EARTH SCIENCES

PLANKTIC FORAMINIFERA AND BIOSTRATIGRAPHY OF THE SHIRANISH FORMATION IN WELL TEL-HAJAR NO. 1, SINJAR AREA, NORTHWESTERN IRAQ

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https://doi.org/10.5281/zenodo.17492567

Abstract

Eight rock samples from Well Tel-Hajar No. 1 (Sinjar area, northwestern Iraq) were analyzed for planktic foraminifera. The ~8 m succession belongs to the uppermost Shiranish Formation, with a ~2 m tongue of the Hartha Formation intercalated. The Shiranish Formation consists mainly of fossiliferous foraminiferal limestones and yields one planktic foraminiferal biozone, Kassabiana falsocalcarata, comprising 37 species from nine genera. These assemblages indicate a Late Cretaceous (latest Maastrichtian) age and deposition in a deep-marine setting. In contrast, the Hartha Formation contains large benthic foraminifera typical of shallow-marine environments.

Keywords: Shiranish Formation, Hartha Formation, Maastrichtian, Planktic foraminifera, Iraq

Introduction

The Shiranish Formation (Campanian–Maastrichtian) is one of the most widespread Upper Cretaceous units that crop out in northern Iraq. It was deposited during the middle to late part of the AP9 megasequence (Sharland 2001) in the Campanian–early Maastrichtian cycle. During this cycle, ophiolite–radiolarite obduction between the Iranian and Arabian plates created the Zagros foreland basin in NE Iraq (Lawa 2018) and was accompanied by a major marine transgression across Iraq. These events led to deposition of several sedimentary facies, including the Shiranish Formation, which formed in outer-shelf to deep-marine settings (Jassim & Buday 2006). The formation was first described by Henson (1940) near Shiranish Islam village, northeast of Zakho in the High Folded Zone (Bellen et al. 1959). It consists of ~228 m of thin-bedded marly limestone in the lower part overlain by blue marl in the upper part, with dolomitic and marly limestones rich in microfossils (Buday 1980). The Shiranish Formation is widely exposed in the Kurdistan Region and is an important reservoir in many Iraqi oil fields; it is penetrated in numerous subsurface wells in central and southern Iraq, including Kirkuk (K09, K116, K117), Chamchamal-2, Injana-5, Ain Zala-16, Jawan-2 and wells in the Khana field. Its reservoir significance relates to abundant fractures, joints and secondary porosity (Ahmed 1980; Awdal et al. 2013; Baban et al. 2020). Previous work addressed the sedimentology, paleontology and stratigraphy of the formation (e.g., Ahmed 1980; Abba Hussein 1983; Al-Banna & Ghafor 1988; Bakkal et al. 1993; Sharbazheri et al. 2009, 2011; Al-Jubouri 2011; Al-Jubouri et al. 2016; Al-Hazaa et al. 2021; Hassan 2021; Al-Nuaimy et al. 2020). The studied well (Tel Hajar-1) is ~30 km southwest of Sinjar town (Kadouri 1982). Drilled in 1978 by the Iraq National Oil Company on the Tel Hajar structure near the Syrian border, it lies in the Foothill Zone (Buday & Jassim 1987) at approximately 41°32′45″E and 36°07′22″N (Fig. 1). The contact between the Kometan and Shiranish formations has been restudied in the Qamchugha Valley (Karim et al. 2008; Fig. 2) and interpreted as conformable, with rapid deposition possibly due to submarine channel switching, storms or tsunami; no evidence of subaerial erosion or prolonged hiatus was observed.

