LITHOSTRATIGRAPHIC STUDY OF THE CONTACT BETWEEN KOMETAN AND SHIRANISH FORMATIONS (CRETACEOUS), IN SULAIMANIYAH GOVERNORATE, KURDISTAN REGION, NE IRAQ

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ABSTRACT

The contact between Kometan and Shiranish formations (Cretaceous) is re-studied in the field and laboratory. The study elucidates the nature of the contact and discusses the previous ideas of unconformable contact. On lithological basis‹ the contact is described and analyzed in eight different sections and grouped into three types: Obvious gradational, Burrowed-glauconitic and sharp contacts. Following recent studies, the basin in which the sediments of these types are deposited is considered as foreland basin and the location of each section is indicated within it. The sections are interpreted to be deposited in the beginning of clastic influx into the basin at threshold time and space between pure carbonate sedimentation and mixed sedimentation of clastic and carbonate, during and after drowning of the previous platform.

The first type of the contact (Obvious gradational) is interpreted to be deposited in front of major submarine fans, which are supplied by regular but intermittent clay influx of highly diluted turbidity currents. The second type (Burrowed-glauconitic) is attributed to the areas between the fans, which are supplied by clear water and rich in nutrient, Fe, Mg and O_2. This supply is most probably due to currents that are driven from the turbidity currents, when the basin was passing from deep water to shallower one. The pebbles and granules exist only in one section, out of eight and they are intraformational clasts (not terrigenous) and formed by submarine erosion. The third type (Sharp) represents sudden and unusual event of clay influx of the turbidity currents into the location of the sections, so that the marl is deposited instead of pure limestone of Kometan Formation. This rapid deposition may be due to a sudden switching of submarine channel, or an event such as large storm or tsunami. All evidences suggest that the contact is most probably conformable and shows no any signs of sub aerial erosion or long non-deposition, but does not exclude short submarine erosions and slow rate of sedimentation across the contact.

دراسة الصخارية الطباقية للحد الفاصل بين تكويني كوميتان وشيرانش (الكريتاسي) في محافظة السليمانية، إقليم كوردستان، شمال شرق العراق

كمال حاجي كريم، خالد محمود إسماعيل و بختيار محمد أمين

المستخلص

تم إعادة دراسة الحد الفاصل بين تكويني شيرانش وكوميتان (الكريتاسي) من الناحيتين الحقلية والمختبرية، لمحاولة توضيح طبيعة الحد الفاصل ومناقشة فكرة سطح عدم التوافق (المقترح سابقا). واعتماداً على الدراسة

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الصخارية، تم وصف وتحليل الحد الفاصل في ثمانية مقاطع مختلفة، قسم الحد الفاصل الى ثلاثة أنواع رئيسية، وهي تدرج واضح ومثقب-كلاكونيتي وفاصل حاد. اعتماداً على الدراسات الحديثة اعتبر الحوض الترسيبي حوض مقدمة القارة (Foreland basin) وتم تحديد موقع كل من المقاطع داخل هذا الحوض، وفسر ترسيب الرسوبيات على إنه حدث في بداية تدفق ترسبات فتاتية الى الحوض في وقت ومكان العتبة بين الرواسب الكلسية النقية ورواسب كاربوناتية - فتاتية ممزوجة. النوع الأول من الحد الفاصل (تدرج واضح) فسر على إنه ترسب في موقع ما أمام المراوح تحت البحرية الرئيسية التي زودت بكميات من الطين بشكل منتظم وبفترات متقطعة بواسطة تيارات العكرة الخفيفة جداً. أما النوع الثاني من الحد الفاصل (مثقب-كلاكونيتي) فهو واقع ضمن المنطقة الواقعة بين المراوح، حيث تكون المياه صافية ومحملة بالغذاء والعناصر اللازمة لتكوين الكلاكونايت ومعيشة الأحياء. وهذه المياه زودت بواسطة تيارات العكرة أثناء تحول الحوض من النوع العميق الى نوع أكثر ضحالة. أما النوع الثالث من الحد الفاصل (الفاصل الحاد) ترسب بسبب التدفق السريع وغير الاعتيادي للطين الى موقع المقاطع بواسطة تيارات العكرة، مرسبة المارل بدلاً من الحجر الجيري النقي لتكوين كوميتان. هذا الترسيب السريع وغير الاعتيادي ربما حدث نتيجة لتغيير مسار قنوات تحت بحرية. كل الدلائل تشير الى ان الحد الفاصل هو على الأغلب حد توافقي بين التكوينين، حيث لم تظهر أية دلائل للتعرية وعدم ترسيب طويل الأمد. ولكن هذه الدراسة لاتستبعد تعرية تحت مائية وعدم ترسيب قصير الأمد عبر الحد الفاصل.

INTRODUCTION

Kometan Formation is first described by Dunnington (1953) in Bellen *et al.* (1959). It is exposed in the High Folded Zone with records in the subsurface sections in the Mesopotamian Zone also (Dunnington 1958; Buday, 1980 and Buday and Jassim, 1987). The type section is located 400 m to the west of Kometan village in the Naudasht valley in the foothills of Qandil Mountain, about 20 Km to the north of Ranyia town in the Imbricated Zone (Fig.1). The formation is composed of well bedded, light grey or white limestone. It contains locally chert nodules or ribbons with rare pyrite concretions. According to the above authors, the lithology of the Kometan Formation is relatively constant. To the west and southwest, it becomes marly and changes from purely globogerianal limestone with subordinate oligosteginal inlayers to prevalently oligosteginal facies. The thickness of the formation, in the High Folded and Imbricated Zones reach (100 – 120) m. The lower and upper contacts of the formation are unconformable (Dunnington, 1953 in Bellen *et al*., 1959; Buday, 1980 and Al-Khafaf, 2005). In the type locality, the first author mentioned that the upper contact is unconformable but without angular discordance. He further added that faunal break and intense glauconitization indicate depositional hiatus and probable erosion. In the type locality, in addition to the glauconite and faunal break he found polygenetic micropebbles.

