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The Reconstruction of Paleo-Environment Albo-Aptian Sediments of the Massive El Hmaima North Tébessa North-Eastern Algeria

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Summary

The paper is concerned with the studying of Albo-Aptian across North Africa to focused on sedimentological, tectonic and paleontological study of Albo-Aptian formations massive El Hmaima-North of Algeria. A systematic study was then initiated consisting of the sampling in a washing furniture samples of some Albo-Aptian rock units, and a careful sorting of microfossils and minerals under the lens of binocular microscope. Albo-Aptian is characterized by carbonate deposits rich in organic matter levels. This interval is marked by a large marine transgression typically connected to a eustatic rise in second order by tectonic events related to the opening of the western part of the Mediterranean sea and/where the rifting of the central Atlantic and conditions paleogeographic. Mineralogically, the studied area are contain the important industries minerals such as; Calcium carbonate, Gypsum, Ferruginous nodules, pyrite, Quartz and clay minerals.

Introduction

The reconstruction of paleo-environment of the studied area common Boulhef Dyr, using sedimentological approach. Sedimentology of facieses which is based on determination of the set of criteria as lithology, fossils continuous and sedimentary structures, allowed us to know the sedimentological and paleogeographic evolution of the Albo-Aptian sediments in the studied area.

The massive El Hmaima North Tébessa was located on the territory of the municipality of Boulhef Dyr, Daira of Morsott or twenty miles in the plain extends to the foot of Djebels Dyr, Chemla and Zitouna belonging to the southern area Mountains Mellegue which belongs to the Saharan Atlas mountains of the Eastern border Algerian - Tunisians. The massive El Hmaima North is located in the center of the sheet Morsott No. 178 (ech: 1/50 000) NNW of the city of Tebessa and there is a distance of about 15 km from it (Figure 1) [1].

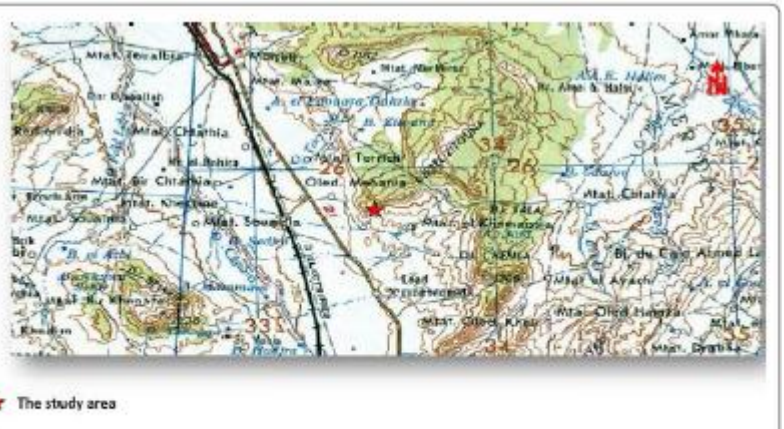

Figure 1: Geographical location of the studied area from the topographical mapTébessa1/25.000.

The massive El Hmaima is composed of two multi-hectometric small clumps (El Hmaima North and El Hmaima South) emerging at the center of a large marl half buttonhole. Cenomanian is framed by escarpment Dj. Boulhef southeast, Dj. Chemla North-East and North Dj. Zaytuna opening to the west of the ditch Tébessa - Morsoft.

The present study is focused on one of these little clumps as El Hmaima North, which also called in some geological contributions as El Hmaima Dahara (Figure 2). El Hmaima North lies on 1600 m long and 600-700 m width, crossed by a single named Oued El Hmaima, NE-SW. Seasonal rains are mainly in spring and the climate is semi-arid to temporary flow. The vegetation is almost virtually absent developing relatively on northern slopes in the form of isolated trees [2].

Figure 2: Photograph showing some exposure of Massive EL Hmaima North at the studied area.

