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Sequence Development of the Sinjar Formation at Jabal Sinjar and Koi Sanjak, Northern Iraq

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Abstract : The Sinjar formation of northern Iraq was deposited on a shallow carbonate platform with a distally steepened ramp setting. Seventeen microfacies were identified representing the different subenvironments within the different parts of the ramp.
The succession can be divided into seven fourth order cycles bounded above and below by Type-1 sequence boundaries. It shows the effect of multiple episodes of relative sea level rises and still stands where the local tectonic component was the main controlling factor on sequence development.
Key words : Sinjar Formation, Ramp setting, Sequence stratigraphy.

Introduction

The Sinjar Formation (Paleocene-Lower Eocene) is part of[1]Megsequence AP 10 across the Zagross Foredeep in the north-central Arabian Plate. Keller (1941, in [2]) first described the Sinjar Formation from the Jebal Sinjar area (Near Mannista Village), it consist of 176 m of algal reef and nummulitic shoal facies. The Formation interferences with the Kolosh Formation at many regions such as in well Taq Taq-1[3], and in the type area of the Kolosh Formation [4,3]. The thickness of the formation is variable as in Derbendikhan area of NE Iraq where it is 120 m[5]. In the Foothill Zone of Northern Iraq, its thickness is 213 m as in well Alan-1, 541 m in Mushorah-1 and 126 m in Demir Dagh-1. In some wells, the formation interferences with the Aaliji Formation, for example in Tel Hajar and Sufaya-A2. The formation is probably the thickest near the Iraq-Syria-Turkey triple border point[6]. The age of the formation, according to[4] is Palaeocene-Early Eocene. [3]considered the formation to be of Early Eocene age because it overlies the Kolosh Formation. Eocene age was indicated for Sinjar Formation of the Derbendikhan area of NE Iraq[5].

[7]showed an important study on the biostratigraphy of Sinjar Formation. [8]studied the depositional environments and facies of the Sinjar Formation from selected sections in Sulaimaniya Governorate. [9]studied the stratigraphy and paleoenvironment of the Khurmala and Sinjar Formations at Shira Swar, Shinawa and Bekhme in Kurdistan Region.

In the present study samples were collected from two exposed sections one at Jabal Sinjar, the other at Koi Sanjak (Fig.1), At Jabal Sinjar it is overlain by the Middle Eocene Jaddala Formation, Its lower boundary in unconformable with the Shiranish Formation (Upper Cretaceous). The formation interfingers with the Kolosh Formation at Koi Sanjak section[4]. The aim of this study is to determine the depositional setting, sequence development, and the tectonic framework of deposition.

