Proposal summary

Public concerns are increasing about the environmental impacts of land use on surface water quality in the boreal forest due to development by industry. However, the chemistry of the unique, organic-rich surface waters of this region, in their natural condition, is poorly understood. Without reliable baseline information, the true impacts of development are difficult to assess and the success of ecological restorations at disturbed sites is difficult to quantify. We will study pristine and disturbed wetlands to discover what is actually dissolved in these waters. Using state-of-the-art instruments housed in the ultraclean, metal-free SWAMP laboratory, it has become possible to characterize the physical and chemical forms (speciation) of the natural nanoparticles which are dissolved (< 0.45 μm) in these waters. This analytical facility allows us to simultaneously characterize aquatic organic compounds and distinguish between complexed and dissolved fractions of trace metals at extremely low concentrations. Using water samples from diverse ecosystems (bogs, fens, and saline marshes from pristine, impacted, and restored sites) we will document the changes in speciation over the entire natural range in pH, redox potential and salinity. This work will discover which metals are dissolved (and therefore available to aquatic organisms, either in a beneficial or detrimental way) versus those which are complexed and unavailable: these distinctions bring new meaning to "background" values and identify the true impacts of human activities. This information will directly benefit industry (coal, forestry, peat moss, oil and gas), society, and the environment, as water quality objectives are critically assessed and real impacts distinguished from perceived ones, allowing monitoring programs to be adjusted, if necessary, and reclamation efforts to be improved. This study of naturally occurring nanoparticles will also directly benefit Canada's nanotechnology industry.