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# Arsenic geochemistry in high altitude Himalayan aquifers of Ladakh, India: source, processes and controls

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Widespread occurrence of groundwater Arsenic (As) is reported from foreland sedimentary aquifers of orogens, where its presence can be traced back to the nearby orogen, which most often tends to be a paleo/active subduction zone. However, its occurrence in aquifers close to its source is rarely investigated. The work being presented reports its presence close to one such source, the Indus-Tsangpo suture zone (ITSZ) in Ladakh, India.

Located on a paleo-subduction zone, the ITSZ marks the junction between the Indian and Eurasian plates. Groundwater resides in both bedrock and surficial aquifers. Groundwater is neutral-alkaline, moderately reducing, and belongs to the Ca-Mg-$HCO_3$ facies. Weathering studies indicate that dissolution of carbonate (calcite and dolomite), silicate phases (Ca-feldspar, Ca-Mg pyroxenes) and cation exchange processes are the major contributors of alkaline earth and alkali elements in the groundwater, respectively. A lower than unity ratio of Na/Cl in a subset of samples points towards non-atmospheric sources of Cl, and suggests mixing between hydrothermal discharges and local groundwater. Thermodynamic modeling suggests groundwater is under to nearly saturated in common carbonate phases and is in equilibrium with anorthite and gibbsite. Groundwater As content ranges from 1 to 86 µg/L. Levels and proportion of As are higher in bedrock aquifers with high As wells being mostly located in the Dras volcanic terrain, and in the vicinity of the Ladakh Plutonic Complex. Oversaturation with respect to Fe oxides and hydroxides suggests that these phases act as carriers of As, from where it is dominantly released by reductive mechanisms. Undersaturation of As minerals suggests that once released, the As will not precipitate from the aqueous phase. It is hypothesized the rocks of the ITSZ, which contain up to 28 mg/kg of As, are primary sources of solid phase As. Hot springs spouting As-enriched water that are common in the area are also possibly contributors to the As content of groundwater. The current study is one of the few studies to have reported and addressed the issue of As contamination in the high Himalayas and hopes to draw the attention of policy makers towards the remediation of this environmental hazard.