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Microbiostratigtaphy and Sequence Stratigraphy of Oligocene – Miocene Asmari Formation in South West of Lurestan Basin, SW Iran

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ABSTRACT

Based on detailed measurement of two Asmari Formation sections at Chenar and Kaseh Mast anticlines in southeast of Lurestan Basin, SW Iran, one Oligocene sequence (Chattian) and three Miocene sequence (Early Aquitanian – Late Aquitanian and Early Burdigalion) have been distinguished.Based on distribution of benthic foraminifer's age of Asmari Formation in Chenar section is late Oligocene (Chattian) to Early Miocene (Burdigalian) and in Kaseh Mast is Early Miocene (Aquitanian to Burdigalian).
KEYWORDS: Asmari Formation, Lorestan , Zagros, Oligocene, Miocene, Chenar.

1. INTRODUCTION

The Asmari Formation is one of the most important and largest oil reservoirs in the world (Beydon 1991, Edgell 1999, Motiei, 1993) which have been producing since 1908. Recent study showed increasing interest in enhanced oil recovery methods to optimize the production of Asmari Formation. One of initial stage in this process is obtaining an improved understanding of the reservoir heterogeneities which are controlled by four factors, lithological variation, depositional geometries, digenesis and structural deformation (Van Buchem et al., 2010).

This paper examines the microbiostratigraphy and sequence stratigraphy in the Asmari Formation in the two sections, Chenar and Kaseh Mast anticlines in the south west of Lurestan Basin (Fig.1).

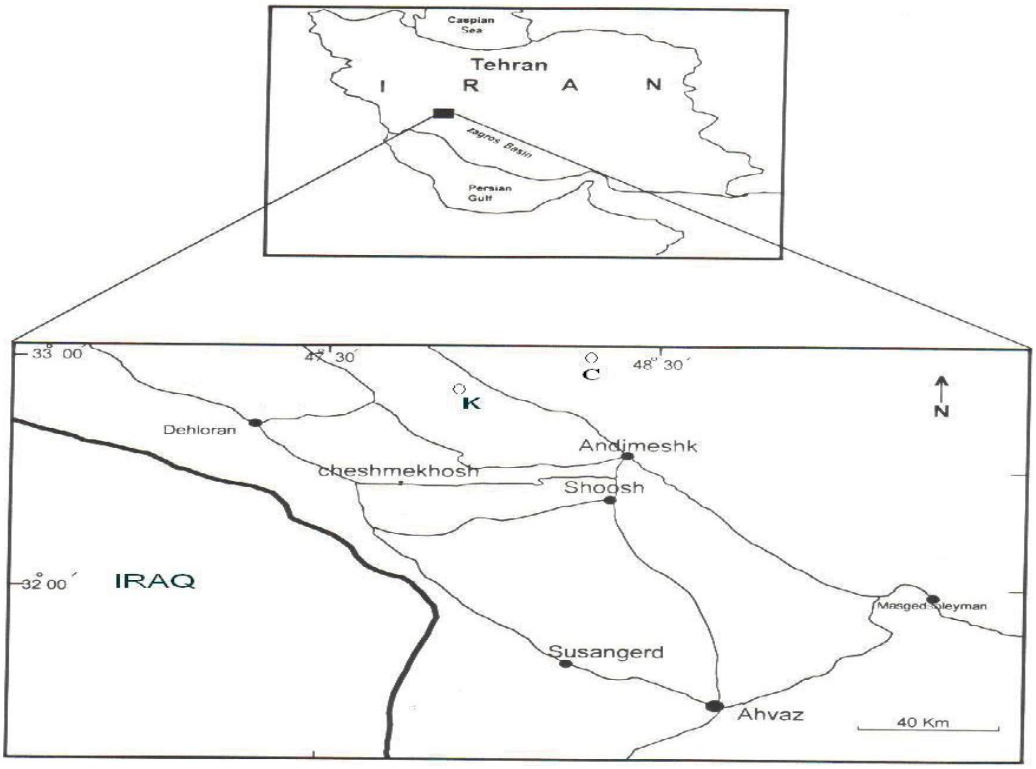

Fig .1: Locatioin map of the studied section,K: Kaseh mast , C: Chenar

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The Asmari Formation was originally defined in primary works by Busk&Mayo (1918). Richardson(1924), Van Boeck et al., (1929), Thomas(1948),James&Wynd(1965),wynd(1965),Adams Bourgeois (1967) ,.

Some of the recent publication on the Asmari Formation are few such as Seyrafian&Hamedani (1998),Seyrafian(2000),Vaziri – Moghaddam et al., (2006,2010), Mosadegh et al., (2009) and Van Buchem et al., (2000), , Seyrafian &Mojkhalifeh(2005), Seyrafian et al.(1996.2003).

Regional setting

The Asmari Formation was deposited in a northwest – southwest oriented foreland Zagros Basin which extended from northeastern Syria through northern and northeastern Iraq into southwestern Iran (Fig.2).

