

## Microbiostratigraphy and Sequence Stratigraphy of Asmari Formation in Zeloï Well No. 5, Southeast of Dezful Embayment

Iraj Maghfouri Moghaddam

Department of Geology, Collage of Sciences, Lorestan University, Iran

Submitted: Jul 20, 2013; Accepted: Aug 31, 2013; Published: Sep 4, 2013

**Abstract:** Formation was deposited in the foreland basin of Zagros Basin (southwest Iran). One subsurface section was studied, Zeloï well no.5, in the Dezful Embayment in the southwest zagros to interpret the biostratigraphy and sequence stratigraphy of the Asmari Formation. Total Thickness of Asmari Formation in this well is 370 m and consists of anhydrite, limestone and intercalation of sandstone. The Asmari Formation is bounded uncomfomably by underlain Pabdeh Formation and the overlying Gachsaran Formation. On the basis of the recognized foraminifera, the section is comparable to *Miogypsina-Elphidium* sp.14 and *Borelis melo curdica-Meandropsina iranica* Assemblages zones and the age of the Asmari Formation in the studied section is assigned to Early Miocene (Aquitania-Burdigalian). Micropaleontological, sedimentary Facies and geophysical logs led to recognition of Three third order depositional sequences that are bounded by type 1 (SB1) And type 2 (SB2) sequence boundary.

**Key words:** Asmari Formation • Sequence stratigraphy • Zeloï well • Aquitania • Burdigalian

### INTRODUCTION

The Cenozoic stratigraphy of the Zagros basin has been the subject of detailed study ever since the first petroleum reservoir in Cenozoic sediments (Oligo-Miocene carbonate of the Amari Formation) was discovered at Masjed-I Soleyman in Iran. Oligo-miocene reservoirs currently produced prolifically not only elsewhere in Iran but also in Iraq e.g., Kirkuk Field, Oligocene Kirkuk Group reservoir [1]. Stratigraphical investigation of the Asmari Formation in Zagros started with the work of Busk & Mayo [2], Subsequent Workers such as Richardson [3] and Thomas [1] reported of Lithostratigraphy and biostratigraphy of Asmari Formation. James & Wynd [1], Wnd (1965), Adams & Bourgeois (1967) introduced the microfaunal characteristics and assemblages zones of the Asmari Formation. More recent studies of the Asmari Formation have been conducted on the biostratigraphy criteria, microfacies and Seunce stratigraphy (Amirshahkarami [8, 9, 10], Ehrenberg [11], Laursen [12], Mossadegh [13], Seyrfian & Hamedanian [13], Seyrfian [14], Soltanian [15], Van Buchem [16, 17, 18] Vaziri Moghaddam [19, 20], Vincent [21]). The present study examines the biostratigraphy and seuencestratigraphical framework based on large benthic foraminifera and geophysical logs in the Asmari

Formation, at the Zeloï well no.5, Dezful Embayment, Zagros Basin. At the studied well, Asmari Formation overlies Pabdeh Formation and overlying by Gachsaran Formation.

**Geological Setting:** The Asmari Formation was depsited in a northwest- southwest oriented foreland Zagros Basin which extended from northeastern Syria through northern and northeastern Iraq into southwestern Iran. 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 orogene in Cenozoic Time [22]. In Jurassic time, Orogenic movement caused Zagros Basin divided into several basins, included the Fars arc, Dezful Embayment (Khuzestan province) and Lurestan Basin, from south to northeast respectively (Fig. 1). The Zeloï well no.5 is located 42 km southeast of Dezful city (Fig. 2).

**Biostratigraphy:** Larger benthic foraminifera are widely distributed in the carbonate of the Asmari Formation. Therefore, biostratigraphic zonation is based on this organism. Biozoations established for the Asmari Formation in this study are largely based on biozonation of Laursen [12] that comprises an Oligocene to Early Miocene Carbonate sequences (Fig. 3).

