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Paleoenvironmental distribution patterns of orbitolinids in the Lower Cretaceous deposits of eastern Rafsanjan, Central Iran

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ABSTRACT

The Lower Cretaceous orbitolinid-rich deposits in eastern Rafsanjan, Central Iran were studied for analysis and interpretation of paleoenvironmental distribution patterns of orbitolinids. Based on detailed studies, a total of seven microfacies were determined. From the microfacies and paleontological studies the continental shelf (with a relative water depth of 0 to 20 m) can be separated into supralittoral, littoral–sublittoral transitional and sublittoral (includes proximal and distal sublittoral) paleoenvironmental zones. Orbitolinids with diverse test shapes were the main inhabitants of the sublittoral zone. The orbitolinids in this zone commonly represent nutrient-rich shallow warm waters of the photic zone with normal marine salinity (ca 30–40 psu) in a depth range of approximately 10 to 20 m. The general abundance or richness of orbitolinids in the sublittoral zone resulted from a nutrient-driven transgression. The studies showed that the conical orbitolinids were the most abundant forms in the sublittoral zone reflecting their better adaptation to different water depths, turbulence, light levels and substrate stability. However, the almost discoidal and discoidal orbitolinids were dominant in the middle part of the proximal sublittoral zone with a muddy substrate, deeper depth, lower water energy and decreased light intensity. All discoidal orbitolinids (slightly discoidal, almost discoidal and discoidal) were very rare and sparsely distributed in the distal sublittoral zone and the middle–outer part of the proximal sublittoral zone and generally reflect the highest sea-level rise or transgression, deepening, maximum nutrient enrichment and increased water cloudiness that can be correlated with a transgressive systems tract (TST) and probably maximum flooding surface (MFS). The lowest diversity and abundance of orbitolinids in the outer part of the proximal sublittoral zone commonly co-occurred with the presence of algal and sparse coral associations reflecting increased water temperature. Also, the absence of in situ orbitolinids in the littoral–sublittoral transitional zone resulted from high siliciclastic input and very high wave energy.

1. Introduction

Large benthic foraminiferal associations were the main biotic components of the shallow-water carbonate platforms during the Early–Late Cretaceous of the tropical–subtropical Tethyan realm. Orbitolinids were one of the most abundant and significant groups of agglutinated robust large benthic foraminifera during the Barremian–Cenomanian (Boudagher-Fadel, 2008). Based on the test shape and the test size of orbitolinids, they had a free epifaunal lifestyle (Boudagher-Fadel, 2008; Masse, 1976). These robust agglutinated foraminifera were lying on the substrate with the flat base of their conical tests by their apertural face (Boudagher-Fadel, 2008). In addition to their biostratigraphic significance (Bachmann and Hirsch, 2006; Iba et al., 2011; Schroeder, 1975; Schroeder et al., 2010; Simmons et al., 2000), orbitolinids are commonly considered as good paleoecological and paleoenvironmental indicators. Generally, due to the stratigraphic complexity, variety and diversity in geologic age, lithology, facies and other physical features of the Cretaceous deposits of the Central Iran structural zone, the Cretaceous outcrops in Central Iran have not been widely divided into major lithologic units such as formations (Aghanabati, 2004). However, two of the few major and significant studies on the Cretaceous deposits in Central Iran were carried out by Wilmsen et al. (2013) (based on description, stratigraphic dating and environmental interpretation of the uppermost Barremian–Lower Aptian carbonates of the Shah Kuh Formation in the Khur area, Yazd Block) and Schlagintweit and Wilmsen (2014) (based on orbitolinid biostratigraphy of the Middle–Upper Aptian deposits of the top parts of the Taft Formation in the Yazd Block). Facies and paleoenvironmental analysis of orbitolinids from shallow-water deposits in Iran are poorly documented. However, some recent related studies were published by Safdari Adimi et al. (2011), Amiri et al. (2011), Afghah and Shaabanpour Haghighi (2014), Rahiminejad and Hassani (2015), and Mansouri-Daneshvar et al. (2015). In order to add more data from the Cretaceous deposits of Iran, this paper is focused on the microfacies