Method

Sedimentology analysis is based on recognition of the terrain (unit delineation, measurement direction, dip, facies description, color, establishing a geologic section, and the systamatic sampling). In a laboratory test range is necessary to interpret such size, sedimentometry morphoscopic analysis. We exploit the results of the various tests in order to highlight the sedimentological parameters, which determine the mode and depositional environment. Petrographic study is to determine the type of facies and depositional environment. For cons, the tectonic study allows us to trace the tectonic phases in the regional context. The material used is existing in geology lab. Tébessa University, Algeria.

The sediments studied were the subject of some chemical-weight analysis methods exposed by Boucart J and Berthois L. The principle is to weigh a few grams of the full sample and attack in a beaker (previously weighed) with HCL diluted 1/10 in unlimited quantity. Was heated a few minutes so as to promote the destruction attack and carbonates including dolomites, then washed with distilled water. Is allowed to settle and after drying in the oven, the beaker was weighed with the dry residue. After deducting the weight of carbonates.

Geologic Setting and Stratigraphy

This field study is limited to the north by latitude 35° 30’ and south by the parallel the parallel 35° 23’. The western and eastern boundaries of the studied area are indicated by the meridian 8° 5’ East and 8° 16’ West (Figure 3).

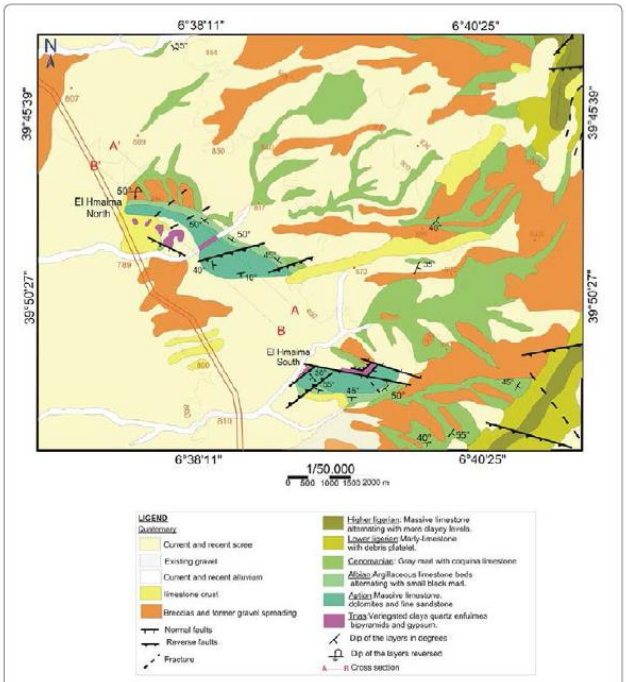

Figure 3: Geological formations of the area of intense study the geological map of Morsott (Algeria) to 1/50.000.

The field work is conducted for two geological sections, the first cut was made on the massive El Hmaima North SW-NE direction. The second cut was made on the massive Boulhaf-Dyr of NW-SE direction (Figure 4) encompassing all the Cretaceous. Samples were taken from the limestone banks of the Aptian, Albian, Vraconian, Turonian,Companien and Maastrichtian in order are fabricating thin blades. Associated with this work, samples were taken from the marly levels to perform washes marl [3,4].

Triassic

Triassic appears on four cuts at the massive El Hmaima North, which outcrops tower along the Southwest side of the massif, especially in the western part where fills up the slope a few meters from the peak [5]. In the central part, Triassic appears at the lower part and the Eastern part of the outcrop. It is limited to a few some benches dolomites breccia intercalated with clay and sandstone levels softer rich baryto-celestite (Sr, Ba) SO4 to neoformation bipyramid smoky quartz and garnet crystals and dolomite in small shoals taped black breccia (Figures 5 and 6) [6]. In El Hmaima south,Triassic outcroped on the north flank. It is found in the Eastern part in the albo-alptians limestone with a sharp contact [7].

