

ORIGIN OF CONGLOMERATIC LIMESTONE "DOKAN CONGLOMERATE" IN DOKAN AREA, KURDISTAN REGION, NE IRAQ

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ABSTRACT

Thick succession of conglomeratic limestone (about 300 m thick) is exposed on right and left sides of Dokan reservoir and covers more than 40 Km² of surface area. It called "Dokan Conglomerate" in this study, which is not described and shown on any geological map, previously. The Dokan conglomerate is indurate and weathering resistant, which mostly consists of blocks, boulders and gravels of Qamchuqa Formation, with some clasts of Kometan Formation, and at the upper part rare clasts of Pila Spi Formation can be observed. The conglomerate is folded and in some place has more than 30 degrees, and angularly overlies the Kolosh, Shiranish, Kometan formations with more than 20 degrees difference in dip. In other areas, the conglomerate shows, more or less equal dip with aforementioned formations.

The paleocurrent analysis revealed southwest, south, southeast direction for lower, middle and upper part of the conglomerate. From indicating the origin of the pebbles of the conglomerate, the succession should be younger than Upper Eocene, due to the presence of clasts of Pila Spi Formation (Upper Eocene). For finding the stratigraphic position and relation of the Dokan Conglomerate with other Tertiary unit, the surround areas were inspected. The inspection was concentrated to the south of Dokan area, toward which the paleocurrent is directed. To the southwest of Taq Taq Town, about 40 Km to the south of Dokan town, an equivalent of the conglomerate was found, which nearly consists of similar lithology, but with finer caliber and more rounded pebbles. This conglomerate is very similar to the Bai Hassan (Upper Bakhtiary) Formation, which according to previous studies is exposed in nearby area. Therefore, the Dokan Conglomerate is believed to be the equivalent of Bai Hassan Formation.

أصل المدملكات الكلسية في منطقة دوكان، إقليم كردستان، شمال شرق العراق

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المستخلص

تظهر على السطح تتابعات سميكة (حوالي 300 متر) من المدملكات الكلسية على الجانب الأيسر والأيمن لبحيرة دوكان وتغطي حوالي 40 كم مربع من المنطقة. سميت هذه المدملكات في هذه الدراسة بـ "مدملكات دوكان" لم توصف ولم توضع هذه المدملكات على الخرائط الجيولوجية سابقاً. تمتاز هذه المدملكات بتماسك جيد، حيث تظهر بشكل جروف عالية ومقاومة للتجوية، حيث تتكون من كتل و جلاميد وحصى كلسية وغالبيتها ترجع الى تكوين القمچوقة وقليل منها تعود إلى تكويني كوميتان وبيلاسبي، في الجزء العلوي.

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هذه المدملكات متشوهة على شكل طيات ويصل ميل الطبقات إلى أكثر من 30 درجة. تقع المدملكات، في بعض الأماكن فوق تكوينات كولوش وتانجيرو وشيرانش وكوميتان وبشكل عدم توافقي زاوي، وبفرق زاوي في الميل يقدر بحوالي 20 درجة. ولكن في أماكن أخرى، تمتاز بالتساوي بشكل تقريبي في الميل، مع التكوينات المذكورة.

ظهر من خلال تحليل اتجاه تراكم الجلاميد والحصى بأن اتجاه التيار القديم كان إلى الجنوب الغربي والجنوب الشرقي، للجزء السفلي والوسطي والعلوي، على التوالي. وظهر بأن عمر المدملكات أحدث من الأيوسين المتأخر بسبب احتوائها على قطع من تكوين البيلاسي. من أجل إيجاد الموقع الطبقي للمدملكات وعلاقتها مع وحدات العصر الثلاثي الأخرى، تم مسح المناطق المجاورة، وتركز المسح باتجاه الجنوب من مدينة دوكان (اتجاه نقل الترسيبات القديمة). وفي جنوب المدينة طق (40 كم جنوب مدينة دوكان) وجد نوع من المدملكات التي تشبه بصورة تقريبية مدملكات دوكان من حيث الصخرية ولكنها تختلف من حيث حجم الحبيبات (أنعم وأكثر تكراراً). لذلك فإن المدملكات المدروسة في منطقة دوكان تكون مكافئة لتكوين باي حسن.

