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The Shah Kuh Formation, a latest Barremian – Early Aptian carbonate platform of Central Iran (Khur area, Yazd Block)

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ABSTRACT

The Shah Kuh Formation of the Khur area (Central Iran) consists of predominantly micritic, thick-bedded shallow-water carbonates, which are rich in orbitolinid foraminifera and rudists. It represents a late(est) Barremian – Early Aptian carbonate platform and overlies Upper Jurassic – Barremian continental and marginal marine sediments (Chah Palang and Noqreh formations); it is overlain by basinal deposits of the Upper Aptian – Upper Albian Bazyab Formation. The lithofacies changes at both, the base and top of the Shah Kuh Formation are gradational, showing that the formation is part of an overall transgressive sedimentary megacycle, and that the formational boundaries are potentially diachronous on larger distances. Analyses of facies and stratal geometries suggest that the Shah Kuh carbonate system started as a narrow, high-energy shelf that developed into a large-scale, flat-topped rudist platform without marginal rim or steep slope. The Shah Kuh Platform is part of a large depositional system of epeiric shallow-water carbonates that characterized large parts of present-day Iran during Late Barremian – Aptian times ("*Orbitolina* limestones" of NW and Central Iran, the Alborz and the Koppeh Dagh). Their biofacies is very similar to contemporaneous deposits from the western Tethys and eastern Arabia, and they form an important, hitherto poorly known component of the Tethyan warm-water carbonate platform belt.

1. Introduction

Cretaceous strata of the Yazd Block (Central Iran) area are very thick, superbly exposed and relatively fossiliferous. They form an important sedimentary archive for the understanding of the geodynamic evolution of the Middle East and the palaeo(bio)geography of that area. However, their detailed stratigraphy (apart from gross lithostratigraphic mapping), depositional environments and palaeontology are poorly known with the exception of Cretaceous ammonites, which have been recorded and described from numerous localities (e.g. Seyed-Emami, 1977, 1982; Kennedy et al., 1979; Seyed-Emami and Immel, 1995, 1996; Wilmsen et al., 2005).

The Barremian – Aptian interval was a time of major changes in the Cretaceous ocean – atmosphere system in response to strong plate tectonic and magmatic activity (e.g., Larson and Erba, 1999; Leckie et al., 2002). The Shah Kuh Formation represents a thick unit of shallow-marine carbonates of Barremian – Aptian age that characterize the Khur area, ca. 200 km north of Yazd (Fig. 1). It is the regional development of a widespread carbonate unit colloquially known in Iranian geology as "*Orbitolina* limestones", which crops out, for example, in the Koppeh Dagh (Tirgan Formation), the Alborz (Tizkuh Formation), SW Iran (Daryan Formation) or the Yazd area (Taft Formation) (see Stöcklin, 1971 for details on these formations). The "*Orbitolina* limestones" usually represent the first fully marine formation overlying non-marine conglomerates, red beds, and evaporites that were deposited in response to the Late Cimmerian tectonic event in the Late Jurassic – earliest Cretaceous (e.g., Wilmsen et al., 2003, 2009a). The scope of the present paper is the description, stratigraphic dating, and environmental interpretation of the Shah Kuh Formation of the Khur area. Furthermore, the Shah Kuh Formation is an important piece in the complex mosaic of Barremian – Aptian carbonate systems that should be considered for future palaeo-bio-geographic reconstructions.

2. Geological setting

The study area belongs to the Central-East Iranian Microcontinent (CEIM) which forms the core of the so-called Iran Plate

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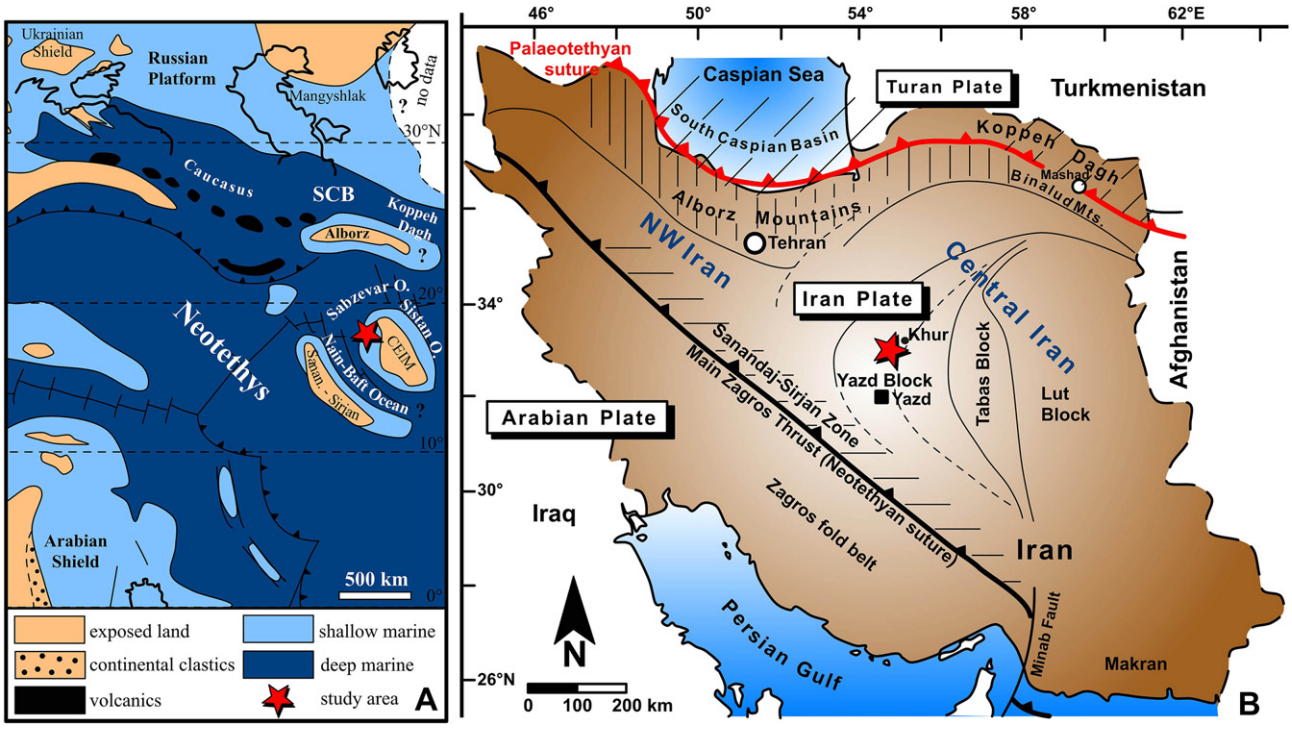

