Microfacies & Depositional Environment and Diagenetic Process in Upper Surmeh Formation in Foroozan Oil Field in Persian Gulf

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Abstract:

Surmeh formation is equally, part of upper Arab formation that is consisting of alternation of carbonate and anhydrite beds. Arab formation is consisting of several members (A, A1, B, C, and D) that each member has a carbonate unit and anhydrite beds have a cap rock roll in this formation. Surmeh formation conformably overlay neyriz formation and its upper boundary is located under Hith formation. Since surmeh formation in this area has not been studies in detail, in this study, Microfacies, depositional environments and diagenetic process have been evaluated.

For this study, 2 subsurface stratigraphic sections from A&B wells were selected and more than 180 thin sections from core & cutting was studied. The thickness of surmeh formation in this study well is about 259 meters. It is mainly composed carbonate rocks. This study shows that this sediments may have been deposited in homoclinal ramp & consist of 3facies assemblages and 15 subfacies. Also, these lithofacies indicate that sedimentation may occurs in shoal, lagoon and tidal flat (Intertidal & supratidal) environments. Carbonate rocks of surmeh formation may have been affected by 3 diagenetic stages including eogeneses, mesogeneses and telogeneses. Diagenetic processes such as neomorphism, cementation, micritization, silisification; dissolution, compaction, fracturing and calcite veins are affected on these rocks. Among of these, process such as dissolution and cementation increase the reservoir quality in surmeh formation. Diagenetic process affected these sediments in three diagenetic environments consist of marine, meteoric and burial that major process is meteoric. Petrography studied shows that primary mineralogy composition of Surmeh is aragonite & calcite and its diagenetic environment is tidal flat and low-depth coast.

1- Introduction

Surmeh formation (Dogger- Malm) is one of carbonates units of Khami Group that is one of the important hydrocarbon reservoirs Zagros Basin. This study is done on the carbonate sediments in upper surmeh formation (Arab formation) in (A & B) wells located in oil field in the southwest of Iran in Persian Gulf. Diagenetic processes such as neomorphism, cementation, micritization, silisification; dissolution, compaction, fracturing and calcite veins are affected on these rocks. Among of these, process such as dissolution and cementation increase the reservoir quality in surmeh formation.

The late Jurassic includes important sedimentary cycles of oil aggregates. The productive rock reservoir of late Jurassic is Arab formation which have been called D, C, B, A1, A members. Each of carbonate members are covered by evaporates sediments which the result of them is anhydrite.

2- Facieses

In this study, Surmeh formation are divided to 15 facies association include Bar, Lagoon & Tidal flat facies which describe as follows:

2-1- Carbonate facies association:

Based on composed part and other textural and structural properties many carbonate facies are determined which description followed.

2-1-1- A Barrier facies association

This association is included 4 facieses A1 ،A2 ،A3، A4.

2-1-1- A1: Algal ooid bioclast grainstone. (SMF11 – FZ6)

This facies has algal fragments in Dasycladacea type accompanied with benthic foraminifera like sodoukrizalidina, fanderina and cornobia, single ooid and ooid aggregates. This microfacies are equal with standard SMF11standard microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-1- A2: Algal bioclast grainstone. (SMF11 – FZ6)

In this facies kinds of benthic foraminifera are accompanied with Dasycladacea type of green algal are funded in base of spars. This microfacies are belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-1- A3: Algal bioclast intraclast grainstone (SMF11 – FZ6)

This facies has algal fragments in Dasycladacea type accompanied with benthic foraminifera like Pseudochrisalidina, fanderina and curnobia, single ooid and composite ooid in less of them. This microfacies is belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-2- The analysis of sedimentary environment in A facies group (Barrier Environment)

The laboratory studies show that A facies group are occurred in skeletal barrier facies. In continue of these studies can pointed the follow point.

The existence of intraclasts and their large size, existence of ooids, lack or fewer lime mud show the turbulence lence current. The properties of them are lack or fewer lime mud among grains and in consequence replacing the space among allochems with sparite cement.

