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Comparing the composition and metal content of Mt Polley mine tailing deposits and natural sediments in Quesnel Lake, British Columbia

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On 4 August 2014, the Mount Polley gold and copper mine tailings pond breached, releasing ∼25 million cubic metres of contaminated and potentially toxic waste water and solids into the Quesnel watershed in British Columbia, Canada. The water and solids, which contained metals including copper, arsenic and selenium, flooded the nearby Polley Lake before scouring vegetation and overburden material along the Hazeltine Creek, widening its channel from its natural 1.5 m to between 35 m and 185 m, reaching about 500 m in width where it joined Quesnel Lake. The Quesnel watershed is an ecologically important region as it is one of North America's most productive rearing regions for sockeye salmon, but also provides a vital habitat for coho salmon and bull trout, which are listed as species at risk by the federal Committee on the Status of Endangered Wildlife in Canada.

The surface area of Quesnel Lake is ∼266 km2 and the tailings deposit which was contained to the west basin of the lake was estimated as being ∼5 km2 and undulating, up to 10 m in height. In the months following the spill the west basin of Quesnel Lake remained highly turbid as fine particles from the tailings and surficial materials settled slowly. Increased turbidity and elevated sediment-associated metal concentrations were also observed in the outlet river in the fall of 2014 and during the winter period of overturn. Efforts to assess the impact of the spill on Quesnel Lake have focused on the physical limnology, the driver of sediment re-distribution, as well as the movement and quality of the fine sediment and the metal content of the biota. Weekly sampling of bulk suspended sediment in the Quesnel River downstream of the west basin indicates that the sediment copper concentrations and loads increase during the lake overturn and freshet periods respectively. This pattern of elevated (as compared to background sediment) copper in the river has continued from the spill in 2014 through to 2017.

In July 2016 a slo-corer was used to collect surficial materials from the area of the deposit (6 impact sites), the distal regions (8 halo sites), and 4 undisturbed sediment core sites. The slo-cores, ∼50 cm long, successfully retained the surface structure which provided visual evidence of the sediment-water interface conditions. The cores were sub-divided and the sediment was analysed for metal concentration, particle size, organic matter and mineral magnetics. The results of the down-core metal analysis were compared to metal concentrations in samples of tailings that were analysed immediately following the spill as well as values of background lake sediment. The down-core concentrations were also used to refine the identification of the undisturbed and halo zones. Several of the impact and halo cores were observed to be unconsolidated at the surface suggesting the material was available for remobilization. This work is useful for assessing the medium to longer environmental impacts of this major industrial disaster.