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Mining is not the major source of aqueous metals in all affected river waters: The example of the Itogon catchment, Philippines

KAREN A HUDSON-EDWARDS[1], EMMA BILES[2], THOMAS J COULTHARD[3], PATRICK BYRNE[2], JENIELYN PADRONES[4], KIM BRYAN N CABRERA[5], DECIBEL V. FAUSTINO-ESLAVA[5], FRANCIS IAN P GONZALVO[5], JUSTINE PERRY T DOMINGO[6], LAURA QUICK[6], GRIGORIOS VASILOPOULOS[3], CECILIA TORTAJADA[6] AND RICHARD D WILLIAMS[6]

[1]University of Exeter
[2]Liverpool John Moores University
[3]University of Hull
[4]University of the Philippines, Los Baños
[5]University of the Philippines Los Baños
[6]University of Glasgow

Globally, mining activities can cause metal contamination of waters in host catchments through direct discharge of effluents and wastes and through chemical interactions between waters and deposited mine wastes. Thus, it is often hypothesized that mining is the main cause of elevated metal concentrations in such catchments. This hypothesis was tested in the Itogon catchment, Benguet, Philippines by sampling waters downstream of large- and small-scale mining and processing operations, and in sites that were apparently unaffected by mining. Analysis of the data suggests that the major sources of most metals were geothermal springs rather than mining inputs. Geothermal springs accounted for elevated filtered aqueous concentrations of As, Cu, V, Li, B, Rb and Cd, whereas mining inputs accounted for elevated filtered aqueous concentrations of Cu, Zn and V. Geothermal-related Cu and V river water concentrations were equal to, or greater than, mining-related concentrations of these elements. Mixing models using REE data were used to determine the relative proportions of geothermal and mining inputs. This study highlights the necessity to consider all possible natural and anthropogenic (including mining) sources of metals when designing contaminant remediation and management strategies.