In recent years, during fieldwork new observations are recorded, by the present authors in many localities that show opposite ideas to previous studies. The possible gradational contact can be seen as regular alternation of white limestone and bluish white marl. These two lithologies represent a transitional zone (5 – 10 m) between Kometan and Shiranish formations. This zone, changes upwards to marl and argillaceous limestone of Shiranish Formation, and downwards to limestone of Kometan Formation, as described by Bellen *et al*., 1959.

BOUNDARY ZONE

Eight sections including the aforementioned three types of contacts are studied in different localities, which are mentioned hereinafter.

■ Gradational Contact

This type of contact is exposed in three sections, the Chaq Chaq, Azmira Bichkola and Azmir Tourism valleys.

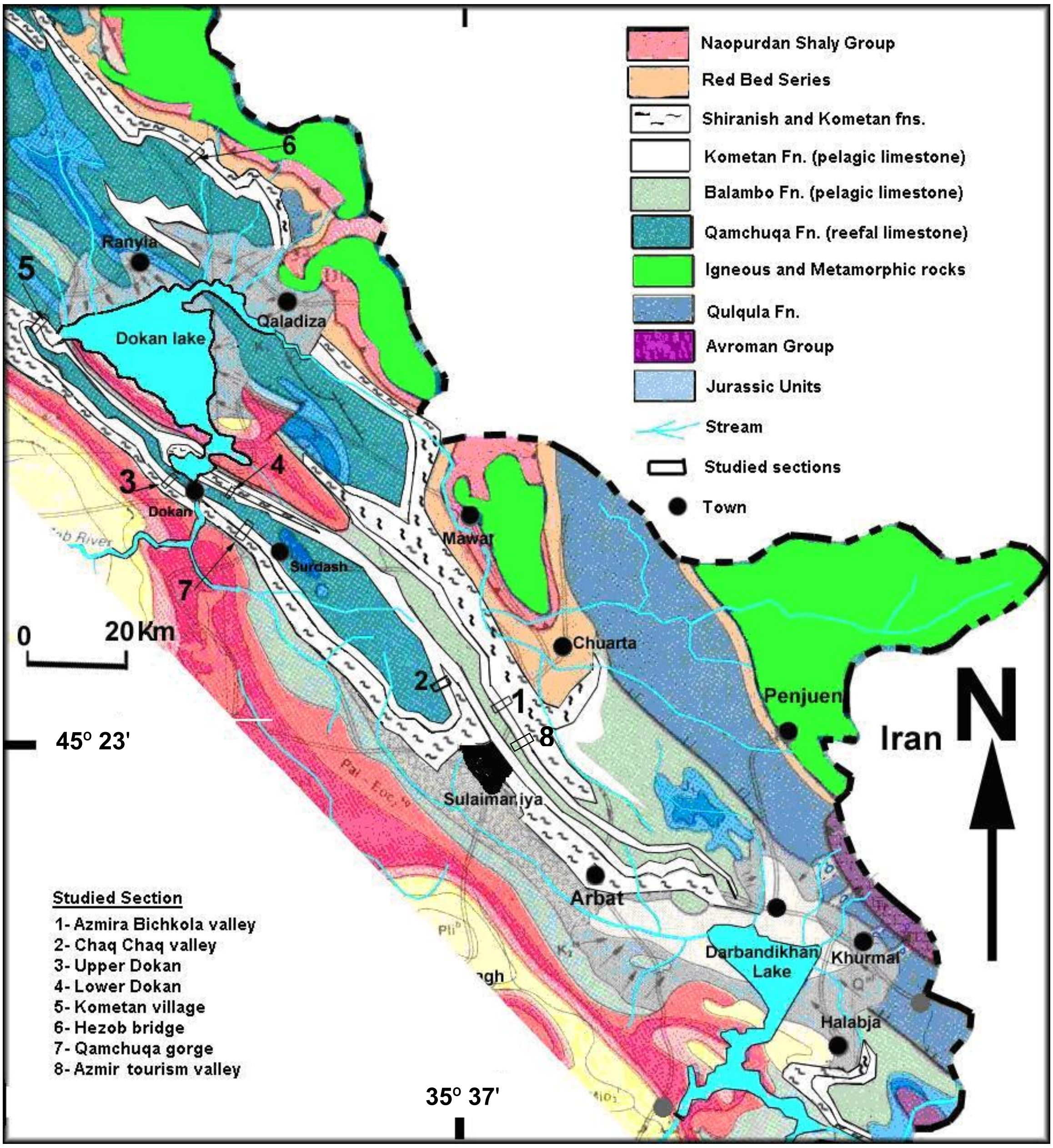

Fig.1: Geological map of the studied area (modified from Sissakian, 2000)

– **Chaq Chaq valley** section, is located 10 Km to northwest of Sulaimaniyah city (Fig.1, section 2) and about 3 Km south of Lower Hanaran village in the intersection of latitude N 35° 39' 46" and longitude E 45° 24' 33". The contact is exposed clearly at the right bank of the perennial stream that discharges the runoff of the valleys (Fig.2). At this place, the gradational contact is very well developed and shows no signs of break in sedimentation or erosion. The contact zone has a thickness of about 10 m and consists of alternation of beds of white limestone and bluish white marl (Fig.2).

– **Azmira Bichkola valley** section, is located 15 Km to north of Sulaimaniyah city (Fig.1, section 1) and 4 Km southwest of Tagaran village at the intersection of latitude N 35° 38' 42.76" and longitude E 45° 04' 01.19". In this locality, the contact is exposed along the bank of intermittent stream in valley bottom. The same type of gradation occurs also, but it is slightly covered by soil (Fig.3A).