INTRODUCTION

The aim of this study is mapping, describing and finding stratigraphic relation of a thick succession of conglomeratic limestone, for the first time, in Dokan area. This conglomeratic limestone is called "Dokan Conglomerate" in this study. The study also included the paleocurrent analysis and paleogeographic reconstructions of the area. Dokan area is located in the High Folded Zone in the Northeastern Iraq. The area includes Dokan reservoir and Dokan town in addition to Bingird, Khidran and Khalakan towns at the northeast, northwest and southeast respectively (Figs.1 and 2).

The Dokan Conglomerate is mainly exposed as four separated outcrops around Dokan Lake. Two of them, the largest, are located to the west of the lake, the large one is called Kostrat outcrop and exposed along the northwestern limbs of Kostrat anticline, while the other one is called Kani watman outcrop, which located on the northwestern plunge of the Kostrat anticline. The other two outcrops are located east of the lake, the larger one is cropping out to the south of Bingird town (called Bingird outcrop) and the last one is called Qarasard outcrop and is exposed along the northwestern limb of the Qarasard anticline (Fig.1). The Dokan Conglomerate is not mentioned and mapped by Buday (1980) and Stevanovic and Markovic (2004). The later authors mapped the involved area and considered the Kometan Formation of the Dokan conglomerate, on the map.

CHARACTERISTICS OF THE CONGLOMERATE

The Dokan Conglomerate consists of thick succession of tough and concrete like rocks, which form high mountains such as Buko Zawa and Kani Zard (about 1050 m high). The thickness is variable, but it reaches more than 300 m in some places (Figs.3 and 4). Due to well lithification and high thickness, it forms high cliffs, which appear as massive mass, and each bed has thickness of (1 – 5) m. Therefore, they appear, at a distance of few kilometers as Qamchuqa or Bekhme formations. Lithologically, it is very coarse and consists of blocks, boulders and granules of different limestones. About 80% of the limestone clasts belong to Qamchuqa Formation and the rest belong to Kometan Formation. In some places, the conglomerate contains rare boulders of Pila Spi Formation, and chert pebbles, especially in the upper part. In the two places, many blocks of the Qamchuqa Formation are more than one meter in diameter (Fig.5). The clasts of Qamchuqa Formation were distinguished when the study of Ameen (2008) is considered. The clasts are dolomitized and contain radiolitic rudist, stromatolite and orbitoids forams. The cement material consists of calcite and the clasts are sub angular to well rounded, badly sorted, which show well developed imbricated pebbles and shows different paleocurrent directions, such as south, southwest or southeast (Figs.6 and 7).

