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The Eocene – Oligocene Facieses and Sedimentary Environments in Sardarreh Area, Garmsar

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Abstract

This research studies the Eocene – Oligocene facieses and sedimentary environments have in Sardarreh, Garmsar. Field studies were conducted to achieve this goal. So, 95samples were taken from the studied section. Because of the similarity of the samples, 49samples were selected for the preparation of thin sections. For facies interpretation and providing sedimentary model(Carruzi, 1989)(Flugel, 2011) and naming of carbonate rocks (Dunham, 1962) (Folk, 1962) and (Chen, 2011) were used. Thin section consists of: skeletal elements, including(Mollusks, Brakiopoda, Akinoderma, Foraminifera, Algae, Ostracoda, Gastropods) and Non-skeletal particles(pelloidy, intra-clast), Quartz(grains of sand), Gloconite, Feldspar, Chert, Gypsum, Salt, Anhydrite and facies's matrix are calcareous mud and micritic or Asparitic cement. These studies led to the identification and separation of 7carbonate and destruction facies that have deposited in 4 facies belt. Open marine facies includes: A1: Bio-clast pack stone. Barrier facies takes in: B1: Pelloid bio-clast grain stone. Pool facies holds: C1: Gypsi- ferrous marl, C2: Calcareous sandstone.Tidal facies zone comprises: D1: Sandy pelloid wack stone / pack stone, D2: Sandy intra-clast wack stone / pack stone and D3: Fenestral mudstone. Due to interpretation of these facieses and their environments, the ancient geographical situation of this area is characterized. This is a carbonate platform which is a kind of carbonate Rimmed shelf.

Keywords: Eocene–Oligocene facieses, sedimentary environments.

Introduction

The studied area is located 80km further from the southeast of Tehran, in the west, north and northwest parts of Garmsar province in the geographical limits of 1, 9 and 52 to 2, 10 and 52 of the eastern length and 3, 16 and 35 to 3, 17 and 35 of the eastern width. The studied area is placed in the southern parts of Alborz mountains and 15km away from the northeast of Garmsar(1-1). The studied Eocene – Oligocene facieses have an appropriate position in the above mentioned limit. In this section, the thickness of Eocene – Oligocene facieses reaches to 229/6m which are mainly consist of average layer of gray lime and thin sequential layers of Maroon, Indrite and Gypse.

Samples were collected by hammer, meter and compass in 1m intervals. Sampling is especially done in places where facieses and textural changes observed in less or more intervals. 90samples were taken.

Sampling operation is held in selected sections through measuring the apparent specifications of rock units and consequently, the layering slope, topographical slope, real thickness of each unit are calculated and the studied surface stratum columns is depicted, however, the thickness of some of the units which were ideal directly measured. The specifications of each unit are first introduced and then the sections are illustrated. The findings of Carruzi(1989) and Flugel(2010) are applied to interpret the facieses and present a sedimentary model and Dunham(1962), Folk(1980) and Cohen(2011) are applied to name carbonate rocks. The current

essay studies the characteristics of rocks, sedimentary facieses, the conditions forming such sediments and Curtase rocks in the studied area.