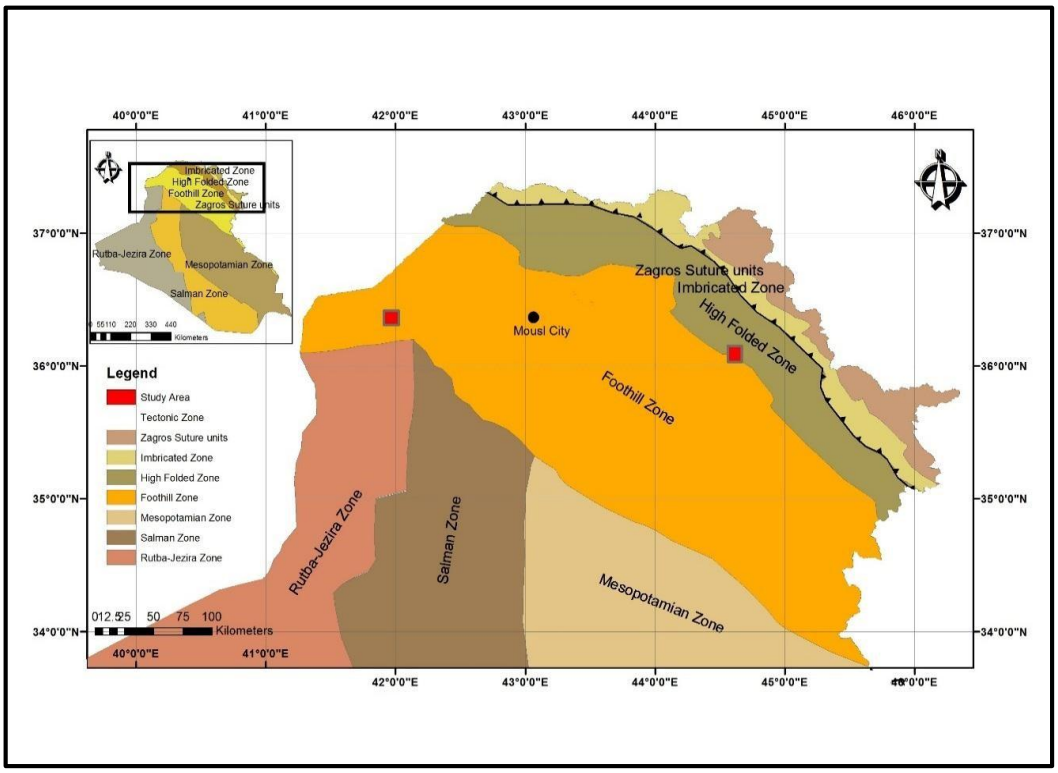

Fig. 1: Location map of the study area after [6]

Microfacies and Paleoenvironments

Detailed petrographic study of the depositional texture and types of carbonate rains and taking into consideration the types of microfacies of[10]; seventeen carbonate microfacies were recognized within the studied sections. These as follows:

1-Peloidal Packstone Microfacies.

This microfacies is consist of peloids of algaes, miliolids, corals, and echinoid plates, ranged from Coarse to fine (sand sized) and moderately sorted peloids (Plt.1-1).

2-Red algae – Coral Packstone Microfacies..

It includes corals and red algae, corals are mainly filled by micrite, and blocky calcite cements. With green algae and few small benthonic forams such as rotlids, textularia and peloids (Plt.1-2).

3-Bioclastic - Packstone Microfacies.

It comprises some gastropods, fragments of bryozoans and echinoid plats with miliolids, textularia, rotliids, and coral fragments within micrite groundmass (Plt.1-3).

4-Red algae – Bioclastic Packstone Microfacies.

It mainlyconsist of red algae besides fragments of bryozoans, gastropods, and echinoid plates with rare of ostracods, textularia and peloids within micrite groundmass (Plt.1-4 and 5).

5-Boundstone Microfacies.

This facies consists mainly of corals (Plt.1-6), red algae and sometimes forams, and other bioclasts. Generally this facies build-up a reef framework with a size of more than one mater.

6-Peloidal Grainstone Microfacies.

It consists of peloids, red algae some foraminifera such as miliolids, textularia, and alviolina.Rounded grains where the predominant of relatively medium to fine (sand size) and well sorted peloids (Plt.1-7).

7-Large Foraminifera Packstone-Grainstone Microfacies.

This microfacies is identified by the dominance of high percentage of large foraminifera such as Nummulite sp., Alveolina sp. and, Cuvillierina sp. with algalfragments and smaller benthonic foraminifera (Plt.1-8).

8-Large Foraminifera Packstone.

This microfacies is composed of large foraminifera such as Cuvillierina sp., Alveolina sp., Nummulite sp.,with some Rotalia sp., Taxtularia sp,.Miliolid sp., some of these grains are mostly bioclasts of echinoids, shell fragments, and algal debris(Plt.2-1).

9-Small Benthic Foraminifera Packstone Microfacies.

It consists of Rotalia sp., Miliolid sp., Textularia sp., with rare Alveolina sp., Cuvillierina sp., and high cement (Plt.2-2).

10-Small Benthic Foraminifera Wackestone Microfacies.

It consist mainly of smaller benthic foraminifera such as Rotalia sp., Miliolid sp., with echinoderms plates and peloids (Plt.2-3).

11-Large Foraminifera Grainstone Microfacies.

This microfacies contains Alveolina sp., Nummulite sp., Cuvillierina sp., with red algae fragments, and Miliolid sp., Textularia sp., Lockhartia sp.

