Geophysical Research Abstracts
Vol. 15, EGU2013-1712, 2013
EGU General Assembly 2013

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MAGNETIC PROPERTIES CHANGES DUE TO HYDROCARBON CONTAMINATED GROUND WATER TABLE FLUCTUATIONS

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This study aims to understand the mechanisms and conditions which control the formation and transformation of ferro(i)magnetic minerals caused by hydrocarbon contaminated groundwater, in particular in the zone of fluctuating water levels. The work extends previous studies conducted at the same site.
The study area is a former military air base at Hradčany, Czech Republic (50°37'22.71"N, 14°45'2.24"E). The site was heavily contaminated with petroleum hydrocarbons, due to leaks in petroleum storage tanks and jet fuelling stations over years of active use by the Soviet Union, which closed the base in 1991. The site is one of the most important sources of high quality groundwater in the Czech Republic. In a previous study, Rijal et al. (2010) concluded that the contaminants could be flushed into the sediments as the water level rose due to remediation processes leading to new formation of magnetite. In this previous study three different locations were investigated; however, from each location only one core was obtained.
In order to recognize significant magnetic signatures versus depth three cores from each of these three locations were drilled in early 2012, penetrating the unsaturated zone, the groundwater fluctuation (GWF) zone and extending to about one meter below the groundwater level (∼2.3 m depth at the time of sampling). Magnetic susceptibility (MS) profiles combined with other magnetic properties were analyzed to obtain a significant depth distribution of the ferro(i)magnetic concentration. Sediment properties, hydrocarbon content and bacterial activity were additionally studied. The results show that the highest ferrimagnetic mineral concentrations exist between 1.4-1.9 m depth from the baseline which is interpreted as the top of the GWF zone. Spikes of MS detected in the previous studies turned out to represent small-scale isolated features, but the trend of increasing MS values from the lowermost position of the groundwater table upward was verified. Mineral magnetic parameters indicate that magnetite is responsible for the MS signal which confirms the previous results (Rijal et al., 2010). The so far existing uncertainty of the groundwater level position could be solved. Bacterial activity is studied at particular depth horizons as it is assumed to be responsible for iron mineralogy changes.

References: Rijal M.L., Appel E., Petrovský E. and Blaha U., 2010. Change of magnetic properties due to fluctuations of hydrocarbon contaminated groundwater in unconsolidated sediments. Environ.Pollut., 158, 1756^{-1}762.