Benthic foraminiferal assemblages in Tirgan formation (Urgonien facies type), West of Kopet-Dagh sedimentary basin, NE of Iran

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Abstract
The Tirgan Formation is a Lower Cretaceous succession in the Kopet Dagh Basin in North East of Iran which lithologically mainly consists of micritic limestones, thick layers of biomicritic limestones, shaly limestones, marly limestones and biosparite limestones. Micropaleontological investigation has been carried out on some 85 surface samples from the Arkan exposure near the Bojnourd city. This study includes both macrofossils (echinoderms, brachiopods, lamellibranches) as well as microfossils (assemblages of benthic foraminifera, calcareous algae). These criteria reveal that an equivalent of the Urgonian facies type (in France-Swiss area) and open marine, low depth sedimentary basin are extended in the Kopet-Dagh Basin. In this article, we tried to introduce some of the important foraminiferal assemblages of this area.

Keywords: Tirgan Formation, Lower Cretaceous, Kopet-Dagh Basin, Micropaleontology.

Introduction
In the present paper the new findings in the Western Tethyan domain is described for the first time from the Barremian-Aptian of the Kopet Dagh mountains in the north-eastern part of Iran.

Geological setting
The Kopet Dagh mountain range represents a NE-trending about 650 km long and about 200 km wide active fold belt at the frontier between Turkmenistan and Iran, east of the Caspian Sea. It was formed on Hercynian metamorphosed basement at the SW margin of the Turan Platform (unpubl. report Geological Survey of Iran) and is composed of about 10 km of Mesozoic and Tertiary sediments (mostly carbonates). Like to the Zagros Mountains, the Kopet Dagh was folded into long linear NW-SE trending folds during the last phase of the Alpine orogeny in Plio-Pleistocene times. No magmatic rocks are exposed in Kopet Dagh except those at the basement occurring in the Aghdarband tectonic window and some Triassic basic dikes (unpubl. report Geological Survey of Iran). The studied samples are from the Barremian-Aptian Tirgan Formation refering to the Tirgan Valley in the eastern central Kopet Dagh sedimentary basin in the northeast of Iran. The name, introduced by geologists of the National Iranian oil company (AFSHARHARB 1969, 1970), applies to a feature-forming unit of massively bedded, oolitic and organodetrital limestones occurring throughout the Kopet
Dagh mountain range. For the eastern part of Kopet Dagh, AFSHAR-HARB (1969) indicated a thickness of 50 m and less but in the type area of the Tirgan Valley the thickness is about 700 m. The Tirgan Formation overlies the Shurijeh Formation and underlies by the Sarcheshmeh Formation; the contacts with both are conformable and a transitional interfingering between the Tirgan and Shurijeh formations have been observed in the southeastern Kopet Dagh. The lithology of the Tirgan Formation includes oolithic, partly fossiliferous (e.g. orbitolinid limestones), partly marly limestones, and marls allowing further differentiation of the formation. The age of Tirgan Formation was essentially Neocomian, in places extending as high as Aptian (STOCKLIN & SETUDEHNIA 1991). According to KALANTARI (1969) the studied Barremian deposits of the Tirgan Formation may reach up to 300 m thickness and consist of alternating calcareous sand and oolitic sandy limestone containing bryozoans, calcareous algae and both benthonic and planktonic foraminifera. The Aptian part of the Tirgan Formation may reach up to 1100 m in thickness and is mainly represented by massive limestones; its foraminiferal fauna includes beside others orbitolinids such as Palorbitolina lenticularis (BLUMENBACH).

