Microfacies, diagenesis processes and reservior characterization of the Dariyan Formation in subsurface section (X1 well) in the Salman Oil Field (Persian Gulf)

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Abstract

The Dariyan Formation (Aptian) is one of the important hydrocarbon reservoir rocks of Khami Group in the south west of Iran. As exact evaluation of reservoir rocks is possible through of microfacies, sedimentary environment, diagenesis processes and reservoir charecterization analysis, by this way, the subsurface section (X1 well) of Dariyan Formation in Salman Oil Field, is located 144 km south of Lavan Island (Persian GulF) with the mentioned aims was selected and considered. This Formation in subsurface section (X1 well), with 105 meters thickness, include limestone with interbeds of shale. Dariyan Formation in mentioned section has transitional contacts with the Gadvan Formation in the lower boundary and disconformity contacts with the Khazhdumi Formation in the upper boundary. Extended microscopic assessment of the Dariyan Formation deposits in mentioned section led to recognition of four facies groups related to environments, open marine (A), bar (B), lagoon (C)and tidal flat(D). Most important diagenesis processes in understudy subsurface section are cementation, dolomitization, micritization, stilolitization, bioturbation, compaction and porosity. Diagenesis processes could have destructive or creative role to increase the quality of reservoir. Cementation and dolomitization respectively are the most important detracting and increasing diagenesis processes in quality of reservoir. Assessment of porosity and permeability according to distribution of microfacies and drawing diagrams, indicate that microfacies C1 realated to lagoon, has the best quality of reservior in this Formation and most of the porosities in understudy well are intergranular and intercrystalline. Assessment The vertical and lateral changes and comparing it with modern and ancient sedimentary environments indicate that the facies of Dariyan Formation in understudy section were deposited in a carbonate shelf.

Keywords: *Microfacies; Sedimentary environment; Diagenesis processe; Reservior characterization; Dariyan Formation and Salman Oil Field;*

Introduction

The Dariyan Formation (Aptian) is a major hydrocarbon reservoir rock of khami group in the south west of Iran. The limestone of Dariyan formation and are considering a rock reservoir. In order to the importance of the mentioned reservoir, facies identified, the conditions of forming and type of sedimentary environment that appear the depositional rocks of this formation is so important. In the past years, the studies on the Dariyan Formation was must about Fossil and public Stratigraphy. (For example: James and Wynd, 1965; Motiei, 1372). But in recent years facies, sedimentary environments and sequence Stratigraphy of this formation in various parts has been studied. (For example: Lassemi & siahi, 1384; Lassemi & Ahmadi, 1385; Barzegar Zandi et al, 1385; Moatari Kazerouni, 1383). The purpose of this

study is examinig microfacies, sedimentary environment, diagenesis processes and reservoir charecterization in X1 well in Salman Oil Field, Persian Gulf.

Location

Salman Oil Field is located, 144 kilometers south of Lavan Island in the shared border of Iran and United Arab Emirates. This field was discovered by Lapco company in 1344 and production of that, was started in 1347. The studied well is located in north west of Salman Oil Field (Figure-1).

Methods

In this study, the 76 number of microscopic thin sections which are made from core in mentioned well has been studied. Microscopic thin sections from different directions, especially the amount and type of skeletal and non-skeletal components, matrix, features and diagenesis, review and then by using Dunham classification (Dunham, 1962) names are marked. In Describing, classifying and interpret the facies and sedimentary environment from various sources (for example: Carozzi, 1989. Flügel, 1982, 2004) is used.

Microfacies and sedimentary environment

Review deposits related to Dariyan Formation in Salman Oil Field led to identifying the four facies open marine (A), bar (B), lagoon (C) and tidal flat (D) is the following:

Open marine facies group (A)

open marine facies group contain microfacies A1: (Bioturbated bioclast lime mudstone/ shale) (Figure2-A&B), microfacies A2: (Foraminifer pelanktonic bioclast wackestone) (Figure2-C), microfacies A3: (Bioturbated bioclast wackestone/packstone) (Figure2-D&E) and microfacies A4 (Calciturbidite). (Figure2-F).

Bar facies group (B)

Bar facies group includes microfacies B1: (Bioclast peloid grainstone) (Figure3-A) and microfacies B2: (Peloid grainstone) (Figure3-B).

