Description Field Geology of the Mesozoic Sediments at the Ras` Quadah Area

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المستخلص

يستخدم الوصف الحقلي للتعرف على التراكيب الجيولوجية والطبقية بالمنطقة. وقد تم اختيار الدراسة بمنطقة جبل اقديح والذي يغطي مساحة تقدر بحوالي 59600 م² تعتبر هذه المنطقة مصدر للخامات الصناعية وذلك بسبب وجود صخور رسوبية والكثير منها ناتجة من عمليات الإحلال كصخور الدولوميت ويقع جبل اقديح في منطقة السبيعة جنوب مدينة طرابلس, حيث اعتمدت هذه الدراسة على تفسير الصخور الرسوبية السطحية والمعلومات الجيولوجية والتركيبية بالمنطقة وكان الهدف من هذه الدراسة هو تقييم الصخور من خلال الوصف الحقلي والتخريط الجيولوجي تم التعرف على التراكيب الجيولوجية والتغيرات البيئية في الصخور التكاوين ومن خلال هذه الدراسة أيضا تم التمييز بين الوحدات الصخرية المختلفة بالمنطقة ومطابقتها بالتكاوين الجيولوجية الموجودة بالخريطة الجيولوجية من حيث الحدود والتعرف على التغيرات في السحنة لهذه الصخور.

وما تم ملاحظته في هذه الدراسة أن الاختلافات الطبقية واضحة وجلية بين التكاوين وما بها من تغيرات في السحنة والتراكيب الجيولوجية وبذلك يمكن اعتبار هذه الأماكن مناطق خامات صالحة للبناء وذات قيمة اقتصادية جيدة.

Abstract:

The field description is used to identify the geological structures and stratigraphic description in the area. The study was chosen in the area of Jabal Quadah, which covers an area of about 59600 m^2.

This area is a source of industrial raw materials due to the presence of good sedimentary rocks, many of which are the result of the substitution of dolomite rocks. The Jabal Quadah is located in the Alsabiea area south of the Tripoli city, this study was based on the interpretation of surface sedimentary rocks and geological and structural information in the region. The objective of this

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study was to evaluate the rocks through the field description and geological mapping. The geological structures and the environmental changes were identified in the formation rocks. A distinction was made between the various rock units in the region and their compatibility with the geological formation that appear in the geological map in terms of boundaries and identification of changes in the facies of these rocks.

Key wards: Mesozoic Sediments, marly limestone.

Introduction:

The study area (Ras` Quadah quarry) is located south of Tripoli about 50 km and also south of the Al Sabah town about 10 km, between latitudes 32˚24`00``and 32˚00`02``N and longitudes 13˚00`02``and 13˚00`12``E (Figure 1). It covers an area of about 5,960 km2. This area is good economic for build. The study is focused on stratigraphic description for these units of the Upper Cretaceous sediments. It consists of three units; Sidi as Sid Formation, which composed of two members, the Lower part is Ain Tobi member and the Upper part Yafrin member (Chriestie, 1955) and followed up to the Nalut Formation, which represents the end formation of the study area. The topographic map on scale of 1:50000 used in this study (Figure 2).and also using the geological map on scale of 1:250000.

The lithology description of the Ain Tobi consists mainly of well bedded of limestone and dolomitic limestone, which lying in between the Kiklah Formation below and Yafrin member above. It probably deposited in shallow marine environment. The Yafrin Member consists mainly of marl, marly limestone and interbedded of clays and the Nulat Formation represents the end unit of the section.

The Ras` Quadah formed several isolated hills, with different shapes, some are elongated shape and others are domal shape with difference dips of strata. The area was affected by the Al Aziziah fault, which are responsible for the hills, with trend NW- SE direction.

The results of the field investigation are including; photogeological interpretation and paleontological analyses and using the geological and topographic maps.