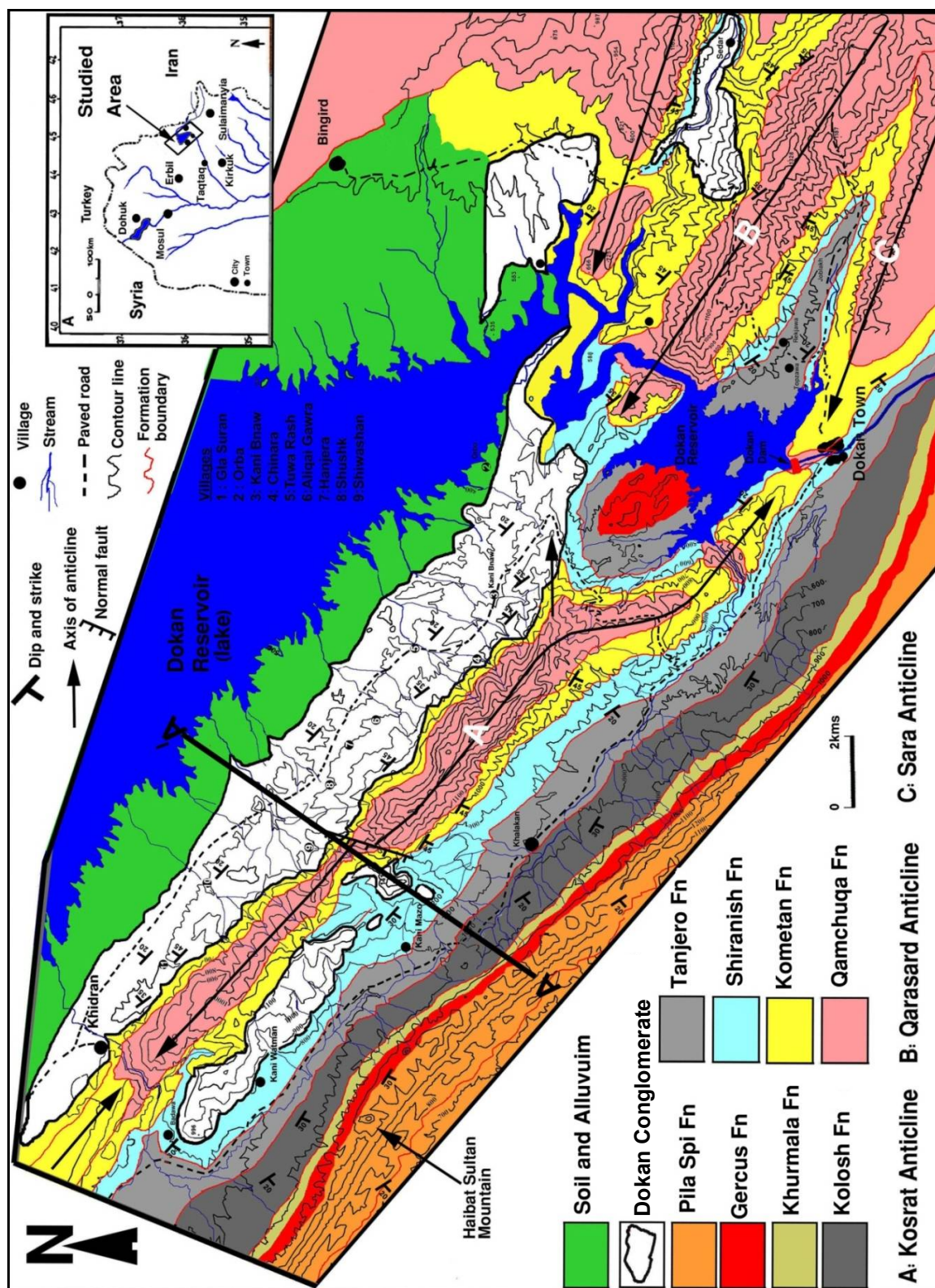


Fig.1: Geological map of the studied area

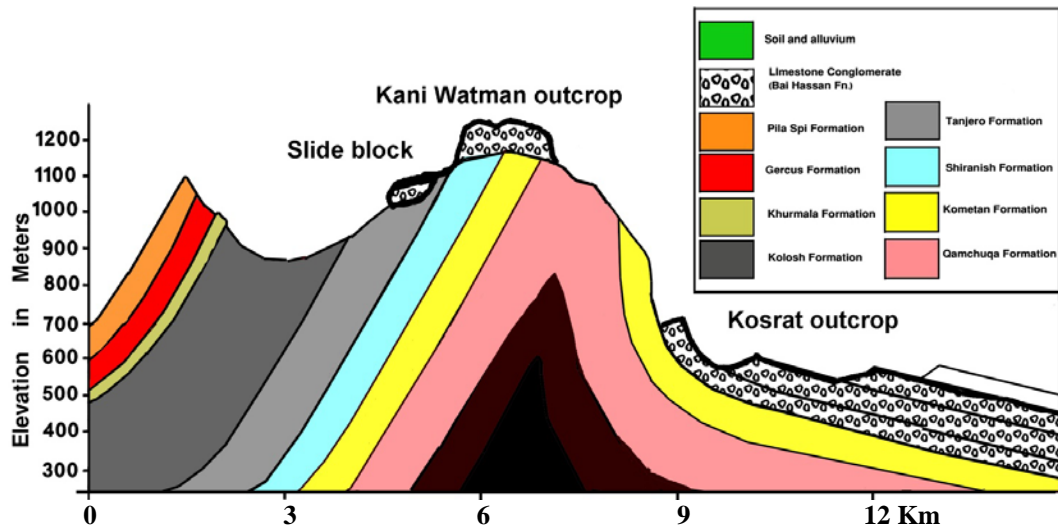


Fig.2: Cross section of the studied area passing through the line A-A' (in Fig.1)

