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APPENDIX 1

Petrographic Description of the Various Units of the Asmari Formation in Karun-3 Dam

Lower Asmari (As..1)

A (Crossed nicols)- Pelmicrite, Wackestone, Coarse subhedral to euhedral cement calcite crystals (Drusy calcite spar) within fracture cavity well developed, it is a characteristic pore-filling cement with an increasing crystal size towards the cavity centre one further feature of drusy calcite spar is the presence of growth zones, X10.

B- Intrabiomicrite, Wackestone. Vuggy and intraparticle porosity, with various shaped micritic and microsparitic intraclasts. Foraminiferal chambers mainly filled by micritic and microsparitic calcite cement. The organic constituents are mainly *Planktonic Foraminifera with axial and tangential sections such as Globigerina sp., Ostracoda shell and skeletal debris*, X10.

C- Intrabiomicrite, Wackestone to Packstone. Vuggy porosity partly filled by sparry calcite cement with irregular shaped of small microsparitic intraclasts. The recognizable organic components are *Foraminifera shell such as Rotalia sp. Bivalve shell fragment showing a finely prismatic calcite microstructure*, small circular black structures are *microborings, Echinoid shell fragments and Echinoid spines in cross section*. The *Echinoid spines* wall zone consists of wedge shaped radial elements which widen toward the periphery, *Dasyclad green calcareous Algae and some small skeletal debris*, X10.

D (Crossed nicols) - Intrabiomicrite, Packstone. Fracture porosity which filled partly by microsparitic calcite cement. With irregular shaped of micritic and microsparitic intraclasts. The organic components are *Echinoid spines in oblique section and small skeletal debris*, X10.

Upper Asmari (As..2)

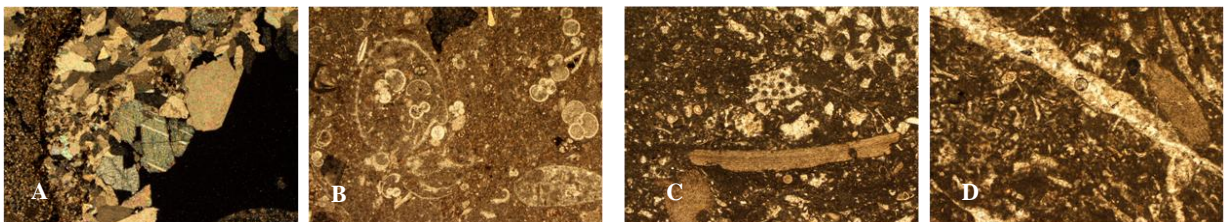
A- Intrapelmicrite, Wackestone. Vuggy porosity partially filled by microsparitic calcite cement, with subangular sparitic intraclasts. Locally recrystallization of micrite to microsparry calcite, X10.

B- Biomicrite, Mudstone. Micritic limestone, Poor porosity, with subrounded microsparitic intraclasts. The organic constituents are mainly *Planktonic Foraminifera such as Globigerina sp.*, X10.

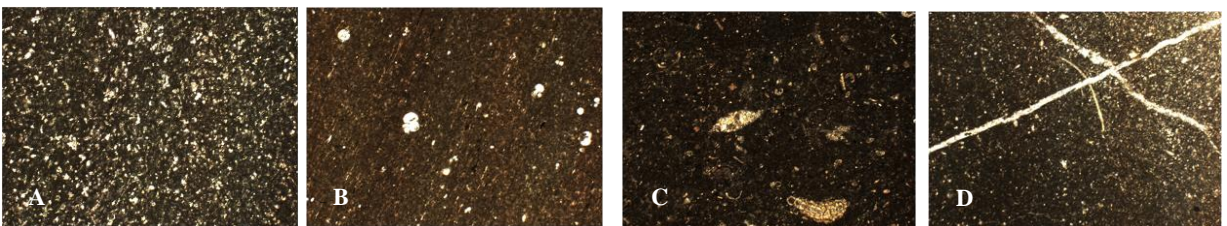
C- Biointramicrite, Wackestone. Poor porosity with irregular shaped of micritic and microsparitic intraclasts. Locally recrystallization of micrite to microsparry calcite cement. The organic components including *Foraminifera shell such as Miogypsina sp. and abundant minute debris belonging to Planktonic Foraminifera (Globigerina sp.)*, X10.