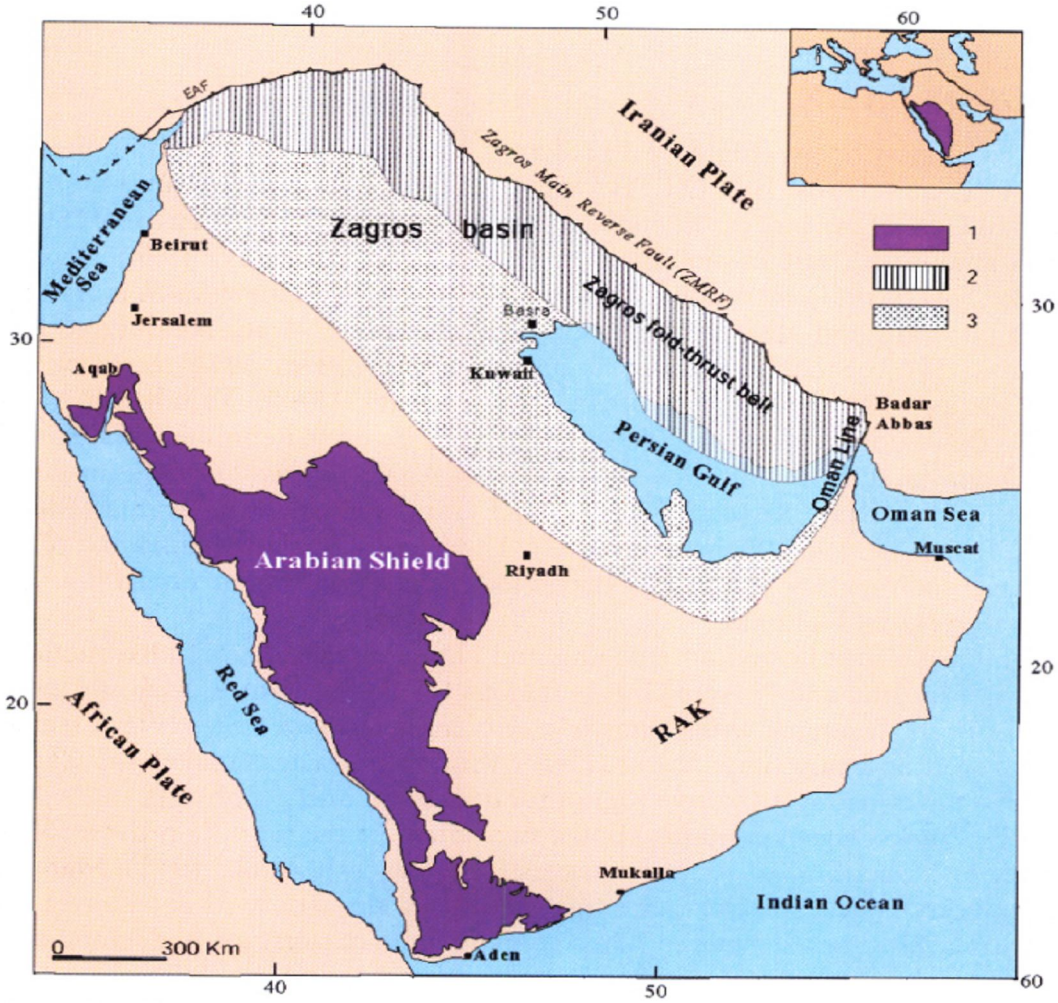


Fig 2: Map of the Middle East showing location of the Zagros Basin Ghazban (2007).

The Zagros Basin was a part of the stable supercontinent of Gondwana in Paleozoic time and a passive margin in Mesozoic time and became convergence orogen in Cenozoic time (Bahroudi & Koyi , 2004).

In Jurassic time, Orogenic movement caused Zagros basin divided into three basins, Including the fars arc, Dezful Embayment (Khuzestan province) and Lurestan Basin, from south to northeast respectively (Fig.3).

