



Calcite newformations in benchmark soils of Catalonia

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Several benchmark soils of mapping units from the Soil Survey of Catalonia, at a scale 1:25 000, were selected for micromorphological analyses, with the objective to elucidate the formation of calcic horizons and related calcitic and non calcitic features of these non-cemented horizons. The soils were chosen in order to reflect a broad range of soil formation processes and land uses (irrigation / dryland). All of them are under a xeric moisture regime and are classified as entisols (xerorthents, xerofluvents), inceptisols (calcixerpts, xerocrepts) and alfisols (haploxeralfs, paleixeralfs).

According to the field descriptions, carbonate redistribution is the main soil forming process occurring in these soils. Carbonatic nodules, soft powdery lime, pseudomycelia, and pendent below coarse fragments were identified as calcitic features in the field. Their identification at macromorphological scale was not enough to understand all the processes related to carbonate dynamics in the soil, since micromorphology revealed different formation processes leading to carbonate accumulation or leaching:

- Carbonate pseudomycelia described in the field consist of pore infillings or coatings of needle-shaped calcite, formed by rapid evaporation of bicarbonated soil solution in pores. They appear only in dryland soils, being absent in irrigated soils. Some of the pseudomycelia described in the field consist of biogenic sparite (queras) due to activity of roots or hyphae that mobilize soil carbonates at a microscale.
- Impregnative hypocoatings or nodules of micritite or microsparite were believed to form either from carbonate-rich watertables or leached from upper horizons.

- Rhizocretionary nodules are related in this study to accumulation of calcite from groundwater tables.
- Carbonate pendants below coarse fragments consist of sparite formed by leaching from upper horizons.

Clay illuviation was identified together with carbonate accumulation in three different conditions:

1. Soil developed on a drained swamp, which evolved to sodic conditions. This soil shows recent clay illuviation related to alkalinity.
2. Clay illuviation as a palaeo character on a calcium carbonate leached soil, that developed an argillic horizon which was later rubified. A recent supply of calcareous material on top of the soil caused the recarbonation of the argillic horizon.
3. Illuviation of mixtures of clay and silt, forming impure clay coatings. This process is observed in some calcareous soils and is not diagnostic for argillic horizons, being attributed to a rapid flow along pores.

Classification as calcic horizons (SSS 1999) was confirmed by micromorphology in all horizons, including those with clay illuviation. Better criteria for field identification of biogenic calcite is necessary in order to distinguish them from non-diagnostic calcitic features, as pseudomycelia. It is proposed that biogenic calcite should be diagnostic for cambic horizons, since its formation is a permanent feature.

The absence of pseudomycelia in the irrigated soils with calcic horizons indicates that they cannot be used as a diagnostic feature of carbonate redistribution.

In general, the field descriptions underestimated the magnitude and importance of carbonate redistribution in the studied soils, which were evidenced by the micromorphological study.