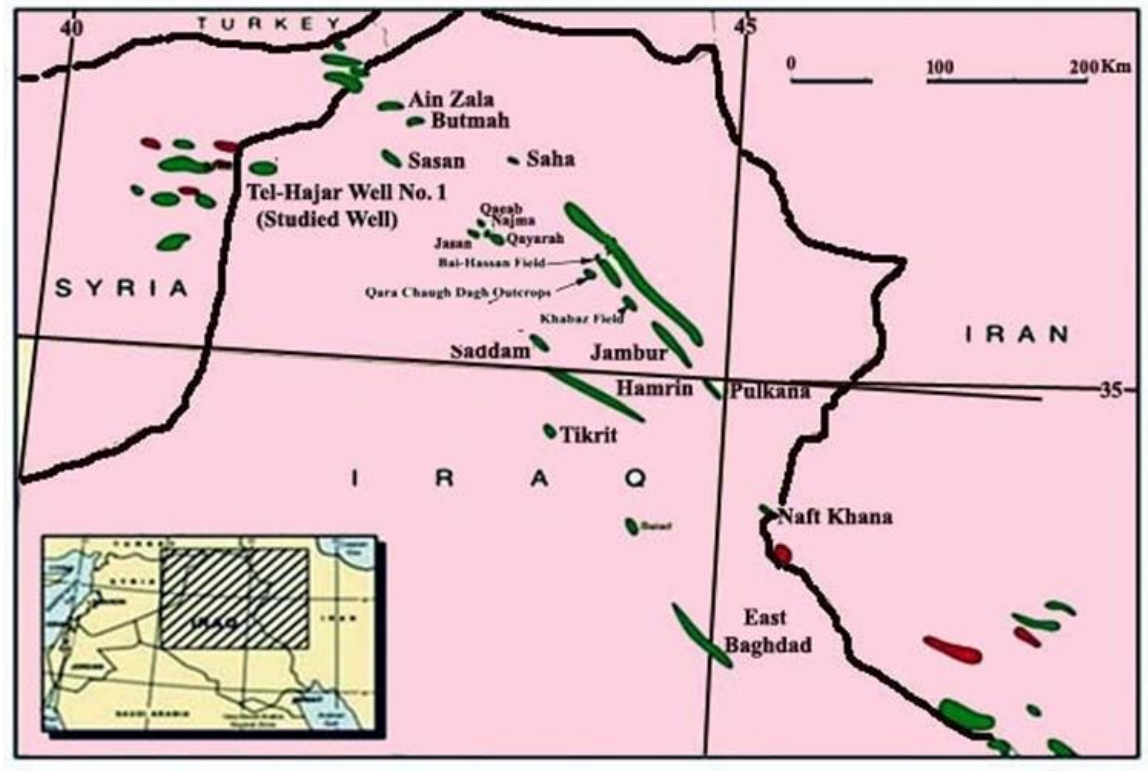

Fig. 1 Location map of the Tel-Hajar-1 well.

Fig. 2 Gradational contact between the Kometan and Shiranish formations in the Chaqchaq Valley (Karim et al. 2008).

The aim of this study is to establish the biostratigraphy and depositional setting of the upper part of the Shiranish Formation at Tel-Hajar-1.

Stratigraphy

The study area lies within the Low Folded Zone (LFZ) of the Outer Platform of Iraq (Fouad 2015), part of the Zagros fold-thrust belt formed by collision of the Arabian and Eurasian plates (Alavi 2004; Fouad 2015). The Sinjar anticline is ~80 km long and ~20 km wide, trending E–W, with a steeper northern limb (45–80°) and gentler southern limb (15–25°). An E–W normal fault follows the northern limb; additional minor faults are present (Fig. 3). A subsidiary low-amplitude anticline along the southern limb is developed within the Sinjar Formation and is separated from the main axis by a shallow syncline. The exposed rocks range in age from Late Cretaceous (Sinjar Formation) to Late Miocene (Injana Formation) (Sissakian & Al-Jibouri 2012). A generalized columnar section is summarized in Table 1.