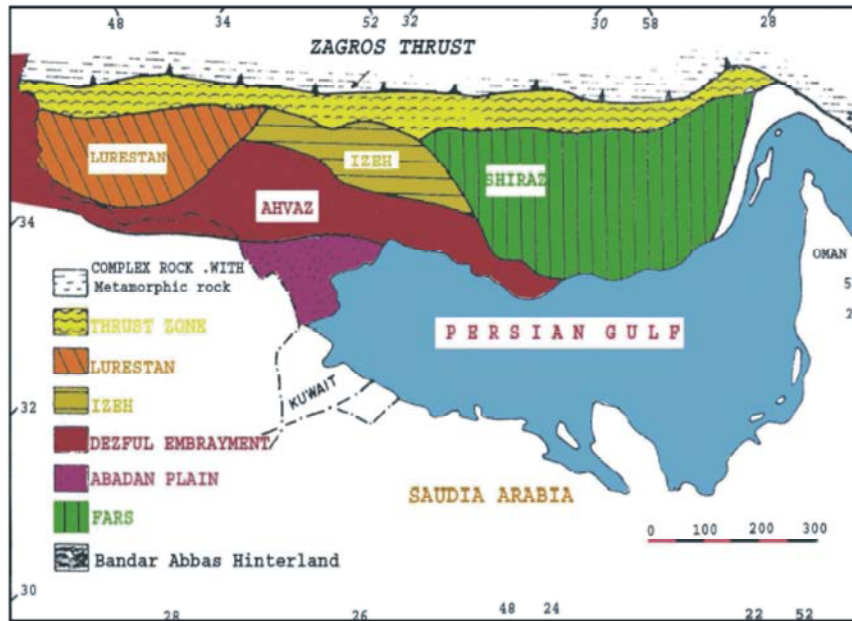


Fig. 1: Structural framework of Zagros Basin [23]

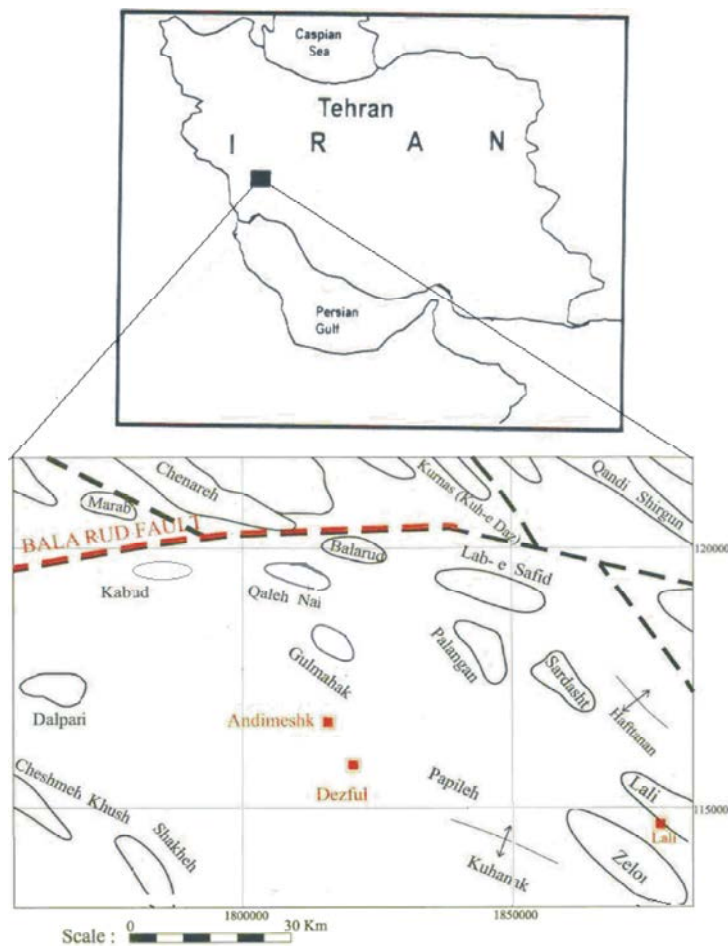


Fig. 2: Location map of Zeloh well no.5 in the Zagros region, southwest Iran

Epoch	Stage	Biozonation of Laursen <i>et al.</i> (2009)	
Miocene	Burdigalian	<i>Borelis melo curdica</i> - <i>Borelis melo melo</i>	
	Aquitanian	<i>Miogypsina</i> - <i>Elphidium</i> sp. 14	
Oligocene	Chatian	<i>Archais hensoni</i> - <i>Miogypsinoidea complanatus</i>	<i>Lepidocyclina</i> - <i>Operculina</i> - <i>Ditrupa</i>
	Rupelian	<i>Nummulites vascus</i> - <i>Nummulites fichteli</i>	
		<i>Globigerina</i> - <i>Turborotalia cerroazulensis</i> <i>Hantkenia</i>	

