Comment on “Tectonic and environmental factors controlling on the evolution of Oligo-Miocene shallow marine carbonate factories along a tropical SE Circum-Caribbean” by Silva-Tamayo et al. (2017)

E. Albert-Villanueva[(a)*], T. Bover-Arnal[(b)], C. Ferràndez-Cañadell[(c)], R. Salas[(b)]

[(a)]

[(b)]Departament de Mineralogia, Petrologia i Geologia Aplicada, Facultat de Ciències de la Terra, Universitat de Barcelona. Martí i Franquès s/n, 08028 Barcelona, Spain.

[(c)]Departament de Dinàmica de la Terra i l'Oceà, Facultat de Ciències de la Terra, Universitat de Barcelona. Martí i Franquès s/n, 08028 Barcelona, Spain.

*Corresponding author. E-mail adress: eduard.albert@ub.edu

Abstract

Silva-Tamayo et al. (2017) study the Chattian to Langhian carbonate succession of the Siamana Formation in the Cocinetas Basin (La Guajira, Colombia). They identify a change in carbonate factory from mixed photozoan-heterozoan and photozoan associations dominated by corals in the Chattian-early Burdigalian to a heterozoan rhodalgal association in the late Burdigalian-Langhian. To validate the regional scale of this shift in carbonate-producing biota along the southeastern Circum-Caribbean realm, Silva-Tamayo et al. compare the Siamana Formation with the San Luis carbonate succession in the Falcón Basin (NE Venezuela) and the Perla carbonates in the Urumaco Trough (Gulf of Venezuela). Referring to Albert-Villanueva (2016) they state that, as in the case of the Siamana Formation, the carbonates of the San Luis Formation also recorded a change in carbonate-producing biota, from a photozoan/heterozoan carbonate factory in the late Oligocene-early Miocene to a heterozoan/rhodalgal carbonate factory in the middle Miocene. Notwithstanding, Albert-Villanueva (2016) interprets the carbonate units cropping out in the Falcón Basin (San Luis

and Churuguara formations) as early Miocene in age, and the passage from photozoan to heterozoan carbonate factory as a lateral change of facies within the lower Miocene carbonate platforms of the Falcón Basin.

Keywords: early Miocene, carbonate facies, biostratigraphy, Falcón Basin, Venezuela.

Silva-Tamayo et al. (2017) present a detailed sedimentological and stratigraphical study of the Chattian to Langhian shallow-marine carbonate succession of the Siamana Formation in the Cocinetas Basin (La Guajira, Colombia). Strontium isotope ($^{87}Sr/^{86}Sr$) chemostratigraphic data are used to establish sequence- and chronostratigraphic frameworks for the sedimentary record of the Cocinetas Basin. The authors identify three different carbonate-producing associations along the sections studied. According to Silva-Tamayo et al. (2017), the Chattian was characterized by mixed carbonate-siliciclastic sedimentation represented by an alternation of coral-rich limestones and skeletal sandstones. The Aquitanian-early Burdigalian was marked by the development of a rimmed carbonate platform dominated by scleractinian colonies, accompanied by a decrease of siliciclastic supply. Finally, the late Burdigalian-Langhian recorded a demise of coral build-ups and a change towards rhodalgal carbonate production. Silva-Tamayo et al. (2017) associate this shift of carbonate-producing biota with changes in photic and trophic conditions driven by an increase of subsidence and accommodation in the Cocinetas Basin, and by global paleogeographic and paleoclimatic events. They suggest a late Burdigalian-Langhian coral demise throughout the southeastern Circum-Caribbean region related to the combined effect of the tectonic reactivation along the South American-Caribbean plate boundary, the closure of the Panama Seaway and the middle Miocene global warming.

To justify the regional scale of this change in carbonate-producing biota along the southeastern Circum-Caribbean basins, Silva-Tamayo et al. (2017) compare the carbonates of the Cocinetas

Basin (Siamana Formation) with the platform carbonates of the San Luis Formation in the Falcón Basin (NE Venezuela) and the Perla carbonates in the Urumaco Trough (Gulf of Venezuela). In this regard, Silva-Tamayo et al. (2017) make some statements about the San Luis carbonate succession referring to the thesis by Albert-Villanueva (2016). (1) The authors state that in the northern part of the Falcón Basin, the San Luis Formation was deposited during the late Oligocene to middle Miocene times and recorded a shift of the predominant type of carbonate-producing biota, passing from a photozoan/heterozoan carbonate factory in the late Oligocene-early Miocene to a heterozoan/rhodalgal carbonate factory in the middle Miocene. (2) Then, they state that in the southern part of the Falcón Basin the upper Oligocene phothozoan/heterozoan carbonates of the San Luis Formation are paraconformably overlain by the lower Miocene fine-grained siliciclastic succession of the Patiecitos Formation.

