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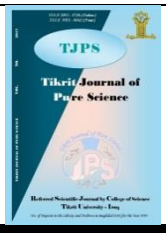

Sedimentological evidences for subaerial exposure in the upper surface of Qamchuqa Formation, Bekhme area, northern Iraq

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ABSTRACT

The study deals with the upper contact of Qamchuqa Formation with the overlying Bekhme area of northern Iraq. This surface is characterized by presence of autobreccia bed including angular grains of (0.05_30cm in size) and composed of dolomite with disseminated black dolomite fragments which may indicates their subaerial exposure.

Cementing materials filled the fractures and pores surrounding the breccias mostly are composed of saddle dolomite with dolomite crystal up to 3cm size that were formed late diageneticly by hydrothermal solution.

Introduction

The Sedimentary and stratigraphic studies indicate that the exposure surface often occurs either for tectonic reasons that raise certain parts of the sediment upwards or due to sea level fluctuations. the exposure of the upper parts of the sediments to atmospheric processes, causing the cessation of sedimentation, and the exposure of sediments to the weathering and erosion processes by rainwater or groundwater and other processes that work to break down the exposed parts of the layers that are in contact with the Weather conditions, as well as the formation of the soil in many cases. , the presence of a regional unconformity surface that included the entire Arab region on the borders between the sequences of the Arabian plate (AP8) and the sequences (AP9) [1].

The upper part of the Qamchuqa Formation in northern Iraq is considered a good oil reservoir due to its highly porous from tectonic and diagenetic processes. The aim of this research is to search at some sedimentary evidence of exposure surface in the upper section of the Qamchuqa Formation of the Bekhme region in northern Iraq.

Geology of the study area

The Qamchuqa limestone Formation (Albian) is one of the important formations in the succession of the Cretaceous system in northern Iraq, as its carapace of many high anticline within the high folds zone. The typical section is located in the region of Qamchuqa / in the city of Sulaimani, northeastern Iraq. the Qamchuqa Formation in the study area consists of alternating layers of limestone and dolomitic stone that are mostly dominated by hydrocarbon materials, and sometimes interspersed with thin layers of marl, especially in its lower and middle parts. The upper part of the formation consists of crystalline, granular, mosaic dolomite rocks, resulting from the process of replacing organic limestone rocks bearing shell

Studies indicate that the upper boundary of formation is characterized by a break of sedimentation as a result of lack of sequence or unconformity surface, which is the most common, and this is evident in the northern and northeastern regions of Iraq, where sediments are absent. As is the case in the regions of Kirkuk and Sulaimani. As for [2], they indicated, in their study of the formation in the Shaqlawa region, that there is a rocky succession with a thickness of

about (30m), consisting of successions of limestone and marl in the upper parts of the Qamchuqa Formation, followed by this succession by the Bekhme Formation, which is distinguished by limestone and dolostone. This conclusion contradicts what was indicated by [2] and what was recorded by the present study in the Bekhme region in terms of the existence of a clear Conglomerate boundary between the Qamchuqa and Bekhme formations. The sedimentary environment n of the formation is the shallow marine environment (Neritic) [3][4].

During its sedimentation period, the Qamchuqa Formation represented an ancient high or barrier. (Palaeoridge). The Qamchuqa Formation changes in a north-eastern direction to the Balambo Formation then in a south-westerly direction across the Mosul high, separating two basins, the Balambo Basin and the Upper Sarmord Basin. Figure 1 shows the transition from the Upper Sarmurd Formation to the Jawan Formation [5], which then transforms to the Muddud Formation in the south [1].

According to the divisions of [6], the research region is located in the perat anticline, north of Erbil in northeastern Iraq, within the high folded zone. (Figure 2)

Study methods

The dolomite layer was studied through field description. Also, (15) samples were taken to make thin slides to study their texture characteristics, in addition to making some polish slabs for the purpose of identifying fine sedimentary phenomena. On the other hand, the rock slides were treated with Alizeren red staining, according to method [7], to distinguish between dolomite and calcite.

