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Uncomformities, surfaces and soils: integrating pedo-, morpho- and sedimentary stratigraphy

R. Ciampalini (1), M. Benvenuti (2) and S. Carnicelli (1)

(1) Dipartimento di Scienza del Suolo, Università di Firenze, P.le Cascine 15, 50144 Firenze, Italy

(2) Dipartimento di Scienze della Terra, Università di Firenze, Via La Pira 4, 50121 Firenze, Italy

e-mail: stefano.carnicelli@unifi.it; phone +390553288398

This presentation focuses a joint research in sedimentary and soil stratigraphy. Seizing the opportunity of contemporary programs for soil and geological mapping, a joint correlation program was set up in the Cecina catchment in Tuscany, Italy. The aim was to define stratigraphic significance of the paleosols known to be common in this area, and their placement within the revised stratigraphy of widespread Quaternary age formations.

The results pointed out the wide scope for strict integration of Quaternary geological mapping and paleosol investigation.

Joint reconstruction of soil-forming intervals, depositional environments and physical stratigraphy necessarily called into play the Late Quaternary geomorphic evolution of the lower reaches of Cecina river.

The kind of history reconstructed by this research is different from straightforward, classical terracing dynamics. It appears that the main Pleistocene-age soil-bearing surface was produced by reworking of possible aeolian deposits over a pre-existing surface. This last was made up of a moderately dissected broad alluvial fan; moderate erosion allowed preservation of substantial portions of the soil cover.

The trend continued across terminal Pleistocene and Holocene; slow tilting of the whole area generally prevented deep dissection, and mild alluvial processes reworked sediments across, not infrequently on top of older soils.

In this setting, both “true” paleosols and more recent soils could not be used as straightforward surface markers. Most soils were found to be actually built up by geometrical superposition of different soil-forming events, while soil genesis was not necessarily arrested by, often shallow, burial, accurate analysis of observable soil columns was required.

It was found that an integrated approach, with a strong field accent, gave the most useful results. Careful pedogenetical investigation allowed to pinpoint multiple inconsistencies in soil horizon sequences, evidencing the opportunity, and necessity, to discriminate between genetic and sedimentary - geometric horizon sequences. Possible soil characters marking post-burial soil processes were identified, and are proposed as prototype criteria for discrimination.

However, pedological inference was inadequate to locate and understand all unconformity surfaces hidden within “soil profiles”. Observation of physical stratigraphy and depositional facies was paramount in several cases, for two main reasons. First, the best developed soils were not so strongly differentiated according to age. Second, frequent lithological discontinuities were present, due to a diffuse presence of alternating sandy and gravelly layers in the alluvial deposits. It was not possible to just mark such discontinuities as unconformity surfaces, while pedological inference is not always reliable across highly contrasting parent materials. It was then necessary to examine the physical nature of the contact between sediment layers and the kind of depositional environment implied.

In overall terms, this integrated field approach, supported by deeper pedological investigations, such as soil clay mineralogy and soil micromorphology, allowed to propose informal soil stratigraphic units of various ranks. Such units can be consistently correlated with “morphostratigraphic” and straight stratigraphic units. This kind of correlation across the board can lay the foundations for more diversified palaeoenvironmental investigations, that could take full advantage of the fairly extensive and accessible Pleistocene outcrops.