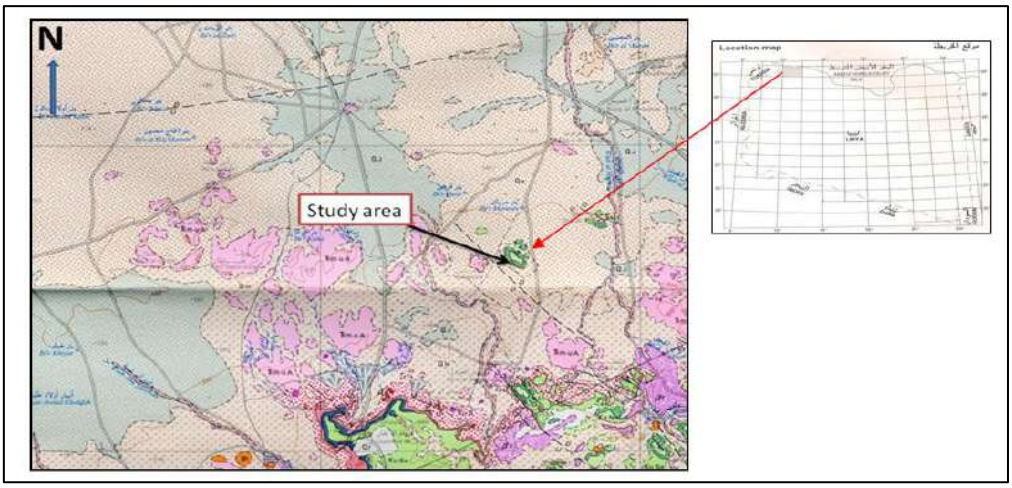


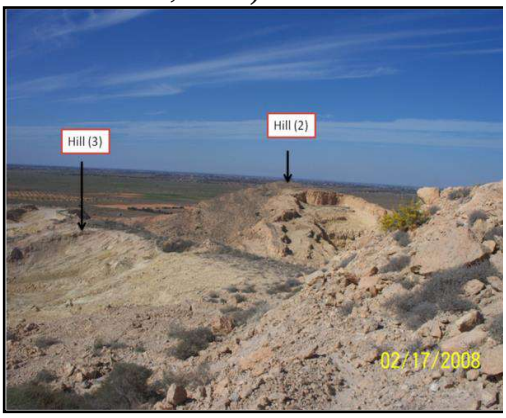
Figure (1) Geological map of the location of the study area (sheet Tarabulus NI 33-13, 1975)

Geology of the study area:

The area is located in the Jeffara plain, north of the Jabal Nafusah escarpment. The topographic feature of the study area can be distinguished into six main geomorphologic hills, which are named by numbers as follows; Hill (1) represents the northwestern, western and south-western parts of the area, Hill (2) represents the northern part, Hill (3) represents the southern part of the hill (2), Hill (4) represents the eastern part, Hill (5) represents the eastern part and southern part, and Hill (6) represents the southeastern and southern parts of the area (photos 1a, b).

The area surrounding of the study area is flat area, which is covered by Quaternary deposits. They are separated by faults, trending NW-SE. These hills have different facies, dip of strata and elevation points (photos.2, 3). They separated between them by probably faults, which trending NW-SE, related to the area the Al Aziziah fault. The tectonic movements of the Alpine Orogeny formed uplift of these hills. According to these movements, the area itself has different position and distribution of the formations, where the Ain Tobi Formation appears entirely at the north of the area hill (2) and absent on the other sides, which is suggest that probably presence fault between this hill (2) and south hill (3), trending NW-SE. The designated hills show different elevations. The highest point is represented by the top of hill 6 at 275 m, and the lowest point is marked at 216 m on top of hill 4. Most of the hills are covered

by the marly limestone of Ain Tobi Member. However, the yifrin marl Member duel the Nalut Formation sit on hills (1, 3, 4, 5 and 6). Intrusive dykes are scattered in various places. The dip of the beds are low inclined in some places and other places are steeper inclined. All of the rocks are Upper Cretaceous units, which are made of limestone, dolomite, dolomitic limestone, and clays. There are intrusive dikes rocks scattered in different places. The origin of the hills was an uplifted and attributed to the Al Aziziyah fault, which took place in pre-Miocene time (Lipparini, 1940 and Miller, 1971).



