Revista Brasileira de Paleontologia, 21(2):105–111, Maio/Agosto 2018
The Journal of the Brazilian Society of Paleontology
CC BY

doi:10.4072/rbp.2018.2.01

NEW OLIGOCENE CYPRIDIDAE SPECIES (CRUSTACEA, OSTRACODA) FROM THE TREMEMBÉ FORMATION, TAUBATÉ BASIN, BRAZIL, AND THEIR PALEOLIMNOLOGICAL SIGNIFICANCE

CRISTIANINI TRESCASTRO BERGUE
Centro de Estudos Costeiros Limnológicos e Marinhos - CECLIMAR, Universidade Federal do Rio Grande do Sul, Avenida Tramandaí 976, 95625-000, Imbé, RS, Brazil.
ctbergue@gmail.com

MARIA INÊS FEIJÓ RAMOS
Museu Paraense Emílio Goeldi, Avenida Perimetral 1901, 66077-830, Belém, PA, Brazil.
mramos@museu-goeldi.br

MARIA DA SAUDADE ARAÚJO SANTOS MARANHÃO
Instituto Geológico do Estado de São Paulo, Rua Joaquim Távora 822, 04015-001, São Paulo, SP, Brazil.
paleontologiams@ig.com.br

ABSTRACT – Two new Oligocene ostracod species, *Eucypris lobatoi* sp. nov. and *Potamocypris taubatensis* sp. nov., are herein proposed. This is the first fossil record of these genera in Brazil, and the species identified occur in two distinct phases of the Tremembé Paleolake. It is assumed that *Eucypris lobatoi* sp. nov. has lived in the oldest and more stable phase of the lake, *Potamocypris taubatensis* sp. nov., in the youngest and more unstable phase. These data support a previous ostracod-based paleolimnological interpretation which sustains a shallowing trend in the paleolake during the final deposition of the Tremembé Formation.

Keywords: Oligocene, taxonomy, paleolimnology, South America.

RESUMO – Duas novas espécies de ostracodes, *Eucypris lobatoi* sp. nov. e *Potamocypris taubatensis* sp. nov., são propostas neste trabalho. Este é o primeiro registro fóssil destes gêneros no Brasil, cujas espécies identificadas ocorrem em duas fases distintas do Paleolago Tremembé. *Eucypris lobatoi* sp. nov. ocorre durante a fase mais antiga e estável do paleolago, enquanto *Potamocypris taubatensis* sp. nov., na fase mais recente e instável. Estes dados corroboram uma interpretação paleolimnológica prévia baseada em ostracodes que sustenta uma tendência de raseamento do paleolago durante o final da deposição da Formação Tremembé.

Palavras-chave: Oligoceno, taxonomia, paleolimnologia, América do Sul.

INTRODUCTION

Although Cretaceous non-marine ostracods are fairly well studied in Brazil (*e.g*. Ramos *et al*., 2006; Do Carmo *et al*., 2008, 2013; Antonietto *et al*., 2012; Queiroz Neto *et al*., 2014; Thomé *et al*., 2014; Guzmán-González *et al*., 2016), this is not the case for Cenozoic assemblages, whose data now available are mostly restricted to the Neogene of the Northern region (*e.g*. Purper, 1979; Purper & Pinto, 1983; Purper & Ornellas, 1991; Muñoz-Torres *et al*., 1998; Whatley *et al*., 1998; Ramos, 2006; Linhares *et al*., 2011; Gross *et al*., 2013).

The ostracods of the Tremembé Formation have been recorded for the first time by Guimarães (1928). Subsequently, the occurrence of this fossil group was mentioned by other researchers (*e.g*. Brito & Ribeiro, 1975; Bernardes-de-Oliveira *et al*., 2002), yet it has never been studied. The first work published on ostracods of the Tremembé Formation was that by Bergue *et al*. (2015b), who obtained some paleolimnological inferences based on the taxonomic study of 16 species. This implies that much is still to be done concerning the study of ostracods in this basin. Thus, this work supplies new data on the ostracods from the Tremembé Formation, as part of a broader effort initiated by Bergue *et al*. (2015a,b), whose objective is to depict the paleolimnological history of the Taubaté Basin based on ostracods and cladocerans.

GEOLOGICAL SETTING

The Taubaté Basin originated from a tectonic lake and lies between the Serra do Mar and Serra da Mantiqueira mountains in the São Paulo State, Southeastern Brazil (Figure 1). It is positioned in NE-SW direction, and is part of the Southeast Brazilian Continental Rift (Riccomini *et al.*, 2004), where a step fault system generated a half-graben. Marques (1990) published the first detailed tectonic-sedimentary study on this basin proposing its subdivision into four sub-basins, as follows: Eugênio de Melo, Quiririm, Roseira and Lorena. Another contribution to the tectonic knowledge of the basin was published by Carvalho *et al*. (2011), who characterized its pre-Cambrian basement using seismic, and gravimetric and core data.

