Geophysical Research Abstracts
Vol. 19, EGU2017-17852, 2017
EGU General Assembly 2017

Soil organic matter degradation and enzymatic profiles of intertidal and subaqueous soils

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The interest on intertidal and subaqueous soils has recently arisen because of the climate changes forecasts. The preservation of these habitats represents an important challenge for the future of humanity, because these systems represent an important global C sink since soil organic matter (SOM) on intertidal and subaqueous soils undergoes very slow degradation rates due to oxygen limitation. Publications on SOM cycle in saltmarshes are very scarce because of the difficulties involved on those studies i.e. the interaction of many abiotic and biotic factors (e.g., redox changes, water and bio-turbation processes, etc) and stressors (e.g., salinity and anoxia). However, saltmarshes constitute an unique natural system to observe the influence of anoxic conditions on SOM degradation, because the tide fluctuations on the soil surface allow the formation of provisionally or permanently submerged soils.

With the aim to investigate the quality of SOM in subaqueous soils, triplicates of subaqueous soils (SASs), intertidal soils (ITSs) and terrestrial soils (TESs) were collected in the saltmarshes of the Baiona Lagoon (Northern Italy) and classified according to their pedogenetic horizons. The SOM quality on each soil horizon was investigated by quantifying SOM, total and water-soluble organic carbon (TOC, WSC) and microbial biomass carbon (MBC). Given the contribution of soil enzymes to the degradation of SOM, some enzymatic assays were also performed. Thereafter, soil classification and humus morpho-functional classification were used to join together similar soil profiles to facilitate the description and discussion of results.

Soils were ranked as Aquent or Wassent Entisols, with an A/AC/C pedosequence. SOM, TOC and MBC were statistically higher in A than in AC and C horizons. Among the A horizons, ITSs were those showing the highest values for these parameters (11% TOC, 1.6 mg kg-1 MBC, 0.9 mg kg-1 WSC). These results, combined with the morpho-functional classification of epipedons, reflect the influence of the type of annual biomass depositions on ITSs (i.e. Salicornia europaea), but also the important role of the tide oscillation that promotes the continuous alternation of red-ox exchanges and thus fasten the organic matter turnover in ITSs. On these pedons, invertase was the most effective enzymes (11.6 μmol glucose g-1h-1). Moreover, in SASs and ITSs, most of the activities linked to the degradation of exoskeletons and fungi (e.g. chitinase) increase along the soil profile, probably due to the disrupting effect of water on the soil and to the type of SOM in saltmarshes soils.

By considering the specific activity (enzymatic activity/TOC content), data showed how SASs, ITSs and TESs had different oxidoreductases and hydrolases trends, suggesting a different path and effectiveness of SOM degradation, which probably depends both on the soil hydric regime, and on the different type of organic compounds. A particular increase of catalase and invertase specific activities along the soil profiles, suggests the presence of microaerophilic environment in some saturated AC and C sandy horizons but generally, it was observed a gradual decrease of biochemical alteration of the SOM by enzymatic activities along the soil profile due to the progressive restriction of the edaphic conditions.