12-Miliolids Packstone Microfacies.

It mainly contains the Miliolid sp. but the Rotalia sp., and Textularia sp., also present or mainly contains Miliolids (Idalina sinjarica, Quinqueloculina sp., Triloculina sp., Pyrgo sp,. Spiroloculina sp), other fossils and bioclasts are characterized by green algae, red algae fragments (Plt.2-4). The Miliolids Packstone Microfacies is found in lower part of the Koi Sanjak section within.

13-Bioclastic Wackestone Microfacies.

Contains some Miliolids, fragments of green algae and echinoid plates or consist only of some Rotalia sp. and Lockhartia sp. (Plt.2-5).

14-Bioclastic Wackestone –Packstone Microfacies.

Itincludes green algae fragments, echinoid spines, bioclasts, nummulites and gastropods fragments or with rare, red algae and coral fragments (Plt.2-6).

15-Fossiliferous Wackestone Microfacies.

This microfacies is identified by the availability of micrite with siltsized skeletal grains (Plt.2-7). The Fossiliferous Wackestone microfacies is only found in the upper part of the Koi Sanjak section within Sinjar Formation.

16-Planktonic Packstone Microfacies.

In the present study, this microfacies is mostly composed of limestone and partially dolomtic limestone with bioclastic and micrite groundmass (Plt.2-8). The main components of the particles are planktonic foraminifera .This facies is only present in the part most of the Koi Sanjak section within Sinjar Formation.

17- Fossiliferous Mudstone Microfacies.

This microfacies is identified by the presence of micrite with siltsized skeletal and bioclastic grains (Plt.2-9). This facies is only present in the part most of the Koi Sanjak section within Sinjar Formation.

