



Paleoenvironmental and paleodepositional characteristics of the Longá Formation, Parnaíba Basin, integrating stable isotopes, total organic carbon/total nitrogen ratio (TOC/TN), drilling cuttings description, and well logs interpretation.

Pedro Muriel Torres Raietparvar¹; Jorge Nadir¹; Francisco Romério Abrantes Júnior^{1,2}; Victor Salgado Campos^{1,2}; Cleverson Guizan Silva^{1,2}; Wagner Moreira Lupinacci^{1,2}; Antônio Fernando Menezes Freire^{1,2}

¹Exploratory Interpretation and Reservoir Characterization Group (GIECAR – UFF)

²National Institute of Science and Technology of Petroleum Geophysics (INCT-GP/CNPQ)

Copyright 2023, SBGf - Sociedade Brasileira de Geofísica.

This paper was prepared for presentation during the 18th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, 16-19 October 2023.

Contents of this paper were reviewed by the Technical Committee of the 18th International Congress of the Brazilian Geophysical Society and do not necessarily represent any position of the SBGf, its officers or members. Electronic reproduction or storage of any part of this paper for commercial purposes without the written consent of the Brazilian Geophysical Society is prohibited.

Abstract

Present work applied techniques that relate total organic carbon and total nitrogen ratio (TOC/NT) and the signature of stable isotopes of organic carbon ($\delta^{13}\text{C}_{\text{org}}$) and nitrogen ($\delta^{15}\text{N}$), present in the bulk organic matter (OM), in the Longá Formation, Parnaíba Basin, NE Brazil, associate with well log interpretation and drilling cuttings description. These geochemical analyzes are widely applied to infer the origin of OM in Cenozoic marine sediments, but the use in older sedimentary rocks is quite unprecedented. The relationship between TOC content (wt %) and NT content (wt %) leads to interpretations of both marine organic productivity and the contribution of continental organic material which, combined with the signature of $\delta^{13}\text{C}_{\text{org}}$ and $\delta^{15}\text{N}$, provides inferences about the origin of OM in sediments. This geochemical behavior is unknown, however, in older rocks. The main objective of this work is to infer paleoenvironmental and paleodepositional characteristics during the Longá Formation sediments deposition, applying this technique to Paleozoic rocks from the Parnaíba Basin, integrating with well logs interpretation. For this purpose, drilling cuttings from wells of the Parque dos Gaviões gas field were used. The integration of geological, geophysical, and geochemical data resulted in the construction of an approximate curve (proxy) of sea level variation, based on qualitative data, since it is possible due to the differences between terrestrial OM and marine OM, based on these proxies. In general, TOC/TN >20, $\delta^{13}\text{C}_{\text{org}}$ >25‰, and negative $\delta^{15}\text{N}$ values are associated to delivered terrestrial OM; on the other hand, TOC/TN <20, $\delta^{13}\text{C}_{\text{org}}$ <22‰, and positive $\delta^{15}\text{N}$ values are associated to in situ marine OM. Intermediate values referring to mixtures. Inputs of continental organic material, associated with siliciclastic sediments from river influxes, are common in periods of lowstand tracts or strong rainfall on the continent, while highstand or transgressive tracts provide autochthonous marine organic matter deposition. Specifically, we identify stratigraphic surfaces and cycles in the muddy intervals of the Longá Formation. Our proposal is to infer chemofacies and eletrofacies by both manual and artificial intelligence for training well logs for paleodepositional/paleoenvironmental interpretation in other wells of the Parnaíba Basin.

KEYWORDS: Drilling cuttings; TOC/TN ratio; $\delta^{13}\text{C}_{\text{org}}$; $\delta^{15}\text{N}$; Paleoenvironments; Paleodepositional settings.