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Ichnofabrics and ichnofossils from the continental deposits of the Serra da Galga Member, Marília Formation, Bauru Group (Upper Cretaceous), Uberaba, Minas Gerais, Brazil

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ABSTRACT

The ichnofabrics and ichnofossils from two outcrops of the Serra da Galga Member (Marília Formation, Upper Cretaceous), in the Municipality of Uberaba, Minas Gerais of Southeastern Brazil, are analyzed: the first is characterized by fluvial deposits (braided rivers) and paleosols with a set of ichnofabrics comprising rhizobioturbation, rhizohalo-*Skolithos*, *Skolithos*, *Taenidium*, and *Skolithos-Taenidium barretti*; and the second have more influence of alluvial deposition and is characterized by occurrences of crustacean (decapod) *Thalassinoides*-like burrows. A reassessment of the *Asthenopodichnium* marks in the "pseudo-coprolites" is also discussed. The *Scoyenia* ichnofacies is suggested as being the most representative for the sedimentary deposits of the Serra da Galga Member in Uberaba.

1. Introduction

The Serra da Galga Member is an important fossiliferous unit of the Marília Formation of the Bauru Group (Upper Cretaceous), being widely known for its vertebrate content (Price, 1955; Estes and Price, 1973; Báez and Perí, 1989; Gayet and Brito, 1989; Bertini et al., 1993; Santucci and Bertini, 2001; Carvalho et al., 2004; Campos et al., 2005; França and Langer, 2005; Kellner et al., 2005; Novas et al., 2005, 2008; Candeiro et al., 2006; Salgado and Carvalho, 2008; Báez et al., 2012; Martinelli et al., 2013). The ichnofossils previously described for the Serra da Galga Member are *Arenicolites*, *Skolithos* (Carvalho et al., 2004), and perforations in pseudo-coprolites, *Asthenopodichnium* (Francischini et al., 2016). Despite its relatively abundant ichnological content, the occurrences of these structures have not yet been described and analyzed in detail, being little studied in the paleontological context of the region.

Invertebrate ichnofossils and fossil roots provide information about the paleoenvironment, paleoecology, and the development of the sedimentary substrate at the time of deposition and may even indicate the presence of paleosols (e.g. Retallack, 1990; Wright, 1992; Fernandes, 2010; Buatois and Mángano, 2011; Knaust and Bromley, 2012).

In this work, the ichnofossils found in the outcrops of the highway BR 050 (locality where the holotype of the titanosaur *Uberabatitan ribeiroi* (Salgado and Carvalho, 2008) was found) and the Caieira outcrop (locality that provided the remains of *Uberabasuchus terrificus* (Carvalho et al., 2004), *Trigonosaurus pricei* (Campos et al., 2005), and *Baurutitan britoi* (Kellner et al., 2005)) in the Municipality of Uberaba (Fig. 1) are described and discussed based on macro- and micromorphological data. Additionally, a re-evaluation of the perforations found in “pseudo-coprolites", *Asthenopodichnium fallax* (Francischini et al., 2016), of the Caieira outcrop is also presented.

2. Material and methods

The ichnofossils collected from the Serra da Galga Member are mainly preserved as ichnofabrics in the BR 050 outcrop and, because of that, they were analyzed and described by direct observation in the field. Only a few samples were collected for laboratory analysis. In the Caieira outcrop, some ichnofossils showing three-dimensional preservation were collected. The samples collected were deposited in the collection of Faculdade UnB Planaltina (University of Brasília) under the catalog numbers: FUP-Ic 109–113.

The main ichnotaxobases (general morphology, wall, infilling, and ramification, *sensu* Bromley, 1996) were taken into account for the ichnofacies description. The description of the micromorphologies and microstructures are in accordance with recommendations of Genise (2017) and follow the ichnotaxonomic guidelines proposed by Bertling et al. (2006). The degree of bioturbation (presented herein as

