

**Primeira ocorrência de camarões fósseis (crustácea, Decápoda) na Formação Ipubi
(Cretáceo inferior, Bacia do Araripe)**

**The first occurrence of fossil shrimps (Crustacea, Decapoda) in the Ipubi
Formation (Lower Cretaceous, Araripe Basin)**

**La primera aparición de camarones fósiles (Crustacea, Decapoda) en la Formación
Ipubi (Cretácico Inferior, Cuenca de Araripe)**

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Resumo

A Formação Ipubi da Bacia do Araripe é uma importante reserva de gipsita cujo ambiente resultou na deposição de evaporitos com estreitas lentes de folhelho escuro. O objetivo do presente trabalho foi apresentar a primeira ocorrência de camarões carídeos para os níveis de folhelho escuro da Formação Ipubi. O espécime coletado em campo e analisado em laboratório embora não tenha alcançado uma determinação taxonômica detalhada, torna-se

importante porque é o primeiro crustáceo decápode encontrado nessa formação. Acreditamos que o espécime LPU-0918/A e B é um carídeo, devido ao seu segundo somito abdominal ter uma pleura fortemente arredondada na base e sobrepor o primeiro e o terceiro somito. O conhecimento sobre camarões fósseis ainda é escasso, e as informações aqui apresentadas podem ser valiosas para a compreensão da história evolutiva dos carídeos.

Palavras-chave: Crustáceo; Carídea; Fósseis; Grupo Santana; Gipsita.

Abstract

The Ipubi Formation of the Araripe Basin is an important gypsum reserve whose environment had resulted in the deposition of evaporites with narrow black shale lenses. The objective of the present work was to present the first occurrence of caridean for the dark shale levels of the Ipubi Formation. The specimen collected in the field and analyzed in the laboratory, although not achieving a detailed taxonomic determination, is a very important one because it is the first decapod crustacean found in this formation. We believe the specimen LPU-0918/A and B, is a caridean because of its second abdominal somite having a strongly rounded pleura in the base and it overlaps the first and the third. The knowledge about fossil shrimps is still sparse, and the information presented here can be valuable to the understanding of the evolutive history of the carideans.

Keywords: Crustacean; Carídea; Fossils; Santana Group; Gypsum layer.

Resumen

La Formación Ipubi de la Cuenca de Araripe es una importante reserva de yeso cuyo ambiente resultó en la deposición de evaporitas con lentes estrechas de esquisto oscuro. El objetivo del presente trabajo fue presentar la primera aparición de camarones carídeos para los niveles de lutita oscura de la Formación Ipubi. El espécimen recolectado en campo y analizado en laboratorio, aunque no ha logrado todavía una determinación taxonómica detallada, quedase importante por ser el primer crustáceo decápodo encontrado en esta formación. Creemos que el espécimen LPU-0918/A y B es un carídeo, debido a que su segunda somita abdominal tiene una pleura fuertemente redondeada en la base y se superpone a la primera y tercera somita. El conocimiento sobre el camarón fósil aún es escaso y la información presentada aquí puede ser valiosa para comprender la historia evolutiva de los carídeos.

Palabras clave: Crustaceo; Carídea fósiles; Grupo Santana; Yeso.

1. Introduction

The Ipubi Formation, an intermediate unit of the Santana Group, composed of evaporites, interspersed by lenses of dark shales, deposited in a lacustrine environment with a semi-arid climate, and comprises lenses of evaporites (gypsum) and associated facies, forming a sedimentary section with a maximum thickness of 30m, interdigitated with grayish-green shales, carbonates, and fine sandstones. In the western portion of the basin, the unit is more developed, especially in the municipalities of Ipubi, Trindade, and Araripina (Assine et al., 2014). At levels of dark shales, fossil impressions of fish, plants, and ostracods are easily found (Barros et al., 2016).

Preservation of shrimps is difficult to occur in the fossil record, considering its susceptibility to decomposition (Feldmann & Pole, 1994).