The remarkably fossiliferous Tremembé Formation is composed predominantly by lacustrine facies made up by greenish massive claystones, rhythmites of shales and marl dolomites, and sandstones reaching, at its depocenter, 500 m thickness (Riccomini *et al*., 2004). It corresponds, according to Riccomini & Coimbra (1992), to a playa-lake depositional system, which lies in the central part of the Taubaté Basin. Cognè *et al*. (2013) proposed that the Taubaté Basin developed in four phases, the deposition of the Tremembé Formation being included in the third one, during a period of tectonic quiescence. The Oligocene age of this unit was firstly proposed by Paula-Couto & Mezzalira (1971) and subsequently confirmed in palynological studies by Lima *et al*. (1985) and Chagas *et al*. (2009).

MATERIAL AND METHODS

The 14 samples herein studied are from a 115 m core of the "Projeto Piloto de Recarga Artificial da Bacia do Rio Una, Município de Taubaté" drilled at the coordinates 45°30'34"W/23°01'49"S in Taubaté, São Paulo State. The sampling intervals of the core were selected according to their lithologic composition, which mostly correspond to shales, argillites and sandstones. A total of 500 g of sediment from each sample was disaggregated with hydrogen peroxide and washed through sieves between 0.062 and 0.250 mm. All the ostracods from the fractions above 0.18 mm were picked and mounted in paleontological slides for study. Specimens representative of the taxa herein described were selected for images in a *Field* emission scanning electron microscope at Laboratório Central de Microscopia e Microanálise of Pontifícia Universidade Católica do Rio Grande do Sul (LabCEMM/PUCRS). Images in optical microscopy were obtained at Laboratório de Microfósseis Calcários of Universidade Federal do Rio Grande do Sul.

SYSTEMATIC PALEONTOLOGY

The suprageneric taxonomy herein adopted is based on Karanovic (2012). The specimens illustrated are held both at Museu de História Geológica do Rio Grande do Sul, Universidade do Vale do Rio dos Sinos (**UNISINOS**, ULVG 11514), and Museu de Paleontologia, Universidade Federal do Rio Grande do Sul (**UFRGS**, MP-O-2759 to MP-O-2766).
Morphological abbreviations: C, carapace; **RV**, right valve; **LV**, left valve; **l**, length; **h**, height; **w**, width.

Suborder CYPRIDOCOPINA Jones *in* Chapman, 1901
Superfamily CYPRIDOIDEA Baird, 1845
Family CYPRIDIDAE Baird, 1845
Subfamily EUCYPRIDINAE Bronshtein, 1947

Eucypris Vávra, 1891

Type species. *Monoculus virens* Jurine, 1820.

Eucypris lobatoi sp. nov.
(Figures 2A–J)

2015b *Eucypris* sp. 1 Bergue, Fauth & Maranhão, p. 1534, figs. 4.1-3.

Etymology. In honor of the writer José Bento Monteiro Lobato, born in the Taubaté Municipality, and a rouser of the Brazilian oil industry.
Type material. Holotype: MP-O-2759, female C, l: 1.1 mm, h: 0.58 mm, w: 0.47 mm; Paratypes: ULVG 11514, male C, l: 1.12 mm, h: 0.56 mm, w: 0.44 mm; MP-O-2760, female LV, l: 1.08 mm, h: 0.58 mm; MP-O-2761, male LV, l: 1.15 mm, h: 0.58 mm, and MP-O-2762, juvenile LV (?A-1), l: 0.95 mm, h: 0.50 mm.
Diagnosis. Carapace smooth, with broad anterior margin and feeble overlap in its upper portion. Duplicature narrow.
Age. Oligocene.
Type locality. Tremembé Formation, Taubaté Basin, sample 71.5 m core depth, 45°30'34"W/23°01'49"S.
Material. 249 valves and 03 carapaces of both adults and juveniles.
Description. Carapace subtriangular-elongate in lateral view. Maximum height near to the anterior cardinal angle. Dorsal margin straight; ventral margin slightly sinuous in the middle. Anterior margin broad, corresponding approximately to one third of the carapace, rounded in the lower half and oblique in the upper; posterior margin shorter than anterior margin, rounded in the lower half and oblique in the upper one. LV larger than RV, with feeble overlap in the upper half of the anterior margin. Fusiform outline in dorsal view, with maximum width in the middle. Surface smooth, somewhat inflated in the middle portion with abundant and evenly scattered normal pore canals (see Figure 2I). Internal features: Anterior duplicature narrow and posterior one poorly developed. Muscle scars and marginal pore canals hardly visible due to recrystallization (see Figure 2J). Only the mandibular scars are visible and short and numerous pore canals are visible in the anteroventral part. Hinge adont. Sexual dimorphism present: The lower, narrower and slightly longer specimens are assumed to be males.

