



## Lithofacies and sedimentary structures of Tanjero Formation at Heeran area North Iraq

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### ARTICLE INFO.

#### Article history:

**-Received:** 12 / 12 / 2017

**-Accepted:** 18 / 1 / 2018

**-Available online:** / / 2018

**Keywords:** Tanjero Formation, lithofacies, sedimentary structures, Heeran area.

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#### Introduction

Tanjero Formation (Campanian-Maastrichtian) is exposed in the structures of the high folded zone of Iraq. It forms low or gentle elevated areas in Heeran area and mostly characterized by soft clastic rocks, with dark yellowish green and olive green colors. Tanjero formation composed of sandstone, claystone, shale and conglomerate beds with common lateral and vertical variation throughout the formation [1]. [2] indicated that the Tanjero Formation cropped out at high folded and imbricate zone north east Iraq. It consists of clastic rocks with thick sequence of sandstone, clay stone and beds of conglomerate with biogenic limestone. The upper part of the formation consist of silty marls, silty stone, sandstone, conglomerate and sandy or silty limestone while the lower part formed predominately of globigerenal open sea marl and sandy or silty limestone [3]. The planktonic foraminifera in the upper part refers to deep marine deposition while the middle and the

#### Abstract

The lithofacies and sedimentary structures of Tanjero Formation (campanian- maastrichtian) have been studied in the field at Heeran area east of Shaqlawa north of Iraq. It is found that the thickness of the formation is (120) m., the lower contact is conformable with Shiranish formation while the upper contact is unconformable with Kolosh Formation and recognized by the presents of basal conglomerate about (1.5)m. in thickness. According to the lithofacies, the formation is divided in to three parts; the lower and the upper parts composed of clastic sand stone interbedded with thin beds of marl and carbonate. While the middle part is friable and composed of marl and shale. The studied sedimentary structures in the formation confirmed that the sediment deposited by turbidite currents with unstable tectonic conditions.

lower part were deposited at deep basinal environment [4-7].

According to [8] during the study of the sedimentology of Tanjero formation in Dukan area divided the formation in to Four beds; recrystallized limestone beds, sugary texture beds, foraminiferal limestone beds and planktonic and benthonic limestone beds. Also they indicated that the lower part deposited under deep marine shelf environments while the middle and the upper parts deposited under open marine environments.

The present work aims to the sedimentological aspect which depending on the lithofacies from the field studies in addition to recognize the sedimentary structures in the clastic sediment succession for Tanjero formation section outcropped near Heeran town north eastern Iraq Figure (1).



Figure- 1 Location map of study area

#### Field study:

The field study of Tanjero formation at Heeran area are including the determination of the lower contact of Tanjero formation and the underlying Shiranish formation from the physical characters of the rocks such as color and hardness of the lower contact, Shiranish formation represent by light color of marly limestone rocks which the Tanjero represent by the appearance of sandstone interbedded with marl or mudstone thin beds. The upper contact recognized by the unconformity with layer of basal conglomerate between Tanjero and the overlying Kolosh formation. Also the field study including the determination of the different types of clastic layers of sandstone, mudstone and thin beds of carbonate. The total thickness of the Tanjero formation is about 120 m. Many sedimentary structures have been identified specially with the sandstone beds and the overlying or underlying beds of marl and ten samples (T1 to T10) (figure -2) have collected from the different types of Tanjero rocks which aims to interpreting the different characters of clastic and non-clastic of the rocks.

#### Tectonic setting:

Laramide orogeny at late Maastrichtian forming a deep wide trough in NE of the Arabian plate with extension WNW-ESE where the flysch clastics deposit accumulated which representing Tanjero Formation [9].

The basin of (upper Cretaceous) Tanjero formation is combined tectonically with that of the underlying Shiranish formation and named upper cretaceous zagros early foreland basin instead of previous miogeosyncline and trench basin [10].

[11] mentioned that the obduction and closure of the southern Neo-Tethys occurred during the late campanian and maastrichtian and that causes a major transsgration across the whole of Iraq.the same stress regime in the NE of Arabian plate led to the formation of intraplate extensional and transextensional basins of NW-SE and E-W trend.