Records of preserved shrimps in shales of the Santana Group were first reported by Viana & Agostinho (1995), positioned stratigraphically at the top of the Romualdo Formation, in the municipality of Santana do Cariri.

In the Santana Group (Romualdo and Crato Formations) it is possible to find these two units' several decapods: in the Crato Formation; *Beurlenia araripensis* is recorded in laminated limestones (Martins-Neto & Mezzalira, 1991); in the Romualdo Formation, six species of shrimps; *Paleomattea deliciosa*, *Kellnerius jamacaruensis*, *Araripenaeus timidus*, *Sume marcosi*, *Priorhyncha feitosa*, *Cretainermis pernambucensis* (Maisey & Carvalho, 1995; Santana et al., 2013; Pinheiro et al., 2014; Saraiva et al., 2018; Alencar et al., 2018; Prado et al., 2019) and three crabs; *Araripecarcinus ferreirai*, *Exucarcinus gonzagai*, *Romualdocarcinus salesi* (Martins-Neto, 1987; Prado et al., 2018) were found in limestone concretions.

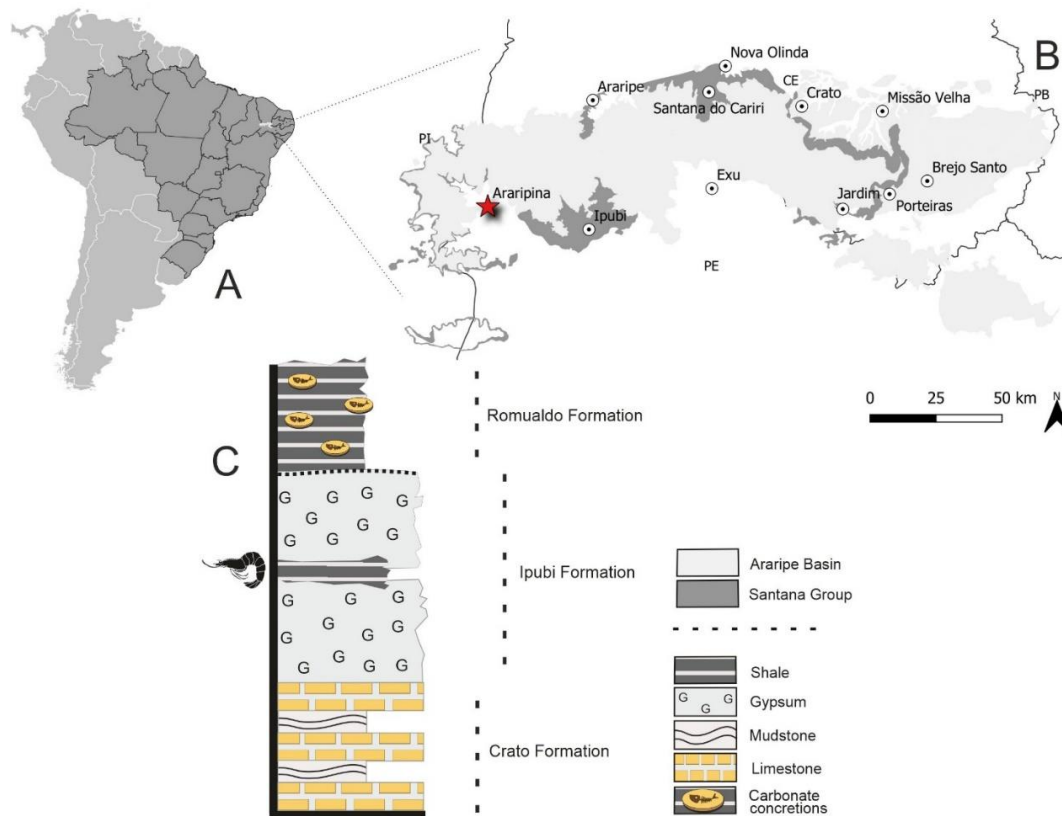
The Ipubi Formation crustaceans are known only by the group's conchostracan and ostracods (Coimbra et al., 2002; Hessel et al., 2006).

