Methodology for the study of urban soils and classification

Classification of Urban and Industrial Soils in the World Reference Base for Soil Resources (WRB)

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[1]. Introduction

The World Reference Base for Soil Resources (WRB) (FAO 1998) is the internationally-accepted soil classification system, endorsed by the International Union of Soil Science (IUSS), and hence by the International Council of Scientific Unions (ICSU). It is intended for correlation of soil individuals as defined by the pedon concept, and is ideally suited to discussing world soils, their major properties and genesis (Driessen *et al.* 2001). It is not intended for the large-scale mapping necessary in urban areas. The WRB is a two-level classification : 30 reference groups which have major differences in terms of pedogenesis, geography, and use potential. Groups may be defined based mainly on substrate (e.g. Arenosols, Andosols, Leptosols) or on pedogenesis (e.g. Mollisols). They are further divided by a long list of qualifiers : strong expression, intergrades, and weak expression. As many qualifiers as apply to a soil may be used.

Historically, built areas were ignored in soil mapping and in studies of soil formation and behaviour. It is now recognized that these areas are of prime importance to human populations. Another trend is the large increase in reclaimed lands and new uses for old industrial areas. In some countries there are active projects to map such areas, either with locally-developed classification systems or *ad-hoc* names (e.g. Arbeitskreis Stadtböden, 1997). The WRB should be used to correlate local efforts in urban & industrial soil studies, exactly as it is used for rural soils. However, the current WRB was developed from the various national classifications and pedogenetic studies that were skewed in favour of rural soils, so that some of the names that are assigned to urban soils are less connotative than they could be. The aim of this study was to propose changes to the WRB to better classify urban and industrial soils, keeping in mind the intended role and current structure of the WRB.

[2]. Materials and method

We first catalogued the urban and industrial soils by their genesis and current processes, using especially examples from the Ruhr area of Germany and a previous proposal by Burghardt (2002). We then attempted to classify these in the WRB and noted areas where this was not satisfactory, because either (1) the genesis, materials, or dominant process was not considered by the WRB or (2) the resulting grouping did not reflect common properties. We then examined the structure of the WRB with the aim of improving the classification of urban soils while changing the WRB as little as possible. We considered adding a new reference group, expanding the definition of the Anthropic Regosols, or extending anthropogenic qualifiers to groups other than the Regosols. We also considered the role of pedogensis and substrate (Burghardt 1995, Hiller & Meuser 1998) in the WRB.

[3]. Results and discussion

The WRB separates urban soils that are based on natural soils heavily modified by human activities considered as a kind of pedogenesis (the Anthrosols) and those that are from technogenic materials or recently-moved natural materials ; all industrial soils are in the latter group. The latter are further sub-divided by the degree of pedogenesis since deposition, beginning from Leptosols (very shallow or dominated by coarse fragments), Arenosols (sandy), or Regosols (others), and progressing from Regosols to Andosols (ash) or Cambisols and finally to 'mature' groups. Soils from 'anthropogeomorphic soil material' (un-consolidated mineral or organic material from landfills, dumps, mine spoil, dredgings, etc.) are Anthropic Regosols, with four modifiers based on substrate : Garbic, Reductic, Urbic, Spolic.
We present and justify an expanded and re-organised list of substrate modifiers for the Regosols, an expanded definition of the andic and vitric horizons to explicitly include technogenic ashes or glass, the addition of a 'Relictic' modifier for soils whose pedogenetic environment has changed, expanding the Anthropic Regosols to include all raw technogenic soils, including skeletal, sandy, and frozen materials (with Hyperskeletic, Hyperarenic, and Cryic qualifiers), allowing anthropogenic qualifiers in Andosols, Cambisols, a clarification of the definition of continuous hard rock to explicitly include technogenic materials such as pavements, and a clarification of the definition of fluvic soil material to exclude industrial sludges.

[4]. Conclusions

Urban and industrial soils were not a central concern of the WRB, which as a general correlation system is not intended to cover all details important for mapping and land use planning. However, even on small-scale maps it is important to give connotative names that result in meaningful groupings. Under our proposal, the technogenic soils are united in the Anthropic Regosols. For example, sandy and skeletal technogenic substrates share more properties (e.g. nature of leachates), as well as genesis, with other technogenic raw soils than with natural Leptosols and Arenosols, so we prefer to group them in one qualified reference group. It is expected that a small-scale WRB map of an urban area, with the proposed revisions, would show more homogeneous map units and more meaningful complexes than would currently obtain.

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