The age of the unconformity which have been concluded within Tanjero formation at Chwarta area is estimated to (1.23m.y.) duration depending on the planktonic foraminiferal biostratigraphy zonation [12] also he recognized (26) planktonic foraminiferal species in addition to (30) benthonic species Figure (2).

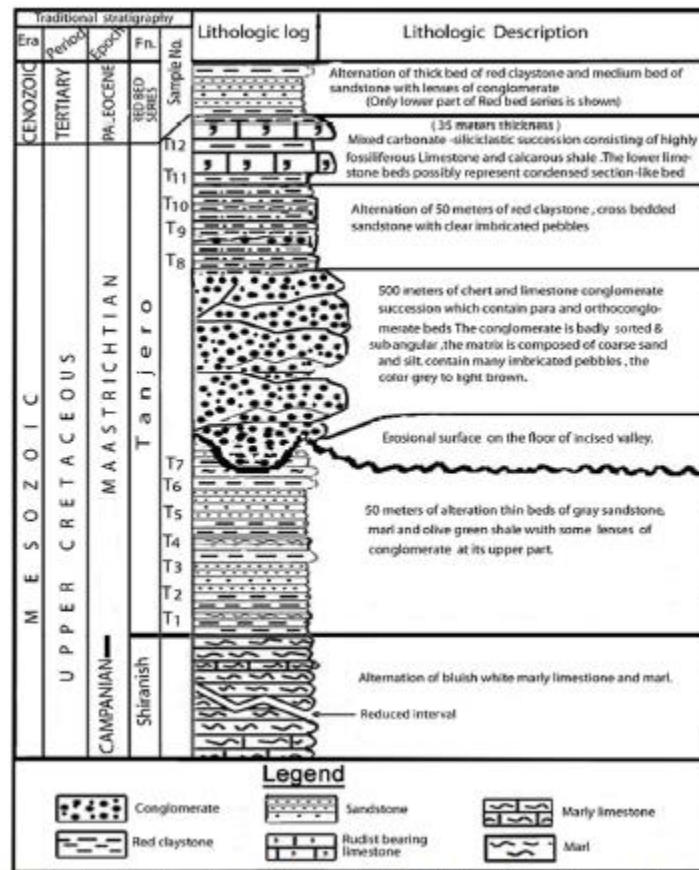


Figure - 2 Stratigraphic column of Tanjero Formation indicating the unconformity within the formation south east of Chwarta city [12].

Tectonically the studied area located at the NE limb of Safien structure which represent the largest plunging anticline with length about (50)km. and height (1970)m. above sea level and distributed by many different faulting, these faulting system causing discontinuity in the axis of the anticline and causing the Qamchuqa formation appears above Shiranish formation at SW of Heeran town, other faults are along Tanjero and Shiranish formations near NW plunge of Safien structure west of Heeran [1], there is no indication of the unconformity in the study area within the succession of Tanjero formation which has been recognized by [12] in Chwarta.

**Lithofacies stratigraphy:**

Tanjero formation composed of clastic sediment mostly friable with dark to olive green colors . the thickness of the formation is about 127 m. on the NE limb of Safien anticline near Heeran town to the east of shaqlawa city.

The lower contact of the formation is conformable with Shiranish formation, identified by the change in the physical character of the two formations such as the change in the color and the hardness of rocks. (Plate - 1 and Plate - 2).

Shiranish formation is characterized by massive marly limestone layers followed by dark green clastic of Tanjero formation.

The upper contact is unconformable and identified by a layer of conglomerate with thickness about 1.5 m. (Plate - 3) between Tanjero and Kolosh formations, this layer is composed of limestone and chert conglomerate.

The lithofacies succession of Tanjero Formation can be divided according to the sediment nature in three parts; the lower part of the formation with thickness about (60)m. composed maily from sandstone layers with alteration of marl and marly limestone with dark to olive color and contained many sedimentary structures such as sand balls, graded bedding and laminations. Six samples (T1 –T6) (Figure-3) and (plate - 4 and Plate - 5).