Fig.2: Gradational contact between Kometan and Shiranish formations in the Chaq Chaq valley. The contact is represented by alternation of grey marl and fine crystalline limestone. The marl increases toward Shiranish Formation
GPS reading of the location is: E 35° 39' 45.25" and N 45° 24' 33.12"

Fig.3: A) Azmira Bichkola valley, the contact is represented by rhythmic alternation of grey marl and fine crystalline limestone. The marl increases toward Shiranish Formation. GPS reading of the location is: E 35° 39' 52.32" and N 45° 29' 22.16".
B) Gradational contact between the two formations on the right side of the paved road to Chwarta town, 50 m northwest of a small pond that is built at the mouth of Azmir Tourism valley.
No conglomerate, erosional surface and glauconite are found in both sections.

− **Azmir Tourism valley** section is exposed on the right side of the paved road between Sulaimanyiah city and Chwarta town, about 50 m northwest of a small pond built at the outlet of Azmir Tourism valley (Fig.1, section 8). The boundary is gradational also, as can be seen in Fig. (3B).

In the aforementioned three sections, neither glauconite nor micropebbles are seen in the contact zone. Conversely, in these localities, there is a glauconitic bed about 30 m above the contact inside the Shranish Formation. In these three sections, there is a transition zone (5 − 30) m thick between the two formations.

■ Burrowed-Glauconitic Contact

This type of contact is observed in two sections, Upper and Lower Dokan sections:

− **Upper Dokan** section, is located about 3 Km east of the dam site near the tourism village (Fig.1, section 4) at the intersection of latitude N 35° 56' 09.11" and longitude E 45° 01' 32.62". The section is along the northwestern limb of Sara Anticline. In this locality, the contact is sharp, which is manifested by sudden change of limestone beds of Kometan Formation to glauconitic sandstone bed (about 20 cm) at the base of Shiranish Formation (Fig.4A and B). However, the contact shows no sign of erosion, except some burrowings on the surface of the last layers of the Kometan Formation. Therefore, the contact is considered to be neither gradational nor unconformable; there is only slow rate of sedimentation or condensed section, which is not assigned as unconformity from sequence stratigraphic point of view, as cited by Vail *et al*. (1977); Loutit *et al*. (1988); Haq (1991) and Emery and Myers (1996). But, the opposite ideas of the previous authors may be attributed to misleading of the limestone clasts and diagenetic nodules with terrigenous clast, as it is discussed later on.

− **Lower Dokan section,** is located 500 m south of the Dokan dam on the right side of the paved road that leads to Koyia and Arbil cities (Fig.1, section 3) at the intersection of latitude N 35° 56' 57.43" and longitude E 45° 56' 54.38". The glauconite beds are exposed along the road cut and are about 1.5 m thick (Fig.5A). The beds consist of glauconitic limestone and some of the layers contain burrows. This section resembles that of the Upper Dokan section, except that it contains two types of gravel-sized grains. These grains are assumed as micro-pebbles by Bellen *et al.* (1959) and Buday (1980). The two types are described hereinafter:

The first type consists of platy angular clasts (pebble sized) of Kometan Formation as they have the same color and lithology of the uppermost part of Kometan Formation. Field and laboratory inspections showed that they are rip-up clasts (intraformational conglomerate) formed by submarine physical or bio-erosion. Karim *et al*. (2001) found burrows and borings below the glauconite beds in the same section.

The second type is green or brown color pebble-sized grains, which have botryoidal and smooth surfaces. The pebbles have different sizes and shapes such as rod, platy, oval and irregular, which are covered by either green or brown color coating, about 1 mm thick (Fig.6A). They resemble nodules that can be seen in Kometan Formation and studied by Al-Barzinjy (2007) that show flattened and ramulose nature (Fig.6B). The lithology of the nodules are grey limestone some of them are slightly siliceous. These pebbles are neither terrigenous nor depositional, because the elongated pebbles stand both vertically and horizontally on bedding planes and does not show any accumulation but are distributed randomly (Fig.6A). Conversely, they are diagenetic in origin and the green color is nothing except the glauconite coating (brown when oxidized). Therefore, this section can be neither assigned as gradational nor unconformable. However, there is a short break (hiatus) without emergence or sub aerial erosions in this section. The trace fossils content of the Lower Dokan section is studied in details by Karim *et al*. (2001).

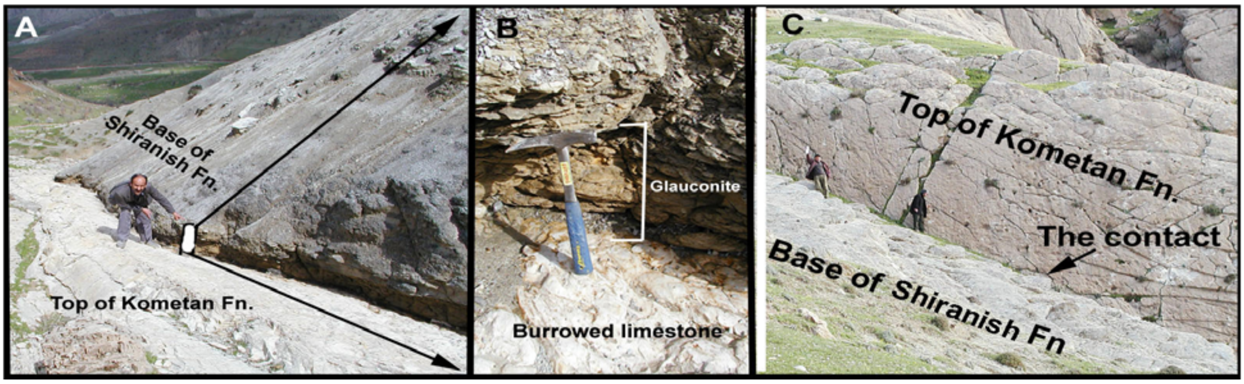

Fig.4: Contact between the Kometan and Shiranish formations

A) In Upper Dokan section (Jublakh village), the contact is sharp between the two formations.