Fig. 3: Zonation in the Asmari Formation (After Lauren *et al.*, 2009)

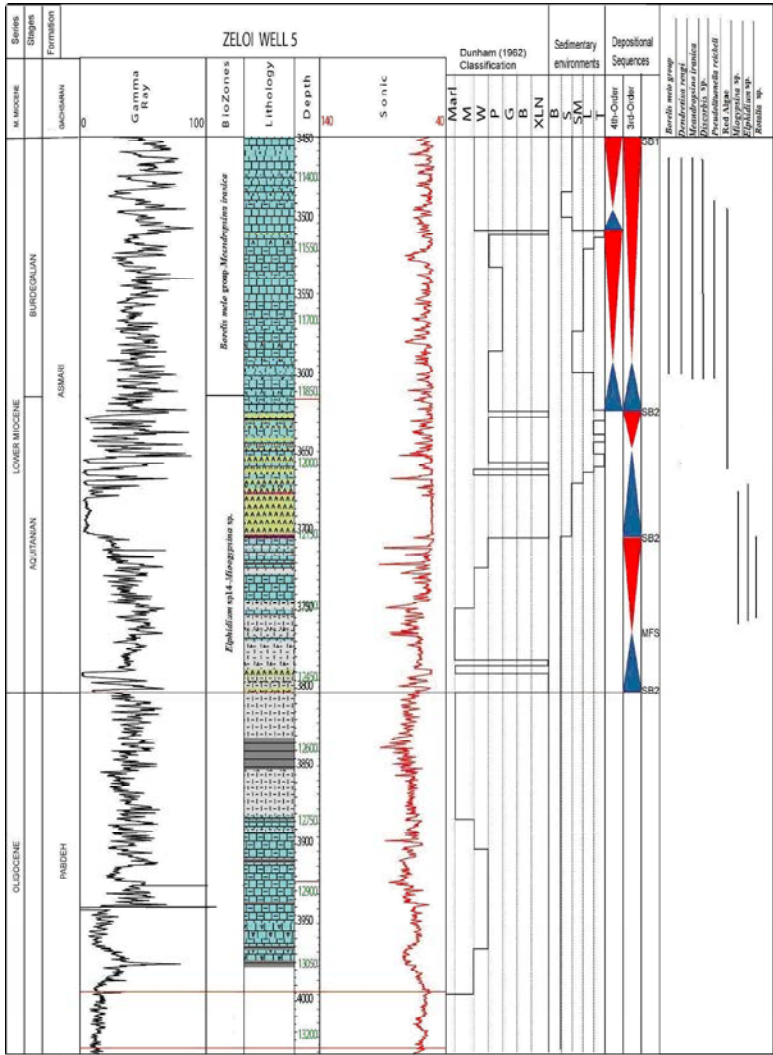


Fig. 4: Sequence stratigraphic and Lithostratigraphic column and vertical distribution of major benthonic foraminifera in ZeloI well No. 5.

