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Solid Earth Discussions

Interactive comment on "Shallow water carbonate platforms (Late Aptian, Southern Apennines) in the context of supraregional to global changes" *by* A. Raspini

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I thank Dr. Immenhauser for his careful review. He suggests a substantial reorganization of the manuscript, a further explanation of some concepts and a discussion about diagenesis and isotopic values. Below it may find my answers to the observations raised by the referee, following his comments point-by-point (see the Revised Text attached as supplement). But, first of all, I must say that if my paper is considered "useful" by the referee it means that I have exactly achieved my aim. When I deal with scientific data, in fact, I don't matter they can be "exciting" for everyone. I am fully satisfied if my work will be useful for someone. My manuscript is not cer-

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tainly a milestone on palaeo-nutrient levels, alkalinity, sea water pH for the Aptian, and does not offer a decisive contribution for understanding all of these fundamental topics. But it reworks and reappraises previously published data and is grounded on many original information deriving from further field and laboratory observations that allowed the bulk of the data to be discussed and interpreted in a new way, following an integrated approach. For example, "the Orbitolina level of the southern Apennines" is interpreted as a deposit induced by a period of increased precipitation linked to a monsoonal circulation just before the minimum accommodation space was reached on the Apenninic platform. In my opinion, such an interpretation of the Orbitolina level of southern Apennines is at least original and, perhaps, useful for someone. Also, in a general context of deterioration of the inner lagoon environmental conditions mostly related to the mid-Cretaceous volcanism, the microbial carbonates (never identified before in the studied area, as far as I know) are a common product of the shallow marine ecosystem during a large-scale sea-level lowering. By contrast, during a large-scale sea-level rise, no or minor microbial carbonate formed in the shallow lagoon that easily remained in a healthy state. It means that the environmental changes mostly induced by the mid-Cretaceous volcanism not influenced the inner lagoon settings.

Abstract. It has been modified and some sentences divided into shorter ones as follows: 1) The phrase "A preliminary study based on the comparison of recently published δ13C record of the Late Aptian Monte Tobenna and Monte Faito sections (Southern Italy) with reference carbon isotope curves" (p. 902, lines 1-3) has been replaced with "This paper is based on the first data obtained by integrating an accurate sedimentological analysis of the Late Aptian Monte Tobenna and Monte Faito sections (Southern Italy) with their recently published δ13C record in turn framed within global trends. This".

2) Lines 5-7: the sentence "the carbonate sedimentation in the inner lagoonal environments of the Apenninic platform and the occurrence of some peculiar facies during a time of increasing volcano-tectonic activity and trophic levels of the water" has been

SED
3, C521–C533, 2011

rephrased as follows “the deposition of some peculiar facies in the shallow lagoonal environments of the Apenninic carbonate platform during a time of major palaeoenvironmental changes.”

3) “During the lowering...of the inner lagoon environmental conditions” (lines 8-10) has been be rephrased as follows “In a general context of deterioration of the inner lagoon environmental conditions triggered by increasing volcano-tectonic activity and trophic levels of the water, microbial carbonates were a common product of the shallow marine ecosystem only during the lowering of the sea level.”

4) Line 15: the phrase “and fresh/brackish water environments spread” has been eliminated.

5) Lines 20-22: the concept “...that were not...in a healthy state” has been divided and rephrased as follows “. They easily remained in a healthy state and were not influenced by the environmental changes mostly induced by the mid-Cretaceous volcanism.”.

Preliminary. I used the term “preliminary study” to mean a study representing a fundament for future, more conceptual work. Because the above term is improper in this context, I’ll use the term “first data” (see the point 1 above).

Introduction. Obviously, not all the facies containing orbitolinids are genuine marker levels, because these forams are generally distributed in discrete intervals. But the Orbitolina level of the Southern Apennines is really a peculiar deposits. It normally consists of a single, marly bed (but a 10-15 cm-thick bed may characterize its upper part; e.g., at Monte Tobenna) crowded of Mesorbitolina texana and M. parva (e.g., Cherchi et al., 1978) and marks their first occurrence in the carbonate sequences of the Southern Apennines. The level has been ascribed to the Late Aptian (Gargasian) and crops out at least from Lucania to southern Latium over a present-day distance more than 3000 km (De Castro, 1963; Cherchi et al., 1978; Barattolo & De Castro, 1991; D’Argenio et al., 1992; Bravi & De Castro, 1995; my unpublished observations). The Orbitolina level of the southern Apennines is encased in carbonate successions that,

