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Stable Isotope and hydrogeochemical characteristics of surface water in the Upper Indus River Basin (UIRB), NW Himalayas

MR. MOHD AADIL BHAT JR., PHD, JUN ZHONG AND SILIANG LI

Institute of Surface-Earth System Science, School of Earth System Science, Tianjin University

Presenting Author: aadilgeo@tju.edu.cn

The Indus River one of the longest rivers of the Indian sub-continent, rises from Mount Kailash near Mansarovar Lake in Tibet and flows through China, India, Pakistan, and Afghanistan, and then drains into the Arabian Sea. Stable isotope signatures ($\delta^{18}O$ and δD) and hydrochemical study of surface water (90 samples) in the Himalayan catchment are important for refining the sources of moisture and chemical weathering processes. The hydrogeochemical facies of the surface water is mostly of HCO_3^- and Ca^{2+} type. Ca^{2+} and HCO_3^- were identified as the dominant cation and anion, respectively. Geochemical modelling and several ionic ratios using PHREEQC indicated that the most important hydrogeochemical processes to affect surface water quality were weathering and dissolution of carbonates and silicate minerals, mixing, and ion exchange. Quantitative investigation of hydro-geochemistry shows that carbonate weathering dominates the chemical properties of river water which account for about 80.5%. The chemical weathering rate of the Upper Indus River Basin (UIRB) is estimated to be 70.1 t km^{-2} a^{-1} for carbonate weathering and 6.0 t km^{-2} a^{-1} for silicate weathering, which consumes 729 x 10^3 mol km^{-2} a^{-1} and 148 x10^3 mol km^{-2} a^{-1} of atmospheric CO_2, respectively. Interpretation and analysis based on new stable isotope measurements show that the key source of moisture in the studied river basin was mainly from westerlies and southwest monsoons. We have derived the Local meteoric water line (LMWL), indicating the meteoric origin of the water and insignificant evaporation in the basin.