Identifying the role of historical anthropogenic activities on urban soils: geochemical impact and city scale mapping

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Recently, European cities have faced several changes including deindustrialization and population increase. To limit urban sprawl, urban densification is preferred. It conducts to (re)develop available areas such as brownfields. Although these areas can be attractive for housing due to their location (in proximity to the city centre or to a riverside), their soils and subsoils are often contaminated. They are therefore potentially harmful for human health and the environment, and potentially costly to remediate.

Currently, in case of contamination suspicion, depth geochemical characterization of urban soil and subsoil are carried out at site scale. Nevertheless, large redevelopment project occur at quarter to city scale. It appears therefore useful to acquire the preliminary knowledge on the structure and quality of soil and subsoils, as well as on the potential sources of contamination at quarter to city scale.

In the frame of the Ile de Nantes (France) redevelopment project, we considered more particularly anthropogenic deposits and former industrial activities as main sources of contamination linked to human activities. To face the low traceability of the use of anthropogenic deposits and the lack of synthesis of former industrial activities, we carried out a historical study, synthetizing the information spread in numerous archive documents to spatialize the extent of the deposits and of the former activities.
In addition we developed a typology of made grounds according to their contamination potential to build a 3D geological model with a geochemical coherence. In this frame, we valorized existing borehole descriptions coming mainly from pollution diagnosis and geotechnical studies.
We also developed a methodology to define urban baseline compatibility levels using the existing analytical data at depth from pollution diagnosis. These data were previously gathered in a local geodatabase towards with borehole descriptions (more than 2000 borehole descriptions, more than 1800 analyzed samples, almost 100 000 analyzed parameters).

The potential quality of soil and subsoil was spatialized in 2D and 3D on the basis of anthropogenic deposits structure and typology as well as of the potential sources of contamination linked to former industrial activities. Volumes were also calculated to help the developer anticipating the management of excavated materials. Comparison with effective soil and subsoil quality (existing chemical data) shows fairly good anticipation of contamination problems, confirming the interest of spatializing the historical anthropogenic activities to anticipate the quality of urban soil and subsoil and guide city scale mapping. Urban geochemical compatibility levels will be used operationally to enhance the reuse of excavated materials.

A better knowledge of soils and subsoils at depth is very useful to optimize urban redevelopment projects, anticipating contamination problems, and managing excavated materials (e.g. local reuse possibilities, disposal costs etc.). The potential economic, environmental and social consequences render it essential for urban sustainable development. 3D geochemical characterization of soil and subsoil for urban (re)development is an ambitious task. Rarely carried out until now, it needs improved development of acquisition, management, visualisation and use of data.