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Catchment and in-stream influences on iron-deposit chemistry, algal-bacterial biomass and invertebrate richness in upland streams, Northern Ireland.

Katrina Ann Macintosh and David Griffiths
School of Environmental Sciences, University of Ulster, Coleraine, Northern Ireland (ka.macintosh@ulster.ac.uk)

The density and composition of upland stream bed iron-deposits is affected by physical, chemical and biological processes. The basic chemical processes producing ochre deposits are well known. Mobilisation of iron and manganese is influenced by bedrock weathering, the presence of acidic and/or reducing conditions and the concentration of dissolved organic carbon. Ferromanganese-depositing bacteria are significant biogenic agents and can cause/enhance the deposition of metals in streams as (hydr)oxides.

Metal concentrations from stream waters in two geological blocks in Northern Ireland were compared to determine the contributions of catchment characteristics and in-stream conditions. One block is composed of metamorphosed schist and unconsolidated glacial drift, with peat or peaty podzol (mainly humic) soils, while the other block consists of tertiary basalt with brown earth and gley soils. Water samples were collected from 52 stream sites and analysed for iron, manganese and aluminium as well as a range of other chemical determinands known to affect metal solubility. Stone deposit material was analysed for metal concentrations, organic matter content and epilithic algae, chlorophyll a concentration. Invertebrates were collected by area-standardised kick samples and animals identified to family and numbers counted.

Higher conductivities and concentrations of bicarbonate, alkalinity, calcium and magnesium occurred on basalt than on schist. Despite higher iron and manganese oxide concentrations in basalt-derived non-humic soils, stream water concentrations were much lower and stone deposit concentrations only one third of those occurring on schist overlain by humic soils. Peat-generated acidity and the limited acid neutralising capacity of base-poor metamorphosed schist has resulted in elevated concentrations of metals and ochre deposit in surface waters.

Algal biomass was determined by catchment level factors whereas in-stream conditions affected bacterial biomass. Strong, non-linear, relations occurred between estimated bacterial biomass and deposit metal concentrations, with iron and manganese becoming relatively more important and algal biomass declining above a threshold deposit/bacterial density. Invertebrate community structure was altered above a deposit density of 10 mg cm-2, when invertebrate richness and diversity declined. These changes are driven by an increase in estimated bacterial biomass.