Stratigraphically, the Dokan conglomerate rests on Kolosh, Tanjero Shiranish, and Kometan formations and it forms angular unconformity. In Kani Watman area, and northeast of Khalakan town, the angular difference of tilting with these formations reaches about 20 degrees (Fig.1A). The dip angles are also variable which range from horizontal to about 60 degrees, which can be seen in the outcrops of Kani Watman and Kosrat, respectively. Along the northeastern limb of the Kosrat anticline the conglomerate has nearly the same dip (15 – 60 degrees) of the underlying formations (Kometan and Qamchuqa). In some place, the conglomerate is folded in the form of domal anticlines, which can be seen to the southeast of Kani Binaw, Mewza and Chinara villages (Fig.7). In Fig. (2), Kani Watman outcrops rest nearly horizontally on tilted Kolosh, Tanjero, Shiranish and Kometan formations, while Kosrat outcrop has nearly the same dip, as the underlying formation. This condition of stratigraphic relation has valuable tectonic implication, as it shows that the conglomerate was deposited on the anticline, and later after deposition, the anticline uplifted and more tilted. The horizontal Kani Watman outcrop is nearly horizontal because it deposited directly on leveled (by erosion) crest of the anticline, and during uplifting, was affected only by vertical force.

ORIGIN OF THE CONGLOMERATE

As the studied succession is barren from the indigenous fossils, two of the hereinafter mentioned characteristics are important for the indicating the relative age and origin of the conglomerate. The first one is the relatively high degree of tilting and folding (in some place), which is an evidence that the succession; most probably is older than Quaternary (Recent and Pleistocene). The second one is the high degree of lithification, by means of which it appears in the form of high cliffs and mountains due to its weathering resistance. These two characteristics are not well known from Quaternary sediments. Therefore, it is clear that the succession is most probably younger than Pleistocene. For knowing the stratigraphic relation with the pre-Pleistocene rocks, the area to the south, southwest and southeast of the outcrops are surveyed in the Low Folded Zone, in Kirkuk and Erbil Governorates. This Survey is conducted during July and August, 2008.

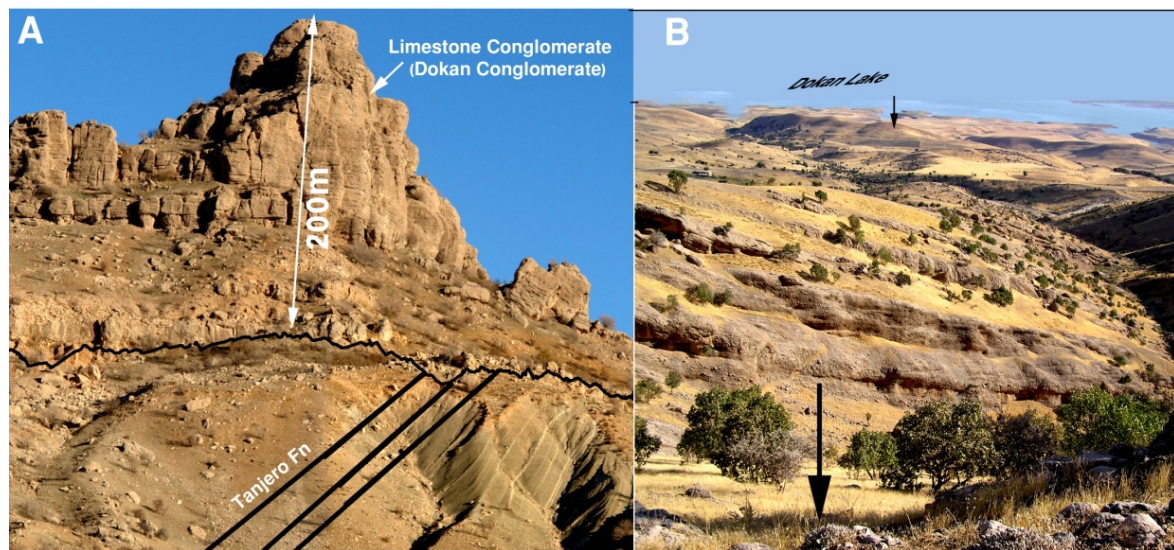


Fig.3: Outcrop section of the Dokan Conglomerate

- A) Part of Kani Watman outcrop at northwest of Khalakan Town N: $36^{\circ} 3' 11.44''$, E: $44^{\circ} 44' 8''$, which rests unconformably on Tanjero Formation with tilt angle of about 30 degrees
- B) At northeastern limb of Kosrat anticline (part of Kosrat outcrop), overlying Kometan Formation with dip amount of about 35 degrees, it is exposed between the two arrows (about 3 Km)



