

Stratigraphy and macrofauna of the Lower Jurassic (Toarcian) Marrat Formation, central Saudi Arabia



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ARTICLE INFO

Article history:

Received 8 December 2016

Received in revised form

30 June 2017

Accepted 1 July 2017

Available online 3 July 2017

Keywords:

Stratigraphy

Macrofauna

Lower Jurassic

Marrat Formation

Saudi Arabia

ABSTRACT

The stratigraphy and macrofaunal content of the Lower Jurassic (Toarcian) Marrat Formation was studied at Khashm adh Dhibi, central Saudi Arabia. The studied succession is dominated by limestones and dolomites, with subordinate occurrences of sandstones, siltstones and claystones. The formation is highly fossiliferous with brachiopods, gastropods, bivalves, ammonites and echinoids, particularly the lower and upper members. Twenty nine species are identified, they include 7 species of brachiopods, 8 gastropods, 8 bivalves, 4 ammonites and 2 echinoids. Many of the identified fauna are correlated with Jurassic equivalents in Jordan, Italy, Morocco, Egypt and India. Three gastropod species: *Globularia subumbilicata*, *Ampullospira* sp., *Purpuroidea peristriata* and seven bivalve species: *Palaeonucula lateralis*, *Chlamys (Radulopecten) fibrosa*, *Eligmus weiri*, *E. integer*, *E. asiaticus*, *Musculus somaliensis* and *Pholadomya orientalis* were recognized for the first time in the Lower Jurassic deposits of Saudi Arabia.

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1. Introduction

The marine Jurassic rocks crop out at various localities in central Saudi Arabia. The succession extends in an arc that is concave to the west and with a maximum eastward bulge west of Al Riyadh City. These rocks exceed 1000 m in thickness and are divided into seven formations namely: Marrat Formation, Dhurma Formation, Twaiq Mountain Limestone Formation, Hanifa Formation, Jubaila Formation, Arab Formation and Hith Formation (Steineke and Bramkamp, 1952b). Most of these rocks contain frequent fauna of brachiopods, gastropods, bivalves, ammonites, echinoids and corals. The Jurassic rocks overly the continental sandstones of Minjur Formation (Late Triassic). These sandstones are devoid of marine fossils with only occurrence of plant remains. The Minjur Formation underlies bedded limestone of the Sulaiy Formation (Upper Jurassic?-Lower Cretaceous).

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Khashm adh Dhibi Area is a representative area where the Lower Jurassic (Toarcian) rocks are well exposed overlying the Upper Triassic rocks and underlying the Middle Jurassic (Bajocian) rocks (Fig. 1). Many studies have dealt with the Jurassic exposures in the center of Saudi Arabia. For example Steineke and Bramkamp in Arkell (1952), later by Steineke et al. (1958) and Powers et al. (1966). The earliest studies on the Jurassic rocks of Saudi Arabia were carried out by Newton and Crick (1908) and Newton (1921, 1923). Alméras (1987) and Cooper (1989) studied the brachiopods distributed in the various Jurassic formations. Gastropods have been studied by Fischer et al. (2001). Ammonites have been studied by Arkell (1952), Imlay (1970), Lewy (1983) and Énay and Mangold (1994). The echinoids were described by Kier (1972) and Melville (1955). More recently, El-Sorogy et al. (2014) carried out a paleontologic study on the various fauna (corals, brachiopoda and mollusca) of the upper Jurassic Tuwaiq Mountain Limestone, central Saudi Arabia. El-Sorogy and Al-Kahtany (2015) studied corals of the Upper Jurassic Hanifa Formation. Youssef and El-Sorogy (2015) studied benthic foraminifera in the Jurassic reefal part of the Tuwaiq Mountain Formation.