(a)

(b)

Photo. 1- Location of the hills in the study area

Tectonic setting:

The Ras` Qudeh area, is a part of the Jafrah plane, and located north of the Jabal Nafusa escarpment, it characterized by uplifts and block faulting. The Jabal Nafusa was uplifted during the Hercynian orogeny (Burollet,1963). The area was probably affected by two main epeirogenic movements, the first movement started in the Late Triassic time, Hercynian orogeny, while the second movement started in the Late Cretaceous time, Alpine orogeny (El-hinnawy &Cheristive, 1975). Due to these movements, the area has been configurated into isolated hills separated between them by probably faults trending NW-SE and the distribution of the formations are different, where the hill (2) at the northern part represents entirely the Ain Tobi Member. On hill (3) Ain Tobi Member is present below the Yafrin Marl Member. The Alpine orogeny movement affected the area, where the magmatic activities (dikes) are emerged at that time; also have trending NW-SE. Al-Aziziah fault reactivated tectonic initiated in the Miocene (Miller, 1971). The dip angles, in the region are mostly low or horizontal. In some locations, however, the dip may reach 40˚.

Faults: There are no observed faults in the study area, but between the hills probably faults occurred, which are the bearing N 50-60 W. Some small faults can be easily observed in the region, other faults are also observed in Ain Tobi beds (photo 10).

Joints: The joints are well observed in some parts of the mapped area. They exhibit different trends, but the majority is oriented in NW-SE direction and which are parallel to the main tectonic (faults) trend in the region.

Volcanic Rocks: There are many dikes in the area; they are cutting the rocks in different places (photos 2, 10). The occurrence of these dikes is related most probably to the Alpine orogeny movement, which took place in the post- Cretaceous time. The orientations of these dikes are N 50˚-60˚W.

General Stratigraphy

The exposed rocks in many quarries in the investigated area are classified into lithostatigraphic rock units (Table 1). All these units are Upper Cretaceous in age, representing the interval from Cenomanian – Turonian. They can be described as followed:

Table 1 - Stratigraphic divisions in the Ras Quadah area.

Geologic age		Rock units	
Upper	Turonian	Nalut fm.	
	Cenomanian	Sidi as Sid Formation	Yafrin Marl
			Ain Tobi Limestone

Sidi as Sid Formation

The name Sidi as Sid Formation was introduced by El-Hinnawy and Cheshitev (1975) from marine sequence that is exposited in hill (1, 2) (photo12, 13, 14). It includes two members; the Lower Ain Tobi Limestone and the Upper Yafrin Marl as two units located in between the Kiklah and the Nalut Formations. Christie (1955) was first introducing the terms Ain Tobi Formation as one unit. He divided this formation into two members. These two units are clearly exposed and distinguished in the study area. The area covered almost by the Nalut Formation with visible contact with the Lower part Yafrin Marl member (photo 5).

Ain Tobi Member

The term Ain Tobi was first and introduced by Christie (1955) as a member of the Sidi as Sid Formation and was named after the water well (Ain in Arabic) near Kaf Tobi northeastern Gharyan. In (1963-a)

Burollet described this rock unit as the Lower member of the Sidi as Sid Formation, which is followed up gradational the Upper member Yafrin Marl. Baar and Weegar, (1972) described the member as dolomitic limestone. It is situated and confined in the northern and eastern parts of the study area, hill (2) (photo 12, 13, 14). and also it exposures in the eastern part of the hill (3) (photo 20) below the Yafrin member. It consists mainly of massive, hard well bedded, white, yellowish to light grey limestone, dolomitic limestone and interbedded of thin calcareous clays. The limestone is light grey, hard, crystalline, and porous with yellowish marls and, marly limestone and bioturbated. Some of the beds are red in color, indicate that sub aerial exposures. The sediments are arranged in a series of thinner upwards, and attain thickness of about 80-90 meters. This hill shows the excellent exposures, due to the working of the quarry along years ago. The Lower boundary is not exposed in several locations in the area, while the Upper boundary is marked by conformable with the Yafrin Marl Member. It was deposited probably in shallow marine conditions.