SED

3, C521–C533, 2011

according to some authors (Mostardini & Merlini, 1986; Marsella et al., 1995), pertained to the same paleogeographic domain (a large carbonate platform system) prior to the orogenic deformation. By contrast, according to others (e.g., D'Argenio et al., 1975; Channel et al., 1979; Finetti et al., 1996), the above sequences were originally part of two different carbonate platforms separated by a deep basin. In outcrops of the Matese Mountains (distal areas of the carbonate platform system or Abruzzese-Campana Carbonate Platform sensu D'Argenio et al., 1975), the Orbitolina level is represented by a calcareous bed and the low conical foraminifera are not crowded as in the successions of Monte Tobenna, Monte Faito, Monti Di Sarno, etc. (more proximal areas of the carbonate platform system or Campano-Lucana Carbonate Platform sensu D'Argenio et al., 1975), suggesting a possible relationship between abundance of orbitolinids and detrital influx (see p. 916, lines 7-11 of my manuscript). Some authors recognized a systematic variation in facies and bed thickness below and above the Orbitolina level that evidences cyclic environmental oscillations and a hierarchy of cycles (bed-scale cycles, bundles and superbundles). Eustatic-climatic, high-frequency changes linked to the Earth's orbital perturbation (Milankovitch-type cycles) have been considered the cause of this hierarchy (e.g., Buonocunto et al., 1994; Raspini, 1998). Other authors were able to correlate the Orbitolina level over a distance of more than 100 km across the carbonate platform deposits of the southern Apennines (D'Argenio et al., 1999). In these sections, as well as all over the Southern Apennines, Mesorbitolina texana and M. parva are not distributed in discrete intervals, but have been found only in the deposit constituting the marker level. More recently, based on chemostratigraphic data, the Orbitolina level of the southern Apennines has been placed close to the boundary of G. algerianus/G. ferreolensis zone (D'Argenio et al., 2004), confirming a Gargasian age. As far as I know, nothing is known about the paleoecological and paleoclimatic meaning of this level cropping out in the Apennines but only an accurate description of its faunal content is available in the literature. Therefore, the Orbitolina level of the Southern Apennines has certainly a regional significance and represents a genuine marker level of the Late Aptian utilized extensively also in the geological mapping of

SED

3, C521–C533, 2011

the Southern Italy since the last century.

1) The following sentence has been included in the introduction (on p. 903, line 19, after the comma): “and the marker bed correlated between widely spaced (present day distance > 100 km) carbonate platform successions cropping out in Southern Italy (D’Argenio et al., 1999; 2004),”.

Morphology of orbitolinids. I agree with the referee comment. Accordingly, I have replaced the term “flat conical orbitolinids” with “low conical orbitolinids”.

Organization of the Introduction. 1) On p. 905, line 5, the phrase “Although D’Argenio et al. (2004) evidenced” has been eliminated.

2) The sentence “they never discussed” (line 7) has been replaced with “have already been evidenced (D’Argenio et al., 2004), but”.

3) Line 10: the sentence “which developed on the southern Tethyan margin and now forms” has been replaced with “now forming the backbone of Southern Apennines have not previously been examined.”.

4) Lines 11-12: the sentence “as large...sedimentary bodies.” has been replaced with “For this purpose, the recently published sedimentologic, cyclostratigraphic and chemostratigraphic features of the above successions are resumed, reappraised and finally discussed following an integrated approach.”.

Studied sections. Most of the referee’s comments refer to the admixture of data presentation and data interpretation. But this is not the case for the section 3 of my ms. The latter just refer what is well known about the outcrops and the related citations. The phrase “exposure related features” is not in the section 3!

Facies analysis. To separate previously published data and new data, the section 4 (now named “Sedimentology”)has been divided as follows: 4.1 Previous data and their interpretation; 4.2 Peculiar facies of the Tobenna-Faito section (it reports data from further field and laboratory work). The latter section consists of the following

SED
3, C521–C533, 2011

three levels of sectioning: 4.2.1 The “Orbitolina level”; 4.2.2 Microbial carbonates; 4.2.3 Salpingoporella dinarica-rich facies.

1) On p. 907, line 2, the word “Previous” has been added at the beginning of the section 4.

2) Line 11: I have replaced “are” with “were”.

3) Line 17: I have replaced “features related to emersion” with “mm-size cavities filled by calcite and/or with geopetal infills”.