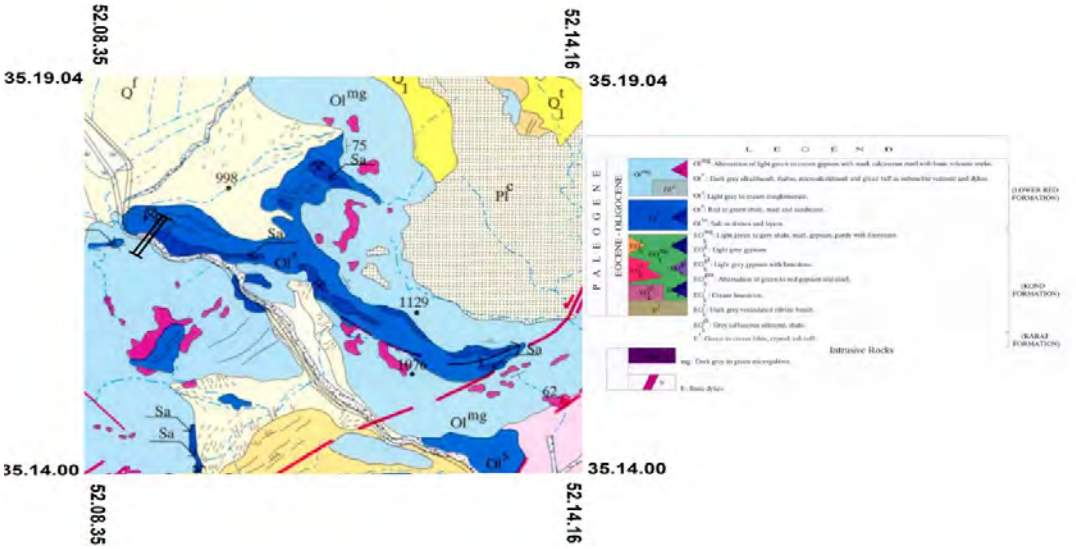


Figure 1: The geological map of the situation of Sardarreh cut on 1:100000 map of Garmsar

Figure 2: The manner of layering in the studied area

Stratumology

The cut taken mainly contains Maroon, Shill, Gypse, Indrite, lime, Maroon and Plaster, the path underneath is covered with Conglomera and impaired multi-Micro-Conglomera. Studies conducted on the sequence of evaporation in the intended area clearly demonstrate that a small evaporating basin is made in the area. Next, a compressive tectonic condition is dominated in Alborz and then a tensile basin is formed in the southern parts of Central Alborz for the sake of changes in the direction of eastern Alborz in comparison to western Alborz. In fact, a convenient environment is provided to form an evaporating sequence. In the studied area, small and floating particles of lime

stones are dispersedly over barriers which are the same as Ghom structure from the characteristics of rock point of view. The only difference is that the above mentioned lime stone is completely tectonized and broken into particles due to some salt dome movements. According to the presence of lime stone of Ghom on salt barriers, the diaperic sedimentation of this region is older than the lime stone of Ghom(Dorri, 1991).

Methodology

Field Work Studies

After the studies are done and data are collected, field studies are conducted and the most convenient stratum surface is selected for measuring and sampling. Samples were collected by hammer, meter and compass in 1m intervals sampling is especially done in places where facieses and textural changes observed in less or more intervals.

Laboratorial Studies

The sample chosen from the ground are analyzed by carbonate, destruction and evaporation facieses laboratorial studies and then the stratum columns are depicted in order to measure, interpret the sedimentary condition and also identify sedimentary facieses and carry out a sedimentary model related to these deposits in thin microscopic parts.

Describing Microscopic Facieses

Field studies and researches on the thin sections made from sedimentary- territiary evaporating facieses display that these facieses are made up of various facieses. The already mentioned facieses are mainly the carbonate and evaporating ones. They are named after Dunham's categorizing(1962). Carbonate facieses include mudstone, wack stone, pack stone and grain stone which shall be defined in this part due to their sedimentary conditions. Considerably, 95 samples were taken from the studied section. Because of the similarity of the samples, 49samples were selected for the preparation of thin sections. For facies interpretation and providing sedimentary model (Carruzi, 1989)، (Flugel, 2011) and naming of carbonate rocks and (Chen, 2011) were used. Holistically, such facieses form a carbonate rimmed shelf. This environment holds open marine, barrier environment, lagoon environment and the tidal one and every one of them has its own properties. Based on alukoms, orthokoms, sedimentary specifications embrace facieses that the very significant characteristics of theses facieses will be explained.

