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HOLOCENE ENVIRONMENTAL CHANGES RECONSTRUCTED IN TWO ARCHAEOLOGICAL SITES IN CALABRIA (SOUTHERN ITALY): A PEDOLOGICAL AND ANTHRACOLOGICAL PERSPECTIVE

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ABSTRACT: Pelle T. *et al., Holocene environmental changes reconstructed in two archaeological sites in Calabria (southern Italy): a pedological and anthracological perspective.* (IT ISSN 0394-3356, 2011)
A reconstruction of Holocene climatic and environmental changes in two archaeological sites of SW and N-central Calabria (southern Italy) is proposed in this paper, based on a comparison of geoarchaeological, pedological and pedo-anthracological data from soil profiles in the coastal hilly and inland mountainous surroundings of Palmi and Cecita Lake, respectively.

RIASSUNTO: Pelle T. *et al.,* Ricostruzione dei cambiamenti ambientali olocenici in due siti archeologici della Calabria (Italia meridionale): una prospettiva pedologica ed antracologica. (IT ISSN 0394-3356, 2011)
In questo lavoro viene proposta una ricostruzione delle variazioni climatiche ed ambientali avvenute nel corso dell'Olocene in due siti archeologici della Calabria sud-occidentale e centro-settentrionale (Italia meridionale). Essa si basa sul confronto di dati geoarcheologici, pedologici e pedoantracologici relativi ad alcuni profili di suolo nelle vicinanze di Palmi e del Lago Cecita, rispettivamente in un'area collinare costiera e montana interna.

Key words: soil features; pedoanthracology; Holocene climatic changes; human impact; deforestation

Parole chiave: caratteri pedologici; pedoantracologia; cambiamenti climatici olocenici; impatto antropico; deforestazione

The study of Holocene paleoclimate and paleoenvironments represents a topical issue in the recent scientific literature, because of its time immediacy and connection with modern climatic changes. Great interest is focused on exploring cause-effect relationships between climate modifications and cultural dynamics across this period, as well as on estimating their mutual role in changing environments.

This paper deals with the reconstruction of climatic and environmental changes recorded in some Holocene soil profiles from two archaeological sites in Calabria (southern Italy). They were excavated in the surroundings of Palmi and Cecita Lake, located in southwestern coastal and north-central inland Calabria, respectively. An integrated archaeological, pedostratigraphic and paleobotanical (pedoanthracological) approach was applied. In particular, archaeological finds and settlements of different epochs provide useful chronological constraints; mineralogical, physical, chemical, macro- and micromorphological soil features are used as proxies of climatic conditions and man's activities; macroscopic soil charcoal content derived from *in situ* natural or anthropogenic fires represents a reliable detailed indicator (complementary to traditional pollen-based methods) of diachronic vegetation changes on a local scale (e.g. DI PASQUALE *et al.*, 2007).

The excavation close to Palmi (Piani della Corona site) is located on a wide terrace at about 500 m a.s.l., along the southern Tyrrhenian coast of Calabria, characterized by a typical stair-like sequence of Pleistocene marine terraces (e.g. TORTORICI *et al*., 2003). It exposed a pedostratigraphic succession partly described by BERNASCONI *et al*. (2010). Deep argillic (Btb) horizons with variable amounts of clay coatings stacked within pores include late Neolithic settlements and artifacts (about 6500-5800 years BP). They are partly truncated and buried by anthropogenically disturbed surface organic-mineral (Ap) horizons, that display repeated ploughing traces of undifferentiated historical epochs, separated by a late early Bronze Age paleosurface (about 4000-3700 years BP). This surface is in turn affected by marks of archaeological structures, ploughing and various excavations, often filled with organic-rich soil material derived from overlying A horizons.