**Discussion**

Bojnourd area is a part of Kopet Dagh sedimentary Basin located in Northern Khorasan. In this area, some outcrops of the Shurijeh, Tirgan, Sarcheshmeh, Sanganeh, and Abderaz formation are present with the Cretaceous age. Tirgan’s type-section is located about 39 km southeast of Dargaz and mainly includes mid to thick grey fossiliferous limestones (AFSHAR-HARB 1994). The Arkan section is located 10 km southwest of Bojnourd, heading for Esfarayen (Fig.1). In this section, the thickness of the Tirgan Formation is about 195 m underlain by sandstones and limestones of the Shurijeh Formation. The Tirgan Formation persistently underlies the Sarcheshmeh Formation. In the study area, the general striking of the beds is approximately E-W with a dipping of 15-35o. For micropaleontological studies, 85 samples were taken and 108 thin-sections were prepared. The following calcareous algae, mainly dasycladales, have been identified: Actinoporella cf. podolica (ALTH), Boueina cf. hochstetteri (TOULA), Clypeina cf. gigantea (SOKAC), Clypeina cf. solkani (CONRAD & RADOICIC), Cylindroporella elliptica (BAKALOVA), Juraella bifurcata (BERNIER), Neomeris cf. cretacea (STEINMANN), Polystrata cf. alba (DENIZOT), Praturlonella nerae (DRAGASTAN, BUCUR & DEMETER), Praturlonella dalmatica (SOKAC & VELIC), Pseudoactinoporella cf. fragilis (CONRAD), Salpingoporella cf. cemi (RADOICIC), Salpingoporella aff. hasi (CONRAD, RADOICIC & REY), Salpingoporella cf. hispanica (CONRAD & GRABNER), Salpingoporella aff. istriana (GUŠIC), Salpingoporella aff. milovanovici (RADOICIC), Salpingoporella muehlbergii (LORENZ), Salpingoporella cf. parapiriniae (CONRAD et al.) and a new species Steinmanniporella ? parsica, n. sp. (TAHERPOUR, CONRAD, ASHOURI & ARYAEI). According to the mentioned microflora, the Barremian- Aptian age is suggested for this studied section (e.g. BASSOULLET et al. 1978, GRANIER & DELOFFRE 1993, BUCUR 1999).

Also, The following benthic foraminifera have been identified: Balkhania balkhanica (Mamonotova, 1966), Choffatella decipiens (Schlumberger, 1905), Trocholina cf. odukpaniensis (Dessauvagie, 1968), Vercorsella sp. cf. V. arenata (Arnaud-Vanneau, 1980),

The above-mentioned faunal content are equivalents of the following identified biozones of Sampo (1969):
- Choffatella decipiens-Orbitolina spp. Assemblage zone: this assemblage is associated with the following foraminifers: Choffatella decipiense, Orbitolina discoidea, Palorbitolina lenticularis, Pseudocyclusminna sp., Lenticulina sp.
- Dictyoconus arabicus-Orbitolina spp. Assemblage zone: this assemblage is associated with the following foraminifers: Dictyoconus arabicus, Orbitolina discoidea, Trocholina sp., Neotrocholina sp., Choffatella sp., Pseudocyclusminna sp., Cuneolina sp., Miliolidae, Cylindroporella sp.

**Conclusion**

The main results of the micropaleontological investigations are:
- Tirgan Formation's lithology mainly consists of medium to thick biogenic oolithical limestones with intercalations of shales and marls.
- 43 genus and 31 species of foraminifera have been determined for the first time from Kopet-dagh sedimentary Basin. These assemblages of benthic foraminifera are equivalents of biozones introduced by Sampo (1969).
- The existence of Urgonian facies in the NE of Iran is accurately certified according to the micro and macro fauna in the studied section.
- Based on the identified benthic foraminifera as well as dasycladalean alga, the Barremian – Early Aptian age can be ascribed for the Tirgan Formation in the studied area.
### Fig 2: Main foraminiferal range chart

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<th>Taxon</th>
<th>Holocene</th>
<th>Oligocene</th>
<th>Miocene</th>
<th>Pliocene</th>
<th>Pleistocene</th>
<th>Lower Cretaceous</th>
<th>Aptian</th>
<th>Albian</th>
<th>Cenomanian</th>
<th>Turonian</th>
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**Legend**

- Acarinina
- Nummulites
- Globotruncana
- Foraminifera

**References**

- Tertiary System
- Quaternary System
- Cretaceous System

**Explanations**

- The chart details the distribution of various foraminiferal species across different geological periods.
- The black and white images on the left are likely micrographs showing the foraminiferal specimens.

References