



Centennial black carbon turnover observed in a Russia steppe soil

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Black carbon from the incomplete combustion of fuels and biomass, constitutes up to 35% of organic carbon in soils. The controls over its cycling, however, are the least known of all soil carbon constituents. Black carbon has been considered highly recalcitrant and a substantial sink for carbon, however recent laboratory studies have shown that black carbon can be degraded. There have been no tests of black carbon turnover under long-term field conditions nor have total soil black carbon stocks been estimated before. We took advantage of soils known to be sampled 100 years apart (1900, 1997, and 2004) from the same location in a Russian Chernozem reserve, along with known reduction in black carbon inputs after 1900, to quantify stocks and loss rates of black carbon *in situ*. Chernozems, fertile soils rich in organic matter, are among the most black carbon-rich soils globally. Here we show that black carbon (2.5 kg m^{-2}) was degraded in the field over the 100 years, with a stock loss of 25% to 130 cm. The implied turnover time of 160-360 years for black carbon in this soil is three to six times faster than the turnover time for inert carbon in the 2001 report of the Intergovernmental Panel on Climate Change (IPCC). These results show that black carbon cannot be assumed a stable sink of carbon on century timescales. Other mechanisms explaining chemical recalcitrance, if indeed it is a major source of stabilized OC in soil, are needed.