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Transfer of sediment-associated metals downstream of abandoned and active mining sites in the Quesnel River catchment, British Columbia

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To examine the downstream transfer of sediment-associated metals, samples of bed sediments and suspended sediments were collected from small streams draining an abandoned hydraulic gold mine and an active open cast copper mine in the Quesnel River catchment, BC, Canada. In addition, sediment from a control site with no apparent upstream contaminant sources was sampled. The samples included bulk suspended sediment samples collected using a time-integrated suspended sediment sampler (n = 5), bulk bed sediment samples collected using the resuspension method (n = 24), and depth profile samples (n = 49). The samples were sieved through a 63 μm mesh sieve and the fraction $<$63 μm was analysed for metal content by ICP-MS after aqua regia digestion. Local background concentrations were estimated by means of linear regression of the metal concentrations on the aluminium content of the control site samples and the deeper, uncontaminated depth profile samples. Metal enrichment ratios (ER) were then calculated by dividing the actual metal concentration by the regression prediction of the background metal concentration. The bed sediments (BS) and suspended sediments (SS) in the stream draining the active copper mine are enriched in Se (ER_{BS} = 3.5; ER_{SS} = 7.2), Mn (ER_{BS} = 3.5; ER_{SS} = 5.5), Cu (ER_{BS} = 1.9; ER_{SS} = 2.5), and Hg (ER_{BS} = 1.5; ER_{SS} = 2.0), whereas the sediments in the stream draining the abandoned gold mine are enriched in Pb (ER_{BS} = 18.5; ER_{SS} = 7.7) and Ni (ER_{BS} = 3.3; ER_{SS} = 2.9). In the stream draining the active copper mine, the ERs for the suspended sediments are larger than those for the bed sediments. This suggests that in this stream, the metal enrichment in the bed sediments will likely increase in the future due to continued supply and deposition of metal-enriched sediment. In contrast, the ERs for the suspended sediments are smaller than the ERs for the bed sediments in the stream draining the abandoned gold mine. This would imply that in this stream, the transfer of metal enriched sediments from upstream sources has declined and that the metal enrichment is likely to decrease over time.