B) Close-up of the previous photo shows 20 cm glauconite bed at the base of Shiranish Formation and burrowed limestone at the top of the Kometan Formation.
GPS readings of both locations are: E 35^o 56' 09.1", N 45^o 01' 32.62", E 35^o 53' 50.88" and N 45^o 00' 47.73", respectively.

C) Qamchuqa Gorge section shows sharp contact without glauconite and burrows

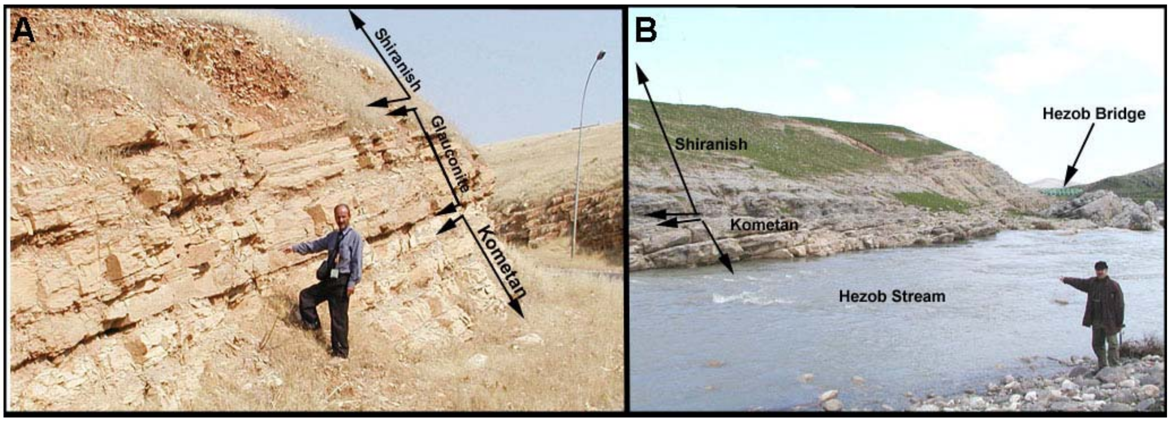

Fig.5: The contact between Kometan and Shiranish formations. A) along road cut in Lower Dokan section. B) Hezop stream section. GPS readings of both locations are: E 35^o 56' 57.43", N 44^o 56' 54.38" and E 35^o 56' 55.59", N 44^o 56' 49.15", respectively

– **Hezob bridge section,** is located 20 Km southwest of Ranyia town, (Fig.1, section 5) directly 200 m to the west of the Hezob bridge. The contact is exposed along the left side of the perennial Hezob stream (Fig.5A). The contact is also gradational, the lithology consists of alternation of white fine crystalline limestone and bluish marly limestone beds. Toward the top, it changes to lithology of Shiranish Formation (Fig.7).

– **Kometan village section,** is the type section of the Kometan Formation, where the formation is first defined by Bellen *et al*. (1959). The section is located about 400 m southwest of Kometan village at the Naudasht valley in the foothill of Qandil mountain in the intersection of latitude and longitude N 36^o 24' 28" and E 44^o 48' 18" (Fig.1, section 6). In the description of this section, Dunnington (1953) in Bellen *et al.* (1959) indicated the contact as unconformable, which is manifested by a conglomeratic nature for the base in Shiranish Formation. In spite of these ideas, the field study by present authors showed that the contact is gradational; this is represented by alternation of marl and limestone beds. The contact is more or less similar to Hezob bridge section. Recently, Kometan Formation is studied micropaleontologically in the type section and in the Lower Dokan section by Al-Khafaf (2005), he mentioned unconformable contact between the two formations while in the prepared biozontaion charts he showed clear conformable contact between the two formations across which no boizones are missing (see discussion, point 6).

■ **Sharp Contact**

This type of contact is exposed in one section only:

– **Qamchuqa Gorge section**, along the left side of the inlet of Qamchuqa gorge, which is located 6 Km west of Surdash village (Fig.1, section 7), directly northwest of the previous location of Qamchuqa village (now transferred to near Dokan town) at the intersection of latitude N 35^{o} 53' 50.73" and longitude E 45^{o} 00' 47.73". At this gorge, the contact is sharp and neither glauconite nor burrowing were seen (Fig.4C). The lithology changes suddenly from white fine crystalline limestone (Kometan Formation) to bluish white marl of Shiranish Formation (Fig.4C).