Yafrin Marl Member:

The name of this member was introduced by Christie (1955) after the village of Yafrin (32˚ 00`N & 12˚30`E) of sequence of 80 m thick marls, exposed along the northern part of the Jabal Nafusa. In the study area, it consists mainly of alternating yellowish well bedded marl, marly limestone with interbedded of green to grey clays and few thin beds of gypsum about 3 cm thick. This member is situated clearly in hills (1, 3, 4, 5 and 6). It is located in the southern and western parts of hill (1) (32˚24`18.7``N &13˚09`02``E). It consists of yellowish bedded of marls and green clays. The contacts of the Yafrin Member in the hill (3) are conformable by the Lower boundary Ain Tobi Limestone Member and by Upper boundary of the Nalut Formation. The depositional environment was probably in lagoon evaporitic to shallow marine to low energy neritic environment according to the lithology type. The age of this member is represents an Upper Cretaceous (Cenomanian) as indicated by fauna evidence (Christie, 1955 and Desio et al, 1963).

Nalut Formation

The name of the Nalut Formation was introduced by Zaccagna (1919), after Nalut town (31˚ 52`N &10˚59`E) along the western part of the Jabal Nafusa (near the Tunisian border). Goudarzi, 1970 named as Gharyan dolomite. In the study area, it represents the top unit and consists mainly of thick sequence about 55m of massive bedded, light grey of

dolomite and dolomitic limestone, fine crystalline on the hill (1). The Upper part presence thinner upward well bedded of light grey, yellow dolomitic limestone (photo 8). The surface of the hill (4) presence scattered nodules of chert (photo 22). The other places contain massive, light grey, red to rose, yellow and fine crystalline beds of dolomite and dolomitic limestone (photo 3). The Lowermost part of the Formation near the contact of the Yafrin Member contains well preserved Mollusca. This kind of fossil is occurring in three places, on the hill 3 about 60 cm thick occurred in the center of the hill (photo 7), while on the hill (1) about 40 cm thick occurred at the southern part of hill and on the hill (5) occurred this type at the eastern part of the hill, which indicate that (Late Cenomanian- Early Turonian). The Middle and Upper part have not much fossils, indicate that the diagenetic processes has destroyed most of the fossils. The Nalut Formation outcrops extensively distributed in all the study area, except in hill (2) at the northern part of the area is not presence, probably due to the erosion, but covered entirely the other parts of the area. The thickness of this Formation is varies in the study area, where it attains about ~ 60-70 m thick at hill (1), hill (3) attains about ~ 6 m thick, hill (4) attains about ~12 m thick, hill (5) attains about ~ 30-35 m thick. However, the dip of this formation is horizontal but other places is gentle dips toward the north as clear in the bottom of hill (1) (photo). It is conformably with the Lower boundary of the Yafrin Member. It is visible (sharp contact). It was deposited in shallow marine environment. The age of this Formation is Early Turonian according to fossil assemblages (Zaccagna, 1919 and Burollet, 1975). However, Zaccagna, 1919 and Burollet, 1963 attributed it to the Turonian on the basis of the correlation with Tunisian Formation.

Field stops

The Field program is divided into two parts, the first part is the examining the stratigraphic sequences, which constitute the exposures of the area. The second part is description of the structural elements of the area.

Stop 1: Nalut Formation

(32˚ 42`50.5``N & 13˚ 08`43.9``E).

The stop (1) is located in the hill (1) at the western part (photo1), the outcrop is representing Nalut Formation. It consists mainly of massive bedded light grey to grey dolomite and dolomitic limestone. There is dike in the quarry, (32 24 50.5 N & 13 08 43.9 E) at elevation 181 meters above sea level. The bearing of the dike is N 80 W trends. The section shows extensive dolomitatzation and bioturbation

sediments. Beds thickness increases upward. It was deposited in the shallow marine condition.

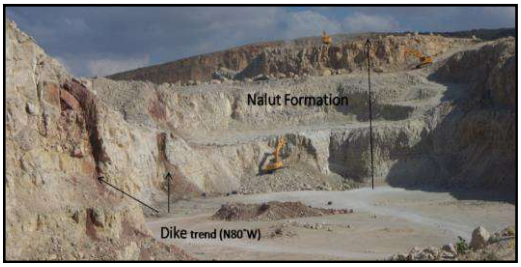


Photo 2. Field photograph showing: View of a quarry in the Nalut Formation at the western side of hill (1).