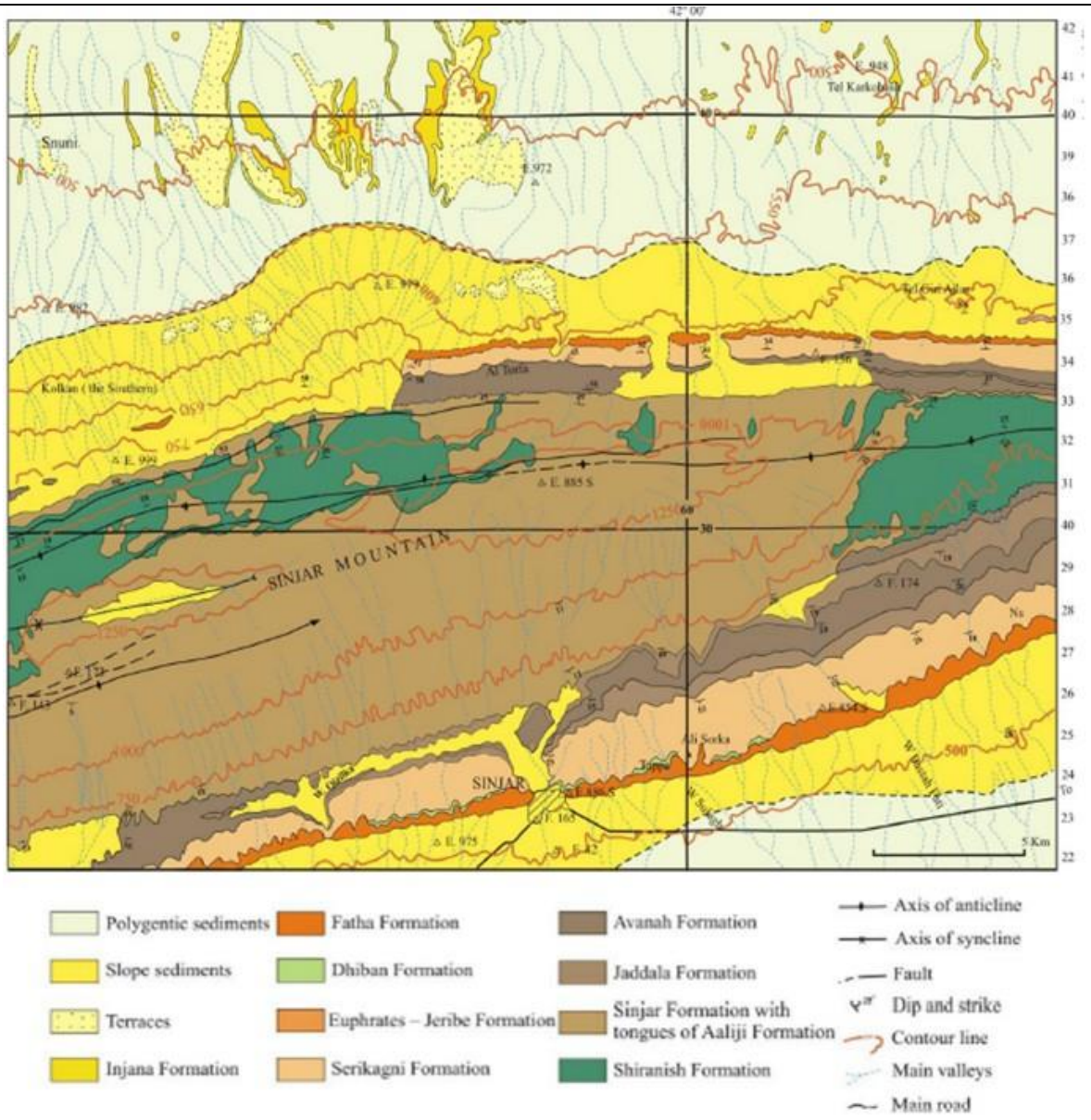

Fig. 3 Geological map of the Sinjar anticline (modified after Sissakian & Fouad 2015).

Table 1 about here — Generalized columnar section of exposed formations (after Sissakian & Al-Jibouri 2012).

Formation	Age	Thickness (m)	General Description
Injana	Late Miocene	900 – 100	Sandstone interbedded with siltstone and claystone in rhythmic cycles, all rocks are reddish-brown in color
Fatha	Middle Miocene	550 – 630	Green marl interbedded with limestone and gypsum in rhythmic cycles, in the upper cycles, reddish brown claystone occurs.
Jeribe	Miocene	100 – 125	Well bedded greyish white limestone
Dhiban	Early Miocene	5 – 100	Mainly limestone with rare limestone
Serikagni	Miocene	65 – 300	Well bedded white limestone with some marl intercalations
Avanah	Middle Eocene	85	Marly limestone interbedded with marl
Jaddala	Eocene	500 – 550	Marl interbedded with marly limestone
Sinjar	Early Eocene- Late	170	Well bedded, white and very hard limestone
Aaliji	Paleocene	50	Shale and marl
Shiranish	Late Cretaceous	565	Bluish green, papery marl, in the upper part well bedded greyish white limestone in the lower part

The area belongs to the Low Amplitude Mountainous Province (Sissakian & Fouad 2015). Apart from the Sinjar Mountain, the surrounding terrain is relatively flat but deeply incised by valleys. Elevations range from ~300 m in the southeast to 1462 m at the summit of Sinjar Mountain. A neotectonic map (Fig. 4) depicts up-warped and down-warped areas as contour lines following the methods outlined in Materials and Methods and consistent with ATOMENERGOEXPORT (1985), Pavlides (1989), Koster (2005), Deikran & Sissakian (2008) and Sissakian & Deikran (2009). The stratigraphic position of the Shiranish Formation within the regional framework is shown in Fig. 5 (after Harland et al. 1990; El-Diasty et al. 2016).