D- Biointramicrite, Wackestone. Fracture and vuggy porosity, conjugate set of fracture veins partly filled by microsparry calcite. With various shaped of micritic and microsparitic intraclasts. The organic constituents including some *Bivalve shell fragments*, X10.

Lower Asmari (As.1)



Upper Asmari (As.2)



APPENDIX 2

Petrographic Description of the Various Units of the Asmari Formation in Karun-4 Dam

Lower Asmari (As.1)

A- Intrapelbiomicrite, Packstone. Intraparticle and fracture porosity that partially filled by micritic and microsparitic calcite cement. With sub angular and irregular shaped of micritic intraclasts. He recognized fauna are mainly *Foraminifera shells such as Operculina sp. (axial and sub equatorial sections), Ditrupa sp. (transverse section) and small skeletal debris*, X10.

B (Crossed nicols) – Biointramicrite, Wackestone. Vuggy porosity that in some small parts filled by microsparitic calcite cement. With various shaped of micritic to microsparitic intraclasts. The organic constituents are *Foraminifera shell such as Operculina sp. and small skeletal debris*, X10.

C (Crossed nicols) – Biopelmicrite, Wackestone. Fracture porosity that filled by coarse blocky/ granular calcite cement, Vuggy porosity. The organic elements are *Echinoid Shell fragments, calcareous Red Algae and some rare Foraminifera tests*, X10.

D - Biointramicrite, Packstone. Fracture/ Channel porosity. With irregular distributed subangular sparitic and microsparitic intraclasts. The recognized organic components are *Foraminifera shell such as Lepidocyclina sp., Elphidium sp., Echinoid shell fragments and small skeletal debris*, X10.

Middle Asmari (As.2)

A- Dolomicrosparite. Fracture/ Intercrystalline porosity, the micritic cement relatively replaced by dolomicrosparitic granular cement. The coarse rhombohedral crystals of dolomite due to dolomitization are relatively well developed specially in the cavities. The bioclasts are composed of some *Echinoid shell fragments*, X10.

B- Biodolomicrosparite, Wackestone. Intercrystalline porosity. Dolomitization extensively developed throughout the rock, the coarser rhombohedral crystals of dolomite locally growth in cavities. The bioclasts are partly affected by dolomitization and comprised of rare *Foraminifera shell such as Miliolide (Quinqueloculina) and Rotalia sp.*, X10.

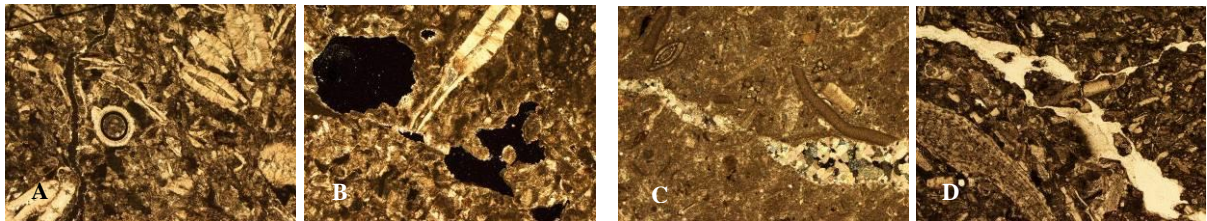
C- Biointramicrite, Wackestone. Vuggy porosity. With irregular shaped of dark micritic intraclasts. The matrix locally influenced by dolomitization (small rhombohedral crystals). The organic constituents are mainly *Foraminifera shell such as Peneroplis sp., Quinqueloculina, Biloculina (Miliolide) and skeletal debris*, X10.

D- Biointramicrite, Wackestone. Vuggy porosity. With micritic intraclasts. The matrix locally changed to microsparitic calcite cement. The identifiable organic components are mainly *Foraminifera such as Austrotrillina sp., Quinqueloculina, Biloculina (Miliolide) and some skeletal debris*, X10.

