Evidence of rock glacier melt impacts on chemistry and diatoms in Alpine headwater streams and lakes

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Active rock glaciers are highly sensitive to increasing air temperature in high mountain areas due to their location near the lower altitudinal boundary of alpine permafrost. Though still sparse, there is first evidence about a climate-related impact by rock glaciers on alpine headwater chemistry. A first study on the potential effects of rock glacier thawing on the ecological quality of headwater streams was recently conducted in the Oetztal Alps (Tyrol, Austria). The streams impacted by active rock glaciers showed high electrical conductivity, but differed in acidity, heavy metal concentrations and by the proportion of acidophilous diatoms. On the contrary, all reference streams exhibited low conductivity and circumneutral to slightly acidic pH values (characteristic for surface waters on crystalline bedrock), with no detectable heavy metals and a diatom composition typical for high altitude softwater streams. Within the project Interreg IV Italy-Austria Permaqua (ID5302) the study was extended to permafrost impacted running waters, springs and lakes located in different siliceous mountain districts of South and North Tyrol, in order to better understand diatom responses to melting permafrost. Due to their remoteness these headwaters are not affected by direct anthropogenic impacts. Both permafrost and reference waters were investigated in late summer for water chemistry and periphytic diatoms. The study confirmed a clear response of diatom species composition to permafrost driven changes in water mineralization level and acidity. In order to obtain a first long term temporal perspective of the potential response of headwater ecosystems to permafrost degradation, deep sediment cores were collected from five Permaqua lakes, radiometrically dated, and analyzed for lithological, geochemical, and biological proxies. Sediment records indicated an ecological transition common to all lakes after the end of the Little Ice Age, while diatom-inferred water pH revealed a slight, possibly permafrost related, acidification in some lakes.