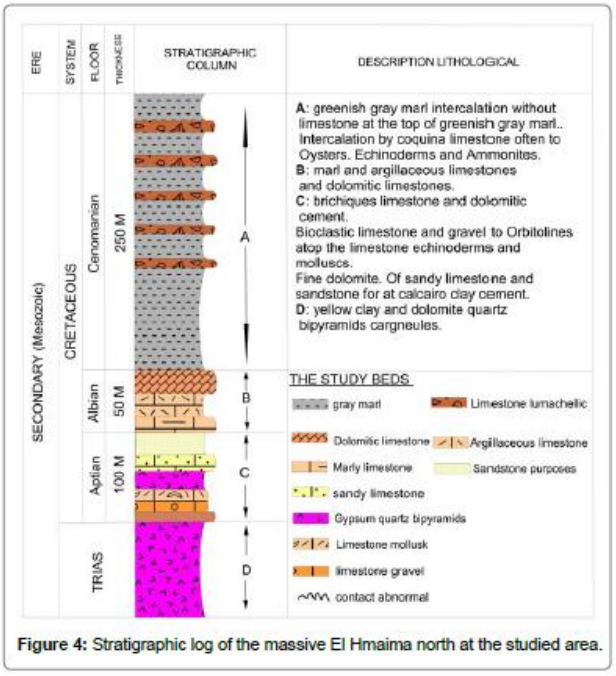

Figure 4: Stratigraphic log of the massive El Hmaima north at the studied area.

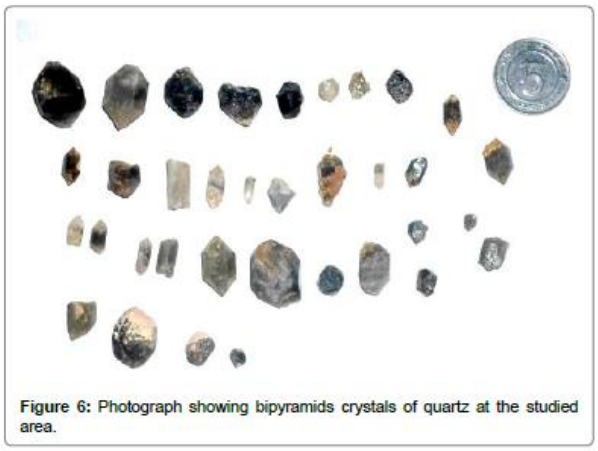

Figure 6: Photograph showing bipyramids crystals of quartz at the studied area.

Figure 5: Photograph showing crystals of garnet at the studied area.

The largest outcrop of the Triassic in the region is located in the North and Northeast Mzouzia. It seems to fit the heart of El Hmaima diapir-Belkfif and it also represented the northern part of the diapir Mzouzia Boukhadra [8].

Aptian

Aptian also well exposed in El Hmaima North represented by the sandstone levels with an intercalation metric limestone bank with micofossils (Figure 7) on a thickness of about 50 meters up the majority of the sequence (Figure 8A-D). It was consists of three types as;

- Limestone polyps and debris of organismes at the base.
- Rudist limestone (Figure 9)
- Limestone debris of various organisms such as echinoderms, bivalves, Polyps, algae (Figures 10-13) [9].

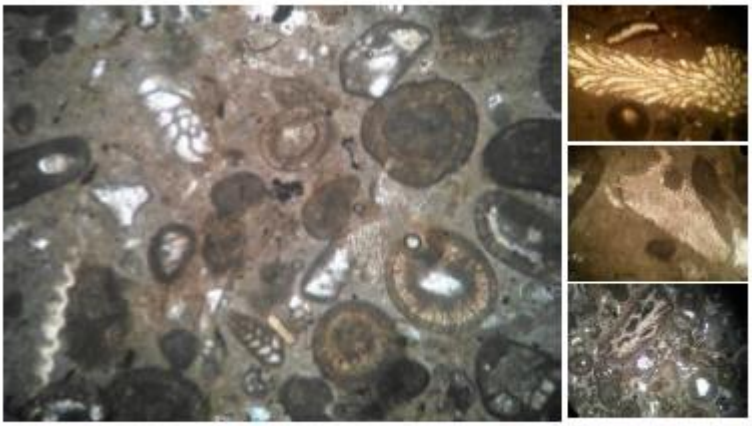

Figure 7: Photograph showing thin section of limestone with microfossil magnification X10000.

