OVERVIEW OF REHABILITATION RESEARCH OF DIAMOND MINE WASTES IN THE HUDSON BAY LOWLAND

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The Hudson Bay Lowland (HBL) is a vast and almost pristine subarctic region in Ontario's Far North, forming the third largest wetland in the world (Abraham and Keddy, 2005). These wetlands consist mostly of peatlands, also known as muskeg, underlain by alkaline carbonate deposits and bedrock, with intrusions of economically-significant mineral deposits. This region is rapidly becoming a centre of Canadian mining activity, with active mining at the De Beers Canada Victor Mine and extensive exploration and advanced permitting in the vicinity of the Ring of Fire. Good environmental management is a primary concern in this region.

One of my research goals is to develop protocols for ecosystem rehabilitation after mining in the HBL, in a similar fashion as has been developed for the peat extraction industry in eastern Canada (Quinty and Rochefort, 2003). Such protocols would detail the best management practices (BMPs) needed to return valuable ecosystem services to mining-disturbed landscapes. Much sound information can be borrowed from other high boreal or subarctic regions with extensive development, such as from the Alberta bitumen mines, but local research is also required to build sound BMPs for the HBL.

My students and I have conducted research around the De Beers Canada Victor Mine on (i) the restoration of disturbed peatlands areas; (ii) the selection of suitable reference conditions to determine mine waste reclamation targets; (iii) upland substrate mixes suitable for natural vegetation made from mine wastes and organic materials; (iv) best plant species to reclaim upland mine sites; (v) field tests of the abilities of soil mixes to support native plant species; and (vi) best protocols for seed collection and the valuation. In this presentation, I am reporting on the first four of these research themes.

Disturbances to peatlands represent the largest area of mining disturbance. Some of these peatlands have been transformed to novel upland ecosystems and cannot be returned to peatlands. However, many of these peatlands have linear disturbances such as winter roads and buried pipelines, with disturbed or no vegetation, but suitable peat

substrates and hydrology. We have shown that the plant cover and species composition of most winter road clearances over peatlands recover within a decade of abandonment, with the exception of the dwarf trees such as tamarack and black spruce, which will take several decades to return (Campbell and Bergeron, 2012). However, some peatland habitats, such as bogs, have slow recovery (Campbell and Corson, 2014) and will require active rehabilitation. We have tested existing BMPs developed to restore mined peatlands in southeastern Canada, and have shown that these can be simplified, by just spreading moss fragments over bare peat substrates in order to rehabilitate the peat-forming function (Corson and Campbell, 2013).

The rehabilitation of the upland mine wastes is more challenging, in part because of the local rarity of upland habitats, which are either found as islands within the vast peatlands or, paradoxically, along the rivers. We have surveyed these upland habitats and have shown that the carbonate-rich silt loam overburden produced by the Victor Mine resembles these natural soils (Garrah, 2013; Fig. 1). Mixes of silty overburden and peat are the most promising as a viable substrate to return sites towards regional representative upland ecosystems. The vegetation along the river has many early succession species, suitable for the rehabilitation of mine sites (Garrah, 2013). We have concentrated on these species and have attempted to identify their abilities to disperse, establish and grow, using a plant trait approach (Laurin, 2012). This information will help identify appropriate species to rehabilitate upland mine waste environments.

These studies together will help build sound BMPs for ecosystem rehabilitation in the Far North of Ontario. We have worked primarily around the Victor Mine, but we are confident that many of these ecosystem rehabilitation approaches can aid similar mines, even in lower carbonate terrain around the Ring of Fire and elsewhere in the subarctic.

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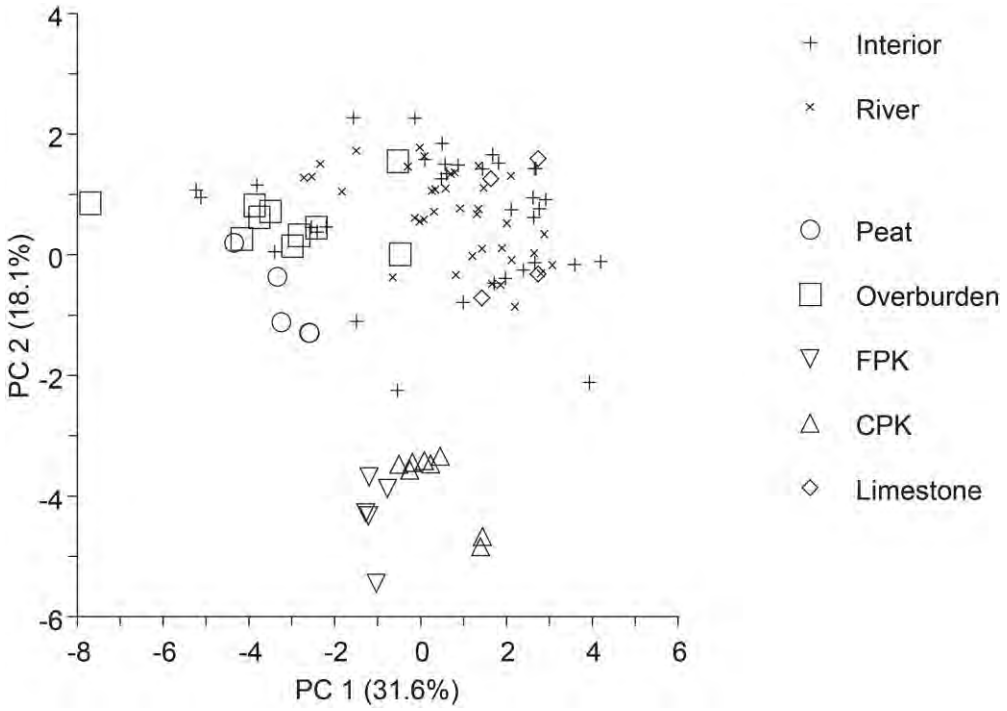

Fig. 1. Principal component analysis of the bioavailable elements in waste materials from the Victor Mine (n = 32) as compared to reference sites in isolated interior uplands (n = 35) and on uplands along the Attawapiskat River (n = 37). The waste materials include peat, silty loam overburden, fine and coarse processed kimberlites (FPK and CPK) and limestone.

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