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Inorganic ion fluxes in an Irish blanket bog catchment: Implications for weathering studies

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Conventional views of blanket bog hydrology suggest the majority of water contributing to stream base flow moves through the peat, with negligible contributions derived from other pathways. However, recent work suggests that water derived from alternative hydrological pathways can make a significant contribution.

This study investigated water movement through an Irish upland blanket bog, underlain by basalt and glacial till, located at the Garron Plateau in Co. Antrim, Northern Ireland. Research aimed to characterise the influence of substrate groundwater discharge on a stream's base flow regime and water quality. Water samples were taken to quantify changes in stream chemistry during an exceptionally dry period in July 2018, followed by more typical wet weather conditions. Regular 24/7 water sampling was carried out and samples were analysed for major ions, ammonium, TOC and DOC. Continuous monitoring of EC and flow at the catchment outlet complemented these data.

Concentrations of most ions were found to be elevated in the dry period, compared to periods of higher flow following intense rainfall; median Ca concentrations declined from 18 mg/l to 5 mg/l, Mg decreased from 12 mg/l to 4 mg/l and Si fell from 9 mg/l to 3 mg/l. These cations fell along a mixing line with higher concentrations encountered during low flow periods, to concentrations more closely resembling rainfall during higher flow periods. The absence of groundwater, with comparable hydrochemistry to runoff, within the peat, suggested an additional more mineralised source contributing to stream flow. Groundwater head measurements in peat suggest this may be derived from bog water discharging through the peat base, where it reacts with inorganic substrate materials, before flowing into streams. Preliminary end member mixing analyses suggested that throughout the driest summer period of 2018 (28^{th} June to 27^{th} July), over 80% of the flow in the system derived from substrate discharge. The decline in concentration of these ions, when runoff increased, reflected a dilution effect, yet indicated that the influx of the groundwater is relatively constant and changes in inorganic ion concentrations reflect supplemental contributions from other hydrological pathways.

As it appears that the stream chemistry in these blanket bogs is highly influenced by the underlying substrate geochemistry, it is therefore possible that stream discharge, when coupled with base flow water quality, could be used to quantify substrate weathering rates.