4) To avoid confusion between data presentation and data interpretation, the periods on p. 907 (lines 21-28)-through p. 908 (line 1), have been rephrased as follows: “Scattered cavities of irregular shape and less than 1 mm in size that show crystal silt at the base passing upward to sparry calcite characterize the uppermost part of many beds. These features were interpreted as evidence of exposure (Raspini, 1998, 2001). In addition, the microbrecciation affecting the top of some characean-rich beds was interpreted as the effect of wetting and drying processes producing mm-size intraclasts which give rise to an in situ breccia, similarly to the examples described by Riding and Wright (1981) in the paleosols of the Lower Carboniferous in southern Britain (Raspini, 1998; Fig. 2g).”

5) On p. 908 (line 4), the sentence “Particular attention has been paid to the analysis” has been replaced with “Further field and laboratory work has been addressed to the description and interpretation”.

6) After the phrase “Salpingoporella dinarica-rich-strata.” (line 6), the following sentences have been added: “This allowed us to identify distinctive fossil traces in the sediments underlying the orbitolinid-rich layer and to interpret lithofacies B4 and B3 as microbially-induced carbonates, outlining both their and the S. dinarica-rich facies distribution along the sections.”.

7) On p. 908, line 23, the words “various species” have been replaced with “a large

SED
3, C521–C533, 2011

number".

8) On p. 909 (lines 1-9), the fossil traces which characterize the deposit immediately underlying the orbitolinid-rich bed have been better described as follow: "Orbitolina floatstone with a marly matrix penetrates downward into the carbonate strata, filling the underlying cm-sized cavity-like features. Owing to the abundant vegetal covering that prevented extensive observations, these latter features have been previously interpreted as the product of paleokarstic processes related to a prolonged emersion of the platform subsequently sealed by the orbitolinid-rich marls when marine conditions returned (Raspini, 1996, 1998). By contrast, further field work carried out on a well exposed outcrop along a road cut has revealed that, as a matter of fact, the cavity-like features are sinuous and irregularly anastomosed "tunnels" traced in the fresh/brackish water deposits immediately underlying the litho and biostratigraphic marker. The "tunnels" may reach 3 cm in diameter and 12 in length and are interpreted as Thalassinoides-like burrows (e.g., Seilacher, 2007) filled with orbitolinid-rich sediment (Fig. 3c). Based on the above observations, the "Orbitolina level" of the Monte Tobenna represents transgressive deposits that settled on the platform following a period of interrupted or very low sedimentation.".

Cyclic stratigraphy. In my manuscript I rework and reassess previous data that, implemented by original information deriving from further field and laboratory observations, are then discussed and interpreted in a new way, following an integrated approach. Several facets regarding the vertical evolution of facies along the Monte Tobenna and Monte Faito outcrops have already been discussed in other papers (e.g., Robson, 1987; Raspini, 1998; 2001; D'Argenio et al., 1999). Nevertheless, for the purpose of the manuscript (the relationships between the distribution of what I call "peculiar facies", sea-level fluctuations and the complex pattern of environmental changes that led to modification of the carbon cycle during the mid-Cretaceous), I think that everything concerning sea-level changes and consequently the way to infer them (e.g., different orders of cyclicity in this case), must be resumed together with the related interpreta-

SED
3, C521–C533, 2011

tion.

1) Following the referee's suggestion, in order to separate previous and new data, I have split the section 5 into 5.1 (Previous data and their interpretation) and 5.2 (Sequence stratigraphy).

2) The sentences "D'Argenio et al. (1999) were able....among their thickness. This" (on p. 911, lines 20-24) and "The fact that superbundles...; Sandulli and Raspini, 2004)", on p. 911 (line 29) through p. 912 (lines 1-5) have been eliminated.

3) On p. 912 (lines 10-12), the sentence "Similarly...emersion-related features – that" has been rephrased as follow "Then, a sharp shift towards the most-open marine lithofacies occur through the 6 m-thick overlapping zone (Fig. 4). These deposits show minor evidence of emersion-related features and form the thickest superbundles recognized in the section studied. They".