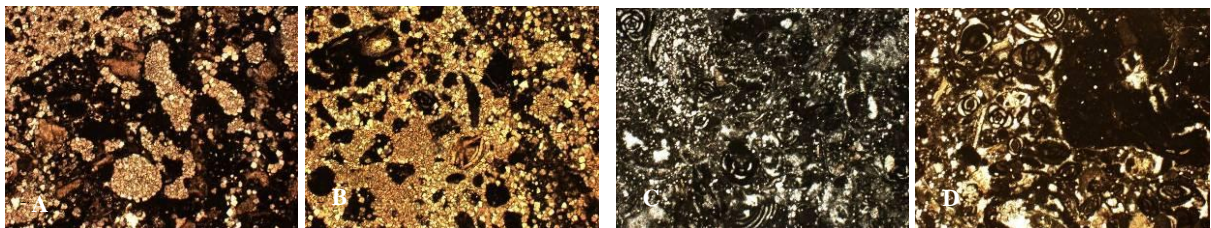
Upper Asmari (As.3)

A, B, C, D- Intra biomicrite, Mudstone to Wackestone. Fracture/ Vuggy porosity, that partly filled by microsparitic calcite cement. With rare and small rounded intraclasts. The Foraminiferal chambers also filled with sparry calcite cement. The recognizable microfauna are mainly *Planktonic Foraminifera shell such as Globigerina sp.*, X 10.

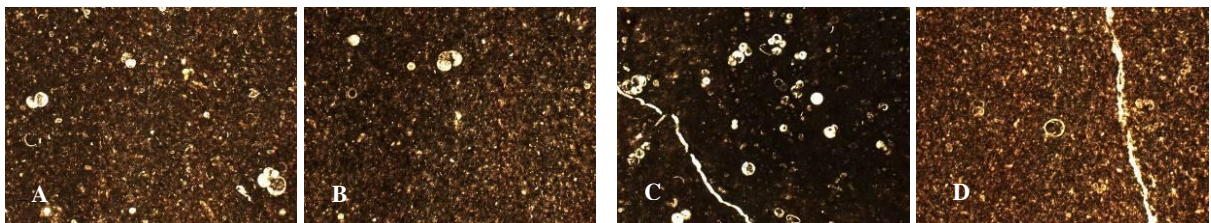
Lower Asmari (As.1)



Middle Asmari (As.2)



Upper Asmari (As.3)



APPENDIX 3

Petrographic Description of the Various Units of the Asmari Formation in Marun Dam

Lower Asmari (As.1)

A- Intrabiomicrite, Packstone. With subangular microsparitic intraclasts, Intraparticle and vuggy porosity. Organic constituents are *Asterigerina sp.*, *Rotalia sp.*, *Miogipsina sp.*, *Biloculina*, *calcareous Red Algae* and *some skeletal fragments*, X10.

B- (Crossed nicols) - Biointramicrite. Packstone, high porosity, vuggy to channel, cavities filled partly by microsparitic calcite cement, the identifiable organic components are *Echinoid shell fragments*, X10.

C- Intrabiomicrite, Wackestone. Cavities filled by coarse sparry calcite vein. Organic constituents are *Foraminifera shell comprises of Peneroplis sp.*, *Biloculina (Miliolide)*. All foraminifer's chambers are filled by microsparry calcite cement, X10.

D- Intrabiomicrite, Packstone. With some irregular shaped of microsparitic intraclasts. Vuggy and Intraparticle porosity, the porosity partly filled by calcite cement. Organic components are *Foraminifera species comprises of Haplophragmium sp.*, *Biloculina* and *some skeletal debris of Pelecypoda shell*, X10.

Middle Asmari (As.2)

A- Pelbiomicrite, Packstone. Vuggy to channel porosity partly filled by sparry calcite cement. Organic constituents comprises of *Peneroplis sp.*, *Calcareous Algae* and *skeletal debris*, X10.