Lagoon facies group (C)

Lagoon Facies group is formed of microfacies C1: (Bioclast lime mudstone) (Figure3-C), C2: (Bioclast wackestone) (Figure3-D), C3: (Bioturbated intraclast bioclast peloid wackestone) (Figure3-E) and C4: (Bioclast peloid packstone) (Figure3-F).

Tidal flat faciesGroup (D)

This group consist of microfaciesD1: (Bioclast peloid wackestone with mud-crack) (Figure 4-A) and microfacies D2: (Bioclast peloid packstone/grainstone with key stone vugs) (Figure 4-B, C & D).

Sedimentary model

The Walter law always in sedimentary model is in consideration. According to Walter law the facies that repose to each other like sequence, have been together at the time that they formed It should be noted that only the include this law, which have sediment continuity and there is no an important discontinuity between the two facies. With the regard to Walter law and true recognition of connection and situation from facies, can offer a good model and presentedthe especial facies in unknown region. Study facies and sedimentary environment of Dariyan

Formation in mentioned section showed that the major mentioned facies have been deposited in open marine environment and with calciturbidite facies can be concluded that the facies of Daiyan Formation in X1 well section have been deposited in a carbonate rimmed shelf.

Diagenesis Processes

Overall diagenesis events cause chemical changes in the distribution of elements and minor changes in the structure and component of carbonate and changes in texture and carbonate minerals. They are obtained by compaction affected or chemical heterology. The most important diagenesis processes in studied subsurface section are cementation, micritization, dolomitization, pyritization,stilolitization, bioturbation, compaction and porosity. Mechanical compaction lead to closer arrangement of grain and the porosity. Chemical compaction is caused forming seam solution and stilolite. Piritization are seen like cubic grains and crystals. (Figure 5,6&7)

Reservior characterization of Dariyan Formation

In order to investigate the reservoir characterization in subsurface section (X1 well) the chart of porosity - permeability of microscopic facies distribution were analyzed. Due to figure-7 and distribution of the data, 3 trend is recognizable (Rezaei, 1384) (figure-8&9).

Trend-1: in this processes, by changing low porosity, permeability will increase to large. This trend have the most effect due to increasing permeability in increasing the reservoir quality, only microfacies C1 shows the same processes (chart-1).

Trend-2: This trend indicates that permeability changes with porosity is systematic, to show by increasing porosity, permeability will also increase. In order to increase the quality of reservoir, this type of porosities are important in the second degree than the porosities that caused by fractures. Microfacies A1,A2,A3,A4,B1,B2 and D2 are consistent with the trend 2 (chart-2).

Trend-3: this process show that by increasing porosity, permeability is almost constant. This type of porosities, have the least role on reservoir quality (chart-3). This processes contain microfacies C2,C3 and D1.

Conclusion

The deposit rocks of Dariyan Formation in subsurface section X1well have been deposited in four facies group open marine (A), bar (B), lagoon (C) and tidal flat (D). Review of vertical and lateral facies changes and compare it with modern and old sedimentary environment show that the facies of Dariyan Formation facies in studied well with calciturbidites have been created in a shelf carbonate platform. The most important diagenesis processes in studied sections are cementation, micritization, dolomitization, stilolitization, pyritization, compaction, bioturbation, porosity and dissolution. by study the permeability and porosity and distribution of microfacies in the drawing diagrams, can be concluded that the microfacies C1 (bioclast lime mudstone) related to lagoon, due to the porosity caused by fracture have the most quality of reservoir. It should be mentioned that attention to the drawing charts, the major type of porosity in Dariyan Formation is intergranular and intercrystalline. (microfacies A1, A2, A3, A4, B1 B2 and D2). Microfacies C2, C3 and D1 contain the reservoir quality.

