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Lateglacial and Holocene paleoenvironments: insights from buried black soils in Emilia (Northern Italy)

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In Lateglacial and Holocene stratigraphic sequences investigated in the eastern Po Plain (northern Italy), close to Bologna, black horizons are sometimes observed. Earlier paleo-environmental studies concerning this area have not interpreted origin and composition of these black buried horizons. In order to test this hypothesis, we are studying three stratigraphic sequences from Salara (SAL), San Mamolo (SMA) and Marzabotto (MRZ). To emphasize morphological characteristics (e.g., colour and thickness), a pedo-stratigraphic criterion was adopted for each layer observed in all the three stratigraphic sets. Totally, the horizons found are: 15 for SMA (two black), 14 for SAL (two black) and 6 for MRZ (one black); for each layer was sampled 1 kg of soil for the next investigations. Afterwards, the samples were treated in laboratory to carry out i) geochemical analyses of major, minor and trace elements, by XRF-WD Spectrometry, ii) carbon speciation in Organic (TOC) and Inorganic (TIC) fractions, by Soli TOC Cube (elemental analyser working in temperature ramp mode), iii) isotopic ($\delta^{13}\text{C}$) analysis, by EA-IRMS System. XRF analysis was necessary to understand how the black horizons are enriched or depleted in major, minor and trace elements compared to the other layers of the stratigraphic sections. Black horizons are enriched in Al_2O_3 (>14.95 wt%), Fe_2O_3 (>5.05 wt%), K_2O (>2.27 wt%), TiO_2 (>0.69 wt%), Ce (>45 mg kg^{-1}), Cr (>148 mg kg^{-1}), V (>91 mg kg^{-1}), and depleted in CaO (<4.52 wt%). In the same way, the Soli TOC Cube analyses were useful to make the carbon speciation for all the layers, demonstrating that black horizons are depleted in TIC (<0.87 wt%) with respect to the other layers. Low calcium and TIC in black horizons indicate that these levels are depleted in carbonates. EA-IRMS measurements were useful to understand the nature of black soils and the different climate conditions existing at the time of pedogenesis. $\delta^{13}\text{C}$ has been measured for Total Carbon, TIC and TOC, and the values of black horizons are systematically more negative with respect to the other layers. The resulting values are a proxy of the type of vegetation coverage, reflecting the different proportions of C3 and C4 plants. The extremely negative values of black horizons suggest a prevalence of C3 plants during their formations, supporting the initial hypothesis of a connection with cold climatic periods. During these periods water was more acid thus explaining the paucity of carbonate. Pollen analysis is in progress to constrain this interpretation.