B- Biomicrite, Wackestone. Vuggy porosity, cement locally changed to the microsparry calcite (sparry patches). Organic components are *Foraminifera shell such as Biloculina, Quinqueloculina, and some skeletal debris*, X10.

C- Biomicrite, Wackestone. Vuggy porosity, micritic cement partly changed to microsparry calcite (sparry patches), organic constituents are comprise of *Calcareous Red Algae and skeletal debris*, X10.

D (Crossed nicols)- Biomicrite, Wackestone. Fenestral porosity, some cavities are filled by microsparry calcite cement. Organic constituents are *Calcareous Algae and some skeletal debris*, X10.

Upper Asmari (As.3)

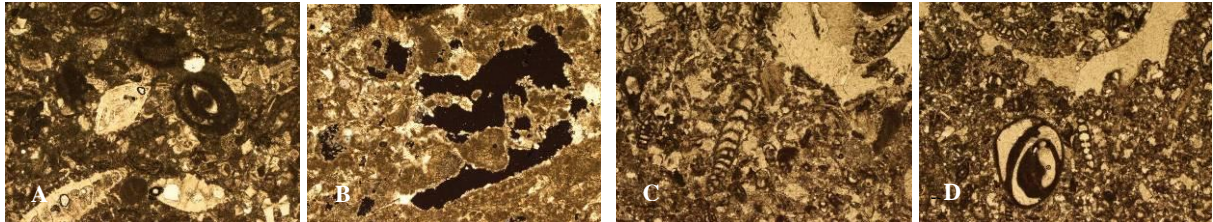
A- Intrabiomicrite, Wackestone. Vuggy porosity, organic constituents are *Echinoid shell and spines, and Foraminifera shell*, X10.

B- Pelbiomicrite, Wackestone. Fracture porosity, partly filled by coarse sparry calcite cement. The identifiable Bioclasts are *skeletal debris*, X10.

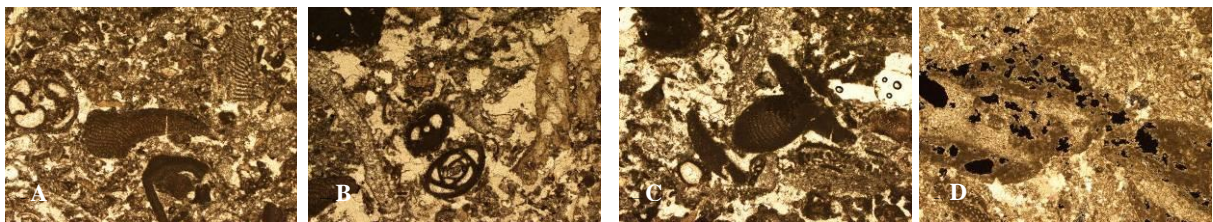
C- Pelbiomicrite, Wackestone. Vuggy and Intraparticle porosity. The identifiable organic constituents are *Foraminifera shell such as Dendritina sp. (equatorial section), Quinqueloculina, and fragments of Echinoid shell*, X10.

D (Crossed nicols), - Pelbiomicrite, Wackestone. Fracture porosity. With small microsparitic intraclasts, bioclasts are *skeletal debris*, X10.

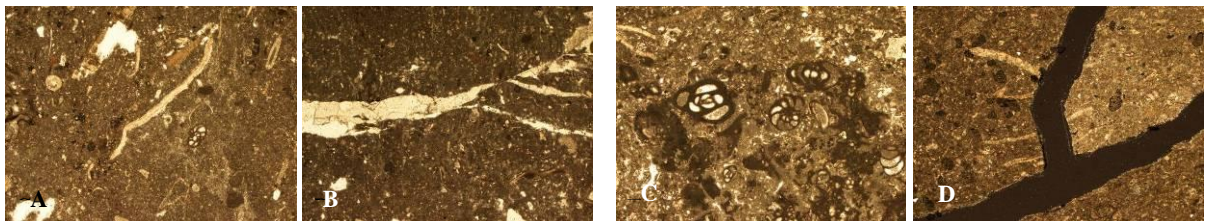
Lower Asmari (As.1)



