DISTRIBUTION OF SEDIMENT-ASSOCIATED METALS IN A RELATIVELY PRISTINE WATERSHED FOLLOWING THE CATASTROPHIC FAILURE OF A MINE TAILINGS STORAGE FACILITY IN BRITISH COLUMBIA, CANADA

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Introduction

On August 4th 2014, the tailings storage facility at Mount Polley gold-copper mine in British Columbia, Canada, failed releasing 25 x 10^6 m^3 of contaminated water, tailings and scoured overburden into the local watershed (~11,500 km^2), which is an important habitat for salmonids and other aquatic and terrestrial species. Most of this material was discharged into Quesnel Lake, one of the largest (262 km^2) and deepest (>550 m) lakes in the province. The coarsest material was deposited at the bottom of the lake but the finest material (mean d50 of ~1 µm) remained in suspension and moved both up-lake and down-lake due to the physical behaviour of the lake (e.g. seiching and overturn; Petticrew et al., 2015).

Methods

Samples of the sediment deposited in the bottom of the lake were collected using an Eckman dredge and of the fine sediment in the water column using a continuous-flow centrifuge (CFC). Samples of the sediment exported to downstream Quesnel River were collected using a CFC, a time-integrated sampler and a resuspension method to collect the fine sediment storage in the channel bed. We have also collected samples of the biota including biofilms and zooplankton.

Results

The sediment deposited in the lake and transported in Quesnel River was enriched in several metals including As and Cu. Typically values decreased with increasing distance from the tailing storage facility, although values for Cu were considerably greater than national sediment quality guidelines (Probable Effect Level (PEL) = 197 mg kg^{-1}), exceeding 500 mg kg^{-1}in several places with values 800 mg kg^{-1} closer to the impoundment breach. The downstream export of metal-enriched sediment from the lake to Quesnel River was controlled by lake turnover and the annual freshet, thus there have been defined periods of sediment and metal transport and storage in the river and these effects continue to the present day. After the spill, As and Cu values in river sediment reached ~75 (PEL = 17 mg kg^{-1}) and ~400 mg kg^{-1}, respectively, and have declined over time. Samples of the biota collected from this lake–watershed system suggest that metals maybe entering the food web.

Conclusion

The Mount Polley spill represents one of the worst mining disasters in Canadian history. The effects on the Quesnel watershed have been widespread, including the dispersal of contaminated sediment up-lake towards sensitive salmonid-spawning habitats and down-lake to the community of Likely and export into Quesnel River, which feeds the Fraser River. Much of the material released from the spill remains at the

bottom of Quesnel Lake. The long-term impacts of this spill on the aquatic and terrestrial ecosystems are uncertain. Our on-going work will contribute to the understanding of these ecosystem effects.

References

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