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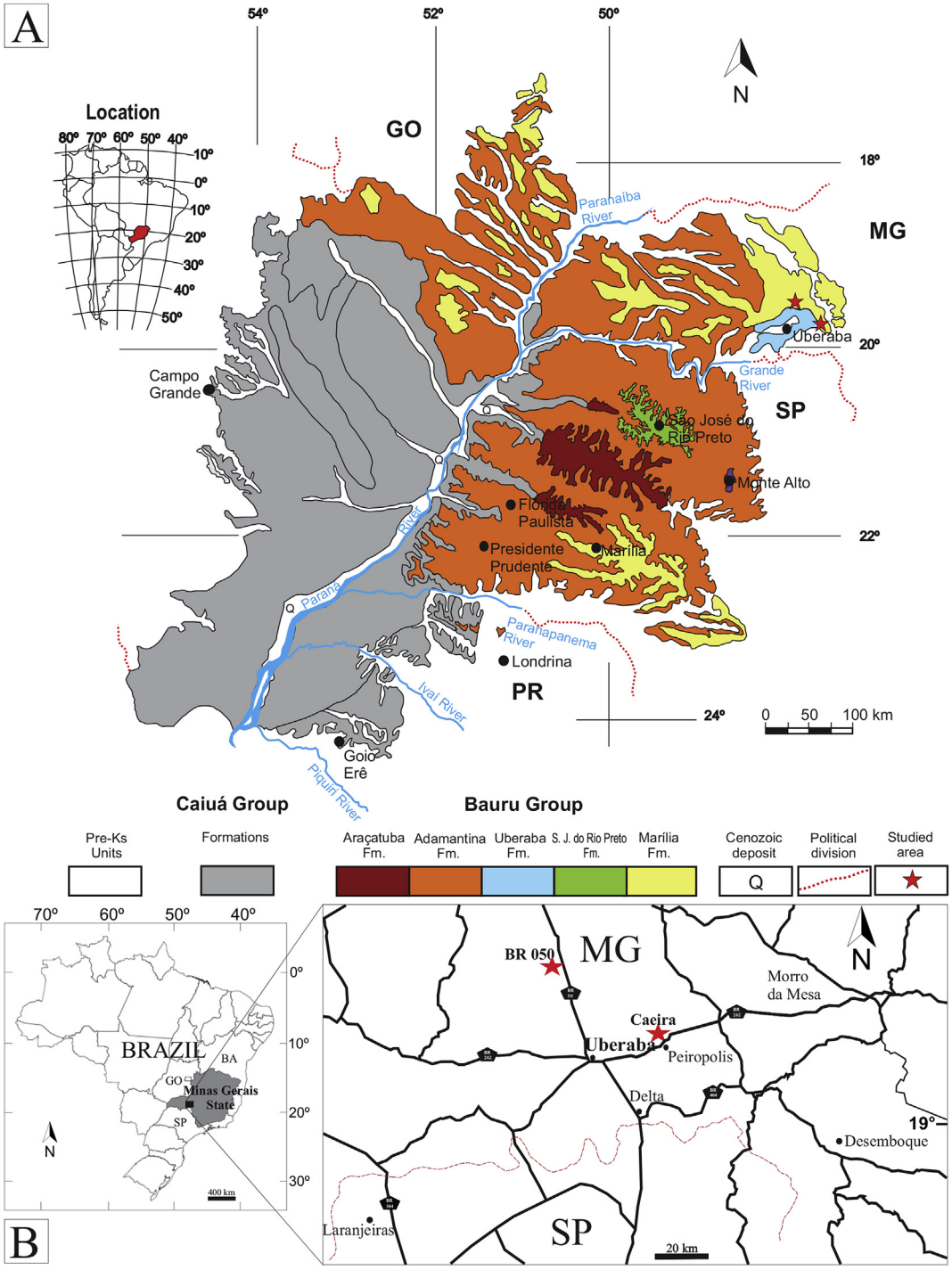

Fig. 1. Geological and location map. **A,** geological map of the Bauru Group depicting the studied areas. Modified from Fernandes (1998), Fernandes and Coimbra (1996). **B**, location map of the outcrops studied in the state of Minas Gerais, southeastern Brazil. The Caieira outcrop is located near the District of Peirópolis, in the Municipality of Uberaba. The BR-050 outcrop is located at km 153 of the homonymous highway, Google maps, ©2018 Google.

bioturbation index (BI)) was based on the scale proposed by Reineck (1963). The term coprolite refers here to all exemplars considered as vertebrate coprolites (probably produced by dinosaurs) and the term pseudo-coprolite refers to carbonate nodules with morphology similar to vertebrate coprolites found in both outcrops (see Oliveira and Santucci, 2017).

3. Geological setting

The Bauru Group mainly overlays the basalts of the Serra Geral Formation (São Bento Group) and crops out in the states of São Paulo, Minas Gerais, Mato Grosso do Sul, Mato Grosso, and Goiás, having an area of approximately 230,000 km^2 (Fulfaro, 1974). According to Batezelli (2010), the Bauru Group is comprised of the formations Araçatuba, Adamantina, São José do Rio Preto, Uberaba, and Marília (Ponte Alta, Serra da Galga, and Echaporã members) (Fig. 1A). The limits of the Bauru Group are characterized by erosive and/or tectonic processes, developed during the Late Cretaceous (Batezelli, 2010). The climate at the time of deposition was considered to be arid/semi-arid (Fernandes and Coimbra, 2000; Batezelli et al., 2005).