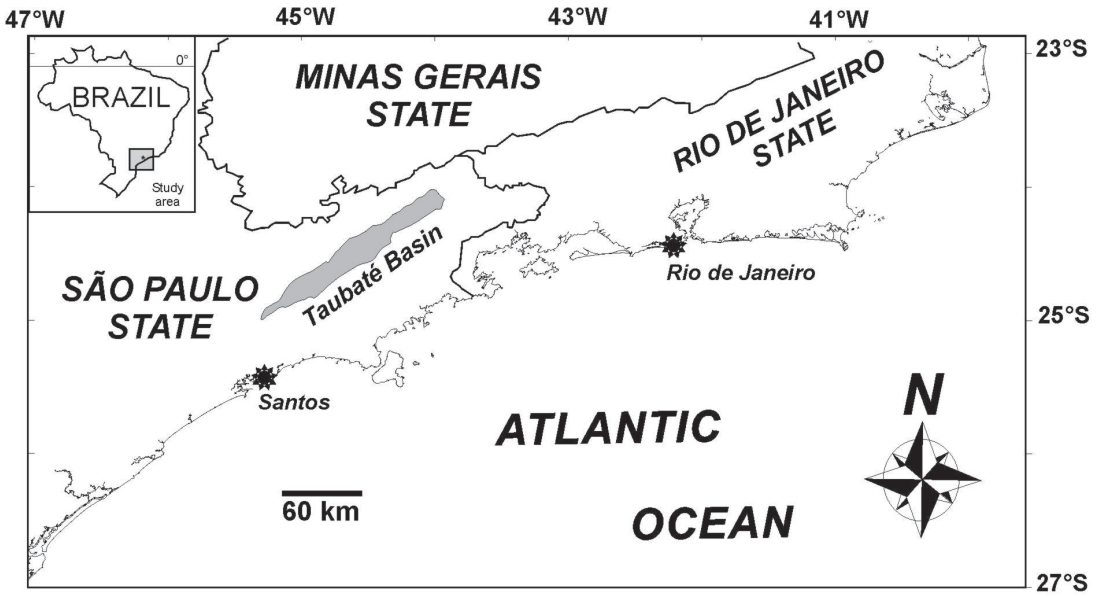

Figure 1. Map of the Taubaté Basin.

Remarks. In South America a few living species of *Eucypris* have been reported. In Chile, Hartmann (1965) described *Eucypris noodti* in El Tabo, and Cárdenas *et al*. (2013) reported the occurrence of *E. virens* (Jurine, 1820) and *E. trapezoides* Hartmann, 1962. In Argentina, Ramos *et al*. (2015) recorded *E. fontana* (Graf, 1931) in permanent water bodies of two localities from Patagonia. A species of *Eucypris* has been also recorded in Brazil by Higuti *et al*. (2017) in the Mato Grosso do Sul State, in open nomenclature. *Eucypris lobatoi* sp. nov. differs from *E. fontana* (Graf, 1931), described in the South Georgia Island, in having a more elongate outline without the compressed area along the anterior margin. From *E. noodti* Hartmann, 1965 differs in the outline, especially in the ventral margin sinuosity. The male specimens of *E. lobatoi* sp. nov. are similar to the species registered as *Pontocypris*? sp. by Sheppard & Bate (1980) in Pliocene–Pleistocene deposits of the Pebas Formation (=Solimões). The specimens from Tremembé Formation, however, are larger than the Pebas' ones.

Subfamily CYPRIDOPSINAE Kaufmann, 1900

Potamocypris Brady, 1870

Type-species. *Bairdia fulva* Brady, 1868.

Potamocypris taubatensis sp. nov.
(Figures 2K–N)

2015b *Potamocypris* sp. Bergue, Fauth & Maranhão, p. 1533, figs. 3.6-7.

Etymology. In reference to the basin name.
Type material. Holotype: MP-O-2763, C, l: 0.67 mm, h: 0.32 mm, w: 0.22 mm. Paratypes: MP-O-2764, C, l: 0.68 mm, h: 0.36 mm, w: 0.29 mm; MP-O-2765 l: 0.61 mm, h: 0.36 mm, w: 0.23 mm, and MP-O-2766, l: 0.67 mm, h: 0.32 mm, w: 0.25 mm.
Diagnosis. Carapace small, smooth. Conspicuous overlap both in dorsal and ventral margin. Maximum width immediately behind the middle.
Age. Oligocene.
Type locality. Tremembé Formation, Taubaté Basin, sample 22.4 m core depth. 45°30'34"W/23°01'49"S.
Material. Over 200 specimens. Mostly crushed carapaces; valves very rare and poorly preserved.
Description. Carapace reniform and compressed in dorsal view. Maximum height in the middle. Dorsal margin short and subrectilinear; ventral margin strongly concave in the middle. Anterior margin broadly and asymmetrically rounded; posterior margin somewhat oblique, forming a narrow curve with the ventral margin. Surface smooth. Symmetry typical for the genus (*i.e.* RV larger than LV), very conspicuous in both dorsal and ventral margins. Carapace maximum width immediately behind the middle. Internal features and sexual dimorphism not seen.
Remarks. The genus *Potamocypris* was firstly recorded in Brazil by Klie (1940), who described the species *P. schubarti* (Pernambuco and Paraíba states) and *P. bituminicola* (Pernambuco State). Higuti *et al*. (2017) recorded *P. schubarti* as well as another species of *Potamocypris* in open nomenclature in the Mato Grosso do Sul State. *P. taubatensis* sp. nov. differs from those species in having the posteroventral corner less acuminate. *P. schubarti* has, moreover, the LV larger than the RV, which is unusual for the genus. *P. taubatensis* sp. nov. is very abundant in the material studied, but the specimens are mostly crushed, possibly due to the fragility of their carapaces.