The choice fell on some samples distributed along the studied section to examine the bulk samples, to analyze them with the X-Ray Diffraction device, to know their mineral content. The analyzes of the section samples were conducted in the laboratories of the Iraqi Geological Survey and Mining / Baghdad. It turned out that most of the rocks consist mainly of the mineral dolomite, with the presence a little calcite mineral (Figure 3).

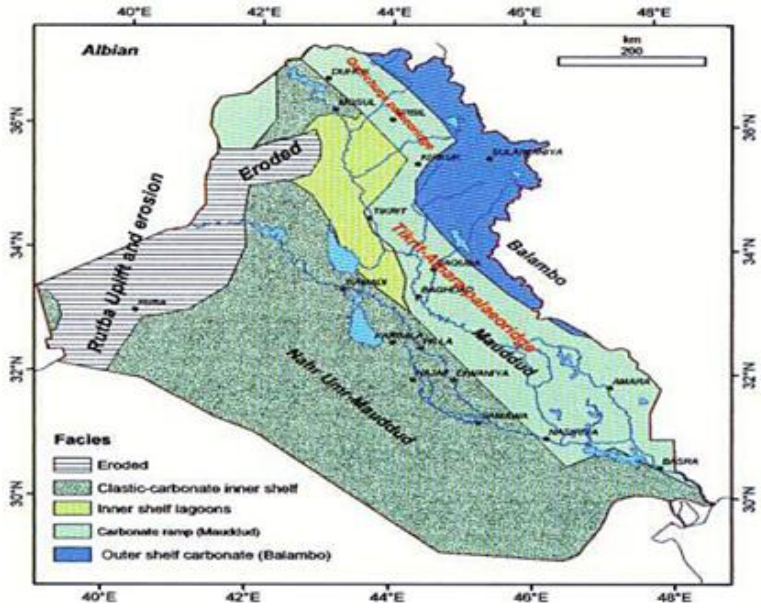

Fig. 1: Ancient geography of the Albian period on [5] .

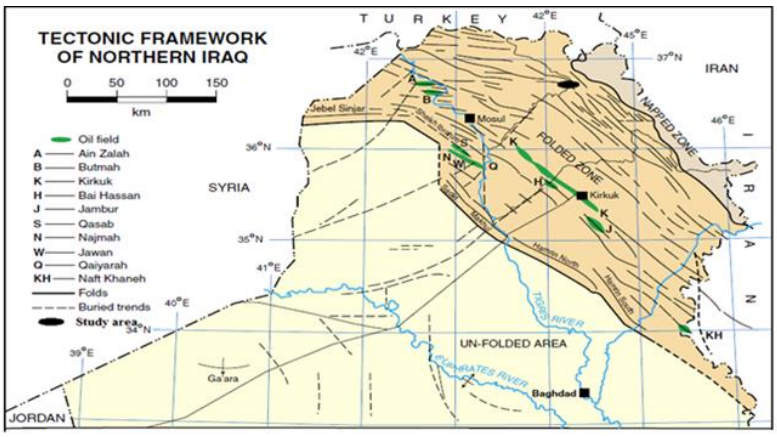

Fig. 2: shows the tectonic map of northern Iraq for [6].

