



## **Tracer-based identification of rock glacier thawing in a glacierized Alpine catchment**

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Current warming in high mountains leads to increased melting of snow, glacier ice and permafrost. In particular rock glaciers, as a creeping form of mountain permafrost, may release contaminants such as heavy metals into the stream during intense melting periods in summer. This may have strong impacts on both water quantity and quality of fresh water resources but might also harm the aquatic fauna in mountain regions.

In this context, the present study used stable isotopes of water and electrical conductivity (EC) combined with trace, major and minor elements to identify the influence of permafrost thawing on the water quality in the glacierized Solda catchment (130 km<sup>2</sup>) in South Tyrol (Italy). We carried out a monthly sampling of two springs fed by an active rock glacier at about 2600 m a.s.l. from July to October 2015. Furthermore, we took monthly water samples from different stream sections of the Solda River (1110 to m a.s.l.) from March to November 2015. Meteorological data were measured by an Automatic Weather Station at 2825 m a.s.l. of the Hydrographic Office (Autonomous Province of Bozen-Bolzano).

First results show that water from the rock glacier springs and stream water fell along the global meteoric water line. Spring water was slightly more variable in isotopic ratio ( $\delta^2\text{H}$ : -91 to -105 ‰) and less variable in dissolved solutes (EC: 380 to 611  $\mu\text{S}/\text{cm}$ ) than stream water ( $\delta^2\text{H}$ : -96 to -107 ‰ and EC: 212 to 927  $\mu\text{S}/\text{cm}$ ). Both spring water and stream water showed a pronounced drop in EC during July and August, very likely induced by increased melt water dilution. In both water types, element concentrations of Ca and Mg were highest (up to 160 and 20 mg/l, respectively). In September, spring water showed higher concentrations in Cu, As, and Pb than stream water, indicating that these elements partly exceeded the concentration limit for drinking water. These observations highlight the important control, which rock glacier thawing may have on water quality of alpine streams and they underline the need for water quality monitoring at high elevations.

**Keywords:** stable isotopes of water; heavy metals, permafrost thawing; alpine rivers; glacierized catchment