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Anthropogenic processes in the evolution of a soil chronosequence on marly-limestone substrata in an Italian Mediterranean environment

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Abstract

Due to anthropic pressure, many areas of the world are affected by a process of soil "entisolization" that leads to the formation of "anthropogenic soils". In order to investigate Man's role in soil evolution, a survey was carried out in Southeastern Sicily (Italy), where, for years, there have been wide farming areas with anthropogenic soils. A chronosequence of anthropogenic soils in a vineyard area, cultivated for 22 years, was investigated. The first stage of the chronosequence was made by the original soils which, in the study area, had been undisturbed till the 1980's. These soils, classified as Entic Haploxerolls under the American Soil Taxonomy (ST) or Calcaric Kastanozem according to the World Reference Base (WRB) system, were used for almond groves and/or grazing and showed an A–C or A–Bw–C profile. In 1982 these soils were subjected to trenching in order to establish a vineyard and resulted in a complete mixing of the original soil horizons and the formation of soils classifiable as Haplic Xerarents (ST) or Aric Regosols (WRB). After 20 years, in 2002, the vineyard was removed and the surface of the Entisol/Regosol was covered by a 50÷70 cm thick layer of transported parent material, composed of soft "marly limestone". In July 2004 these soils were mixed once again by deep ploughing (~100 cm deep) to establish a new vineyard. These deeply disturbed soils, were surveyed again and tentatively classified. These newly created soils show a double sequence of artificial horizons at an oblique angle to the soil surface. Their complex genesis pattern does not allow their classification as Arents (ST) or Regosols (WRB), so a tentative classification is proposed following both the ST and the WRB rules, as Miscic Geofragmexerants and Geomiscic Anthrosols, respectively.

Keywords: Anthropogenic processes; Anthrosols; Soil chronosequence; American Soil Taxonomy; WRB classification

1. Introduction

Over the last few years man's role in the formation of soil has become a matter of great concern among soil scientists. The spread of industries and urban settlements, the development of infrastructures and mining operations, the introduction of powerful equipment and the intensification of agriculture have resulted in considerable changes of the soil cover over large areas (Dudal et al., 2002). Man's influence on soil has become so incisive that in several soil classification systems the need arose to introduce a new group of soils called Anthropic soils (Hewitt, 1993), Anthroposols (AFES, 1995; Isbell, 1996; Florea and Munteanu, 2000), Anthrosols (FAO/ISRIC/ISSS, 1998; CSTC, 2001), and Antropozem (Němeček, 2001). Also in Soil Taxonomy a new soil Order regarding the so-called Anthropogenic soils will be introduced in 2007 (ICOMANTH, 2003).

The genetic peculiarity of the strongly human-influenced soils together with their features and properties, was shown in several soil surveys carried out in urban areas (Short et al., 1986a,b; Agarkova et al., 1991; Burghardt, 1994a,b), in mining areas (Ciolkosz et al., 1985; Indorante et al., 1992; Haering et al., 2005), in iron and steel production areas (Buondonno et al., 1998) and in agricultural areas (Dazzi and Monteleone, 1999). From a pedogenetic point of view, the construction of soils through physical manipulation of "earthy materials" are catastrophic events that take the soil back to time zero, and the area of the newly created soils is often as large as the area of well developed soils that have been destroyed (Fanning and

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Fanning, 1989). These are the most remarkable effects of the construction of roads and motorways, or of the burial of various kinds of waste.

There are however, examples which are less striking, but just as dangerous for the protection of soilscapes, such as the case of soils created by large scale farming (Dazzi et al., 2004). Although many processes related to long-term agricultural use have deeply influenced the soil properties over a few thousand years, the anthropogenic processes are relatively fast-acting, compared to the natural processes of soil formation (Bryant and Galbraith, 2003) and over the last few years have marked out the main vine-growing areas of Mediterranean Europe (Dazzi et al., 2004; Pla Sentis et al., 2004).

Our work, carried out on a large scale vine-growing area in South-East Sicily (Italy), aimed to: i) illustrate the anthropogenic processes that in 22 years have characterized the evolution of a soil chronosequence on marly-limestone substrata; ii) investigate the structural elements and the main physical, chemical and morphological features of the soils composing the anthro-chronosequence; and iii) propose a tentative classification of the soils created by man at the end of the survey period, using the Soil Taxonomy (Soil Survey Staff, 1999) and the World Reference Base (WRB) (FAO/ISRIC/ISSS, 1998).

