



Significant differences in biogeochemical processes between a glaciated and a permafrost dominated catchment

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It is increasingly recognised that microbially mediated processes have a significant impact on chemical fluxes from glaciated catchments. One important reaction is the oxidation of pyrite since the production of sulphuric acid facilitates the dissolution of minerals without the need for acidity generated by dissolved atmospheric CO₂. Thus weathering processes can still continue even when isolated from the atmosphere, as is thought to occur under large ice masses. However, as a glacier melts, it is expected that the microbial community will change with knock-on effects on the stream water chemistry. Understanding the difference in solute generation processes between glaciated and un-glaciated terrain is key to understanding how glacial-interglacial cycles affect atmospheric CO₂ consumption by chemical weathering.

In order to investigate whether biogeochemical processes differ between glaciated and un-glaciated terrain we collected stream water samples from two small catchments (each approximately 3 km²) in Svalbard. One catchment is glaciated and the other catchment is un-glaciated but is affected by permafrost and a seasonal snow-pack. The two catchments are situated next to each other with identical bedrock (shale with minor siltstone and sandstone). The proximity of the catchments to each other ensures that meteorological variables such as temperature and precipitation are very similar. Sampling was conducted early in the melt-season when there was still significant snow-cover and in mid-summer when most of the seasonal snow-pack had melted. The water samples were analysed for $\delta^{34}\text{S-SO}_4$, $\delta^{18}\text{O-SO}_4$, $\delta^{18}\text{O-H}_2\text{O}$, $\delta^{13}\text{C-DIC}$ and $\delta^{13}\text{C-DOC}$, together with major anions and cations.

Despite the nominally identical lithology, there were significant differences in the stream water chemistry between the two catchments. For example, sulphate was the dominant anion in the un-glaciated catchment whereas bicarbonate was the dominant anion in the glaciated catchment. Pyrite oxidation under anoxic conditions and microbially mediated sulphate reduction occur in both catchments. However, in the glaciated catchment pyrite oxidation is mainly coupled to carbonate dissolution and in the un-glaciated catchment it is mainly coupled to silicate dissolution. These significant differences in weathering processes will be discussed with reference to the microbial communities found in the two catchments.