# Origin of arsenic contamination of springs in an alpine environment, examples of the Seckau Tauern Range (Austria)

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For humans arsenic is one of the most toxicologically dangerous elements on the planet. In most cases it occurs geogenically dissolved in drinking water resources. The influencing factors for a contamination of water are widespread and for most locations individual. Four dominant mechanisms are known, two are associated with adsorption processes on metal oxides or clay under an alkaline or a reductive environment. The others are sulfate oxidation and evaporation of geothermal waters. High level contaminations like in Bangladesh are intensively discussed in literature, however low level contaminations are less investigated. This work aims to understand the processes of arsenic mobilization in low contaminated settings bound to crystalline periglacial landforms such as rock glaciers in alpine regions. The investigation area in the Seckau Tauern Range led to new questions related to arsenic contamination of spring water bound to these landforms, since that none of the four dominant dissolution and mobilization processes does fit to the behavior of the investigated springs. Water temperatures between 2-4 °C, short retention times (hours – several months) and neutral pH values are not favorable conditions for dissolution and mobilization. Furthermore, the overall total cation concentration is less than 22.58 mg/l, where $Ca^{2+}$, $Si^{4+}$, $Mg^{2+}$, $Na^{+}$ and $K^{+}$ dominate. Anions, such as $HCO_3^{-}$, $SO_4^{2-}$, $NO_3^{-}$, $NO_2^{-}$, $Cl^{-}$ and $PO_4^{3-}$, are also extremely low concentrated ($\sum$ <27.42 mg/l). Nevertheless, the arsenic concentrations in some spring waters exceed 10 µg/l, which is the recommended threshold (parameter value) for drinking water according to the WHO. The important questions related to this context are: (i) What is the source of the contamination? (ii) What are the dissolution and the transport mechanisms? (iii) Why do they not fit to the dominant processes? (iv) Is an influence discernible due to the hydrogeological behavior of rock glaciers or other landforms like debris talus, etc.? Therefore, water sampling for hydrogeochemical analysis as well as rock and sediment sampling was done to investigate the distribution and the source of the contamination. Additionally, stable isotopic data of the water samples (H, O and S) were taken for a better understanding of the dissolution and mobilization processes. Finally, PHREEQC will be applied for inverse modelling by using the hydrogeochemical data in combination with geochemical and mineralogical data from exposed lithologies of the catchment areas. Thus, this work contributes to a better understanding of the origin and fundamental process of low arsenic pollution in crystalline basement areas.