Direct discovery of buried mineralization through microbial community fingerprinting

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Mineral exploration in northern latitudes is challenging in that undiscovered deposits are likely buried beneath significant glacial overburden. The development of innovative exploration strategies and robust techniques to see through cover is imperative to future discovery success.

Microbial communities are sensitive to subtle environmental fluctuations, reflecting these changes on very short timescales. Shifts in microbial community profiles, induced by chemical differences related to geology, are detectable and can be used to vector toward discreet geological features. The modernization of genetic sequencing and big-data evaluation allows for efficient and cost-effective microbial characterization of soil profiles, with the potential to see through glacial cover.

Results to date have demonstrated the viability of microbial fingerprinting to directly identify the sub-crop of mineralization in addition to entrained geochemical signatures in till. Soils above two copper-porphyries and an epithermal gold deposit in southern British Columbia, and two kimberlites in the Northwest Territories, have undergone microbial community profiling. These community-genome derived datasets have been integrated with chemistry, mineralogy, surface geology, vegetation type and other environmental variables including Eh and pH. Analyses show significant microbial community shifts, correlated with the presence of subsurface mineralization, with a distinct community response at the species level directly over known deposits. The relationship between microbial profiles and mineralization can lead to the application of microbial fingerprinting as a method to accurately delineate geological changes such as the presence of ore deposits in glacially covered terrain.

The integration of microbial community information with soil chemistry and landscape development coupled with geology and geophysics significantly improves the drill / no-drill decision process. There is high potential for application as a field-based technique, as sequencing technology is progressively developed into portable platforms.