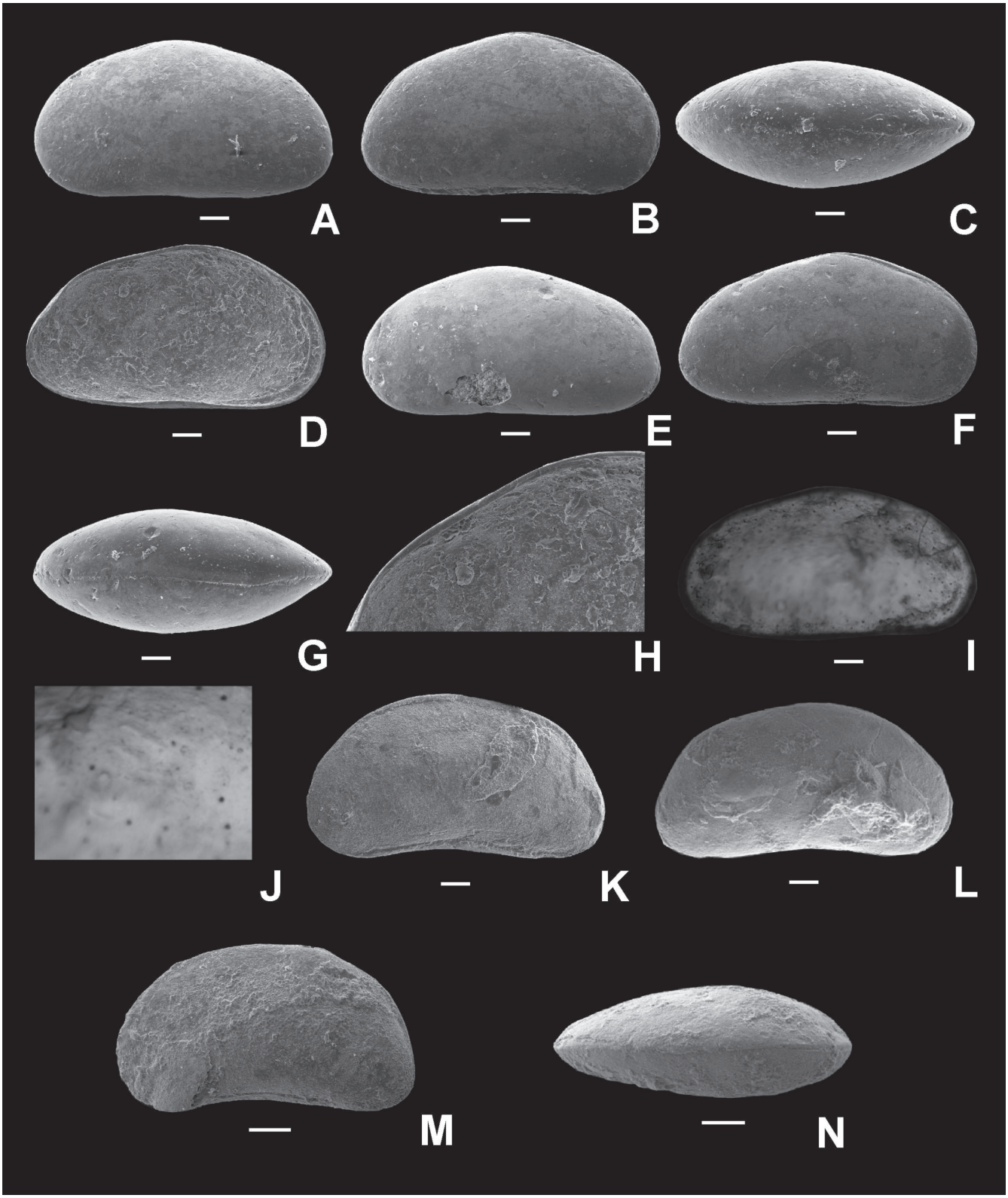

Figure 2. A–J, *Eucypris lobatoi* sp. nov. **A**, female C left lateral view (MP-O-2759); **B**, same specimen right lateral view; **C**, same specimen dorsal view; **D**, female LV internal view (MP-O-2760); **E**, male C left lateral view (ULVG 11514); **F**, same specimen right lateral view; **G**, same specimen dorsal view; **H**, detail of the hinge region of the female LV (MP-O-2760); **I**, juvenile LV (MP-O-2762) in optical microscopy transmitted light; **J**, detail of the central muscle scars area of the same specimen. **K–N**, *Potamocypris taubatensis* sp. nov. **K**, C left lateral view (MP-O-2763); **L**, same specimen right lateral view; **M**, C (MP-O-2764) left lateral view; **N**, C (MP-O-2766) dorsal view. Scale bars = 100 μm.