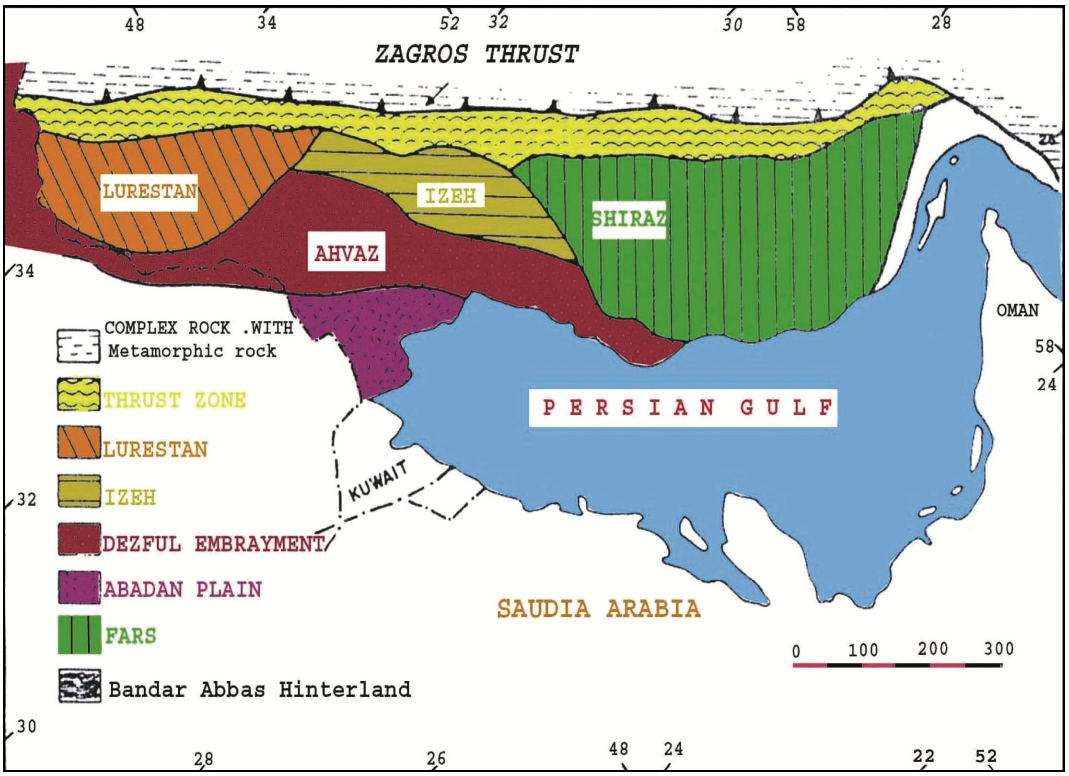


Fig.3: Structural of the Zagros Basin (Sherkaty and Letouzey, 2004).

The Lurestan Basin with marine carbonate platform sedimentation became established in the Early Jurassic and continued until Miocene times with the greatest subsidence being located in the axis of basin. During the Paleocene and Oligocene the Pabdeh (Neritic to basinal marl and argillaceous limestone) and Ksahkan (Lacustrine and river clastic) Formations were deposited in the middle and on northeastern sides of the Lurestan basinal axis, respectively.

Southeastern margin of Lurestan basin was deeper of northeast and massive shallow marine carbonate (Shahbazan Formation) was deposited.

The Lurestan basinal axis was gradually narrowed and in Early Oligocene time, the lower Asmari Formation, including carbonate deeper marine were deposited.

The important feature of this time is the rough coincidence of these intrabasin with the main NW/SE trending basement faults (Bahroudi & koyi, 2004).

MATERIAL AND METHOD

This study is based on the two outcrop sections at Chenar and Kaseh Mast anticlines. Systematic sampling for thin section preparation was used in the outcrop logging with a sample frequency of one sample every 3-4 m. From the Chenar sectin 143 and from kaseh Mast 74 samples were collected. The samples range through the Asmari Formation and cover the upper most part of the underlying Pabdeh Formation (at Kaseh Mast) and Shabbazan Formation (at Chenar section) and the lowest part of the overlying Gachsaran Formatioin.

Foraminifera biostratigraphy and microfacies determination are based on thin sections examination. Unpublished assemblage zone establish for the Zagros by Wynd (1965) and Adams & Bourgeios (1967) on the base of mainly benthic foraminifera are applied to the section.

Recently result of Sr stratigraphy of Asmari Formation throughout the Dezful Embayment (Fig .4). New biozonation of Asmari Formation indicate that Archias asmaricus-Archias hensoni Zone is Oligocene age (Van Buchem et al., 2010).

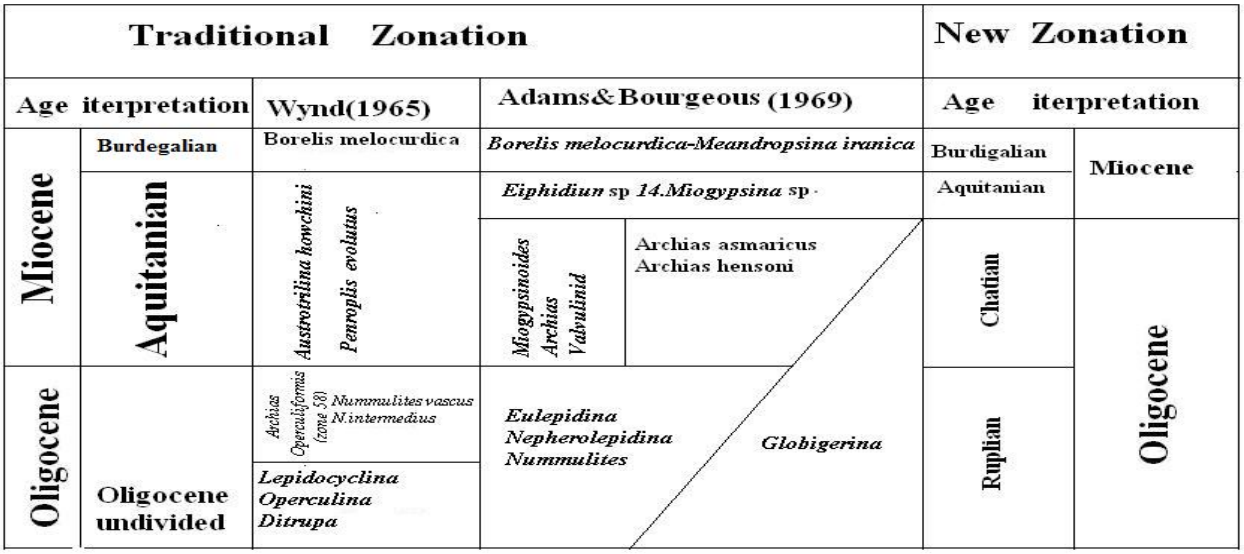


Fig.4: Camparison of traditional biostratigraphic zonation of Asmari Formation and new age interpretation (Van Buchem et al., 2010).