Middle Asmari (As.2)



Upper Asmari (As.3)



APPENDIX 4

Petrographic Description of the Various Units of Asmari Formation in Seymareh Dam

Lower Asmari – As.1

A (Crossed nicols), – Intrabiomicrite, Packstone. Vuggy porosity, with irregular shaped of micritic intraclasts, the cavities partly filled by sparry calcite cement. The identifiable organic constituents are *Foraminifera* such as *Archaias* sp., *Quinqueloculina*, *Triloculina* (*Miliolides*), *Calcareous Red Algae*, and some *skeletal debris*, X 10.

B- Intrabiomicrite, Packstone. Vuggy porosity, the organic constituents are *Corals* (transverse section) and some *skeletal debris*, the coral chambers are filled by micritic and sparry calcite cement, X 10.

C- Intrabiomicrite, Packstone. Vuggy porosity, cavities filled by coarse blocky/granular calcite cement, with subrounded microsparitic intraclasts. *Bioclasts* are *Foraminifera* such as *Rotalia* sp. (axial section), *Ditrupa* sp. (worm tube, *Echinoid shell* and *Calcispongia* fragments, X 10.

D- Pelbiomicrite, Packstone. Vuggy porosity partly filled by sparry calcite cement, with a few micritic pellets. The organic elements are comprised of *Pelecypoda shell*, *Echinoid shell*, *Echinoid spines*, *Hydrozoans* (*spongiomorphids*) fragments, *Calcareous Algae*, *Foraminifera* such as *Rotalia* sp. and *skeletal debris*, X 10.

Middle Asmari – As.2

A- Biointramicrite, Packstone. Vuggy porosity, with irregular shaped of micritic and microsparitic intraclasts, Organic constituents are *Foraminifera* shell such as *Operculina* sp. (sub equatorial section) and *skeletal debris*, X10.

B- Biodolomiticrite, Wackestone. Dolomitization extensively developed throughout the rock even bioclasts partly impressed by dolomitization process. Bioclastic elements are comprised of *Calcareous Red Algae* and *Foraminifera* such as *Lepidocyclina* sp. (sub axial section), X10.

C- Intrapelbiomicrite, Wackestone to Packstone. With rounded to sub rounded microsparitic intraclasts. The identifiable organic components are *Echinoid shell and spines*, *Hydrozoans* (*spongiomorphids*) fragments, *Pelecypoda shell*, *Quinqueloculina* (*Miliolide*) and *skeletal debris*, X10.

D- Intrapelbiomicrite, Wackestone to Packstone. With irregular shaped of micritic and microsparitic intraclasts. The identifiable organic components are *Pelecypoda shell fragments*, *Echinoid, shell*, *Hydrozoans* (*spongiomorphids*) fragments, X 10.

Upper Asmari – As.3

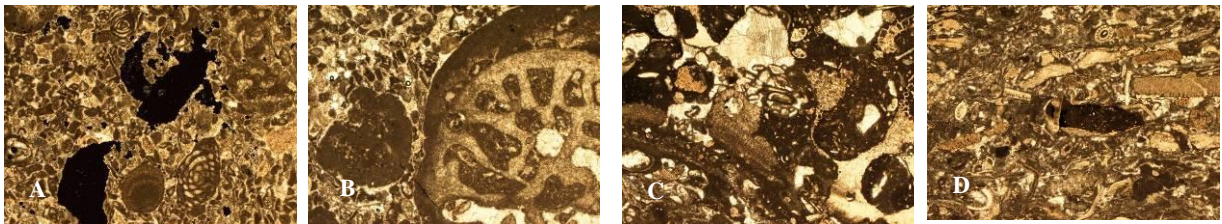
A – Intrapelbiomicrite, Wackestone. Vuggy porosity, some cavities filled by coarse sparry calcite cement. Micritic cement locally recrystallized to microsparry calcite. Organic constituents are some *skeletal debris*, X10.

