Reply to referee #1

Minor corrections:

1) End of & 2.4: the citation of Hulth et al (1997) stands here for the core incubation technique and does not rely to the studied sites. Nevertheless, the work from Denis et al (2001) is also relevant for the core incubation technique and was added to this section.

2) End of 2.7: "They ranged from" was replaced by "These rates ranged".

3) Middle 3.2: water was added to the following sentence: "and decrease with water depths and distance from the mouth".

4) End of 3.3: The sentence "As expected from higher TOU/DOU ratios, DOU estimated from the model at stations I, F and J are lower than TOU measured by core incubations" was replaced by "As expected from higher TOU/DOU ratios, DOU estimated from the model at station I, and to a lesser extent at stations F and J, are lower than TOU measured by core incubations". As highlighted by the referee, the DOU estimated by the model is only significantly lower at station I when taking into account the SD. The DOU estimated by the model at station F and J tend to be lower than the measured TOU, but still lay within the SD range.

5) Middle 4.1: Biomass accumulation stands for Phytoplankton biomass.

6) End of 4.2: "The OC inputs in ocean margins" here refers to the total OC inputs in ocean margins (export from rivers but also marine production, erosion…)

7) & 4.3 line 3: nevertheless was deleted. Lines 8-9: significant has been deleted and replaced by visible; as the decrease of sulfate has been stated from visual observation of the profiles. The referee here stands that the decrease of sulfate at stations K, N, and C is not observable (figure 3). The fit and data showed on this figure are only for the 10 first centimeter of sediment. The coring depth for station K, N and C is respectively 25 , 20 and 20 cm. The measured concentration of sulfate in the bottom waters are about 30mM, and decreased to ca. 23, 26 and 27 mM at depth in the pore waters at station K, N and C, respectively.

8) & 4.3: "Our results suggest that the terrestrial OM delivered by the Rhône River, constituted of a reactive fraction, also pushes the diagenetic system towards major reduced products burial" was replaced by " Our results suggest that the terrestrial OM delivered by the Rhône River, constituted of a reactive fraction, also pushes the diagenetic system towards the burial of major reduced products".

9) 4.3 page 4: the sentence has been changed to: "The re-oxidation of reduced products does not contribute significantly to oxygen consumption".

10) Conclusions: As the model was, for now, only run for the April cruise, no additional results are yet available for other sampling periods. A complementary work is currently being processed with a more detailed non steady state model including all the secondary reactions. This model will be run on 3

different campaigns exhibiting different water and particulate matter discharge (April 2007 Q< 1000 m3/s, June 2008 Q > 3000 m3/s (flood) and December 2008 Q= 2000-2500 m3/s). For now, the reduced products profiles do exhibits similar shapes throughout the campaigns, except at station A (located at the close vicinity of the river outlet) during the flood in June 2008 where a large deposit of new sediment carried by the flood event buried the original species profiles. Possible changes in reduced products behavior, carbon deposition and burial will then be discussed more accurately.

More explanations on the authors assumptions and choices have been added in the first part of the discussion:

The Rhône River prodelta area is a highly dynamic system, mainly driven by the river discharge and meteorological events, which lead to episodic supply of sediment, resuspension, and erosion events. Due to these processes, the reader certainly understands that this system cannot reach steady-state. Nevertheless, previous studies in this area showed no significant variations of DOU rates in the continental shelf through time during "non-flood" conditions (Cathalot et al., 2010 and references therein). We then made the assumption that our sampling period in April 2007, exhibiting relatively average water discharges, was representative of an average functioning of the system. Flood inputs indeed, have been evidenced to impact significantly the benthic mineralization processes in prodeltaic areas (Deflandre et al, 2002; Eyre and Ferguson, 2005), including the Rhône River prodelta (Cathalot et al, 2010). The present study focus only on "non-flood" conditions and is a first step to a better understanding of the benthic biogeochemistry in this highly dynamic system.

References:

1) de Madron was replaced by Durrieu de Madron.

2) Huerta-diaz was replaced by Huerta-Diaz

3) Soetaert, Petzoldt and Meysman, 2009 was replaced by Soetaert et al 2010

4) Rasmussen and Jorgensen (1992) is now in ref list

5) Cathalot et al (in prep) has been deleted as not submitted yet.

6) Berg et al 1998 and 2003 are now in the list.

7) Soetaert et al 1996a

8) Berner 1984, Hedges and Keil 1995 and Bottrel et al 2009 are now in the ref list. Wegrzynek et al 1997 reference has been deleted.

Reference list:

1) Anschutz et al 2000 is in the text (&2.5, Anschutz et al., 1998, 2000)

2) Canavan et al 2006 has been deleted from the ref list

3) Froelich et al 1979 has been deleted from the ref list

4) Hartnett et al 1998 has been deleted from the ref list

5, 6, 7, 8, 9, 10, 11) The typing has been revised