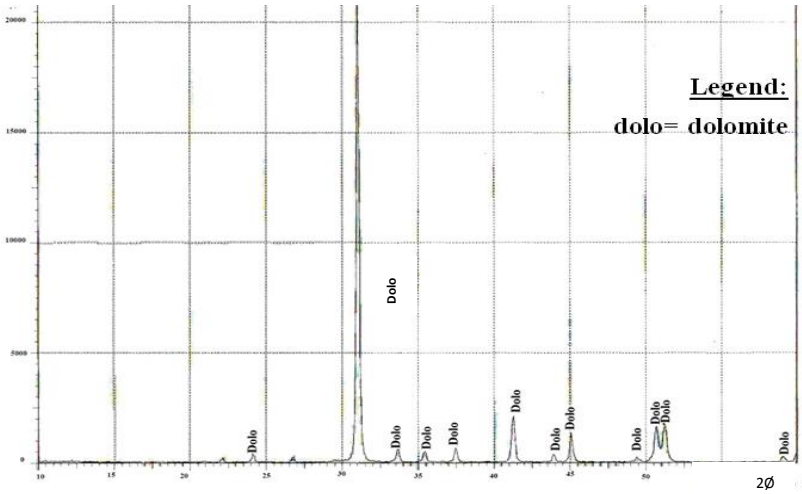

Fig. 3: The X-ray diagram shows the dominance of the mineral dolomite

Subaerial exposure indications

First: sedimentological evidence

The present study documented sedimentary evidence of this exposure surface, the most notable of which is the autobreccia formation, as it was noted in the upper portion of the Qamchuqa formation the presence of a layer about 25 cm thick (plate A-1) formed of dolomite breccia (autobreccia). These broken pieces vary in size, since the angular grain size spans from (0.05-30cm). (Plate B-1).

These grains are composed mostly of dolomite interspersed with small dark black dolomite pieces (Plate C-1). These black dolomite pieces give a clear indication of the occurrence of subaerial exposure, as [8] recorded the presence of such black dolomite granules in the course of his study to prove subaerial exposure in the Dachstein Formation in Hungary, these breccia are formed by the tectonic factor that causes the uplift of these layers, which led to the occurrence of joints and fractures of the dolomite layers exposed during the uplift and movement, so the waters permeate these fractures and joints, which works to enlarge the fractures and shatter the upper surface of the layers The exposed ones, and the broken grains remaining in their place, as broken breccia, placed in their places. It is worth noting that the present study did not record any effect of collapse type breccia, which usually occurs by dissolving evaporite rocks, which causes gaps and cavities to occur, and the upper layers collapse, so a special type of collapsed breccia is formed. The study did not record any trace of evaporite rocks, nor did it Monitor traces of breccia moved to a considerable distance from its place.

Second: petrographic evidence

The petrographic study recorded the presence of small silicate pieces of the type of replacement silica within the grains of the breccia (Plate 2-A), where[9] during his study of the layers subjected to subaerial exposure of the Cambrian-Middle Ordovician succession in the United States of America indicates the presence such pieces, which gives strong evidence of the surface exposure. At the upper layers of the Qamchuqa Formation, as the presence of these silicate pieces gives an indication of the change of geochemical conditions due to the processes of tectonic uplift, which facilitated the passage of solutions rich in dissolved silica mostly meteoric through the joints and fractures, which facilitated the processes of replacement and formation of these silicate pieces. The petrographic study also recorded the presence of dolomite rhomb inside some silicate rock pieces (Plate 2-A). [10] explained that the presence of these rhomb inside the flint was due to the release of Mg ions when the opal CT (cristobalite-trydimite) turned into quartz, and these excess ions are considered The appropriate source for the formation of dolomitic rhombs during late diagenetic processes.

Many studies have indicated that the deposition of the Qamchuqa Formation is in the form of an isolated platform [11] [12], and this case provides a justified explanation for the lack of small-sized materials during the pieces of breccia and its granules in the current study, as this is due to the Qamchuqa formation's distance from the coast line. Furthermore, the erosion processes that occurred after the surface exposure may have caused the removal of these detrital materials by the washing operations, and this case is similar to what was recorded by a study [13][14] about the evidence of Devonian sediment surface exposure in southern China.

The present study also documented saddle dolomite, which fills voids and fractures between grains of breccia. Saddle dolomite is a type of dolomite with twisted lattice crystals that have curved crystalline faces, cleavage, and sweeping. It typically contains hydrocarbons, metallic minerals, and sulfate-rich calcareous rocks. Saddle dolomite is regarded as a geothermometer, indicating a temperature range of (60°-150°) [15].