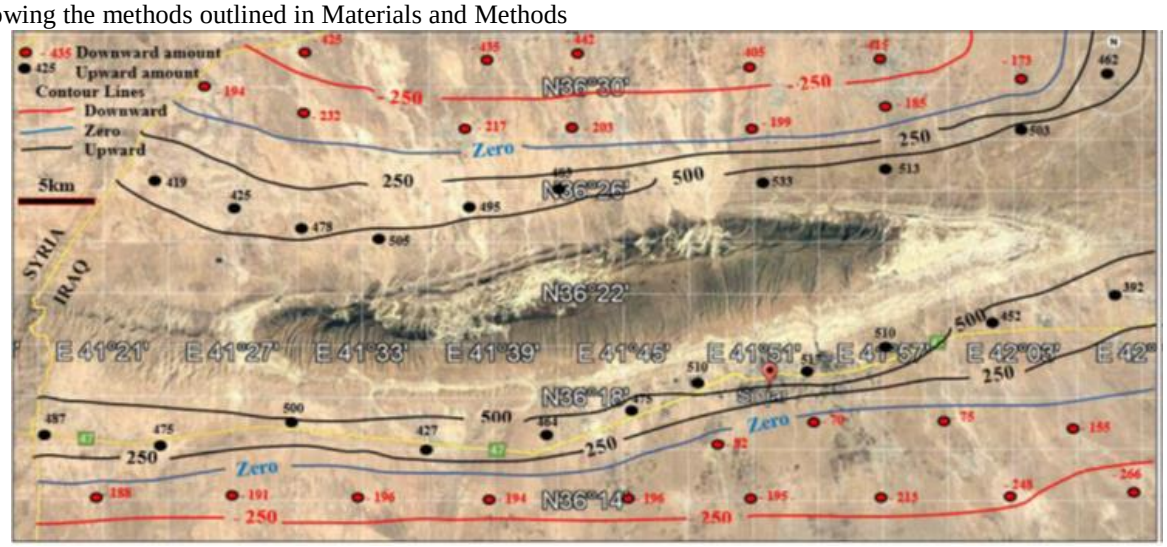

Fig. 4 Satellite image and neotectonic contours of the Sinjar anticline (after Sissakian et al. 2022).