2. Study area

The study area is located within the urban limits of Mazzarrone, a small town in the South-East of Sicily, Italy (37.0849° N, 14.5590° E) (Fig. 1). In the late 1970's vineyards spread copiously in the area and produced a large increase in capital income. At present most of the farms in the area are vine growing, favoured also by the climate. The average monthly temperature reaches a maximum of 25.5 °C in August and a minimum of 10.3 °C in January, the average annual rainfall is about 452 mm, so the area is characterized by Mediterranean climate.

2.1. Litho-geo-morphology

From a geomorphological point of view, Mazzarrone's landscape is characterized by a fairly level-morphology (max

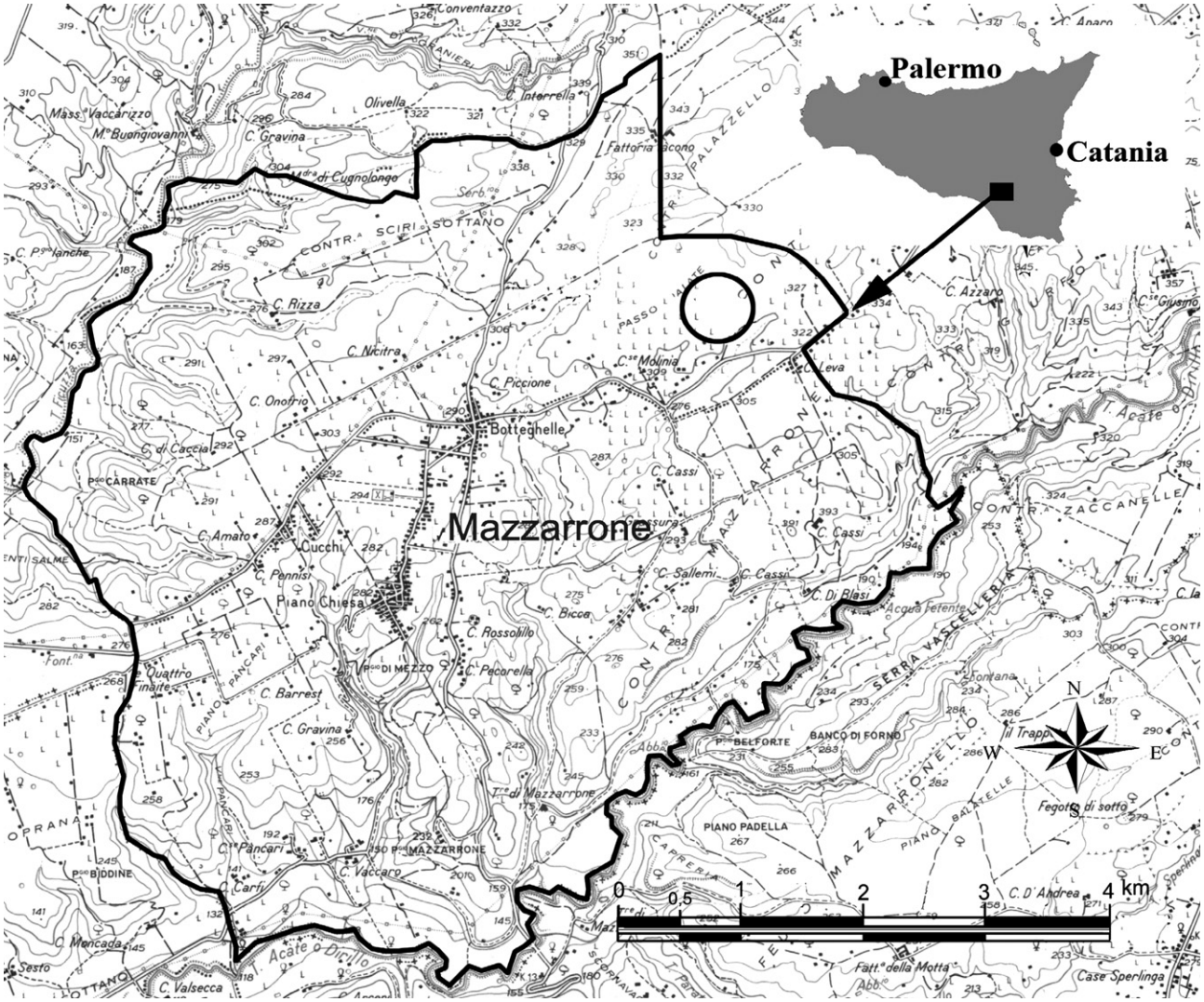

Fig. 1. The study district of Mazzarrone is located in the southeast of Sicily (Italy). The black circle outlines the study area.