



Contents lists available at ScienceDirect

## Proceedings of the Geologists' Association

journal homepage: [www.elsevier.com/locate/pgeola](http://www.elsevier.com/locate/pgeola)



# Paleoecology and paleoenvironment of the Middle–Upper Jurassic sedimentary succession, central Saudi Arabia

Ahmed M. El-Sabbagh<sup>a</sup>, Magdy M. El-Hedeny<sup>a,b,\*</sup>, Ahmed S. Mansour<sup>a</sup>

<sup>a</sup> Department of Geology, Faculty of Science, Alexandria University, Alexandria 21568, Egypt

<sup>b</sup> Deanship of Scientific Research, King Saud University, Riyadh 11451, Saudi Arabia

### ARTICLE INFO

#### Article history:

Received 9 November 2016

Received in revised form 27 January 2017

Accepted 16 February 2017

Available online xxx

#### Keywords:

Microfacies

Macrofaunal

Paleoecology

Paleoenvironment

Jurassic

Saudi Arabia

### ABSTRACT

Four Middle–Upper Jurassic sections from central Saudi Arabia have been investigated to evaluate microfacies types and macro-invertebrate paleocommunities and to interpret their paleoecology and paleoenvironments. The studied Jurassic successions are part of the Middle–Upper Callovian Tuwaiq Mountain Limestone and the Middle–Upper Oxfordian Hanifa Formation. Three main facies were recorded, including mud-supported microfacies, grain-supported microfacies and boundstones. A data matrix comprising 48 macrobenthic species in 35 samples collected from four sections were grouped into fifteen assemblages and one poorly fossiliferous interval by means of a Q-mode cluster analysis. The recorded macrofaunal assemblages have been subdivided into low-stress and high-stress on the basis of hydrodynamic conditions, substrate type, nutrient supply and hypoxia. The low-stress assemblages occur in (a) high-energy paleoenvironments with firm substrates; (b) high-energy shoals with unstable substrates of low cohesion and in (c) low-energy open marine environments with soft-substrates. The moderate- to high-stress assemblages occur in (a) oligotrophic environments with reduced terrigenous input in shelf lagoonal or in restricted inner ramp settings; (b) low-energy, soft substrate environments with hypoxia below the sediment–water interface; and, in (c) high-energy shoals and shelf lagoonal environments. The temporal distribution patterns of epifaunal and infaunal bivalve taxa are controlled by variations in water energy, substrate characteristics and productivity level. The reported litho- and biofacies confirmed that the Callovian Tuwaiq Mountain Limestone and the Oxfordian Hanifa Formation were deposited across wide spectrum of depositional environments, ranging from restricted lagoon to moderately deeper open marine basin, and providing the perfect conditions for macrofossils.

© 2017 The Geologists' Association. Published by Elsevier Ltd. All rights reserved.