Stop 2: Nalut Formation

(32˚ 24` 42.1`` N & 13˚ 08` 50.4`` E), elevation is 178 m.

This stop represents the Nalut Formation and is located at the western part, south of the stop 1.

The outcrop consists of massive bedded grey to light grey dolomitic limestone and limestone with very thin clays. The dolomite is light grey, red, pinkish, yellow, fine crystalline with black spots. Some beds are reworked, which may indicting high energy.

Photo 3. View of the rose dolomite of the Nalut FM. at the western side of hill (1).

Stop 3: Nalut Formation

(32˚ 24`33.1``N & 13˚ 08`48.5``E), elevation is 191 m.

Located at the western part of the area to the south side of the stop 2. This quarry is composed of massive bedded grey to light grey, reddish, and yellow dolomitic limestone and limestone with very thin clays. Beds are thicker at the base, and become thinner upward. The top of the section is an elevation of 245 m above sea level, (32˚24`39.8``N & 13˚09`01.1`` E).

Photo 4. View of a quarry in the Nalut Formation at the western side of hill (1).

Stop 4: Contact between Nalut Formation and Yafrin Member.

(32˚ 24`33.6``N & 13˚08`49``E), elevation is 176 m a. s. l.

This stop is located at the southern part of the area to the south side of stop 3. This quarry is composed of two kinds of rock units, the Nalut

Formation, which consists of massive bedded grey to light grey, reddish, and yellow dolomitic limestone and limestone with very thin clays ,and the Yafrin Marl Member consists of well bedded of yellowish marls, marls limestone and interbedded of thin beds of green clays. The strata here are horizontal and the thickness of the section is about 40 m thick of the Nalut Formation, it is conformable and sharp. at the north side of the quarry, while the Yafrin Marl is about 7 m with many cycles of deposition at the southern side of the quarry. At this side there is barccia layer, may be fault affected W-E direction and also there is small collapse affected on the beds (photo 6). Above the contact between the formation and member there is 30 cm thick of large Pelecypoda fossil located in center of quarry (Photo 7).

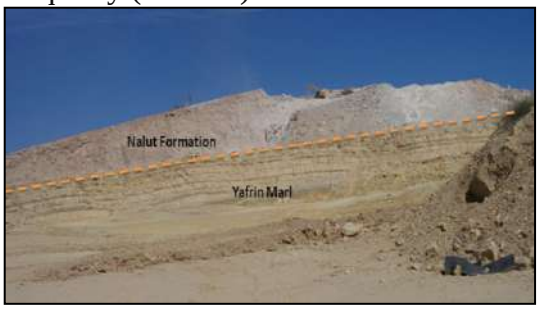


Photo 5. View of the contact between (1) yellow Yafrin Marl and (2) grey Nalut Formation at the northern side of hill (1)

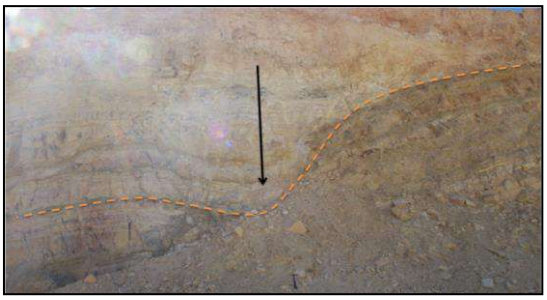


Photo- 6. View of post- deposition deformation or collapse of the Yafrin Marl at the southern side of hill (1)

Photo 7. Mullasca fossil in the Nalut Formation at the southern side of hill (1)

Stop 5: Nalut Formation

(32˚ 24` 07.1``N & 13˚ 09`23.9``E), elevation is 221 m.a.s.l.

This section is composed of massive bedded grey to light grey, reddish, and yellow dolomitic limestone and limestone with very thin clays. Beds are thicker in the lower parts of the unit, showing gradual thinning upward. It attains a thickness between 7-10 m.

Photo 8. View of exposure of the thinner upward of the Nalut Formation at the southern side of hill (1)

Stop 6: Nalut Formation.

