Meteoric water fluxes in the Himalayas

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The infiltration and circulation of water in the bedrock landscapes of high mountains is to date largely considered to be negligible. Yet, recent studies demonstrate that high mountain groundwater is an important source of water. Water percolating through bedrock is channeled along fractures and cracks that do not necessarily follow topographic gradients. Along these conduits water can be funneld efficiently into the subsurface and over longer distances, where it reacts with rocks and dissolves minerals. Once this water reaches the surface it can dominate the chemical budget of mountain rivers. Thus, to understand weathering rates and the role of mountains in global chemical cycles, it is important to understand the pathways, timescales and surface-subsurface connectivity of waters draining from bedrock steeplands.

We present new data from the trans-himalayan Kali Gandaki River in the Nepal Himalaya. We have monitored this river, its tributaries and springs for four years,measuring rainfall and discharge, major elements, and stable water isotopes to characterize hydrological compartments and their associated weathering fluxes. Addtionally, we have measured ^{222}Rn in the river to define zones of groundwater discharge, as well as trace gases CFC's , SF_6, Tritium, and noble gases to estimate groundwater ages and zones of recharge.

With our observations we can characterize the spatial and seasonal distribution of groundwater input to river discharge. Especially during the baseflow season, groundwater is the dominant water source and our ^{222}Rn measurements show that groundwater seeps into the main channel along the full river length. Geochemical fingerprinting allows us to distinguish between different source regions and to recognize the temporal shifts in discharge contributions and the weathering activity. Furthermore, spring water samples from the headwaters have isotopic signatures and ages that point towards substantial subsurface drainage capture, possibly reaching beyond the Himalayan divide. This ensemble of observations indicates that water and solute fluxes from mountain belts such as the Himalaya can't be understood and predicted without due considerations of groundwater flow and surface-groundwater interactions.