Lithostratigraphy

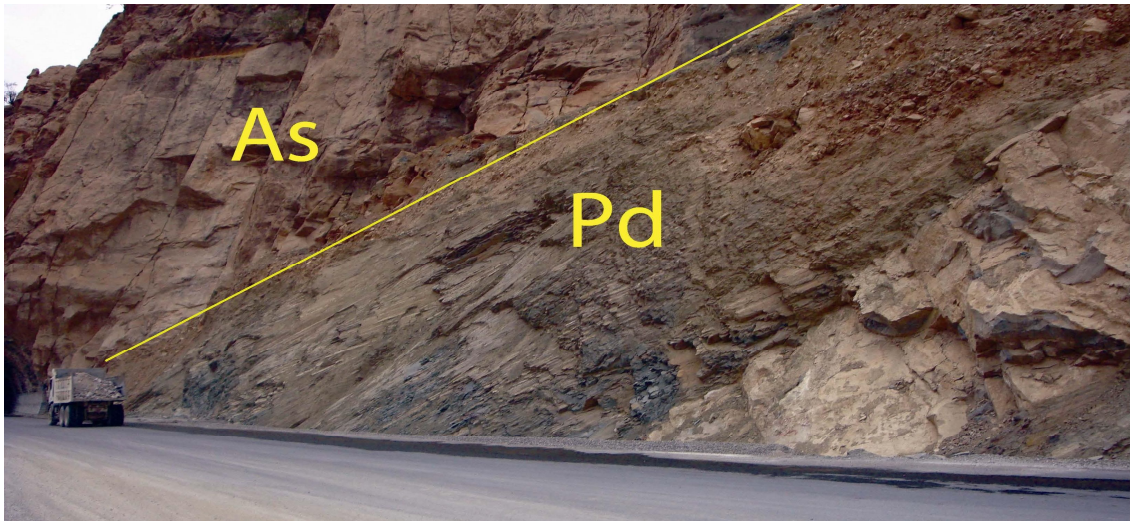
The Chenar section is located on the southwestern limb of the Chenar anticline in the Zagros folded belt, south eastern belt. In this section, the Asmari Formation overlies limestone of the upper part of the Shahbazan formation and underlies the Gachsaran Formation which is dominated by evaporate deposited (Fig.5). The thickness of the Asmari Formation at Chenar section is 122 m.

Asmari Formation dominated by limestone with intercalation of marl and Dolomite particularly towards the top of the formation. The Kasemast section is located on the southwestern margin of the Kaseh Mast anticline in the Zgros folded belt, Sw Lurestan Basin. The Asmari Formation is carbonate dominated, reaches a total thickness of 156.5m (Fig.6).

The lower part of the Asmari Formation is represent by kalhur Member and consist of an alternation of anhydrite and marl rich intervals that shows an overall shallowing up trending from basinal marls of the Pabdeh Formation at the base to basinal evaporate at the top.

The lower part of the kalhur member consists of Anhydrite beds which corresponds in Dezful Embayment to middle Anhydrite (Van Buchem et al., 2010).

Asmari Formation is marked with alteration of thin bedded dolomite and shallow water carbonate. At base of this part and top of kalhur member marked by a well developed solved breccia.



a

b

Fig.5: A lower boundary of Asmari Formation with Shahbazan Formation at Chenar section, B: upper boundary of Asmari Formation with Gachsaran Formation.

Fig.6: Asmari Formation at Kaseh Mast section, A: Asmari Formation , G: Gachsaran Formation, P: pabdeh Formation.

Biostratigraphy

In terms of local foraminiferal zonations applied to the Zagros basin, the interval from base of Chenar section to 75m (Fig. 7), characterized by the presence of Nephrolepidina belongs to assemblage zone 56 of wynd (1965) and to Assemblage zone 3 of Adams and Bourgeios (1967). With occurrence of *Austrotrillina* , *Peneroplis evoultus*, *Elphidium* sp and *Miogypsina* sp., the 75 m to 102m interval belongs to Assemblage 59 of wynd (1965), and with Assemblage zone 2a of Adams and Bourgeios (1967). Based on the presence of *Borelis melo curdica* the upper part of the section (102m to 160m) belongs to Assemblage zone 61 of wynd (1965) and with Assemblage zone 1 of Adams and Bourgeois (1967).

