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Rebuttal of Leite and Do Carmo 2021 'Description of the stratotype section and proposal of hypostratotype section of the Lower Cretaceous Quiricó formation, São Francisco Basin, Brazil'

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The biochronostratigraphy based on non-marine Late Jurassic/Early Cretaceous ostracods is recognized around the world as one of the most powerful tools to the knowledge of the geological history of lacustrine basins. In Brazil, the first economically exploited pre-salt oil rocks were in the lacustrine Recôncavo/Tucano Basin, localized in the NE of the country. Supported by an abundant and species-rich ostracod fauna with short biochrons, a number of biozones and subzones were named and formally described by Viana et al. (1971). Two years before, an Aptian/Albian biozone had been formally proposed for a transitional sequence of the Sergipe/Alagoas Basin

(Schaller, 1969). The construction of knowledge related to this stimulating and complex theme is detailed in Poropat & Colin (2012).

As an essential background for the elaboration of the above mentioned biochronostratigraphic framework, the detailed taxonomic study of the ostracods of these basins was the greatest challenge. It should be noted that most of the ostracods described in the Recôncavo/Tucano Basin were studied by the German paleontologist Karl Krömmelbein between 1961 and 1966 (see the references in Coimbra 2020). Five years later, along with Rolf Weber, he described another 51 new species and one new genus for that basin (Krömmelbein & Weber 1971). Krömmenlbein's works became fundamental for the biozoning of the Recôncavo/Tucano Basin, which until now has been successfully applied in other coeval sections of NE and SE Brazil, including the pre-salt rocks where the largest oil reservoirs in the country are located.

Considering that a biochronostratigraphic framework will be good if and only if the taxonomic basis on which it rests is robust, I have reached the crucial point of this work. That is, in the taxonomy presented by Leite et al. (2018) and reiterated by Leite & Do Carmo (2021) as a key support for the determination of ages in the Quiricó Formation, Sanfranciscana Basin, SE Brazil.

Leite et al. (2018) identified 16 non-marine ostracod species recovered in some outcrops of the Quiricó Formation. In the last paragraph, they wrote the following: *"The new data on ostracode taxonomy presented herein improve*

the current understanding of distribution of limnic ostracodes from the Cretaceous of Brazil, Argentina, and Africa because it is possible to develop a correlation study with 13 other basins ... From this study, it is possible to infer that the Quiricó Formation began its deposition during the Valanginian".

Coimbra (2020) pointed out that Leite et al. (2018) committed taxonomic mistakes that changed the geographic and stratigraphic distribution of various species and, consequently, the correlation among the numerous basins cited by them in their conclusions. The subject of Coimbra work was the taxonomy of the *Cypridea* species, since it was based on them that Leite et al. (2018) reached their biochronostratigraphic conclusions. Coimbra (2020) studied the well-established ostracods *Cypridea hystrix* Krömmelbein, 1962, *Cypridea hystricoides* Krömmelbein, 1962, *Cypridea conjugata* Krömmelbein & Weber, 1971, *Cypridea infima* Krömmelbein & Weber, 1971 and *Cypridea jequiensis* Krömmelbein & Weber, 1971. He concluded that the cause of the taxonomic mistakes performed by Leite et al. (2018) partially was *"because the authors adopted some misconceptions regarding morphological terminology used in the original diagnoses and/or descriptions, employing terms which are nowadays unusual"*, highlighting that at least since Sames (2011) there is a carapace morphological terminology that embraces a number of peculiar features of *Cypridea*. An example of this problem is showed by Coimbra (2020, p. 94): *"Krömmelbein used the expression 'Pore-Grübchen' (= pore cavities) to refer to punctate or even finely reticulate ornamentation. He was not referring to the normal porecanals."* Unfortunately, Leite et al. (2018) interpreted *"Pore-Grübchen"* as being the normal pore-canals.

In view of what has been discussed so far, I was astonished when I read the article by Leite & Do Carmo (2021), which is the reason for this reply. Why? Because, among other points that will follow in this document, the authors state (p. 6) that: (i) *"Coimbra (2020), from the analysis of figures and descriptions from Leite et al. (2018), concluded that all* Cypridea *species were erroneously identified, and, therefore, the attribution of the base of the Quiricó Formation to the Valanginian would be incorrect"*; (ii) *"Considering Leite et al. (2018), position followed herein, if someone compared the original description of these four species, would observe that the material recovered from the Quiricó Formation yield all characteristics to identify* Cypridea hystrix *Krömmelbein 1962,* Cypridea conjugata *Krömmelbein & Weber 1971,* Cypridea infima *Krömmelbein & Weber 1971 and* Cypridea jequiensis *Krömmelbein & Weber 1971".* It should be noted that they forgot to quote *Cypridea hystricoides*, which they mistakenly considered a junior synonym of *Cypridea hystrix*. Contrary to what the excerpt reproduced here indicates, it is clear in Coimbra (2020) that he analyzed in detail the original diagnosis, descriptions and illustrations of these species. And, in doing so, he demonstrates that the morphological study and identifications by Leite et al. (2018) are biased.

In this scenario, it is also important to point out that Coimbra (2020) highlighted his surprise with Leite et al. (2018, p. 677) when they assigned a Hauterivian age to the middle portion of the Tereza Farm outcrop. Why? Because the authors did not show how they arrived at that Hauterivian age.

In addition to the discussion of ostracods, there are two other remarks pertinent to this reply. The first one concerns figure 3 of Leite & Do Carmo (2021) and the texts that refer to it. The authors used a chronostratigraphic column

adapted from Campos & Dardenne (1997), following Leite et al. (2018). In this figure, which is essential for a good reading of the articles cited here, the entire Areado Group, which includes the Quiricó Formation, appears restricted to the Upper Barremian-Albian interval. That is, the ages related to the Valanginian and Hauterivian do not appear here.

The second remark deals with the coelacanth fish *Mawsonia* Woodward 1907, whose type species is *M. gigas*. Leite & Do Carmo (2021, p. 5), quoting Carvalho (2002) and Carvalho & Maisey (2008), affirm that this genus occurs in many basins of northeastern Brazil being typical of the Berriasian-Valanginian-Hauterivian interval. Besides, analyzing the material studied by Leite et al. (2018), they proposed that all fossils of *Mawsonia* in the Quiricó Formation are conspecific with the type species of the genus. In the Conclusions (p. 12), those authors stated that *"The dating of the Quiricó Formation is based on biostratigraphy, and although fish and ostracod occurrences in the Tereza Farm seem to indicate a Valanginian age for the base of the section,..."*. Being that "fish" is referring to *Mawsonia*, and probably to the type species of the genus. This causes some surprise, as it is well-known that *Mawsonia* is a genus of complex and controversial systematics and phylogeny (see Cavin et al. 2019, Torriño et al. 2021; and their references), with generally rare and fragmentary specimens from the Late Jurassic to the Cenomanian (Medeiros et al. 2011; and their references).

Finally, the last sentence by Leite & Do Carmo (2021, p. 12) is highlighted. There, and only there, the authors stop being peremptory and soften the proposed of a Valanginian age for the base of the Quiricó Formation, as follows: *"... due to controversies regarding ostracod taxonomy, the age of the Quiricó Formation remains to be reevaluated considering new fossil record and isotopic dating"*. However, throughout the article, a Valanginian-Hauterivian age was considered the correct one for the base of the referred formation, and not only based on the ostracod species erroneously identified by Leite *et al.* (2018), but also in some records of the mawsoniid coelacanth *Mawsonia*.

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