(32˚ 25` 03.5``N & 13˚ 08` 39.6``E), elevation is 167 m. a.s.l.

It is located at the northern part of the hill (1) in north of stop 1, it represents Nalut Formation. The exposure consists mainly of grey, light grey, hard, massive bedded dolomite and dolomitic limestone, reworked, bioturbation dolomite. The thickness of the section is about 30˚ meters and the dip of strata is 15˚ N and 6˚- 19˚W at the western limb of the hill. Beds show bearing N 25˚W.

Stop 7: Top Nalut FM

(32˚ 24` 52.8``N & 13˚ 08` 48.6``E), elevation is 201 m. a. s. l.

This point of the stop represents Nalut Formation on the hill (1), which is composed of light grey to grey massive bedded dolomite and dolomitic limestone. The beds have geodes and bone fragments. The thickness of this section about 25 meters, also the dipping of strata is 20˚ NE and the strike is N 30˚ E

Photo 9. View of quarry of Nalut Formation at the northern side of hill (1).

Stop 8: Nalut FM.

(32˚24`49.8``N & 13˚ 08` 58.6``E), elevation is 167 m. a.s.l.

This stop is continue from the last stop down, it consists of about 40 meters white, light grey to grey bedded limestone (calcarenites) and dolomitic limestone. Beds dip towards the south at 8-9, and strike at N53˚E.

Photo 10. View of exposure a dike within the Nalut Formation at the northern side of hill (1).

Stop 9: Nalut FM.

(32˚ 24`42.9``N & 13˚09`05.9``E), elevation 207 meters a. s. l.

This section is the Nalut Formation and it consists of massive bedded light grey to grey dolomite and dolomitic limestone. It attains thickness of about 60 meters. The measured of the dip is 8˚-9˚ S and the strike is N53 E.

Photo 11. View of exposure of Nalut Formation at the northern side of hill (1)

Stop 10: Ain Tobi Me.

(32˚25` 13.3``N & 13˚ 09` 23.5``E), elevation 220 m. a. s. l.

This is located at the northern part of hill 2, including the entire section of Ain Tobi Limestone Member, which is composed of several cycles composed of well bedded white, light grey, yellow and grey limestone, dolomitic limestone and marl with interbedded of thin beds of clays. Beds become thinner upward with thickness about 60 meters.

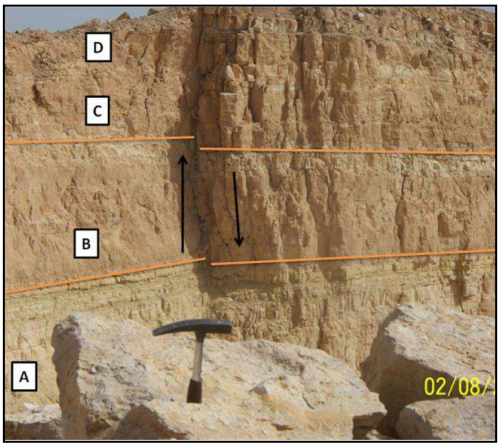


Photo -12. View of exposure of the cyclist of Ain Tobi M. at the northern side of hill (2).

Photo 13. View of exposure of the Ain Tobi Member of hill (1) at the southern

Photo 14. View of exposure of the Ain Tobi Member at the western side of hill (2)

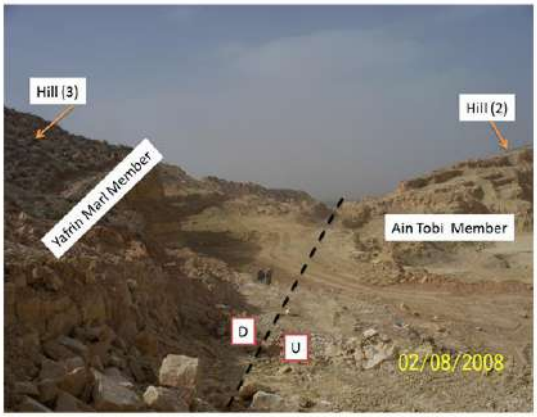


Photo 15. Fault beteen two hills, trending NW-SE.

Stop 11: Ain Tobi Me.

