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Characterization of the plant availability of heavy metals in weakly alkaline soils, heavily polluted with Cu, Zn and Cd in SE Georgia

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The Mashavera valley in SE Georgia is characterized by a continental, semi-arid climate. The high agricultural potential of Chernozem-like soils with a pH of 7.1 – 7.5, is limited by water. Therefore the soils are intensely irrigated by a canal system which is supplied by the river Mashavera. Because of insufficient safeguards of metal mining in mountainous catchment areas the river carries a high load of Cu, Zn and Cd bearing mining waste, which contaminates irrigated soils. The high concentrations of heavy metals (HM) lead to impairment of plant growth and an increase of health-damage of local population. In order to characterize the binding forms of the HM, the samples were extracted with aqua regia (total amounts), EDTA (potentially available supply fraction) and NH_4NO_3 (mobile fraction, plant available), according to the regulations of the German Soil Protection Ordinance (BBodSchV, 1999). The results show that a high proportion of HM belongs to the supply fraction. The narrow correlation of this fraction with the mobile and plant available fraction of HM indicates a high long-term risk potential within the food chain. Due to the recent high adsorption capacity of the soils for HM, only a small amount of HM in the mobile fraction was found with proportions of less than 1 % of the total amounts for Cu and Zn, and a maximum of 1.5 % for Cd. Nevertheless, investigations of cereals and vegetable species indicate a high uptake of Cu, Zn and Cd. Electro ultra-filtration (EUF) was applied. The results show much higher (up to >5 times) concentration of this plant available fraction. Especially

the high anode-fraction indicates the existence of soluble organic HM complexes. Obviously the NH_4NO_3-extraction is not suitable for the characterization of the mobile HM fraction in alkaline soils. Originally this method was developed and proven for Middle European neutral to acid soils. The hypothesis that the high pH-level reduces the exchange of adsorbed HM due to volatilization of NH_3 from NH_4NO_3 is under investigation.