Geophysical Research Abstracts, Vol. 9, 07549, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07549

Mobility of heavy metals related to mineralogical changes in the mine tailings deposited on the riverside

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In abandoned mines, the weathering of waste rocks and mine tailings produce acid mine drainage and affect nearby soils and hydrologic systems. The grain size of mine tailings are very fine and can be easily removed by flood or wind and deposited far from the locations where those were disposed. If they are deposited on riverside, the weathering will be accelerated by the river water and the heavy metals from the mine tailings will be easily leached out. In the upstream of the Nakdong river in Korea, the red deposits of weathered mine tailings are easily found, which are considered to be removed by flood from the abandoned mines. Most of the ore minerals are weathered but still contain high contents of heavy metals. The chemical forms of heavy metals in weathered deposits are very important due to the possible influence of mobile metals on the quality of river water. We studied the geochemical and mineralogical changes during weathering of deposited mine tailings and their impacts on the rive water. XRD and SEM with EDS were used for the characterization of the weathering products in the tailing deposits and sequential extraction method was used to investigate the geochemical mobility of the heavy metals. Quartz and feldspar with minor amount of mica and pyroxene were main primary minerals identified in the deposits. Secondary minerals such as gypsum, bassanite, goethite, kaolinite, and jarosite were generally identified for the red or brown layers. For the black and grey layers, Mn oxide, which cannot be characterized by only XRD, was identified by EDS. The sources of Mn are probably from Mn-pyroxene which is the main composition of the black layers. From EDS, iron sulfate phases were also detected, which is probably schwertmannite, which may be the intermediate product before being transformed to goethite. Zn, Pb, and As were the three most abundant heavy metals in most deposits regardless of the colors of the deposit layers and they were in the residual forms. Large portions of heavy

metals are also in the fraction adsorbed on the Fe and Mn oxides, especially at the site 1 containing larger amount of Mn pyroxene, indicating the weathering products are very important in fixing heavy metals. Significant contents of metals are also in the exchangeable and carbonate bound fractions, which can be potentially toxic to the organisms in the river.