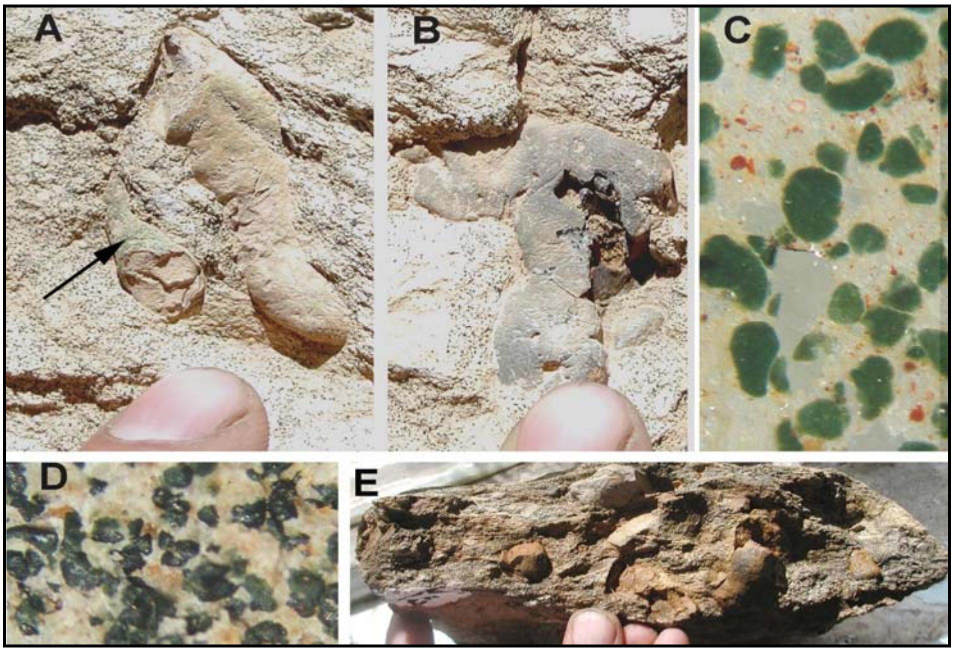

Fig.6: Different constituents of the Lower Dokan section, assumed as conglomerate (Bellen *et al*., 1958)

A) Two elongated pebbles in the glauconite sand, the left one is coated with green pigment as indicated by arrow.
B) Chert pebbles which has the shape of chert nodules.
C) Glauconite as seen in thin section, S4, X20, PPL.
D) Same mineral as seen under binocular microscope, S4, X20.
E) Hand specimen of pebbly and glauconitic limestone of Lower Dokan section.

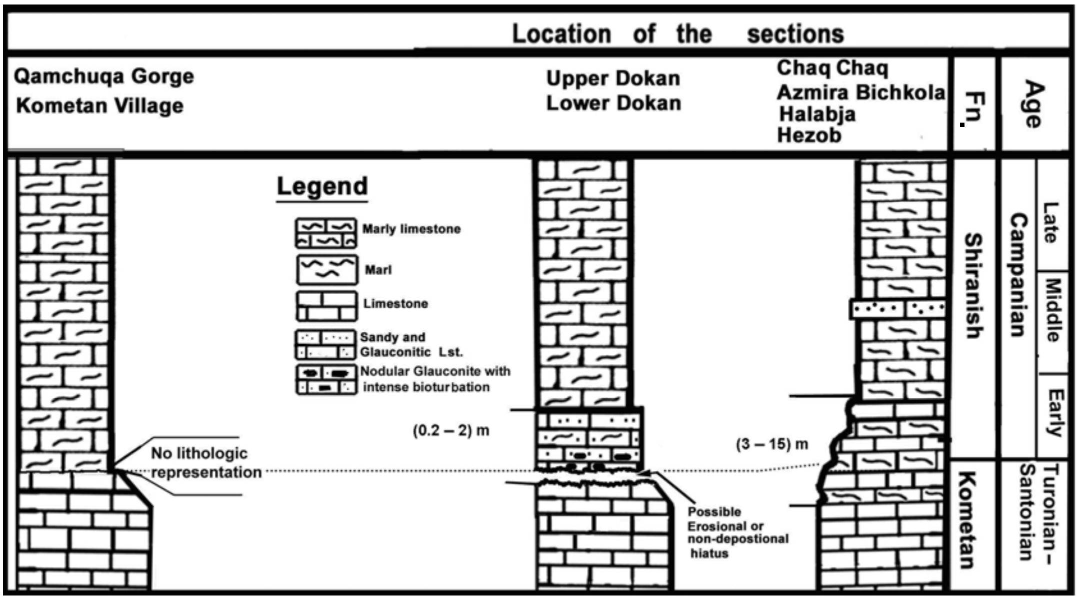

Fig.7: Stratigraphic column of the contact between Kometan and Shiranish formations in different areas

Note: The location of sections is shown on the top of each column, none of them shows unconformity, except short submarine erosion in the Upper and Lower Dokan sections.

DISCUSSION

As aforementioned, from the eight studied sections only one section contains pebbles and granule grains, which are not terrigenous and formed either by submarine erosion (for angular limestone clasts) as intraformational conglomerate or by diagenetic processes (for nodules). Moreover, from the aforementioned lithologic changes of the contact, the stratigraphic relations between the two formations could be inferred. This is based on the realization of the basin configuration, tectonics and depositional environment, which can give reasons for the lithologic changes across the contact. These changes, in this study, are not attributed to existence of an erosional gap (unconformity) or major non-deposition. Conversely, they are attributed to many factors or processes inferred in recent years, which all prove most probable conformable contact between the two formations. The six factors are:

1- In sequence stratigraphy publications (Vail *et al.*, 1977; Loutit *et al.*, 1988; Haq, 1991 and Emery and Myers, 1996) the glauconite bearing bed or layer is called a condensed section, which consists of thin marine stratigraphic horizons. They stressed that condensed sections are composed of pelagic and hemipelagic sediments, characterized by very slow sedimentation rate and glauconite content (Fig.6D and C). They further added that within a depositional sequence, the condensed section occurs partly at the top of transgressive systems tract and partly within high stand systems tract. The condensed sections represent the maximum landward extent of marine condition and flooding or subsidence, not uplift of the basin. Marine condensed sections are created by sediment starvation and thus characterized by apparent hiatus, thin zones of burrowed and somewhat lithified beds. Considering these facts (aforementioned authors), the condensed sections are not stand of unconformity, because they are located in the middle of the depositional sequence and the unconformity is located at the top or bottom of the sequence. In this concept, Karim and Surdashy (2006) studied the sequence stratigraphy of Tanjero Formation and considered it with Shiranish Formation in the same depositional sequence, which was deposited in the Zagros Early Foreland Basin. However, this does not mean that there is no more or less hiatus in sedimentation. This hiatus, in the case of the contact between Kometan and Shiranish formations, was very short and existed only in some local places, in one or two sections out of the eight studied sections. This hiatus is most possibly attributed to submarine erosion during covering of the Kometan Formation with clastic sediments (marl or calcareous shale). The two sections that have condensed section are Upper and Lower Dokan sections. While in Chaq Chaq and Azmira Bichkola valleys sections; the glauconite bed is located 30 m inside the Shiranish Formation, not in the contact. In Sinjar area, El-Anbaawy and Sadek (1978) found 23 m of glauconitic limestone near the middle part of Shiranish Formation. This means that this mineral can be formed in any stratigraphic position (depending on the environment) and not necessarily to be restricted to the boundary of the formation, indicating to large unconformity, as previously indicated by Bellen *et al*. (1959) and Buday (1980).

