope composition of base flow and surface runoff in the Black River of northwestern China

Y. Qian (1), Z. Pang (2), D. Qin (3), J. Turner (4) and A. Herczeg (5)

(1) Yellow River Conservancy Commission, Zhengzhou, China, (2) Isotope Hydrology Section, International Atomic Energy Agency, Vienna, Austria, (3) Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China, (4) Division of Land and Water, Commonwealth Scientific and Industrial Research Organization, Perth, Australia, (5) Division of Land and Water, Commonwealth Scientific and Industrial Research Organization, Adelaide, Australia (z.pang@iaea.org / Fax:+43-1-26007 / Phone: +43-1-2600-21742)

The Black River is the second largest internally draining river in the arid region of northwestern China with a catchment covering an area of 1.43 x 10^5 km^2. The river is used extensively for irrigation and town water supplies, particularly along the semi-arid middle reach from Gaoya to Zhangye. This paper describes results of an isotopic study, starting in 2001 that seeks to quantify the contributions and changes in river discharge from snowmelt runoff, and contributions from shallow and deep groundwater aquifers. Water samples were taken at different locations on the river and at groundwater sites in June (before rainy season) and in September (after the rainy season) and analyzed for Electrical Conductivity, δ^2H and δ^{18}O and ^{3}H, Radon-222 and CFCs. Additional river water samples were collected on a monthly basis at four selected hydrologic stations along the river.

The upper reach originates in the northern slop of the Mt. Qilian, a NW-SE stretching mountain range at the northern front of Qinhai-Tibetan plateau, where the mean annual precipitation is 550mm. The river integrates all its headwaters and enters its middle reach at Yingluoxia gorge and annual precipitation in this sector is 140mm. At Yingluoxia gorge station in the upper reach, ^{2}H and ^{18}O tend to be more depleted in summer than in winter, due to increased contribution from snowmelt from Mt. Qilian as the source of headwaters in the Black River. In the middle reach, i.e. from Yingluoxia gorge to Zhengyixia gorge, isotope composition remains constant in the rainy season, but shows an enrichment trend during the dry season when river base-

flow was sampled. Tritium values in river water and near-bank groundwaters along the middle reach of the river (where most of the irrigation occurs) correlates negatively with electric conductivity and Radon-222 indicating that a substantial fraction of river flow is contributed by irrigation return to the river. In the lower reach of the river, where annual precipitation is 50mm only, the river loses its water to near-bank aquifers and therefore dominates the isotope composition of the groundwater near the riverbanks but not the groundwaters in the deep aquifers or those farther away from the river.