Geochemistry of Northern Stream Waters: Metal Mobility and Implications for Mineral Exploration in the MacMillan Pass, Yukon

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Stream waters and silt sediments are regularly sampled as a mineral exploration vectoring tool. While chemical weathering and mineral precipitation in stream sediments are well documented, the effect of varying environmental conditions on exploration samples are not always well understood or accounted for, particularly with regards to redox, pH, and sorption to oxides and clays and organics. Thermodynamic modelling of metal speciation may allow samples to be normalized across varying conditions.

During the summer of 2013 streams in the MacMillan Pass, Yukon, were sampled by the Geological Survey of Canada to characterize the stream waters of a natural, northern (63° latitude) acid rock drainage (ARD) system. This area contains two known ore deposits, acid generating black shales and localized carbonates. Streams sampled had pH values ranging from 2.9-8.2, conductivities ranging from 30-2100 μS/cm and moderate water temperatures of 8-14°C. Detrital sediments were composed of silt to boulder lag deposits. These were overlain by metal-oxides in the most acidic waters (pH <3.5), red iron oxide rich precipitates at moderate acidity (pH 4-5) and unidentified white precipitates (possibly aluminium oxides) in slightly acidic waters (pH 5-6). Neutral to basic waters without acidic tributaries had no visible precipitates. Highly acidic (pH 3) waters in stagnant pools showed signs of microbial mineral formation, however there was no indication this was widespread. Valley side tributaries were either acidic (pH <3.5), or neutral to alkaline (pH >7). Waters with intermediate pH values were only found along the main channel after mixing.

Recently there has been interest in ARD systems being created by the exposure of surficial metal sulphide minerals by receding glaciers [1]. Being that the upper extents of this system were recently glaciated, this system may aid future exploration and water quality studies as similar systems are exposed.

[1] Fortner *et al* (2011) *app. geochem.* **26**. 1792-1801