

**Lithology and Microfacies Analysis of Shiranish Formation at Selected Section  
Near Shaqlawa City- Northeastern Iraq**

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**Abstract**

The lithology of Shiranish Formation in Shaqlawa area is composed of grey- yellow, marl and marly limestone. The lower contact with Bekhma Formation is unconformable surface as indicated by the physical features such as the traces of the biological activities while the upper contact with the Kolosh Formation is recognized by the changing in lithology and also consider as unconformable. The microfacies of Shiranish Formation composed of four facies: Globigerinelloides planktonic foraminiferal lime mudstone microfacies (Sh1), lime mudstone microfacies (Sh2), Globotruncana planktonic foraminiferal lime wackestone microfacies (Sh3), Globogerina planktonic foraminiferal lime packstone microfacies (Sh4). Many diagenetic processes have been detected such as cementation, dissolution, dolomitization, neomorphism and composition of authigenic minerals, pyrite, glauconite and iron oxides. The environments of the formation recognize as lower, middle and upper bathyal environments which represented deep marine basin.

**Keywords:** Lithology, Shiranish, Facies, Sedimentation, Environment.

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دراسة صخرية والتحليل السحني لتكوين شرانش في مقطع مختار قرب منطقة شقلاوة شمال شرقي  
العراق

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الخلاصة

درست صخرية تكوين شرانش في منطقة شقلاوة. تتألف تتابعات التكوين من الحجر الجيري المارلي والحجر المارلي بالوان الاخضر والرصاصي والاصفر. وان سطح التماس السفلي مع تكوين بخمة لاتوافقي ذات صفات فيزيائية كالفعليات الحياتية واثار الاحياء، وان سطح التماس العلوي مع تكوين كولوش لاتوافقي من التغيرات الصخرية. تتألف سحنات الدقيقة تكوين شرانش من اربع سحنات وهي: سحنة الحجر الجيري الطيني الفورامنفيرا الطافي الكلوبوجيرانيلودي (Sh1) وسحنة الحجر الجيري الطيني (Sh2) وسحنة الحجر الجيري الواكي الفورامنفيرا الطافي الجؤجو (Sh3) وسحنة الحجر الجيري المرصوص الفورامنفيرا الطافي الكلوبجيراني (Sh4). وحددت العديد من العمليات التحويرية كالمتمنة والاذابة والدلمة والتشكل الجديد وتكوين المعادن الموضعية النشأة البيرايت والكلوكونايت والاكاسيد الحديد. تميزت بينات التكوين الباثيال الاسفل والاوسط والاعلى والمتمثلة بالحوض البحري العميق.

**الكلمات المفتاحية:** صخرية، شرانش، سحنات، ترسيب و بيئة.

Introduction

Shiranish Formation is crops out in the High Folded Zone of northeast Iraq. While at Shaqlawa area Shiranish Formation crops out at the northeastern limb of seffen anticline at the low areas. The coordinates are longitudes (44° 09' 4") East and latitudes (36° 25' 36") North figure 1. From the tectonic point the area formatted of association of many longed narrow syncline and anticline, represented be low hill [1] at that area with thickness (35 m).The lithology of the formation represented by cycles depositions of soft marl reflected weathering origin alternated with marly limestone which is hard and massive the thickness of formation is variable from area to, it's maximum (1500 m) at well of Sassan near the city of Tal Afar and (704 m) in Ein Zalah and (480 m) West of the fold of Sinjar. The type section of Shiranish Formation is located near village of Shiranish near Duhok with thickness (227.8 m). The selected type locality of