The present study aims to revise the macrofossil content

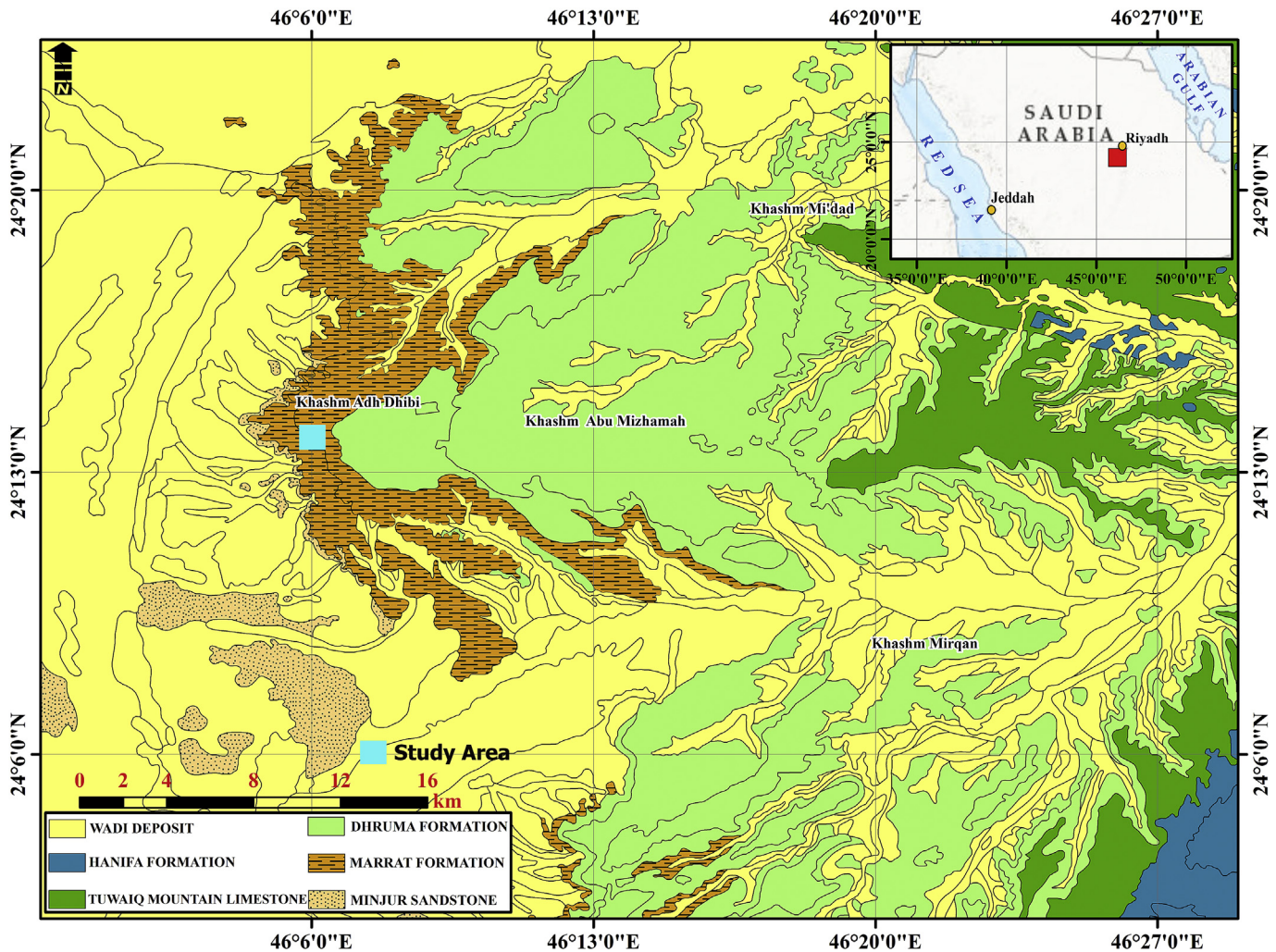


Fig. 1. Location map of the study area (after EL-Sorogy et al., 2017).

encountered in the Marrat Formation from the taxonomic point of view and to study their stratigraphic position and distribution in the formation. It aims also to correlate the identified species with those described from other Jurassic exposures in nearby countries.

2. Geologic setting

Triassic and Jurassic strata are exposed in Khashm adh Dhibi area. The oldest exposed rock unit is composed of sandstones and shales that belong to Minjur Formation (Upper Triassic). The Marrat Formation starts with limestone and dolostone beds that mark the contact between the two formations (Fig. 2). The boundary between the two formations is an unconformity surface. The Marrat Formation narrows and dips under the Twaiq escarpment southwards. It appears as isolated remnants north of Khashm adh Dhibi.

The Marrat Formation takes its name from the town of Marah (lat 25° 04' N., long 45° 29' E.) where a section of about 111 m, composed of soft red shale unit bracketed by resistant limestones was described by Steineke and Bramkamp (1952a). The upper limestone bed is golden brown in colored, weathered and underlies the Bajocian Dhruma Formation. The formation has been dated by ammonites as Toarcian (Arkell, 1952). It is locally very fossiliferous containing numerous brachiopods, gastropods, bivalves and echinoids. Arkell (1952) established nine ammonite zones in the Jurassic of Saudi Arabia, two zones namely *Bouleiceras* Zone and

Nejdia Zone exist in the Toarcian Marrat Formation.

3. Stratigraphic setting

The Marrat Formation can be distinguished at the type locality into three informal units (Bramkamp and Steineke in Arkell, 1952), the lower Marrat which is composed of tan to grey compact limestone and dolostone, intercalated with shales and sandstones and attains 34 m thickness. The top of this unit is fossiliferous and contains *Bouleiceras elegans* and *Protogrammoceras madagascariens* (ammonites), *Stomechinus* sp. (echinoids), *Spiriferina* sp. (Brachiopods) and *Pecten* sp. (bivalves). The middle Marrat unit is composed of shales intercalated with sandstones and thin limestones at its upper part. It attains a thickness of 56 m and is barren of fossils. The upper Marrat unit is 21 m thick and consists of light grey oolitic limestones with shale interbeds at its base. The unit contains ammonite fauna of *Hildaites sanderi*, *Nejdia bramkampi* and *Nejdia furnishi*. The *Bouleiceras* fauna is considered by Arkell (1952) to be lower Toarcian; the *Nejdia* fauna is dated as early upper Toarcian.

Khashm adh Dhibi section (study area) is considered the reference section of the Marrat Formation (Powers et al., 1966). At this section the Marrat Formation lies unconformably on the Minjur Sandstone and unconformably underlies the Dhruma Formation (Fig. 3a). The total thickness at the study area is 127 m, it can be subdivided into the lower, middle, and upper Marrat units (Fig. 3b).

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