The Pedogeochemical Map of Emilia alluvial plain (1:250,000 scale)

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Following a pilot study in the area covered by Sheet 181 of 1:50,000 Soil Map, Regione Emilia-Romagna is promoting a pedogeochemical mapping project at 1:250,000 scale throughout Emilia-Romagna alluvial plain. This project, which relies upon accurate geochemical characterization of soil units, covered in its first leg the Emilia alluvial plain, between Tidone and Secchia rivers. Individual soil units were accurately assembled, on the basis of their different maturity, into three major groups: i) soils with high degree of weathering, developed close to the Apennines foothills, ii) soils with moderate degree of weathering, developed on top of Holocene sediments of pre-Roman age, and iii) soils with low degree of weathering, developed on alluvial plain sediments of post-Roman age.

Selection of sampling sites was not performed through regular grids, but finalized to cover the wide spectrum of soil units reported by Regione Emilia-Romagna Soil Map, following the indications of ISO/DIS 19258. A total of about 600 samples were collected at about 300 selected sites by hand-drilling, using a professional equipment. Two different sets of samples were collected at each site, within depths of 20-30 cm and 120-130 cm, respectively. Chemical analyses for determination of total pedogeochemical contents were conducted up to standard indications ISO/DIS 19528 on 120-130 cm deep samples, using X-ray fluorescence spectrometry (XRF). For the estimation of geochemical anomalies, analyses of samples collected within a depth of 20-30 cm were duplicated, using both XRF and inductively coupled plasma mass spectrometry (ICP-MS), with aqua regia digestion.

Detailed fingerprinting of soil units in terms of natural metal contents was used, *in lieu* of simple statistical analysis, as a guide to the construction of the pedogeochemical map. Two separate sheets compose the pedogeochemical map of Emilia alluvial plain: i) the "Map of Pedogeochemical Contents", and ii) the "Map of Geochemical Anomalies". In the former, four concentration classes, identified by different shades of the same colour, are mapped for each metal, and boundaries between classes are calculated on a statistical basis on the whole data set (25th, 50th, 75th percentile concentrations, expressed as mg/kg), following recommendations of ISO/DIS 19258. Spatial metal distribution as a function of sediment provenance is emphasized by a series of boxplots (and related statistical parameters), reflecting sediment contribution from Po River and its tributaries.

The "Map of geochemical anomalies", which provides a reliable estimate of anthropogenic disturbance at 300 sites, was constructed by matching natural pedogeochemical contents against metal concentrations observed within topsoil samples (20-30 cm depth) at the same locations. Metal pollution is expressed using the "Index of geoaccumulation", while soil quality defined through subdivision into seven classes (from unpolluted to extremely polluted soils).

In summary, the Pedogeochemical Map of Emilia alluvial plain at 1:250,000 scale represents a powerful tool which can be used pragmatically: i) to delineate metal distribution as a function of sediment provenance, grain size and soil maturity; ii) to separate the anthropogenic contribution from the pedogeochemical content, and thus identify geochemical anomalies. Specifically, accurate intersection of the "Map of Pedogeochemical Contents" with the "Map of Geochemical Anomalies" enables precise interpretation of spatial metal distribution in soils, and may be of help in risk assessment and for making environmental decisions.