The two above-mentioned statements by Silva-Tamayo et al. (2017) regarding to Albert-Villanueva (2016) are commented below:

(1) According to Albert-Villanueva (2016) and Albert-Villanueva et al. (2017) the San Luis Formation is early Miocene in age based on the occurrence of *Lepidocyclina favosa/undosa*, *L. canellei*, *Heterostegina antillea*, *Operculinoides panamensis*, *Miogypsina* aff. *mexicana*, *M.* aff. *gunteri*, *M.* aff. *globulina*, *M.* aff. *panamensis*, *M.* aff. *cushmani*, *Miosorites americanus* and *Annulosorites spiralis* (Fig. 1), and not late Oligocene or middle Miocene as Silva-Tamayo et al. state. Along the same lines, Eames et al. (1962) already ascribed the San Luis Formation to the early Miocene. Besides, for the San Luis Formation (northern Falcón Basin), Albert-Villanueva (2016) describes a lateral facies change from upper ramp coral-dominated deposits (photozoan association) to middle ramp rhodalgal limestones (heterozoan association) (*sensu* James, 1997). In the Churuguara Formation (southern Falcón Basin) (Fig. 1), Albert-Villanueva (2016) characterizes two lower Miocene ramps separated by basinal marly deposits; an Aquitanian ramp dominated by echinoids (heterozoan association) and a Burdigalian ramp, which exhibits a lateral facies change

from upper ramp coral-bearing deposits (photozoan association) to middle ramp rhodalgal carbonates (heterozoan association).

(2) The lithostratigraphic units cropping out in the inverted Falcón Basin were early described by Senn (1935), González de Juana (1938), Wheeler (1963), and more recently by Albert-Villanueva (2016) and Albert-Villanueva et al. (2017). According to all these authors, the San Luis Formation crops out in the northern margin of the Falcón Basin and it consists of a succession of platform carbonates dominated by coralline algae, larger foraminifera and corals with interbedded deltaic deposits of the Patiecitos and Guarabal formations towards the north, while the southern margin of the Falcón Basin is integrated by a mixed carbonate-siliciclastic succession belonging to the Churuguara Formation. The assumption by Silva-Tamayo et al. considering the San Luis and the Patiecitos formations in the southern part of the basin thus contradicts the geological literature about the Falcón Basin.

We are grateful to Silva-Tamayo and co-authors for the references to our work. However, we interpret the platform carbonates of the San Luis and Churuguara formations as early Miocene in age, and the passage from a photozoan association to a heterozoan carbonate factory as a lateral facies change within the lower Miocene carbonate platforms of the Falcón Basin, and not as an late Oligocene to middle Miocene biotic evolution.

Acknowledgements

We thank Repsol Exploración S.A., the Grup de Recerca Reconegut per la Generalitat de Catalunya 2014 SGR 251 "Geologia Sedimentària" and the I + D + i research project CGL2015-69805-P (BIOGEOEVENTS) for financial support.

References

Albert-Villanueva, E., 2016. Facies y secuencias deposicionales mixtas carbonático-siliciclásticas del Mioceno inferior de la Cuenca de Falcón (noroeste de Venezuela) como modelo exploratorio en el Caribe: unpublished Ph.D. dissertation thesis, University of Barcelona, Barcelona, 312 p.

Albert-Villanueva, E., González, L., Bover-Arnal, T., Ferràndez-Cañadell, C., Esteban, M., Fernández-Carmona, J., Calvo, R., Salas, R., 2017. Geology of the Falcón Basin (NW Venezuela). Journal of Maps 13 (2), 491–501.

Eames, F.E., Banner, F.T., Blow, W.H., Clarke, W.J., 1962. Fundamentals of mid-Tertiary stratigraphical correlation. Cambridge Univ. Press, 163 p.

González de Juana, C., 1938. Contribución al estudio de la cuenca sedimentaria Zulia-Falcón. Boletín de Geología y Minería Ministerio de Fomento de Venezuela 2 (2–4), 123–138.

James N.P., 1997. The cool-water carbonate depositional realm. In: James, N.P., Clarke, J.A.D. (eds.) Cool-water Carbonates. SEPM Special Publication 56, 1–20

Senn, A., 1935. Die stratigraphische Verbreitung der Tertiären Orbitoiden, mit spezieller Berücksichtigung ibres Vorkommens in Nord-Venezuela und Nord-Marokko. Eclogae Geologicae Helvetiae 28 (1), 51–373.

Silva-Tamayo, J.C., Lara, M.E., Nana Yobo, L., Erdal, Y.D., Sanchez, J., Zapata, P.A., 2017. Tectonic and environmental factors controlling on the evolution of Oligo-Miocene shallow marine carbonate factories along a tropical SE Circum-Caribbean, Journal of South American Earth Sciences 78, 213–237.

Wheeler, C.B., 1963. Oligocene and Lower Miocene stratigraphy of western and northeastern Falcón basin, Venezuela. American Association of Petroleum Geologists Bulletin 47, 35–68.

Figure Captions

Fig. 1 Distribution of age-diagnostic larger foraminifera species along the mixed carbonate-siliciclastic successions cropping out in the northern and southern margins of the Falcón Basin. The ages and the different lithostratigraphic units are also indicated (modified from Albert-Villanueva, 2016).

Fig. 1 (2-column fitting image)