Biogeochemical Sources and Exports in a Small Headwater Catchment Underlain with Discontinuous Permafrost

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High frequency surface water sampling was conducted at multiple locations along the main drainage of a small headwater catchment (2.25 km^2) located on the Seward Peninsula of Alaska that is underlain with discontinuous permafrost. The predominately southeast-facing hillslope is divided by a relatively deep catchment-drainage that flows perennially and also collects seasonal runoff from snowmelt and rain. As such, discharge varies significantly with season and numerous transitory seepages can be observed at certain times of the year. The main drainage also receives water from several relatively small branching tributaries. One of the larger tributaries (henceforth "the tributary") was monitored in this study because of its function as a natural culvert of overland flow, as well as clearly visible seepages from both organic and mineral layers. During the summers of 2016 and 2017, automated samplers were used to collect regular (24hrs 2016; 48hrs 2017) surface water samples from 2 locations along the main drainage (upstream and downstream) and 1 location along the tributary. Surface water pH, redox potential, and temperature were measured during sampler deployment in an effort to characterize "typical" geochemical conditions of the drainage and tributary. Surface water samples were monitored for major cations, major anions, and stable water isotopes. Precipitation (as snow and rain) was also collected and monitored for major cations, major anions, and stable water isotopes, when possible. The downstream automated sampler was co-located with a gaging station from a separate study, which made it possible to consider concentration versus discharge relationships of the catchment. Stable water isotopes indicate that the primary source of water to each sampling location was via long flow paths that provide ample time for meteoric waters to mix prior to reaching the main drainage. Nevertheless, it was clear that each location receives water from different sources. The upstream location receives water relatively high in sulfate and nitrate; the sulfate likely from oxidation of sulfidic minerals, while the source of nitrogen could be thawing permafrost, but is uncertain at this time. The stability of both sulfate and nitrate suggests persistently oxic subsurface conditions. The tributary location receives water relatively high in calcium, strontium, and magnesium; time versus concentrations trends suggests calcium and strontium are from a similar source and magnesium is from a dissimilar source. The downstream location shows clear indications of mixing between the upstream and tributary locations. A chemostatic/non-chemostatic concentration versus discharge analysis was conducted is presented within.