B- Intrapelbiomicrite, Wackestone to Packstone. Vuggy and fracture porosity that partly filled by sparitic calcite cement. With irregular shaped of dark micritic intraclasts. The organic components are *Foraminifera* such as *Quinqueloculina* (*Miliolide*), *Echinoid shell fragments* and *skeletal debris*, X10.

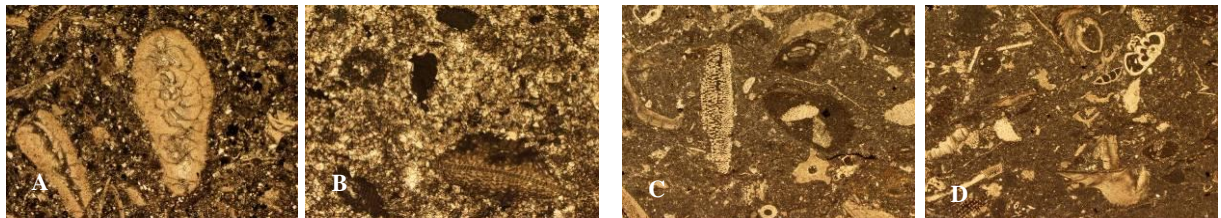
C- Pelbiomicrite, Packstone. Vuggy to fracture porosity partly filled by sparitic calcite cement. With sub rounded microsparitic intraclasts. Organic constituents are *Foraminifera* such as *Borelis* sp., *Echinoid shell fragment*, *spines*, *calcareous Red Algae* and some *skeletal debris*, X10.

D- Intrapelbiomicrite, Packstone. Fracture porosity partly filled by sparry calcite cement. With irregular shaped of micritic intraclasts. The organic elements are composed of *Foraminifera* such as *Borelis* sp. and some *Planktonic species*, *Hydrozoans* (*spongiomorphids*) fragments, X10.

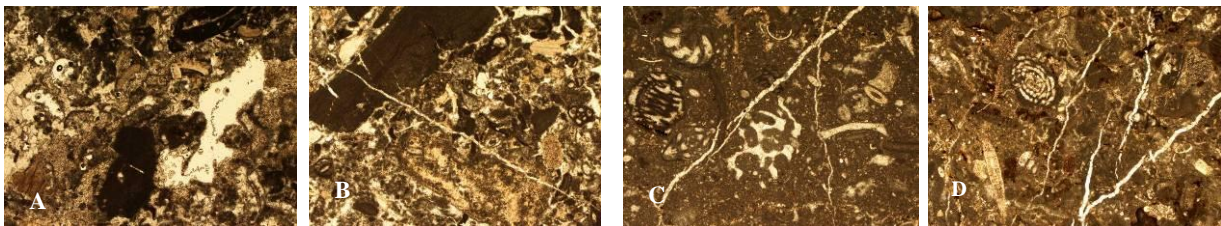
Lower Asmari (As.1)



Middle smari (As.2)



Upper Asmari (As.3)



APPENDIX 5

Petrographic Description of the Various Units of Asmari Formation in Salman Farsi Dam

Lower Asmari (As.1)

A- Biomicrite, Packstone. With small vuggy and fenestral porosity, some of them filled with micro sparry calcite cement. Organic components are mainly *Benthic Foraminifera* such as *Operculina sp.*, *Heterostegina sp.*, *Rotalia sp* (axial sections). fragments of calcareous Red Algae and Echinoid shell debris, X10.

B- Biomicrite, Boundstone. With fenestral porosity, channel porosity filled by blocky micro sparry calcite cement. Organic materials are *Calcareous Red Algae and some skeletal debris*, X10.

C- Pelmicrite, Wackestone. With Vuggy porosity, fractured porosities are filled with coarse sparry calcite cement, X10..

D- Biopelmicrite, Wackestone. With vuggy porosity. Organic components are *Foraminifera shells also some planktonic species and fragments of Echinoid shell*, X10.

Middle Asmari (As.2)

A- Biointrapelmicrite, Wackestone. Vuggy and intraparticle porosity. With irregular shaped of microsparitic intraclasts. Organic constituents are *Foraminifera shell such as Operculina sp. (axial section) some porcelaneous tests and skeletal debris*, X10.