Fig.4: Kani Watman outcrop

- A) at northwest of Kani Watman village
- B) The bedding characteristics in close view



Fig.5: Large blocks of Qamchuqa Formation (more than 1 m in diameters)
at 4 Km to the northwest of Khalakan village

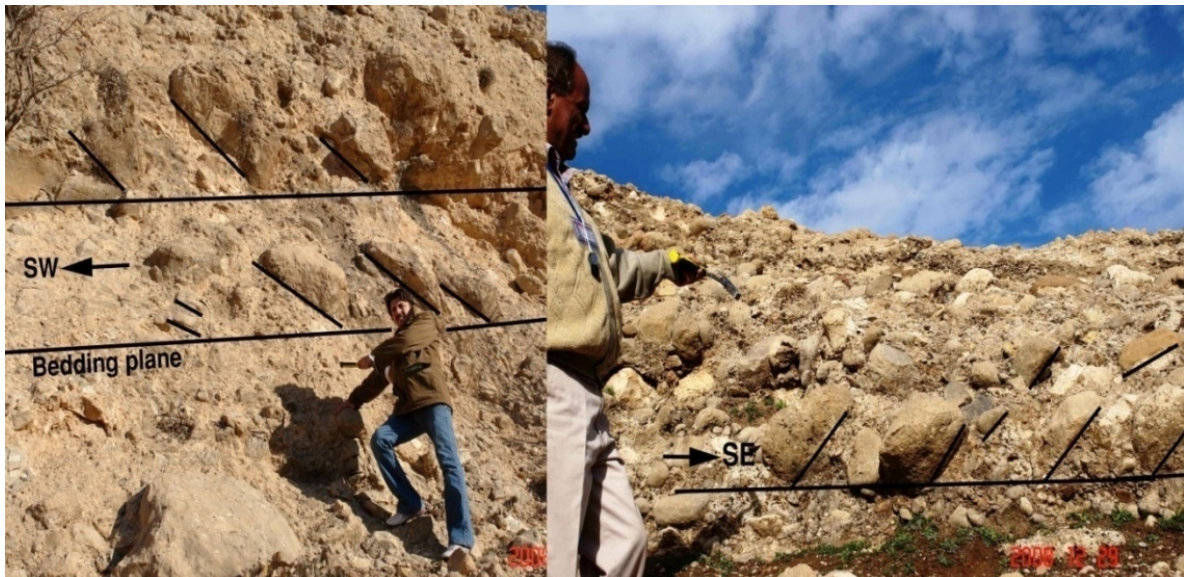


Fig.6: Imbricated boulders, which indicate
A) Southwest direction
B) Southeast direction of the paleocurrent



Fig.7: Folding in the Dokan conglomerate, southwest of Chinara Village
(the entire view is Dokan Conglomerate)

In the survey, the direction of the paleocurrent direction was considered. All the conglomerate and sandstone beds were inspected for finding the time equivalent of the conglomerate. Therefore, the basal conglomerate at the base of Pila Spi and Fatha (Former Lower Fars) formations were studied. These two conglomerates (as studied by Ameen, 2006 and 2009) are different; they did not contain clasts of Qamchuqa Formation. When the survey is further shifted toward south, an equivalent conglomerate was found near the Bai Hassan (Upper Bakhtiari) Formation, which is locally called "Taq Taq Conglomerate", in this study. This conglomerate consist of three beds (each about 4 m thick) and located at 3 Km southwest of Taq Taq town, directly to the west of the paved road that lead to Kirkuk City (Fig.7). Like the Dokan Conglomerate, the Taq Taq Conglomerate is mainly consists of clasts (rounded boulders and gravels) of limestone of Qamchuqa Formation with about 15% of igneous and chert clasts (Fig.8). This minor difference in the lithology is justified and discussed below.

