High-Resolution Palynostratigraphy, Northern Arabian Plate – A Correlation Tool for Clastic Sequences*

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Introduction

Our stratigraphic investigations have focused on the northern Arabian Plate regions (Figure 1), where there are thick Upper Palaeozoic (Pennsylvanian, Permian) carbonate and clastic sequences. More or less intensely interrupted depositional cycles and complexes extend widely (as far as Saudi Arabia and Oman), with many units including source rock and reservoir intervals (oil and nonassociated gas reservoirs). However, the age classification and correlation of individual clastic units is still a matter of discussion. These questions have been previously discussed for some clastic units and subsurface sections in Iraq. Our aim here was to produce a reliable palynostratigraphic tool for precise dating and correlation applicable across the northern Arabian Plate region.

The Palynostratigraphic Model

In recent studies, some of us were able to correlate the Permian mixed clastic-carbonate sequences in SE Turkey and Iraq with the international standard stages, especially with reference to mid-Permian sections (e.g., Al-Juboury and Al-Hadidy, 2009; Stolle et al., 2011). Based on data from these palynologically well analyzed sections (e.g., Nader et al., 1997; Stolle, 2010, Figure 2), fourteen stratigraphic markers (including the recognition of eleven newly established taxa) were used to erect a new palynostratigraphic model. This model allows the precise differentiation of deposits from the SE Turkey/ Iraq region within the time span of the late Wordian, to assign strata to the mid and late Wordian, and to the earliest Capitanian, and even to characterize strata older or younger than late Wordian. Deposits can be placed, in high-resolution, within a time interval of less than a half a million years (Figures 2 and 3).

Stratigraphic Correlation of Clastic Units

The applicability of the palynostratigraphic model within the basal Permian clastic deposits of the Kas Formation in SE Turkey has already been proven in several dated and correlated surface and subsurface sections (Figure 3A, B). Other examples include dated intervals within

clastic sections of the 100/B/85, TI9, UB8A wells (W Iraq, upper Ga'ara Formation, middle Wordian), and of the Mityaha-1 and Atshan-1 wells (N Iraq, Chia Zairi Formation, late Wordian/early Capitanian). The high-resolution palynostratigraphic model is (in parts) also applicable in southern Arabian Plate areas and a correlation chart compares the dated northern clastic sections with approximately time-equivalent strata in Oman (e.g., with a mudstone band below the Khuff Formation, Huqf area, mid (late) Wordian) (Figure 3B).

Expanded Application?

The high-resolution palynostratigraphic model has been developed as a tool for stratigraphic control on lateral distribution for mid-Permian clastic deposits of SE Turkey and Iraq, and it can be successfully applied at a regional level. However, a comparison with the palynostratigraphic record of other selected regions (e.g., Jordan) suggests that comprehensive stratigraphic solutions for the southern Arabian Plate (Middle East) regions will require individually customized palynostratigraphic analysis.

