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Soil and substrate morphology as witnesses of present and former agricultural landscape management

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Water and tillage erosion, combined with the effect of successive regrouping of the land campaigns, have sensibly modified the morphology of cultivated hillslopes. Nowadays, we can still observe over cultivated landscapes various anthropogenic structures (e.g. lynchets) that correspond to former and/or present field limits. The aim of this work is to spatially characterise the geometry of these various structures, and to assess their relation with soil variability.

The 10 ha studied site corresponds to an hillslope located in a small calcareous watershed near Tours in the Parisian Basin (France). Soils are mainly Cambisols (calcaric), Epileptic cambisols (calcaric) and Colluvic cambisols. This watershed is characterised by the presence of many soil accumulation structures and has been submitted to an important regrouping of the lands since the 1960's. The existing structures were accurately located and defined through a topographical analysis (slope, profile curvature...), and then related to past and present field limits using aerial photographies and cadastral maps. Two main morphological structures, deeply marked in the topography, are identified. The most remarkable type corresponds to well developed lynchets located at the lower part of field limits. Secondary structures, less marked than lynchets, are linked to field limits which existed at least since 1836, but that disappeared from the 1960's. These secondary structures look like longitudinal bulges placed perpendicularly to the direction of the main slope.

A soil survey on these two geomorphic structure types has been performed in order to determine their specific geometry. Lynchets are characterised by a large increase in the thickness of soils: from 35 cm at 24 m upslope to more than 120 cm on its top. But, in some cases, the elevation study shows a topographical discontinuity between the top of the accumulation and the field or road below, discontinuity that is more important than the maximum soil thickness observed in the lynchet. This implies that the substrate, which is mostly homogeneous, has been largely excavated below these limits certainly due to repeated tillage operations. Concerning the secondary structures, soil thickness increases slightly from 35 cm at 16 m up- and downslope the former field limit to 70 cm at the maximum of the bulges convexity. However, the slope morphology seems to show larger soil accumulation considering a regular substrate morphology along the hillslope profile. Here too, by combining soil thickness and surface topography, we show that the substrate has certainly been strongly remodelled at these former field limits by tillage erosion. The spatial variability of the various soils types is closely linked to the sequence of structures oriented perpendicularly to the direction of the main slope.

Although the current topography is clearly marked by various structures linked to former and present field limits, it appears that soil thickness is not the only factor explaining these large variations in the slope morphology: long-term agricultural practices, certainly tillage, "shape" the substrate as well. It is thus important to take into account these substrate excavations for sediment budget studies.

The use of tracers such as 137Cs will allow to understand the intensity of these morphological changes at the slope scale within the last decades.