Palaeogeography, Palaeoclimatology, Palaeoecology 439 (2015) 1–3

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Editorial

Contributions of ichnology to palaeoecology, palaeogeography, and sedimentology
A special issue related to the Second Latin-American Symposium on Ichnology (SLIC 2013)

1. Introduction

The field of ichnology straddles the areas of palaeontology and sedimentology, and displays multiple connections with disciplines within these areas and also with biology. Biogenic structures record the behavior of their tracemakers and provide valuable information for palaeoecologic and palaeoenvironmental analysis, and also have potential contributions to palaeogeography. Trace fossils yield valuable insights into the palaeoecology of ancient benthic communities and the environmental dynamics of depositional systems. The relatively young discipline of ichnology is experiencing significant advances in the last years. A reflection of these advances is the considerable number of recently published textbooks (Carvalho and Fernandes, 2007; Seilacher, 2007; Buatois and Mángano, 2011; Bennett and Morse, 2014) and thematic volumes and special issues (Bromley et al., 2007; Lucas et al., 2007, 2010; Miller, 2007; Avanzini and Petti, 2008; Pieńkowski et al., 2009; Klein and Lucas, 2010; Milàn et al., 2010; Uchman and Rindsberg, 2010; Hunt et al., 2012; Knaust and Bromley, 2012; Netto et al., 2012; Domènech Arnal et al., 2014; McIlroy, 2015). Many of these mentioned special issues and thematic volumes were related to scientific meetings.

This issue contains some of papers presented at the Second Latin-American Symposium on Ichnology, held at Santa Rosa, La Pampa province, Argentina, from September 13–23, 2013 (Fig. 1). This meeting had its origins in the 1st Argentine Meeting on Ichnology convened in 1993. This pioneer and successful meeting grew to include larger audiences from other Latin American countries. In 1998, along with the 3rd Argentine Meeting on Ichnology, the Ichnological Meeting of the Mercosur was first convened. Finally, in 2010, on the basis of the merging of the two meetings, the 1st Latin American Symposium on Ichnology (SLIC 2010) was convened in Brazil. The third Latin American Symposium on Ichnology (SLIC 2015) will be held in Uruguay in October of 2015.

Although the SLICs are regional meetings, this special issue is not restricted to Latin America. Eight papers are from that region (Argentina, Brazil and Mexico) and the remaining are review papers (two) or refer to Italy (two) or to Spain (one). The common theme of this set of papers is the contributions of ichnology to palaeoecology, palaeoenvironmental interpretation, and palaeogeography. The set of 13 papers can be divided into two large subsets: marine and continental ichnology (the latter including neoichnology).

2. Marine ichnology

Contributions in the marine subset give insights onto palaeoenvironmental controls on the development of the *Nereites* (Pazos et al., 2015-a) and *Zoophycos* ichnofacies (Richiano, 2015); examples of *Dictyodora* in the Palaeozoic of Argentina (Pazos et al., 2015-b); the distinguishing features of *Ophiomorpha irregulaire* (Leaman et al., 2015); and palaeoecologic interactions of sclerobiont communities (Pineda-Salgado et al., 2015; Richiano et al., 2015).

Pazos et al. (2015-a,b) describe the trace fossil content of a Late Silurian turbidite-like sequence from western Argentina, including several ichnospecies of *Nereites* that reveal interaction of their producers with microbial mats and a new ichnospecies of *Dictyodora*. Pazos et al. (2015-b) also suggest new palaeoecological preferences of *Dictyodora* that challenges previous interpretations. Richiano et al., (2015) analyzes the contrasting expression of specimens of the ichnogenus *Zoophycos* (including size, degree of bioturbation and associated trace fossils) from two stratigraphic intervals of the Lower Cretaceous Río Mayer Formation, Austral Basin, Argentina. These differences are linked to contrasting stratigraphic context (transgressive vs progradational), sedimentation rate and availability of benthic food. Leaman et al. (2015) deals with one of the less characterized ichnospecies of the well-known ichnogenus *Ophiomorpha*, *O. irregulaire*. Through examination of both core and outcrop specimens (including material from the type locality) and 3D reconstructions, it is suggested that flame-like pellet morphology is a valid criterion for identifying O. *irregulaire* in core. The distribution of the ichnospecies is widened to include Jurassic to recent examples and palaeoenvironments, ranging from shallow marine to continental slope settings. Neoichnological experiments further suggest that callianassids are good candidates for producing this type of structure.