Little has been published on the paleontological layers of the Ipubi Formation. In this research the objective was to present the first occurrence of shrimps for the dark shale levels from the Ipubi Formation, incorporating a new taxonomic group for this stratigraphic level. This study began when it was found the first decapod crustaceans of the formation, a strong indication we will find new materials and, most likely, new species in this formation (see Oliveira et al., 2015; Barros et al., 2019).

2. Material and Methods

The material studied here was collected in a mining area of calcium sulfate (Rancharia mining), municipality of Araripina, Pernambuco State, 07°44'51.1" S; 040°28'11.2" W, Araripe Basin of northeastern Brazil (Figure 1).

Figure 1. (A) Geographic location of the Araripe Basin, northeastern Brazil, (B) Featured in the Araripina city, locality of the collect the fossiliferous samples, (C) generalized lithological of the Santana Group with featured fossil shrimp in dark shales from Ipubi Formation.



Drawing: Olga A. Barros.

We collected the samples with the help of a backhoe for the extraction of a dark shale occurring below the gypsum layer.

It was deposited in the Laboratory of Paleontology (LPU) of the Universidade Regional do Cariri (URCA), the best-preserved shrimps with numbers LPU-0918/A, 0918/B, LPU-

0303, LPU-0304, LPU-0306, and LPU-0307. We chose the sample 0918/A and 0918/B to carry out the description of the specimen because it has a better state of preservation when compared to the other specimens found at the same stratigraphic level.

In laboratory, mechanical preparations were made to the sample using a trinocular microscope, Olympus C011 and to capture the images the infinity capture program was used. The specimen was measured and illustrated using a stereomicroscope with a Camera Lucida and a drawing table, Parblo A610 – Graphic Tablet.

