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Permian and Triassic microfloral assemblages from the Blue Nile Basin, central Ethiopia

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ABSTRACT

Palynological investigation was carried out on surface samples from up to 400 m thick continental siliciclastic sediments, here referred to as ‘‘Fincha Sandstone’’, in the Blue Nile Basin, central Ethiopia. One hundred sixty species were identified from 15 productive samples collected along a continuous roadcut exposure. Six informal palynological assemblage zones have been identified. These assemblage zones, in ascending order, are: ‘‘Central Ethiopian Permian Assemblage Zone – CEPAZ I’’, earliest Permian (Asselian–Sakmarian); ‘‘CEPAZ II’’, late Early Permian (Artinskian–Kungurian); CEPAZ III – Late Permian (Kazanian–Tatarian); ‘‘CETAZ IV’’, Lower Triassic (Olenekian Induan); ‘‘CETAZ V’’, Middle Triassic (Anisian Ladinian); ‘‘CETAZ VI’’, Late Triassic (Carnian Norian). Tentative age ranges proposed herein are compared with faunally calibrated palynological zones in Gondwana. The overall composition and vertical distribution of miospores throughout the studied section reveals a wide variation both qualitatively and quantitatively. The high frequency of monosaccate pollen in CEPAZ I may reflect a Glossopterid-dominated upland flora in the earliest Permian. The succeeding zone is dominated by straite/taeniate disaccate pollen and polyplicates, suggesting a notable increase in diversity of glossopterids. The decline in the diversity of taeniate disaccate pollen and the concomitant rise in abundance of non-taeniate disaccates in CEPAZ III may suggest the decline in *Glossopteris* diversity, though no additional evidence is available to equate this change with End-Permian extinction. More diverse and dominant non-taeniate, disaccate, seed fern pollen assignable to *Falcisporites Alisporites* in CETAZ IV may represent an earliest Triassic recovery flora. The introduction of new disaccate forms with thick, rigid sacci, such as *Staurosaccites* and *Cuneatisporites*, in CETAZ V and VI may indicate the emergence of new gymnospermous plants that might have favourably adapted to coastal plain wetland environments with the return of humid conditions in the Middle to early Late Triassic. The present data constitute the first paleontologically substantiated record for the existence of Permian strata in the Blue Nile Basin. The new results allow for the first time a reliable biostratigraphic subdivision of the central Ethiopia Karoo and its correlation with coeval strata of adjacent regions in Gondwana. From a phytogeographic point of view, the overall microfloral evidence is in support of the position of central Ethiopia occupying the northern part of the southern Gondwana palynofloral province. In view of palaeoecological and paleoclimatic conditions, the microfloral change from the base to the top of the studied section may indicate a response to shifting climatic belts from warm- and cool-temparate climate in the earliest Permian to progressively drier seasonal conditions at successively higher palaeolatitudes during the Late Permian to Middle Triassic.

1. Introduction

Permian and Triassic sedimentary rocks are known from most African countries south of the Equator, starting from Ethiopia in the north up to South Africa in the south. These dominantly siliciclastic sedimentary successions of continental and marine origin are commonly referred to as Karoo sediments because they were first described from the Great Karoo Basin in South Africa (SACS, 1980; Wopfner, 2002). They encompass a time span ranging from Late Carboniferous to Late Triassic (Hankel, 1987; Wopfner and Kaaya, 1991), possibly extending up to Early Jurassic (Catuneanu et al., 2005; Hankel, 1994). Time equivalent strata, exhibiting similar sequential trends are observed all over Gondwana (Veevers and Powell, 1994; Wopfner, 1999; Wopfner and Casshyap, 1997).

The central Ethiopian Karoo in the Blue Nile Basin represents the northern-most outcrops in the East Africa/Madagascar region (Fig. 1a). These strata show clear similarity with other Karoo

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sediments in south-central Africa and were deposited in a series of NE and NW-trending intracontinental rifts and pull-apart basins, known collectively as Karoo rift basins (Papini and Benvenuti, 2008; Schandelmeier et al., 2004). Although the geodynamic evolution of these complex rift basins is not yet entirely clear, they were believed to have been formed along a zone of weakness of the former Pan-African mobile belt (Geiger et al., 2004; Montenat et al., 1996; Pique et al., 1999) due to transtensional tectonics related to cratonic SW–NE mega-shear zones (Katz, 1987; Daly et al., 1989; Schandelmeier et al., 2004). Veevers et al. (1994) suggested right lateral translation between Gondwana and Laurasia as a possible cause for the creation of the Late Palaeozoic strain distribution.

Despite their significance in reflecting the tectonic, phytogeographic and climatic events during the time of the Pangean first-order cycle of supercontinent assembly and breakup, little is known about the litho- and biostratigraphy of the central Ethiopian Karoo. This paper aims at erecting a Permian and Triassic palynological scheme for the central Ethiopian Karoo section in the Blue Nile Basin based on plant microfossils. It also attempts to make some inferences regarding the Permian and Triassic phytogeography, paleoclimate and paleoecology.