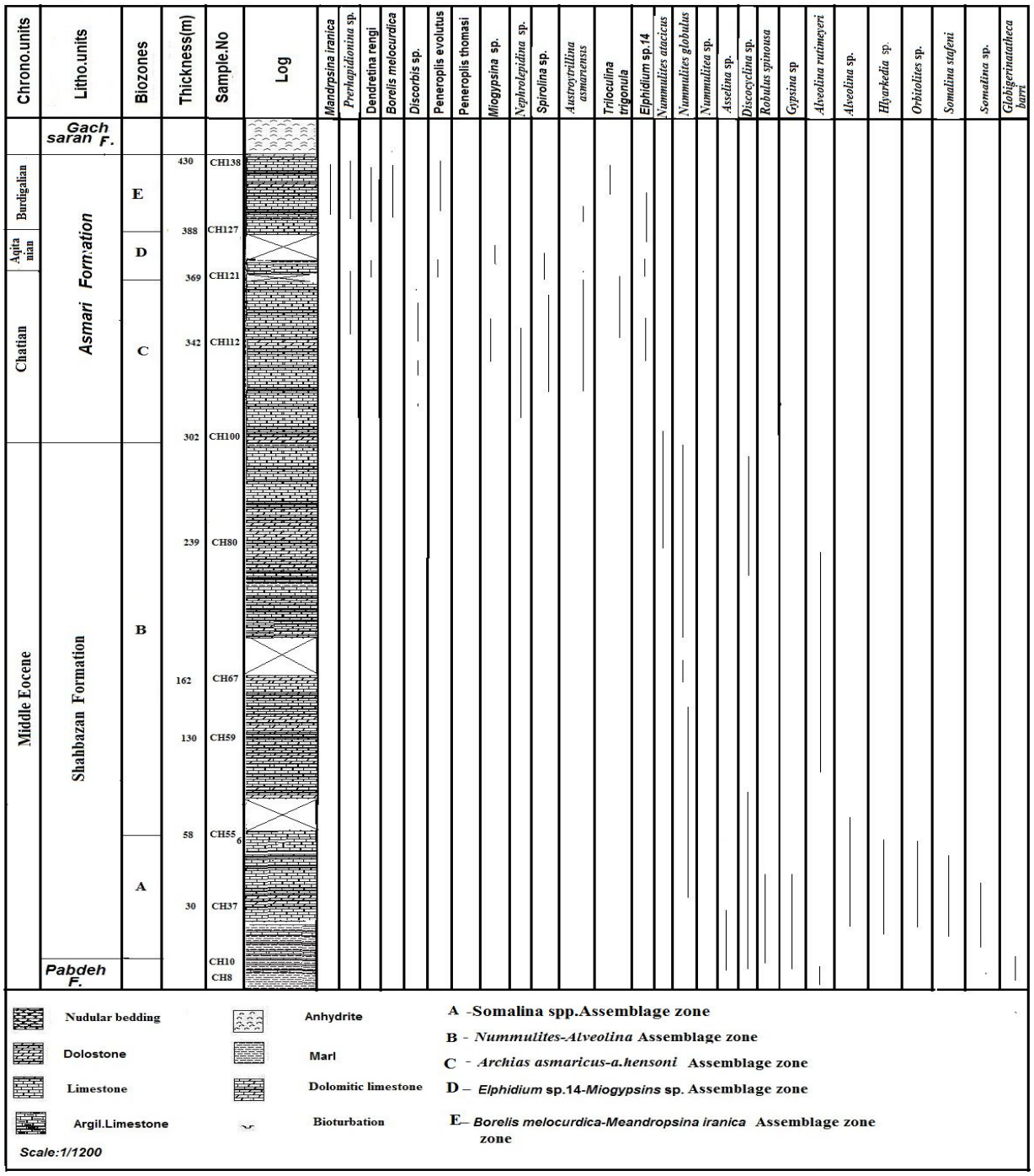


Fig. 7: Forminiferal biozonation of the Chenar section showing ranges of index species.

The lowest occurrences of complex benthic formaminifera is at 9m above base of section where this interval contains minute planktonic foraminiferal which are dominated by Globigerine forms.

The interval of from 9m to 128m of Kaseh Mast section(Fig.8) belong to Assemblage zone 59 of wind (1965), and with Assemblage zone 2a of Adams & Bourgeois (1964). Based on the presence of *Borelis melo curdica*, the upper part of the section (128m to 156m) belongs to Assemblage zone 61 of wynd (1965), and Assemblage zone 1 of Adams & Bourgeois (1967).