3. Systematic palaeontology

Subphylum CRUSTACEA Brünnich, 1772

Order DECAPODA Latreille, 1892

Suborder PLEOCYEMATA Burkenroad, 1963

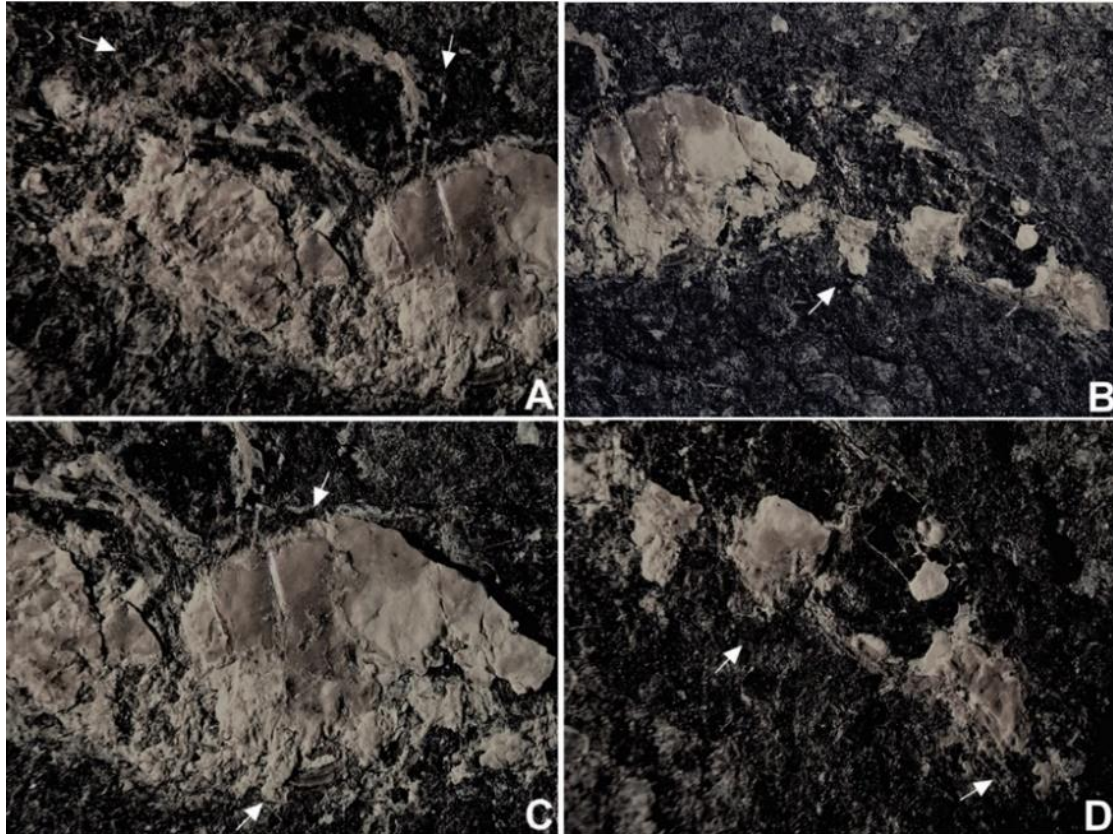
Infraorder CARIDEA Dana, 1852

LPU-0918/A and 0918/B (Figures 2-6)

Material: Shrimp LPU-0918/A and B

Description: Fossil preserved in lateral view. The total length of 22 mm. It's preserved carapace with strong diagenesis and high compaction. Ocular peduncles were not preserved, but the structure observed in the cephalothorax resembled the ocular orbit (Figure 2).

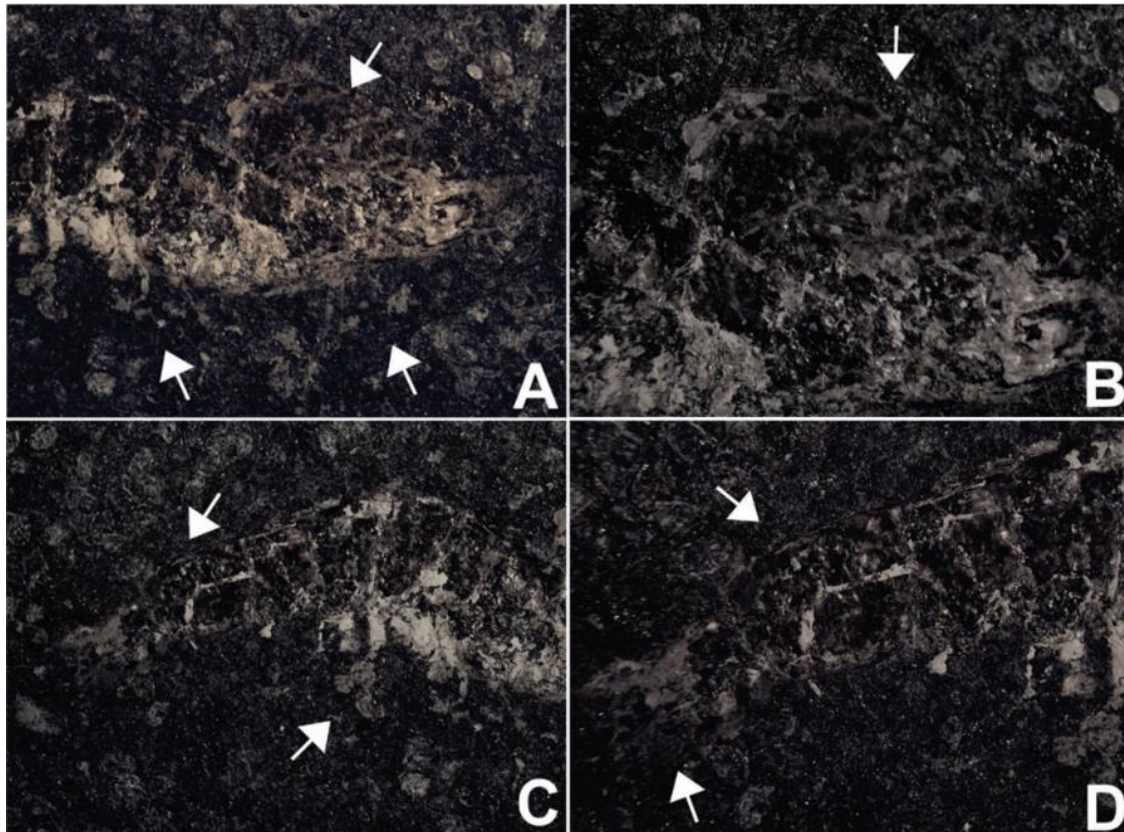
Figure 2. LPU 0918/A, A) with emphasis on ocular structure, antenna, and antennule, B) Emphasis on part of the pleopods preserved. C) Detail of the second abdominal somite with the strongly rounded base and has one expressive groove. D) Detail of the last abdominal somites is shorter with an emphasis in the small proximal fragment of uropods and telson faintly preserved.