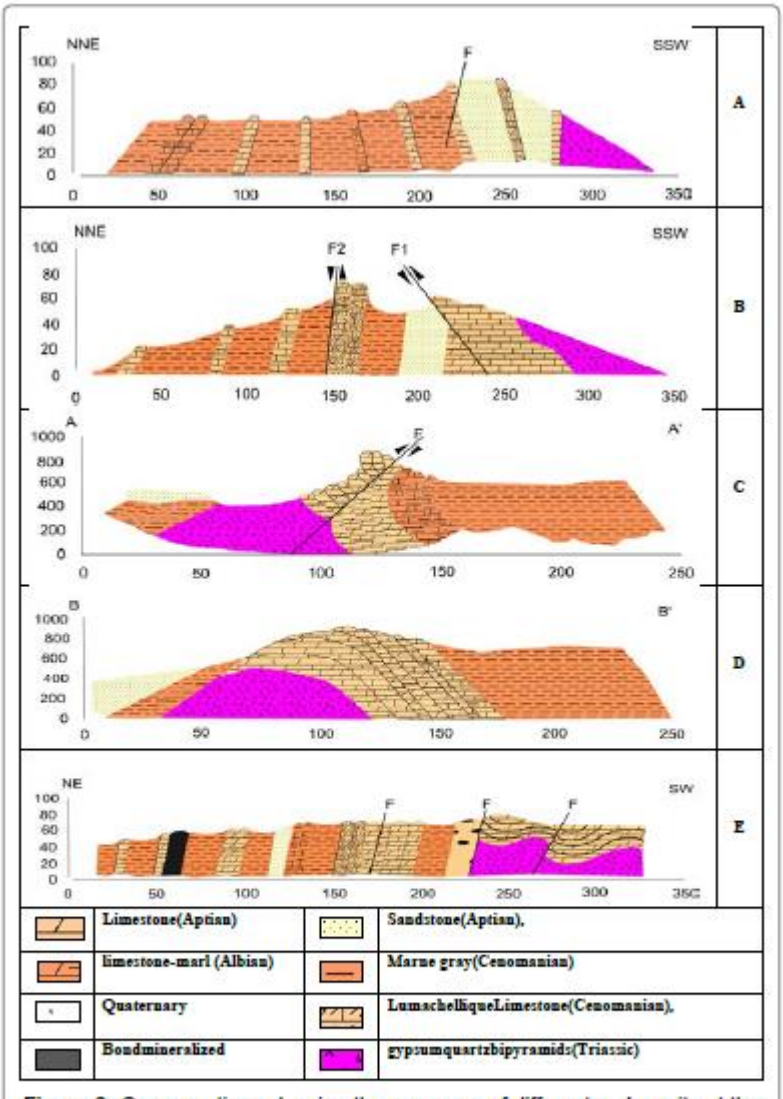

Figure 8: Cross-sections showing the sequence of different rocks units at the the study area.
Cross-sections A, B, C, and D are signed through massive EL Hmaima North, while cross-sections E is signed through Wadi El Hmaim.

Albian

Albian of mountains Mellègue present as a marly facies and more generally very thick in Boukhadra area. The lower Albian has a powerful sequence of about 245 m [10] and follows the clansyasien with yellow marl facies intercalated sandy limestone (Figure 8A-D). North El Hmaima Albian is different from other sectors, where its smaller in thickness than neritic limestone facies [11].

Figure 9: Photograph showing some fossils as Oyster and Exogera at the studied area.

Figure10: Photograph showing Echinodermata fossils at the studied area.

Figure 11: Photograph showing Bivalves fossils at the studied area.