PALEOLIMNOLOGICAL REMARKS

Lacustrine systems are highly influenced by both climate and geomorphological setting. Several factors affect the hydrologic balance and the chemical properties in these dynamic environments, such as the sedimentation rate, water inflow and biological production (Bradley, 1999). According to Kutzbach (1980), climatic influence in lakes can be estimated basically by the hydrologic (water income *vs*. evaporation) and energetic (evaporation) balances. Benson (1981) also argues that the air temperature, the upper water layer temperature and the amount of precipitable water are the main climatic parameters influential on lakes. Most of the paleolimnological models are based on Quaternary deposits of existing lakes [*i.e*. ancient lakes; see Frogley *et al*. (2002) for a discussion on this term] not only because they can be easily sampled, but also because they can be compared to the present characteristics of these water bodies. In this work the term paleolake designates a lake that no longer exists or, more precisely, lacustrine deposits of a sedimentary basin, such as the case of the Taubaté Basin.

The fossil *Lagerstätte* of the Tremembé Formation is a prodigious source of information not only of the lacustrine biota, but also of the organisms that have lived in adjacent areas. Yet, a comprehensive panorama of the bathymetry, water chemistry, and biological interactions of that lake is far from being conclusive. Data gathered from different fossil groups, however, supply clues for the understanding of the paleoecology of the Tremembé Paleolake. Ragonha (1982) argues that the pirobetuminous shale has been deposited in a poorly oxygenated stagnant water body with reducing characteristics and low pH. On the other hand, Martins-Neto (1989) claims that the presence of larvae of Trichoptera, and palemonid crustaceans are evidences that the waters of the Tremembé Paleolake were not stagnant. Gallego & Mesquita (2000) ascribe the low diversity and abundance of conchostracans in the Tremembé Formation either to the predatory pressure by fishes, or to environmental restrictions in chemical parameters. Due to their sensitiveness to ecological parameters at the water-sediment interface, and high fossilization potential, ostracods provide invaluable data for paleoenvironmental reconstruction of lacustrine environments. Based on occurrences of ostracods and ephippia of Cladocera, Bergue *et al*. (2015a,b) have observed a shallowing trend in the Tremembé Paleolake.

The two ostracod species herein proposed have well defined and distinct occurrences in the studied core and, therefore, it is assumed that they lived under different environmental contexts. This hypothesis is reinforced by some taphonomic features of the specimens, in special the color and the crushing. Specimens of *Eucypris lobatoi* sp. nov. are mostly dark, sometimes with pyrite, which indicate a dysoxic and possibly deeper environment (Palacios-Fest *et al*., 1994). The individuals of *Potamocypris taubatensis* sp. nov. are predominantly crushed, restricted to the core top and have white color. It is the largely dominant taxon in a low diversity assemblage where scarce individuals of *Cytheridella* (Cytheridoidea, Ostracoda) and other unidentified ostracod taxa also occur. Several studies have demonstrated the occurrence of *Potamocypris* in either very shallow or temporary water bodies (Martens, 1982; George & Martens, 2002; Altinsaçli & Altinsaçli, 2009; Horne *et al*., 2011). This is possibly an evidence of that this genus is adapted to unstable environments.

CONCLUSIONS

The two species herein described reinforce the possibility to characterize distinct phases in the Tremembé Paleolake using ostracods. The interval of occurrence of *Eucypris lobatoi* sp. nov. probably corresponds to an older and more stable (permanent and deeper) water body, and *Potamocypris taubatensis* sp. nov. to a younger and more unstable (shallow), or even temporary water bodies in the marginal area of the lake. These data reinforce previous interpretation by Bergue *et al*. (2015b) related to the shallowing trend in the final deposition of the Tremembé Formation (Oligocene), toward the overlying Pindamonhangaba Formation (Late Miocene–Pliocene), during the fourth phase of development of basin (Cognè *et al*., 2013).

ACKNOWLEDGMENTS

The authors wish to express their gratitude to H.N. Diniz who supplied the core from *Projeto Piloto de Recarga Artificial na Bacia do Rio Una, Município de Taubaté*, which was supported by *Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)* grant number 2003/07183-1. E.K. Piovesan and R. Mazke-Karasz made invaluable contribution to the improvement of the first version of this work. C.T. Bergue thanks the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior–CAPES, for the PNPD grant at Programa de Pós-Graduação em Geociências/UFRGS. K. Martens is thanked for the bibliographic supply.