Photos in grayscale by Olga A. Barros, disponible:
<https://data.mendeley.com/datasets/mmnk9kws84/1>

LPU- 0918/B is possible to observe the detail of the cephalothorax part preserved above of the shrimp, for more detail see data base (Barros, 2020). Rostrum, spines of the carapace, and scaphocerite were not preserved. The antennas and antennules were preserved but had been curved above the carapace and fragmented. Pleon laterally compressed, six-segmented, all somites apparently without spines. The first pleonal somite also suffered strong diagenesis and high compaction. The second pleonal somite has one expressive groove, it is possible to observe that the base of this somite is strongly rounded as in the carideans, the pleura is well developed and the second pleura covering first and third (Figures 3 to 5).

Figure 3. Shrimp LPU - 0918/B, A) With an emphasis on partially preserved pleopods, pereopods, and carapace, B) The detail on the cephalothorax part that was preserved above of the shrimp, C) Shrimp with emphasis on the sixth abdominal somite and pereopods partially preserved, D) Arrow showing the last abdominal somite and structure partially preserved that is the possibility it is uropods.



Photos in grayscale by Olga A. Barros, disponible:
<https://data.mendeley.com/datasets/mmnk9kws84/1>

The third pleonal somite was partially preserved and has a larger size. The fourth and fifth pleonal somites appear to be of the same size. At the base of the fourth and fifth somites, part of the pleopods is preserved, making it difficult to conclude where the somite ends and pleopods begin. In the sample, LPU-091/B it is easier to observe the termination of the somite, where the specimen's rounded base abdominal pleura can be seen (Figure 4).

Figure 4. (A) Lateral view of the Shrimp LPU – 0918/A, (B) Detail of the parts preserved, the antennas and antennules have been partially preserved but are curved above the carapace and fragmented, (C) Detail of the drawings and six abdominal somites showing the overlap of the seconds over first and third (note the groove on the second and third abdominal somites). The fourth and fifth somite the same size. At the base of the fourth and fifth somites, part of the pleopods is preserved, making it difficult to conclude where the somite ends and pleopods begin. The sixth abdominal somite is shorter than the others.