The Taq Taq Conglomerate is located in the distal area as compared to the Dokan Conglomerate, which is located in the proximal area (Fig.9). The distal area can be the locus of the deposition from different source areas and may be locus of several streams' confluence. Therefore, it is possible that the chert and igneous clasts derived from Mawat and Chuwarta areas (areas of ophiolite and chert sources) and transported by smaller stream and mixed with main stream that was descending from main Qamchuqa source area. Therefore, the Dokan Conglomerate is derived mainly from limestone source area in proximal area, while in distal area, was slightly mixed with different source areas. Moreover, it is equivalent to Bai Hassan (Upper Bakhtiari) Formation in age, tectonics and in source areas.

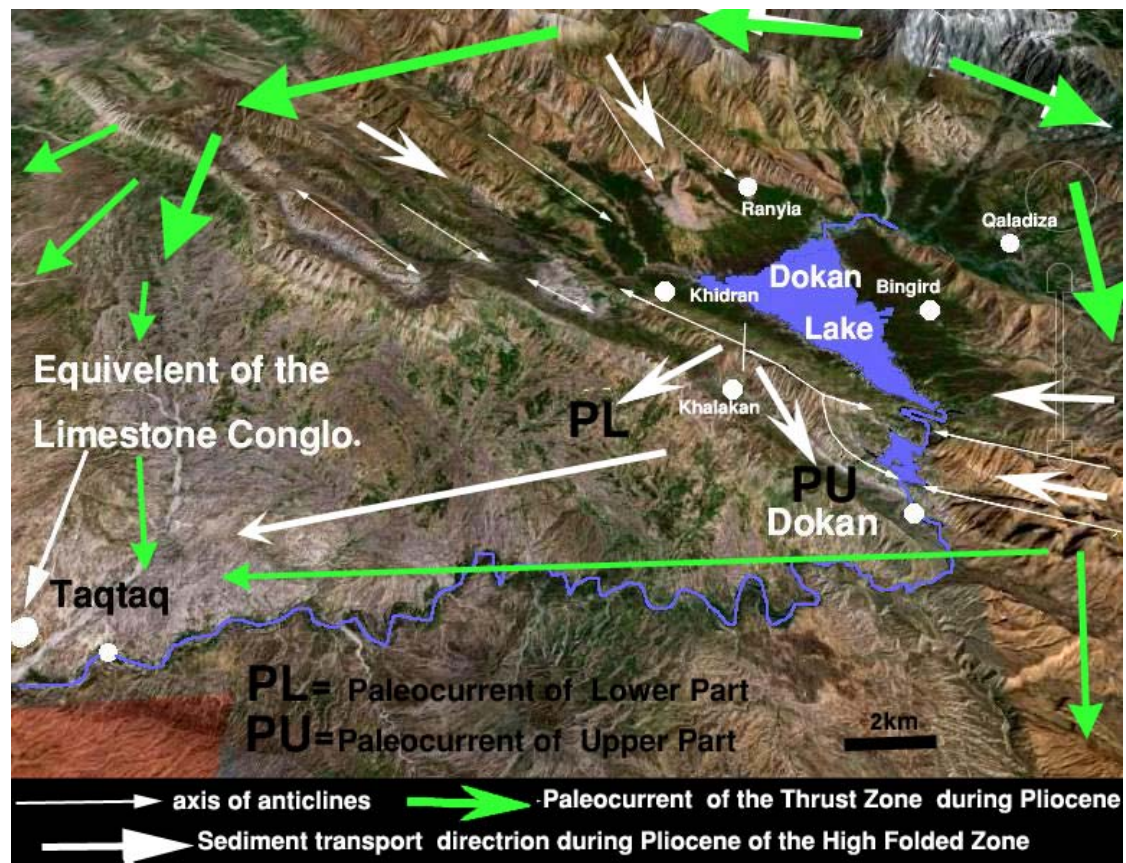


Fig.8: Google Earth image showing why the Dokan Conglomerate mainly compose of limestone clasts, while Bai Hassan Formation consists of polygenetic clasts?. This is clarified by mean of route of the paleocurrent direction of the two conglomerates, which showed that the paleocurrent direction of the thrust zone was either to east or west of the studied area.