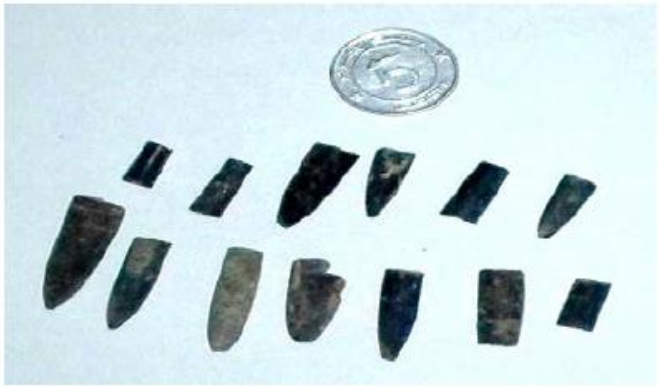

Figure 14: Photograph showing the beaks of Belemnites at the studied area.

Figure 13: Photograph showing another type from bivalve fossils at the studied area.

Figure 12: Photograph showing Trigonhdae and Myophorelle fossils at the studied area.

Vraconian

Vraconian outcrops were at the north-east of North El Hmaima. it was overturned in tectonic contact with the Triassic to the east with the Albo-Aptian sandstone and carbonate. In the Eastern part, the Vraconian seems to be normal contact with the Albo-Aptian limestones and form a kind of incomplete closure periclinal (Figure 8A-D) [12].

In El Hmaima south Vraconian flush only on the south side, and show normal contact with the Aptian in the most part, where visible only to the southwestern corner of the massif. At the South-East end contact appears to have replayed and is masked by brecciation and the beaks of Belemnites (Figure 14). Vraconian has about 50 m thick, and the same lithological nature as El Hmaima North. At Djebel Belekfif, the Vraconian as small limited as Albo-Aptian sequence [13].

Cenomanian

Cenomanian surrounding El Hmaima North and El Hmaima South. It is limited by the Turonian limestones forming the cuesta of Djebels Boulhaf, Chemla, Zaytuna. The outcrop continuous in the northern flank of Djebel Boulhaf south of El Hmaima south. With about 250 m slightly greenish gray marl intercalation without limestone [14].

Turonian

Turonian is very remarkable in the region by large limestone beds that form ledges surrounding mountains among which Djebel Boulhaf, Djebel Chemla, Djebel Zitouna, Djebel Belkfif, Djebel Melloug. Turonian is almost similar in Djebel Belkfif and Djebel Boulhaf with the following units (Muriel Ruault-Djerrab, Bruno Ferré, & Fatiha Kechidbenkherouf)

- Limestone platelet (20 m).
- Very marly limestone and marl covered scree (about 220 m).
- Sub-lithographic gray massive limestone pink (60 m).

The thickness of Turonian is about 300 m. It is the ridge that forms the top of Djebel Melloug south of Djebel Mzouzia, which continuated to the Northwest cornice perched syncline Haoud Es sghir northwest of Djebel Boukhadra [10].

Senonian

Senonian is represented by a thick marl series in rare interbedded limestones and calcareous clay. Belkfif it reaches 1700 m thick where it flow into low-lying areas to the west of the massif [15]. The microscopic slides study of the thin section, from sedimentary formations limeston in the era of Aptian, showed the presence of a significant number of micro-fossil and these varied between foraminifère and calpionella in the picture.

Tectonics and Structure

Small clumps of El Hmaima North and El Hmaima South belong to a large anticlinal structure trended NE-SW. In the North East periclinal it is formed by Djebel Zitouna, Djebel Chemla and Djebel Boulhaf, while in the South-West periclinal it is formed by Djebel Troubia and Djebel Es senane. The diapiric Triassic outcrops in El Hmaima North and El Hmaima south at south Belkfif.

El Hmaima North is a small elongated massive trended NW-SE with 1700 m long and 600 m width. It Can be divided into Eastern part and Western part [16].