2- The sharp contact, can be explained by very recent studies of Karim (2004 and 2006) and Karim and Surdashy (2005a, 2005b and 2006). In these studies, both Shiranish and Tanjero formations are regarded as lateral facial changes to each other, also interfingering, which have lateral and vertical gradation to each other. Both formations, with the upper part of Kometan Formation, are included in one of the two depositional sequences in which Kometan, Shiranish and Tanjero formatios were deposited. According to aforementioned studies, these formations are deposited in large foreland basin, which occupied most of the Iraqi land during Late Cretaceous. The foreland basin was bordered from north and northeast by a positive land of Iranian Plate front (or foreland of Iranian Plate). From the foreland and hinterland the river driven influx of sediments reached the coastal area of the foreland basin and there they were reworked by turbidity currents and storm to deeper part of the basin (Fig.8).

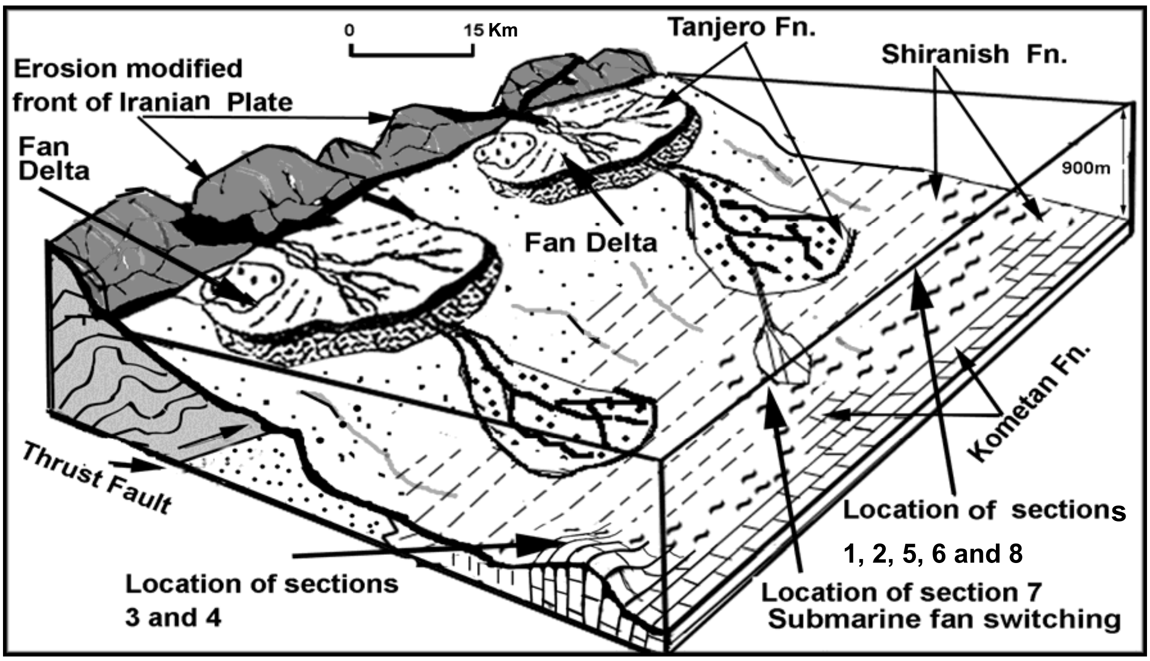

Fig.8: A paleogeographic model, interpreting the nature of the boundary and indicating its location between Kometan and Shiranish formations, during Lower Campanian in the newly developed foreland basin

Considering the foreland basin, turbidity currents and nutrient influx, the three types of contacts (sharp, gradational and burrowed-glauconitic) can be explained easily. Within the basin, the contact of the two formations represents the threshold time and place between possible deep marine carbonate dominated and clastic dominated environments, which are represented by Kometan and Shiranish (with Tanjero) formations, respectively. In this time and place, the sharp contact represents rapid and unusual influx of clay from the turbidity currents into the basin, so that the marl is deposited, as highly diluted turbidity current sediments, instead of limestone of Kometan Formation (Fig.7).

This rapid deposition (might be) is due to sudden switching of submarine channel or an event such as large storm or tsunami. The burrowed-glauconitic contact is standing for the places in the basin where Fe, Mg and nutrient rich currents were prevailing (Fig.8). These clay free currents might be driven by turbidity currents. These currents formulated the nutrient and oxygen rich physicochemical milieu for survival of organism and diagenetic deposition of glauconite. The stratigraphic position of the glauconitic bed in the Shiranish Formation most possibly does not indicate maximum flooding surface. This is because it is overlain and underlain nearly by the same lithologies (marl or marly limestone) as in the Chaq Chaq, Azmir Tourism valley and Azmira Bichkola sections. Moreover, the bed is deposited in one systems tract, which according to Karim and Surdashy (2006) consists of lowstand systems tract. The granules and pebbles that exist with glauconite, in the Lower Dokan section, most probably represent intraformational clasts and formed by submarine erosion in local areas, because they were seen only in one section. This is because limestone clasts are derived from the Kometan Formation (see discussion of Lower and Upper Dokan sections).