In some facieses lack of lime mud and matrix show the sedimentation under shallow and turbulence lent condition such as bars and ridges (Mess and et al 2003; sandoli and raspini, 2004). Also the existence of ooids in some facies in form of radial and base of sparite show the sedimentation under shallow and turbulence lent condition.

B1 facies due to exist of fossils diversity and skeletal parts maybe located in front of open marine, wheras, B3 facies due to lesser fossil content maybe located in front of lagoon.

2-1-2-1- Lagoon facieses association

This association is included 3 facieses B1 ،B2 and B3.

2-1-2-1- B1 :Algal peloid intraclast grainstone (SMF11- FZ6)

In this facies fund most amounts of intraclast and ploieds in base of sparite. Intraclasts have well sorted well rounded and dark color. This microfacies are belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.

2-1-2-1- B2 :Laminated ostracod peloid wackestone- mudstone (SMF11- FZ6)

In this laminated facies found ostracod and peloid in base of lime mud. Also the existence of stylolite which is filled with iron oxide and bioturbation in this facies is observable. This microfacies are equal with standard SMF18 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ7 facies belt.

2-1-2-1- B3 :Green algal wackestone. (SMF25- FZ8)

The most important part of this facies could point to green algae fragment in Dasycladacea type which is located in base of microspaite. Micritization and neomorphism of alochems especially micritization of green algae fragment is the most important properties of this facies. This microfacies are comparable with standard SMF25 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ8 facies belt.

2-1-2-2- The analysis of sedimentary environment in B facies group (Lagoon facies)

By studied on facies of this group, is considered lagoon environment for their which are appointed of this facies related to lagoon environment in follow reasons:

The amount of lime mud in B1facies compare with others of this association is less. This issue is clarified of the environmental energy in contrast with other facieses of this association is higher. Also the existence of intraclast is illustrated the lagoon environment are in front of the bar.

The amount of lime mud in B1facies in contrast with other facies is lesser. This issue confirms that environmental energy in contrast with other facies is more than them. Also the existence of intracalst confirms that lagoon environment is in front of the bar.

2-1-3- Tidal Flat Facieses Association

This facieses association is included 6 intertidal facies (C1, C2 ,C3 ,C4 ,C5 and C6) and 3 supertidal facieses (D1, D2, and D3).

2-1-3- A: Intertidal facieses association

2-1-3- C1: Algal peloid ooid intraclast grainstone with evaporate mineral (SMF11- FZ6)

In these facies different kinds of non skeletal grains such as superficial peloids, composite ooids and intraclast in base of sparaite cement are found. This facies are equal with standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.

2-1-3-1- C2: Bioclast intraclast grainstone (SMF11- FZ6)

The main parts of this facies in the base of sparite cement are connected to each other. This facies are comparable with standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.

2-1-3-1- C3: Algal peloid packstone with keystone vug (SMF16- FZ8)

This facies has algal fragments in Dasycladacea type accompanied with peloide non skeletal fragments are the main part of this facies. The Filaments of green algae in Dasycladacea type which product stromatolithes. This microfacies are comparable with standard SMF16 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and located in FZ6 facies belt.

2-1-3-1- C4: Stromatolithes Bondstone (SMF20- FZ8)

This facies are totally composed of green algae in Dasycladacea type in which located in base of lime mud. Stromatolithes are frequently composed in middle to upper intertidal environment. This facies are equal with SMF20 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975).

2-1-3-1- C5: Peloid bioclast ooid wackestone- packstone.(SMF20- FZ8)

This facies includes the different kinds of benthic foraminifera and gastropod and non skeletal fragments like peloid and ooid which are found in base of lime mud. This microfacies are comparable with standard SMF16 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and located in FZ8 facies belt.

2-1-3-1- C6: Intraclast peloid wackestone-grainstone(SMF16- FZ8)

In this facies peloids accompanied with intraclast are found in base of lime mud. Wavy and laminated structures due to tidal movement are seen abundant.

