GEOLOGICA CARPATHICA, DECEMBER 2013, 64, 6, 499–501 doi: 10.2478/geoca-2013-0035

DISCUSSION — REPLY

Reply to the Comment of A. Pszczółkowski on "Calpionellid distribution and microfacies across the Jurassic/Cretaceous boundary in western Cuba (Sierra de los Órganos)" by López-Martínez et al. (2013)

RAFAEL LÓPEZ-MARTÍNEZ[1], RICARDO BARRAGÁN[1], DANIELA REHÁKOVÁ[2] and JORGE L. COBIELLA-REGUERA[3]

[1]Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, C.P. 04510 México D.F., México; rafaelopez83@hotmail.com
[2]Comenius University, Faculty of Natural Sciences, Department of Geology and Paleontology, Mlynská dolina G, 842 15 Bratislava, Slovak Republic; rehakova@fns.uniba.sk
[3]Departamento de Geología, Universidad de Pinar del Río, Martí 270, Pinar del Río, C.P. 20100, Cuba

(Manuscript received October 24, 2013)

Introduction

Discussions about the Jurassic/Cretaceous boundary in Cuba are welcome and expected. We are grateful to A. Pszczółkowski for his interesting comment on our work. Our paper focuses on the calpionellid biostratigraphy and facies distribution to establish the Jurassic/Cretaceous boundary in a "specific" section of the Guasasa Formation named the San Vicente section. Unfortunately, the comment by A. Pszczółkowski included no special mentions of the main objectives of our publication. Comments are mainly stressed out around some minor discrepancies of the results of our contribution with those previously published by the aforementioned author.

Reply to individual points of the comment

… the authors have omitted some important features … In the type section, the El Americano Member deposits were described as dark-grey to black limestones with ammonites (Houša & Nuez 1972).

As Pszczółkowski (2013) clearly explains, no more detailed description of the unit was made in López-Martínez et al. (2013), due to the fact that earlier works characterized the El Americano Member (Houša & Nuez 1972; Pszczółkowski 1978; Myczyński & Pszczółkowski 1990; Pszczółkowski 1999; Cobiella-Reguera & Olóriz 2009; Pszczółkowski & Myczyński 2010; Iturralde-Vinent & Pszczółkowski 2011). Nonetheless, the description in López-Martínez et al. (2013) took into account all the necessary aspects for its recognition, including the presence of ammonites and calpionellids; only the attribute "dark-grey to black limestones" was not specified.

… should not be restricted to the Rancho San Vicente section, as it presents the stratigraphic position of the Guaniguanico units in general, in the Los Órganos and Rosario successions.

The lithostratigraphic units of the Rancho San Vicente section are part of the Guaniguanico units. If Figure 2 by Pszczółkowski & Myczyński (2010) represents the stratigraphic position of the Guaniguanico units, it is hard to conceive how it does not include that section. Thus, the stratigraphy of the Rancho San Vicente would be embraced by the stratigraphic framework of the Guaniguanico megaunit as a whole.

The authors do not mention, that at San Vicente the age … was identified by Pop (1976, fig. 4) as Late Tithonian (Crassicollaria Zone). Therefore, the Late Tithonian age of the boundary between the San Vicente and El Americano members in the San Vicente section was known after 1976.

López-Martínez et al. (2013), described the San Vicente Member as follows: "… This unit is of Kimmeridgian–Early Tithonian age according to Pszczółkowski & Myczyński (2010)". Then, the overlying El Americano Member has to be Late Tithonian for the Steno principle since no a hiatus was identified. Moreover, the Tumbadero Member was described as: "Middle–Late Berriasian age with very thin cherty beds and lenses". Therefore, the El Americano Member, spanning from the end of the San Vicente Member to the beginning of the Tumbadero Member, has to span from the Late Tithonian to the Early Berriasian.

On the other hand, although stressed by Pszczółkowski in his comment, the fact that the Late Tithonian age of the

boundary between the San Vicente and El Americano members in the San Vicente section was known from Pop (1976), it seems not to be accepted by Pszczółkowski & Myczyński (2010). On figures 2, 3, 5b and 20 of that work, such contact is placed as Kimmeridgian–Tithonian. Furthermore, on page 228, they explain "The ?Late Oxfordian–Kimmeridgian age of the San Vicente Member was defined on the basis of its lithostratigraphic position between ammonite-bearing units and scarce pelagic microfossils found in the limestones of this Member". Also, on page 235 they explain "The San Vicente/El Americano Members boundary correlates approximately with the Kimmeridgian/Tithonian boundary, at the base of the Hybonoticeras-Mazapilites Zone (Fig. 2)".

Despite previous discussion, in our work we refine the biostratigraphy of the San Vicente section. The age of the basal stratum of the El Americano Member is clearly late-Early Tithonian (*sensu* Jach et al. 2012), *Chitinoidella* Zone (Boneti Subzone) which was previously designated as the *Crassicollaria* Zone (*sensu* Pop 1976).

… "in more detailed work it is possible to find a diachronism in the appearance of pelagic conditions" (and so on) is true, but not new (please see Pop 1976 and Pszczółkowski 1978, 1981).