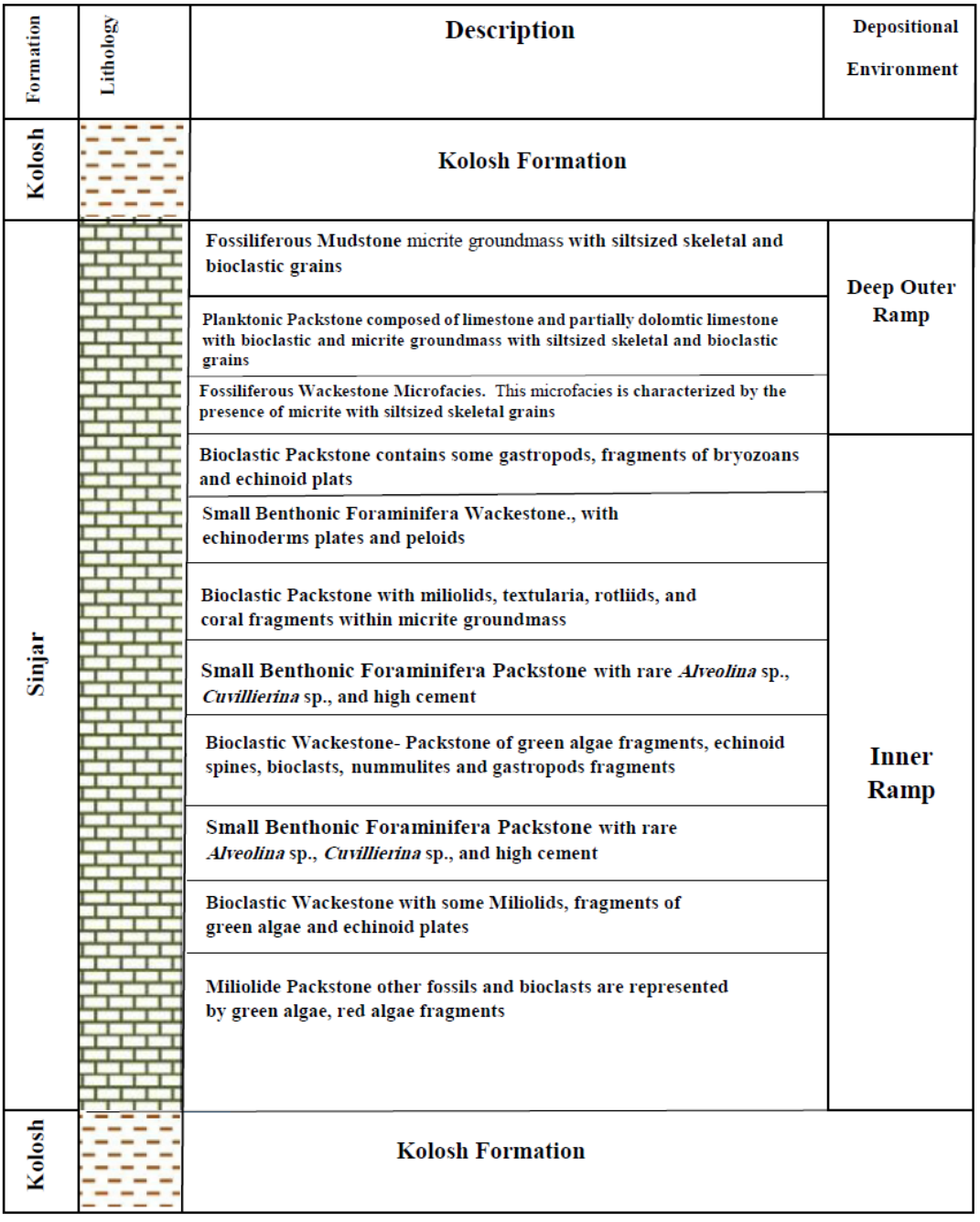

Fig.2: Distribution of paleoenvironment at Koi Sanjak section

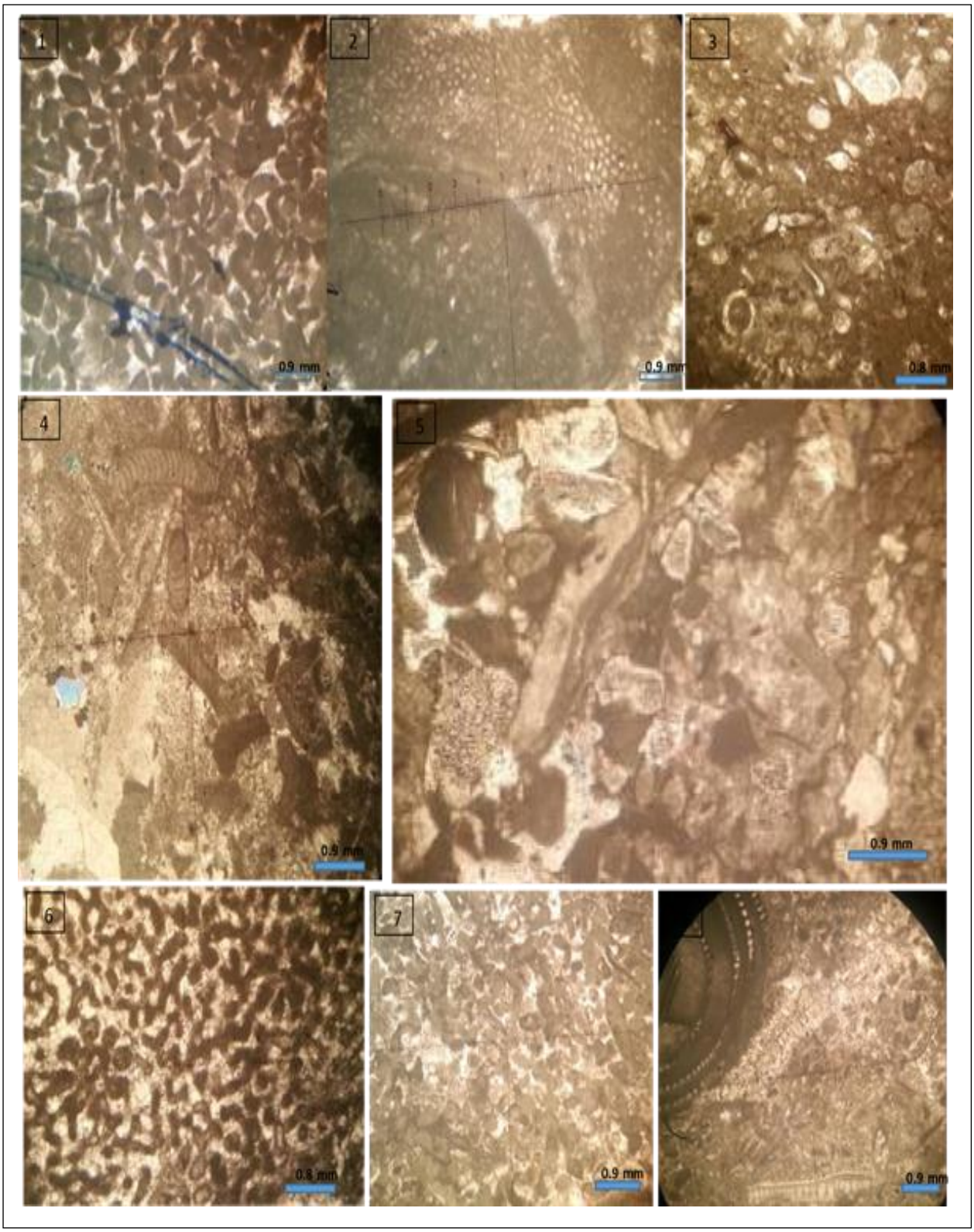

Plate-1-1.Peloidal PackstoneMicrofacies (Jeb 14);2-Red algae – Coral Packstone Microfacies (Jeb 2); 3-Bioclastic Packstone Microfacies with green algae(Jeb 45);4,5-Red algae – Bioclastic Packstone Microfacies with echinoid plates(Jeb 5,7);6-Boundstone Microfacies(Jeb32);7-Peloidal Grainstone Microfacies(Jeb 51);8-Large Foraminifera Packstone-Grainstone Microfacies(Jeb .83)