Two contributions examined bioerosion structures. Pineda-Salgado et al., (2015) studied the bioeroding ichnofauna from a Miocene rocky shore at Veracruz, México. The authors used ichnological signatures on gravel clasts to identify an ancient rocky shore, and the prevailing environmental conditions during the deposition of the bioeroded material. Richiano et al., (2015) analyzed the bioerosion variation on *Crepidula* within Quaternary marine deposits along a latitudinal gradient, from Buenos Aires to southern Patagonia. The authors suggest that sea surface temperature and productivity are the most important factors controlling bryozoan bioerosion.

http://dx.doi.org/10.1016/j.palaeo.2015.05.022

Fig. 1. Attendees to the second Latin American Symposium on Ichnology.

3. Continental ichnology

The continental subset includes a review of the application of vertebrate trace fossils to palaeoenvironmental analysis (Melchor, 2015); the role of Permian tetrapod footprints in palaeoenvironmental and palaeoclimatic inferences in an alluvial setting (Marchetti et al., 2015); the contribution of dinosaur ichnology to palaeogeographic reconstructions in complex geodynamic settings (Citton et al., 2015); late Miocene ground sloth footprints from Argentina (Melchor et al., 2015); a revision of the ichnotaxonomy of the amazing Pleistocene Pehuen Co mammal and bird footprint site (Aramayo et al., 2015); and behavioral inferences from neoichnological studies on modern vertebrate traces (Dentzien-Dias and Figueiredo, 2015; Muñiz et al., 2015).

Using a wide variety of examples and settings, Melchor (2015) provides an updated compilation of the uses of vertebrate trace fossils, ichnofabrics, and ichnofacies for palaeoenvironmental analysis. After the revision of an Early Permian classical locality of the southern Alps (Italy), Marchetti et al. (2015) update the icnotaxonomy of its vertebrate and invertebrate trace fossils and contribute to the characterization of the hosting sedimentary facies. The ichnological dinosaur record of Italy is revised by Citton et al. (2015), highlighting its palaeogeographic distribution. These authors suggest that the available evidence for the late Tithonian–late Cenomanian dinosaur track assemblage invokes a model that includes repeated dinosaur migrations from Africa to the southern Italian carbonate platforms. From spectacular examples exposed along the coast of southern Argentina, Melchor et al. (2015) offer new insights into the origins of the late Miocene trackway *Megatherichnum oportoi*. On the basis of detailed observations on track shape and alignment, the delineation of coastal sedimentary facies, consideration of associated invertebrate and plant trace fossils, and comparison to other South American footprints of similar scale, they interpret individual tracks as non-overlapping manus and pes, and the tracemaker as a quadruped that traversed prograding intertidal flats. Pehuen Có (southern Buenos Aires province, Argentina) has yielded a highly diverse late Pleistocene mammal and bird footprint assemblage, which is re-evaluated by Aramayo et al. (2015). These authors revise the ichnotaxonomy of the site and the corresponding ichnodiversity to compare it with other similar assemblages of Pleistocene age. Dentzien-Dias and Figueiredo (2015) filled the open, modern burrows of the South American rodent *Ctenomys* with plaster of Paris, and then excavated the hardened structures in order to study their architecture. This work yielded intriguing insights into predator avoidance and digging behavior, and demonstrates the utility of burrow architecture for reconstructing ancient environments. Finally, Muñiz et al. (2015) enlarge the types of potential fish traces that may be found in the fossil record by analyzing feeding traces of extant fishes in estuarine flats, which roughly resemble the ichnogenera *Cruziana* and *Rusophycos*.