REFERENCES

Altinsaçli, S. & Altinsaçli, S. 2009. The freshwater ostracod *Potamocypris producta* (Sars, 1924) new for Turkey (Ostracoda: Cypriddidae). *Zoology in the Middle East*, **48**:110–112.

Antonietto, L.S.; Gobbo, S.R.; Do Carmo, D.A.; Assine, M.L.; Fernandes, M.A.M.C.C. & Lima e Silva, J.E. 2012. Taxonomy, ontogeny and paleoecology of two species of *Harbinia* Tsao, 1951 (Crustacea, Ostracoda) from the Santana Formation, Lower Cretaceous, Northeastern Brazil. *Journal of Paleontology*, **86**:659–668. *doi:10.1666/11-012R.1*

Benson, L.V. 1981. Paleoclimatic significance of lake-level fluctuations in the Lahontan Basin. *Quaternary Research*, **16**:390–403. *doi:10.1016/0033-5894(81)90018-1*

Bergue, C.T.; Kotov, A. & Maranhão, M.S.A.S. 2015a. Ephippia of Cladocera (Crustacea: Branchiopoda) from the Oligocene Tremembé Paleolake, Brazil. *Journal of Natural History*, **49**:2265–2273. *doi:10.1080/00222933.2015.1022237*

Bergue, C.T.; Maranhão, M.S.A.S. & Fauth, G. 2015b. Paleolimnological inferences based on Oligocene ostracods (Crustacea: Ostracoda) from Tremembé Formation, Southeast Brazil. *Anais da Academia Brasileira de Ciências*, **87**:1531–1544. *doi:10.1590/0001-3765201520140366*

Bernardes-de-Oliveira, M.E.C.; Mandarim-de-Lacerda, A.F.; Garcia, M.I. & Campos, C.C. 2002. Fazenda Santa Fé (Tremembé), SP. A maior associação de fósseis do Terciário brasileiro. *In*: C. Schobbenhaus; D.A. Campos; E.T. Queiroz; M. Winge & M.L. Berbert-Born (eds.) *Sítios Geológicos e Paleontológicos do Brasil*, DNPM/CPRM, Comissão Brasileira de Sítios Geológicos e Paleobiológicos (SIGEP), p. 63–71.

Bradley, R.S. 1999. *Paleoclimatology – Reconstructing climates of the Quaternary*. 2nd ed. San Diego, Elsevier, 614 p.

Brady, G.S. 1868. A monograph of the Recent British Ostracoda. *Transactions of the Linnean Society of London*, **26**:353–495. *doi:10.1111/j.1096-3642.1968.tb00199.x*

Brito, I.M. & Ribeiro, F.A.M. 1975. Ocorrência de lepidópteros nos folhelhos de Tremembé e algumas considerações sobre a bacia geológica do Paraíba, estado de São Paulo. *Anais da Academia Brasileira de Ciências*, **47**:105–111.

Cardenas, J.; Baltanás, A.; Figueroa, R.; Cusminski, G.; Laprida, C.; Mercau, J.R.; Alvarez, D. & Urrutia, R. 2013. Contribution to the knowledge of the continental ostracod from Chile. *Naturalista Siciliano*, **37**:67–71.

Carvalho, A.M.A.; Vidal, A.C. & Kiang, C.H. 2011. Delimitação do embasamento da Bacia de Taubaté. *Geologia USP, Série científica*, **11**:19–32. *doi:10.5327/Z1519-874X2011000100002*

Chagas, R.B; Mendonça-Filho, J.G.; Mendonça, J.O. & Menezes, T.R. 2009. Caracterização palinofaciológica de uma sucessão sedimentar oligocênica da Formação Tremembé, Bacia de Taubaté. *Revista Brasileira de Paleontologia*, **12**:257–266. *doi:10.4072/rbp.2009.3.08*

Cognè, N.; Cobbold, P.R.; Riccomini, C. & Gallagher, K. 2013. Tectonic setting of the Taubaté Basin (Southeastern Brazil): insights from regional seismic profiles and outcrop data. *Journal of South American Earth Sciences*, **42**:194–204. *doi:10.1016/j.jsames.2012.09.011*

Do Carmo, D.A.; Coimbra, J.C.; Whatley, R.C.; Antonietto, L.S. & Citon, R.T.P. 2013. Taxonomy of limnic Ostracoda (Crustacea) from the Alagamar Formation, middle-upper Aptian, Potiguar Basin, Northeastern Brazil. *Journal of Paleontology*, **87**:91–104. *doi:10.1666/11-108R.1*