The middle part composed mainly of thin layers of dark marl and mudstone with thickness about (20)m. (Figure 3). Two samples (T7 and T8) have been taken from this part, the main sedimentary structures are lamination and slumping. (Plate - 6). The upper part of the formation characterized by thick and hard bedded of sandstone interbedded with marl and claystone, also thin bedded of marly limestone is present. The basal conglomerate indicates the unconformity contact between Tanjero and the overlying Kolosh formation (Figure 3) and (Plate - 7).

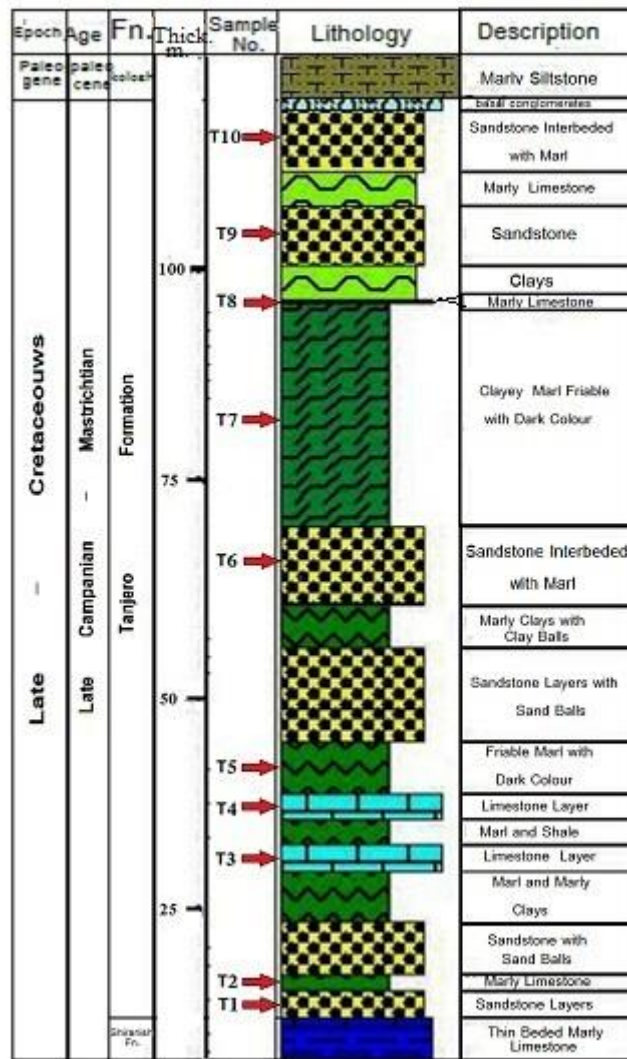


Figure - 3 Stratigraphic cross section indicating the lithofacies of Tanjero Formation at Heeran area.

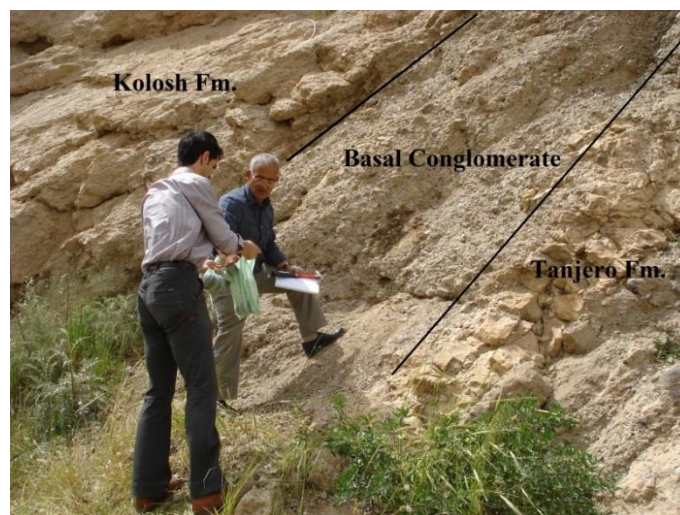


Plate - 1 showing a layer of massive marly limestone between shiranish and the lower contact of Tanjero Formation.





