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Solid Earth Discussions

Interactive comment on "Bio-chemostratigraphy of the Barremian–Aptian shallow-water carbonates of the southern Apennines (Italy): pinpointing the OAE1a in a Tethyan carbonate platform" *by* M. Di Lucia et al.

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Dear Helmi,

first of all we wish to thank you for your constructive criticism to our paper. The main issue you raised in your review is that we did not cite previous papers on the carbon isotope stratigraphy of the southern Apenninic carbonate platform. We acknowledge that Ferreri et al. (1997) is the first paper using carbon isotope stratigraphy to correlate a shallow water carbonate succession of the southern Apennines (Monte Raggeto) to a

deep-water reference section (Cismon), and to use this correlation to infer the position of the Selli level equivalent. Failing to cite Ferreri et al. (1997) was certainly a mistake. In the revised version of our ms we will add a citation to this paper and to Wissler et al. (2004), straight from the introduction. However, we will not deal either with Ferreri et al. (1997) or with Wissler et al. (2004) in our discussion on chemostratigraphic calibration of the southern Apenninic carbonate platform biostratigraphy. The main reason is that there are very few biostratigraphic data in Ferreri et al. and Wissler et al., as you correctly acknowledged in your review. Following your suggestion, we will also add the Monte Raggeto δ13C curve of Wissler et al. (2004) to our chemostratigraphic correlation figure. However, we will also briefly discuss that, due to the lack of biostratigraphic tie-points (Orbitolina level, FO of Archaeoalveolina reicheli) in the Monte Raggeto section, the correlation between the Wissler et al. curve and our Monte Croce curve could be less straightforward than you suggest (as explained more in detail below).

Once more we wish to thank you for your comments to our manuscript. Please, find below a detailed reply to any of the specific points you raised:

Referee Comment (RC) - p. 16 (804): "please cite the precursor work from your region".

Author Comment (AC) - We will cite Ferreri et al. (1997) and Wissler et al. (2004) straight form the introduction. We will add a sentence before the motivation of our paper, explaining that previous studies have already used carbon isotope stratigraphy to individuate the Selli level equivalent in the southern Apenninic carbonate platform. We believe that the main merit of our paper is that we offer a chemostratigraphically calibrated biostratigraphic criterion.

RF - p. 19 (807): “The Monte Croce +4permil excursion matches well with the excursions documented in Wissler et al. from the Monte Raggeto, please refer to this and I highly recommend, that you add the Raggeto curve to your summary figure”.

AC - We will add the Monte Raggeto curve to our figure 12 (see the preliminary version in Fig. 1). However, we will also add a short discussion explaining that there are two

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alternative correlations between the Monte Raggeto and the Monte Croce curve. The one you favour matches the +4 per mil excursion in the uppermost part of the Wissler et al δ13C curve, with the excursion starting above the Orbitolina level at Monte Croce. This correlation is contradicted by other data produced by the D'Argenio/Weissert group. In fact, D'Argenio et al. (2004, fig. 19) correlate the superbundle T3 of Monte Tobenna, containing the Orbitolina level (with M. parva and M. texana), with the superbundle R23 at Monte Raggeto. The positive excursion you identified as the Selli level positive excursion ends with superbundle R23 (Wissler et al., 2004, fig. 3). Therefore, this excursion precedes the Orbitolina level and should be correlated with the corresponding (pre-OAE1a) excursion at Monte Croce. The upper part of the Monte Raggeto carbon isotope profile, shown in D'Argenio et al. (2004, figs. 4, 8), further supports this alternative correlation: there is another positive excursion between the superbundles R23 and R31, peaking at >+4‰ in the superbundle R29. At Monte Faito, the first occurrence of A. reicheli is in the upper part of the superbundle F4, which correlates with the superbundle R30 of Monte Raggeto (D'Argenio et al. 2004, fig. 8). Therefore, if the correlation of D'Argenio et al. (2004) is correct, it is this second positive excursion that correlates with "our" Selli level CIE at Monte Croce, inasmuch as it starts above the Orbitolina level and terminates slightly above the FO of A. reicheli. The discussion above highlights the main point we wish to make in our paper: chemostratigraphy without biostratigraphy can give equivocal correlations, biostratigraphy without chemostratigraphy is not sufficient (in carbonate platforms lacking ammonites): chemostratigraphically calibrated biostratigraphy is the most effective way of individuating the Selli level equivalent in the southern Apenninic carbonate platform (and in other resilient platforms).

RC - p. 19 (807): "I have quite some problems with the correlations Croce-Motola-Coccovello. The amplitude of the prominent Aptian excursion is expected to be about 4 permil (Croce, Raggeto). In the other sections you just reach about 3 permil or less. This indicates that either you are missing positive excursion (and also the corresponding negative spike) or that you correlate the Aptian excursion with an older

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Barremian/Aptian C-isotope excursion (most of them peak around +3permil). If you maintain your correlation you have to discuss the significant difference in amplitude of the curves. You may refer to D'Argenio et al. and Wissler et al, if you discuss emersion events in the studied sections".

AC - In our ms we infer the presence of a gap in the Monte Coccovello section, truncating the rising limb of the Selli level positive excursion. This gap is clearly marked in our figure 12. Also at Monte Motola we highlight the presence of a substantial gap truncating the first positive excursion (the earliest Aptian one). We acknowledge that another (shorter) gap might be responsible for "lowering" at +3‰ the peak of the Selli level positive excursion. The presence of this gap is supported also by the distinctly smaller thickness separating the LO of S. dinarica from the FO of A. reicheli at Monte Motola, compared with Monte Croce. Figures 8-9 of D'Argenio et al. (2004) also support the presence of a gap in the inner platform sections (compared to more complete outer platform sections) exactly in this position. Thanks a lot for your comment! We will add something to our discussion on the correlation between the three studied sections.