The new data on the age of the San Vicente Member in the "San Vicente section" in our study, place the contact San Vicente/El Americano in the late–Early Tithonian (Boneti Subzone). This datum applies solely to the studied section, and not to the whole Sierra de los Órganos as, according to Pszczółkowski (2013, his comment), we pretend to affirm. Thus, regardless of "how new" the idea of the diachronism of pelagic conditions is in the whole Sierra de los Órganos, the age datum is new for the San Vicente section since it contradicts previous works (i.e. Pszczółkowski & Myczyński 2010), refining and bringing up to date its biostratigraphic framework.

… Originally, the figured juvenile gastropods were found in other sections of the Guaniguanico megaunit; their occurrence was interpreted in terms of moderate to poor oxygen levels at the sediment-water interface.

Gastropods in the San Vicente section are taken into consideration separately in another paper about the Taphonomy of the section and which is now in press. Nonetheless, the explanation of the juvenile gastropods in Pszczółkowski & Myczyński (2010) is ambiguous, because their data are contradictory to their conclusion.

On page 233, those authors explain: "Juvenile gastropods (Ampullospiridae, mainly Globularia spp., and Pleurotomariidae) co-occur with dark-brown to black faecal pellets. The presence of Globularia-dominated minute (juvenile) gastropods and lack, or extreme scarcity, of adults in the Lower Tithonian limestones suggest an unfavourable environment for these molluscs. Low oxygenation levels are a reasonable explanation for this type of micro-gastropod assemblage".

On page 235 of the same publication: "3.2. Facies type 2: Bioclastic to shelly limestones (coquinas) and Breccias. This facies type is represented by dark-grey to black bioclastic and shelly limestones (Fig. 16) composed of ammonites, aptychi, juvenile gastropods and, sometimes, phosphatic (sh) detritus (Fig. 14.4). Juvenile ammonites occur in thin micritic intercalations occasionally preserved in ammonite coquinas (Fig. 14.5 and Fig. 17.3–4)"; "Current imbrication was observed in an aptychi coquina; origin of bioclastic and shelly interbeds was related to episodic high-energy events, probably caused by heavy storms and/or stronger paleocurrent activity"; "3.3. Facies type 3: Pelagic biomicrites with occasional calcarenite interbeds. … Juvenile ammonites (Figs. 14.6 and 17.4) and gastropods (Fig. 15.1–3) often occur in these biomicrites"; "Calcarenite interbeds composed mainly of the shallow-water constituents (ooids, bioclasts, Favreina coprolites, etc.) have been reported from the Late Tithonian–Early Berriasian strata of the Southern Rosario succession (Pszczółkowski 1978). These interbeds, 0.2–10 m thick in various sections, were interpreted as calciturbidites, mainly".

On page 236: "Drowning of the Kimmeridgian carbonate banks of the Sierra de los Organos and Northern Rosario occurred during the Kimmeridgian/Tithonian boundary interval, although shallow-water bioclasts and coated grains were intermittently shed into the Tithonian deposits (Pszczółkowski 1978, 1999)".

Thus, the Pszczółkowski & Myczyński (2010) data suggest that juvenile gastropods are linked to an important influence of shallow water derived clasts, but their interpretation of such juvenile gastropods and ammonites identifies them as indicators of lower oxygen levels. In the studied section, all gastropods found in the El Americano Member are resedimented by tempestites and, they were not taken into consideration because those entities do not reflect the physical and chemical conditions that prevailed during the sedimentation of the sample. The size of the gastropods and ammonites (juvenile) is not due to lower oxygen levels, it is the result of the Stokes law. Small size gastropods and ammonites can be transported longer distances. We are not in conflict with the lower oxygenation of the sediment/seawater interface; abundant data have favoured this phenomenon. However, small gastropods and ammonites are not part of those data.

"As a matter of fact, the paper by Fernández-López & Meléndez (1995) concerns middle Jurassic ammonites, not juvenile gastropods; the term "gastropods" does not appear in this publication".

This is a very peculiar observation and perhaps is based on a misinterpretation of what is written in our paper. The work by Fernández-López & Meléndez (1995) is about Taphonomic Gradients and of course, we agree that those authors used Middle Jurassic ammonites to define different types of such gradients. However, the definition of the gradients is based on taphonomic, and not necessarily on taxonomic information. Therefore, application of those gradients may be extended to other groups besides the ammonites. One of those gradients deals with the process of remobilization, while the other is based on the size of the specimens. In our work we express (on the basis of the size distribution of the assemblage regardless of the taxonomic group involved), that the taphonomic

gradients that explain the presence of juvenile and the scarcity or lack of adult gastropods in Rancho San Vicente Section are similar by analogy to those described for ammonites by Fernández-López & Meléndez (1995).

"… Such simple extrapolation does not work, because there are differences between various sections of this belt as shown by the studies of previous authors. Moreover, the authors (López-Martínez et al. 2013) did not take into account some important arguments, which may not confirm their conclusions, for example, distribution of ammonites and microfacies documented from other sections in previous publications".