Fig. 1. Mid-Cretaceous palaeogeographic map of the Middle East (A, modified after Philip and Floquet, 2000) and structural map of Iran (B) with indication of the Khur area, north of Yazd, in Central Iran (modified from Wilmsen et al., 2009b).

(Fig. 1). The CEIM, an independent microplate within the complex Mesozoic plate tectonic mosaic of the Middle East, consists, from east to west, of three structural units, the Lut, the Tabas, and the Yazd blocks (see Berberian and King, 1981 and Davoudzadeh, 1997 for overview). While Jurassic strata are well exposed and well studied on the Tabas Block (see Wilmsen et al., 2009a for overview), Cretaceous strata are very thick and widespread in the western part of the CEIM (Yazd Block). During the Cretaceous, the CEIM was detached from Eurasia (Turan Plate) and surrounded by small oceanic basins (Sistan, Sabzevar, Nain Baft oceans) which opened and closed in response to (inferred) counter-clockwise rotational movements of the microplate (Fig. 1; e.g., Dercourt et al., 1986; Philip and Floquet, 2000). These oceanic basins opened in early Early Cretaceous ('Neocomian'; Seyed-Emami et al., 1972; Lindenberg et al., 1983) times and the opening may be related to an inferred post-Triassic rotation of the CEIM of about 135° around a vertical axis with respect to Eurasia (e.g., Davoudzadeh et al., 1981; Soffel et al., 1996). The various small oceans were subsequently closed during the later part of the Early to Late Cretaceous and in the Paleogene, in connection with the advance of the Arabian Plate and the closure of the Neotethys (e.g., Tirrul et al., 1983; Dercourt et al., 1986; Stampfli and Borel, 2002; Rosetti et al., 2010).

From the aforementioned data it becomes clear that the Cretaceous sedimentary sequence of the Yazd Block bears important information for the geodynamic history of the Middle East. A key area for the Yazd Block is around Khur, ca. 200 km north of Yazd, where Cretaceous rocks are very well exposed, widespread and have already been mapped in the early 1980s (Aistov et al., 1984). The post-Cimmerian succession in the Khur area (Fig. 2) starts with conglomerates and sandstones of the Chah Palang Formation (Aistov et al., 1984) covering a pronounced palaeo-relief of basement rocks (metamorphics, granitoids, metasediments) of various ages belonging to the Anarak metamorphic complex *sensu lato* (Upper Palaeozoic – Triassic) and the Shemshak Group (Upper Triassic – Middle Jurassic; Fürsich et al., 2009a). The basal unconformity is related to the Mid-/Late Cimmerian tectonic event/s (Middle to Late Jurassic; Fürsich et al., 2009b and Wilmsen et al., 2009b, 2010a). The Chah Palang Formation is up to one kilometre thick and has been assigned a Late Jurassic age (Aistov et al., 1984). However, no reliable data exist so far, and an exclusively early Early Cretaceous age may also be possible.

Onlap onto the palaeo-relief continued with the succeeding Noqreh Formation (Aistov et al., 1984), which consists of interbedded terrestrial to marginal marine sediments (red fluvial sand- and siltstones, gypsum layers, dolostones, oolitic-bioclastic limestones, sandy marls; Fig. 2). Biostratigraphic data are again sparse, but calcareous algae in the upper part of the formation indicate already a Late Barremian age (see below). The thickness of the formation strongly varies across short distances, ranging from 500 m on the southern slope of Shah Kuh to nearly zero at Kuh-e-Kashki.

The next unit is the Shah Kuh Formation (Aistov et al., 1984), consisting of thick-bedded to massive, often dark-coloured, micritic limestones (wacke-, pack-, rud- and floatstones) with abundant orbitolinid foraminifera and rudists. The formation is up to 500 m thick, cliff-forming and has been assigned a Barremian – Aptian age (Aistov et al., 1984). At Dizlu, north of Esfahan (west of the study area), the Upper Barremian ammonite *Hemihoplites soulieri* (Matheron) is reported from the base of *Orbitolina* limestones (Seyed-Emami et al., 1971, p. 10). New biostratigraphic data obtained from the study area (see below) suggest a late(est) Barremian – Early Aptian age for the unit.

The Shah Kuh Formation is overlain by basinal sediments of the up to 1.5 kilometre-thick Bazyab Formation (Aistov et al., 1984; marly siltstones, marls and nodular limestones with intercalated fine-grained sand- and siltstones as well as some limestone levels). Ammonites are common and date the formation as Late Aptian to early Late Albian (Seyed-Emami and Immel, 1996; unpubl. data).