Acknowledgements

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Figure 1. Localities of our stratigraphic investigations, northern Arabian Plate regions (in orange).
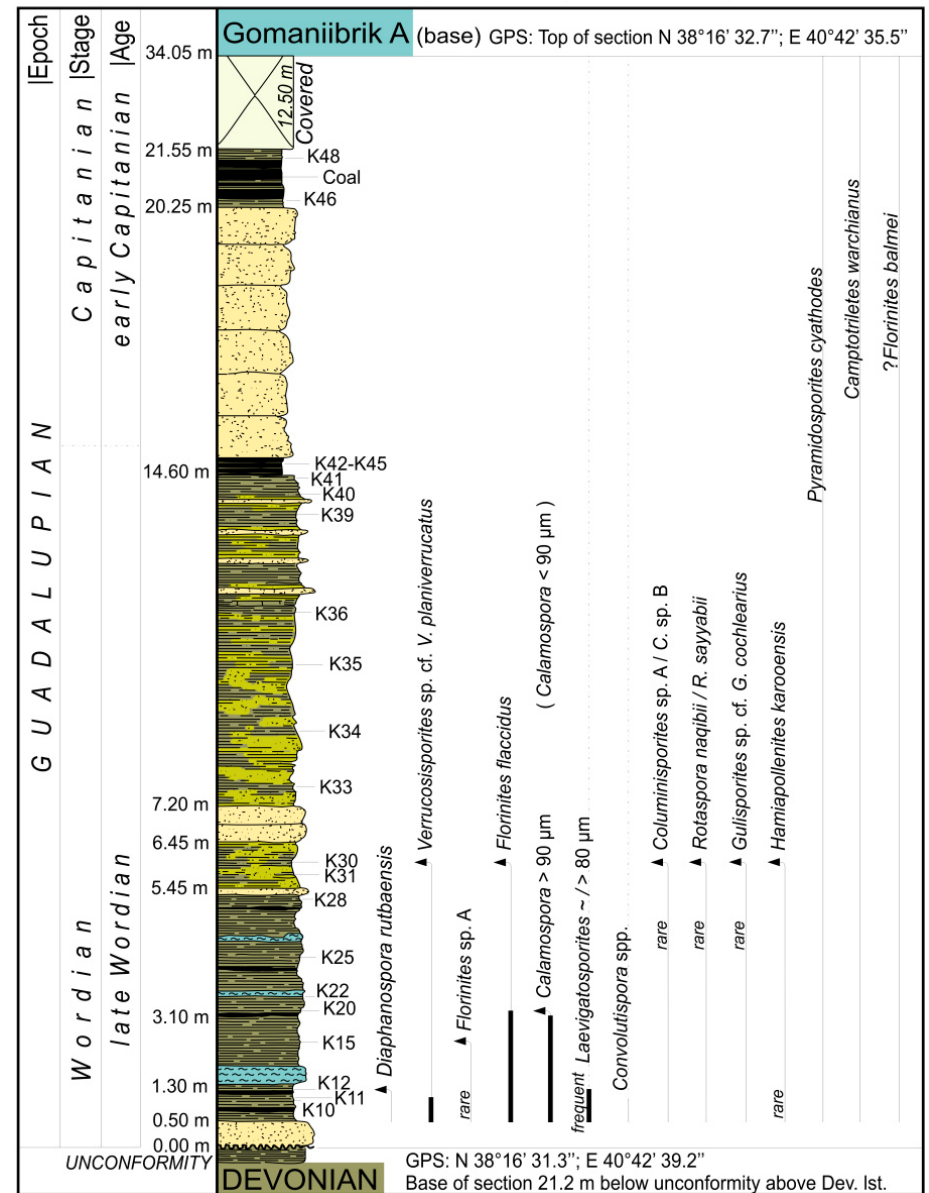
Figure 2. The reference section (outcrop section, left hand), where fourteen stratigraphic markers were used to erect a new palynostratigraphic model (right hand; illustration modified from Stolle, 2010; Stolle et al., 2011).
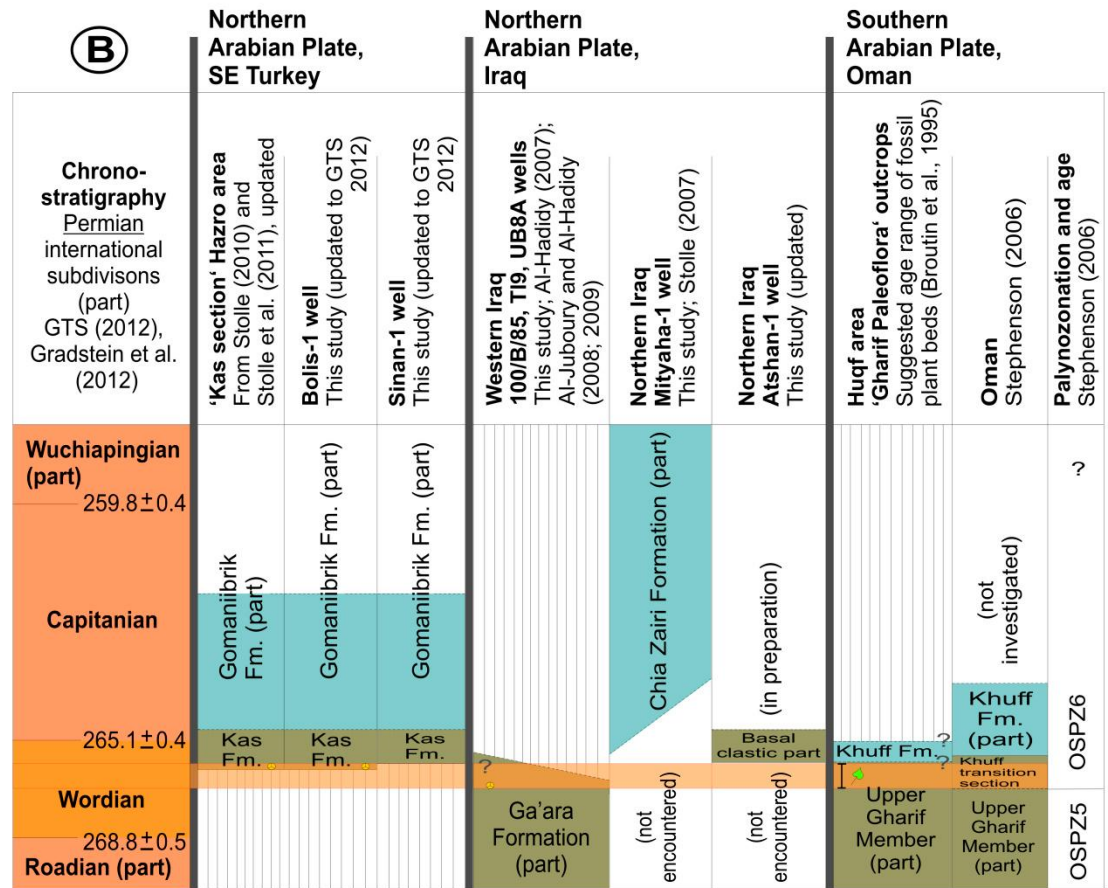
Figure 3. Selected studied sections (compare with maps in (A)) correlated by the application of the palynostratigraphic model (in B). The model allows the precise differentiation of deposits from the SE Turkey/ Iraq region within the time span of the late Wordian (see the reddish-tan-brown band), to assign strata to the mid- and late Wordian, and to the earliest Capitanian, and even to characterize strata older or younger than late Wordian. Deposits can be placed, in high-resolution, within a time interval of less than one-half million years. (Clastic deposits in grey, carbonates in blue.) (Correlation chart modified from Stolle, 2010; Stolle et al., 2011. Additional references in these articles.)