

CARBON ISOTOPIC COMPOSITION OF PROXIMAL AND DISTAL SEDIMENTS IN THE VACA MUERTA FORMATION, NEUQUÉN BASIN ARGENTINA (YEAR 2)

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PROJECT OBJECTIVES

- Evaluate the ability to use $\delta^{13}\text{C}$ values from organic material to correlate between different sections within the basin, sections kilometers apart, in both proximal and distal positions.
- Reevaluate the reliability of carbon isotopic values ($\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$) for reconstructing Late Jurassic–Early Cretaceous climatic signals.
- Confirm that $\delta^{13}\text{C}$ values of organic material can be used to correlate coeval sections within a basin more accurately than the $\delta^{13}\text{C}$ values of carbonate.
- Assess the impact of diagenetic processes and localized sedimentary influences on $\delta^{13}\text{C}$ records.
- Integrate legacy ocean drilling core data (NSF Proposal) to understand and resolve existing discrepancies and enhance the reliability of carbon isotopic values to understand global climate of the past.

PROJECT RATIONALE

Understanding the Earth's past climate is critical for deciphering the complex interactions between geochemical cycles and environmental change. Carbon isotopic compositions recorded in sedimentary deposits have long served as proxies for global climatic conditions. However, depositional processes, diagenetic alterations, and localized basin effects can obscure these primary signals, leading to significant discrepancies with the global record.

$\delta^{13}\text{C}$ values of carbonate and organic material within sedimentary deposits have been studied extensively and variations have been interpreted principally as changes in the rates of organic carbon production relative to burial and preservation (Hayes et al., 1999). We have studied the $\delta^{13}\text{C}$ values of organics and carbonates from 800 m of continuous, Late Jurassic to Early Cretaceous strata (~ 15 Myrs) exposed in the Neuquén Basin, Argentina (Rodríguez Blanco et al., 2020; Tenaglia et al., 2020). The data provided a unique opportunity to compare this high-resolution $\delta^{13}\text{C}_{\text{org}}$ record to other published organic carbon isotope records from the same time period sourced in Atlantic, Arctic, and Tethyan sections. The data from the Vaca Muerta showed correlation to several

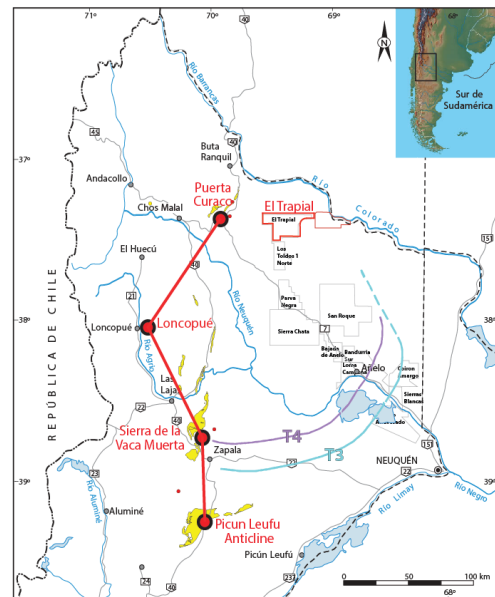


Figure 1: Location of outcrops in the Neuquén Basin.

globally distributed locations that show a large negative isotopic excursion of organic carbon ($\delta^{13}\text{C}_{\text{org}}$) of over 4‰ (V-PDB) and to a minimum of -30.3‰ ; an anomaly that has been named the 'Volgian Isotopic Carbon Excursion' (VOICE).

WORK PROPOSED

We have obtained additional samples from approx. 350m of measured section of outcrops at the Picun Léufú anticline, the Tithonian portion of the Vaca Muerta Formation in a proximal setting. We plan to compare these new samples from proximal locations within the Neuquen Basin to the basinal portions of the Vaca Muerta Formation that we have previously analyzed (Rodriguez Blanco et al., 2022; Weger et al., 2023). In addition, we just submitted a NSF proposal that, if funded, will expand this project and include the analysis of samples from legacy ocean drilling cores alongside those from the Neuquén Basin to re-evaluate the reliability of carbon isotopic values ($\delta^{13}\text{C}_{\text{org}}$ and $\delta^{13}\text{C}_{\text{carb}}$) for reconstructing global Late Jurassic–Early Cretaceous climatic signals.

SIGNIFICANCE

This study represents a combined study of the $\delta^{13}\text{C}$ values of organic and inorganic material found within the Neuquén Basin in Argentina. The $\delta^{13}\text{C}_{\text{org}}$ values appear to be unrelated to the global patterns in $\delta^{13}\text{C}_{\text{carb}}$ values, but they show similarity to patterns seen in $\delta^{13}\text{C}_{\text{org}}$ values at several boreal localities. This study will provide a detailed comparison of $\delta^{13}\text{C}$ values of carbonate and organic carbon and their variations between coeval distal and proximal locations. Key questions to be answered is if changes in $\delta^{13}\text{C}$ values proximal and/or distal behave correlative within the Neuquén Basin and their reliability as global climate proxies.

REFERENCES

- Hayes, J. M., Strauss, H., and Kaufman, A. J., 1999, The abundance of ^{13}C in marine organic matter and isotopic fractionation in the global biogeochemical cycle of carbon during the past 800 Ma: *Chemical Geology*, v. 161, no. 1-3, p. 103-125.
- Rodriguez Blanco, L., Eberli, G., Swart, P., Weger, R., and Tenaglia, M., $\delta^{13}\text{C}$ as a Proxy of Paleoenvironmental Water Conditions During Deposition of the Vaca Muerta Formation (Tithonian–Early Valanginian)—Neuquén Basin, *in* Proceedings 2019 AAPG Annual Convention and Exhibition:2019.
- Rodriguez Blanco, L., Eberli, G. P., Weger, R. J., Swart, P. K., Tenaglia, M., Sanchez, L. E. R., and McNeill, D. F., 2020, Periplatform ooze in a mixed siliciclastic-carbonate system–Vaca Muerta Formation, Argentina: *Sedimentary Geology*, v. 396, p. 105521.
- Rodriguez Blanco, L., Swart, P. K., Eberli, G. P., and Weger, R. J., 2022, Negative $\delta^{13}\text{C}_{\text{carb}}$ values at the Jurassic–Cretaceous boundary–Vaca Muerta Formation, Neuquén Basin, Argentina: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 603, p. 111208.
- Tenaglia, M., Eberli, G. P., Weger, R. J., Blanco, L. R., Sánchez, L. E. R., and Swart, P. K., 2020, Total organic carbon quantification from wireline logging techniques: A case study in the Vaca Muerta Formation, Argentina: *Journal of Petroleum Science and Engineering*, v. 194, p. 107489.
- Weger, R. J., Eberli, G. P., Rodriguez Blanco, L., Tenaglia, M., and Swart, P. K., 2023, Finding a VOICE in the Southern Hemisphere: A New Record of global organic carbon? : *GSA Bulletin*.