Do Carmo, D.A.; Whatley, R.C.; Queiroz Neto, J.V.Q. & Coimbra, J.C. 2008. On the validity of two lower Cretaceous non-marine ostracode genera: biostratigraphic and paleoceanographic implications. *Journal of Paleontology*, **82**:790–799. *doi:10.1666/07-008.1*

Frogley, M.R.; Griffiths, H.I. & Martens, K. 2002. Modern and fossil ostracods from ancient lakes. *In*: J.A. Holmes & A.R. Chivas (eds.) *The Ostracoda: applications in Quaternary Research*, Washington, D.C., American Geophysical Union, p. 67–184 (Monograph 131). *doi:10.1029/131GM09*

Gallego, O.F. & Mesquita, M.V. 2000. First record of Oligocene conchostracans (Tremembé formation, Taubaté Basin) from São Paulo, Brazil. *Journal of South American Earth Sciences*, **13**:685–692. *doi:10.1016/S0895-9811(00)00048-1*

George, S. & Martens, K. 2002. On a new species of *Potamocypris* (Crustacea, Ostracoda) from Chalakkudy River, Kerala (India) with a checklist of the *Potamocypris*-species of the world. *Zootaxa*, **65**:1–15. *doi:10.11646/zootaxa.66.1.1*

Graf, H. 1931. Süβwasser Ostracoden aus Sudgeorgian. *Zoologischer Anzeiger*, **93**:185–191.

Gross, M.; Ramos, M.I.F.; Caporaletti, M. & Piller, W.E. 2013. Ostracods (Crustacea) and their palaeoenvironmental implication for the Solimões Formation (Late Miocene; Western Amazonia/Brazil). *Journal of South American Earth Sciences*, **42**:216–241. *doi:10.1016/j.jsames.2012.10.002*

Guimarães, D. 1928. Notas sobre os folhelhos betuminosos de Tremembé. *Minério, Combustível e Transporte*, **1**:219–220.

Guzmán-González, J.; Piovesan, E.K.; Fambrini, G.L. & Oliveira, E.V. 2016. Non-marine Ostracoda from the Aliança Formation in the North-Central portion of the Jatobá Basin, Northeastern Brazil. *Revista Brasileira de Paleontologia*, **19**:15–24. *doi:10.4072/rbp.2016.1.02*

Hartmann, G. 1962. Ostracoden des Eulitorals III. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, **60**:169–270.

Hartmann-Schröder, G. & Hartmann, G. 1965. Zur Kenntnis des Sublitorals der chilenischen Küste unter besonderer Berücksichtigung der Polychaeten und Ostracoden (Mit Bemerkungen über den Einfluβsauerstoffarmer Strömungen auf die Besiedlung von marinen Sedimenten). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, **62**:307–384.

Higuti, J.; Roche, K.F. & Martens, K. 2017. Checklist de ostrácodes (Crustacea, Ostracoda) dulcícolas do Pantanal Sul Mato-grossense, Brasil. *Iheringia, Série Zoologia*, **107**:2017114. *doi:10.1590/1678-4766e2017114*

Horne, D.; Jocque, M.; Brendonck, L. & Martens, K. 2011. On *Potamocypris compressa* (Crustacea, Ostracoda) from temporary rock pools in Utah, USA, with notes on the taxonomic harmonization of North American and European ostracod faunas. *Zootaxa*, **2793**:35–46.

Jurine, L. 1820. *Histoire des Monocles, qui se trouvent aux Environs de Genève*. Genève, 220 p.

Karanovic, I. 2012. *Recent freshwater ostracods of the world. Crustacea, Ostracoda, Podocopida*. 1st ed. Heidelberg, Springer, 608 p. *doi:10.1007/978-3-642-21810-1*

Klie, W. 1940. Süβwasser-ostracoden aus Nordostbrasilien. VI. Cyprinae mit geißelförmiger furka. *Zoologischer Anzeiger*, **130**:59–73.

Kutzbach, J.E. 1980. Estimates of past climate at paleolake Chad, North Africa, based on a hydrological and energy balance model. *Quaternary Research*, **14**:210–223. *doi:10.1016/0033-5894(80)90049-6*

Lima, M.R.; Salard-Cheboldaff, M. & Suguio, K. 1985. Étude palinologique de la Formation Tremembé, tertiaire du bassin de Taubaté (Etat de São Paulo, Brésil), d'aprés les echantillons du sondage nº42, du CNP. *In*: CONGRESSO BRASILEIRO DE PALEONTOLOGIA, 8, 1983. *Anais*, Rio de Janeiro, SBP, p. 379–383.

Linhares, A.P.; Ramos, M.I; Gross, M. & Piller, W.E. 2011. Evidence for marine influx during the Miocene in southwestern Amazonia, Brazil. *Geología Colombiana*, **36**:91–104.

Marques, A. 1990. Evolução tectono-sedimentar e perspectivas exploratórias da bacia de Taubaté, São Paulo, Brasil. *Boletim de Geociências da Petrobras*, **4**:253–262.