(32˚ 25` 03.5``N & 13˚ 08` 39.6``E), elevation 167 m. a. s. l.

This stop is located at the bottom of the Ain Tobi member, which is composed of cyclists of massive well bedded white, light grey, yellow and grey, crystalline limestone and dolomitic limestone with interbedded of thin beds of clays. The strata are vuggy porous, lamination, burrowing, bioturbatin, ripple marks thicker upward. It forms cycle or system of tidal flat.

Stop 12:Yafrin Marl Me.

(32˚25` 03.5``N & 13˚ 08` 39.6``E), elevation167 m. a.s.l.

This stop is located on the northern side of the hill (3), and it situated in between Ain Tobi below and Nalut Formation. This section consists mainly of well bedded yellowish, light grey marl, marly limestone with interbedded of the clays (photo). The thickness of the section is about 30 meters, which is a horizontal bed.

Photo 16. View of exposure of the cyclist Yafrin Marl at the northern side of hill (3)

Stop 13: Nalut FM.

(32˚25`06.2``N & 13˚09`10.3``E), elevation 199 m. a.s.l.

It represents the Nalut Formation at the top of hill (3). It consists of light grey to grey hard crystalline dolomite and dolomitic limestone with bioturbations and burrowing. The thickness is about 5 meters. The dip of beds is 40˚W, because of the faulting is affected and the strike is N 40˚W. A 60 cm bed of Mullasca exists at the base of this succession at (32˚25`06.7``N & 13˚ 09`10.3``E), preservation of the shells is good indicating deposition in shallow marine.

Photo 17. Rich Mullasca of the Nalut Formation h, hill (3)

Stop14:Yafrin Marl Me.

(32˚ 24`59.1``N & 13˚09`18.3``E), elevation 200 m. a.s. l.

This represents the Yafrin Marl Member. It consists mainly of soft to medium well bedded white, yellowish marl, marly limestone, lamination with interbedded of green clays and thin beds of gypsum about 0.5-3cm. The dip of beds is 19˚W and the strike is N36˚E.

Photo 18. View of quarry of the well beds marl and clays of the Yafrin Marl at the southern of hill (3)

Photo 19. Yafrin Marl at the southern side of hill (3), showing thin laminations of marl and clays.

Stop 15: Ain Tobi Me.

(32˚ 25`03.5``N & 13˚08` 39.6``E), elevation 167 meters a. s. l.

This stop is located at the bottom of hill (3), representing the Ain Tobi Member, which is composed of cycles of massive well bedded white, light grey, yellow and grey, crystalline limestone and dolomitic limestone with interbedded of thin and some thick beds of clays with thickness is about 15 meters. The strata are thinner upward with vuggy porous.

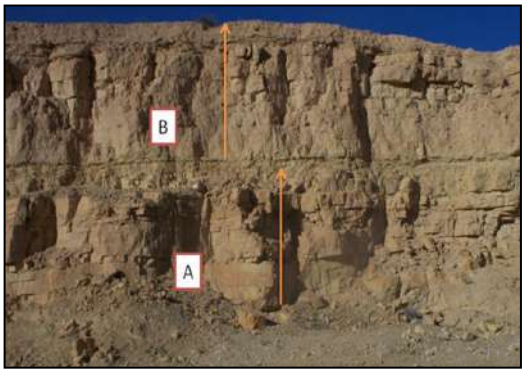


Photo 20. View of exposure of the Ain Tobi Member at the eastern side of hill (3)

Stop 16: Top Nalut FM.

(32˚ 24`46.7``N & 13˚ 09`30.1``E), elevation 216 m. a. s. l.

This stop is located at hill (4). It represents the top of the Nalut Formation and consists mainly of light grey to grey massive bedded dolomite and dolomitic limestone with nodules of cherts. The dip of the strata ranges from 18˚-32˚E and at the western side is 13˚E. The strike is N30˚-40˚E.

Photo 21. View of dipping strata of the Nalut Formation on top of hill (4)

Photo 22. Chert nodules of the Nalut Formation of the surface of hill(4).

Stop 17: Yafrin Marl Me.

(32˚ 24`36.6``N & 13˚ 09`28.8``E).

