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Mass transport of contamination released into surface water by landslide

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Landslide, or mass-failure, of contaminated soil into surface waters represent an overlooked exposure pathway that has not been addressed properly in existing risk assessment methodologies for contaminated soils and sedi-ment. A landslide of contaminated soil into surface water implies an instantaneous exposure of water to the con-taminated soil. In Göransson et al. (2009) environmental risk classified sites were combined with a landslide risk analysis for one part of the Göta älv river, southwest Sweden. The result showed that of 31 potentially contami-nated sites, eight had moderate to high probability for landslide, and of these eight sites, five were classified as having a high or very high environmental risk. The risk for mass-failure as contaminant carrier were later on also identified for other rivers in Sweden (Åkesson, 2010). These findings had not been revealed when data on envi-ronmental risk assessment and landslide risk analysis had been considered separately, and implies that in river systems with slope failure sensitive areas the 'actual' risk can be much higher than environmental risk assess-ments actually suggest.

The release and transport mechanisms can be described as instantaneous release followed by long-term release of sediment. The instantaneous and near-field release of sediment represents the course of event when a landslide rapidly slides into a river, creating an impulse-generated wave. The instantaneous rise of the surface level gener-ates two wave fronts travelling upstream and downstream the river and a run-up on the opposite bank (Pérez et al., 2006). The stirring of soil and sediment by the slide and associated waves generates a large amount of sus-pended matter (SPM). This course of event is rapid and intense and the contaminants are mobilized instantane-ously with the suspended matter. In addition, old contaminants stored in the river sediment may be released as well as contaminants from the bottom sediment and the river bank, which may be eroded due to the changes in the hydrodynamic conditions (Gerbersdorf et al., 2007; Hilscherova et al., 2007). The long-term release and associated impact over long distances takes place when the hydraulic regime returns to normal conditions and the SPM settles in the far field. Long-term release of contaminants refers to erosion of the submarine landslide run-out and the areas where sediment from the SPM pulse has settled.

Mass-transport of contamination in rivers due to landslides is a not yet recognized hazard and the information on consequences is therefore very scares (read zero). In an on-going study, the effect of a landslide with contami-nated soil have been simulated using a 1D solution of the advection-dispersion equation based on a defined con-ceptual model, recorded turbidity data from the Agnesberg landslide in 1993 and contaminant data on the run-out sediments from that slide, and by using site specific data on some contaminants.

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