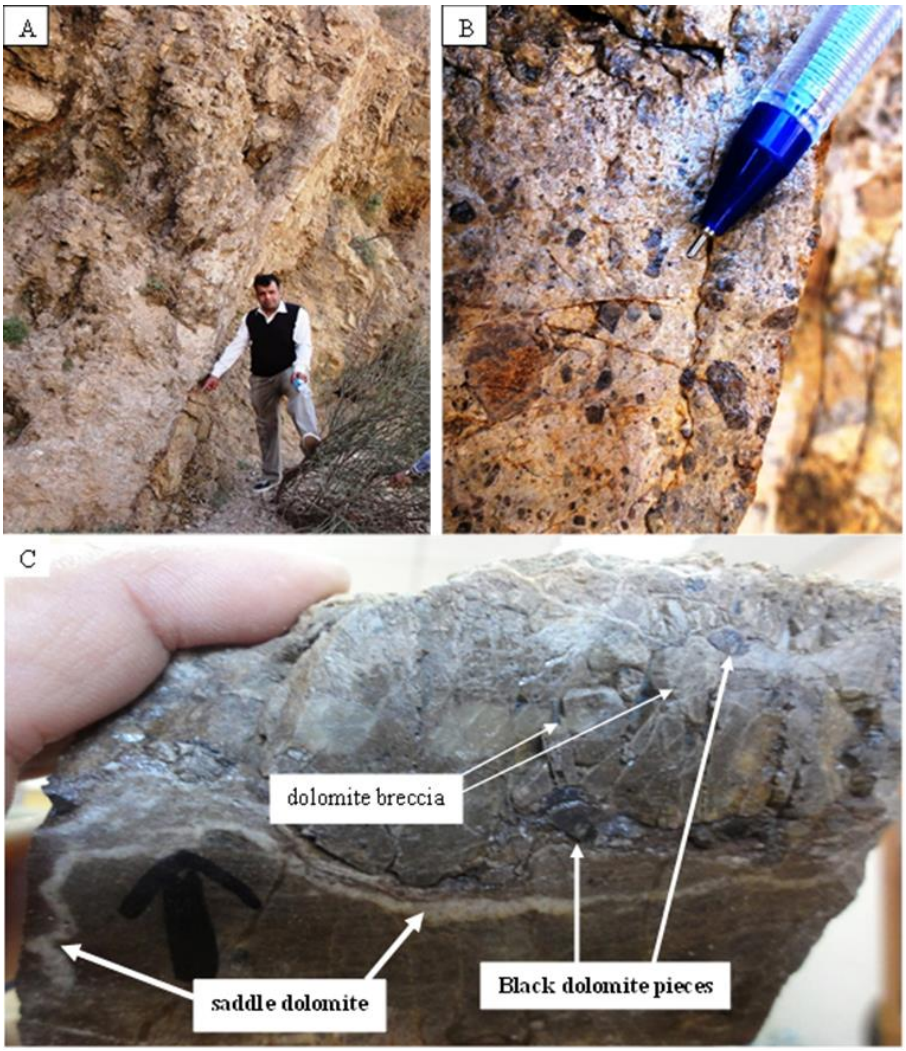

Plate No. 1: Field photos, A- The layer of breccia at the upper part of the Qamchuqa Formation, B- The breccia of different sizes and the Black dolomite pieces, C- A polished model showing the saddle dolomite and

It is well known that high temperatures exceeding (60) C are required for the formation of dolomite crystals by direct precipitation, which hydrothermal solutions provide. As a result, the presence of saddle dolomite crystals indicates high temperature conditions.

Discussion

The formation of the breccia at the upper part of the Qamchuqa Formation is clearly linked with humidity and the increase in meteoric diagenesis, which require meteoric water during exposure, as the depressions resulting from the processes of dissolution and enlargement of the fractures require surface water provided by the exposure. And it is worth noting that the loss of fossils of all kinds, as well as the presence and prevalence of dolomite, is important evidence of these layers' surface exposure.

The presence of evidence such as dolomite breccia and the complete absence of fossils of all kinds in the layer, as well as the presence of block cement in the interstitial spaces recorded by the study (as will be mentioned later) are strong evidence of the existence of a regressive surface to produce sediments in shallow marls, as [16] indicates during his discussion of the evidence of surface exposure of the Aptian-Cenomanian successions in the middle east of Crete.

