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Baseline Ecotoxicity of Waters from a Pristine Creek on Ultramafic substrate (Pluhuv Bor, Czechia)

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Ultramafic environments (UME) have naturally high concentrations of nickel (Ni) and chromium (Cr). In 2030, more than 60% of the total world Ni production is expected to originate from mining in UME [1]. Pristine UME can host healthy aquatic communities adapted to low levels of macronutrients and high levels of potentially toxic elements. However, understanding the potential baseline ecotoxicity of ultramafic waters to naïve organisms can provide valuable information for sustainably planning anthropogenic activities to be carried out in UME.

Pristine ultramafic waters were collected in the Pluhuv Bor creek (PLB, Czechia) on several sampling occasions between 2019 and 2023. Filterable [Ni] and [Cr] were 34–194 µg/L and of 23–40 µg/L, respectively; above known thresholds of potential ecotoxicological concern. Under normal to high flow conditions, colloidal Ni and Cr accounted for more than 70% of filterable concentrations. Truly dissolved concentrations were below the corresponding ecotoxicological thresholds for Cr, but not for Ni. Chromium speciation in filtered waters using IC-ICP-MS showed a co-occurrence of Cr(VI) and Cr(III). Synchrotron analysis suggested that most colloidal Cr occurred in the trivalent state.

Using standardized laboratory procedures, waters from PLB did not affect the growth of the freshwater alga *Raphidocelis subcapitata*. Spiking of PLB waters with Cr(VI), Cr(III) and Ni salts showed that 450 µg/L Cr(VI) or Cr(III) and more than 225 µg/L Ni were necessary to reduce algal growth. These concentrations exceeded by 4- to 8-fold the corresponding values obtained in synthetic laboratory media. On the contrary, waters from PLB negatively affected the swimming behavior and growth of the crustacean *Daphnia magna*. These effects may be linked to the presence of a pool of bioavailable truly dissolved Ni, although ingestion of Ni-and Cr-bearing colloids may contribute to the observed biological responses. Ecotoxicological approaches can help in establishing the possible baseline ecotoxicity of pristine ultramafic waters, thus contributing, for example, to develop responsible mining practices and set realistic restoration goals during the decommissioning phases.

[1] IEA (2024), Global Critical Minerals Outlook 2024, IEA, Paris