Soil Amendments in Mine Closure, New Afton Mine, South-Central British Columbia: Proposed Work

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Introduction

Environmental laws and regulations govern mining and oil-and-gas extraction in Canada, including reclamation. Prior to development, resource-extraction companies are required to post a bond as a promissory that their activity and closure will meet approved government environmental standards. Despite the rising demand for restoration management, there is limited research on environmental restoration and there are few dedicated university postgraduate training programs in Canada to address the complexities of ecosystem reclamation. There is a critical need to work with the mining and oil-and-gas industries, in partnership with governmental agencies, to develop better management practices for successful ecosystem restoration, and to train Highly Qualified Personnel (HQP) for reclamation work.

Current restoration plans and mine-closure proposals for land reclamation are generally not based on sound scientific evidence. They are more likely to be based on past practice and administrative and logistical constraints. In order to rectify this lack of information, optimize reclamation methods and allow for a more harmonious coexistence between industry and environment, research focused on understanding and mastering ecosystem reclamation is needed.

This project is located at the New Afton mine in south-central British Columbia (Figure 1) and will study topsoil stored in a stockpile at the mine (Figure 2) to explore the use of soil amendments as they relate to enhancing viability of stored topsoil.

Project Location

During mine operation, topsoil stockpiles are established for use in reclamation upon closure of the mine. The height of these piles can reach up to 30 m. In addition, stockpiles can sit for the entire duration of mine operation, which may be decades. A major question is "Does topsoil stored in piles remain viable after so many years?" In order to address this question, the viability of the topsoil stockpile must be characterized over time and by depth. Furthermore, strategies must be developed to increase the viability of stored stockpiles.

Figure 1. Location of the New Afton mine, south-central in British Columbia.

A large stockpile on the site of the new New Afton mine (Figure 3) was selected for study. One way to assess viability is to measure the soil microbiota through DNA sequencing. A sampling protocol has been established to measure differences in the microbial community by depth in the stockpile. Experimental plots will also be established to test methods of rejuvenating the viability of a stockpile, which will include the use of soil amendments, such as 'fresh' topsoil from an undisturbed site, biochar, compost and wood chips.

Objective

The easiest way to restore topsoil and microbial communities after mine closing to their full pre-closing health status (i.e., equivalent soil characteristics and microbial community composition and function), and therefore the most likely route to achieve fully functional reclamation, would be to simply replace the excavated overburden with the

