Geophysical Research Abstracts
Vol. 15, EGU2013-13517, 2013
EGU General Assembly 2013

Toxic element mobility assessment and modeling for regional geo-scientific survey to support Risk Assessment in a European Union context

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The Mine Waste Directive 2006/21/EC requires the risk-based inventory of all mine waste sites in Europe. The geochemical documentation concerning inert classification and ranking of the mine wastes requires detailed field study and laboratory testing and analyses of waste material to assess the Acid Mine Drainage potential and toxic element mobility. The procedure applied in this study used a multi-level decision support scheme including: 1) expert judgment, 2) data review, 3) representative field sampling and laboratory analysis of formations listed in the Inert Mining Waste List, and 4) requesting available laboratory analysis data from selected operating mines. Based on expert judgment, the listed formations were classified into three categories. A: inert B: probably inert, but has to be checked, C: probably not inert, has to be examined. This paper discusses the heavy metal contamination risk assessment (RA) in leached quarry-mine waste sites in Hungary. In total 34 mine waste sites (including tailing lagoons and heaps of both abandoned mines and active quarries) have been selected for scientific testing using the EU Pre-selection Protocol. Over 93 field samples have been collected from the mine sites including Ore (Andesite and Ryolite), Coal (Lignite, black and brown coals), Peat, Alginite, Bauxite, Clay and Limestone. Laboratory analyses of the total toxic element content (aqua regia extraction), the mobile toxic element content (deionized water leaching) and the analysis of different forms of sulfur (sulfuric acid potential)) on the base of Hungarian GKM Decree No. 14/2008. (IV. 3) concerning mining waste management. A detailed geochemical study together with spatial analysis and GIS has been performed to derive a geochemically sound contamination RA of the mine waste sites. Key parameters such as heavy metal and sulphur content, in addition to the distance to the nearest surface and ground water bodies, or to sensitive receptors such as settlements and protected areas are calculated and statistically evaluated using STATGRAPHICS® in order to calibrate the RA methods. Results show that some of the waste rock materials assumed to be inert were found non/inert. Thus, regional RA needs more spatial and petrological examination with special care to rock and mineral deposit genetics.