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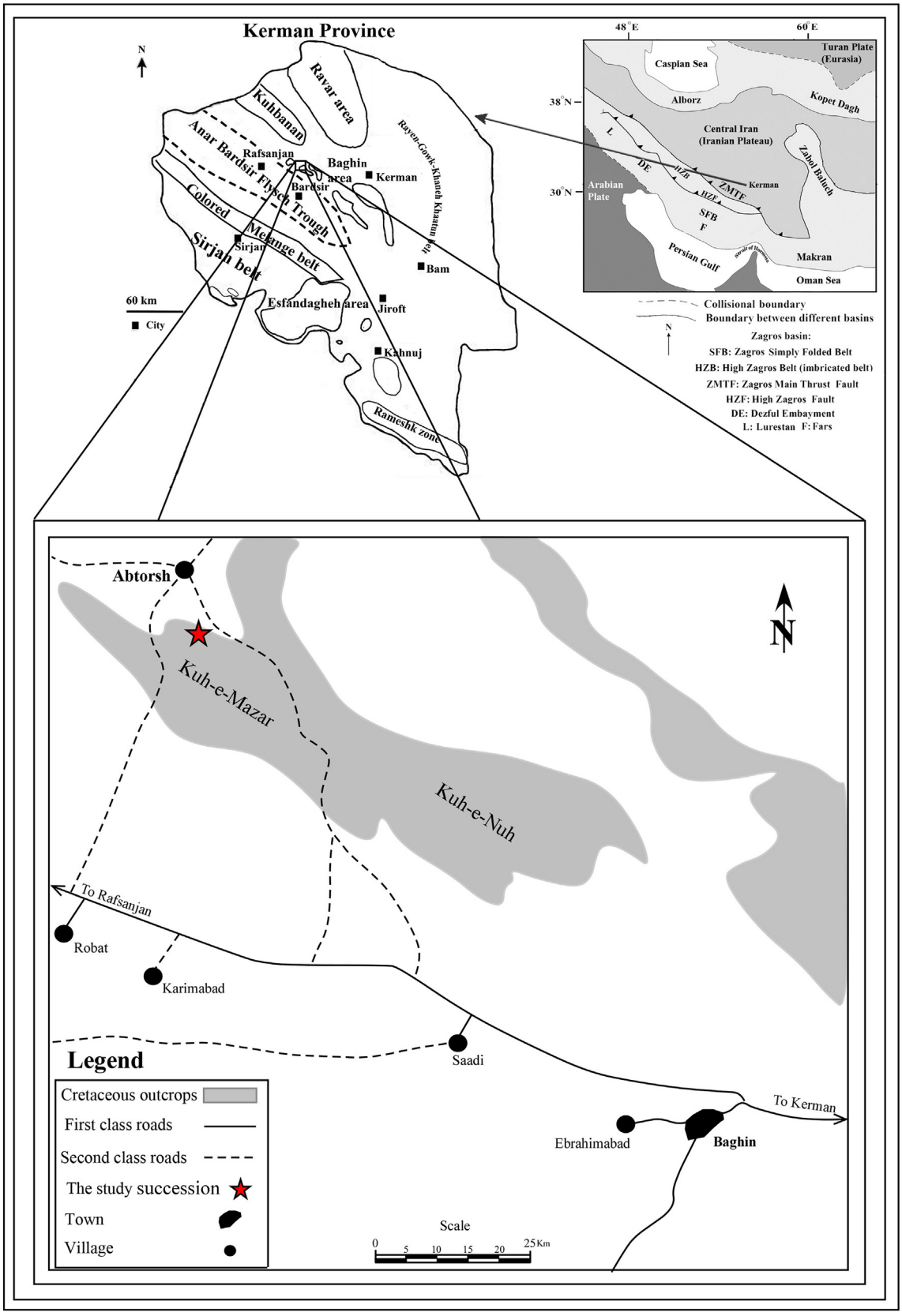

Fig. 1. The structural subdivisions of Iran and the geological and locality map of the studied area in the east of Rafsanjan.
Based on and redrawn from Djokovic et al. (1972), Berberian and King (1981), Casini et al. (2011), Dimitrijevic (1973), Rami et al. (2012) and Sepehr and Cosgrove (2004)).