The Eastern part has moderatly inclinal dip and stretches to the south-eastern end of the structure up to about 250 m northwest of Oued El Hmaima in contact with a fault oriented N160°. On the southwest side, it

appears as a half-anticline. The layers of Albo-Aptian are normal stratigraphic contacted with brecciated Triassic dolomites and having a sweet dipping 10° to 20° NE and they become horizontaly to the South East, while the dip becomes stronger toward the top and the northeast side, reached 25° to 40° NE. The contact between the Albo-Aptian and Vraconian form a kind of sleeves complicated by small faults. It reappears on the Southwest side, where it unconformably overlies the Triassic dolomites form of small banks limestones directions (N5°- 60°) (Figure 15) [17].

Figure 15: Representation of tectonic in massive EL Hmaima North.

The Western part has vertical to reverse dip and break picking N160° to the northwest end of the structure. It is characterized by vertical dip then overthrown by layers of Triassic to Vraconian. Going to the North West, the Albo-Aptian limestone disappears, and there is a contact between silicified limestone and Vraconian. The contact between Triassic and Vraconian also formed a kind of periclinal closure, and disjointed in southernwest flank which occupied by Triassic dolomites [18].

Mineralogical and Geochemical Aspects

Calcium carbonate (CaCO3)

The average value of 42% obtained for the samples ‘furniture’ reflects the membership there of to the petrographic class marl. However, extreme values allow us to distinguish, petrographic sense, clays (20% of the samples indeed contain less than 15% CaCO3) and marly limestones (about 20% have a rate greater than 65% CaCO3). The logical increase in carbonate limestone benches approach reflects a decrease in the water column, and conversely, an increasing proportion of clay is generally explained by a deepening of the depositional environment. Assuming normal conditions of oxygenation during deposition is therefore expected to find the most carbonate samples greater proportion of benthic organisms.`

Gypsum

‘Gypsum marl’: this term applies well to the Cenomanian marly levels. Nearly 10% of the samples indeed contain gypsum (sometimes clearly identified on the ground, sometimes only through the lens of the magnifying glass).

Ferruginous nodules and pyrite

Very common at all levels (present in about 30% of samples), these nodules are formed under reducing conditions, also necessary for the formation of pyrite. A certain effect levels, microorganisms (such as ostracods and foraminifera) are widely pyritized. Such an environment also allows the preservation of organic matter, as evidenced by the often dark color samples.

Quartz and clay minerals

Variations in quartz content can be explained logically according to these authors a greater or lesser distance from the continent-source.

Changes in relations between the various clay minerals is also explained by variations in paleoenvironmental conditions, including eustatic level.

Petrographic and Geochemical

Study methods

First time, we conducted an analysis based on macroscopic observations chromofaciologiques variations and identification of hardness, structure and texture of the rock. The thin refusal rocks are studied under a microscope to estimate roughly the presence or absence of light and heavy minerals that are often useful markers of the origins of rocks.

The sediments studied were the subject of some chemical-weight analysis methods exposed by Boucart J and Berthois L. The principle is to weigh a few grams of the full sample and attack in a beaker (previously weighed) with HCL diluted 1/10 in unlimited quantity. Was heated a few minutes so as to promote the destruction attack and carbonates including dolomites, then washed with distilled water, is allowed to settle and after drying in the oven, the beaker was weighed with the dry residue. After deducting the weight of carbonates.

The systematic position of the studied samples is shown in the triangular diagram A. Vatan which proposes to establish a descriptive classification to put a name on a rock. Other descriptive classifications have been adopted.

Chemical-weight analysis

Sediments studied two profiles are brittle variable colors (a color chart rocks is published by the National Research Council, Washington) changing between reddened, beigeâtre and rarely whitish. Reddening tells us about the climate conditions and demonstrate the presence of an oxidizing environment, continental. Sample processing using the method previously mentioned, gave the following results: According to the systematic A.Vatane (Figure 16).