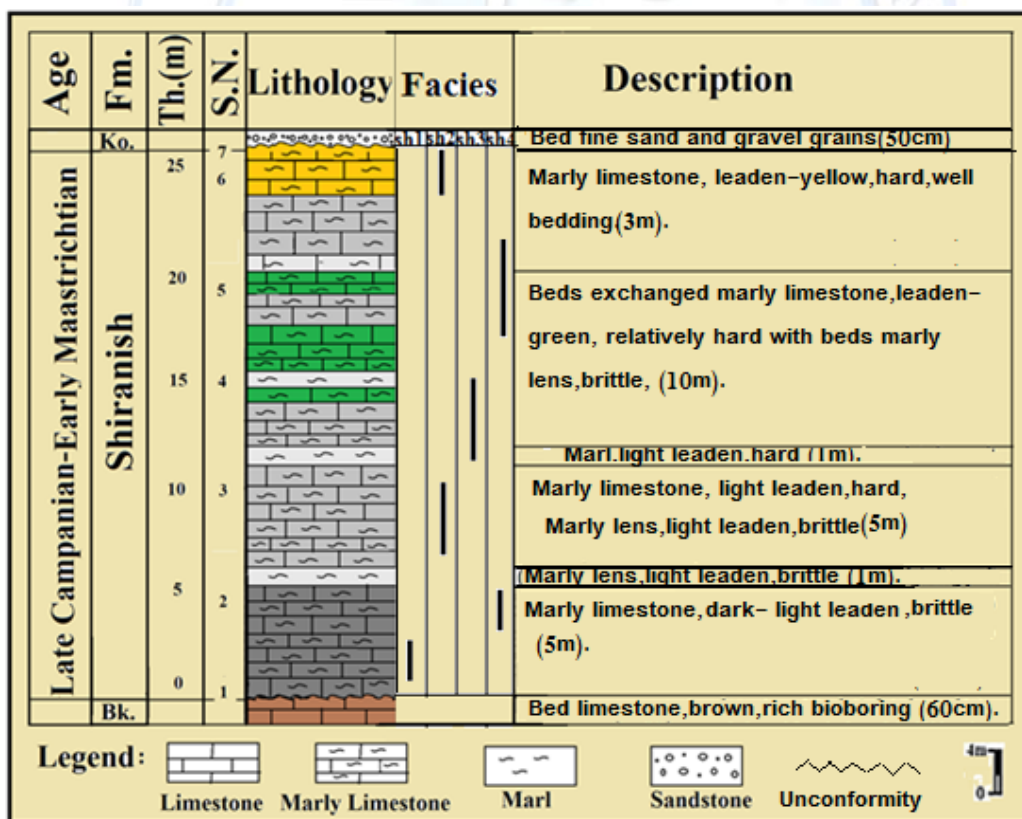


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**Description the sequences of the Shiranish Formation**

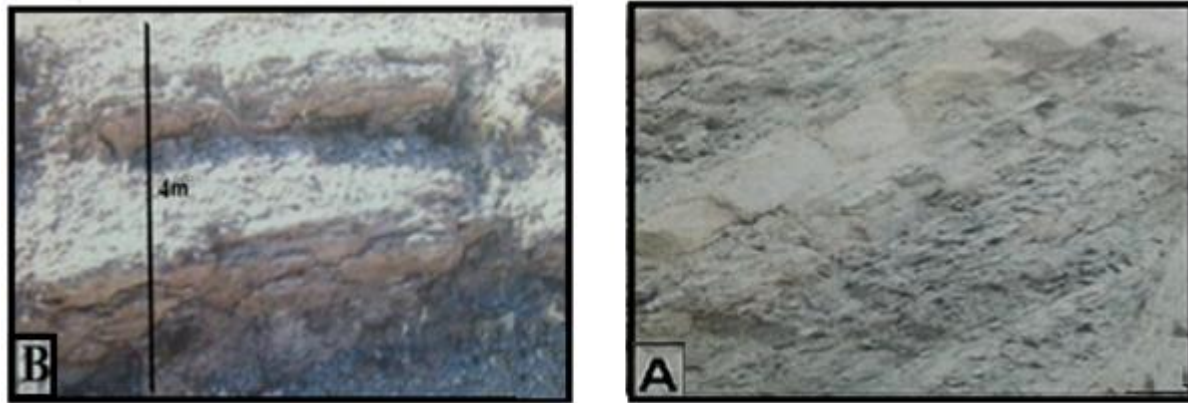
Shiranish Formation sequences in Shaqlawa area (25 m) are characterized by good bedding and moderately solid, consist of a succession beds of marly limestone and marl superimposed with overlapping beds marl lenses and brittle. The most recognized sedimentary structures at this section are: plane and laminated bedding. Is the most characteristic lithologic component of Shiranish Formation comprising alternation of marl and marly limestone. The successions of the formation consist of hard beds (5 m), dark and light lead well-bedded marly Limestone, while changes to soft beds (1 m) light grey marl laminae, with veins calcareous and patches of iron oxides Picture 1. At the top of sequences, the thickness of the beds increased generally, but with less thinner beds, it consists of mainly of alteration grey marly limestone and grey marl. Toward the top of the sequence, the beds thickness decreases to hard beds (3m) yellow–lead marly limestone figure 2.