RC - p. 19 (807): "if we look at the S. Apennine data sets, it looks as if Croce and Raggeto are the most complete records. The Aptian positive excursion seems, however, not complete in both localities (Raggeto is marked by emersion horizon cutting the end of the peak, is this also observed at the Mte Croce locality?). The positive excursions covers around 30-40m, in extended and more complete localities (like the Basque-Cantabrian Basin, see Millan et al., EPSL, 2009) the excursion covers a few hundred meters".

AC - Our sections (especially Mt. Motola and Mt. Coccovello) show many evidence of subaerial exposure: this is the rule more than the exception in platform top successions (see also the comment by Adrian Immenhauser and our reply). According to the works of the D'Argenio′s group (D'Argenio et al., Tectonophysics, 1999 and references therein) there is a hierarchy of gaps, from those contained within elementary cycles to those causing the omission of bundle(s) or even superbundle(s). The du-

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ration of these gaps is generally beyond the resolution of biostratigraphy (they take less than one biozone), but, as shown above, the shape and absolute values of the carbon isotope curve, together with detailed bio- and lithostratigraphic correlation, can highlight the presence of some “longer” gaps. D’Argenio et al. (2004) use a different, cyclostratigraphic approach to infer the position and duration of gaps in sections that are incomplete by reference to a section that is assumed (but not proved) to be complete. Coming to your observation, we have no positive evidence of a substantial gap during the positive excursion but there could be many small gaps because we have subtle evidence of at least ephemeral subaerial exposure. Moreover, as said above, according to D’Argenio et al. (2004, fig. 8) the peak of what we believe is the Selli level positive excursion is probably where the longer gap is expected (based on cyclostratigraphic data) in the inner sectors of the southern Apenninic carbonate platform. As to the thickness of the excursion in other areas, we think that it is a matter not only of how long are the gaps, but also of net accumulation rate, that on carbonate platform top is ultimately controlled by accommodation. The Basque Cantabrian basin is probably not just more complete but more expanded (higher accumulation rate? higher accommodation?).

RC - p. 19 (807): "mark in figure what you consider as negative spike".

AC - Your request raises a point that is becoming a real problem in the OAE1a literature. First there was the negative spike. The C3 of Menegatti et al., was actually a negative spike, not a negative shift. But then other papers started finding a more gradual decrease of δ13C values and people started talking about C3 as a segment of the curve. The C3 negative spike is clearly marked in our fig.12 on the Cismon curve and, from there, it is correlated to our sections along the line separating the yellow from the grey panel.

Conclusions

RC - p. 26 (814): “The first step to unlock this archive is the precise chronostratigraphic

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dating and correlation of shallow-water carbonate successions with deep-water successions, which represent the reference record of palaeoceanographic events. In this paper we fulfil this task". This first step was attempted in the mid 90ties by D'Argenio and colleagues. Please refer to this".

AC - The revised version of our manuscript will incorporate a citation of Ferreri et al. (1997) and a discussion of Wissler et al. (2004).

RC - Line 20: "Wissler et al. describe this OAE1a interval as characterized by thin-bedded dark limestones. Do you recognize comparable facies trends as in the Mte Raggeto locality?"

AC - We did not find any thin-bedded dark interval neither in the position corresponding to what we interpret as the Selli level equivalent nor in other parts of our sections. In our paper we stress that dysoxic facies could be misleading in platform carbonate successions: they are often the result of locally restricted circulation more than of global paleoceanographic conditions. Interestingly enough, all the famous fossil lagerstätten with platy facies and exquisitely preserved fossils, pointing to dysoxic to anoxic conditions, are not related to oceanic anoxic events (Bravi, 1996: Ricerche sui livelli ad ittioliti in facies di piattaforma carbonatica dell'Italia Meridionale. Unpublished PhD Thesis, University of Napoli "Federico II", 396 pp.; see also Carannante et al., Facies, 2006, on the famous fossil lagerstätten of Pietraroia).

Interactive comment on Solid Earth Discuss., 3, 789, 2011.

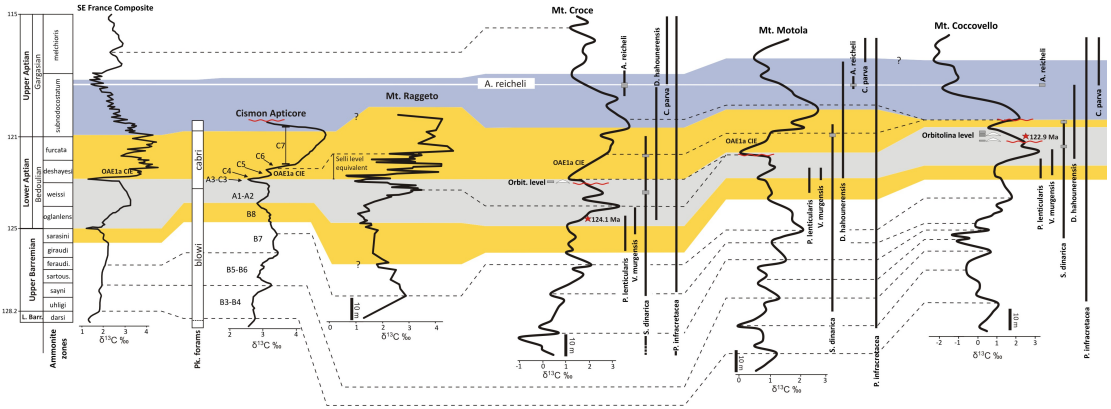

Fig. 1. Fig. 12: Preliminary version of the chemostratigraphic correlation including the carbon isotope curve of M.te Raggeto (Wissler et al., 2004).

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