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processes controlling the depth distribution of soil organic carbon

Brian Murphy (1), Brian Wilson (2), and Terry Koen (3)
(1) brian.amaroo@bigpond.com, (2) bwilson7@une.edu.au, (3) terry.koen@environment.nsw.gov.au

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Brian Murphy1, Brian Wilson2 and Terry Koen3.

1 Honorary Scientific Fellow, New South Wales Office of Environment and Heritage, Cowra, NSW 2794, Australia
brian.amaroo@bigpond.com
2 Associate Professor, School of Environmental and Rural Sciences University of New England Armidale NSW 2351 Australia
3 New South Wales Office of Environment and Heritage, PO Box 445, Cowra, NSW 2794, Australia

Knowledge of the processes controlling the depth distribution of soil organic carbon (SOC) has two major purposes:
A. Providing insights into the dynamics of SOC) that can be used for managing soil organic carbon and improving soil carbon sequestration
B. The prediction of SOC stocks from surface measurements of soil carbon.
We investigated the depth distributions of SOC in a range of soils under a number of land management practices tested how various mathematical models fitted these distributions. The mathematical models included exponential, power functions, inverse functions and multiphase exponential functions. While spline functions have been shown to fit depth distributions of SOC, the use of these functions is largely a data fitting exercise and does not necessarily provide insight into the processes of SOC dynamics. In general soils that were depleted of SOC (under traditional tillage and land management practices that deplete the soil of SOC) had depth distributions that were fitted closely by a number of mathematical functions, including the exponential function. As the amount of SOC in the soil increased, especially in the surface soils, it became clear that the only mathematical function that could reasonably fit the depth distribution of SOC was the multiphase exponential model. To test the mathematical models further, several of the depth distributions were tested with semi-log plots of depth v log (SOC). These plots clearly showed that there were definite phases in the distribution of SOC with depth. The implication is that different processes are occurring in the addition and losses of SOC within each of these phases, and the phases identified by the semi-log plots appear to be equivalent to the zones of SOC cycling postulated by Eyles et al. (2015). The identification of these zones has implications for the management and sequestration of carbon in soils.

Eyles, A, Coghlan, G, Hardie, M, Hovenden, M and Bridle, K (2015). Soil carbon sequestration in cool-temperate dryland pastures: mechanisms and management options. Soil Research 53, 349 – 65.