The tectonic stresses caused by Alpine movement caused the layers of the Qamchuqa Formation to rise to the surface, where they were subjected to fragmentation, fracturing, and crushing, particularly in the exposed upper layers, transforming them into breccia, and later buried by meteoric diagenesis due to disslution. The movement of salty hydrothermal solutions through these fractured and buried layers resulted in the precipitation of saddle dolomite cement. Saddle dolomite cement is formed either as a direct precipitation from hydrothermal solutions or by replacement [13]. According to the findings of the present investigation, the saddle dolomite was precipitated directly from those hydrothermal fluids during their transit through voids and fractures as a late diagenetic. Cement dolomite crystals can grow to be rather massive (3 mm). (Plate 2-B). This suggests that there are hydrothermal fluids high in Mg that

took long enough to precipitate dolomite crystals as cement in those relatively huge spaces. When the Mg in these solutions is depleted, the spary calcite crystals begin to precipitate as block-type calcite cement, which was also seen in the study. (Plate 2-C). In this context, [13] suggests that saddle dolomite typically precipitates from very salty fluids rich in (Mg) at high temperatures between (50-60) Celsius below the surface, implying that the process occurs after surface exposure and burial. On the other hand, [17] indicates that the presence of this type of saddle dolomite in northern Alberta near the Cordillera belt in Canada indicates the proximity of this area to areas of orogenic movements that allow the provision of such solutions. When the necessary conditions for its deposition as cement filling the spaces of the breccia manifold fractures are supplied, saline hydrothermal traveling through the vast fractures towards those layers with small fractures of saddle dolomite sedimentation, and this condition is quite similar to what was observed in the present research of the Qamchuqa Formation as alpine orogenic migration connected with periods of exposure surface of the Qamchuqa Formation and subsequent burial during the Upper Cretaceous period [18] [19].

According to the evidence, the upper layers of the Qamchuqa Formation were exposed to subaerial conditions, sedimentation ceased, and they were exposed to mostly atmospheric and sometimes vadose diagenetic processes associated with sea level fluctuations, where these processes produced a surface layer of dolomite breccia (Autobreccia), and after burial of this layer, the layers were exposed to hydrothermal solutions, which contributed to the deposition of saddle dolomite and other minerals.

Conclusions

The upper part of the Qamchuqa Formation (Albian) with the Bekhme Formation Upper Senomenian) in the Bekhme Dam area, northern Iraq, is a erosional surface resulting from the exposure surface due to the tectonic processes to which the formation was subjected.

This surface is characterized by the presence of a layer of breccia with a thickness of (25 cm) consisting of dolomite breccia of local origin (Autobreccia), resulting from the tectonic uplift processes of the Qamchuqa Formation, which led to the formation of joints in most parts of the formation, especially in the upper part and its exposure, and then the expansion of the joints with the influence of meteoric diagenesis and the collapse of those layers formed thus the breccia, which consist of sharp-edged pieces of different sizes (0.05-30 cm) dolomite and interspersed with small pieces of dark black dolomite. Between the pieces of the breccia there is dolomite cement of the type saddle dolomite, resulting from hydrothermal solutions due to the proximity of the area to the tectonic activity.