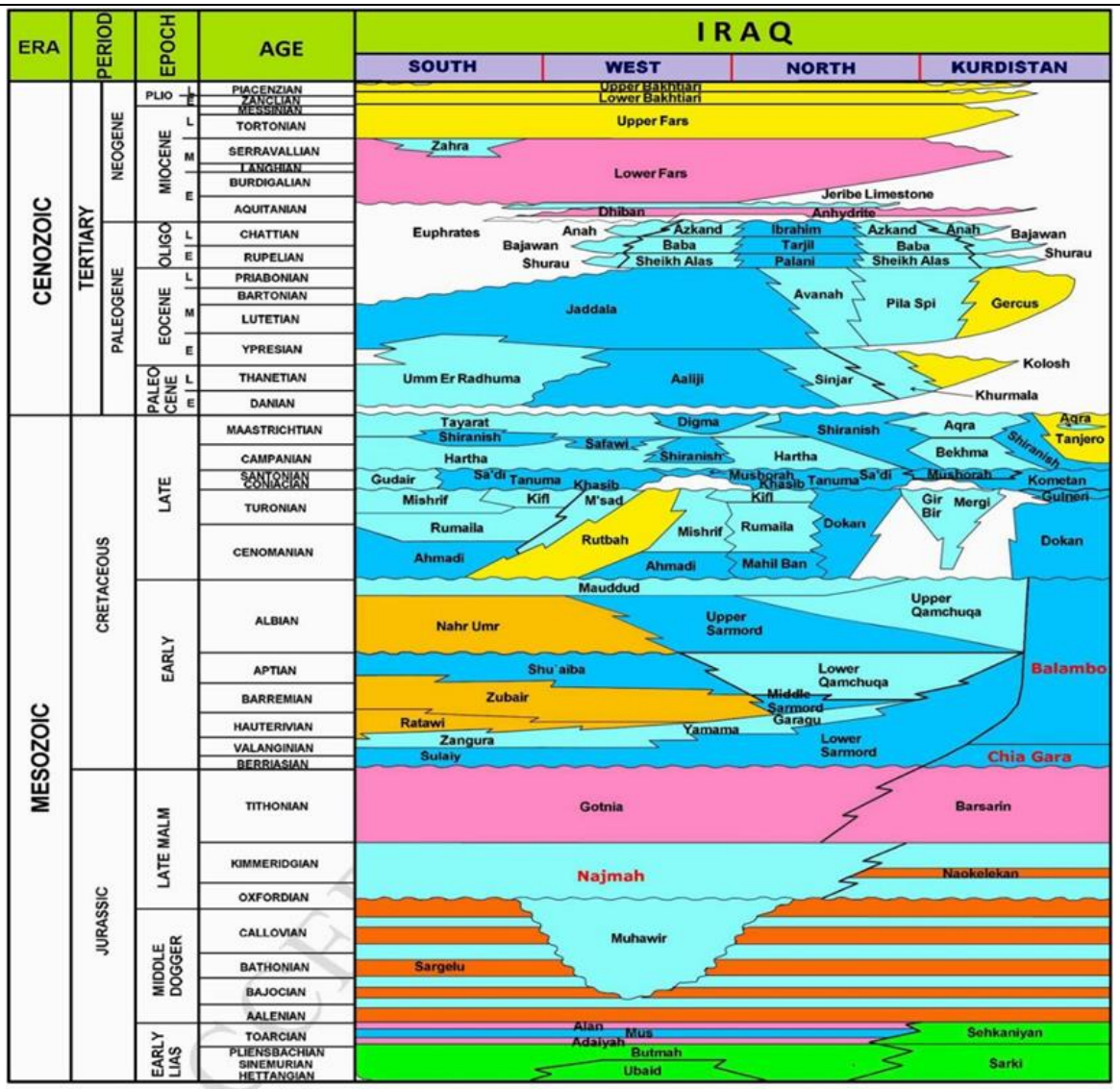

Fig. 5 Regional stratigraphic correlation including the Shiranish Formation (modified after Harland et al. 1990; El-Diasty et al. 2016).

Lithostratigraphy

The studied interval in Tel Hajar-1 comprises ~7 m of the uppermost Shiranish Formation and ~2 m of the Hartha Formation occurring as a tongue within Shiranish. Seven samples were collected between 2180 and 2175 m (depth); samples at 2177–2178 m represent the Hartha tongue, whereas the remainder belong to the Shiranish Formation. The Shiranish lithology consists of foraminiferal calcareous clay and wackestone rich in planktic foraminifera with micrite. A simplified measured section is provided in Fig. 6.

