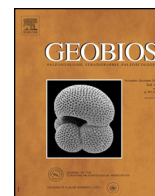




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Original article

Lower Cretaceous gastropods from the Qayen area, Eastern Iran[☆]



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ABSTRACT

Four gastropod genera are newly recorded from Lower Cretaceous deposits of the Qayen area, Eastern Iran. Based on the paleoecological interpretation of the faunal assemblage and especially on the newly identified gastropods, a shallow temperate marine environment is suggested for the fossil-bearing carbonate rocks. The gastropod assemblage shows a typically Tethyan composition comparable to those already reported from the Caucasus and Eastern Europe.

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1. Introduction

The study area is part of the Qayen quadrangle map (Berthiaux et al., 1991), northern part of the South Khorasan Province, Eastern Iran. Tectonically, this area is situated in the northern part of the Sistan suture zone, between the Lut and Afghan blocks (Figs. 1, 2(B)). It probably was connected to the Pre-Caspian and Caucasus trough via Sabzevar and northern Iran (Fauvelet and Eftekharneshad, 1990; Wilmsen et al., 2005). The margins of the Lut and Afghan blocks were covered by sea from Cretaceous to Eocene times (Stocklin et al., 1972; Davoudzadeh and Schmidt, 1985). A succession of thin to thick-bedded limestone bearing orbitolinids and planktic foraminifera was deposited on the eastern part of the Lut block. It is characterized by shallow to deep water facies deposited upon platform to peripheral domains. Geological investigations of Cretaceous oceanic and continental margin sediments are the key for unravelling the complex geological history of platforms of the Eastern Iran Neo-Tethyan margin. Here, typical exposures relate to carbonate platform and peripheral margin facies. Benthic faunas indicating shallow marine, tropical facies prevailed in the Lower Cretaceous, whereas the pelagic facies characterized by open marine organisms such as planktic foraminifera and ammonites (*Mantelliceras mantelli* (Sowerby,

1814)) indicate deep marine environments during the late Albian and Cenomanian (Raisossadat et al., 2011). Detailed geological studies of the area were performed by Fauvelet and Eftekharneshad (1990), Berthiaux et al. (1991) and Raisossadat et al. (2011, 2014). The rudists were studied by Raisossadat and Skelton (2005) and Khazaei et al. (2011), whereas the *Orbitolina* limestones were studied by Babazadeh et al. (2010).

The Qayen area is one of the most important areas for studying Cretaceous biostratigraphy of Eastern Iran. This is due to the well-exposed sections of carbonate platform sediments and their well-preserved micro- and macrofaunas. The aim of the present study is to provide a first taxonomic description of the Lower Cretaceous gastropods found there, the first gastropods to be reported from Iran and most probably from the Middle East, and to discuss the paleoecology and palaeobiogeographic distribution of the identified taxa.

2. Geological and stratigraphical settings

2.1. Geological setting

The studied area is located within the Qayen quadrangle map area (Berthiaux et al., 1991) and the Grimonj sheet map area (Amidi and Navai, 2009). Tirrul et al. (1983) did not study this area in details and put a question mark on their map. A major goal of previous works as well as the present contribution is therefore to improve the biostratigraphical and paleoecological interpretation of the Cretaceous deposits of the Qayen area.

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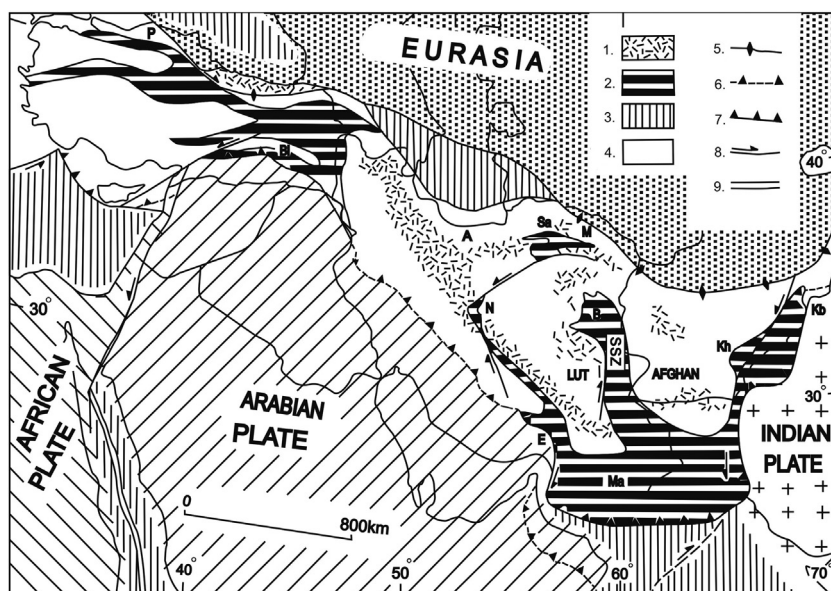