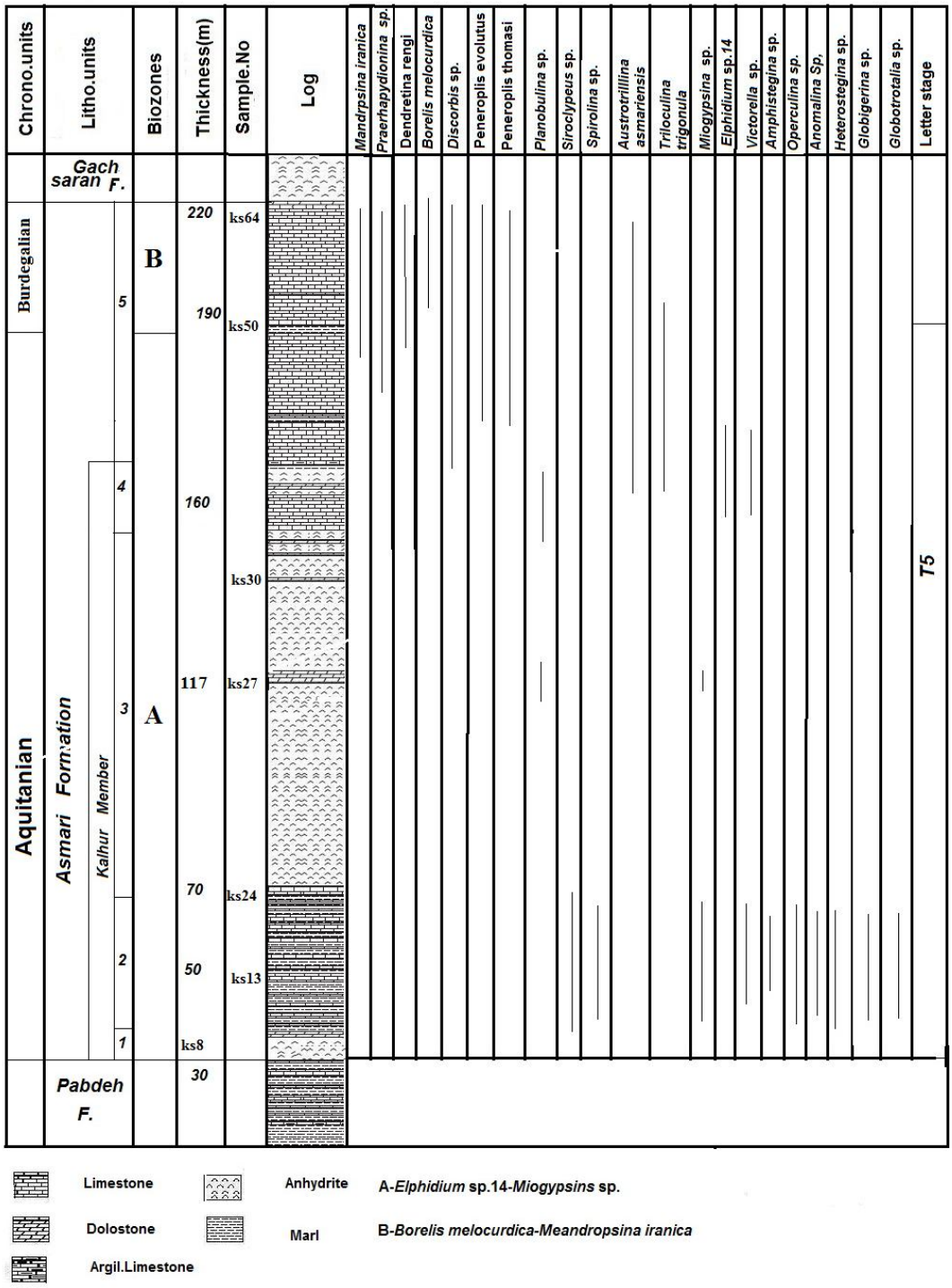


Fig.8: Foramininferal biozonation of the Kaseh Mast section showing ranges of index species.

Sequence stratigraphy

In Chenarel and Kaseh Mast sections, three depositional order sequences following the time – based classified by Vail et al. (1991) were identified (Fig 9).

