The geochemistry of land use change during the Late Holocene in the Istrian-littoral River Basin, Croatia

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The change of land from natural to urban or agricultural cover increases sediment discharge to river ecosystems and can result in change of stream sediment chemistry causing changes of water quality. Therefore, it is important to understand the relationships between land uses, geomorphology, erosion, stream sediments, and the geochemical and mineralogical changes. These are the purpose of this study, focused on late Holocene land use changes in the Istrian-littoral river basin (Croatia). Most of the studied catchments are located within the Palaeogene flysch basin of Istria. A small portion of the catchments is located within Cretaceous limestone covered with terra rossa soils. Since the Middle Oligocene, the surface Cretaceous limestone has been affected by karst processes and weathering which has led to the development of both surficial and underground features. Different types of sediments, polygenetic palaeosols and soils have been formed on the karst bedrock. Forest and agricultural topsoil (0-5 cm) and subsoil (40-50 cm), as well as stream sediments from 59 subcatchments of the Dragonja, Mirna and Raša rivers, were investigated to determine the influence of different soil environments as sources metal species bound to sediments discharged into the mainstreams of the rivers flowing into the northern Adriatic. Generally high concentrations of heavy metals such as Cr, Ni, Zn, Co, V and Mn are found in the Mediterranean cambisols and luvisols of the Croatian coastal region, which are a consequence of the specific conditions of their formation. To estimate the degree of contamination, metal enrichment factors (EF) were calculated for topsoils. Each topsoil concentration was compared with those obtained from subsoil concentration (40-50 cm). Forest topsoils were found to be enriched Pb, Hg, Cd, Mo, and Se. Agricultural topsoils were enriched in Cu and Cd, while As, Ni, Zn while Tl showed no enrichment in the analysed soils. The sediment cores, which were analysed at 10-cm intervals, were used to evaluate past geochemical variability in the studied catchments. The sediment cores showed enrichments linked with mineralogical changed, indicating periods of distinct sediment inputs relating to erosion from sub-catchments with distinct lithology and soil cover. The results indicate that metal contents in stream sediments and sediment cores are closely associated with both the proportions of soil type, land use and the amount of runoff from agricultural and forest areas in the catchments.

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