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A neglected - but not negligible – carbon reservoir in the Italian forests: relic charcoal kiln soils.

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Charcoal production in forests is one of the oldest human activities in Italy and the other European countries. Here, 3 thousand years ago civilizations were already used to convert wood into charcoal for energetic and metallurgic purposes. The technique for making charcoal remained substantially unchanged in time: wood piles covered with turf were built in appositely shaped emplacements, and then left to pyrolyse for days under controlled semi-anoxic conditions. This widespread activity lasted until a few decades ago, leaving as legacy a plethora of repeatedly used emplacements where soil shows a thick top layer very rich in charcoal. Despite the high frequency of relic charcoal kilns in the European forests, no studies aimed at accurately determining their C stock to assess their relevance as C sink in forest environment.
In this work, we studied some relic charcoal kilns in a mixed oak forest at Marsiliana, Tuscany, central Italy, where charcoal production was enduring and massive at least since the Middle age.
At Marsiliana, density of charcoal kiln sites was not uniform within the forest areas as it mostly depends on biomass availability. According to the aspect, northerly or southerly, we recognized two main forest areas where kiln sites density ranged between 2 and 3 sites per hectare. In general, the C content in the kiln soils was eight times the one in the surrounding soil, with just one third of the C in the form of pyrogenic C. Hence, natural organic carbon content was significantly higher in the kiln soils. Such a finding confirms that charcoal gives a substantial contribution to the C stock in the kilns but does not fully account for their particular richness in C. It has been thus hypothesized that charcoal is somehow able to stimulate the accumulation of native soil organic matter.
At Marsiliana forest, relic charcoal kilns soils cover less than 0.5% of total surface. Nonetheless, their contribution to the total C stock in the top soil (30 cm) ranged between 2.5% and 15%, that is 1.2% to 4.2% of the C stored in the whole forest ecosystem, including litter, deadwood and above and below biomass. Taking into account the very long residence time of pyrogenic C in soil, charcoal kilns have great environmental significance in terms of climate change mitigation.
The results of this study stress the importance of safeguarding relic charcoal kilns as a significant C reservoir, as well as a precious historical memory of the customs and traditions of past generations.