Pszczółkowski (2013, his comment) insists that there are either extrapolations or general conclusions to embrace the whole Sierra de los Órganos in López-Martínez et al. (2013). However, our results count exclusively for the San Vicente section; in fact, on page 206, in reference to the Simplex Subzone problem, López-Martínez et al. (2013) state "An appropriate explanation of this phenomenon is out of the scope of the present work, and perhaps a regional detailed composite section will be necessary to unravel this biostratigraphic interval in the future".

Moreover, in our conclusions we emphasize that this contribution is based on "high resolution sampling of an outcrop of the Guasasa Formation in the Rancho San Vicente section of the "Sierra de los Órganos"". In fact, there are no attempts in López-Martínez et al. (2013) to make conclusions about the whole Sierra de los Órganos area. It is clearly stated that our work is focused on only one section, and that no data from other sections were used because it was not part of the goal of the study. This assertion is even stressed on the very first page of the manuscript, where the objective of the investigation is clearly stated: "definition of an updated and sound calpionellid biozonation scheme for the section" (López-Martínez et al. 2013, page 195, Abstract).

"Finally, the study of the San Vicente section improves but does not change fundamentally the "good correlation of the Jurassic/Cretaceous Cuban facies with European sections" (López-Martínez et al. 2013, Conclusions), established by the results of previous studies (Pop 1976, 1986; Pszczółkowski et al. 2005; Pszczółkowski & Myczyński 2010)."

As stated before, the main goal of López-Martínez et al. (2013) is "the definition of an updated and sound calpionellid biozonation scheme for the section". That means that from the very beginning, while planning the study, we intended to improve the biostratigraphic scheme to facilitate more educated correlations with the coeval European sections. In that regard, we finally agree with this part of the comment since the objective of López-Martínez et al. (2013) has been fully accomplished.

References

Cobiella-Reguera J.L. & Olóriz F. 2009: Oxfordian–Berriasian stratigraphy of the North American paleomargin in western Cuba: Constraints for the geological history of the proto-Caribbean and the early Gulf of Mexico. In: Bartolini C. & Román Ramos J.R. (Eds.): Petroleum systems in the southern Gulf of Mexico. *AAPG Mem*. 90, 421–451.

Fernández-López S. & Meléndez G. 1995: Taphonomic gradients in Middle Jurassic ammonites of the Iberian Range (Spain). [Gradients taphonomiques chez les ammonites du Jurassique Moyen de la Chaîne Ibérique (Espagne)]. *Geobios, M.S*. 18, 155–165.

Houša V. & Nuez M.L. 1972: Hallazgo de ammonites del Kimmeridgiano en Hacienda El Americano (Pinar del Rio). *Actas, Academia de Ciencias de Cuba, Inst. Geol. Paleont*. 2, 14–16.

Iturralde-Vinent M.A. & Pszczółkowski A. 2011: Geología del terreno Guaniguanico. In: Iturralde-Vinent M.A. (Ed.): Compendio de Geología de Cuba y del Caribe. Primera Edición. DVD-ROM. *Editorial CITMATEL*, La Habana, Cuba.

Jach R., Reháková D. & Uchman A. 2012: Biostratigraphy and paleoenvironment of the Kimmeridgian–Lower Tithonian pelagic deposits of the Krížna nappe, Lejowa Valley, Tatra Mts. (southern Poland). *Geol. Quart*. 56, 4, 773–788.

López-Martínez R., Barragán R., Reháková D. & Cobiella-Reguera J.L. 2013: Calpionellid distribution and microfacies across the Jurassic/Cretaceous boundary in western Cuba (Sierra de los Órganos). *Geol. Carpathica* 64, 3, 195–208.

Myczyński R. & Pszczółkowski A. 1990: Tithonian stratigraphy in the Sierra de los Organos, Western Cuba: correlation of the ammonite and microfossil zones. In: Fossili, Evoluzione, Ambiente (Atti del secondo convegno internazionale, Pergola 25–30 ottobre 1987). *Edit. Comitato Cent. Raffaele Piccinini*, 405–415.

Pop G. 1976: Tithonian–Valanginian calpionellid zones from Cuba. *D.S. Şed., Inst. Geol. Geofiz. (3. Paleont.)* 62, 237–266.

Pszczółkowski A. 1978: Geosynclinal sequences of the Cordillera de Guaniguanico in western Cuba; their lithostratigraphy, facies development, and paleogeography. *Acta Geol. Pol.* 28, 1, 1–96.

Pszczółkowski A. 1999: The exposed passive margin of North America in western Cuba. In: Mann P. (Ed.): Caribbean basins. Sedimentary basins of the World, 4 (series editor: Hsü K.J.). *Elsevier*, Amsterdam, 93–121.

Pszczółkowski A. 2013: Comment on "Calpionellid distribution and microfacies across the Jurassic/Cretaceous boundary in western Cuba (Sierra de los Órganos)" by López-Martínez et al. (2013). *Geol. Carpathica* 64, 6, 497–498.

Pszczółkowski A. & Myczyński R. 2010: Tithonian–Early Valanginian evolution of deposition along the proto-Caribbean margin of North America recorded in Guaniguanico successions (western Cuba). *J. South Amer. Earth Sci*. 29, 225–253.