## 1. Introduction

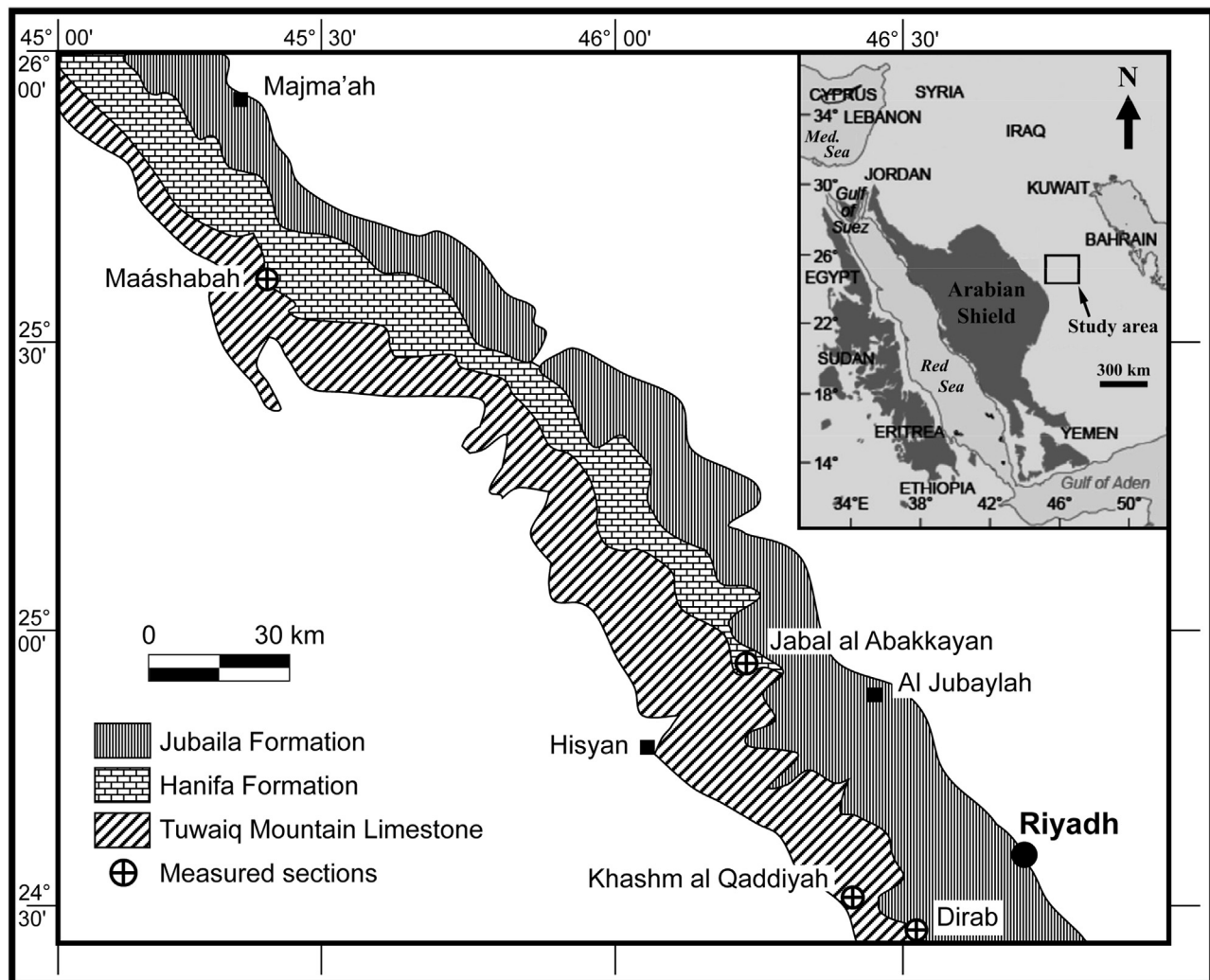
Jurassic rocks widely crop out in the Tuwaiq Mountains of central Saudi Arabia. These mountains represent one of the major topographic features of the Arabian Peninsula. They extend in a north-south direction sub-parallel to the eastern edge of the Arabian Shield (El-Asa'ad, 1991). The lithostratigraphy of the Jurassic System in Saudi Arabia (i.e., the Shaqra Group) was established by Powers et al. (1966). The Shaqra Group lies unconformably upon the Upper Triassic Minjur Formation and is overlain by the Lower Cretaceous Sulaiy Formation. Formally, the Shaqra Group is subdivided, in ascending stratigraphic order, into

the Marrat, Dhurma, Tuwaiq Mountain, Hanifa, Jubaila, Arab and Hith formations (Steineke and Bramkamp, 1952; Powers, 1962).

