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Are the topsoil structures relevant indicators of alluvial soil evolution ?

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Floodplains contain a wide range of all steps of soil evolution, which are relevant in order to study the initial steps of soil structuring. Alluvial soils exhibit characteristics of both sediment and / or inherited soil deposition, and in situ soil formation resulting in different types of soil structure, especially in the topsoil layers. In calcareous alluvium deposits, the structuration processes of the topsoil are fast resulting in different structures. In this context, our aim is to verify if these topsoil structures, at macroscopic and microscopic scales, are relevant indicators of in situ soil evolution in a carbonate-rich and calcium saturated environment. We hypothesise that along a soil-vegetation stabilisation gradient both macroscopic and microscopic structures of topsoil reflect this in situ soil evolution. Along this evolutionary gradient the type of structure changes and becomes more stable and widespread within the topsoil.

We characterize the topsoil structure in three different vegetation types from the pioneer stage (willow vegetation) on new sediment deposits (carbonate-rich FLUVIOSOLS BRUTS according to the Sound Reference base for soils, 1998) to mature forests (beech, ash, spruce) on stable soils (carbonate-rich FLUVIOSOLS TYPIQUES) at three different altitudes (subalpine to hill levels). In order to evaluate the heterogeneity within each site and between them three replicates are made resulting in a total of 27 soil samples.

At the macroscopic scale, topsoil structure is described based on morphological and macroscopic descriptions (humus form, type and size of structure) as well as structure stability (Mean Weight Diameter, MWD) and water stable macro aggregates (WSA%) according to Kemper and Rossenau (1986). At the microscopic scale, polished slabs (dimension of 7cm X 10 cm and 0.5 cm in thickness) are used to quantify pore space using a morphological approach and 2D image analysis. After binarization of the image, leading to the detection and quantification of the soil porosity, a multi fractal algorithm is applied in order to characterize the pores by the slope value of the regression line between the frequencies and their associated amplitudes. In addition, the pore size distribution is described using moments of the third and the fourth orders applied on the pore cumulative curve (pore size vs frequency). These holistic parameters of the structure can be compared with other evolution indicators (e.g. vegetation stage, soil type, structural stability) and are pertinent to evaluate the stage of the humiferous topsoil evolution. They can be considered as relevant indicators of in situ alluvial soil evolution.