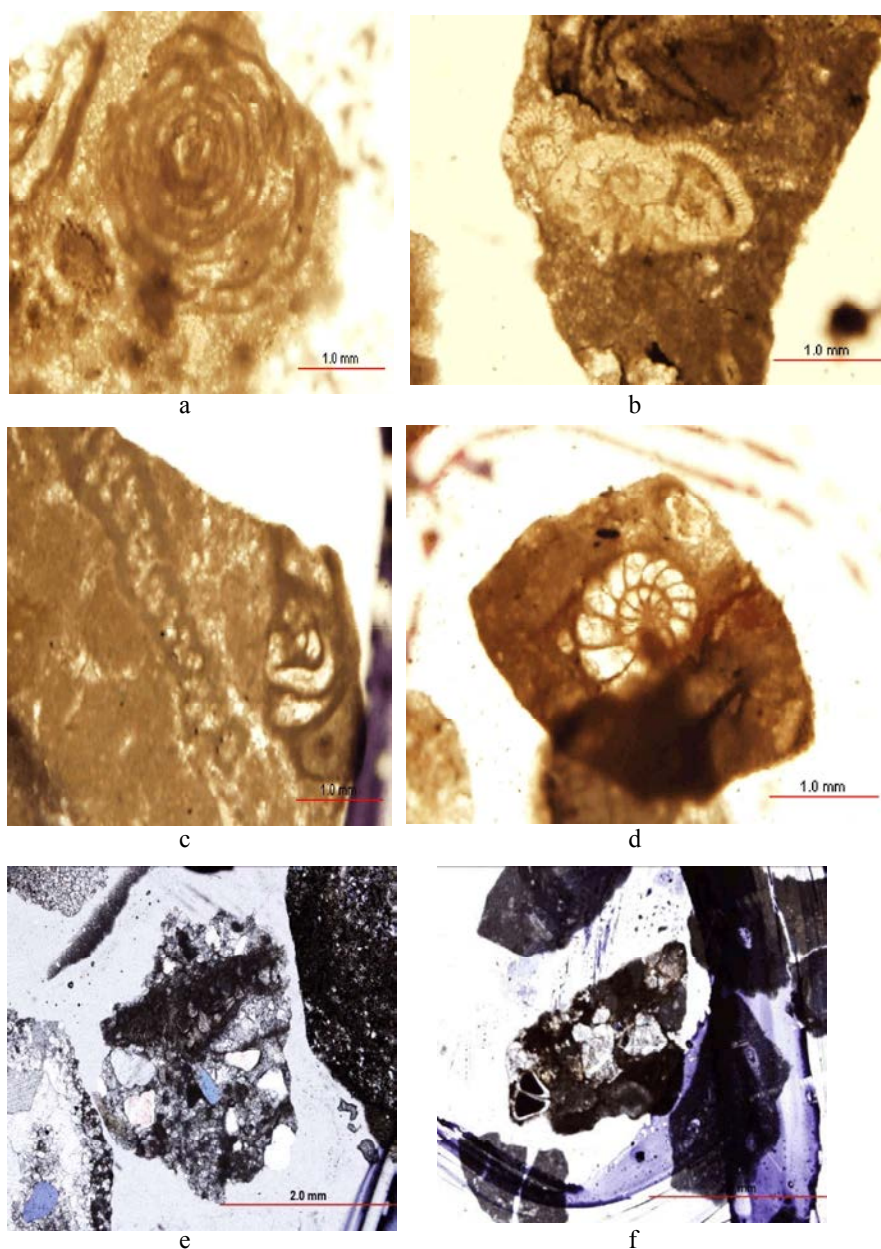


Fig. 5: a: *Borelis* sp., Zeloi well No.5, Asmari Formation, Sample No.3757, b: *Discorbis* sp., Zeloi well No.5, Asmari Formation, Sample No.3478-80, c: *Meandropsina iranica*, Zeloi well No.5, Asmari Formation, Sample No.3510-12, d: *Dendritina renyi*, Zeloi well No.5, Asmari Formation, Sample No.3522-24, e : *Miogypsina* sp., Zeloi well No.5, Asmari Formation, Sample No.3556-58, f: *Rotalia* sp., Zeloi well No.5, Asmari Formation, Sample No.3574 -76.

From base to top two foraminifera assemblages were recognized in the studied well (Fig. 4):

Assemblage 1 (from base to 3665m depth) characterized by presence of *Miogypsina* sp., *Elphidium* sp., *Rotalia* sp. and corresponds to the *Miogypsina* sp., *Elphidium* sp. 14 of Laursen *et al.*, [12]. This assemblage is attributed to the Lower Miocene (Aquitanian).

Assemblage 2 (from 3665m to top) has these associated Fauna: *Borelis melo* group, *Meandropsina iranica*, *Discorbis* sp., *Pseudolithonella reicheli*. This assemblage is attributed to the Lower Miocene (Aquitanian) and corresponds to the *Borelis melo curdica*, *Meandropsina iranica* of Laursen [12].

**Sequence Stratigraphy:** Based on the distribution of benthonic foraminifera, geophysical log and sedimentological data, we defined three third order sequence in Zelloi well no. 5.