Open Marine Facieses Belt

There is not much energy in this environment and the sedimentary facieses are almost the same and are divided into semi-deep and deep areas and they hold bio-clast pack stone. The main constituents of these facieses hold bio- particles that some of them are tiny and unidentifiable. The identifiable ones include: bivalve, brachiopod, echinoderm, stracoda and miliolide. These particles hold supporting grain texture and are placed inside a micritic paste. There is a phenomenon called endomorphism which changes this paste into micro-spar. Since living things such as pelagic foraminifer, radiolarian and sponge spicule are absent, it is concluded that the forming environment is not deep. On the other hand, some of particles like alga are easily transported in the environment(Chen, 2011 and Flugel, 2010). Furthermore, they can be expanded and moved into open marine along with other components of the transported lagoon environments. The sediments related to these facieses are observed on the ground in from of yellow thin layer of micritic limes. According to the above properties, it is considered that these facieses are formed in a low depth of an open marine.

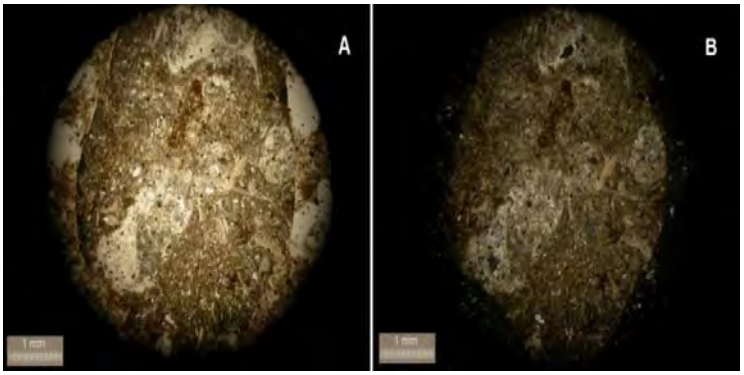


Figure 3: Facieses A1, Pack stone bio-clast A: natural light B: polarized light(magnitude 40X)

Barrier Micro-Facies

Barrier islands hold sand islands separating open marine environment from the lagoon one. Its shape is highly affected by wind, weather, the compression rate of sedimentation and the primary slope of the sedimentary basin. Barrier environments include grain stone/pelloid bio-clast.

Micro facies B1: pelloid bio-clast grain stone

This facies is mostly made up of biological parts including bivalve, echinoderm, stracoda and alga and other parts are pelloid which are placed in spratie cement. It is simply concluded that formation is done in a high energy environment because micrite is totally washed out of the grains and it is usually supplied in bio- accomolated to hydrodynamic built up(Carruzi ,1989, as cited in Shirzad, 2012). The sediments of this facies are seen in milk, sparite, thin and average layer of limes. Due to the above specifications, the environment in which this facies is formed is a barrier belt one (Figure 4).

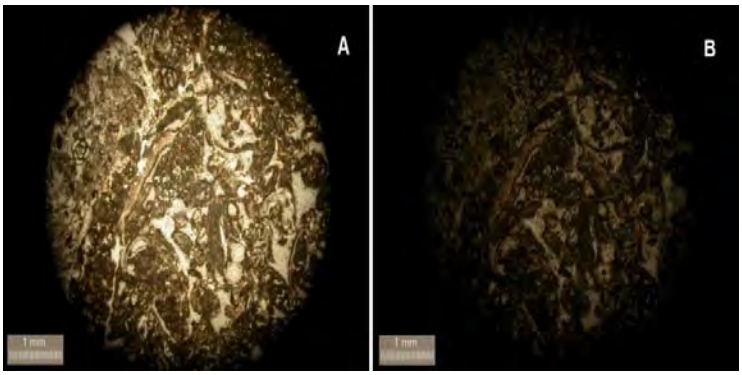


Figure 4: Facies B1, grain stone /pelloid bio-clast, a: natural light, B: polarized light(magnitude 40 X)

Lagoon Facies Bolt

Lagoon are referred to the under tidal areas placed behind barriers which might be formed by riffs or shoals. Living things habiting in lagoon and sediments settling in pacific areas greatly rely on the relationship between the marine water and barrier stability. The lagoon environment includes facieses of gypsi-ferrous marl, calcareous sand stone.

Micro Facies C1: gypsi-ferrous marl

According to the specifications observed in desert embraces azure and olive maroons and lime sand stones. According to the fact that analyzable thin sections are made from them, their desert images are presented.

