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Assessment of diffuse heavy metal pollution, mass transfer and flows at a gold mining site within the Lake Baikal Basin

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The flux, transfer and accumulation of heavy metals in aquatic systems pose a potential danger to the ecosystem at various scales, due to their toxicity and non-destroyable nature. Mining and ore excavation can cause heavy metal pollution of both local and downstream water systems, including groundwater sources. The Zaamar Goldfield, located in the upper Lake Baikal Basin (Mongolia), is an example of an extensive gold mining site, which significantly contributes to downstream increases in riverine concentrations of heavy metals, both in dissolved and suspended phases. However, the placer mining area is large and the pollution is diffuse by nature. Due to lack of detailed monitoring, it is unclear how the pollution is transported from the mine tailings to the river. There are several potentially important pathways, such as mobilization of bank sediments, in-stream dissolution from metal-rich suspended/bottom sediments, and through polluted groundwater.

We here aim at estimating diffuse mass flows from the source zone to the river, in addition to riverine mass flows. Additionally, the behaviour of heavy metals under varying geochemical conditions (such as pH) is investigated, to be able to understand the solubility of various heavy metals and their partitioning between particulate and dissolved phase.

We base our analysis on on-site hydrogeochemical field campaigns. These include concentration measurements in different media (groundwater, waste ponds, ditches, river water, suspended sediments, and bottom sediments). Runoff estimations from the site as well as solubility calculations are also main analytical methods.

Results show a net increase in both dissolved and suspended riverine mass flows over the Zaamar site. Concentrations in the deep groundwater system are generally in the same order of magnitude as river concentrations, which suggest important inputs of dissolved heavy metals to the river through groundwater flows. The input of dissolved concentrations are important, not just for the local environment, but also for the pollution of downstream regions, since dissolved heavy metals can be transported over long distances. It is thus of further interest to study the local sources of pollution and their potential transboundary impacts on Lake Baikal and its delta.