**Sequence 1:** The sediments of sequence 1 are Early Miocene (Early Aquitanian) in age. At Zelloi well no. 5. This sequence is 100 m thick (Fig. 4) and begins with 10 m-thick sediments of the anhydrite facies. These are interpreted as the lowstand systems tract (LST) of this sequence. The contact between the LST with the basinal deposits with pelagic fauna (Pabdeh Formation) below is sharp. TST comprises of open marine deposits. Wackstone with abundant hyaline foraminifera represent deep-water facies; this is, therefore, interpreted as the mfs. An upward shallowing facies trend (HST) is indicated by Shallow open marine gradational facies, overlain by shallow-lagoonal facies.

**Sequence 2:** The sediments of sequence 2 are Early Miocene (Late Aquitanian) in age. At this well, the second third order sequence of Early Miocene is 90 m thick and begins with 7.5 m alternation of anhydrite and carbonate and characterized by a type 2 sequence boundaries (SB2). At the base, the anhydrite is homogenous, but passes up interdigitates with shallow water carbonates. TST system tract is indicated by shallow subtidal facies. An upward shallowing facies trend (HST) is indicated by shallow open marine gradational facies, overlain by shallow-lagoonal facies.

**Sequence 3:** This sequence is Burdigalian in age and has 170 m thick. The lower boundary of sequence 3 is characterized by a type 2. TST system tract is indicated by Lagoonal facies, Deeping upward microfacies trend (TST) of sequence 3 is indicated by change from restricted lagoonal microfacies to open marine facies. The mfs of this sequence was marked by packstone with perforated large benthic foraminifera. The HST system tract is characterized by wackstone with low diversity imbricate foraminifera.

## CONCLUSION

The sediments of Asmari Formation at Zelloi well no. 5. Dezful Embayment of the Zagros Basin was studied on the basis of biostratigraphy and sequence stratigraphy factors. On the basis of the foraminifera recognized in the studied section, the Asmari Formation is comparable to

the *Miogypsina* sp., *Elphidium* sp. 14, and *Borelis melocurdica*-*Meandropsina iranica* Assemblage Zones. The Asmari Formation at the study well is Aquitanian-Burdigalian in age. In addition, Three third-order sequences are identified.

## REFERENCES

1. Jones, R.W. and M.D. Simmons, 1996. A review of the stratigraphy of eastern paratethys (Oligocene to Holocene). *Bulletins of the British Museum (Natural History), Geological Series*.
2. Busk, H. and T. Mayo, 1919. Some notes on Geology of the Persian oil field. *J. Inst. Petrol. Tech.*, 50: 5-26.
3. Richardson, P.K., 1924. The geology and oil measures of southwest Persia. *J. Inst. Petrol. Tech.*, 43: 259-283.
4. Thomas, A.N., 1948. The Asmari Formation of southwest Iran. *Aloc. Report 706*, Unpublished.
5. James, G.A. and J.G. Wynd, 1965. Nomenclature of Iranian Oil Agreement area. *AAPG, Bulletin*, 49(12): 2182-2245.
6. Wynd, J., 1965. Biofacies of the Iranian consortium agreement area, Iranian Oil Corporation companies, Geological and Exploration Division, unpublished.
7. Adams, T.D. and F. Bourgeois, 1967. Asmari Biostratigraphy, Geological and exploration Div. *loc. Report No. 1074*, pp: 37.
8. Amirshahkarami, M., H. Vaziri-Moghaddam and A. Taheri, 2007. Paleoenvironmental model and sequence stratigraphy of the Asmari Formation in southwest Iran, *Historical Biology*, 19: 173-183.
9. Amirshahkarami, M., H. Vaziri-Moghaddam and A. Taheri, 2007. Sedimentary facies and sequence stratigraphy of the Asmari Formation at the Chaman-bolbol-Zagros basin, *Journal of Asian Earth Sciences*, 29: 47-59.
10. Amirshahkarami, M. and A. Seyrafian, 2008. Late Oligocene-Early Miocene benthic foraminifera and biostratigraphy of the Asmari Formation, South Yasuj, North-Central Zagros basin, Iran, *Carbonate and Evaporates*, 23(1): 1-10.
11. Ehrenberg, S.N., N.A.H. Pickard, G.V. Laursen, S. Monibi, Z.K. Mossadegh, T.A.A. Svana, A.A.M.A. Qrawi, J.M. McArthur and M.F. Thilawal, 2007. Stratum stratigraphy of the Asmari Formation (Oligocene-lower Miocene), SW Iran, *Journal of Petroleum Geology*, 30(2): 107-128.

