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Chemostratigraphy of the Neoproterozoic Mirassol d'Oeste cap dolostones (Mato Grosso, Brazil): An alternative model for Marinoan cap dolostone formation

E. Font [a,b,*], A. Nédélec [b], R.I.F. Trindade [a], M. Macouin [b], A. Charrière [b]

[a] *Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, São Paulo, Brazil*
[b] *LMTG, UMR #5563, OMP, Université Paul-Sabatier, Toulouse, France*

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Abstract

We have conducted a detailed study of the Neoproterozoic Mirassol d'Oeste cap dolostones that overlay the glacial diamictites of the Puga Formation (~635 Ma, Amazon craton, Brazil) in order to understand the formation of these post-glacial dolostones. Petrographic features indicate that the dolostones are primary to early diagenetic in origin and precipitated in a moderately shallow-water platform corresponding to a carbonate ramp during transgressive conditions. Major and trace element contents, as well as C and O isotopic signatures, are consistent with an anoxic sediment influenced by sulphate-reducing bacteria. Such an environment is known to provide favourable conditions for the precipitation of dolomite as observed nowadays in modern hypersaline lagoons. Isotopic compositions of tube-like structures suggest local upward fluid seepage from the underlying cap dolostone. Our data concur with geochemical data from other Neoproterozoic cap dolostones to support a microbially-mediated model in specific environmental conditions for the formation of these unusual deposits worldwide.

Keywords: Neoproterozoic; Marinoan glaciation; Cap dolostone; Sulphate-reducing bacteria; Amazonian craton

1. Introduction and geological setting

The Neoproterozoic era encompasses at least three glacial events (Sturtian, Marinoan and Gaskiers glaciations). The corresponding glacial deposits (diamictites and tillites) are usually overlain by "cap" carbonates composed by a lowermost cap dolostone and an upper (cap) limestone, marking severe climatic changes from icehouse to greenhouse conditions [1]. Paleomagnetic data from Neoproterozoic glacial deposits and associated cap carbonates show that ice caps have extended into equatorial latitudes [2–5], comforting the hypothesis of a Neoproterozoic snowball Earth [6].

Cap carbonates are especially well developed over the Marinoan Neoproterozoic glacial successions (recently dated at ~635 Ma [7]) and give us an insight on environmental changes in this ice-age aftermath. They form transgressive sequences associated to the post-glacial sea-level rise and comprise a thin basal dolomitic unit (the so-called cap dolostones) and a thick overlying cap limestone

* Corresponding author. IAG-USP, Cidade universitária, Rua do Matão, 1226, 05508-090, São Paulo, Brazil. Tel.: +55 11 3091 2790; fax: +55 11 8101 5045.
E-mail addresses: eric@iag.usp.br, font_eric@hotmail.com (E. Font).

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succession. Stratigraphic and isotopic data of Marinoan cap carbonates, and especially their negative C isotope compositions, have been extensively reported for Australia, Namibia, Canada, China, Svalbard and Amazonia (see summary by [8] and references therein), but are still a matter of debate. In addition, the Marinoan cap dolostones show unusual structures such as tube-like structures, aragonite fans and megaripples (or pseudo-tepees) which received diverse interpretations [1,9].

Recently, the Neoproterozoic cap dolostones of the Mirassol d'Oeste Formation (Mato Grosso, Brazil, Fig. 1), which were deposited above the Puga diamictites in the south-east of the Amazon craton [10], yielded a dual polarity component providing a low paleolatitude for the Amazon craton at the end of the glaciation [4]. The primary character of the magnetization was suggested by the presence of several stratabound geomagnetic reversals and certified by a magnetic mineralogy study that unravelled detrital haematite and detrital magnetite as the remanence carriers [4,11]. Nogueira et al. [12] proposed a post-Marinoan age for the Mirassol d'Oeste (MO) cap dolostones on the basis of C isotopic correlations with the Maieberg and the Elantoek Formations, Namibia. These latter formations that cap the Ghaub glacial deposits have

