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Interaction between soil formation and geomorphic dynamics along a soil catena in the Turbolo watershed (northwest Calabria, southern Italy)

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This work focuses on the analysis of a soil catena located along a slope in the Turbolo watershed in northwest Calabria, southern Italy. This geomorphological context can be assumed as representative of widespread sites in the same region, as well as of several zones in the Mediterranean area, on the basis of its variegate but common lithological, topographic, pedological and climatic features, on the whole prone to high soil erosion susceptibility. The Turbolo stream is a tributary of the Crati river, covers an area of about 30 km^2 and develops longitudinally from west to east up to about 13 km in length. It originates from the eastern flank of the Coastal Range and ranges from more than 1000 m to 75 m asl. The watershed is developed through Palaeozoic metamorphic rocks in the western sector, where high relief and steep slopes dominate, whereas the eastern hilly reaches are characterised by gentler slopes and terraces cut on sedimentary terrains of Neogene-Quaternary ages. The soil toposequence we analysed consists of six soil profiles in the eastern sector, on a north-facing slope, cut across Pleistocene marine silty clays, comprised between 85 to 140 m asl in elevation and 5 to 20° inclined.

Field observations, chemical-physical data and micromorphological features contribute interesting considerations in the understanding of the interplay between soil-forming processes and geomorphic dynamics. At present, the land is uncultivated with sparse olive trees and is mainly affected by sheet wash and rill erosion, with poor gully incision in places. These processes are presumably promoted by the recent abandon of agricultural crops in the last decade and by the slight local relief of the footslope (about 3 m) above the Turbolo valley-floor, whose main channel occurs less than 100 m far. The selected soil profiles represent loam to (sandy-)clay-loam Inceptisols characterised by accumulation of organic matter (always $> 2\%$ except in one profile) in topsoils, neutral to strongly alkaline reaction, granular to (sub)angular blocky (to prismatic) structure, some vertic properties, poor $CaCO_3$ dynamics, and pseudogley features in deep horizons indicating transient *aquic* moisture regime (seasonally saturated) and fluctuating water-table. The soils consist of variable combinations of most or few of these genetic horizons: Ap1-Ap2-BA-Bw-Bg1-Bg2. The variable juxtaposition of such horizons, along with wavy to irregular, sharp to abrupt lower boundaries and variable thickness of surface Ap horizons (completely lacking in one upslope soil profile of the catena and doubled in the lowermost one), clearly testify for the influence of past agricultural activities, soil erosion and colluviation. On the whole, reworked soil accumulation prevails at the slope bottom, whereas erosion is severer upslope, as also evidenced by the overall decrease of carbonate reaction and total $CaCO_3$ content downslope. This result is consistent with the occurrence of some small carbonate concretions in surface or upper subsoil horizons in the intermediate-upper soil profiles. The micromorphological analysis of thin sections from undisturbed soil samples confirmed the presence of carbonate concretions, hydromorphic features (Fe-Mn segregations and iron-depleted zones), anisotropic clay domains (observed between crossed polars) representing stress features due to vertic dynamics, and highlighted occasional clay coatings emplaced by relict illuviation processes. Moreover, topsoils exhibit variably aerated, highly porous structures with frequent evidence of bioturbation and likely anthropogenic disturbance. Some centimetre-thick surface crusts occur, especially in one soil profile along the lower-intermediate slope segment, where subhorizontal, upward-concave, laminar aggregates separated by sub-millimetric to 1-2 mm thick cracks, were identified. Mercury intrusion porosimetry performed on topsoil samples revealed slight changes in percentages of intra-aggregate microporosity, but very variable pore size distribution and

extremely different permeability.