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Magnetic tracing of material from a point source in a river system

Erwin Appel (1), Zhao Liu (1), Christina Mülller (1), Stanislav Frančišković-Bilinski (2), Wolfgang Rösler (1), and Qi Zhang (1)

(1) Department of Geosciences, University of Tübingen, Germany (erwin.appel@uni-tuebingen.de), (2) Ruđer Bošković Institute, Division for Marine and Environmental Research, Zagreb, Croatia

In fluvial environment, the mechanism of transport, distribution, and fate of contaminants, and the resulting distribution patterns are complex but only limited studied. A case in Croatia where highly magnetic coal slag was dumped into a river for more than one century (1884-1994) offers an ideal target for studying principles of how to capture the magnetic record of environmental pollution in a river system originating from a well-defined point source. Downstream transport of the coal slag can be roughly recognized by simple sampling of river sediments, but this approach is poorly significant due to the extremely variable magnetic properties caused by hydrodynamic sorting. We suggest applying variogram analyses in river traverses to obtain more reliable values of magnetic concentration, and combining these results with modeling of river bottom magnetic anomalies in order to estimate the amount of coal slag at certain positions. A major focus of this presentation is the translocation of coal slag material to the riverbanks by flooding, i.e. the possible identification of flood affected areas and the discrimination of different flood events. Surface magnetic susceptibility (MS) mapping clearly outlines the extent of flooded areas, and repeated measurements after one year reveal the reach of two recent smaller floods within this period by spatial delineation of strong positive and negative changes of MS values. To identify older flood signatures, dense grids of vertical MS profiles were analyzed at two riverbank areas in two different ways. First, by determining differences between depth horizons at the measurement points, and second, by contouring the vertical MS profiles as a function of the distance to the river (area with flat riverbank topography) and as a function of terrain elevation (area with oblique riverbank). Single flood events cannot be discriminated, but the second approach allows to approximately identify the extent of major historical floods which were interrupted by longer periods of less intensive flooding. The so far obtained results suggest that a more detailed magnetic study of this ‘Croatian case’ can contribute to better understanding of material displacement in a river system and how to perform significant sampling of river sediments.