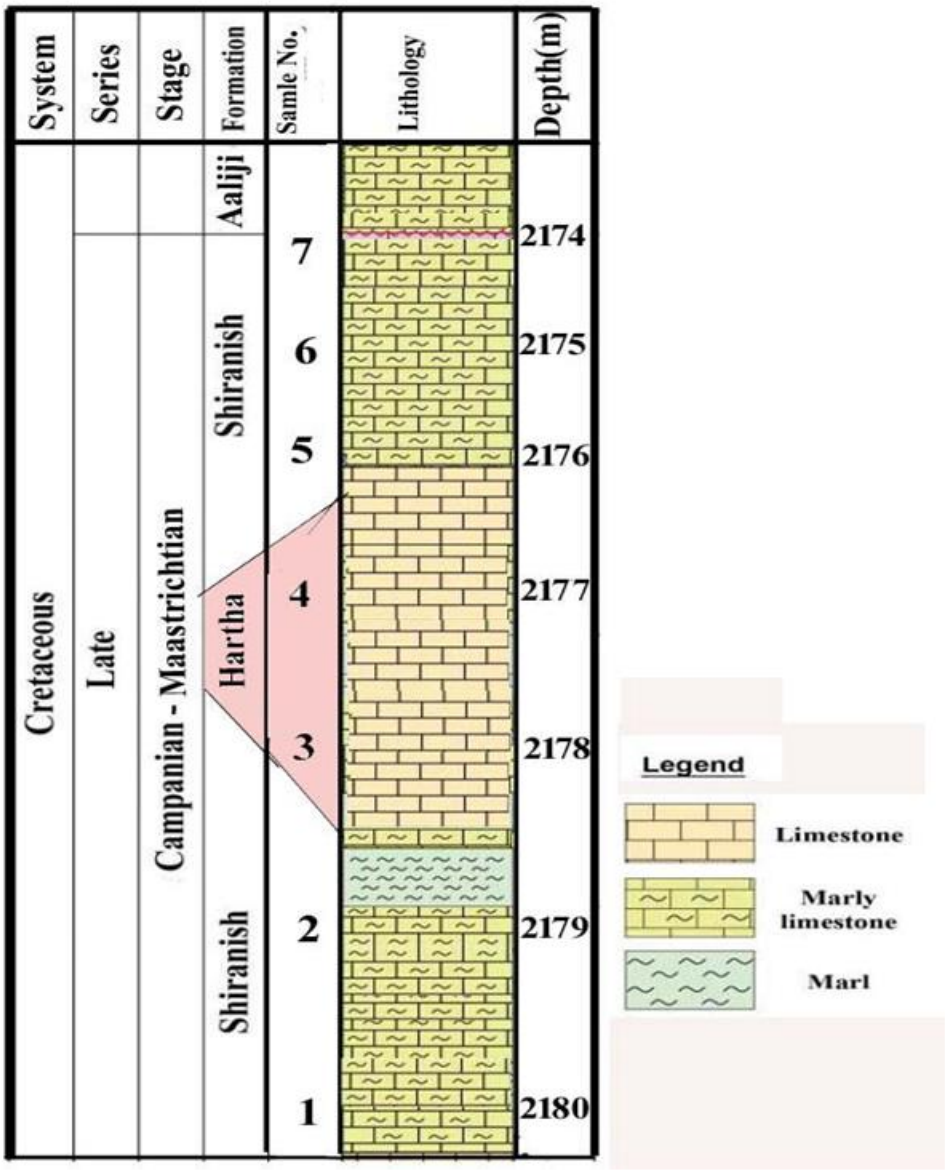

Fig. 6 Columnar section of the studied interval.

Results and discussion

Biostratigraphy

Samples from the Shiranish Formation yield rich and diverse planktic foraminiferal assemblages. Approximately 6 m of Maastrichtian strata were analyzed, documenting 32–37 species belonging to 5–9 genera. Two samples contain large benthic foraminifera characteristic of the Hartha tongue (limestones with local dolomitization), with common occurrences of Orbitoides spp. The two highest samples include planktic foraminifera attributable to the Aalii Formation, including species of Subbotina, Globigerina, Chiloguembelina and Globorotalia.

One assemblage zone is recognized: the Kassabiana falsocalcarata Zone (Figs. 7, 8), indicating a latest Maastrichtian age. The zone is characterized by numerous species of Pseudotextularia, Heterohelix, Pseudoguembelina, Globigerinelloides, Globotruncanita, Globotruncana, Rugoglobigerina and others. Correlation with regional schemes is shown in Fig. 9.

