

Chemical characteristics and heavy metal mass flux of an Armenian river in a mining area

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In Armenia, a serious heavy metal problem exists in some areas due to decades of mining activity and the operation of mining related industries, based on a regularly framework of the former Soviet Union with low or absent environmental standards. The Armenian government and local authorities have acknowledged this problem and put hydrochemical river monitoring programs into force. Often, the data (ions, metals) from those programs are not investigated in detail. In this research we analyzed the heavy metal (HM) databases for Cr, Cu, Mn, Ni and Zn from rivers in Armenia for the period 2004-2008. Basic statistical analyses (min, max, median, average and potential outlier) were performed for 13 stations after a plausibility check of all data. The HM mass flux for Cr, Cu, Mn, Ni, Zn was calculated using hydrological databases for the catchment-system of the rivers Pambak-Debed (Northern Armenia), which was awaited to be strongly influenced by mining activities. The analyzed river gauges were up- and downstream of mining sites (2 stations upstream, 1 downstream), offering the possibility to investigate the quantitative influence of mining activities into the rivers.

The results showed that the 13 Armenian rivers studied have a median concentration of Cr = 0,4 - 0,8 $\mu\text{g/l}$, Cu = 2 - 13 $\mu\text{g/l}$, Mn = 17 - 53 $\mu\text{g/l}$, Ni = 0,7 - 1,3 $\mu\text{g/l}$ and Zn = 17,5 - 38,1 $\mu\text{g/l}$ (for all HMs $n > 500$ cases). A comparison with HM concentrations in river water in Central Europe showed that armenian rivers are usually in the same order of magnitude. The scattering of the HM concentration in the Armenian rivers was high (high standard deviation) before 2007 and seemed to become more evenly distributed until 2008. The mass flux of HM with high geogenic background concentration in the Pambak-Debed-system was usually increasing downstream of mining areas (more than a factor of 2). For some HM (Cr, Cu) an increase of the mass flux since 2005 could be observed, the total mass flux of all HM studied was decreasing between 2005 -2008 for all 3 stations; the evidence of this findings is not clear. Due to the lack of sediment data it could not clearly be proofed that this increase is solely going back to mining activities.