12. Laursen, G.V., S. Monibi, T.L. Allen, N.A.H. Pickard, A. Hosseiney, B. Vincent, Y. Hamon, F.S.P. Van V. Bouchem, A. Moallemi and G. Durillion, 2009. The Asmari Formation Revisted: Changed stratigraphical allocation and new biozonation, Shiraz, First International Conference and Exhibition, 4-6: 5.
13. Mossadegh, Z.K., D.W. Haig, T. Allen, M.H. Adabi and M.H. Sadeghi, 2009. Salinity changes during Late Oligoceneto Early Miocene Asmari Formation deposition, zagros, Iran. *Paleogeography, Paleiclimatology, Paleoecology*, 272: 17-36.
14. Seyrafian, A. and A. Hamedanian, 2003. Microfacies and paleoenvironmental interpretation of the lower Asmari Formation (Oligocene) North-Central Zagros basin, *Neus jahrbuch fur Geologie Und paleontology, Ab undpaleontology, Abband Lungen*, 2(3): 164-167.
15. Soltanian, N.A., H. Seyrafian and H. Vaziri, 2011. Biostratigraphy and paleo-ecological implications in the microfacies of the Asmari Formation (Oligocene), Naura anticline(Interior Fars) of the Zagros Basin , Iran, *Carbonate Evaporate*, pp: 31-46.
16. Van Buchem, F., 2000. The Petroleum System of the Dezful Embayment and Northern Fars (Southwest Iran) with special attention to the Jurassic and Cretaceous carbonate systems. NIOC, Geological Report No. 1947, Unpublished.
17. Van Buchem, F. and T. Allen, 2006. The evolution of the Oligocene-Early Miocene mixed sedimentary system in the Dezful Embayment (SW Iran). *Geo Arabia conference, Abstact, Geoarabia*, 12(2): 202.
18. Van Buchem, F.S.P., T.L. Allan, G.V. Laursen, M. Lotfpour, A. Moallemi, S. Monibi, H. Motiei, N.A.H. Pickard, A.R. Tahmasbi, V. Vedrenne and B. Vincent, 2010. Regional stratigraphic architecture and Reservoir types of the Oligo- Miocene Deposits in the Dezful Embayment (Asmari and Pabdeh Formations) SW Iran. In: F.S.P .Van Buchem, K.D. Gerdes and M. Esteban, (Eds.), *Mesozoic andCenozoic carbonate Systems of The Mediterranean and the Middle East: Sequence and Digenetic Reference Models*. Geological Society, London, Special Publication , 329: 219-263.
19. Vaziri Moghaddam, H., M. Kimiagari and A. Taheri, 2006. Depositional Environment and sequence stratigraphy of the Oligo-Miocene Asmari Formation in SW Iran, *Springer Verlag*, 52: 41-51.
20. Vaziri-Moghaddam, H., A. Seyrafian, A. Taheri and M. Motiei, 2010. Oligocene-Miocene ramp system (Asmari Formation) in the NW of the Zagros basin, Iran:*de Ciencias Geologicas*, 27: 56-71.
21. Vincent, B., T. Allen, F. Gaumet, Z. Karimi, G. Laursen, M. Lotfpour, F.M. Masse, P. Moallemi, S. Monibi, A. Tahmasebi, F.S.P. Van Buchem and E.V. Verdrenn, 2006. Quantitative stratigraphy in the Oligo–Early Miocene carbonates system in the Dezful Embayment (Sw Iran). *Geo Abstract, Geoarabia*, 12: 222.
22. Bahroudi, A., E.J. Garranza and B. Soleimani, 2011. Geochemical analysis of evaporate sedimentation in the Gachsaran Formation, Zeli oil field, southwest Iran, *Journal of Geochemical Exploration*, 111: 92-112.
23. Sherkaty, S. and J. Letouzey, 2004. Variation of structural style and basin evolution in the central Zagros (Izeh zone and Dezful beltI Iran): *Marine and Petroleum Geology*, 21(5): 535-554.