Acknowledgments

Editor David Bottjer and editorial staff of Palaeo3, including Yanping Hou and Krishnaveni Reddy, are thanked for their guidance and efforts to finish this special issue. This issue is possible also thanks to the authors that contributed and colleagues that read the manuscripts and suggested changes to improve them. Guest editors thank the following specialists that acted as reviewers: Jacob Benner, Diego Castañeda, Richard Callow, H. Allen Curran, Rosa Domènech, Allan Ekdale, Murray Gingras, Hartmut Haubold, Liam Herringshaw, Adrian Hunt, R. Matthew Joeckel, Markes Johnson, Hendrik Klein, Dirk Knaust, Martin Lockley, Spencer Lucas, Radek Mikuláš, Jesper Milàn, Nicholas Minter, Eduardo Olivero, Davide Olivero, Richard Owen, Andrew Rindsberg, Francisco Rodríguez-Tovar, Ana Santos, Rebecca Schmeisser, Jennifer Scott, Edward Simpson, Francisco Tognoli, Alfred Uchman, Mark Wilson, and Andreas Wetzel.

References

Aramayo, S.A., de Bianco, Manera, Bastianelli, N.V., Melchor, R.N., 2015. Pehuen Co: An updated taxonomic review of a late Pleistocene site in Argentina. Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 144–165.

Avanzini, M., Petti, F.M., 2008. Italian ichnology. Studi Trentini Sci. Nat. Acta Geol. 83, 1–347.

Bennett, M.R., Morse, S.A., 2014. Human Footprints: Fossilised Locomotion? Springer (216 pp.)

Bromley, R.G., Buatois, L.A., Mangano, M., Genise, J.F., Melchor, R.N., 2007. Sediment-organism interactions: a multifaceted ichnology. SEPM Spec. Publ. 88, 1–393.

Buatois, L.A., Mángano, M.G., 2011. Ichnology: Organism-Substrate Interactions in Space and Time. Cambridge University Press, Cambridge (370 pp.).

Carvalho, I.S., Fernandes, A.C.S., 2007. Icnologia. Sociedade Brasileira de Geologia, Serie Textos 3 (Sao Paulo, 178 pp.).

Citton, P., Nicosia, U., Sacchi, E., 2015. Updating and reinterpreting the dinosaur track record of Italy. Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 117–125.

Dentzien-Dias, P.C., Figueiredo, A.E.Q., 2015. Burrow architecture and burrowing dynamics of *Ctenomys* in foredunes and paleoenvironmental implications. Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 166–175.

Domènech Arnal, R., Ekdale, A.A., Gámez Vintaned, J.A., Martinell Callicó, J., 2014. Tribute to Jordi María de Gibert Atienza. Span. J. Paleontol. 29, 1–104.

Hunt, A., Milàn, J., Lucas, S., Spielmann, J.A., 2012. Vertebrate coprolites. N. M. Mus. Nat. Hist. Sci. Bull. 57, 1–387.

Klein, H., Lucas, S.G., 2010. Review of the tetrapod ichnofauna of the Moenkopi Formation/Group (Early-Middle Triassic) of the American Southwest. N. M. Mus. Nat. Hist. Sci. Bull. 50, 1–67.

Knaust, D., Bromley, R.G., 2012. Trace fossils as indicators of sedimentary environments. Developments in Sedimentology 64. Elsevier, Amsterdam (924 pp.).

Leaman, M., McIlroy, D., Herringshaw, L.G., Boyd, C., Callow, R.H.T., 2015. What does *Ophiomorpha irregulaire* really look like? Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 38–49.

Lucas, S.G., Spielmann, J.A., Lockley, M.G., 2007. Cenozoic vertebrate tracks and traces. N. M. Mus. Nat. Hist. Sci. Bull. 42, 1–330.

Lucas, S.G., Spielmann, J.A., Klein, H., Lerner, A., 2010. Ichnology of the Upper Triassic (Apachean) Redonda Formation, east-central New Mexico. N. M. Mus. Nat. Hist. Sci. Bull. 47, 1–75.

Marchetti, L., Ronchi, A., Santi, G., Voigt, S., 2015. The Gerola Valley site (Orobic Basin, Northern Italy): A key for understanding late Early Permian tetrapod ichnofaunas. Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 97–116.