Fig.9: **A)** Alternation of conglomeratic Limestone with red claystone of Bai Hassan Formation, southwest of Taq Taq town. It is the only coglomerate that high resembles the Dokan conglomerate, **B)** Closeup photo of the the conglomerate, which contains only of rare igneous clasts as indicated by black arrow at the upper left corner

DEPOSITIONAL ENVIRONMENT

In the geologic record of Iraq, three major conglomerates are recorded. The first is the 500 m thick conglomerate that is located at the lower part of Tanjero Formation (Maastrichtian), which consists of boulders and pebbles of chert and limestone. According to Karim (2006) and Karim and Surdashy (2005), this conglomerate was deposited in the low stand fan delta environment (Alluvial Fan that was connected to sea). The second major conglomerate is that of the Red Bed Series which according to Al-Barzinjy (2005) and Karim *et al.* (2007), about 1500 m thick and mostly deposited in fan delta environments too. The third one is that of present study, Dokan Conglomerate, which is about 300 m thick. As that of Maastrichtian, Dokan Conglomerate is deposited in alluvial fan environment. This fan was deposited inland; far away from the sea, which forms the most proximal part of the fan and most probably belongs to the sediments of the fan apex of one of the large fans that was covering the mountains fronts during Pliocene.

As known, the typical Bakhtiari Formation contains chert and igneous boulders and pebbles in areas of its occurrence, such as Dialla, Sulaimaniyah, Kirkuk, Erbil and Dohuk Areas (Bellen *et al.*, 1959). Consequently, a question arises: Why does the Dokan Conglomerate is composed only of limestone clasts. For answering this question, the following are clarified. The present conglomerate is located in the proximal area (more close to mountain range) therefore, it is less affected by stream confluence from different source area and the clasts are only derived from Qamchuqa, Dokan and Kometan formations. The outcrops of the typical Bakhtiari Formation are located in distal area (far from mountain range at time of deposition) and deposited by adjoining of many streams coming down from many source areas (such as radiolarite, Qandil Metamorphic Group and ophiolite). These sources area are located at north, northeast and northwest of the studied areas (Fig.8). The Dokan conglomerate is similar to the people of Andes Mountain whom have less modified native language than people that are living away from mountain ranges.

The general absence of clasts such as chert and ophiolite are most possibly attributed to the presence of a barrier that prevented the influx of the sediments from present Thrust Zone toward south (towards of present outcrop of Dokan Conglomerate). This barrier consisted of limbs of the anticlines that composed of about 600 m of hard limestone of the Qamchuqa Formation. The evidence for this is that there are, in the source area of the Dokan conglomerate, many northwest-southeast anticlines. The crests and cores of these anticlines are removed during Pliocene and supplied limestone clasts to studied area forming the Dokan conglomerate, while the limbs acted as barrier for diverting the streams from the sources in the present source are away from location of Dokan conglomerate during deposition.

It is possible that during Quaternary, gates (routes) are opened for Lesser Zab River to transport sediment to studied area from Thrust Zone. But during Pliocene it is drained to the east or west away from studied area and then toward south in Sulaimaniyah and Erbil areas (Fig.8).

CONCLUSIONS

The following could be concluded from this study:

- Thick succession of conglomerate limestone (about 300 m thick) described and mapped for the first time on right and left sides of Dokan dam and covers more than 40 square kilometers of surface area.

- The conglomerate is well lithified and weathering resistance, which mostly consists of blocks, boulders and gravels of Qamchuqa Formation, with some clasts of Kometan and at the upper part rare clasts of Pila Spi Formation can be observed.
- It is folded and makes, in some place, angular unconformity with the Kolosh, Shiranish, Kometan formations with more than 20 degrees of difference in dip. In other areas it shows, more or less equality of dip with aforementioned formations.
- The paleocurrent analysis revealed southwest, south, southeast direction for lower, middle and upper part of the succession. Lithology of the succession showed that the succession is younger than Upper Eocene due to presence of the clasts of Pila Spi Formation.
- Field study showed that the limestone conglomerate in the Dokan Area is equivalent to Bai Hassan Formation in age and tectonic and source area.

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