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Biostratigraphy of the Tirgan Formation in the Kopet-Dagh basin: Stratigraphic sections of the Tirgan village and Amirabad

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Abstract

The Lower Cretaceous successions of the NE Iran in the sedimentary Kopet-Dagh basin are result from transgression of the Berriasian-Barremian marine, which are deposited after first erosional cycle (Late Jurassic-Early Cretaceous). In this research, two stratigraphic sections of these successions, including the Tirgan Formation, described and studied in detail, and is provided a biostratigraphic framework for them. The new paleontological results of the Tirgan Formation are based on the benthic foraminifera. Some of them are reported for the first time (e.g. *Conorbinella azerbaijanica*, *Cuneolina composaurii*, *Feurtillia gracilis* and *Orbitolinopsis cf. nikolovi*). *Feurtillia gracilis* taxon range zone offers the Valanginian age for the base parts of the Tirgan Formation as well genera and species; *Balkhania balkhanica*, *Dictyoconus pachymarginalis* and *Orbitolinopsis cf. nikolovi* confirm Late Barremian-Aptian age for the upper parts of this Formation. This study shows a diachrony in the age of base of the Tirgan Formation, so that transgressive successions start with Valanginian age (or probably Berriasian) in the Tirgan village section, however the Amirabad section shows Late Barremian age at the beginning of transgression.

Keywords: Kopet-Dagh basin, Tirgan Formation, Valanginian age.

Introduction

In Iran, Lower Cretaceous carbonate successions occur in different regions such as in the Zagros and Alborz Mountains, Kopet-Dagh basin, and Central Iran (Afshar-Harb 1994; Davoudzadeh 1997). In this research, we describe two sections through Lower Cretaceous sediments (Tirgan Formation) from the Kopet-Dagh basin (northern Tethys margin), which are located in the Khorasan-e-Razavi province. The first one is the Tirgan village section, placed in 3 km south of the Tirgan village (37° 07' 11" N and 59° 18' 45" E). The second investigated section is Amirabad section, which is located in 80 km northeast of the Mashhad city, about 20 km east of the Gojgi (36° 33' 40" N and 60° 04' 02" E). Here, we provided a new biostratigraphic framework for these sections using thin sections.

Material and Methods

In the Tirgan village and Amirabad sections, a total of 392 samples were collected and processed. In this study we examined the distribution of foraminifera using thin sections.

Discussion of Results and Conclusions

The Tirgan village section is approximately 640 m thick. This section is subdivided into four units. These lithostratigraphic divisions are separated by prominent surfaces, which can laterally be followed on Google Earth map. Lithologically, Tirgan village section is dominated by oolitic and bioclastic limestones, which includes partly reworked components and which are rich in bryozoans. Limestone rich in macrofossils, dolomitized limestone, nodular and marly limestone, marl, and fine sandstone beds, are further lithologies present in the section. At the Tirgan village section, unit 1 overlies clastic and evaporitic sediments (gypsum) of the Shourijeh Formation. The boundary between the Shourijeh and Tirgan formations is very irregular and erosive. This interval of the Tirgan Formation is marked by approximately 30 m of grey to buff, massive, limestone, without visible stratification. The sediments of this unit are barred by a dam and are unfortunately not accessible and could not be sampled. The Tirgan Formation also underlies shaly sediments of the Sarcheshmeh Formation. The second section, Amirabad section, is approximately 80 m thick, and is subdivided into

three units, which can also be followed on Google Earth map. These units are named; carbonate platform facies, hemiplegic carbonates and shales and marls of the Sarcheshmeh Formation. The Tirgan Formation in the Amirabad section is mostly composed of fossiliferous limestones, gray argillaceous and marly limestone and shale. Like the Tirgan section, the Tirgan Formation is restricted here between the conglomerates and sandstones of the Shourijeh Formation and green shales of the Sarcheshmeh Formation.

The new paleontological results of the Tirgan Formation are based on the benthic foraminifera assemblages. Some of them are reported for the first time (e.g. *Conorbinella azerbaijanica*, *Cuneolina composaurii*, *Feurtillia gracilis* and *Orbitolinopsis cf. nikolovi*), and taxon range zones of benthic foraminifera are used to obtain a first-order age control in the Tirgan village section (Neagu and Cîrnaru 2002). *Feurtillia gracilis* taxon range zone offers the

Valanginian age for the base parts of the Tirgan Formation as well genera and species; *Balkhania balkhanica*, *Dictyoconus pachymarginalis* and *Orbitolinopsis cf. nikolovi* confirm Late Barremian–Aptian age for the upper parts of this Formation. Overall, the benthic foraminifera allowed to distinguish two distinct time intervals: 1) the *Feurtillia gracilis* range zone (Valanginian); 2) the Orbitolinid assemblage zone (Aptian). This study shows a diachrony in the age of base of the Tirgan Formation, so that transgressive successions start with Valanginian age (or probably Berriasian) in the Tirgan village section, however the Amirabad section shows Late Barremian age at the *beginning* of *transgression*, so this diachrony in the age of base of the Tirgan Formation suggests the effect of a long-term subsidence in the Kopet-Dagh Basin during the Early Cretaceous, following probably the Cimmerian phase of orogenesis.