Geophysical Research Abstracts
Vol. 15, EGU2013-11814, 2013
EGU General Assembly 2013

Tracing sources and deposition processes of organic carbon in river deltas: carbon isotopes (Δ14C and δ13C) coupled to density fractionation in the Rhône River delta (Gulf of Lion, France)

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Despite its relatively modest surface area, coastal zones play a crucial role in the biogeochemical cycles of carbon because they receive large inputs of terrestrial organic matter (OM) by rivers, and appear as a large biogeochemical reactor. The terrestrial OM inputs can be buried or mineralized depending of physical and biological processes. Improved understanding of the fate of organic carbon and its distribution in River-dominated ocean margins is necessary to predict evolution of carbon in this system impacted by human disturbances and climate change.
The Rhône River is the main source of freshwater and terrigenous particles including organic carbon to the Mediterranean Sea. Previous studies based on bulk 14C analysis of surface sediment of Rhône delta have shown an aging of the OM from the River mouth to the continental shelf. The distribution of OM is stable over several years (without flood) with a decreasing proportion of terrigenous OM with increasing distance of the river. Yet, the processes leading to this distribution are still being investigated: degradation, size or density sorting, petrogenic carbon accumulation...
In order to better understand the origin and the distribution of matter, we measured radiocarbon and δ13C in the different fractions of sediments samples obtained by density fractionation. Surface sediment of 4 sites located on a transect offshore (A, K, C and E) was sampled in April 2007, in May 2011 and during one flood event, together with the suspended material discharged by the Rhône River. Sediment aliquot was separated in 4 fractions with sodium polytungstate using the same methods as Wakeham et al. (2009) (<1.6, 1.6-2, 2-2.5 and >2.5 g cm-3) in order to separate different types of OM. Radiocarbon measurements were obtained after physicochemical treatment by Accelerator Mass Spectroscopy at LMC14 and stable carbon isotopes measurements by EA-IRMS Mass Spectrometer (ThermoFiniganDelta+XP) at LSCE. First results indicate that the δ13COM values are low for the density fraction 1.6-2 g.cm$-$3 (terrestrial signature) and then increased to the denser fractions. A general increase in δ13COM with increasing distance from the river is observed on all fractions indicating a progressive loss of terrestrial signature. At each station, the different density fractions had the same concave pattern of Δ14COM, with youngest values in the fraction 2-2.5 g.cm$-$3 (shift $\approx$500 or 600 ‰ and older values in lightest and heaviest fractions. Similarly to bulk analysis, each density fraction shows aging towards offshore.
The density separation method suggests different evolutions of OM pools in normal condition which reflects the interplay of several processes: retention of large particles near the river mouth, a general aging of the material and a loss of the terrestrial signature along offshore transect. A reservoir containing old carbon in the density fraction > 2.5 g.cm$-$3 is also observed.