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Mid-Late Devonian assemblages of herbaceous lycophytes from northern Argentina and Bolivia: Age assessment with palynomorphs and invertebrates and paleobiogeographic importance

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ABSTRACT

Implications of a new collection of lycophytes of the genera *Haplostigma* Seward and *Paleostigma* Kräusel and Dolianiti from southern Bolivia and northern Argentina are presented. Fragmented herbaceous stems of lycophytes preserved as compressions, impressions and casts come from the Middle and Late Devonian Pescado (Huamampampa), Los Monos and Iquiri formations at Mataral, Yesera, Angosto del Pescado and Balapuca. The interbedded shales and siltstones bearing the lycophytes were also examined for palynology. They yielded mostly terrestrial palynomorphs with *Grandispora pseudoreticulata* and other Eifelian to Givetian species and fewer microplanktonic species (i.e., acritarchs, prasinophytes, chitinozoans). At Yesera, diagnostic spores and elements of the microplankton suggest a Givetian-Frasnian up to early Famennian age for the *Haplostigma* beds. Moreover, presence of the same brachiopod taxon in the *Haplostigma* intervals at Yesera Dique (palynologically barren) and Yesera Centro supports their correlation. This new information supports terrestrial connections between these Bolivian and Argentine areas and other regions of South America in the Eifelian – Givetian Afrosouthamerican Subrealm, which extended up to the early Famennian.

1. Introduction

Megafloras from the Middle to Late Devonian of southern Bolivia and northern Argentina are not well understood, mainly due to the scarcity of records and the uncertainty over the identification of *Haplostigma* Seward 1932 and *Paleostigma* Kräusel and Dolianiti 1957 species. This relates to poor preservation of fossil plant remains in many cases. Newly discovered specimens provide important taxonomic information at the generic and specific level, and on the biodiversity and the succession of floristic events. This includes its paleobiogeographic distribution (di Pasquo et al., 2009; Moisan et al., 2011). To date, we have well documented specimens from the Balapuca section published by di Pasquo (2007), while those illustrated by Ahlfeld and Branisa (1960) and Branisa (1965) have been lost. The *Centro de Información de Hidrocarburos YPFB* (Santa Cruz de la Sierra, Bolivia), allowed M. di Pasquo to visit the repository where the Branisa's specimens should have been housed. Neither specimens of *Haplostigma* nor other plant species were found there nor at the Museum in Cochabamba where Drs. Ramiro Suárez Soruco and Ramiro Suárez might have had unpublished specimens. Hence, to improve knowledge the current biostratigraphy (Limachi et al., 1996), of particular importance are the new records of *Haplostigma* presented herein. These were collected from southern Bolivia (Balapuca, Mataral and Yesera areas) and northern Argentina (Balapuca and Angosto del Pescado, Figs. 1 and 2). Their age is provided by palynology and

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invertebrates, associated with these plants (Fig. 3), and their paleobiogeographic importance is also addressed.

2. Geological setting

The Devonian deposits in South America constituted marine sedimentary basins (Fig. 1) that were interconnected during transgressive intervals. Terrestrial connections are also based on common paleontological records (Grahn, 2005; di Pasquo et al., 2009). To the east of the Puna Highlands, the Peru–Bolivia Master Basin was a foreland basin where siliciclastics were deposited during the Silurian and Devonian. In the latest Devonian the structure of the basin changed perhaps due to the docking of the Chilenia terrane to the south causing an unconformity between the Devonian rocks and the overlying Carboniferous attributed to the Chanic Orogeny (Starck et al., 1993b; Starck, 1995; Sempere, 1995; Tankard et al., 1995; Ramos, 2008).