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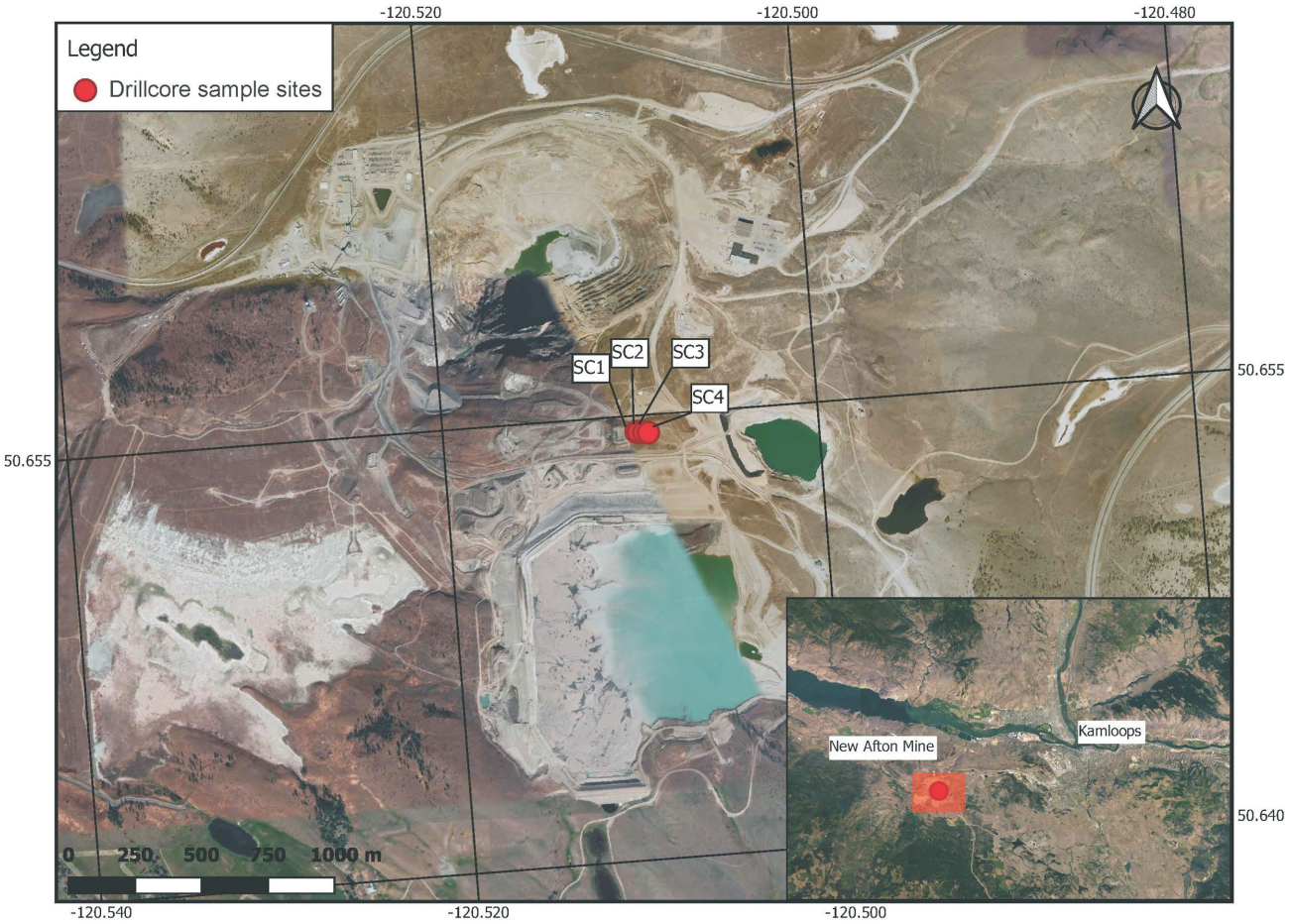

Figure 2. Site of stockpile and drill locations at the New Afton mine.

stockpiles of these materials kept on site. Unfortunately, it is known that microbial composition and functions degrade significantly over time, likely depending on factors such as depth of the stockpile, exposure to sun and weather, temperature, and chemical and microbial interaction.

Figure 3. Topsoil stockpile at New Afton mine, with drill rig on top.

Methodology

The project will investigate factors that affect changes to microbial health in topsoil stockpiles by evaluating such a stockpile at the New Afton mine. The soil and microbial characteristics, and microbial functions in these stockpiles will be characterized.

Soil samples will be collected at soil depths of 0—30 cm, 30–60 cm, 60–90 cm, 90 cm–1.2 m, 1.2–1.5 m, 1.5–3.0 m, 3.0–4.5 m, 4.5–6.0 m, 6.0–7.5 m, 7.5–10.5 m, 10.5–13.5 m, and at 3 m intervals until the bottom of the stockpile has been reached (Figure 4).

Soil characterization will include mineralogy and organic-matter content. High molecular weight, bulk DNA extracts will be collected. High throughput DNA sequencing will be done on the Thermo Fisher Scientific Ion S5 XL System.

Bulk soils collected at each depth interval will be stored in a –20°C freezer until the greenhouse trials are established. The basic premise is to take soils at each depth, treat with different combinations of soil amendment, and grow a phytometer (model plant species) as a test species to deter-

Figure 4. Drill operation and sample collection at the New Afton mine topsoil stockpile, September 26, 2018.

mine relative growth potential under different treatment conditions.

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