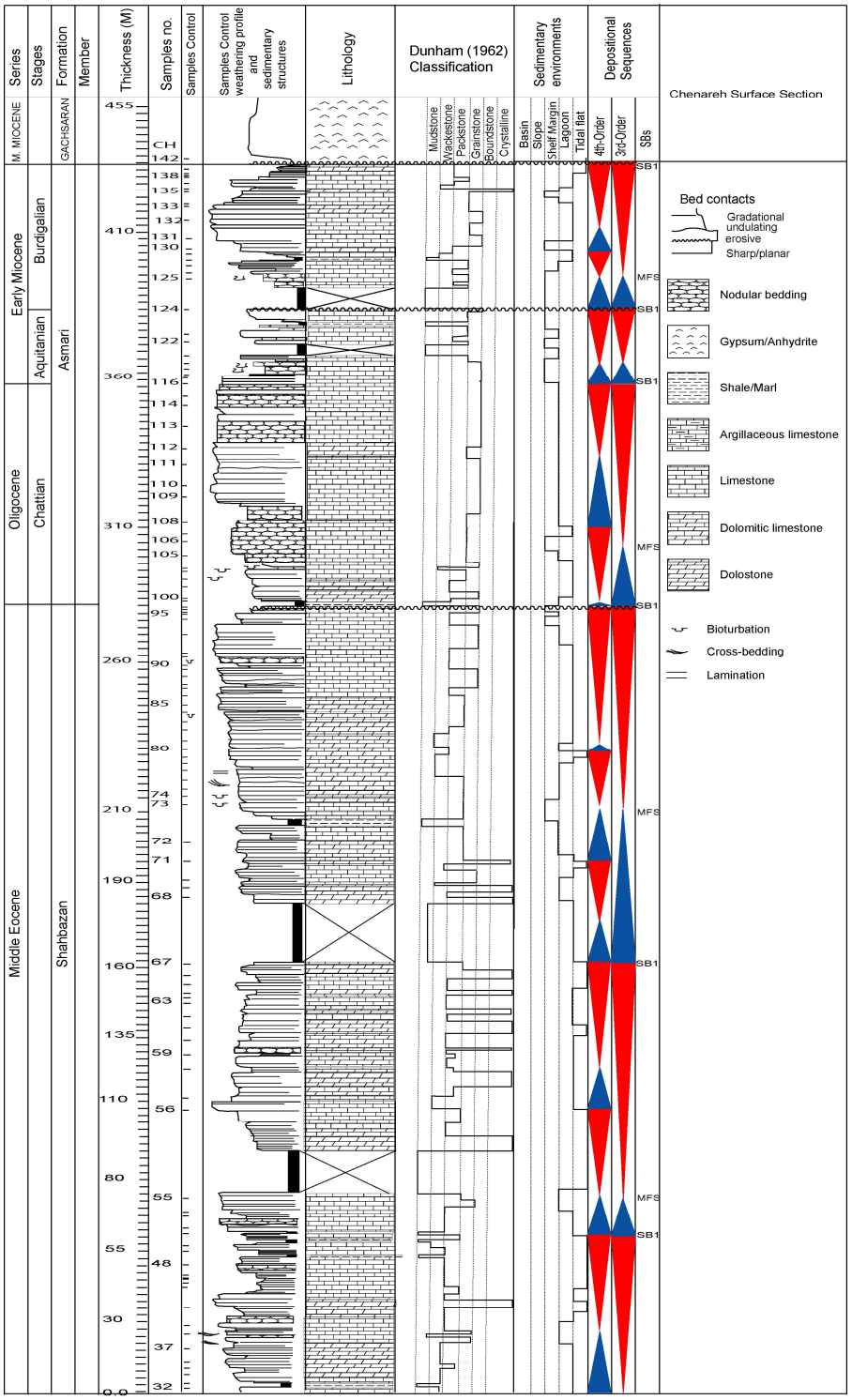


Fig.9: Stratigraphic column showing the sequence stratigrahic organization for Chenar section.

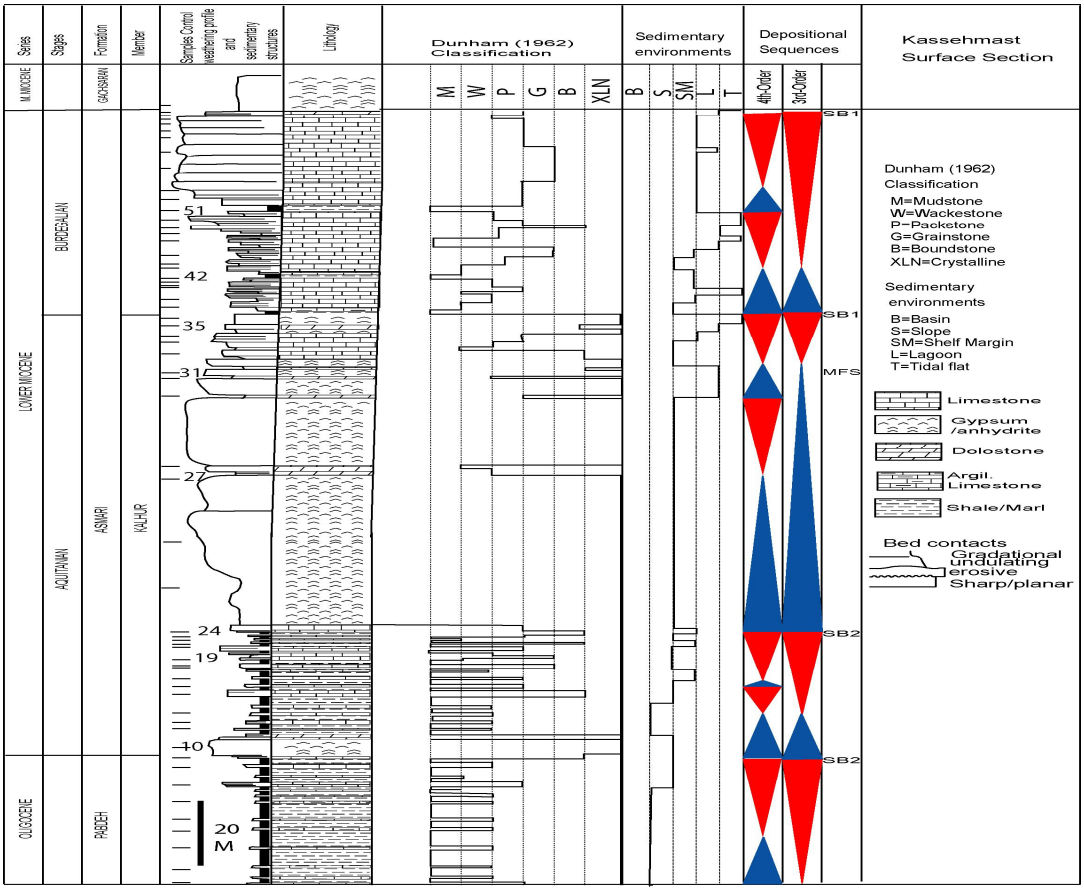


Fig.10: Stratigraphic column showing the sequence stratigraphic organization for Kaseh Mast section.

Sequence Chatian sequence boundary 1 identified as a type 1 sequence boundary by evidence of non-deposition of the late Eocene and Early Oligocene (Ruplian). The top boundary of this sequence(SBII) is dated as latest Chattian, just below the Chattian- Aquitanian boundary.

The general lithology in this sequence consists essentially of limestone in the deeper water domain and dolomite in the shallow- water domain. The dolomitic bed just above the basal sequence boundary is interpreted as a initial of TST. This dolomite is interpreted to have been deposited when sea level initiated to rising and entrance into sediment and caused dolomitization.

This maker a overlain by a interval that is characterized by a flood of benthic foraminifera which is interprets as the HST of this sequence:

The lithological composition in this sequence is mixed carbonate/ evaporates in the kaseh Mast, carbonate dominated in the Chenar section. Lowstand evaporate deposits have been identified in the basin center in the Kaseh Mast section.