Figure 5: Desert image of azure maroons holding C1 facies

Figure 6: Desert image of olive maroons holding C1 facies

Micro facies C2: calcareous sandstone

This facies is shaped by sand stones range from tiny to average grains(the grain diameter of grains is from 0.01mm to 10mcr) and it usually includes single crystal quartz with some chert, feldspar and mica placed in a carbonate paste(micritic). Moreover, gloconite grains are dispersedly observed. According to the fact that there is redundant quartz, it is called quartz wack. There grains are perfectly paired, however, they are not rounded well and the grains are mainly angular. It is implied that they are originated near basins and they are not transported and eroded. Sediments related to this facies are seen on the ground in form of gray and brown thick lime sandstones. Based on the above said properties, it is considered that this facies is formed in the lagoon belt(Musavi Herami, 2004).

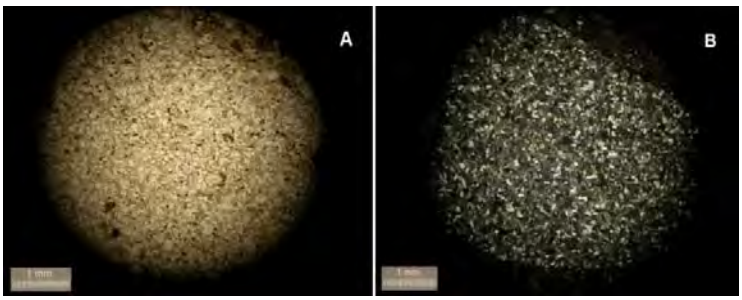


Figure 7: Facies C2, calcareous sand stone A: natural light, B: polarized light(magnitude 40X)

Tidal Flat Facies Belt

Tidal flat facies are areas that are constantly covered with water and are affected by the weak flows of waves. These areas are vastly expanded over epirick platforms. They are typically formed in the slope of coastal barriers around lagoons along the coastal strips of plateaus and ramps with low energy. In the studied area, D1, D2 and D3 facieses are observed as below.

Micro-facies D1, sandy pelloid wack stone / pack stone

The main components of this facies are mostly tiny and partial pelloid and sand grains. Since the texture of these components is grain like, the paste support is placed in the micritic field. As pelloid look irregular and reflect various sizes and there is intra- clast in adjacent facieses, it seems that these pelloid come from crumpled and eroded intra-clasts. As a result, their type is lithic pellet. Sand grains are made of single quartz and chert and are mostly angular. The paste which is present amongst grains is seen as micro spar because of neo-forming phenomenon. In desert, the sediments of this facies is observed as thin olive color lime stones. Considering the above mentioned facts, sub tidal regions are detected as the formation place of this facies(Flugel, 2010, quoted by Mohammadi 2003).

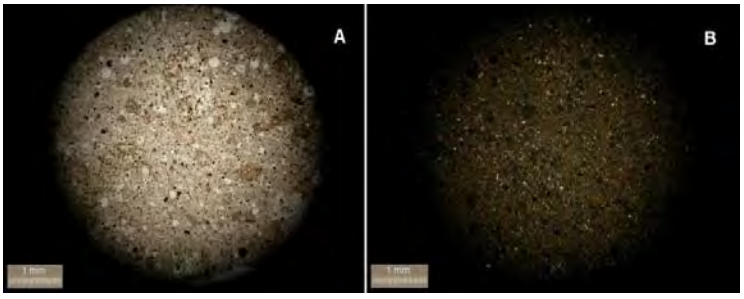


Figure 8: Facies D1, wack stone/ sandy pelloid pack stone A: natural light, B polarized light, magnitude(40X)

Micro facies D2: sandy intra-clast wack stone / pack stone

The main constituents of this facies are intra- clast grains and the partial components contain sand grains and some pelloid. These components hold a grain like texture and are placed in the micritic field with paste support. Intra- clast grains hold micrite or mudstone texture. In addition, they might be formed through turning half- tough supra tidal sediments affected by moving from water and getting dried. The disturbance and collision of the environment make the grains in intra tidal gradually lose their corners and have been approximately rounded. Furthermore, some of them get tinier and smaller and they are changed into stone plates. The sand grains are made of both mono and multi-crystal quartz in middle size. Considerably, they are seen in both round and angular

shapes. The paste is found as micro- spar and pseudo spar for the sake of neo-forming. The sediments related to this facies are usually seen in shape of thick layer of gray lime stone. According to the above observations, the condition forming this facies is considered a limit between the tides.(Flugul, 2004).