Martens, K. 1982. On some freshwater ostracods (Crustacea, Ostracoda) from Hoboken Polder, including *Potamocypris unicaudata* Schäfer and *Potamocypris smaragdina* (Vavra), two new species for the Belgian fauna. *Biologisch Jaarboek Dodonaea*, **50**:124–134.

Martins-Neto, R.G. 1989. Novos insetos terciários do estado de São Paulo. *Revista Brasileira de Geociências*, **19**:375–386.

Muñoz-Torres, F.; Whatley, R.C. & van Harten, D. 1998. The endemic non-marine Miocene ostracod fauna of the Upper

Amazon Basin. *Revista Española de Micropaleontología*, **30**:89–105.

Palacios-Fest, M.R.; Cohen, A.S. & Anadón, P. 1994. Use of ostracodes as paleoenvironmental tools in the interpretation of ancient lacustrine records. *Revista Española de Paleontología*, **9**:145–162.

Paula-Couto, C. & Mezzalira, S. 1971. Nova conceituação geocronológica de Tremembé, estado de São Paulo, Brasil. *Anais da Academia Brasileira de Ciências*, **43**:473–488.

Purper, I. 1979. Cenozoic ostracodes of the Upper Amazon Basin, Brazil. *Pesquisas*,**12**:209–281.

Purper, I. & Ornellas, L. 1991. New ostracodes of endemic fauna of the Pebas Formation, Upper Amazon Basin Brasil. *Pesquisas*, **18**:25–38.

Purper, I. & Pinto, I.D. 1983. New genera and species of ostracodes of the Upper Amazon Basin. *Pesquisas*, **15**:113–126.

Queiroz Neto, J.V.; Sames, B. & Colin, J.-P. 2014. *Kegelina*: a new limnic ostracod (Cyprididae, Cypridoidea) genus from the Lower Cretaceous of the Americas and Africa. *Journal of Paleontology*, **88**:800–813. *doi:10.1666/13-019*

Ragonha, E.W. 1982. Evolução tectono-sedimentar da Bacia de Taubaté com fundamento na sua ictiofauna. *Anais da Academia Brasileira de Ciências*, **54**:679–689.

Ramos, L.Y.; Alperin, M.; Pérez, A.P.; Corriaga, C.A.; Schwalb, A. & Cusminsky, G.C. 2015. *Eucypris fontana* (Graf, 1931) (Crustacea, Ostracoda) in permanent environments of Patagonia Argentina: a geometric morphometric approach. *International Journal of Limnology*, **51**:125–138. *doi:10.1051/limn/2015007*

Ramos M.I.F. 2006. Ostracods from the Neogene Solimões Formation (Amazonas, Brazil). *Journal of South American Earth Sciences*, **21**:87–95. *doi:10.1016/j.jsames.2005.08.001*

Ramos, M.I.F.; Rosseti, D. & Paz, J.D.S. 2006. Caracterização e significado paleoambiental da fauna de Ostracodes da Formação Codó (Neoaptiano), Leste da Bacia do Grajaú. *Revista Brasileira de Paleontologia*, **9**:339–348.

Riccomini, C. & Coimbra, A.M. 1992. Geologia da bacia sedimentar. *In*: A. Negro Jr.; A.A. Ferreira; U.R. Alonso & P.A. Luz (eds.) *Solos da cidade de São Paulo*, ABMS/ABEF, p. 37–94.

Riccomini, C.; Sant'Anna, L.G. & Ferrari, A.L. 2004. Evolução geológica do Rift Continental Sudeste do Brasil. *In*: V. Mantesso-Neto *et al*. (eds.) *Geologia do Continente Sul-Americano: evolução da obra de Fernando Flávio Marques de Almeida*, Beca, p. 383–405.

Sheppard, L.M. & Bate, R.H. 1980. Plio-Pleistocene ostracods from the upper Amazon of Colombia and Peru. *Palaeontology*, **23**:97–124.

Thomé, M.E.T.R.; Lima Filho, M.F. & Neumann, V.H.M.L. 2014. Taxonomic studies of non-marine ostracods in the Lower Cretaceous (Aptian–lower Albian) of post-rift sequence from Jatobá and Araripe basins (Northeast Brazil): stratigraphic implications. *Cretaceous Research*, **48**:153–172. *doi:10.1016/j.cretres.2013.12.007*

Whatley, R.C.; Muñoz-Torres, F. & Van Harten, D. 1998. The Ostracoda of isolated Neogene saline lake in the western Amazon Basin. *In*: S. Crasquin-Soleau; E. Braccini & F. Lethiers (eds.) *What about Ostracoda! Actes du 3o Congrès Européen des Ostracodologistes*, Pyrénées-Atlantiques, Centre de Recherches Elf Exploration Production, p. 231–245 (Mémoire 20).

Received in 05 January, 2018; accepted in 06 May, 2018.