Devonian rocks of the Tarija Basin are known from northern Argentina cropping out in the areas of the Cordillera Oriental, western Subandean Ranges and Santa Barbara System, and they

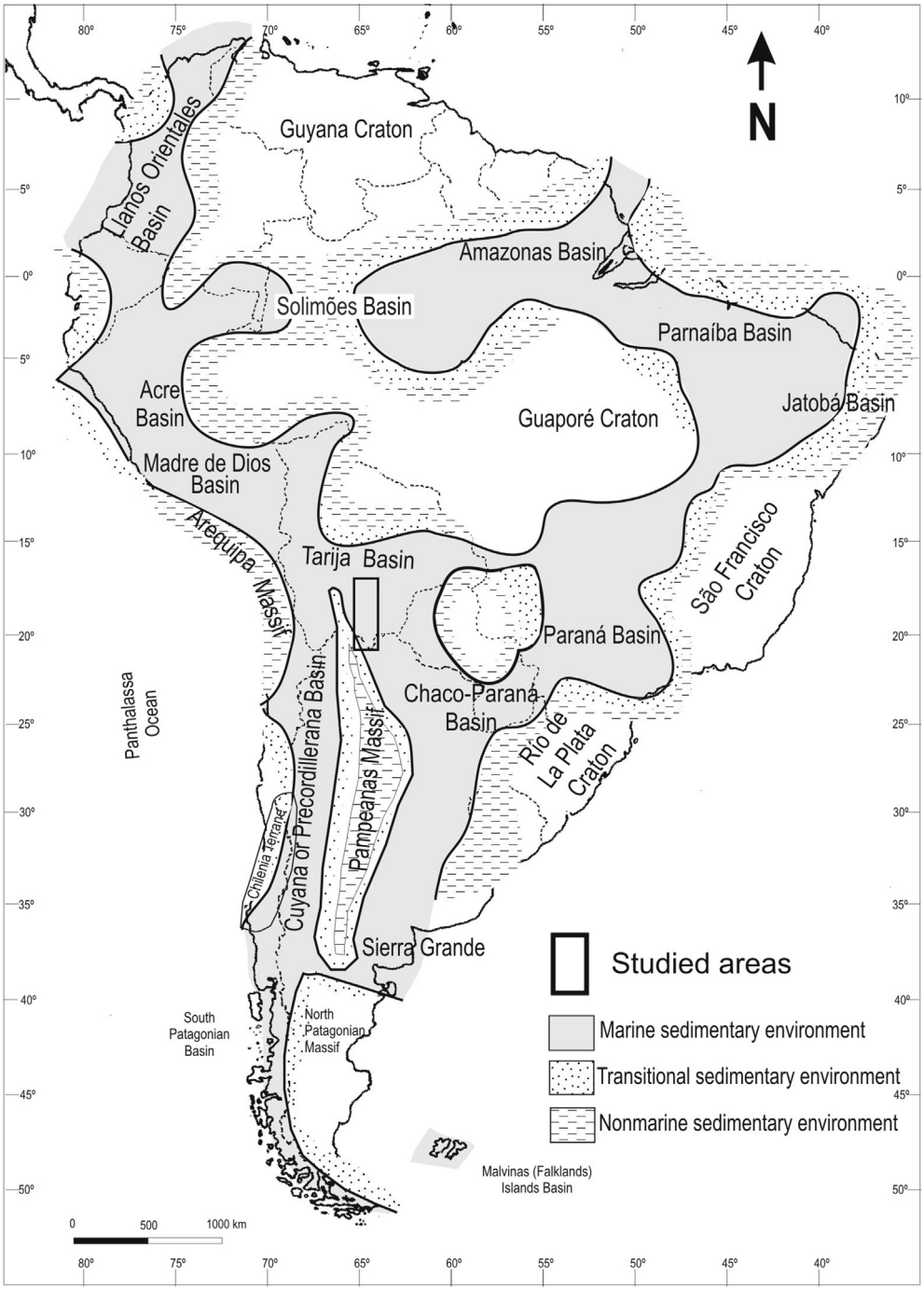

Fig. 1. Location of the Tarija Basin in South America within the paleogeographic map at Givetian-Frasnian time (modified from di Pasquo et al., 2009).