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Chemostratigraphic and facies characterization of Ediacaran platform carbonates (Tamengo Formation, Corumbá Group): Preliminary results

Caracterización quimioestratigráfica y facies carbonatadas de una plataforma ediacárica, Formación de Tamengo, Grupo de Corumbá: resultados preliminares

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ABSTRACT

This study presents updates and upgrades concerning the stable isotopic register of the Tamengo Formation, upper part of the Corumbá Group, which crops out in the meridional portion of the Paraguay Belt. This work includes detailed stratigraphic sections paired with high-resolution $\delta^{13}C$ and $\delta^{18}O$ geochemistry from two mining sites near Corumbá (Mato Grosso do Sul, Brazil).

Keywords: Carbonate; Chemostratigraphy; Tamengo Formation; Ediacaran; Brazil.

RESUMEN

Este estudio presenta una actualización del registro isotópico de la Formación de Tamengo, parte superior del Grupo Corumbá, que se encuentra en la parte meridional del Cinturón Paraguayo. Este trabajo incluye cortes estratigráficos detallados enlazados con la geoquímica de alta resolución $\delta^{13}C$ y $\delta^{18}O$ de dos yacimientos mineros cercanos a Corumbá (Mato Grosso do Sul, Brasil).

Palabras clave: Carbonate; Quimioestratigrafía; Formación de Tamengo; Ediacárico; Brasil.

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Introduction

The Tamengo Formation comprises carbonate and siliciclastic rocks with highly relevant fossiliferous content of Ediacaran age. Babinski *et al*. (2008) and Parry *et al*. (2017) dated zircons (U-Pb method) from volcanic ash found at the upper Tamengo Formation and obtained ages of 543 ± 3 Ma and ~ 542 Ma, respectively, placing it at the late Ediacaran, close to the basal Cambrian boundary, period of outstanding climatic and evolutionary changes.

The Ediacaran is marked by strong fluctuations in the carbon isotopic record, which are observed at both global and local level, and reach amplitudes greater than 10 ‰ (Grotzinger *et al*., 2011). Variations of this intensity are not observed in other geologic periods and possibly reflect rare biogeochemical events. Knoll *et al*. (2006) and the Subcommission on Neoproterozoic Stratigraphy acknowledge that the $\delta^{13}C$ chemostratigraphy can be a great tool for strata correlation and even definition of the Ediacaran chronostratigraphic limits (Xiao *et al*., 2016). Thus, isotopic studies of $\delta^{13}C$ are essential to establish a better Ediacaran time scale as well as to support palaeogeographic studies.

This work intends to contribute to the validation of the Tamengo Formation $\delta^{13}C$ curve and elevate it to an international standard level. In addition, the detailed stratigraphic sections should provide an enhanced characterization of the palaeodepositional environment and promote Tamengo's correlation with other well-known late Ediacaran sections in South America and worldwide.

Results and discussion

Several sites were observed in the vicinity of Corumbá, then fresh outcrops at Corcal and Laginha Mines were selected, sampled and described for three detailed stratigraphic sections (Fig. 1) paired stable isotope geochemistry, in a scale never published for this unit before, in order to better comprehend its palaeodepositional environment. The limestones are mostly dark gray, range from pure to dirty, are variably recrystallized and some levels are dolomitized. In terms of sedimentary structures, they exhibit massive bedding, various types of cross stratification, from tabular to swaley, as well as erosional surfaces.

The Corcal sections are homogeneous, made of fine grainstones, often containing shell fragments, alternating with siltstones. There are coarser grainstones and fossiliferous rudstones towards the top of the section, as well as possible volcanic ash levels.

The Laginha section, located nearly 12 km southeast of Corcal Mine, on the other hand, exhibits miscellaneous facies. The section starts with dolomitic grainstones from the underlying Bocaina Formation, passes into Tamengo's basal polymictic breccia, and then dolomitic to calcitic mudstones, wackestones, grainstones, and intraclastic breccias interbedded with marls and siltstones. The carbonates often contain extraclasts of various composition, such as quartz and mica.

High-resolution carbon isotopic compositions are very diverse between Corcal and Laginha sections. The lower interval at Corcal starts with $\delta^{13}C$ values between 4.05 and 2.94‰ with a gradual increase to 6.97‰ at 13 m, with a small peak at 5.33 at 10 m. A rapid decrease follows to 4.94‰ at 14 m, and then persists until the end of the section, except for a 5.75‰ peak at 16 m. There are five outliers. The upper section starts and persist with $\delta^{13}C$ values between 3.74 to 5.24‰ throughout the first 10 m, with a negative peak of 4.16 at 3 m. Thenceforth values range from 4.75 to 5.67 until 22 m, where there is a decrease to 3.40‰ followed by an increase to 5.20‰ at 23m and a second and final decrease to 2.83‰ at 24, 6 m.

The Laginha section starts with $\delta^{13}C$ values of 1.53‰ linearly increasing to 3.14‰ at the Bocaina-Tamengo contact. There is a large gap in the register corresponding to the massive polymictic breccia bed. The initial dolostones from Tamengo Formation decline from 0.79 to -0.13‰, followed by a 500 m set of dolostones and limestones with tangled $\delta^{13}C$ signal, ranging from -3.03 to 0.17‰, perhaps on a rising curve. There a second gap due to a massive intraclastic breccia body and the signal comes back at 10.75 m with a value of 1.92‰ followed by -2.74‰ at 11.5 m and an increase to -0.72‰ at 12.5 m. Thenceforth there is a clear negative peak of -2.14‰ at 14.90 m followed by the curve stabilization at values ranging from -0.33 to -0.76‰. There are two outliers at 18.05 and 19.05 m.