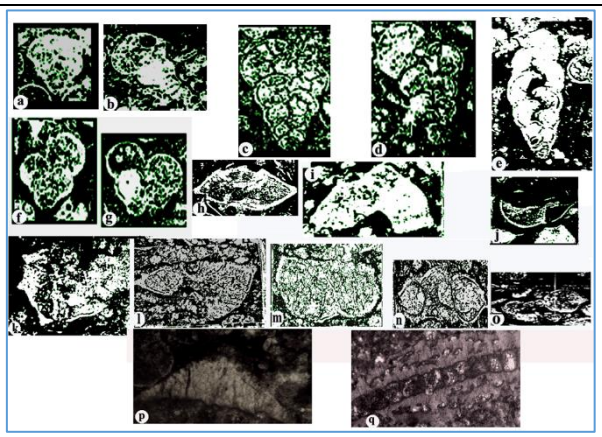

Fig. 7 Representative planktic foraminifera from the Shiranish and benthic Orbitoides from the Hartha tongue. a, Pseudotextularia elegans (Rzehak),1891,(X320), Shiranish Formation, sample no. 7, b—Pseudotextularia elegans (Rzehak), 1891 (X320), Shiranish Formation, sample no. 3, c – Heterohelix reussi (Cushman), 1938, (X330), Shiranish Formation, sample no. 2., d –Heterohelix globulosa (Ehrenberg), 1840, (X340), Shiranish Formation, sample no. 2, e – Pseudoguembelina costulata (Cushman), 1838, (X290), Shiranish Formation, sample no. 1, f- Heterohelix ultimatumedia (White), 1929, (X360), Shiranish Formation, sample no. 7, g – Heterohelix ultimatumedia (White), 1929, (X390), Shiranish Formation, sample no. 7, h- Globotruncanita stuarti Shiranish Formation, sample no. 1, i-Globotruncana trinidanensis Gandolfi 1951, (X160), Shiranish Formation, sample no. 2, j-kassabiana falsocalcarata Kerdany & Abdelsalam, Shiranish Formation, Late Maastrichtian, (X140), Shiranish Formation, sample no. 6, k- Kassabiana falsocalcarata Kerdany & Abdelsalam, Shiranish Formation, Late Maastrichtian (X130), Shiranish Formation, sample no. 1, l- Globotruncanita stuartiformis Dalbiez, 1955, (X360), Shiranish Formation, sample no. 7, m- Globotruncana gansseri gansseri Bolli, 1951, (X350), Shiranish Formation, sample no. 1, n- Globotruncana marginata Reuss, 1845, (X350), Shiranish Formation, sample no. 1, o-Pseudoguembelina costulata Cushman, 1938. (X290), Shiranish Formation, sample no. 7. P, q- Orbitoides sp., (X350), Hartha Formation, sample no. 3.

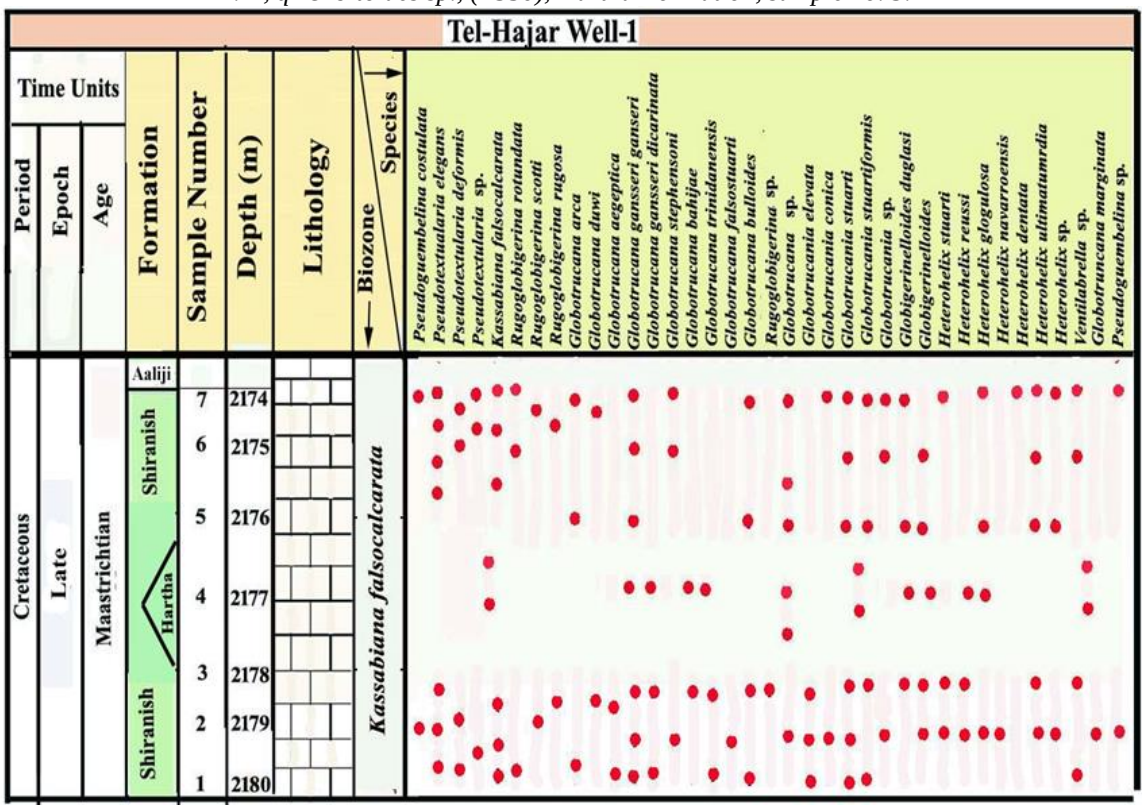

Fig. 8 Biostratigraphic range chart of planktic foraminifera in the studied interval.