In central Saudi Arabia near the capital Riyadh, the Callovian–Oxfordian rocks are well exposed and easily accessible. They are represented by two famous rock units: the Callovian Tuwaiq Mountain Limestone and the Oxfordian Hanifa Formation (Fig. 1). In general, carbonates of the Middle and Upper Jurassic successions were deposited on an extensive submarine platform that extended eastward over most of the Arabian Peninsula (Hughes, 2004a, 2004b, 2008). Although shallow marine environments generally prevailed, there is evidence that the platform was also the site of several deeper intra-shelf basins (Al-Husseini, 1997). Eustatic sea-level rise combined with intraplate subsidence are considered the main factors that controlled sedimentation (Al-Husseini, 1997; Hughes, 2004a, 2004b, 2008).

Despite the common occurrence of diverse macrofaunal assemblages in the Jurassic deposits of Saudi Arabia (e.g., Arkell,

\* Corresponding author. Current address: Deanship of Scientific Research, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia, fax: +966 11 4694926.  
E-mail address: [mmelhedeny@gmail.com](mailto:mmelhedeny@gmail.com) (M.M. El-Hedeny).



**Fig. 1.** Geological sketch map of the study area showing the location of the measured sections and outcrops of the Tuwaiq Mountain, Hanifa and Jubaila formations (modified after El-Hedeny et al., 2012).

1952; Imlay, 1970; Alm  ras, 1987; Enay et al., 1987; El-Asa'ad, 1989, 1991; Fischer et al., 2001; El-Sorogy et al., 2014; Hewaidy et al., 2016), they are mostly studied from the paleontological point of view. Marine invertebrate faunas of the Jurassic are generally considered to have been provincial rather than cosmopolitan (Feldman et al., 2012; F  rsich et al., 2016). The abundance and distribution of these benthic macrofossil assemblages within a given environment are mainly controlled by several physical and chemical variables (see Federal Geographic Data Committee, 2012). The response of macrofaunal assemblages to changes in these variables is clearly manifested by changes in species diversity, dominance and the representation of major and/or rare species (Hoffman, 1979, 1982; F  rsich, 1984b; Oschmann, 1988; F  rsich and Aberhan, 1990; Aberhan, 1992; Gahr, 2002; Zuschin and Stanton, 2002; Aberhan et al., 2006; F  rsich et al., 2012; Hofmann et al., 2013).

The present work is the first of its kind on macrofossils collected from the Middle–Upper Jurassic rocks of Saudi Arabia. The aim of the present study is to describe the microfacies associations and benthic macrofaunal assemblages (bivalves, gastropods, brachiopods, corals and echinoids) within the Callovian–Oxfordian succession exposed in central Saudi Arabia and to interpret the paleoecology and paleoenvironmental conditions. To achieve these goals, four Callovian–Oxfordian sections were selected at Dirab

(24°31'38"N, 46°36'34"E), Khashm al Qaddiyah (24°32'45"N, 46°26'08"E), Jabal al Abakkayn (24°57'48"N, 46°12'48"E) and at Ma'ashabah (25°33'25"N, 45°23'14"E) (Fig. 1).

## 2. Stratigraphy

During the Callovian–Oxfordian, Arabia was characterized by a wide shallow shelf on the western passive margin of the Neo-Tethys Ocean on which carbonates accumulated (Al-Husseini, 1997; Ziegler, 2001) and represented by the Tuwaiq Mountain Limestone and the Hanifa Formation, respectively.

### 2.1. The Tuwaiq mountain limestone

The description of the type section of this formation along the Riyadh–Jiddah road through the Hisyan Pass was first provided by Arkell (1952). At this outcrop, the Tuwaiq Mountain Limestone attains a thickness of about 184 m. It is mainly composed of thick-bedded, hard, cliff-forming, coral- and stromatoporoid-bearing limestones. It lies disconformably upon the softer shale-dominated upper Dhurma Formation.

In the present study, a relatively complete succession of the Middle–Late Callovian Tuwaiq Mountain Limestone was sampled at the Khashm al Qaddiyah section, attaining a thickness of about

Download English Version:

<https://daneshyari.com/en/article/5786433>

Download Persian Version:

<https://daneshyari.com/article/5786433>

[Daneshyari.com](https://daneshyari.com)