2. Stratigraphic framework

The Blue Nile canyon of central Ethiopia harbours one of the best-exposed Palaeozoic and Mesozoic sedimentary sequences in eastern Africa. The canyon is formed by the Blue Nile River (locally called Abay River), whose numerous tributaries also form smaller

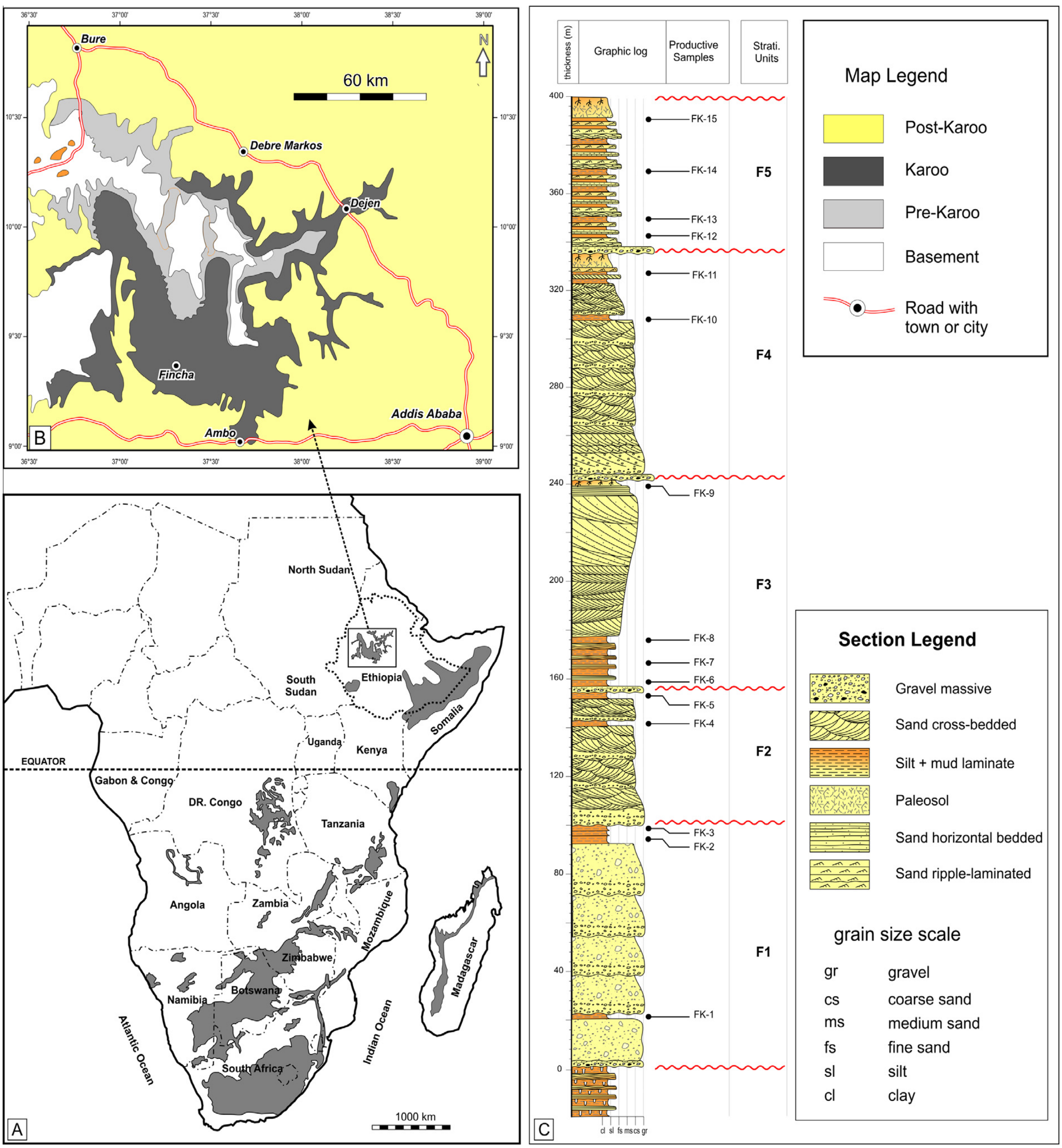

Fig. 1. (A) Distribution of Karoo basins and the location of the central Ethiopian Karoo (modified after Catuneanu et al., 2005). (B) Simplified geological map showing the distribution of pre-Karoo, Karoo and post-Karoo sediments in the Blue Nile Basin, central Ethiopia. (C) Graphic sedimentologic log showing the five Members of the Fincha Sandstone, and the location of palynologically productive samples.

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