Concentrations of trace elements in superficial lake sediments before and after metalliferous tailings dam failure (Republic of Macedonia)

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One of the greatest problems concerning environmental pollution arises from mining activities and the processes of extracting metals from ore. Large affects on the environment often occur when mining accidents happens. The most common accidents are tailings dam failures and they can cause huge environmental impacts. In past 70 years, numerous incidents involving operating tailings dams have occurred. One of these major environmental disasters occurred in the eastern Republic of Macedonia. On 30 August 2003, part of the Sasa mine tailings dam collapsed and caused an intensive flow of tailings materials through the Kamenica River valley. The estimated height of the tailings flow was around ten meters and the length of the flow was approximately 12 km. Between 70 000 – 100 000 m^3 of tailings material was discharged and spread through the Kamenica River valley, down to the city of Kamenica into Lake Kalimanci. Therefore, a geochemical study of the superficial sediments of Lake Kalimanci in the eastern part of the Republic of Macedonia was carried out to determine their elemental compositions before and after accident in 2003, and to evaluate the pollution status of lake sediments before and after the accident by employing an enrichment ratio (ER) and index of geoaccumolation (I_{geo}). The trace element contamination in superficial lake sediments was studied to assess the effects of metalliferous mining activities. The mean concentrations of trace elements for years 2001-2007 are [mg/kg]: Co 17-20, Mo 1.5-3.0, Cu 150-480, Pb 2900-7400, Zn 3600 -10100, Ni 27-47, As 48-64., Cd 28-66, Ag 1.9-6.5, Au 0.01-0.02, Sb 1.5-1.9. ER presents the impact of the mining activity on the lake before and after the accident. According to average values of ER the superficial sediments in Lake Kalimanci are, after the accident, extremely severely polluted with lead, zinc, cadmium and silver and have very severe enrichment with arsenic. Use of the calculated Igeo indicates similar conclusions, with the difference, that next to lead zinc, cadmium and silver it shows that the superficial lake sediments are also very strongly polluted with arsenic. Although all the studied elements also occur within minerals of the surrounding magmatic and metamorphic rocks and may contribute to sediment loading through weathering, the main reason for the substantial increase of elements after year 2003 is ascribed to the Sasa tailings dam failure in 2003 and further metalliferous mining activity in the vicinity of the Lake Kalimanci.

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