**Plate - 2 contrast in color between Tanjero and Shiranish Fm. Which indicate the lower contact of Tanjero Formation.**



**Plate - 3 Showing the basal conglomerate between Tanjero and Kolosh Fm. That indicates the upper contact of Tanjero Formation.**



**Plate - 4 showing alternation of sandstone and marl of Tanjero Formation at the lower part.**

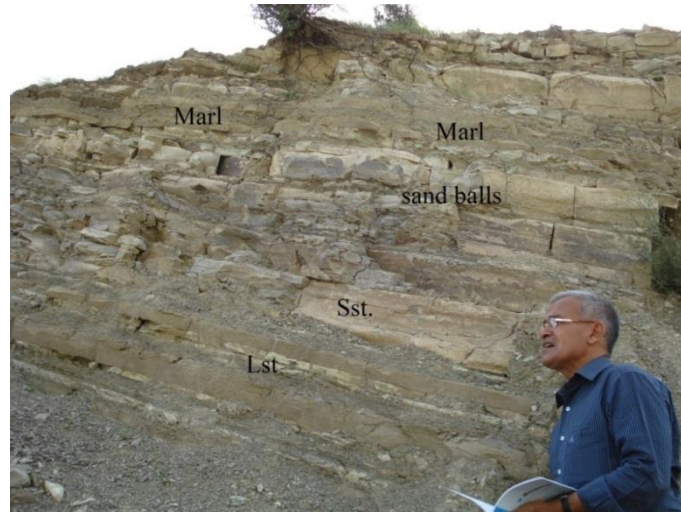


Plate -5 showing succession of sandstone with interlayers of marl, limestone or marly limestone at the lower part of Tanjero Formation.



Plate - 6 mixing layers of carbonate, marl and clastic at the middle part of Tanjero Fm.



Plate - 7 showing thick bedded of sandstone with sand balls interbedded with friable marl at the upper part of Tanjero Formation.

#### Sedimentary Structures:

Sedimentary structures are the large scale features of sedimentary rocks and used for the interpretation of paleocurrents, environmental condition at the time of deposition and to study the paleogeography and

tectonism of the sedimentary rocks. [13]. In the field study of Tanjero formation north Iraq and according to the previous studies [10]; [7] the formation has been deposited in flysh environment with turbidity conditions. During the field study and the lithofacies



description many sedimentary structures have been identified specially in the clastic rocks such as sandstone and mudstone.

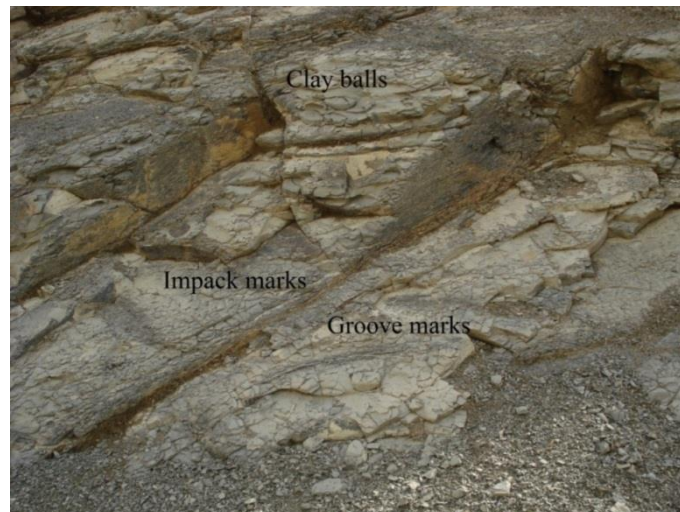
The important sedimentary structures are:

1. Groove marks are liner ridges between the sandstone beds and the under lying mudstone or marlstone [13] (plate - 8).
2. Impack marks with different shapes at the studied section within the clastic rocks, these structures are common in the sediment which accumulated by turbidities currents (Plate - 8).
3. Bedding and lamination which are produced by changes of sedimentation conditions leads to change in grain size (Plate - 9).
4. Graded bedding which are showing coarsening in grain size downward as recognized in the sandstone beds at the studied section of Tanjero formation (Plate -10).
5. Slumping, sliding and convolute structures which have been identified in Tanjero formation ,as a result of unstable tectonism directly after the deposition of

the sediment and also formed by dewatering within the load of overburden accumulated sediments [13]. In the present study the slumping and slide structures are with different sizes (Plate - 11).