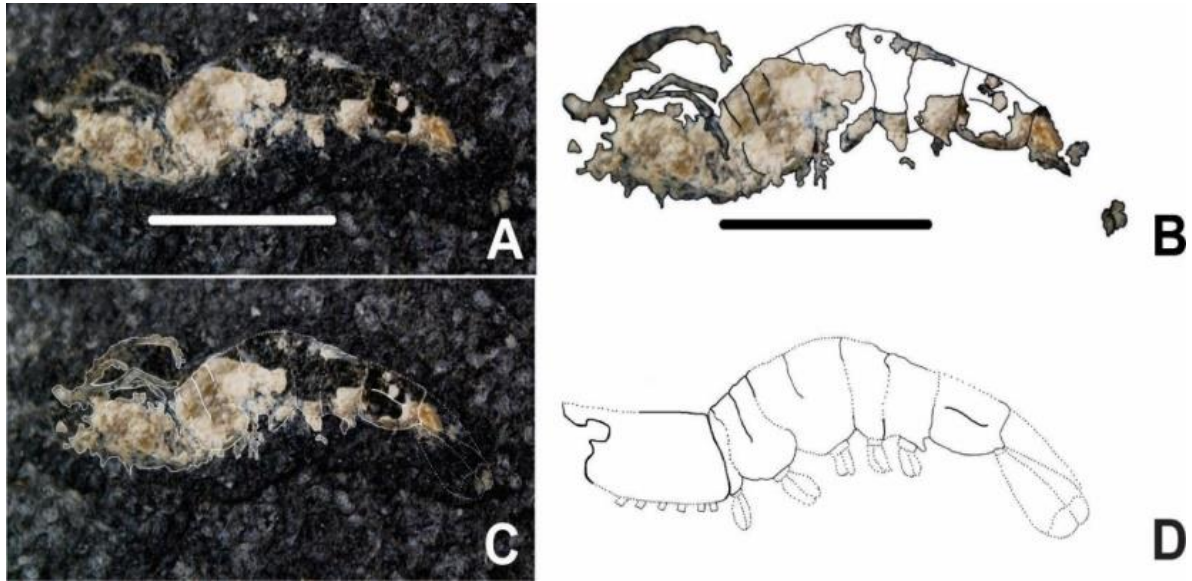


Photo and drawing by Olga A. Barros, bar: 10mm. Disponible:
<https://data.mendeley.com/datasets/mmnk9kws84/1>

The sixth pleonal somite is shorter than the others and it preserved a fragment of the pereopods over the somite. Other appendages were not preserved, only a small proximal fragment of uropods and telson were faintly preserved (Figure 5).

Figure 5. (A) Lateral view of the Shrimp LPU-0918/B, (B) Detail of the parts preserved with drawing over the photo. Detail of the cephalothorax part that preserved over the shrimp, (C) Schematic drawing over photo emphasizing the interpretation of the fossil, detail of the carapace and six abdominal somites showing the overlap of the second over first and third (note the groove on the second and third abdominal somite). The sixth abdominal somite is shorter than the others and it preserves a fragment of the pereopods over the somite, (D) Reconstitution of fossil shrimp from Ipubi Formation.

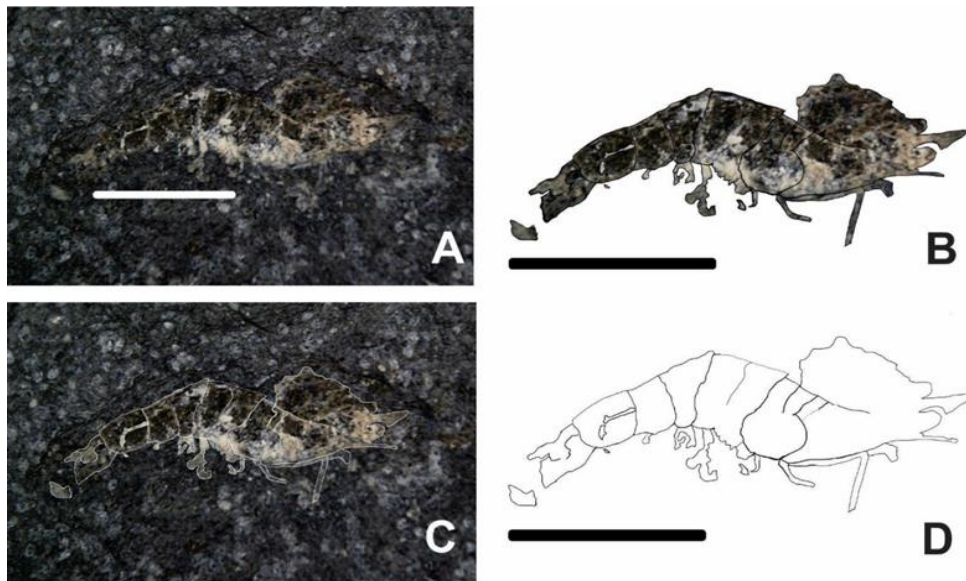


Photo and drawing by Olga A. Barros, bar: 10mm. Disponibile:
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4. Discussion