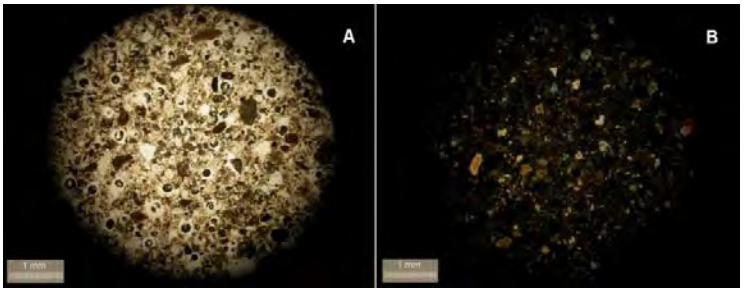


Figure 9: Facies D2, wack stone/pack stone, intra clast A: natural light, B: polarized light(magnitude 40X)

Micro-facies D3: fenestral mud

This facies is seen in form of carbonate or a micrite with the lack of grain or alucom. Neo-forming phenomenon leaves a specific effect on this facies and it is changed into a micro-spar. Fenestral holes are very remarkable and they are sometimes attributed to the moulds left by evaporated minerals and in some cases made by holes of the gas rising from the spoiled organic deposits. On the other hand, tiny romboedric crystals dolomite are dispersedly seen. The sediments of this facies are observed as olive or gray micrite lime stones. The above outcomes reveal that this facies is formed in supra tidal.

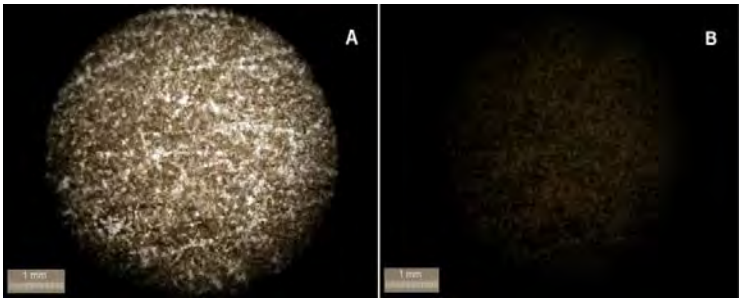
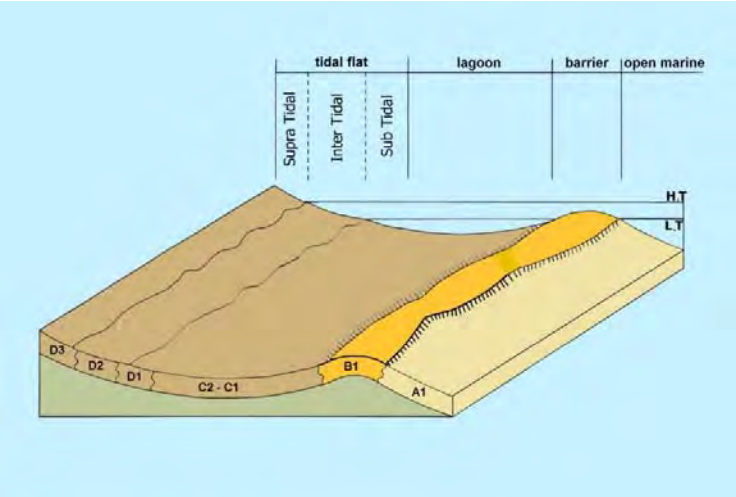


Figure 10: FaciesvD3, fenestral mudstones A: natural light B: polarized light(magnitude 40X)

Sedimentary Environment of Eocene – Oligocene Facieses in Sardarreh Area, Garmsar

