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Soil aggregates, organic matter turnover and carbon balance in a Mediterranean eroded vineyard

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The carbon cycle is being affected by the human impacts (Novara et al., 2011; Yan-Gui et al., 2013), and one of those is the intensification in the soil erosion in agriculture land (Cerdà et al., 2009; García Orenes et al., 2009). Vineyards also are affected by the human activities (Fernández Calviño, 2012).
Vineyards in Sicily are cultivated on 110.000 ha, 10% of which on >10% slope. Deficiencies of soil organic matter are typical of the semi arid Mediterranean environment especially where traditional intensive cropping practices are adopted (Novara et al., 2012; 2013). These practices in vineyards could lead soil to intensive erosion processes (Novara et al., 2011). The fate of SOC under erosion processes is difficult to understand because of the influence of the erosion impact on SOC pathway, which depends on the different features of the process involved (detachment, transport and/or deposition).
Soil erosion must be considered a net C source (Lal, 2003), as eroded soils have lower net primary productivity (NPP) (Dick and Gregorich, 2004) caused by reduction in the effective rooting depth and all in all determining decline in soil quality. Breakdown of aggregates and soil dispersion expose SOM to microbial/enzymatic processes and chemical soil properties (Dimoyiannis, 2012; Kocyigit and Demirci, 2012). Moreover the light fraction, transported by runoff, is labile and easily mineralized determining CO_2 emission in the atmosphere (Jacinthe and Lal, 2004). Therefore, the carbon pool is lower in eroded than in un-eroded soil scapes and the rate of mineralization of soil organic matter is higher in sediments than in original soil.
In this survey we show a research conducted on a slope sequence of three soil profiles in an irrigated vineyard located in Sambuca di Sicilia, Italy (UTM33-WGS84: 4169367N; 325011E). The SOC content was measured at depth intervals of 10 cm up to a depth of 60 cm in each pedon. Wet aggregate-size fractions with no prior chemical dispersion, were isolated by mechanical shaking of 100 g, air-dried fine earth on a column with sieves of 250 and 63 μm using a Shaker AS 200 Sieve (RETSCH analytical, Haan, Germany) (200-mm sieves, amplitude of 2 cm, frequency of 1.6 Hz and a water flux of 2 litres minute-1). After the physical fractionation, we discriminate three main aggregate-size fractions: >250, 63–250 and <63 μm. Three replicate samples of 5 g of the soil material that we prepared for the fractionation from three different pedons along the slope gradient were incubated at two different depth intervals (Topsoil: 0–15 cm; Subsoil: 35–50 cm). Respiration was monitored during a period of 50 days keeping moisture and temperature constant. Both in topsoil and subsoil layers, particle size distribution in the depositional area shows a decrease of the finest size (<63 μm) respect to the soil in the detachment area. A SOC increase was observed due to depositional processes. Mean Residence Time of SOC strongly decreased in the subsoil particularly in the depositional area corroborating that erosion processes could be a SOC sink. Anyway we should also stress that, considering the estimated “off farm” erosion processes, the carbon budget resulted highly negative.

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