Close Association of Aluminium and Nutrients in Glacial Meltwater

STACHNIK Ł.[1,2], YDE J.C.[2], DALY L.[3], NIEDZIELSKI P.[4], HAWKINGS J.[5], IGNATIUK D.[6], SITEK S.[6]

[1] University of Wroclaw, 50-205 Wrocław, Poland (*correspondence: Lukasz.Stachnik@gmail.com)
[2]Western Norway University of Applied Sciences, 6851 Sogndal, Norway (Jacob.Yde@hvl.no)
[3]University of Glasgow, Glasgow, G12 8QQ, UK (Luke.Daly@glasgow.ac.uk)
[4]Adam Mickiewicz University in Poznań, 61-614 Poznań, Poland (pnied@amu.edu.pl)
[5]Florida State University, 1800 E. Paul Dirac Dr. Tallahassee, FL 32310-3706, USA (jhawkings@fsu.edu)
[6]University of Silesia, 41-200 Sosnowiec, Poland (dariusz.ignatiuk@us.edu.pl, slawomir.s.sitek@us.edu.pl)

Aluminium (Al) is potentially harmful for biota, but its biogeochemical cycling in glacierised basins has received limited attention thus far [1]. Our study aims to elucidate the relationships between filterable and sediment-bound Al and glacier-derived nutrients (Fe, Si, P). As a case study, we investigated the Werenskiöldbreen basin (44.1 km^2, 60% glaciated) situated in SW Svalbard, High Arctic. Meltwater samples were collected from supraglacial streams, subglacial outflows and the proglacial river, and analysed for major and trace elements and dissolved organic carbon, while suspended sediments were analysed for mineralogy and geochemical composition (e.g. by TEM analysis on dry residues). Our results show that filterable Al concentrations (passing through a pore size of 0.45 μm) in meltwater are significantly correlated to filterable glacier-derived nutrients (Fe and Si) concentrations [2]. Subglacial weathering is the main source of Al, as Al concentrations were unchanged between the subglacial outflows and further downstream. Furthermore, a relatively high concentration of Al-PO_4 ligands, determined by geochemical modelling, suggests a potential increase in Al bioavailability in supraglacial streams and in the proglacial zone [2]. At Werenskiöldbreen, the filterable annual Al yield was estimated to be 2.7 mmol m^{-2}, which was of similar magnitude as Fe (3.0 mmol m^{-2}) and ~6 times lower than dissolved silica during 2011 [2]. We conclude that a labile Al pool derived from glacierised basins is incorporated in biogeochemical cycles, as Al is strongly related to the export of glacier-derived nutrients and the formation of Al-phosphorus ligands likely occurs.

[1] Exley (2003), *Journal of Inorganic Biochemistry*, **97(1)**, 1-7, [2] Stachnik, *et al.* (2019), *Hydrological Processes*, DOI: 10.1002/hyp.13426.