Resource

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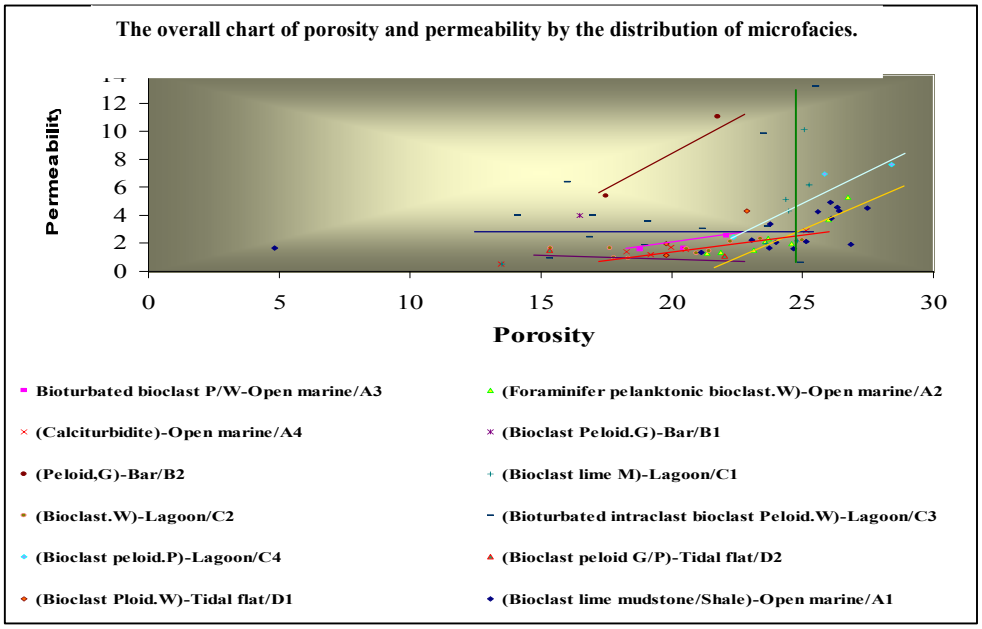
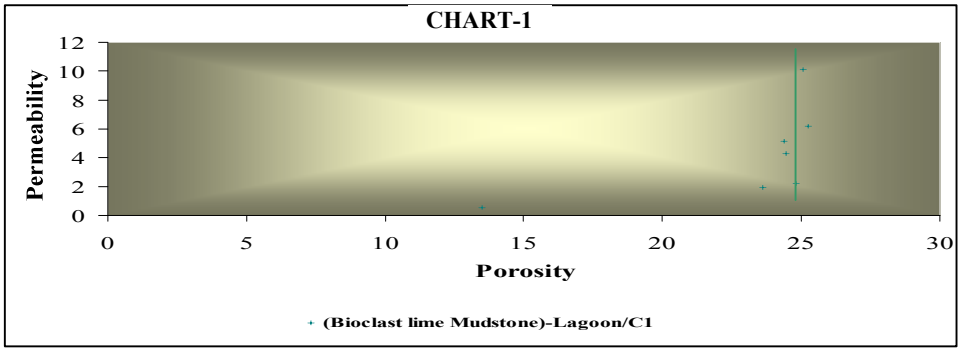
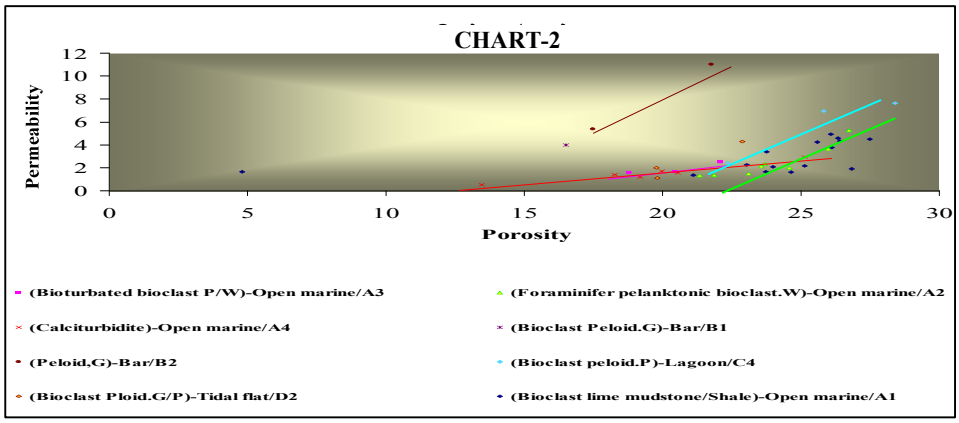


Figure8- Realationship between porosity-permeability with the microscopic facies in X1 well in Salman Oil Field, Persian Gulf





