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Program and Abstracts

Major global carbon cycle disturbances unveiled by paired carbon isotopes at the Ediacaran-Cambrian transition of the Bambuí Group (Brazil)

Sergio Caetano-Filho[1], Gustavo M. Paula-Santos[2], Pierre Sansjofre[3], Cristian Guacaneme[1], Ricardo Trindade[4] and Marly Babinski[1]

[1] Instituto de Geociências, University of São Paulo, Brazil, email: sergio.caetano.filho@usp.br
[2] Instituto de Geociências, University of Campinas, Brazil
[3] Institut Universitaire Européen de la Mer, University of Western Brittany, France
[4] Instituto de Astronomia, Geofísica e Ciências Atmosféricas, University of São Paulo, Brazil

The Ediacaran Period encompasses remarkable events in the geological record, such as widespread glaciations, metazoan diversification and deep ocean oxygenation. These events are directly associated with disturbances in the global carbon cycle recorded by the carbon isotope compositions of carbonate ($\delta^{13}C_{carb}$) and organic matter ($\delta^{13}C_{org}$) and their paired signal ($\Delta^{13}C = \delta^{13}C_{carb} - \delta^{13}C_{org}$). Coupled $\delta^{13}C_{carb}$–$\delta^{13}C_{org}$ values became more frequent in the late Ediacaran and are commonly related to variations in the redox state of the water column, changes in the photosynthetic fractionation factor (ε_p), or diagenesis. In this study, we present paired $\delta^{13}C$ data from the lower Bambuí Group, São Francisco Basin (Brazil), to constrain and understand the carbon cycle at local and global scales throughout the Ediacaran-Cambrian transition. The $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ curves present overall coupled behavior throughout the lower Bambuí Group, in which photosynthesis can be considered the main isotopic carbon fractionation process. However, a substantial variation in the carbon isotope fractionation ($\Delta^{13}C = \delta^{13}C_{carb} - \delta^{13}C_{org}$) is observed at the base of succession. Cap carbonates at the base of the stratigraphy showed an anti-covariation with a progressive increase of $\delta^{13}C_{carb}$ associated to a decrease in $\delta^{13}C_{org}$ values (from –4 to –1‰, and –25 to –28‰, respectively), leading to an increase in $\Delta^{13}C$ (23 to 27‰). Despite the possible influence of local controls over the $\delta^{13}C_{org}$ values in this initial marine transgression, increasing $\Delta^{13}C$ values could represent higher ε_p resulting from enhanced atmospheric pCO_2. Towards the top, $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ curves are directly coupled, with a constant $\Delta^{13}C$ of ~27‰. Initially with $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ values around +1.5 and –25.5‰, respectively, in a marine connected stage in the late Ediacaran. Upward, the succession is marked by a positive excursion in $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ with values around +10 and –18‰, respectively. These strongly ^{13}C–enriched values are compatible with an increase in organic carbon burial, in a more restricted stage related to the final Gondwana amalgamation at the Ediacaran–Cambrian transition. However, considering a steady state model, this carbon isotope evolution would correspond to extreme values of organic carbon burial (24 to 52%), therefore suggesting that other processes were involved in the carbon isotope fractionation, such as methanogenesis. The results show that the Bambuí Group potentially records major disturbances in the Ediacaran global carbon cycle, related to the final Gondwana assembly.