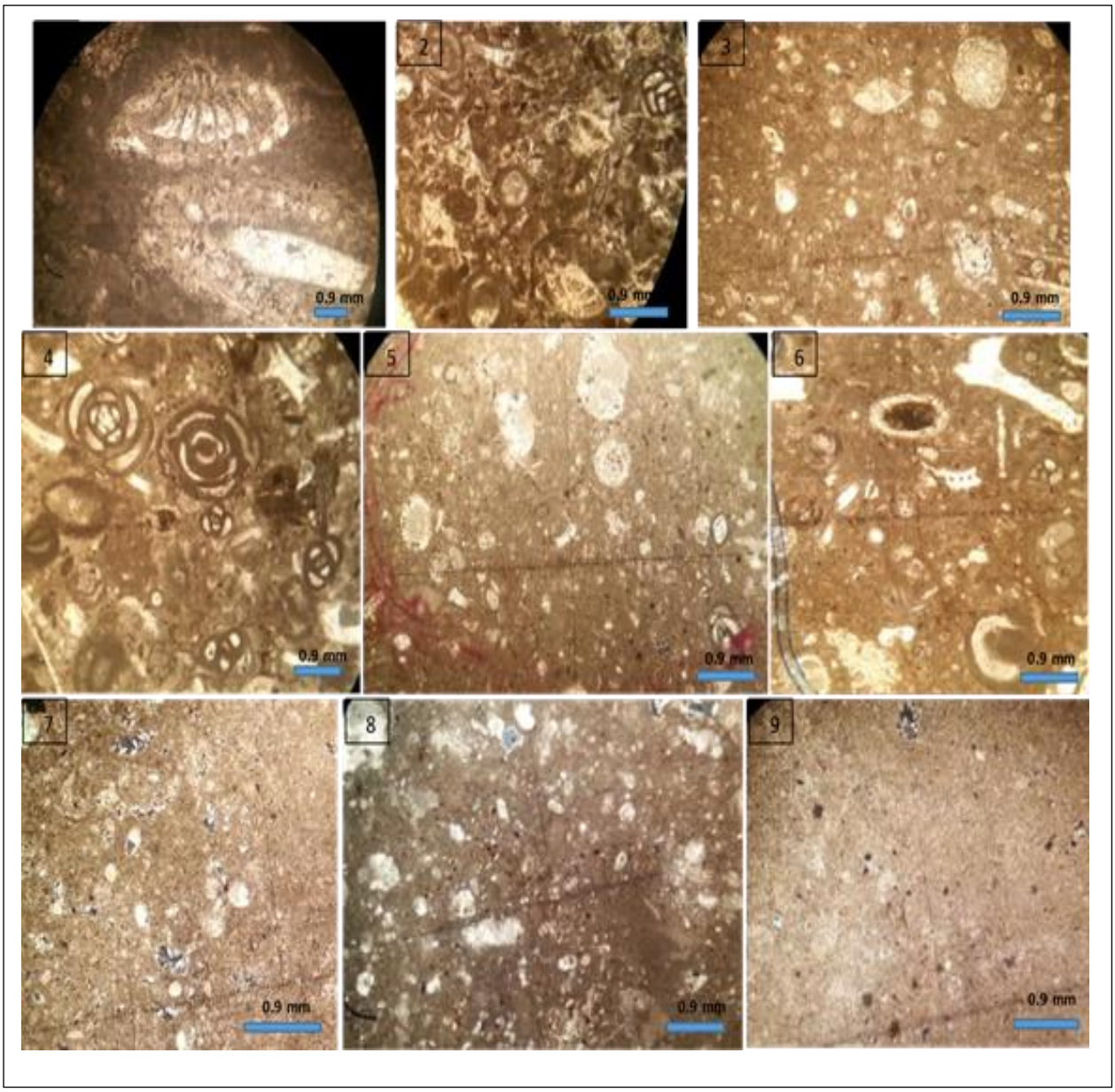

Plate-2-1.Large Foraminifera Packstone (Jeb62); 2.Small Benthic Foraminifera Packstone Microfacies (Koi 29) 3.Small Benthic Foraminifera Wackestone Microfacies (Koi 42); 4. Miliolids Packstone Microfacies (Koi 6);5. Bioclastic Wackestone Microfacies (Koi 12); 6. Bioclastic Wackestone – Packstone Microfacies (Koi 23); 7.Fossiliferous Wackestone Microfacies (Koi 38);8. Planktonic Packstone Microfacies (Koi 44); 9- Fossiliferous Mudstone Microfacies (Koi 48).

Depositional Setting:

The Sinjar succession in northern Iraq represent deposition on a shallow carbonate platform with a distally steepened ramp setting. Three main facies association can be recognized, one for each part of the ramp; as follows (Fig.3):

Inner Ramp Association

It consist of shallow open marine facies with good water circulation, mainly; small foraminifera packstone, small foraminifera wackestone, large foraminifera packstone, peloidal packstone, bioclastic packstone, and bioclastic wackestone packstone.

Mid Ramp Association

This association is represented by large foraminifera (Nummulite) packstone, red algae-coral packstone, boundstone, red algae bioclastic packstone, and peloidal grainstone. Such facies are typical of mid ramp deposition [11].

Deep Outer Ramp Association

This association is present at Koi Sanjak section only, and consist mainly of fossiliferous mudstone, fossiliferous wackestone, and planktonic packstone (Fig.2). The Sinjar succession is characterized by relatively thick aggradational inner and mid ramp deposits, which is typical of ramp setting.

