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Testing contamination risk assessment methods for toxic elements from mine waste sites

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Major incidents involving mine waste facilities and poor environmental management practices have left a legacy of thousands of contaminated sites like in the historic mining areas in the Carpathian Basin. Associated environmental risks have triggered the development of new EU environmental legislation to prevent and minimize the effects of such incidents. The Mine Waste Directive requires the risk-based inventory of all mine waste sites in Europe by May 2012. In order to address the mining problems a standard risk-based Pre-selection protocol has been developed by the EU Commission. This paper discusses the heavy metal contamination in acid mine drainage (AMD) for risk assessment (RA) along the Source-Pathway-Receptor chain using decision support methods which are intended to aid national and regional organizations in the inventory and assessment of potentially contaminated mine waste sites. Several recognized methods such as the European Environmental Agency (EEA) standard PRAMS model for soil contamination, US EPA-based AIMSS and Irish HMS-IRC models for RA of abandoned sites are reviewed, compared and tested for the mining waste environment. In total 145 ore mine waste sites have been selected for scientific testing using the EU Pre-selection protocol as a case study from Hungary. The proportion of uncertain to certain responses for a site and for the total number of sites may give an insight of specific and overall uncertainty in the data we use. The Pre-selection questions are efficiently linked to a GIS system as database inquiries using digital spatial data to directly generate answers. Key parameters such as distance to the nearest surface and ground water bodies, to settlements and protected areas are calculated and statistically evaluated using STATGRAPHICS® in order to calibrate the RA models. According to our scientific research results, of the 145 sites 11 sites are the most risky having foundation slope >20o, 57 sites are within distance <500m to the nearest surface water bodies, and 33 sites are within distance <680m to the nearest settlements. Moreover 25 sites lie directly above the 'poor status' ground water bodies and 91 sites are located in the protected Natura2000 sites (distance =0). Analysis of the total score of all sites was performed, resulting in six risk classes, as follows: <21 (class I, 4 sites), 21-31 (class II, 16 sites), 31-42 (class III, 27 sites), 42-54 (class II, 38 sites), 54-66 (class V, 40 sites) and >66 (class VI, 20 sites). The total risk scores and key parameters are provided in separate tables and GIS maps, in order to facilitate interpretation and comparison. Results of the Pre-selection protocol are consistent with those of the screening PRAMS model.

KEY WORDS
contamination risk assessment, Mine Waste Directive, Pre-selection Protocol, PRA.MS, AIMSS, abandoned mine sites, GIS