2-1-4- The analysis of sedimentary environment in C facies group (Tidal flat)

In order to facies properties could be concluded that this facies are formed in Tidal flat environment. The main important of this appointment is followed by:
In C1 facies, dominated intraclast non skeletal fragments are demonstrated the temporary high water and scour the intraclast of followed environment which related to tidal flat environment. The existence of ooid in C1 and C5 facies descriptive that these fragments are not depend on this environment and due to turbulence and disorder is transferred to this environment.
2-2- Supertidal facies association
This association is included 3 facieses D1 ،D2 and D3.
D1: Fenestral mudstone (SMF21- FZ9A)
This facies is totally composed of lime mud and nearly is effect of skeletal and non skeletal fragment which are not seen. In this facies, fenestral fabric is seen frequently. This facies are comparable with standard SMF21 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ9A facies belt.
D2: Fenestral peloid wackestone with anhydrite (SMF21- FZ9A)
In this facies most amount of peloid are accompanied with fenestral fabric which is seen in lime mud. This facies are equal with standard SMF21 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ8 facies belt.
D3: anhydrite facies(SMF21- FZ9A)
The massive anhydrite is another part of the existence rocks in supertidal area which was fine and long anhydritic crystals and partially has folded small structures. The massive anhydrite are inter bedded with mudstone. This microfacies are equal with standard SMF20 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ9A facies belt.

3- Conclusion

1-The thickness of surmeh formation in the study well is about 259 meters. It is mainly composed carbonate rocks. This study shows that this sediments may have been deposited in homoclinal ramp & consist of 3facies assemblages and 15 subfacies in shoal, lagoon and tidal flat (Intertidal & supratidal) environments.
2-Skeletal fragments in upper surmeh formation consists of Gastropid, ostracod , dasycladacea algae and bivalve. Non skeletal fragments consists of peloid, intraclast and ooid.
3- upper surmeh formation is equally, part of upper Arab formation that is consisting of alternation of carbonate and anhydrite beds. Arab formation is consisting of several members (A, A1, B, C, and D)

References

Flugel, E., (2004), Microfacies of Carbonate Rocks. Analysis, Interpretation and Aplication New York, Springer – Verlag, 976p.

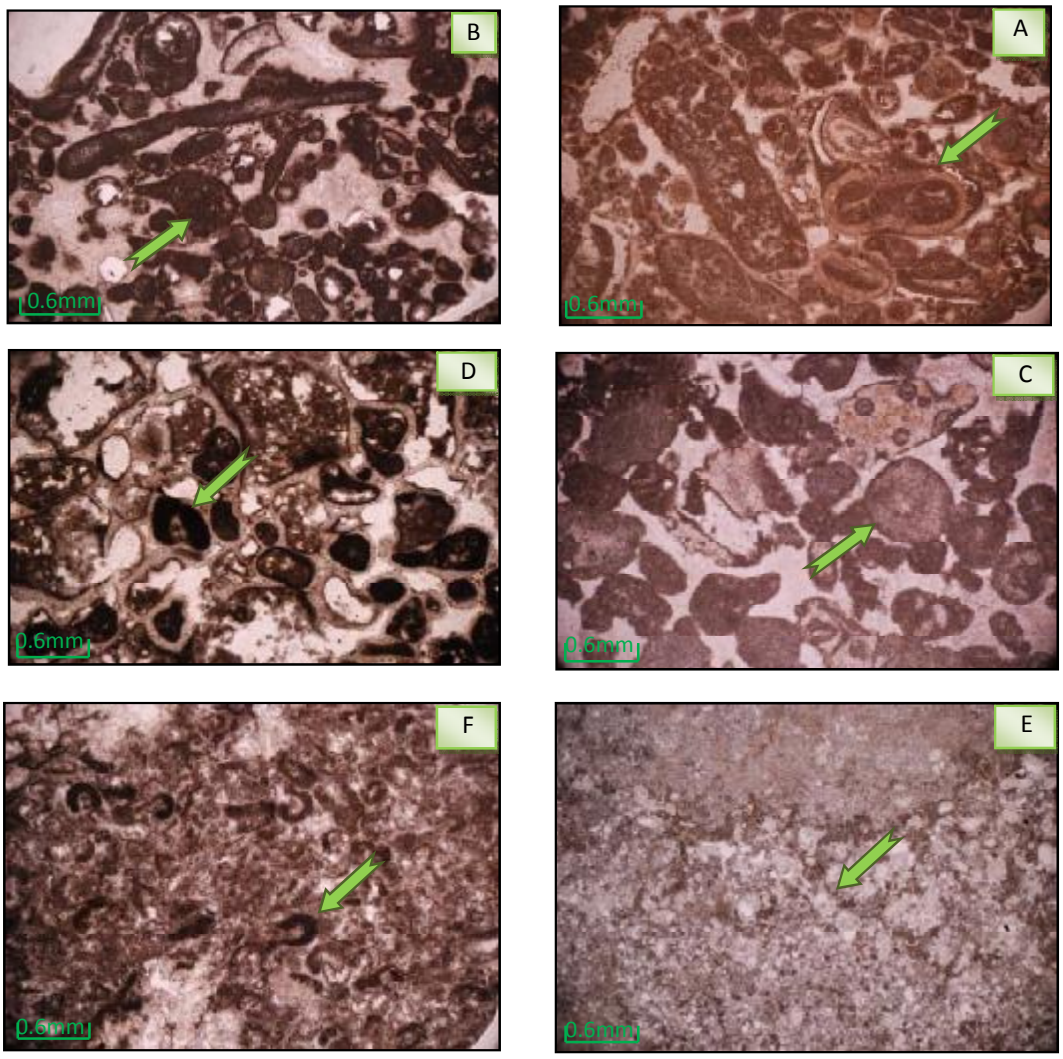
Folk, R.L., (1959), Practice petrographic classification of limestone , American Association of Petroleum Geologist Bulletin, v.43, p.1-38.

