Geophysical Research Abstracts
Vol. 13, EGU2011-13940, 2011
EGU General Assembly 2011

Use of nuclear magnetic resonance spectroscopy for evaluation of soil properties at a riparian-paddock interface

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Nuclear magnetic resonance spectroscopy (NMR) is widely used for quality evaluation of environmental matrices. Among the others, solid state NMR with cross polarization (CP) and magic angle spinning (MAS) setup is applied on systems which are insoluble or poorly soluble in the common deuterated solvents used for liquid state NMR spectroscopy. Based on the magnetization transfer from abundant nuclei (e.g. spin 1/2) having a high gyromagnetic ratio, such as protons, to the less abundant 13C nuclei with low gyromagnetic ratio values, 13C-CPMAS NMR spectroscopy is often applied in environmental chemistry to obtain quantitative information on the chemical composition of natural organic systems such as whole soils.
Riparian zones are the ecotone or critical transition zone between a river's catchment and its channel. Riparian zones favour biodiversity enhancement, provide valuable ecosystem services (e.g. mediation of the flow of energy), water (via surface flows and groundwater), sediments, nutrients, and biota between waterways and their catchments. Finally, soils play a critically, important role in riparian nutrient dynamics.
In the present study CPMAS 13C NMR spectroscopy has been applied for the recognition of the chemical characteristics of the soils comprised in the riparian zone of Faithful Creek, a lowland tributary stream in the Goulburn River Catchment, located 15 km north of Euroa, Victoria (36.7°S, 145.5°E). Results revealed that carboxyl, aromatic and alkyl systems are constantly present in all the samples. However, nature of these components change according to the sample under investigation. In fact, as an example, the resonance of the carboxyl groups moves from 170 to 180 ppm as soil sample is collected nearby the water stream, thereby indicating that -COOH groups are deprotonated in the proximity of the river. Conversely, the amount of carbohydrates appear to decrease in the soils which are sampled closer to the stream. This is a confirmation that the riparian interface protects soils from the removal of the organic systems which are useful for microbial activity and, hence, for soil fertility.