Chemostratigraphy, isotopic values and diagenesis. As stated above, in my manuscript I utilise the well-grounded isotopic data published by D'Argenio et al. (2004). The data set they produced has a low resolution and this is one of the reasons why the research presented here represents a fundament for future, more conceptual work I hope to realize. The purpose of my manuscript, however, is the definition of the paleoenvironmental significance of some peculiar facies deposited in shallow lagoonal settings of the Apenninic carbonate platform within the complex pattern of environmental changes that led to modification of the carbon cycle during the lower Cretaceous as recorded on a global scale. To do this, I needed reliable trends of δ13C values (not the absolute isotopic values) recorded in the Tobenna-Faito composite section with reference C-isotope curves of the Aptian. Firstly, I have compared the above δ13C trends with the ones obtained from a succession that encases the Orbitolina level, is now located more than 100 km from the Tobenna-Faito one and, according to some authors, pertains to a different carbonate platform domain (cf. D'Argenio et al., 1975; Laubscher & Bernoulli, 1977; Channel et al., 1979; Finetti et al., 1996). From this, it emerged that:

SED
3, C521–C533, 2011

i) similar trends of δ13C values are recorded in both sections; ii) the main trends of δ18O values of both sections (used as a tool to confirm the previous correlation of the δ13C trends) are well comparable regardless of diagenetic effects the oxygen isotope absolute values locally suffered; this lends further support to the regional correlation of the δ13C trends (Fig. 5 of my ms). Secondly, the trends of δ13C and δ18O reproduced at a regional scale have been also compared with global trends as recorded by reference curves (Figs 6 and 7 of the ms). The good correlation implies that, the studied successions record global - rather than local - trends of δ13C and δ18O values not significantly influenced by environmental/diagenetic effects. Summing up, although diagenetic effects could have locally shifted the absolute isotopic values from the original ones (see, for example, my ms, on p. 913, lines 20-28; on p. 914, lines 7-11) and data have a low resolution, isotopic trends extracted from the Tobenna-Faito section are reliable. This is what I needed in order to frame the "Orbitolina level" within the complex pattern of environmental changes of mid-Cretaceous and to hypothesize its possible comparison with the Niveau Fallot. Therefore, in my view, an in-depth discussion about the diagenetic influence on the isotopic values is unnecessary because it does not add much to the manuscript, considering its purpose.

1) To improve the structure of the manuscript, the section 6 has been split into two subheadings: 6.1 (Materials and methods) and 6.2 (The isotopic record and its regional-to-global significance).

About Steuber (2002). Although Steuber (2002) provides a good example of the evolution of carbonate-producing biota (mostly rudists) on Cretaceous carbonate platforms as a function of the evolving physico-chemical conditions of the seawater, schemes provided by Stanley & Hardie (1998) and Stanley (2006) are more suitable to show the relationship between the bloom of Salpingoporella dinarica-rich facies and the low Mg/Ca molar ratio of seawater during the Aptian.

Final remarks. I apologize, but I really do not understand why the referee is so confused and frustrated about "Final remarks". However, I have no problem in replacing it with

SED
3, C521–C533, 2011

"Conclusions", modifying just two sentences as follows: on p. 922 (line 2), the phrase "In view of the above, it emerges that," has been eliminated and the phrase "Under these environmental conditions," (line 6) added.

In summary, I have followed the referee's suggestions and accordingly rearranged the text (see the file attached as supplement), paying particular attention in separating new and previously published data. This has improved the paper, allowing the general message of the manuscript to be better focused. Nonetheless, I must stress again that previous authors the reviewer often refers ("I do not see where the author goes significantly beyond the point previous authors have reached before", on p. C501 of his comment. But he adds that ". . .the paper is still useful because it adds new data from new sections... ..." on the same line) never discussed if and how the Aptian paleoenvironmental and paleoceanographic changes influenced the carbonate factory of the platform which developed on the southern Tethyan margin and now forms the backbone of Southern Apennines. Also, microbial carbonates have never been identified before in the studied area. Finally, the interpretation of some peculiar facies encased in shallow-marine carbonate strata (included microbial carbonates) as the Apenninic platform's response to supraregional-to-global environmental changes during the Early Cretaceous is entirely new. Previously published data, if adequately reassessed and interpreted following an integrated approach, can reveal unknown facets of an already-known scientific topic, becoming even fundamental for those who are searching for something different. As the Nobel prize Albert Szent Györgyi said "Research is to see what every one else has seen and to think what no one else has thought".

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SED

3, C521–C533, 2011

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SED

3, C521–C533, 2011

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Please also note the supplement to this comment:

http://www.solid-earth-discuss.net/3/C521/2011/sed-3-C521-2011-supplement.pdf

Interactive comment on Solid Earth Discuss., 3, 901, 2011.