Development of stable isotope records in permafrost and the implications for paleoclimate thermometry

C Buchanan[a]

[a] *Department of Earth and Atmospheric Science, University of Alberta, Canada*

Reconstructions of past climate change are used to inform predictions for modern climate change. These reconstructions are built upon paleoclimate proxy data derived from, but not limited to, tree rings, ice cores, lake sediments, pollen, midges, and corals. $\delta^{18}O$ and $\delta^{2}H$ in permafrost ice have been utilized in previous studies as a proxy record for *relative* changes in past air temperatures. However, mechanisms that influence the isotopic signature of pore waters prior to their incorporation into the permafrost record – namely isotopic fractionation and thaw depth recurrence – are not well understood, hindering our ability to produce robust air temperature reconstructions. In late May of 2016, permafrost cores were collected from the Klondike and Ogilvie Mountains of east-central Yukon Territory. These cores were used to construct $\delta^{18}O$ and $\delta^{2}H$, gravimetric water content, pH, electrical conductivity, DOC, and major cation depth profiles at high (1cm) resolution. From these chemical profiles, we have identified cryostratigraphic horizons representing different stages of permafrost growth and isotopic record development, including the *transition zone* – a horizon between the active layer and permafrost in which important isotopic and permafrost-forming processes occur. The results of this study show that *1)* comprehensive cryostratigraphic characterization of permafrost requires correlation between multiple geochemical parameters; *2)* geochemical signatures are tied to the probability density distribution of annual thaw depth; and *3)* isotopic signatures in permafrost primarily record waters averaged together during abnormally warm summers of low recurrence. Together, these findings improve our interpretations of historic air temperature from $\delta^{18}O$ and $\delta^{2}H$ of permafrost ice and reinforce the importance of transition zone processes.

Corresponding Author: cabuchan@ualberta.ca