**Figure 2:** Stratigraphy section sequences of the Shiranish Formation.

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**Picture 1:** (A) Beds marly limestone bedding and laminated with marl lenses in lower sequences of Formation. (B) Marly limestone medium hardness (4m) in middle sequences of formation

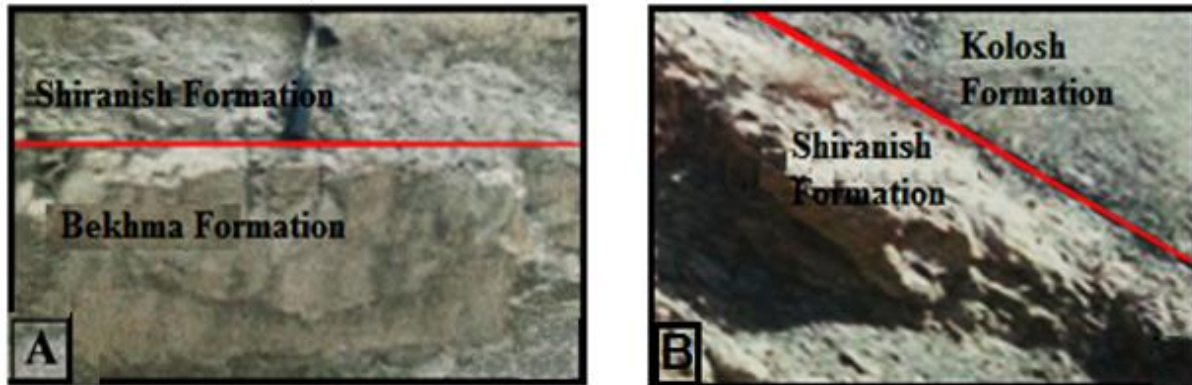
#### **Limits of contact**

The sequences of the Shiranish Formation in the study area are complex, due to many factors, especially tectonics, which had a clear effect on the formation and construction of sedimentary basin by various sedimentary processes and subsequently destroyed by the influence of various natural factors. Fieldwork, new observations are recorded in many different localities that showed distinct character in opposite to previous studies, like gradational conformable [2, 20, 21 and 22]. The present study represented unconformably surface between Shiranish Formation and Bekhma Formation, recognized by bed calcareous brown Bekhma Formation, while the thickness (60 cm) rich in biologic pores, trails and benthonic foraminifera, overlain by Shiranish Formation and the contact is marked by the first regular alternating of beds marly limestone light laden hard.

The nature of the upper contact surface of Shiranish Formation with Kolosh Formation in outcrops north-east of Iraq conformably [23, 24, 25 and 12]. In the studied area the Shiranish Formation overlain by Kolosh Formation unconformably and the contact is marked by the first appearance of gray sandstone or siltstone beds at the top of Shiranish Formation (grey – yellow marly limestone) and starting bed (50 cm) grains rounded sub rounded gravels, coarse sand and fine silt soft brown - dark brown well sorted picture 2.

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**Picture 2:** (A) The unconformity surface between Shiranish Formation (Marly limestone) and Bekhma Formation (limestone). (B) The unconformity surface between Shiranish Formation (Marly limestone) and Kolosh Formation (Sandstone rich in gravels).

### Petrographic study

The petrographic description showed that succession the Shiranish Formation is consist of many skeletal and non-skeletal grains with matrix (micrite). Skeletal grains: Mostly are represented by good preserved, small sized, thin walled planktonic foraminifera (*Globigerinelloides*, *Globotruncana*, *Globigerina*, *Heterohelix*). Sometimes calcisphere is found with small size thin wall. Also, rare well- preserved echinoderms and bioclasts Planktonic foraminifera. No non-Skeletal grains are recognized within Shiranish Formation except some authigenic minerals as quartz, pyrite and glauconite which may indicate to a reduction depositional environment. Matrix is represented micrite dark brown color (organic, iron oxides) which indicates to low energy depositional environment [26]. Four microfacies were described in the studied formation as shown below:

#### 1. *Globigerinelloides* planktonic foraminiferal lime mudstone microfacies (Sh1)

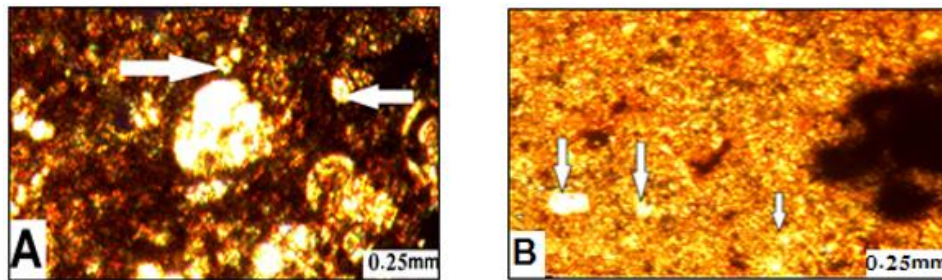
This microfacies has widespread distribution within the Shiranish Formation where it is recognized in the lower of the formation figure 2 and it formed about (8%) of skeletal grains which composed mainly of planktonic foraminifera such as *Globigerinelloides* circular shape plate 1A and it is less bioclastic planktonic and echinoderms. This microfacies contain quartz grains rounded small in size (external origin) which distributed within brown micrite matrix Plate 1B. This microfacies was affected by many types of diagenesis process like neomorphism (Inversion and recrystallization), dolomitization (euhedral and sub-hedral rhombs), with little



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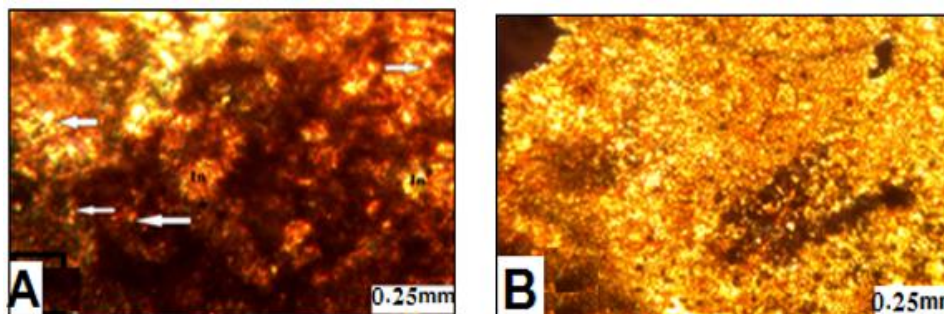
effected of the process dedolomitaion Plate 1A. The compare these facies with standard microfacies [27] found to scales (SMF-3) was deposited within the facies zone (FZ-1) known the deep sea.



**Plate 1:** (A) *Globigerinelloides* planktonic foraminiferal lime mudstone microfacies with orthrhombic dolomite(stock). (B) External Quartz grains (stock). Sample (1) in the lower parts of the formation

## 2. Lime mudstone microfacies (Sh2)

This microfacies is found in the middle and upper parts of the formation figure 2 and it is essentially consist of (8%) quartz rounded grains (0.10-0.05mm) dark brown micrite mixed with iron and organic oxides with low percent (less than 10%) of skeletal grains mainly of planktonic foraminifera in addition to some bioclasts oxides Plate 2A. Dissolution and compression are the most affected diagenetic features on this microfacies, also contain authigenic minerals, especially pyrite Plate 2B. These facies are standard facies (SMF-3) was deposited within the facies zone (FZ1) known deep sea.



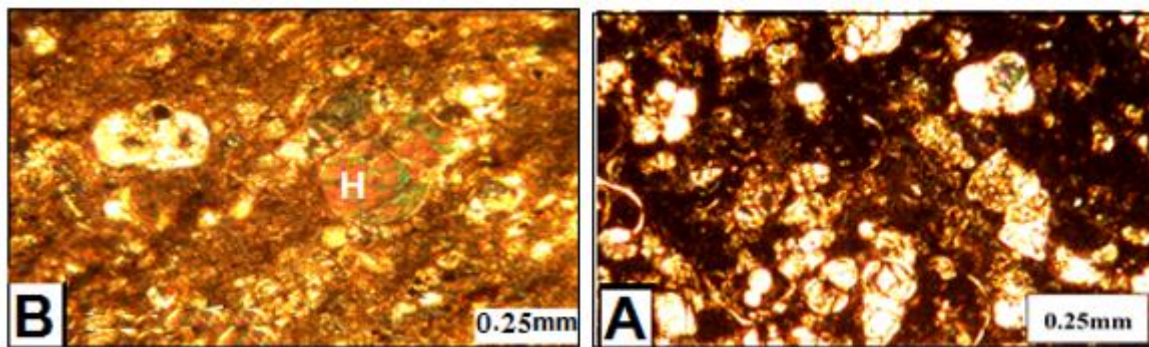
**Plate 2:** (A) Authigenic quartz grains in lime mudstone microfacies (stock). (B) Echinoderms filling of pyrite. Sample (3) in the middle parts of the formation