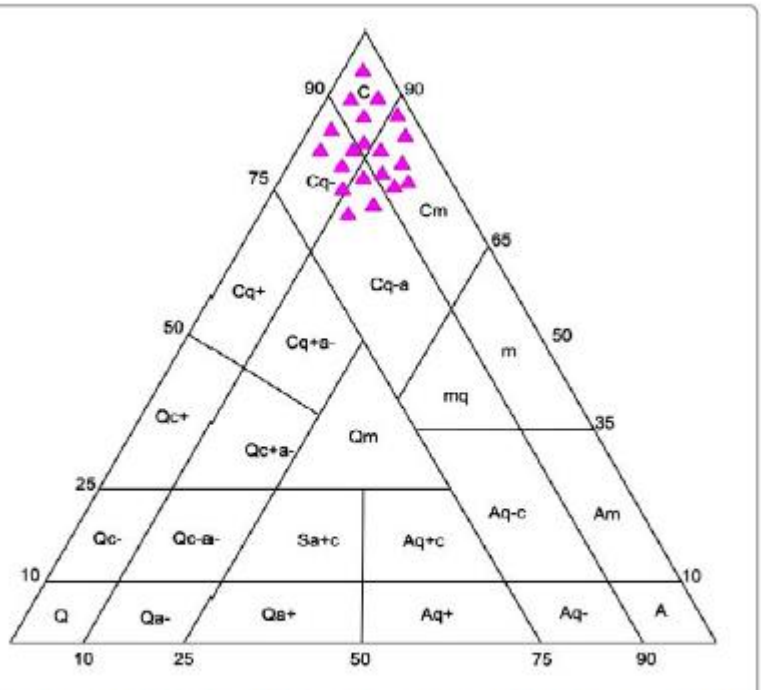

Figure 16: Triangular classification of sedimentary rocks three essential components: Quartz, Carbonate , Clay(A.Vatan, 1967.).
Q: Quartz ; A: Clay; C: Carbonate; m: Marne ; +: many ; -: little.

Figure 17 is Showing the percent content of component of the studied rock units covered the studied area.

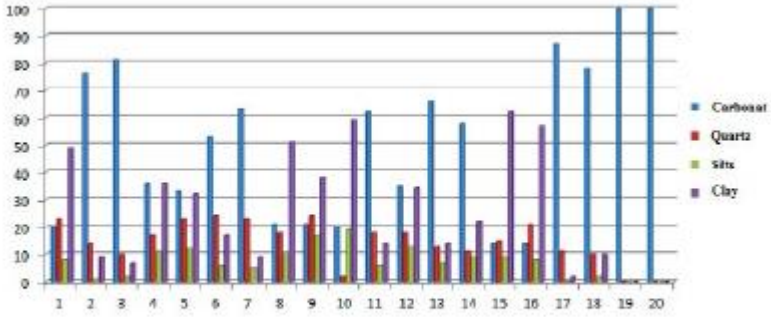

Figure 17: The percent content of component of the studied rock units covered the studied area.

Conclusions

In North Africa, the Aptian-Albian is characterized by carbonate deposits rich in organic matter levels. This interval is marked by a large marine transgression typically connected to a eustatic rise in second order by tectonic events related to the opening of the western part of the Mediterranean sea and / where the rifting of the central Atlantic and conditions paleogeographic. Thus, among the parameters that control sedimentation in this region, some are global such as eustatic variations and climatic parameters, while the others are local like tectonic events are local [19].

To isolate local factors, a sedimentary and paleontological analysis relied on a high-resolution biostratigraphy derived from fossils and microfossils (Figure 7), on sections located in different regions.

The Aptian sea in the studied area

Region Tébessa is almost completely covered by water during the Aptian, this fact is most typical installation reefs elongated wrinkles [20]. The fauna collected includes oysters, which living at the lower 200 or 250 funds. The early Aptian level was ended by 2 m thick dolomitic limestones intercalated with limestone gravel with a more or less thick layer of limestone molluscs (Figures 9,11-13) and the middle level becomes hot and restless [21,22].

The depth is increased and the environment become calm and allow to the sedimentation of calcareous sandstone, this time breaking the sea sedimentation allows for degrees [23].

Albian sea in the studied area

The Albian transition is made within a marly limestone layer indicates that the deep sea calm and cold. Transgression of the sea allows filed a considerable amount of sediments. Summit of the Albian is represented by dolomitic limestones, and argillaceous limestones at the middle level [24].

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