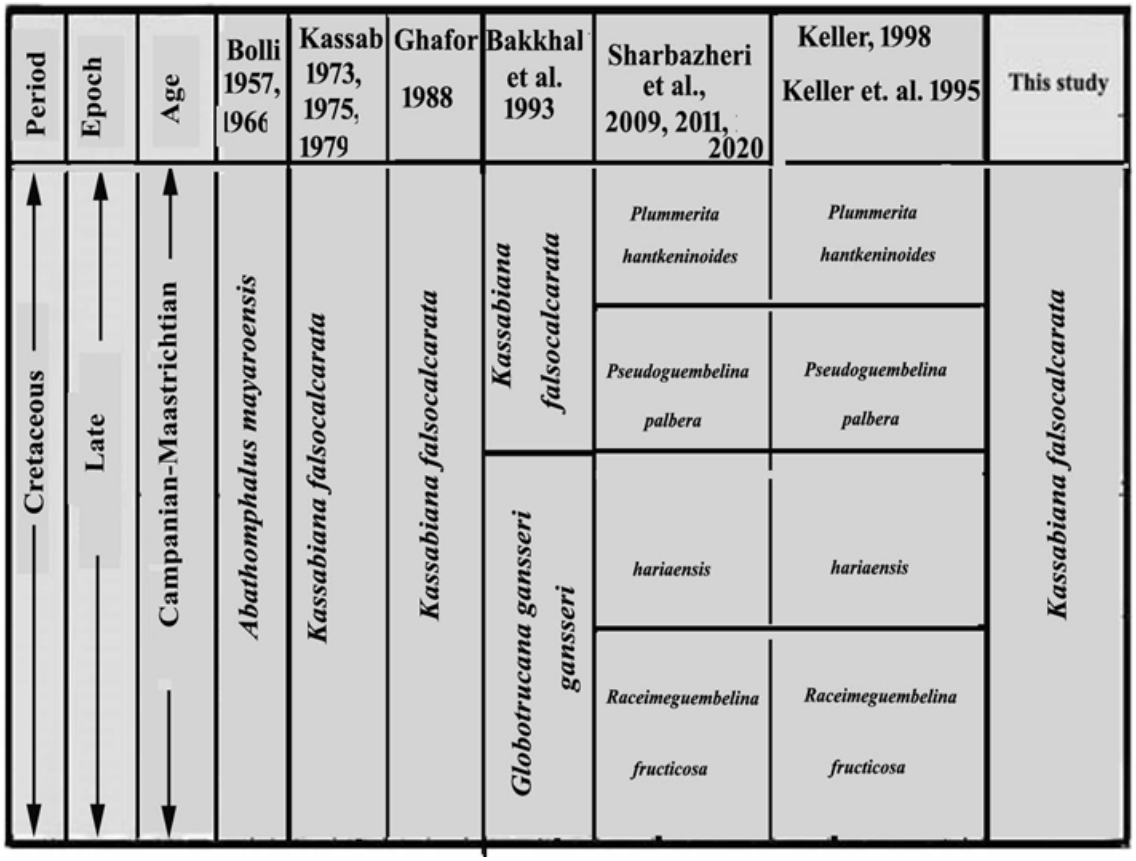

Fig. 9 Correlation of the recognized zone with other studies.

Depositional environment

Facies analysis indicates deposition of the Shiranish Formation in a pelagic (deep-basin) setting dominated by wackestone, packstone and mudstone microfacies and characterized by abundant planktic foraminifera. In contrast, the intertonguing Hartha Formation records shallow-marine conditions with large benthic foraminifera.

Conclusions

• Thirty-seven species from nine genera of planktic foraminifera were recorded from the upper Shiranish Formation at Tel Hajar-1.

• A single biozone, the Kassabiana falsocalcarata Zone (latest Maastrichtian), is recognized and correlated regionally.

• The Hartha Formation intertongues with Shiranish and contains shallow-marine benthic assemblages (e.g., Orbitoides spp.).

• The Shiranish Formation was deposited in a deep-marine environment.

Statements & Declarations

Funding: No funding was received for conducting this study.

Conflicts of interest: The authors declare no conflict of interest.

Author contributions: IMG designed the study and wrote the manuscript; AJ performed micropalaeontological analyses; RRF contributed stratigraphic interpretation.

Data availability: Data are available on reasonable request from the corresponding author.

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