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# Anthropogenic Charcoal Deposits: Analogues for the Long-Term Functioning and Stability of Biochar in European Soils?

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Anthropogenic charcoal deposits, characterised by thick charcoal-rich soil horizons, offer an invaluable Late Quaternary record of pyrogenic carbon (PyC) additions to soils. A traditional source of archaeological, anthracological and palaeoecological data, the potential contribution of anthropogenic charcoal deposits to soil science and assessment of carbon (C) sequestration is often overlooked. If addition of biochar to soils is to form a key component of a low-C economy, crucial questions must be addressed relating to its longevity and behaviour in the soil environment. With rare exceptions, previous studies have focussed on short-term incubation experiments and field or pot trials, often neglecting important natural soil and environmental processes.

This study addresses these issues by comparing the physicochemical properties of European anthropogenic charcoal-rich deposits, with $^{14}$C ages ranging from $>$ 43 ka to Modern, to native soils (nearby control sites). We will present results from a study of 23 charcoal-rich soil cores, collected from a “Pre-historic” ditch mound, a Bronze Age burnt mound, a Roman furnace, and post-mediaeval and Modern *Meilers,* situated along a climatic gradient from Mediterranean (Southern Italy) to Humid Temperate (South Wales). The ability of charcoal to alter fertility and retain plant-available nutrients was assessed by measuring soil cation- exchange capacity. Retention of refractory C by the charcoal deposits was evaluated from their total organic C (TOC) contents, atomic H:C and O:C ratios, and residues after acid- dichromate oxidation. Picked charcoal fragments were also compared with modern biochars and biomass using: 1) their thermogravimetric recalcitrance ($R_{50}$) indices (Harvey et al. 2012); and 2) attenuated total reflectance (ATR) FT-IR data, to gauge the development of functional groups linked to the long-term oxidation of the particle surfaces. Radiocarbon dating was used to assess the ages of the deposits.

Our study attests to the considerable potential of anthropogenic charcoal deposits as a tool to predict the fate, functioning and C-sequestration potential of PyC in soils on long ($10^2$ – $10^3$yr) time scales, which are inaccessible to field and laboratory experiments. Centuries to millennia after charcoal addition, these charcoal-rich soils have undergone limited environmental degradation and still display significant recalcitrance and C-sequestration potential.