Geophysical Research Abstracts
Vol. 14, EGU2012-12537, 2012
EGU General Assembly 2012
© Author(s) 2012

Assessing the mineralisation of charcoal carbon in temperate soils

PL Ascough (1), E Tilston (2), and M Garnett (3)

(1) SUERC, The University of Glasgow, Rankine Avenue, East Kilbride, G75 0QF, U.K. (philippa.ascough@gla.ac.uk), (2) Crop and Soil Systems, SAC, West Mains Road, Edinburgh, EH9 3JG, Scotland, U.K., (3) Natural Environment Research Council Radiocarbon Facility (Environment), Rankine Avenue, East Kilbride, G75 0QF, UK

Charcoal is pyrolized biomass characterized by its high C content and environmental recalcitrance. Recently 'biochar' has emerged as a concept as a means of long-term C sequestration with a sequestration potential that is comparable with current global anthropogenic fossil fuel emissions (5.5-9.5 Pg C yr-1 and 5.4 Pg C yr-1, respectively). However, charcoal is not a permanent C sink and estimates of charcoal degradation rates vary from the decadal or centennial timescales, with soil residence times in the order of thousands of years. Possible mechanisms of charcoal degradation include biotically and abiotically-mediated transformation and mineralization processes, resulting in a range of products of varying recalcitrance, including CO_2. In soil science the decomposition of organic matter is routinely estimated by measuring CO_2 efflux, but a key obstacle for the quantification of charcoal-derived CO_2 is the accurate and precise apportionment of C sources arising from slow decomposition rates. Moreover, the addition of charcoal to soil can promote decomposition of indigenous soil organic matter and the concomitant increase in CO_2 production does not therefore necessarily demonstrate mineralization of the charcoal C. Radiocarbon (14C) offers significant benefits in this regard as a sensitive technique for C source apportionment. We used the 14C content of CO_2 respired by a surface soil to quantify the rate of charcoal mineralization, thus demonstrating the efficacy and sensitivity of our 14C approach for estimating charcoal degradation. During incubation the variations in charcoal-derived C mineralization are consistent with the loss of more labile components in the charcoal with a maximum of 2.1% of the evolved CO_2-C being attributable to mineralisation of charcoal C. Extrapolation to an annual basis suggests that the loss rate of charcoal C is <1%, supporting the view that rates of charcoal C respiration are slow in temperate woodland soil. Implications for biogeochemical cycling of charcoal C are discussed in context of previous and ongoing work in this field.