During the transgression, Evaporate beds are overlain by an interval the characterized by a fold of small Globigerina which is interpreted as the basinal expression of the TST. In the more proximal position (Chenar section) bioturbation and hard ground is interpreted as the basinal expression of the TST and HST.

In kaseh Mast section, Aquitanian sequence can be divided in two sequences by main part of Kalhur Member (Fig.10).

The lower boundary in this sequence in center of basin (Kaseh Mast)is at the base of lower evaporate(time – equivalent) to middle Anhydrite in Dezful Embayment and base of main part of Kalhur evaporate Member. During the Aquitnian,eustatic sea level drops, which twice a used the isolation from the Neoethys and the deposition of submarine anhydrite in its centre.

In Chenar section Geopetal and a key stone fabric indicate a regression of marine and exposed of sediment so , lower boundary of this sequence are SB1. the top of sequence late Aquitarian.

Burdigalian sequence: The base of this sequence is amalgamated with the underlying SB and interpreted as a subaerial exposure surface (type 1 sequence boundary) and is well constrained by the occurrences of the benthic index fossil *Borelis melo curdica* in the Burdigalian.

The top boundary is picked below the first anhydrdrite of the overlying Gachsaran Formation. The lithological composition of this sequence consists of shallow water limestone and basinal marls. No lowstand deposits have been identified in this sequence.

In the Kaseh Mast section, TST is recording by carbonate contains Miliolina, pelecypoda. The gradual sea level rise is recognized by occurrences of red algae and hardground which is substratum for *Ostra* (Fig.11).

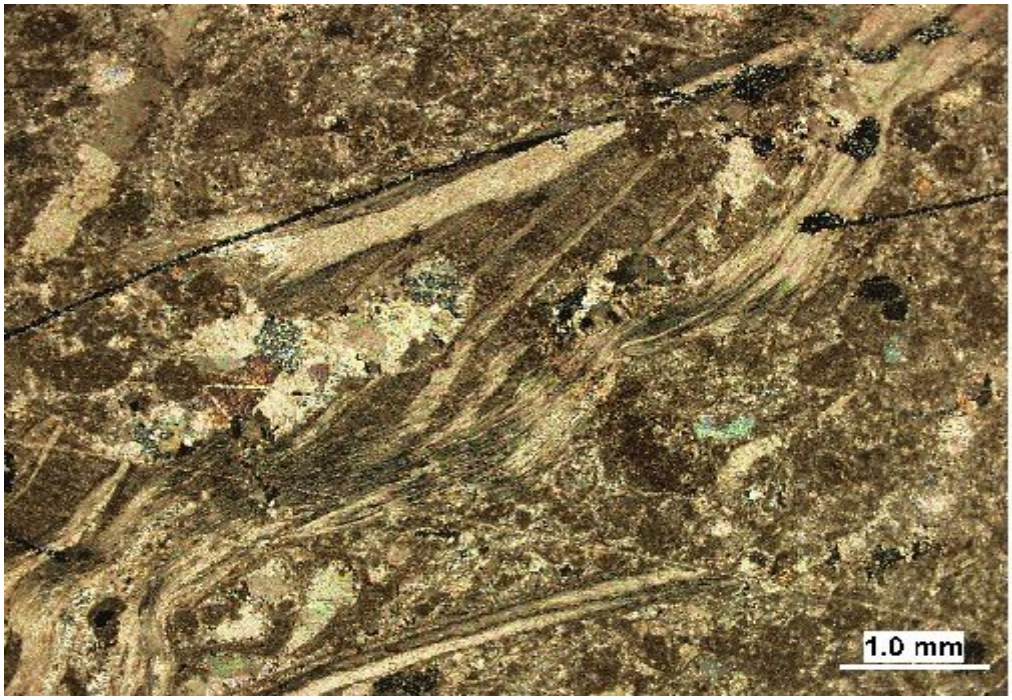


Fig.11: Bioclastic wackstone contain *ostra* shell which is on the hard ground related to mfs.

During the transgression sedimentation was again more carbonate and characterized by Echinoid, Bryozoans which gradually re- established a connection with the open ocean and return to normal carbonate deposition. In initial stage of HST, the Asmari beds are ticking upward and thinning Fig.12, which indicted increase of accommodation space in the aggradations and thinning in the retro gradation.

Fig.12: parasequences of HST in Burdigalian sequence, Notice thinning of the which is caused by decrease of accommodation space.

Conclusion

The current study show the age of Asmari Formation at Chenar section is Chattian to Burdiglation and in Kaseh Mast section is Aqitanian – Burdigulian.

In studied sections, four depositional sequences have been constructed. Sequence Chattian was deposited in onlap position against the Shahbazan Formation paleorelief in Chenar section time equivalent to this sequence in the basinal center (Kaseh Mast section) is deep marine marl of Pabded Formation.

Three Miocene sequences are distinguished. Sequences 2,3 of Aquitanian age start with lowstand deposits if subaqueous anhydrites deposits (middle anhydrite and main part of Kalhur Member). That was deposited when the basin became isolated from the Neothetys. By the end of sequence 4 of Burdigalian age, regional tectonic movement caused decreased accommodation space in the Chenar section.

The sequence was terminated by a regional water evaporate environment (Gachsaran Formation), which marked the closure the Neothethys at this time.

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