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**3- Globotruncana planktonic foraminiferal lime wackestone microfacies (Sh3)**

This microfacies were recognized in the lower and upper parts of the Shiranish Formation figure 2 and it formed about (10-30%) of skeletal grains which composed mainly of planktonic foraminifera *Globotruncana* and it is less *Heterohelix* (5%), in addition to foraminifera bioclasts (1%) and authigenic minerals such as pyrite, iron oxides, glauconite and quartz grains. The skeletal grains were distributed within dark brown micrite matrix rich organic material Plate 3A. Cementation and compaction are the most affected diagenetic features on this microfacies Plate 3B. These facies scale standard facies (SMF-3) was deposited within the facies zone (FZ1) known deep sea.



**Plate 3:** (A) *Globotruncana* planktonic foraminiferal lime wackestone microfacies. (B) *Heterohelix* (H) filling spary calcite cement. Sample (4) in the middle parts of the formation.

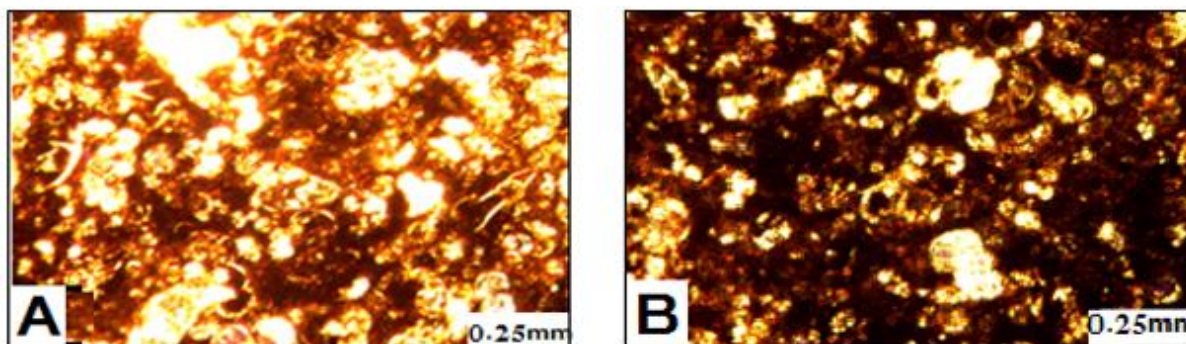
**4-Globigerina planktonic foraminiferal lime packstone microfacies (Sh4)**

This microfacies has widespread distribution within the lower and upper parts Shiranish Formation figure 2 and it formed about (30-60%) of skeletal grains which is essentially comprised from planktonic foraminifera with spherical chambers such as the genus *Globigerina*, *Globigerinelloides*, in addition to the rare shells of *Heterohelix*, *Calcisphere* their most calcification Plate 4A. This microfacies contain skeletal grains which distributed within matrix microspar with some oxides iron and spot pyrite. The affected diagenesis process on this microfacies represented dissolution, cementation and neomorphism, plate 4B. These facies scale standard facies (SMF-3) was deposited within the facies zone (FZ1) known deep sea.



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**Plate 4:** (A) *Globigerina* planktonic foraminiferal lime packstone microfacies. (B) Micrite brown mixed materials organic with spot pyrite. Sample (5) in the lower parts of the formation.

### Discussion

Most of the studied thin sections revealed that sedimentation environment was the deep, open offshore [2, 6]. Numerous studies have been based on the ancient marine depth through the benthonic foraminifera for their sensitivity to environmental changes and other studies have determined the ratio of the percentage of planktonic foraminifera to the total benthonic foraminifera.

The precipitation recognized sequences of Shiranish Formation rich in sedimentary structure (such as lamina and plane bedding) these are index sediments processes in deep marine environment and also sediments micrite, some spare, the abundance of fine grains and lack of coarse grains indicated to the sedimentation in a relatively quiet environment. The localized grains authigenic (glauconite and pyrite) are according to [28] the characteristics of the isolated environmental non-oxidation conditions isolated in full or near complete, dark micrite also indicate to the oxygen-deficient environment. The absence of non-skeletal granules in the sequence reflects the quiet sedimentary environment. The Physical, chemical, dissolution and cementation points to deep marine sediments.