We can find several works about shrimp in the Santana Group (Martins-Neto & Mezzalira, 1991, Maisey & Carvalho, 1995; Saraiva et al., 2009; Santana et al., 2013; Pinheiro et al., 2014; Saraiva et al., 2018; Alencar et al., 2018; Prado et al., 2019, Alencar et al., 2020) but only two carideans *Beurlenia araripensis*, *Kellnerius jamacaruensis* (Martins-Neto & Mezzalira, 1991; Santana et al., 2013). We believe the specimen LPU-0918/A and B, is a caridean because of its second abdominal somite have a strongly rounded pleura on the base and apparently overlap, the first and the third. Although the antennae and chela of the first pereopod are not discernible on the material, it is possible to suggest that this decapod is possibly a Palaemonidae.

In the specimen LPU-091/A and B, the third pleonal somite has a groove, not extending to the pleurite, and its size is twice as large as the other somites like *Kellnerius*

jamacaruensis. The pleonal somites IV and V appear to be relatively the same size, but it does not appear to have somites with strongly acute pleura like *Beurlenia araripensis*. The specimen LPU-918/A and B has a shorter sixth pleonal somite compared to the *Kellnerius jamacaruensis*. We believe it to be possible because of the angulation of the specimen preserved in the rock. Even LPU-091/A and B having a single groove clearly visible in the second somite, which distinguishes it from the other described carideans for the Araripe Basin, it is difficult to sustain and suggest a new species due to the fragmentary nature of the sample, but here we point out the occurrence of caridean from the Ipubi Formation, composing a new taxon for this formation.

Some specimens found were mostly fragmented and incomplete, containing only whitish imprints of the abdominal segments on the shale, without anatomical details that could facilitate the identification of the specimens described here, reflecting either their rarity or the difficulty in finding morphologically informative specimens. Also, we found on this level traces of fish, ostracods, coprolites, and vegetables. The samples LPU-0303, LPU-0304, LPU-0306, and LPU-0307 had partially preserved cephalic appendages, pleopods, and abdominal somites and were cited here for corroborating paleoenvironmental inferences for the Ipubi Formation. The other specimens, LPU-0918/A, and 0918/B (Figures 3 and 4) were described in detail here.

5. Conclusion and Suggestions

Here we provide new data about fossil decapods from the Santana group. The recent fieldwork carried out in the Ipubi Formation enabled the discovery of new taxa for these shale levels, thus showing the fossiliferous potential that this layer presents. Even with a few anatomical characters preserved, we emphasize here the importance of discovering the taxon found in this formation. The knowledge about fossil shrimps is still sparse, and information presented on this fossil from the Ipubi Formation can be valuable to the understanding of how the evolutive history of the caridean correlate with space and time in the geological record.

So far, Carideans have been reported at two distinct levels in the Santana Group (Crato and Romualdo Formation) by two genera, *Beurlenia araripensis*, and *Kellnerius jamacaruensis*. With the new occurrence of caridean shrimp from the Ipubi Formation, we affirmed this fossil group lived in the three layers from Santana Group (Crato, Ipubi and Romualdo Formation) from Araripe Basin, with different water stresses, and they adapted to

the change of salinity tolerance observed by the three layers of occurrence of caridean in the geological and paleontological setting.

It is worth mentioning that the Ipubi Formation requires special attention, the significant quantities of crustaceans collected in the area showed the importance of this fossil layer, and new collect is necessary for a more intense investigation of this fossil group.

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