The archaeological soils from Cecita, a nowadays

artificial lake which occupies a paleo-lake depression in the Sila Massif upland (e.g. SCARCIGLIA *et al*., 2005, 2008), occur on fluvio-lacustrine terraces at about 1130-1140 m a.s.l. Their main features are described by PELLE *et al*. (2010). They span from late Neolithic/early Eneolithic (about 5800-5350 years BP) to Greek (6th to 3rd century BC) and Roman times (3rd century BC – 6th century AD). We focused on late prehistoric and Roman soils, because at present the Greek site is submerged about 6 m below lake level. They all consist of surface A horizons, in places affected by repeated prehistoric to modern ploughing traces (Ap). These organic-mineral horizons may include very scarce clay coatings in pores, which become more abundant in the Neolithic soil, where the A horizon overlies a Bw horizon.

Above soils from both sites partly developed on volcanic ash and display variable Andisol-like features (IUSS WORKING GROUP WRB, 2006; SOIL SURVEY STAFF, 2010) related to formation of some amounts of short-range order minerals. Volcanic parent material mainly consists of very small pumices with rhyolitic composition, identified and analyzed at the microscale using SEM-EDS. Their composition, the pedostratigrahic position and some radiometric dates suggest a provenance from late Pleistocene/Holocene explosive eruptions of the Aeolian Islands (SCARCIGLIA *et al*., 2008; BERNASCONI *et al*., 2010), about 80 to 170 km far to the southwest (from Palmi and Cecita Lake, respectively).

Micromorphological observations performed in thin sections prepared from undisturbed soil samples, highlighted the occurrence of clay coatings in the Neolithic layers of both sites, and their relict (present-day inactive) significance (cf. CATT, 1989), testified by smooth-banded to grainy extinction pattern in crossed polarized light and fragmentation (e.g. FITZPATRICK, 1984; KEMP, 1998). These features, coupled with the dominance of phyllosilicate clays identified by X-ray diffraction analysis (XRD) and Fourier transformed infrared spectroscopy (FTIR) in the same horizons, suggest climatic conditions characterized by high moisture availability and some seasonal contrast, enhanced by a warm-humid climate. Therefore, main soil development may have occurred during the late early-middle Holocene climatic *optimum* (SCARCIGLIA *et al*., 2005, 2008; BERNASCONI *et al*., 2010; PELLE *et al*., 2010). The post-Neolithic soil horizons (Roman age at Cecita and undetermined at Palmi) show more abundant short-range order minerals than phyllosilicates (XRD, FTIR and geochemical parameters) and no to very rare clay coatings, that suggest climatic changes towards overall prolonged humid (and probably cooler) conditions. The lack of a distinct and continuous chronological record for the post-Neolithic soil horizons from Palmi and Cecita dos not permit a detailed reconstruction and interpretation of late Holocene climatic changes and their extent in these sites. However, above humid/cool conditions during the late Holocene could be related to repeated phases of higher lake levels documented from middle Europe to central Italy around 2700-2500, ~1800 and 1300 -1000 years BP (MAGNY, 2004; GIRAUDI, 2007). Moreover, between the distinct climatic phases identified during and after the Neolithic, a severe land degradation is recorded. It is testified by human impact (deforestation, cultivation and other activities) and soil erosion. Pedoanthracological data from Cecita give good evidence of it. In fact, charcoal fragments from Neolithic soils are dominated by deciduous oak-forest (mainly *Quercus* deciduous type), whereas a transition to a mountain pine forest dominated by *Pinus sylvestris* group (probably *Pinus laricio*) is recorded in the Roman soils. Preliminary soil charcoal data from Palmi suggest a stability of a deciduous forest cover dominated by oaks. In fact, this *taxon* is present both in the Neolithic and in the post-Bronze Age horizons. Finally it is noteworthy the presence of *Abies alba,* belonging today only to mountain vegetation, identified in a Neolithic horizon. Both the data concerning the silver fir and post-Bronze oaks need to be dated with AMS technique.

It cannot be ruled out that also some effects of climate drying (one or more episodes known in the literature; e.g. SAURO *et al*., 2003; MAYEWSKI, 2004; DI DONATO *et al*., 2008; DI RITA & MAGRI, 2009) could have enhanced land degradation after the Neolithic climatic *optimum*. Neither the hilly coastal site of Palmi nor the inland mountainous one of Cecita Lake seem to register clear evidence of it, although diminished to absent clay illuviation in younger soil horizons could be also related to such climatic changes.

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