6. Sand and clay balls are common in the beds of sandstone and mudstone, sometimes have elongated or elliptical shape resulted from the activity of turbidity currents (Plate - 11).

The clastic rocks of Tanjero formation have been deposited in foreland basins at elongated deep troughs at continental margins and most of the clastic sediments are showing indications of sliding and slumping structures with internal deformations resulting from gravity flow down a steep slopes, also the turbidity currents showing gradual change in the grain size and scoured base with the mud and carbonate beds under the sandstone. The thickness of the beds are variable and showing deformations resulted from the dewatering causing that the sediment lose the original volume and deformed the bedding with different degrees [13]; [14].



**Plate -8 Showing groove marks, impact marks and clay balls structures**



**Plate -9 Bedding and lamination structures.**



**Plate -10 Graded bedding structure.**



**Plate -11 Slumping, convolute and sand balls structures.**

### **Discussion**

Tanjero Formation have been studied by many authors from the tectonic development and biostratigraphic infistigation they concluded that the formation deposited in deep marine condition and effected by the tectonic condition and turbidite currents which represented by a foreland basin the clastic sediment of the formation are of flysh type. The thickness and the composition of the formation are different from place to place according to the development of the basin of deposition, however it deposited in narrow elongated deep trough and must of the clastic and carbonate derived from the older rocks on the sides of the trough under unstable conditions with turbidite currents and variation in the sea level conditions. The study of the lithofacies and sedimentary structures of the formation indicated that the sediment of the formation deposited under turbidity condition in foreland basin. The thickness of the formation in the studied area is (120)m. and divided in three parts according to the lithology and composition. It is found that Tanjero formation in Heeran area is different from other outcrops in north and north east Iraq which confirm the lateral variation

in depositional condition during Campenaian – Maastrichtain age.

### **Conclusions**

From the field study of the lithofacies and the sedimentary structures of Tanjero formation (Campenaian – Maastrichtain) at Heeran area east of Shaqlawa concluded the following:

1. The lower contact between Tanjero and Shiranish Formations is conformable and recognized by the lithological change from clastic of Tanjero to carbonate of Shiranish formation. .The upper contact between Tanjero formation and the underlying Kolosh is unconformable and identified by layer of basal conglomerate with thickness about (1-5) m. composed of carbonates and chert gravels.
2. According to lithofacies Tanjero Formation is divided to three parts

The lower and upper parts composed mainly of clastic rocks interbedded with marl and marly limestone while the middle part mostly formed of friable marl and shale with sandstone and mudstone beds.



3.The sedimentary structures are; groove marks, impack structure, bedding and lamination, slumping

structure, sand and clay balls and convolute bodies.

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## دراسة السحنات الصخرية والتراكيب الرسوبية في تكوين تانجيرو منطقة هيران شمالي العراق

لفته سلمان كاظم

قسم علوم الارض التطبيقية ، كلية العلوم ، جامعة تكريت ، تكريت ، العراق

### الملخص

تم دراسة السحنات الصخرية والتراكيب الرسوبية لتكوين التانجيرو (كامبين-ماستريختين) لمكاشف التكوين في منطقة هيران شرق مدينة شقلاوة/ شمالي العراق. يبلغ سمك التكوين (120) متر والمماس الاسفل له مع تكوين الشيرانش يكون متوافق ويتم تمييزه بالصفات الفيزيائية بينما المماس الاعلى يكون غير متوافق مع تكوين الكولوش ويتم تشخيصه بوجود طبقة من المدملكات القاعدية سمكها حوالي 1.5 متر. أعتادا على نوعية سحنات الصخرية تم تقسيم التكوين الى ثلاثة أقسام الجزء الاسفل والاعلى يتكون من صخور فتاتية من الحجر الرملي المتداخل مع طبقات رقيقة من المارل والكربونات اما الجزء الاوسط فيتألف من صخور غير متماسكة من الطفل والمارل. التراكيب الرسوبية التي تم تمييزها تؤكد بان التكوين ترسب بواسطة تيارات عكرة مع عدم وجود الاستقرار التكتوني.

**الكلمات الدالة:** تكوين تانجيرو، السحنات الصخرية، التركيب الرسوبية، منطقة هيران.