McIlroy, D., 2015. Ichnology: papers from ICHNIA III. Geological Association of Canada, Miscellaneous, Publication 9 (272 pp.).

Melchor, R.N., Perez, M., Cardonatto, M.C., Umazano, A.M., 2015. Late Miocene ground sloth footprints and their paleoenvironment: *Megatherichnum oportoi* revisited. Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 126–143.

Melchor, R.N., 2015. Application of vertebrate trace fossils to palaeoenvironmental analysis. Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 79–96.

Milàn, J., Lucas, S., Lockley, M.G., Spielmann, J.A., 2010. Crocodyle tracks and traces. N. M. Mus. Nat. Hist. Sci. Bull. 51, 1–244.

Miller, W.I., 2007. Trace fossils. Concepts, Problems, Prospects. Elsevier, Amsterdam, (632 pp.).

Muñiz, F., Belaústegui, Z., Cárcamo, C., Domènech, R., Martinell, J., 2015. *Cruziana*- and *Rusophycus*-like traces of recent Sparidae fish in the estuary of the Piedras River (Lepe, Huelva, SW Spain). Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 176–183.

Netto, R.G., Carmona, N.B., Tognoli, F.M.W., 2012. Ichnology of Latin America — Selected papers. Monogr. Soc. Bras. Paleontol. 2, 1–196.

Pazos, P.J., Heredia, A.M., Fernández, D.E., Gutiérrez, C., Comerio, M., 2015a. The unusual record of *Nereites*, wrinkle marks and undermat mining trace fossils in the Late Silurian-–earliest Devonian of central-western margin of Gondwana (Argentina). Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 4–16.

Pazos, P.J., Heredia, A.M., Fernández, D.E., Gutiérrez, C., Comerio, M., 2015b. The ichnogenus *Dictyodora* from late Silurian deposits of central-western Argentina: Ichnotaxonomy, ethology and ichnostratigrapical perspectives from Gondwana. Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 27–37.

Pieńkowski, G., Martin, A., Meyer, C., 2009. Special issue: second international congress on ichnology (Ichnia 2008) Kraków, Poland. Geol. Q. 53, 369–482.

Pineda-Salgado, G., Quiroz-Barroso, S.A., Sour-Tovar, F., 2015. Analysis of bioerosion in clasts from a rocky shore of Miocene age, Concepción Formation, Veracruz, México. Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 50–62.

Richiano, S., 2015. Environmental factors affecting the development of the *Zoophycos* ichnofacies in the Lower Cretaceous Río Mayer Formation (Austral Basin, Patagonia). Palaeogeogr. Palaeoclimatol. Palaeoecol. 439, 17–26.

Richiano, S., Aguirre, M., Farinati, E., Davies, K., Castellanos, I., 2015. Bioerosion structures in Crepidula (Mollusca, Gasteropoda) as indicators of latitudinal, palaeoenvironmental changes: Examples from the marine Quaternary of Argentina. Palaeogeogr. Palaeoclimatol. Palaeoecol 439, 63–78.

Seilacher, A., 2007. Trace Fossil Analysis. Springer, Berlin (226 pp.).

Uchman, A., Rindsberg, A.K., 2010. Advances in marine ichnology. Acta Geol. Pol. 60, 1–138.

Ricardo N. Melchor
Instituto de Ciencias de la Tierra y Ambientales de La Pampa (CONICET and Universidad Nacional de La Pampa), Av. Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina
E-mail address: rmelchor@exactas.unlpam.edu.ar

Emilio Bedatou
Instituto de Ciencias de la Tierra y Ambientales de La Pampa (CONICET and Universidad Nacional de La Pampa), Av. Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina

Mariano Verde
PEDECIBA Geociencias-Biología, Instituto de Ciencias Geológicas, Facultad de Ciencias, Universidad de la República, Iguá 4225 CP 11400, Montevideo, Uruguay
E-mail address: verde@fcien.edu.uy

David Loope
University of Nebraska, Earth & Atmospheric Sciences, Lincoln, NE 68588-0340, USA
E-mail address: dloope1@unl.edu