Galloway, W.E., (1968), Depositional system of the lower Wilcox Group, north central Gulf Coast basin, Transaction, Gulf Coast Association of GeologicalSocieties, v. 18, p. 275-289.

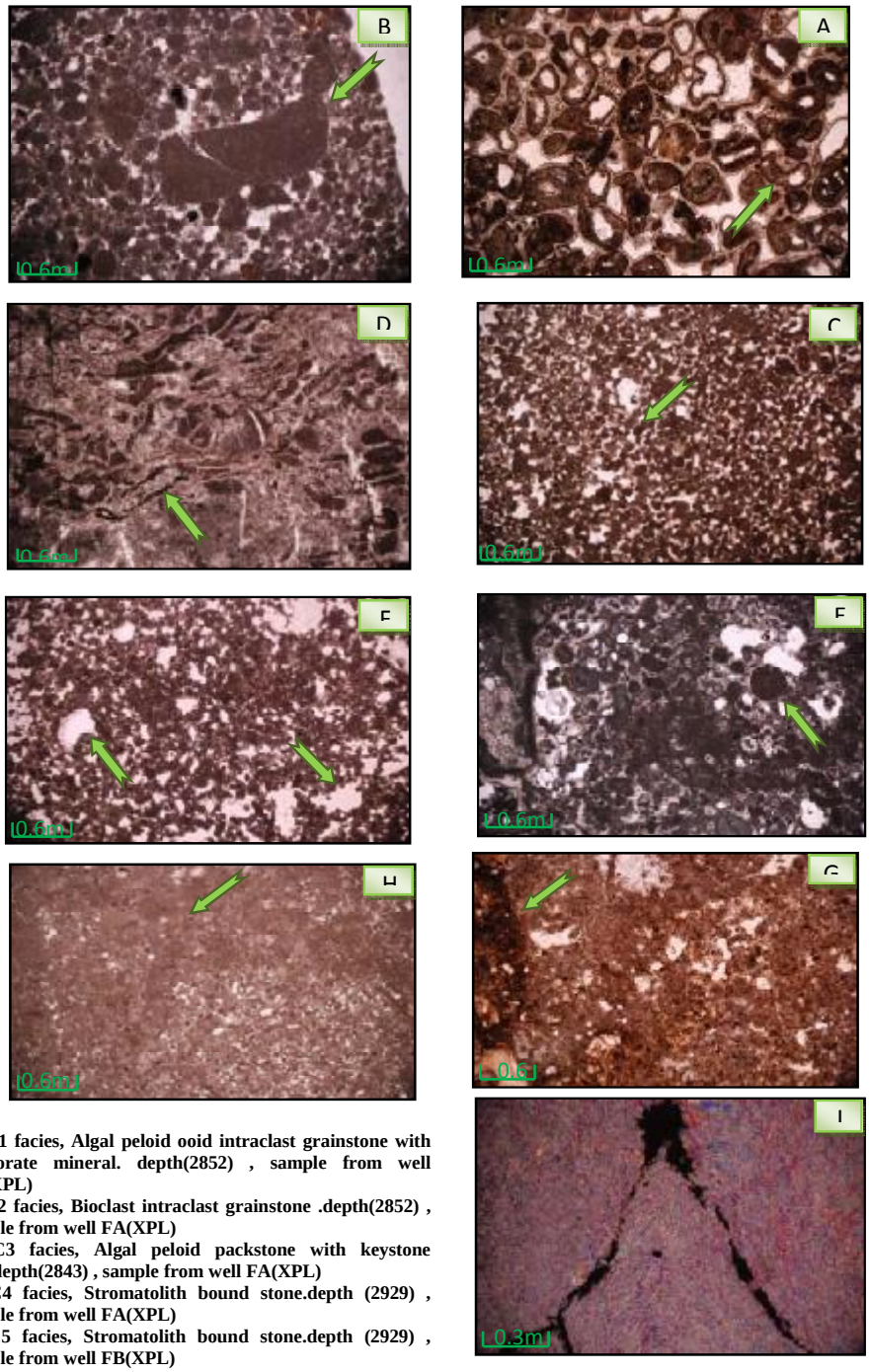
Moor, C.H., (1989), Carbonate Facies, Diagenesis and Porosity, Elsevier, Amsterdam, 338p.

Tucker, M.E., and Bathurst, R.C.C., (1990), Carbonate Diagenesis, LAS Reprint Series, 1.Blackwell, Oxford, 312p.

Purser, B.H. (1973), The Persian Gulf: Holocene Carbonate Sedimentation and Diagenesis in a Shallow Epicontinental Sea, Springer- Verlag Berlin, 471p.



A: A1 facies, Algal ooid bioclast grainstone. depth(2850) , sample from well FA(XPL)
B: A2 facies, Algal bioclast grainstone.depth(2932) , sample from well FA(XPL)
C: A3 facies, Algal bioclast intraclast grainstone. depth(2932) , sample from well FA(XPL)
D: B1 facies, Algal peloid intraclast grainstone. depth(2853) , sample from well FA(XPL)
E: B2 facies, Laminated ostracod peloid wackestone- mudstone. depth(2858) , sample from well FA(XPL)
F: B3 facies, Green algal wackestone. depth(2923) , sample from well FA(XPL)



A: C1 facies, Algal peloid ooid intraclast grainstone with evaporate mineral. depth(2852) , sample from well FA(XPL)
B: C2 facies, Bioclast intraclast grainstone .depth(2852) , sample from well FA(XPL)
C: C3 facies, Algal peloid packstone with keystone vug.depth(2843) , sample from well FA(XPL)
D: C4 facies, Stromatolith bound stone.depth (2929) , sample from well FA(XPL)
E: C5 facies, Stromatolith bound stone.depth (2929) , sample from well FB(XPL)
F: C6 facies, intraclast peloid wackestone-grainstone. depth (2877) , sample from well FA(XPL)
G: D1 facies, Fenestral mudstone. depth (2894) , sample from well FB(XPL)
H: D2 facies, Fenestral peloid wackestone with anhydrite. depth (2843) , sample from well FA(XPL)
I: D3 facies, anhydrite facies .depth (2873) , sample from well FB(XPL)