

Interactive comment on “Carbonate chemistry in sediment pore waters of the Rhône River delta driven by early diagenesis (NW Mediterranean)” by Jens Rassmann et al.

Anonymous Referee #2

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Rassmann and collaborators present a very nice dataset of sediment properties in the Rhône river delta. Based on direct (microelectrodes) measurements of pH and O₂ and on pore-water analyses of DIC, TA, Ca²⁺ and SO₄²⁻ along a gradient from the river mouth to the open Mediterranean Sea (3 domains considered), this manuscript aims to describe and understand the main diagenetic reactions that control these sediment properties and the impact of the sediment on the bottom water carbonate chemistry. I would recommend publication of this manuscript following the proposed minor modifications and an extensive copy-edition by a native speaker.

Table 2 and Section 2.7 should not be presented in the Material and Methods section but more likely in the Discussion. I do not believe CO₂ dissolution should be presented

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as a diagenetic reaction. Table 2 should be made much clearer and for instance updated by: 1) providing the full name of the presented reactions, 2) dividing into 3 parts with reactions occurring in the presence of oxygen (oxic mineralization and reoxidation of reduced species), in the anoxic section (anaerobic mineralization and precipitation of reduced species), and both: CaCO₃ dissolution or precipitation. Reaction R2, it is not clear whether you present CaCO₃ dissolution or precipitation or both. I would consider 2 lines, one for precipitation, and one for dissolution as their effects on TA, DIC, pH and Omega are opposite. Finally, I would move this reaction to the end of the table (see above). Why don't you show nitrate reduction? This can be in some cases an important pathway. All reactions should be presented considering the same amount of OM mineralized (in some cases you have 1 or 2 moles of CH₂O mineralized).

Figure 6 should be updated. First, you don't show the same Y-axis scale than on Figure 5, why is that? and furthermore, this scale is not the same between the 3 domains in this Figure 7. I am a bit surprised by the very high heterogeneity that you found between stations in the Proximal domain and believe there are a number of mistakes to correct. For instance, you have DIC and TA data for station Z' until 30 cm while you calculate pH up to 25. For station A', you seem to have DIC/TA data down to 25 cm and you calculate pH data down to 35 cm or more. Please check. Furthermore, I have calculated pH for station Z at the last sampled depth (between 20 and 25 cm) considering TA of 48 and DIC of 50 mmol/L, I end up with a pH of 7.18, far from the 7.8 shown in Figure 6. Again, this should be carefully checked. L284-287: You should present the determination coefficients and the corresponding slopes for each domain separately. L291: I would really like to see a more detailed comparison between measured and calculated pH. Section 3.4. Why all stations are not shown for Ca²⁺ (D, A' and Z' missing), why 3 datasets for A ?

Minor corrections: L39: et al., L43: This is not correct, following your Table 2, aerobic mineralization does not produce TA. L54: Jahnke et al. (1997) L57: (Jahnke and Jahnke, 2004) L62: Jahnke et al. (1997) and Jahnke and Jahnke (2004). Burdige

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et al. (2008, 2010) L65: Van Capellen and Wang (1996) L69: (Froelich et al., 1979; Berner, 1980) L72: Pastor et al., 2011 a or b? L72: (Jourabchi et al. 2005; ...) L80: (Arndt et al., 2013; ...) L86: ; Cathalot et al., 2013) L92: Cathalot et al., 2010 L110: Abbreviation for year should be consistent throughout the text (yr-1) L114: Roussiez et al., 2005 L119: Got and Aloisi (1990) L124: Miralles et al., 2005 L141: *in situ* in italics L152: I don't understand what is "the slope of the pH variation", please rephrase. L156: .. "using this BW value the micro electrode measured pH variations", please rephrase L162: surface of 109 cm, this is not a surface. L171: according to Broecker and Peng (1974) L180 to 191: please precise how many replicates were measured for each parameter (pH, O₂, DIC and TA) L254: oxygen penetration depth (OPD) was of: please correct L259-260: units should be mmol m⁻² d⁻¹ L265: between 7.4 AND 7.6 L267: please add high "spatial" heterogeneity L299: (Fig. 5) L313: > 95% calcite + >5 % Mg-calcite do not leave much room for aragonite. ...

Many grammatical and formatting errors in the Discussion.

All figures starting from Figure 2: Average OPD for each domain should be shown on these plots. Figure 2 legend: *in situ* in italics Figure 3 legend: what do the vertical error bars correspond to? Please add.

Figures 5 and 7: I would use the same x-axis scale for all 3 domains and for Figure 7 separate SO₄²⁻ and Omega, consider using 2 figures. On Figure 7, please note that the legend box hides the axis, which should be avoided.

Figure 6 and 7, and legends: what do the horizontal error bars correspond to? Please add.

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