World Academy of Science, Engineering and Technology
International Journal of Geological and Environmental Engineering
Vol:10, No:09, 2016

Organic Carbon Pools Fractionation of Lacustrine Sediment with a Stepwise Chemical Procedure

Authors : Xiaoqing Liu, Kurt Friese, Karsten Rinke

Abstract : Lacustrine sediment archives rich paleoenvironmental information in lake and surrounding environment. Additionally, modern sediment is used as an effective medium for the monitoring of lake. Organic carbon in sediment is a heterogeneous mixture with varying turnover times and qualities which result from the different biogeochemical processes in the deposition of organic material. Therefore, the isolation of different carbon pools is important for the research of lacustrine condition in the lake. However, the numeric available fractionation procedures can hardly yield homogeneous carbon pools on terms of stability and age. In this work, a multi-step fractionation protocol that treated sediment with hot water, HCl, H2O2 and Na2S2O8 in sequence was adopted, the treated sediment from each step were analyzed for the isotopic and structural compositions with Isotope Ratio Mass Spectrometer coupled with element analyzer (IRMS-EA) and Solid-state 13C Nuclear Magnetic Resonance (NMR), respectively. The sequential extractions with hot-water, HCl, and H2O2 yielded a more homogeneous and C3 plant-originating OC fraction, which was characterized with an atomic C/N ratio shift from 12.0 to 20.8, and 13C and 15N isotopic signatures were 0.9‰ and 1.9‰ more depleted than the original bulk sediment, respectively. Additionally, the H2O2- resistant residue was dominated with stable components, such as the lignins, waxes, cutans, tannins, steroids and aliphatic proteins and complex carbohydrates. 6M HCl in the acid hydrolysis step was much more effective than 1M HCl to isolate a sedimentary OC fraction with higher degree of homogeneity. Owing to the extremely high removal rate of organic matter, the step of a Na2S2O8 oxidation is only suggested if the isolation of the most refractory OC pool is mandatory. We conclude that this multi-step chemical fractionation procedure is effective to isolate more homogeneous OC pools in terms of stability and functional structure, and it can be used as a promising method for OC pools fractionation of sediment or soil in future lake research.

Keywords : 13C-CPMAS-NMR, 13C signature, lake sediment, OC fractionation
Conference Title : ICIHG 2016 : International Conference on Isotope Hydrology and Geochemistry
Conference Location : Rome, Italy
Conference Dates : September 15-16, 2016