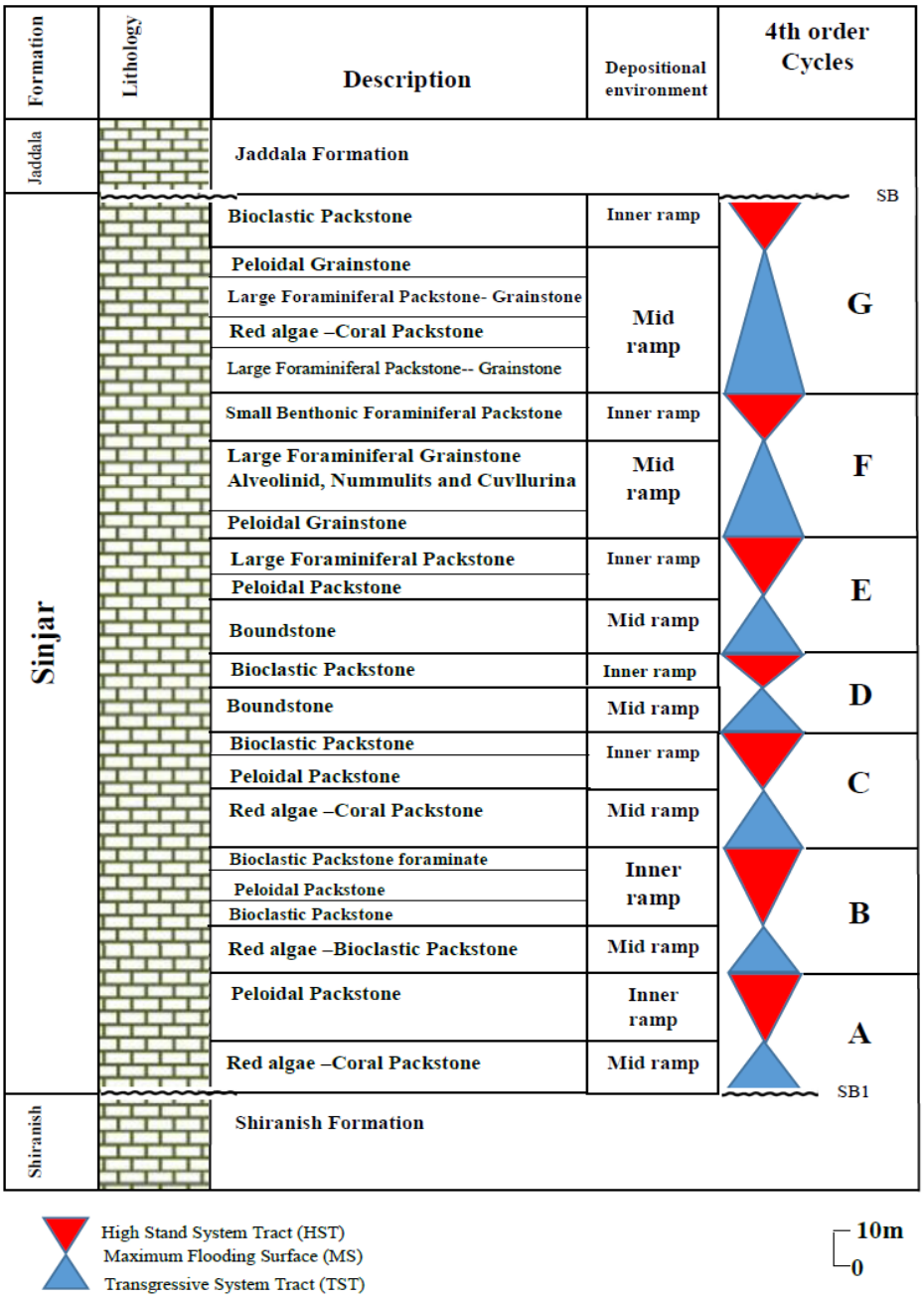

Fig. 3: Sequence stratigraphic subdivision of the Sinjar Formation at Jebal sinjar section.

Sequence Development

Seven fourth order cycles can be recognized within the Sinjar succession (Fig.3), they are bounded by Type-1 sequence boundaries. They represent successive episodes of relative sea level rises and stillstands. The transgressive systems tract (TST) of each cycle is the mid ramp facies associations followed by the inner ramp associations representing the high stand systems tract (HST), some of these cycles are symmetrical (C&E), others show slight asymmetry. Such cyclicity may show that the tectonic component is the main controlling factor of cycle development.

Conclusions

The sinjar Formation of northern Iraq was deposited in different subenvironments within a shallow carbonate ramp (Distally steepened). These subenvironments are represented by seventeen microfacies. The succession can be divided into seven fourth order cycles representing fluctuations of sea level rises and stillstands of the relative sea level. In this case, the local tectonic component in the main controlling factor on sequence development.

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