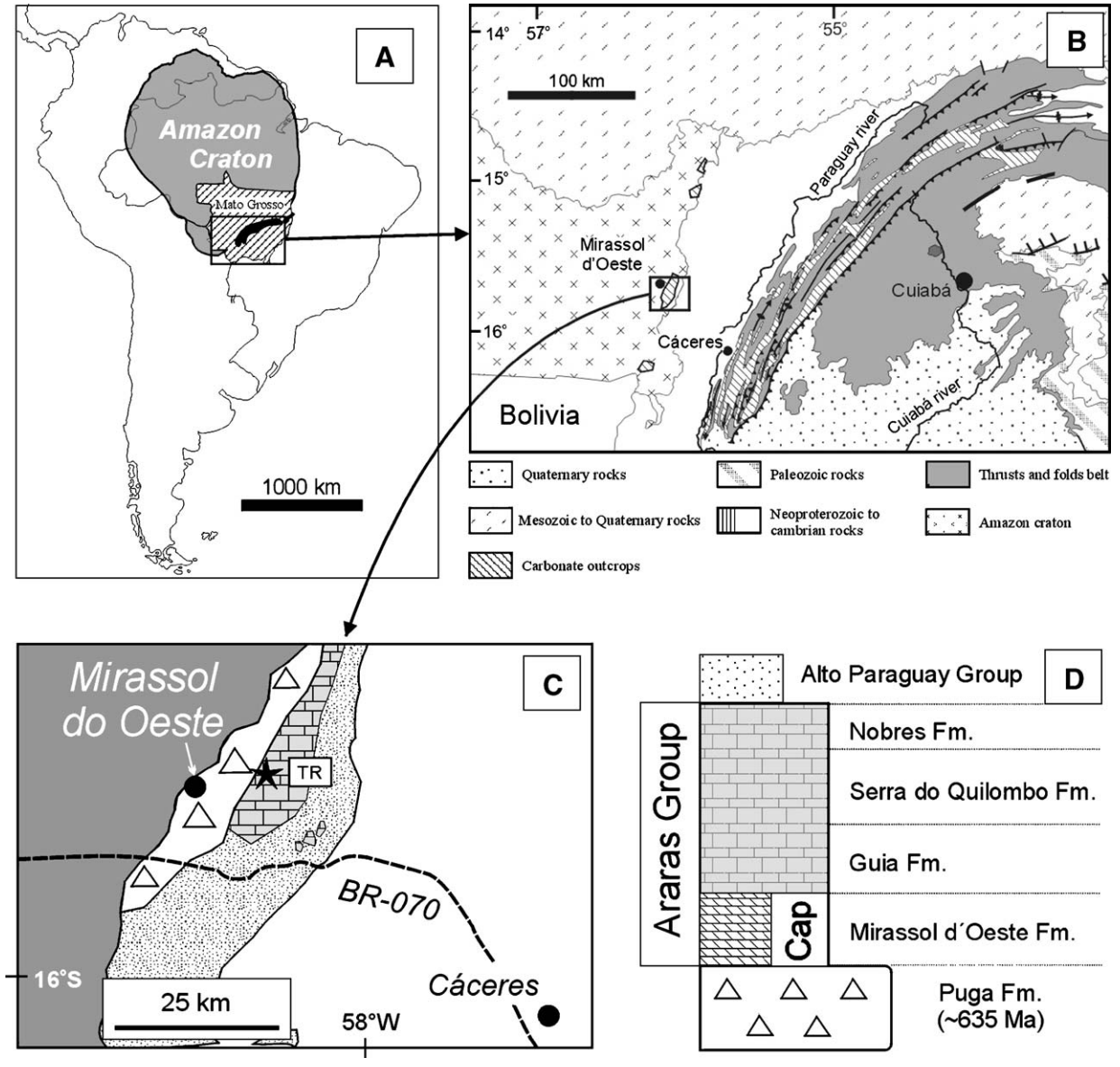

Fig. 1. Location of the Amazon craton (A) and Paraguay belt (B). Geological map of the studied sector (C) with localization of Terconi section (TR) and regional stratigraphic sequence (D).