Fig. 1. Position of Iran between the Arabian and Turan plates in the Alp-Himalaya Belt, and of the Sistan suture zone between the Afghan and Lut blocks. 1. Maastrichtian-Paleogene volcanic rocks. 2. Neo-Tethyan accretionary complex (inner ophiolite subbelt). 3. Oceanic crust. 4. Cimmerian continent (Sengor, 1979). 5. Paleo-Tethyan suture. 6. Neo-Tethyan suture. 7. Active trench. 8. Active major strike-slip fault. 9. Spreading rift. Geographic localities: A: Alborz; B: Birjand; Bi: Bitlus; E: Esfandagheh; Kb: Kabul; Kh: Kandahar; M: Mashhad; Ma: Makran; N: Nain; P: Pontides; Sa: Sabzevar; SSZ: Sistan Suture Zone (Sistan Ocean). Modified from Tirrul et al. (1983).

The basement of the sediments in the area is unknown. Metamorphic rocks (gneisses, granite intrusions and metasediments), which occur in fault-bounded blocks and are assigned to the Proterozoic, are exposed near the centre of the quadrangle area. Paleozoic and Triassic sediments are plotted only in southern parts of the Qayen map. Sedimentary deposits and volcanic intrusions exposed in the region are younger than Triassic and older than Oligocene. The lithostratigraphy of Cretaceous sediments is particularly complex. From a structural viewpoint, the region appears as a puzzle of blocks with the lithostratigraphy and/or tectonics of each block differing more-or-less from adjacent ones (Fauvelet and Eftekhar-nezhad, 1990).

2.2. Stratigraphy

In Post-Neocomian Cretaceous deposits from the Qayen area, a basal conglomerate is followed by *Orbitolina* limestones, and then overlain by marl, limestone, sandstone and flysch-type sediments (Berthiaux et al., 1991). Gastropods have been collected in three distinct sections (Fig. 2):

- **Section S1.** This section is located in the Kuh-e-Qumenjan and lies at 58°51' E, 33°32' N (Fig. 2(A)). This section starts with a red to brown conglomerate and sandstone sequence. The conglomerates decrease upwards and the colour of sandstones changes into green. It is overlain by a carbonate sequence (Figs. 3, 4). Gastropods were collected at two sample levels (Nos. 9 and 10) corresponding to fine-grained, moderately cemented sandstones (Fig. 5(A, B)). They are small-sized and well-preserved. Isolated specimens could be collected. In contrast, gastropods from sample No. 14 are large and occur in cream-coloured to light brown, thickly-bedded limestones together with rudists and orbitolinids (Fig. 5(C)). The specimens cannot be removed easily from the matrix. In addition to the rudists *Pseudotoucasia catalaunica* (Astre, 1932), *P. santanderensis* (Douvillé, 1889), *P. sp.* and *Toucasia carinata* (Matheron, 1842) (Khazaei et al., 2011), the gastropod

genera “*Aphanoptyx*”, *Affiniptyxis* and *Pchelincevia* have been newly recorded from this level. Orbitolinids recorded from the same level are *Palorbitolinoides orbiculata* Zhang, 1986, and *Palorbitolinoides cf. ultima* (Cherchi et Schroeder, 1978) (Fig. 6). Babazadeh et al. (2010) reported *Palorbitolina lenticularis* (Blumenbach, 1805), *Mesorbitolina cf. texana* (Roemer, 1849), and *Palorbitolinoides hedini* Cherchi and Schroeder, 1980;

- **Section S2.** The section is located at 59°00' E, 33°52' N (Fig. 2(A)). Basal conglomerates and sandstones are not as thick as in section S1. They are overlain by grey, medium-bedded sandy limestones, marly limestones and limestones. Only the upper part of the section contains rudist fragments. The middle part of the section contains *Mesorbitolina* sp. and the gastropod *Sogdianella* sp.;
- **Section S3.** The section is located at 58°57' E, 33°50' N (Fig. 2(A)). The lower part is composed of red to brown conglomerates and sandstones that grade upwards into light brown to grey orbitolinid limestones and fossiliferous limestones. The section continues upwards with light brown limestones packed with gastropods of the genus *Pchelincevia* and cream-coloured to brown orbitolinid and rudist-bearing limestones.

3. Material and methods

Three stratigraphic sections were selected and sampled (Fig. 2(A)). The hand specimens of rocks were described in the field and some of them were prepared for thin sections. About twenty specimens of gastropods have been collected. The preservation is generally good. Axial sections of Nerineoidea specimens have been made to investigate internal structures, which are essential for taxonomic identification. Because of the large number of species, which have been established based on inadequate morphological characters, it is almost impossible to determine Nerineoidea species without consulting the original material. For this reason, the present specimens were determined only at the generic level. The classification is based on Bouchet and Rocroi (2005) as well as Kollmann's papers

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