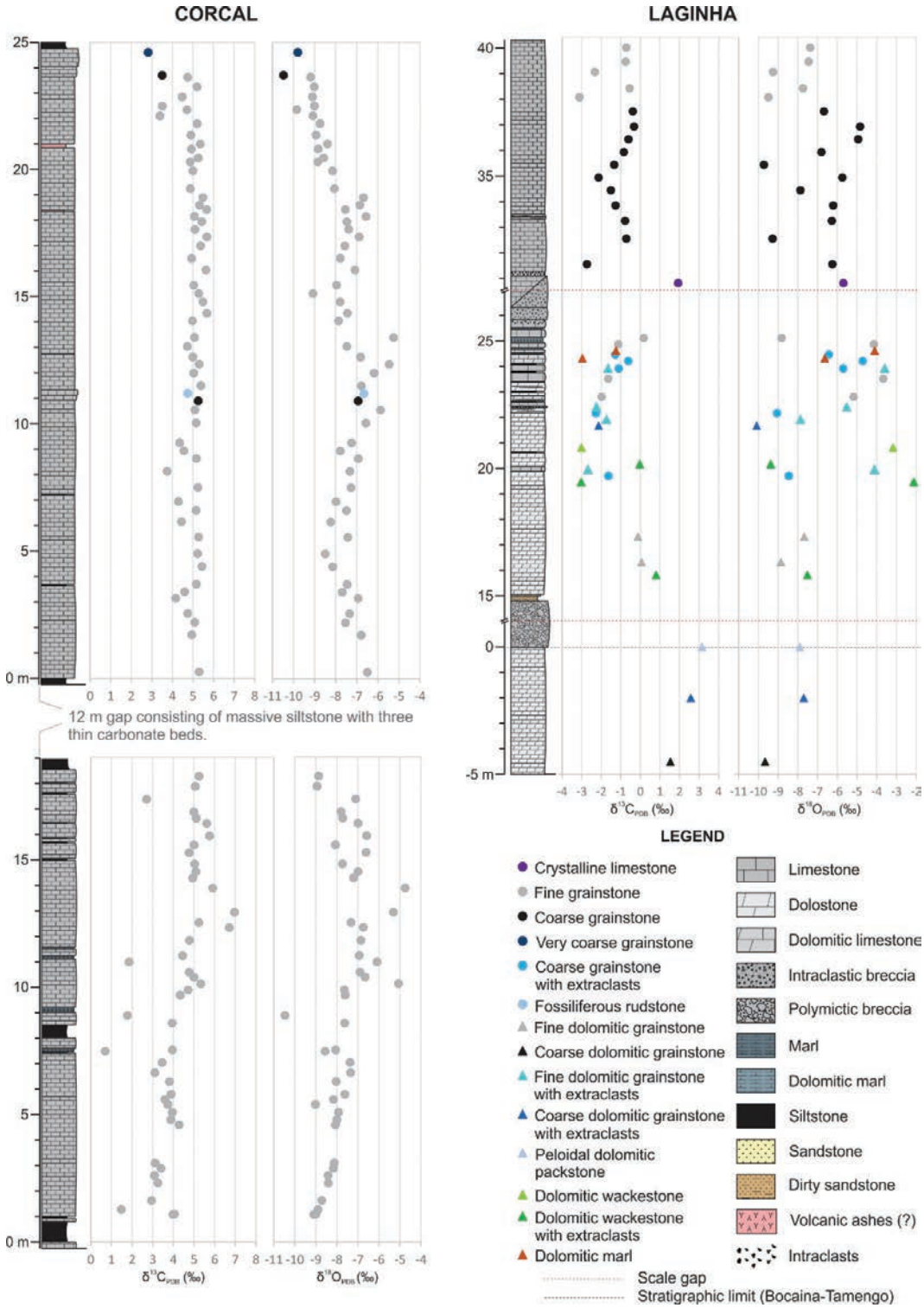

Figure 1.— Stratigraphic sections for Corcal and Laginha mines paired with $\delta^{13}C$ and $\delta^{18}O$ data. The bottom left-hand column is Corcal basal section; top left-hand column is Corcal upper section; top right-hand column is Laginha complete section. The gray dotted line marks the stratigraphic contact between Tamengo Formation and the underlying Bocaina Formation. The red dotted lines signalize break points on the drawing scale. They correspond to portions in which the same lithology extends for many meters.

Concluding remarks

These initial results reveal a homogeneous section at Corcal, in both stratigraphic and isotopic aspects. Laginha section, however, presents a complex isotopic signal and facies heterogeneity, which are not clearly connected. Nonetheless, it is clear that Bocaina and Tamengo formations have distinct isotopic signatures. It is necessary to investigate the origin of the isotopic fluctuations, whether they are related to primary conditions, diagenesis, or a combination of factors.

The $\delta^{13}C$ curves are valuable tools for Neoproterozoic stratigraphic studies, nonetheless should be used with caution. Corcal is suitable for a chemostratigraphic reference section, but Laginha may be better suited to study the effects of paleoenvironmental and diagenetic variations on the isotopic signal.

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