The arrangement of micro-facieses feature out an ideal vertical sequence. This sequence shows a relative reduction of depth starting from the facies of lower part of slope of open marine and ending to tidal facieses. Based on superposition, studying the relationship between micro-facies forming the units create an ideal shallow upward sequence and their environment. Following Walter's principles and scientific sources such as Carruzi(1989), Flugel(1982,2010), Reading(2001), Wilson(1975) and Chen and Wang(2011) quoted by Mohammadi(2013) and comparing it to the modern environment all directed into rebuilding to sedimentary facieses of Eocene – Oligocene in Sardarreh, Garmsar. This model holds an open marine and a surrounded one(lagoon) separated by a barrier from one another and each one of these facieses have their own specifications. However, it is necessary to regard that in the studied samples, the facieses related to the deep area of the open marine haven't been observed(micro-facies number A1) and the deepest facies belongs to the

shallow part of the open marine. Next, the depth is gradually reduced and moves toward the facieses related to environment with more energy till they get to a barrier belt exposed to waves and flows. Micro-facies number B1 is identified as the most energetic facies. Special facies with the limited rotation of water are seen at the banks. Remarking the redundancy of their components, they are placed in behind the barrier, lagoon bank and the area between the tide and finally the facies of carbonate mudstone is set in super tidal. The figure below illustrates the three dimensional situation of theses facieses(Shirin 2012).



A1: bio-clast pack stone
B1: pelloid bio-clast grain-stone
C1: gypsi-ferrous marl
C2: calcareous sandstone
D1: sandy pelloid wack stone / pack stone
D2: sandy intra-clast wack stone / pack stone
D3: fenestral mudstone

Figure 11: The three dimensional sedimentary model of Eocene – Oligocene facieses in the studied area

Conclusion

Studies on the Eocene - Oligocene stones in the studied area(Sardarreh village) have conducted the following results:

1. Evaporating sediments and the Eocene – Oligocene carbonate mark the thickness of 229/6m. They are first identified and then classified in 7facieses in form of 4belts of facieses. In fact, they belong to environments including open marine, barrier, lagoon and tide which they have been first studied and identified in this area.

2. The constituents of thin parts are: the skeletal components(Bivalve, Gastropod, Brachiopod, Echinoderm, Briozua, Algae and Ostracoda), Non- skeletal particles contain(plate and pelloid, intra-clast) and non-lime stone hold maroon grains(Quartz, Mica, Feldspar, Chert, Gypse and Indrite) and gloconite is in the field of micritic and spar cement. They are first scrutinized in this area.

3. The facies of the open marine includes:

A1: bio-clast pack stone

Barrier facies embraces:

B1: Grain stone/pelloid bio-clast
Pool facies includes:
C1: Pool facies.
C2: Calcareous sandstone.
Tidal facies zone holds:
D1: Sandy pelloid wack stone / pack stone.
D2: Sandy intra-clast wack stone / pack stone.
D3: Fenestral mudstone.

4. No one has ever reported these facieses in this region. It is inferred that the paleontology of the geographical situation of the studied area at the time of Eocene - Oligocene sedimentation is carbonate rimmed shelf according to comprehensive analyses on stratum column, carbonate micro - facieses and their related environments. An apparent slope change is observed between the interior region of the continent plateau and the deeper water of the outside part in many of today's carbonate platforms. This slope change makes a specific area containing high energy where waves greatly affect it. A shallow rough and stormy environment is very appropriate for riff making creatures because they are away from muddy sediments. In case there are not any coral riffs, skeletal and oedie deposits create marine sand which they can make certain barriers. These rimmed platforms are half- continual or they hold a barrier parallel with rims. The section toward the dry part of the barrier is placed beside a low energy pool and it is further from open ocean and it might comprises a width of some hundred meters or tens of kilometers(Batmann Ghlich, 2012).

5. It is proved that marine started to advance at Eocene - Oligocene through studying stone facieses and according to the formation of evaporating and marine lime stones on conglomera to micro-conglomera and continental impairment.

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