3- The gradational contact, in sections of Chaq Chaq, Azmir Tourism and Azmira Bichkola valleys; Kometan village and Hezob bridge are located (within the basin) in front of large submarine fans (outer fan) that frequently were supplied by clay during large events of turbidity currents. From the currents, marl is deposited while during quiescence limestone is deposited. According to Karim (2006); Karim and Surdashy (2005a and 2006) when the front of the Iranian Plate was advancing southwestwards, the basin becomes more and more closer to present position of the studied sections, the clay and sand increase gradually, consequently Shiranish and Tanjero formations were deposited, respectively (Fig.8).

4- According to Bellen *et al.* (1959) and Buday (1980), the lower and upper contacts of the Kometan Formation are characterized by existence of glauconite. This fact, if is true, then it gives very important information and reasons that are concerned with the deposition of glauconite in the base and top of Kometan Formation. This is because; the glauconite indicates that during development of Kometan basin, the beginning and termination of this basin passed through same depth of water and physicochemical condition. The basin developed, in some places, from shallow reefal environment of Qamchuqa Formation, as seen in the field in Piramagroon area. It is logic that this beginning (contact with underlying Qamchuqa Formation) is neither deep nor shallow, but is characterized by intermediate depth. Therefore, the termination (contact with overlying Shiranish Formation) also passed through this intermediate depth (as indicated by glauconite deposition). These facts indicate that the glauconite possibly (at the contact of the two formations) was not representing maximum flooding surface but returned to the generation of suitable environment, when the environment changes from shallow to deep basin.

5- In literature, the citation of Emery and Myers (1996, p.101) about probability of development of condensed section by delta switching and on submarine highs is applicable for the contact of the two formations in Dokan area (Fig.8). Einsele (2000) showed that glauconite is deposited in shallower seas than foraminifera bearing lime mud (Kometan Formation). According to the aforementioned facts, the expanded time stratigraphic column of Bellen *et al.* (1959) is modified to show the gradational contact of the two formations (Fig.9A and B). In the stratigraphic column, the three formations laterally and vertically pass to each other and show conformable contact. Toward southwest, Shiranish Formation is most probably replaced by Kometan Formation.

6- The aforementioned discussion about the gradational contact is supported by Al-Khafaf (2005); he studied the biostratigraphy of Kometan Formation in Sulaimanyiah area in two sections, including the Lower Dokan section of the present study. He concluded that the age of Kometan Formation is Middle Turonian – Early Campanian. He also recorded the *Globotruncana ventricosa* index fossil of Middle Campanian that overlies *Globotrancanita elevata* Zone (Early Campanian) inside Shiranish Formation. In his two biozonation charts no gap can be seen from Turonian to Middle Campanian (Figs.10 and 11). Al-Jassim *et al.* (1989) have conducted biozonation of Kirkuk well No. K166 and Qara Chuq well No.1. They neither recorded unconformity nor gap in sedimentation from Turonian to Middle Campanian. Before these two latter studies, the age of Kometan Formation was indicated as Turonian – Santonian (Buday, 1980, p.174).

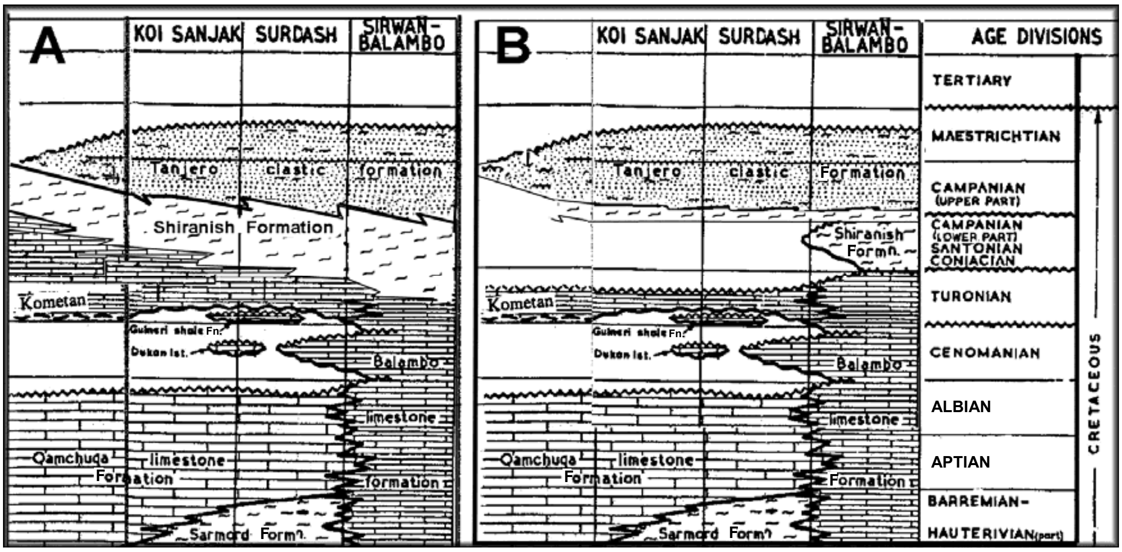

Fig.9: A) Time stratigraphic column (modified from Bellen *et al.*, 1959), showing gradational contact between Kometan and Shiranish formations. B) Original column (Bellen *et al.*, 1959)

