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Adsorption on subsoil horizons of dissolved organic matter (DOM) in agrosystems: inputs of fluorescence spectroscopy

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Dissolved organic matter (DOM) reactivity to subsoil horizons according to its genesis and origin has been investigated for its implication in many soil processes. The impact of land-use on the genesis of DOM and its stabilization in the subsoil remain poorly understood in agroecosystems due to the complexity and the multiplicity of involved processes. We aimed in the present study to quantify DOM sorption to subsurface soils from two contrasted different agroecosystems conducted on long term observatories for environmental research (ORE): The ORE-ACBB, site of Lusignan (introduction of leys within arable crop rotations) and the Feucherolles QualiAgro site (an arable soil amended with different organic waste composts). In both sites DOM samples were extracted by deionized water from the top soil horizon (0-28 cm). At Lusignan site, a 5 years temporarily grassland soil previously occupied by cultures (T3) and a 5 years temporarily grassland soil previously occupied by grassland, then removed and allowed to be occupied by 20 years temporarily grassland (T5) were compared with an arable soil (T1). At Feucherolles site, comparisons were conducted between soils amended respectively with a co-compost of sewage sludge and green wastes (SGW), with municipal solid waste compost (MSW), with biowaste compost (BIO) and a non amended control soil (CONT). Batch equilibration experimentations were performed to quantify DOM sorption to horizons subsoil profile for each site. Sorption of DOC was determined by use of the initial mass (IM) linear isotherm approach. Low concentration ranges of DOC extracts as indicated by data field were measured by a Shimadzu TOC-5050 analyzer. Initial extracted and equilibrium DOM after sorption were characterized by the specific UV-absorbance (SUVA-aromatic indicator, L g-1 cm-1) and fluorescence emission-extinction spectra analysis. No significant differences in DOM sorption were observed between subsoil horizons despite this could have been expected from physico-chemical properties such as pH, oxides and clay contents. For each site, sorption of DOM from different origins was approximately similar as indicated by the high slopes of the different linear isotherms. Intensities of fluorescence and derived parameters such as the humic index, HIX or the intensity of fluorescence bands ratio were used to track the change in DOM quality associated to sorption. Fluorescence intensities of equilibrium DOM after sorption reflected a composition similar to the DOM released by the subsoil horizon. Furthermore, the HIX strongly decreased from initial DOM extracts to equilibrium DOM after adsorption. In parallel, the decrease of SUVA index suggested that aromatic compounds were implicated in sorption. Differences in HIX and SUVA variations through the sorption processes were observed between the origins of DOM, especially at Feucherolles site. They may reflect some effects of DOM quality impacted by compost amendments. These results along with initial mass isotherms parameters showed that DOM extracts from the different topsoils had large sorption capacities whatever the subsoil horizon considered. This was explained by low concentration range of DOC used in the sorption experiments and by the relatively high proportion of reactive compounds present in these extracts.