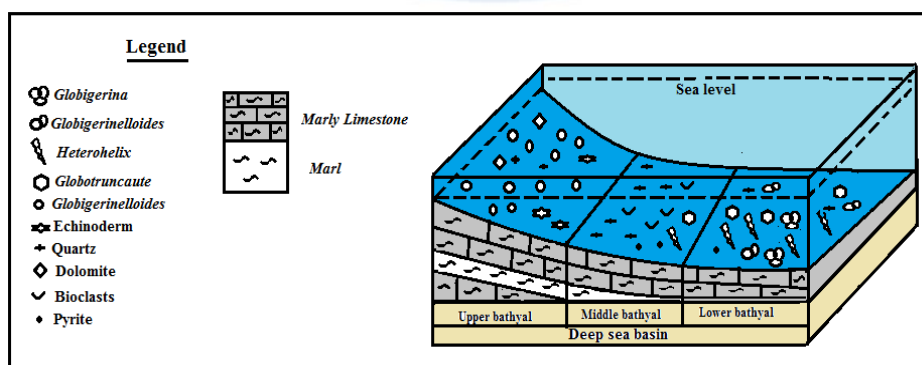
Biologically, the sequences of Shiranish Formation are characterized by the abundance planktonic foraminifera shells and their bioclastic, and according to [27, 29] the pelagic-semi-Pelagic sea environment. The high content of organic matter, the few of benthic foraminifera and the trace fossils within the marl calcareous deposits indicate to reduced environmental conditions that characterize the deep marine environment.

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The configuration sequences in the selected section show that they were deposited in essentially progressive conditions, accompanied by minor marine oscillations with low density deposits. The standard microfacies (SMF-1, SMF-3) are deposits within (FZ-1), known as deep sea basins, correspond to the model range shown above [30] within the zone (Lower, middle, and upper bathyal). The lower bathyal zone is represented by Globigerinelloides planktonic foraminifera lime mudstone microfacies and lime mudstone microfacies. The middle bathyal zone is represented by Globotruncana planktonic foraminiferal lime wackestone microfacies. The upper bathyal zone is represented by Globigerina planktonic foraminiferal lime packstone microfacies. The characterized facies record field and microscopic within sequences formation in the deep environmental range: dark brown color and well bedding, the formation molds and cast of fossil shells, the laminating texture, the abundance of micrite with the quartz granules, the prevalence of planktonic foraminifera shells within the calcareous layers, the mineralization of the pyrite and glauconite formed within the calcareous layers figure 3.

The analysis of microfacies of the formation sequences is supported by micrite and rich in planktonic shells, and is shown in the field, thin and well bedding in the formation sequences. The abundance of planktonic foraminifera shells is the clear and distinctive of the deep environment, and the precipitation of micrite, according to [27] sedimentation within low energy environment and the reduction conditions in the conservation of planktonic shells and their integrity within sediments [31]. The thickness of laminating and plane bedding good level and thickness varying (5-10 cm) to three meters represent the characteristics of facies basin deep [32, 33 and 28].



**Figure 3:** A depositional model of Shiranish Formation in the studied area

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### Conclusions

The conclusions that have been drawn by this study are listed as below:

- Both lower contact with Bekhma Formation and upper contact with Kolosh Formation are unconformity surface by the change's lithology.
- The petrographic study showed that the prevalent skeletal grains of Shiranish Formation are represented by planktonic foraminifera beside lesser ratio bioclasts (planktonic foraminifera, echinoderms).
- The dominant microfacies are: Globigerinelloides planktonic foraminiferal lime mudstone microfacies (Sh1), lime mudstone microfacies (Sh2), Globotruncana planktonic foraminiferal lime wackestone microfacies (Sh3), Globigerina planktonic foraminiferal lime packstone microfacies (Sh4).
- Various diagenetic features are associated with microfacies due to many diagenesis processes during different stages such as cementation, compaction, neomorphism, dolomitization and dedolomitization.
- The paleoenvironments of Shiranish Formation have been deduced on basis of petrographic study and microfacies analysis as upper, middle and lower bathyal environments.

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