Age			Planktonic foraminiferal Zones	Datum Markers
				⊥ *Globotruncana ventricosa*
Upper Cretaceous	Early Campanian		*Globotruncanita eleveta*	
Upper Cretaceous	Santonian		*Dicarinella asymetrica*	T *Dicarinella asymetrica* ⊥ *Dicarinella asymetrica*
Upper Cretaceous	Santonian / Coniacian		*Dicarinella concavata*	⊥ *Dicarinella concavata*
Upper Cretaceous	Coniacian		*Dicarinella primitiva*	⊥ *Dicarinella primitiva*
Upper Cretaceous	Turonion	Late	*Marginotruncana sigali*	
Upper Cretaceous	Turonion	Middle	*Helvetoglobotruncana helvetica*	T *Helvetoglobotruncana helvetica* ⊥ *Helvetoglobotruncana helvetica*

⊥ First Occurrence
T Last Occurrence

Fig.10: Index fossils of Kometan Formation (Middle Turonian – Early Campanian) (Al-Khafaf, 2005)

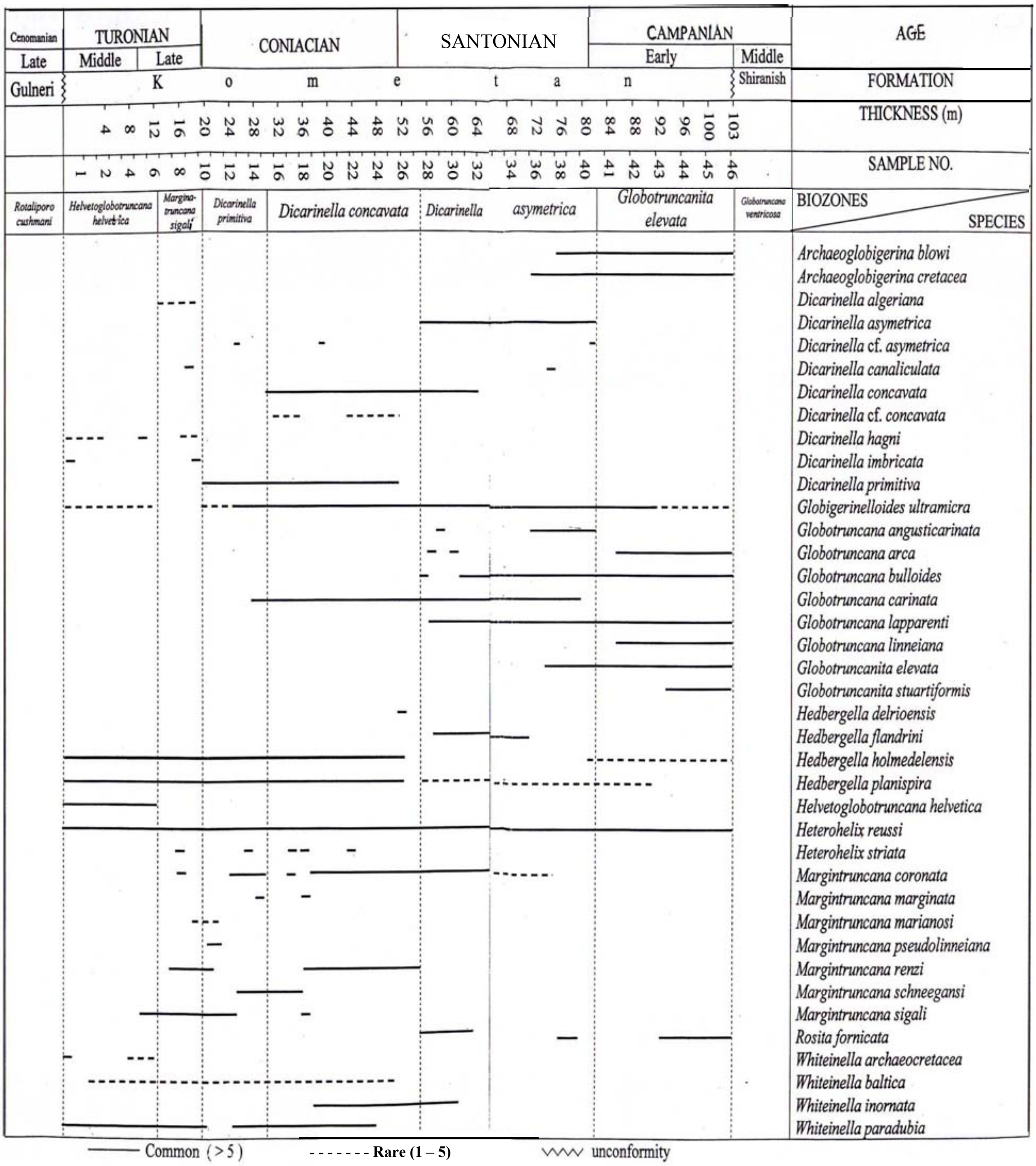

Fig.11: Biozonation chart of Lower Dokan section (Al-Khafaf, 2005), which shows continuation of sedimentation from Turonian until Middle Campanian, across the boundary between Kometan and Shiranish formations

CONCLUSIONS

This study has the following conclusions:

- The contact between Kometan and Shiranish formations is most probably conformable, but not every where, this depends on the basin configuration; and show no sub-aerial erosion or major gap in sedimentation, as mentioned previously. The existed gap in sedimentation is local and submarine only.
- Most of the studied sections show obvious gradational contact, only one of them shows sharp contact and in other two sections burrowing and glauconitization is recorded.
- Among eight sections, only one contains rip-up clasts and pebble-like bodies, which have intraformational and diagenetic (nodules) origin, respectively.
- Depending on the recent studies, these sections are interpreted in term of depositional basin, which consisted of a foreland basin that existed in front of southwest advancing front of Iranian Plate.

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