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Hydrogeology and colloids in a peatland affected by mine dewatering: field and modeling study

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Mine dewatering can alter hydrological conditions in adjacent peatlands, with possible consequences on geochemical behavior of colloids, dissolved organic carbon (DOC) and trace metals (TM) in its groundwater. This study investigates how dewatering associated with the Akasaba West mine, an open-pit operated by Agnico Eagle, affects colloid-mediated TM geochemistry in a boreal peatland located approximately 15 km southeast of Val-d'Or, within the Bourlamaque river watershed (Québec, Canada). Hydrological conditions have been continuously monitored since 2019 using eighteen piezometers installed across the peatland. This monitoring allows a comparison between pre-dewatering conditions and changes observed after the beginning of the mine dewatering in 2023. Physicochemical parameters and geochemical data collected during field campaigns between 2019 and 2025 were used to document the mobility of DOC and TM within the peatland. Additional tests were conducted to assess the potential influence of suspension effects on pH and ORP measurements. Sequential ultrafiltration (0.45 μm, 100, 30, 10 and 3 kDa) indicates that lanthanides, iron and aluminum are predominantly associated with colloidal size fractions, while the truly dissolved phase (<3 kDa) remains minor. DOC characterization, supported by UV absorbance at 254 nm, E4/E6 ratios, and SUVA indices, provides additional information on the nature and distribution of organic matter across size fractions, indicating a comparable contribution of colloidal and truly DOC in the studied waters. By combining six years of field monitoring with numerical modeling and experiments, we explore the implications of mining-related hydrological perturbations on colloid-associated TM geochemistry and transport.