This stop is located at the western side of the hill (5), it consists mainly of yellowish marl, marly limestone

with interbedded of clays and formed a deformation of the strata.

Photo 23. View of exposure of Yafrin Marl at the western side of hill (5).

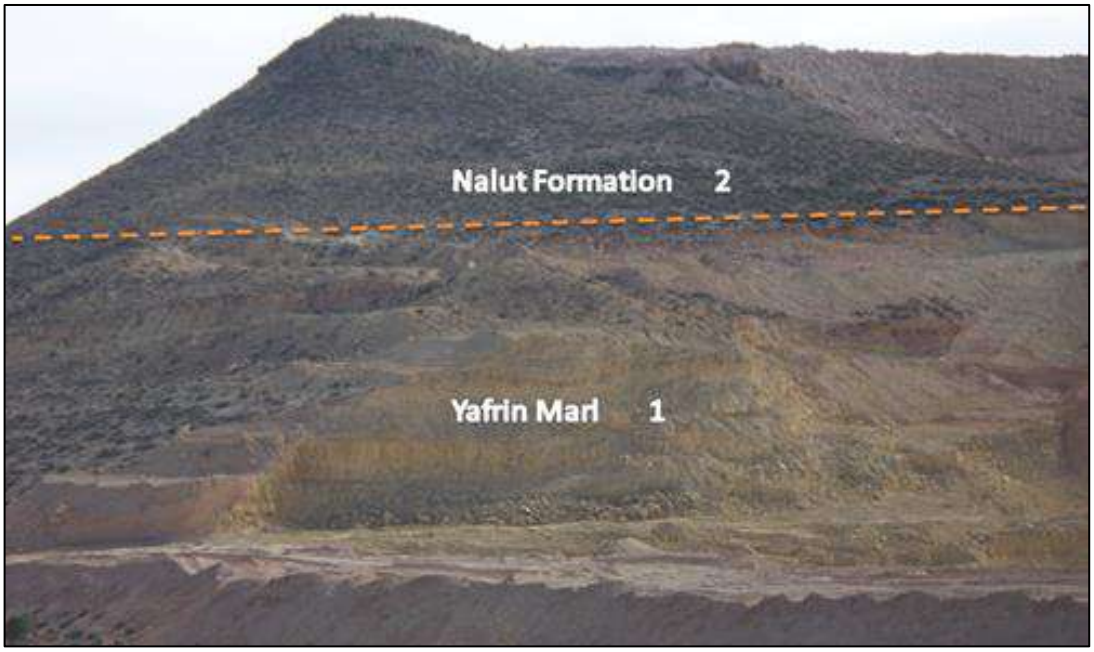


Photo 24. General view of 1 Yafrin Marl and 2 top of the Nalut Formation at the northern side of hill (5).

Stop 18: Nalut FM (32˚ 24` 26.5``N & 13˚ 09`24.3``E), elevation 225 m. a. s. l.

This stop is located on top of hill (6). It consists of well bedded white, light grey to grey and red massive dolomite and dolomitic limestone with very thin clays, and red barrcia, which may indicate channel lag deposit.

Photo 25. Brecciated bed in the Nalut Formation at hill (6).

Economic Geology:

All the formations of the area are important. The Ain Tobi Limestone produces stones good crushed stone are useful for building and for cement and lime industry. The Yafrin Marl produces crushed stones, which are useful for road building. The Nalut Formation produces stones from dolomite beds, which are useful for building.

Photo 25. View of industry of crushed stones in study area.

Summary and Conclusion

The study area has six isolated hills scattered near each other and surrounding by flat area of quaternary sediments. The Ras Quadah area consists of three units including: the Sidi as Sid Formation, which includes of two members; the Lower member is Ain Tobi Limestone, while the Upper member is Yafrin Marl, and the Nalut Formation at the top unit of the area.

It composed of different lithology carbonate sediments with different thickness. The Ain Tobi member occurred in the northern part of the area Hill 2 and Hill 3 below Yafrin Marl, indicate fault between these Hills. However, the area of the study affected probably by the Al Aziziah fault in the Miocene time to forms these hills trends NW -SE.

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