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The long-term environmental impacts of the Mount Polley mine tailings spill, British Columbia, Canada

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On the 4^{th} August 2014 a tailings impoundment failure at the Mount Polley gold and copper mine in British Columbia, Canada, released approximately 25 million m^3 of solid and liquid waste into Hazeltine Creek, Quesnel Lake and Polley Lake. The sheer volume of the tailings released caused Haseltine Creek channel to expand from 2m to over 25m in width and Polley Lake water level to rise by 1.7m. The spill also removed trees in a 900 km^2 corridor either side of Hazeltine Creek. Local residents and government officials have expressed serious concerns regarding the potential long-term effects on regional biodiversity, water security and to the livelihoods of First Nation communities.

Among impoundment failures, the Mount Polley disaster is unique in that the solid tailings contain an unusual mixture of metal contaminants (arsenic, copper, gold, manganese, nickel, lead, vanadium). As particulate matter is the principal carrier of metal contaminants, the spilled tailings may reside in the regional soils and sediments for 1000s of years serving as a secondary source of pollution. The environmental risk posed by the spilled tailings is compounded by the location of the spill in a mountainous forested catchment, affected by severe winters with prominent spring snow melts that have the potential to remobilise very large quantities of spilled tailings. No data currently exist on the short- to long-term behaviour of these tailings in soils and sediments and the effects of the clean-up operations on their behaviour in this type of river environment.

In this study, we adopt a multidisciplinary approach to determine the environmental and geomorphological impacts of the tailings spill. We have two specific objectives. (1) The physicochemical speciation and geochemical stability of spilled tailings will be characterised in surface and hyporheic sediments using bulk chemistry, mineralogical (XRD and SEM) and speciation methods (sequential extractions, electron microprobe analysis, XAS). (2) Pre- and post-remediation geomorphological assessments will use unmanned aerial vehicle (UAV) photographic surveys and ground-based topographic surveys to (i) establish the efficacy of remediation efforts in stabilising Hazeltine Creek channel and (ii) quantify the physical remobilisation of tailings during the spring snowmelt.