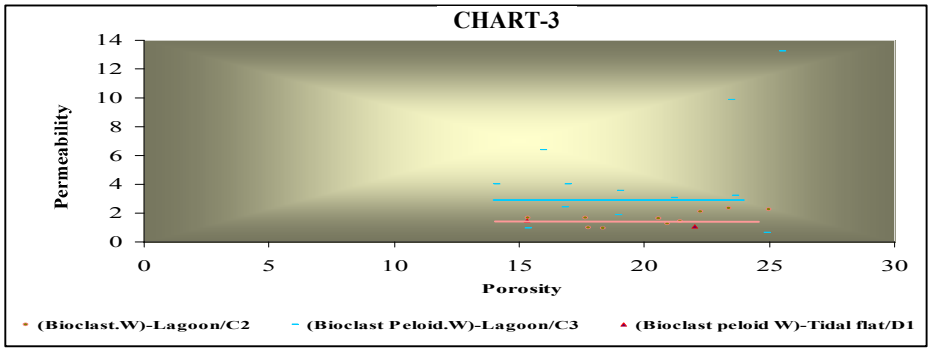


Figure9- Evaluation of reservoir characterization with the trend of changing porosity-permeability in different microscopic facies.

Chart-1 is realated more to the porosities that caused by fractures and have the most effect due to increasing permeability also in increasing the reservoir quality. Chart-2 shows that with increasing porosity, permeability is also increase and it will be realated to the intergranular and intercrystalline porosities. Chart-3 shows that by increasing porosities, permeability is almost constant and this processes realated to disconnected prosities.

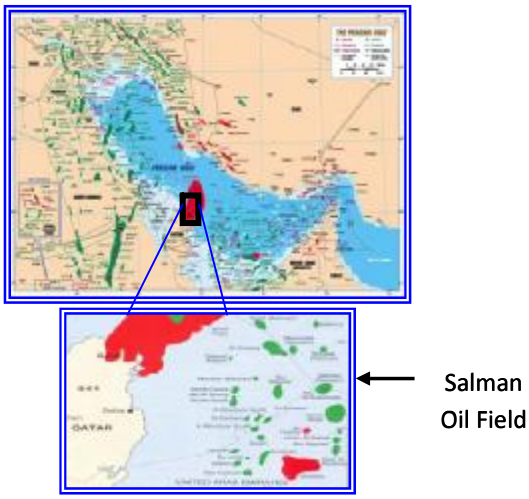


Figure-1 Geographical situation of Salman Oil Field (borrowed from Iranian Off shore Oil Company Reports).

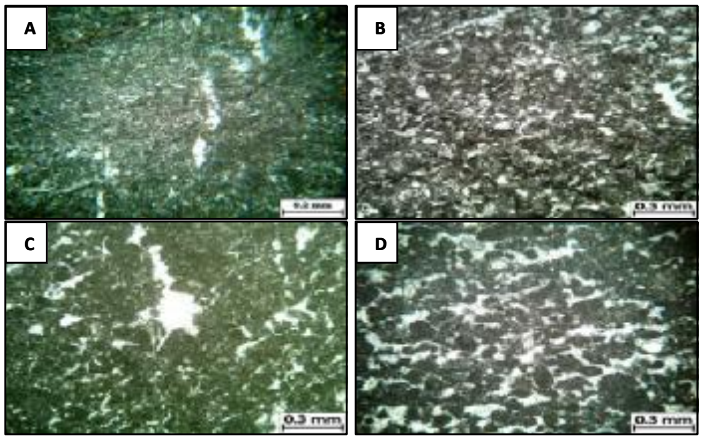


Figure 4-.(A) microfacies D1: bioclast peloid wackestone with works like mud-crack. (B,C&D) microfaciesD2: bioclast peloid grainstone/packstone with keystone vugs.