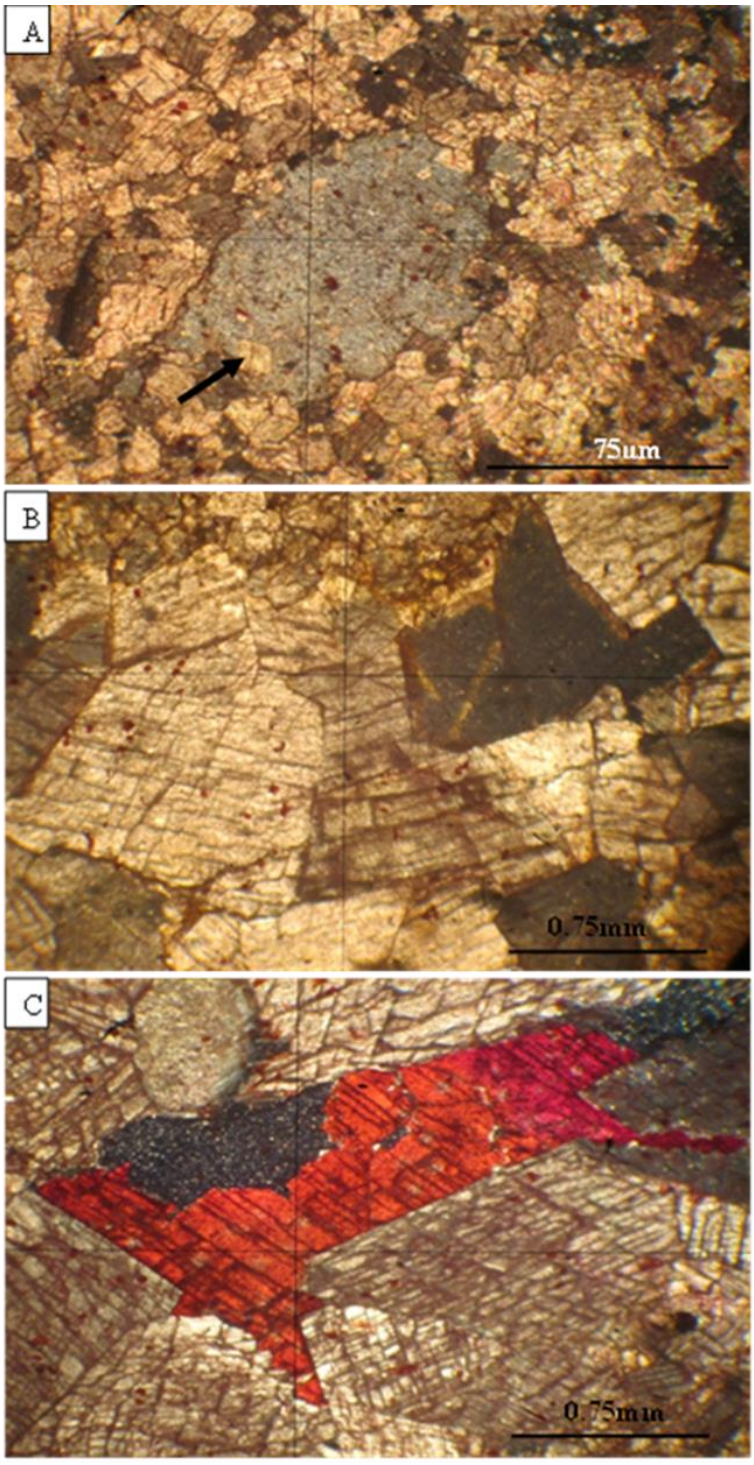

plate No. 2: Pictures under a polarizing microscope A- A piece of silica (chert) containing dolomite rhomb (arrow), B- Large crystals of saddle dolomite, C- Spary cement calcite between crystals of saddle dolomite.

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الدلائل الرسوبية على الانكشاف السطحي للسطح العلوي لتكوين قمجوقة في منطقة بخمة، شمالي العراق

رافع إبراهيم الحميدي

قسم علوم الارض, كلية العلوم, جامعة الموصل، الموصل ، العراق

الملخص

يتناول البحث الحالي دراسة التماس العلوي لتكوين قمجوقة الجيري مع تكوين بخمة الذي يعلوه في منطقة بخمة شمال العراق اذ يوجد في الجزء العلوي من تكوين قمجوقة طبقة من البريشيا الموضعية النشاة (Autobreccia) وهذه البريشيا تكون مزواة وباحجام مختلفة تتراوح بين(30_0.05 cm) وتتكون من الدولومايت ويتخللها قطع سوداء اللون دولوماتية ويدل وجودها على انكشاف السطح العلوي للتكوين للهواء.

المادة السمنتية المالئة للكسور والفراغات واحيانا محيطة للبريشيا تكون من الدولومايت السرجي (saddle dolomite) يصل حجم بلوراتها الى(cm3) متكونة كعملية تحويرية متاخرة بفعل محاليل حرمائية.