Geophysical Research Abstracts
Vol. 13, EGU2011-2037, 2011
EGU General Assembly 2011

Dual roles of tillage erosion in lateral SOC movement in the landscape

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The fact that the global C budget cannot be currently balanced, and current estimates of agricultural sources and sinks may be inaccurate, may be linked to unaccounted-for erosion-induced changes in soil organic carbon (SOC). The closed landscape with field banks and the open landscape without field banks were selected from two sites located in Jianyang County (30° 26' N and 104° 28' E), Sichuan Province and Zhongxian County (30° 25' N and 108° 11' E), Chongqing Municipality, respectively. In these landscapes, the role of tillage and water erosion was examined using measurements of soil redistribution in relation to 137Cs radionuclide depth-stratigraphy, to elucidate the mechanism of SOC depth distribution in the soil profile and resultant stocks in agricultural landscapes of terraced field systems. Changes in the 137Cs inventory at different landscape positions depend on both 137Cs concentrations of individual subsample layers (5-cm depth slice) and the vertical extent of 137Cs depth distribution in the terrace system with field banks, while the changes are only associated with the vertical extent of 137Cs depth distribution in the terrace system without field banks because of similar 137Cs concentrations of individual subsample layers. The profile shape of SOC depth distribution exhibits notable differences between the upper and lower parts of the terrace in terrace systems with field banks, but no apparent differences were found in the terrace systems without field banks and the SOC profile shape is similar to that of the upper part of the terrace in terrace systems with field banks. It is suggested that SOC depth distribution in these two types of terraced field systems is controlled by different soil erosion patterns. Tillage erosion playing a dominant role in the process of soil erosion within a landscape can increase SOC stocks. However, SOC depletion take place in situations where the two processes of tillage and water erosion are both important and tillage erosion acts as a delivery mechanism for water erosion. We conclude that tillage erosion plays a dual role: enhancing carbon storage at depositional positions, and accelerating carbon depletion through water erosion if it is a key delivery process for soil in the same landscape.

Keywords: caesium-137, SOC stratigraphy, soil redistribution, tillage erosion, water erosion