B (Crossed nicols)- Intrapelbiomicrite, Packstone. Channel porosity, some cavities are filled with microcrystalline quartz. With irregular shaped of microsparitic intraclasts. The identifiable organic components are some small *Foraminiferal shell and skeletal debris*, X10.

C- Biodolomiticrite, Wackestone. Micro vuggy porosity. Dolomitization relatively extended throughout the rock (coarse rhombohedral crystals of dolomite). Organic constituents are *Echinoid fragments and some skeletal debris*, X10.

D- Intraobiosparite, Grainstone. With vuggy and intraparticle porosity. The identifiable organic components are *Foraminifera that comprised Peneroplis sp. (equatorial section), Miliolides (Quinqueloculina) and some skeletal fragments*, X10.

Upper Asmari (As.3)

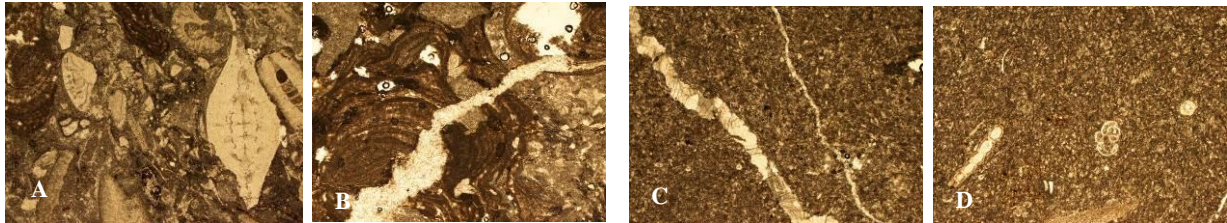
A- Dolopelmicrite, Wackestone. Vuggy and channel porosity. Micritic cement partly changed to rhombohedral crystals of dolomite that scattered throughout the rock, X10.

B- Biodolomiticrite, Wackestone. Vuggy porosity, with chert stains, Dolomitization extensively changed rock matrix (granular and uniform). Foraminifer's chambers are filled by microsparry calcite cement. Bioclasts peripherally changed to dolomite. Organic components are *Foraminifera such as Nummulites sp. and Operculina sp. (axial sections)*, X10.

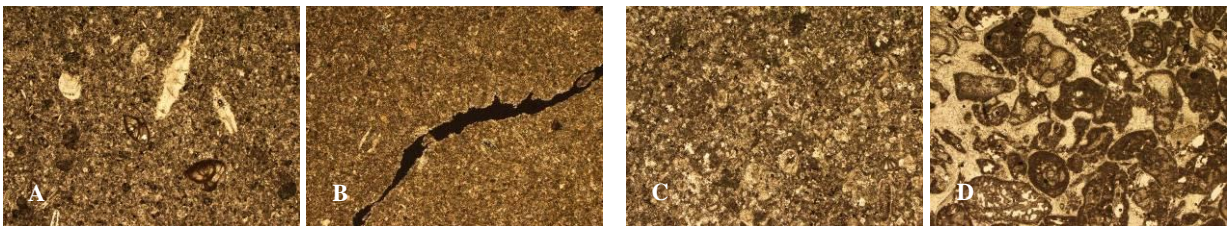
C- Biointrasparite to Biointraomicrite, Packstone to Grainstone. Vuggy porosity, the identifiable organic elements are *Foraminifera such as Archaia sp., Quinqueloculina, Biloculina and Mollusk shell fragments*, X10.

D- (Crossed nicols), H (Ordinary light) - Fault Microbreccia, Breccia porosity, from thrust zone (Dareh Siah Fault) where the Asmari Formation thrust on Razak Formation. Microbreccia is composed of clasts that are smaller than 1.0 mm but greater than about 0.1 mm, with irregular shaped of angular to subangular intraclasts that cemented partly by fine blocky calcite cement. High porosity (19.40 %), cavities partly filled by microsparry calcite cement, X10.

Lower Asmari (As.1)



Middle Asmari (As.2)



Upper Asmari (As.3)