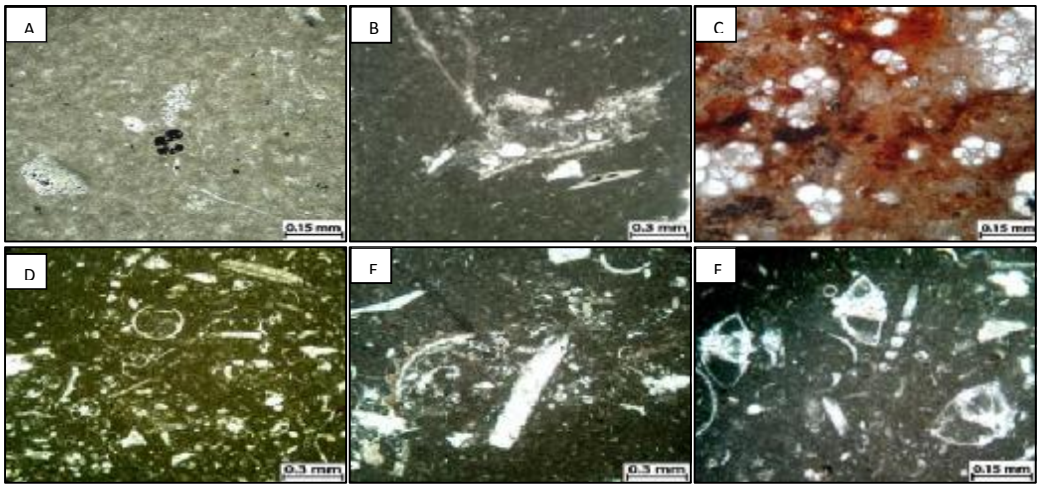


Figure 2- (A) microfacies A1: bioclast lime mudstone. (B) microfacies A1: bioturbation fabric in lime mudstone. (C) microfacies A2: pelanktonic foraminifer bioclast wackestone, the main skeletal allocheme in this microfacies is pelanktonic foraminifer. (D) microfacies A3: bioclast packstone/wackestone, including pelecypod, pelanktonic foraminifer, gastropod and echinoderm. (E) microfacies A3: bioturbation fabric. (F) microfacies A4: calciturbidite, the mixture of benthic foraminifer, the allocheme from shallow sea environment with the pelanktonic foraminifer, the allocheme from deep sea environment have seen.

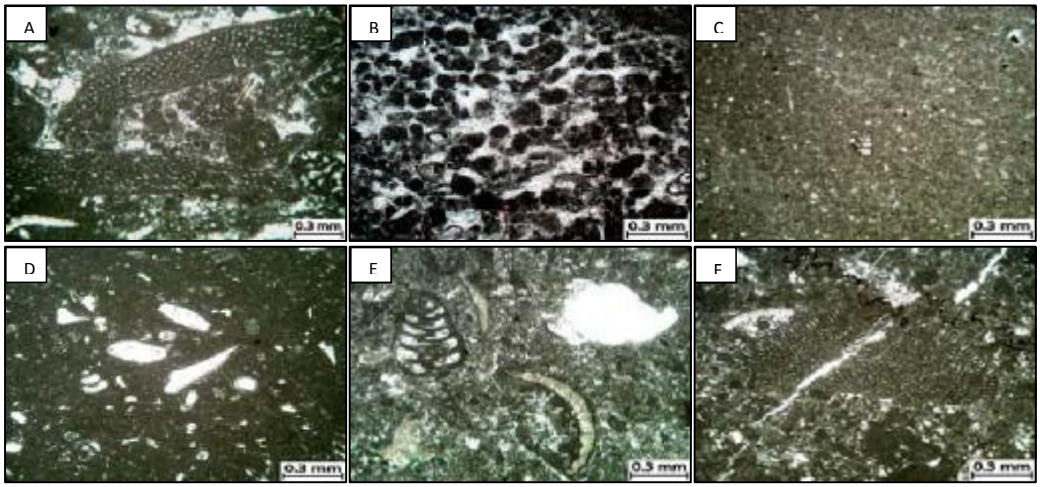


Figure 3- (A) microfacies B1:bioclast peloid grainstone. (B) microfacies (B2): peloid grainstone. (C) microfacies C1: bioclast lime mudstone, a little benthic foraminifer has been seen. (D) microfacies C2, bioclast wackestone. (E) microfacies C3: bioclast peloid wackestone, in this image benthic foraminifer with pelecypod and peloid (non-skeletal grains) have observed. (F) microfacies C4: bioclast peloid packstone

