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Assessment of heavy metals contamination in Mamut river sediments using sediment quality guidelines and geochemical indices

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Abstract This paper describes the concentration of selected heavy metals (Co, Cu, Ni, Pb, and Zn) in the Mamut river sediments and evaluate the degree of contamination of the river polluted by a disused copper mine. Based on the analytical results, copper showed the highest concentration in most of the river samples. A comparison with Interim Canadian Sediment Quality Guidelines (ICSQG) and Germany Sediment Quality Guidelines (GSQG) indicated that the sediment samples in all the sampling stations, except Mamut river control site (M1), exceeded the limit established for Cu, Ni, and Pb. On the contrary, Zn concentrations were reported well below the guidelines limit (ICSQG and GSQG). Mineralogical analysis indicated that the Mamut river sediments were primarily composed of quartz and accessory minerals such as chalcopyrite, pyrite, edenite, kaolinite, mica, and muscovite, reflected by the geological character of the study area. Enrichment factor (EF) and geoaccumulation index (I_{geo}) were calculated to evaluate the heavy metal pollution in river sediments. I_{geo} values indicated that all the sites were strongly polluted with the studied metals in most sampling stations, specifically those located along the Mamut main stream. The enrichment factor with value greater than 1.5 suggested that the source of heavy metals was mainly derived from anthropogenic activity such as mining. The degree of metal changes (δ_{fold}) revealed that Cu concentration in the river sediments has increased as much as 20 to 38 folds since the preliminary investigation conducted in year 2004.

Keywords Geoaccumulation index · Enrichment factor · River · Pollution · Heavy metal · Mineralogy

Chin Yik Lin will be designated as corresponding author and will handle correspondence at all stages of refereeing and publication, also post publication.

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Introduction

Mining is considered as a significant anthropogenic source for heavy metals pollution in the environment (Galan et al. 2003; Canovas et al. 2007; Gandy et al. 2007). Elevated concentrations of heavy metals are often found in the vicinity of disused metalliferous mines due to the dispersion of dissolved and particulate mine wastes. These wastes are capable of contaminating adjacent agricultural soils, food crops, and aquatic