Was the Brazilian Romualdo Formation (Aptian-lower Albian) ever marine? Integrated paleoecologic and isotopic data suggest otherwise

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Abstract

The Romualdo Formation of the Araripe Basin represents one of the innermost records of the first stage of the post-Rift sequence of the opening of the Atlantic Ocean. Due to its fossil record comprising several well-preserved large vertebrate taxa, traditionally associated to marine environments, it is common to associate its deposition to shallow marine paleoenvironments. This interpretation is further supported by the presence of coquina levels, rich in bakevellid bivalves, echinoids, and nannofossils in the upper layers of this unit. However, several of the aforementioned groups present very little diversity compared to open sea environments, a feature that is even more evident when considering the Foraminifera, Decapoda, and, most of all, Ostracoda of the Romualdo formation, dominated only by the species *Harbinia micropapillosa*. The dominance of this taxon among ostracoda allowed for retrieving material sufficient for extensive C and O isotopic analyses to study what types of paleoenvironments were the most common in representative sections of the Romualdo Formation. In the present work, we evaluated populations from several outcrops, namely the Pedreira Vitória, Campo Belo, and Santo Antônio in the Pernambuco state, and the Sobradinho in the Ceará State. Eodiagenetic processes (dissolution/cementation) were effective in modifying isotopic signals only from specimens collected at the Pedreira Vitória and Campo Belo outcrops, which are, in terms of lithology, representative of more proximal, riverine to delta paleoenvironments. In the Santo Antonio and Sobradinho sections, the lithofacies are more lagoonal to transitional in character, diagenesis had little or no effect on fossil specimens recovered, and the isotopic signals recorded are closer to the expected during deposition. Additional specimens from the Sobradinho section display very light $\delta^{1}O$ values (between –11‰ and –17.5‰) that may be indicative of interaction with subsurface fluids after burial (as the presence of sulfur also suggests). When considering only samples with a weak diagenetic signal, present results are comparable with previous ones observed in other outcrops of Aptian-early Albian age, from the Araripe Basin. Proxies obtained in carbonates from the underlying Crato Formation also demonstrate variation in isotopic signatures expected for shallow paleoenvironments, such as coastal, playa and/or hypersaline

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lakes as well as sabkhas. Similar results are encountered in previous ostracods and benthic foraminifera analyses from the Cedro, Arrojado, and Canastra outcrops of the Romualdo Formation, to which transitional to restricted marine paleoenvironments were proposed. The paleoenvironmental interpretation of hypersaline lakes, however, is not consistent with the sedimentological or paleoecological record of the Romualdo Formation. In this unit, the extensive presence of levels rich in organic matter, interbedded with calcareous concretions and containing abundant and poorly diverse ostracod faunas, indicates brackish paleosalinity. Therefore, the hypothesis of a restricted lagoon system, with very marginal marine influence, makes a more plausible alternative, even for outcrops in the southeastern portion of the basin – the traditional pathway to seaway transition in previous paleoenvironmental models. In this newly envisioned scenario, the presence of the aforementioned macrofossils in the Romualdo Formation paleoenvironments would result not from its usage as an everyday ecological niche, but instead as an occasional breeding ground for these organisms, similar to the role played by mangrove forest ecosystems in present-day littoral and bay areas.

Keywords: Romualdo Lägerstatte, Brazilian pre, salt, brackish ostracoda, isotope geology, mangrove origins