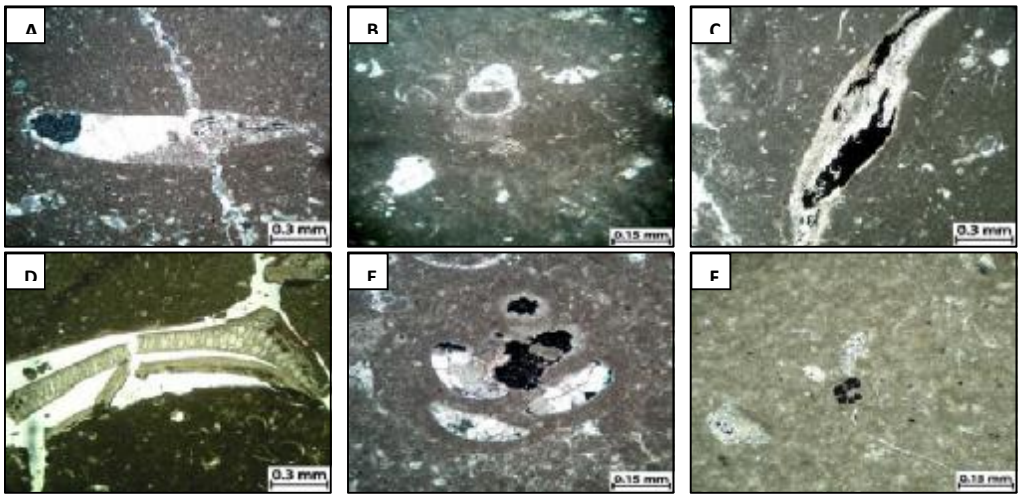


Figure-5 (A): Compaction processes. (B):Geopetal fabric. (C): Hematitization in a shel fragment. (D): Compaction processes and the bioclast is breaking. (E): Intergranular porosity and cementation. (F): Pyritization.

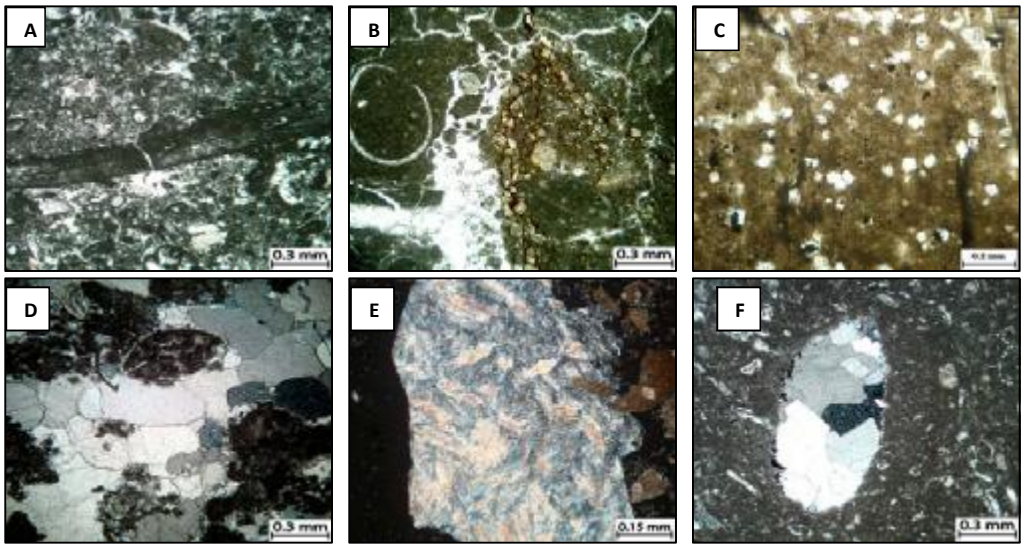


Figure-6 (A): Micritization. (B): Chemical compaction and forming the stilolite. (C): Dolomitization. (D): Forming calcite cement caused by dissolution. (E): Anhydrite cement. (F): Bioclast dissolution and succession with coarse calcite crystal.

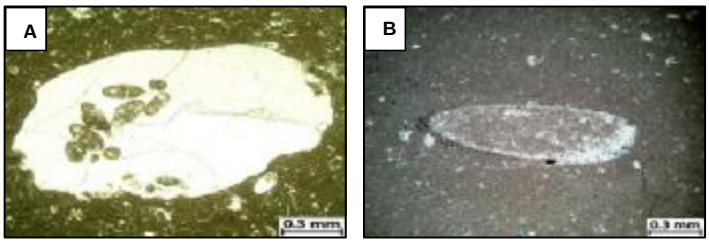


Figure-7 (A): Boring processes. (B) Bioturbation.