

Depositional Environment and Sequence Stratigraphy of the Neocomian Fahliyan Formation in North Dezful Embayment, Iran

Mostafa Sabouhi^{1*}, Davood Jahani², Farid Taati Qurayem³ and Ali Aminzadeh⁴

^{*1} Young Researchers Club, Islamic Azad University, North Tehran Branch, Tehran, Iran. (E-mail: msgeologist@gmail.com)

² Department of Geology, Islamic Azad University, North Tehran Branch, Tehran, Iran.

³ Exploration Directorate, National Iranian Oil Company, Tehran, Iran.

⁴ Petroleum Engineering Department, Petroleum Engineering Development Co. (PEDEC), Tehran, Iran.

Abstract

Fahliyan Formation (Neocomian) is one of the important hydrocarbon reservoirs for Khami group in southwest of Iran. This formation with 332m thickness in type section consists mainly of carbonate rocks. In this research, Fahliyan Formation was investigated in subsurface section of Azadegan borehole in the Dezful Embayment. Lower boundary of Fahliyan Formation with Garau Formation is continuous and there is an unconformity between upper Fahliyan Formation with Gadvan Formation. According to Petrographic studies and Interpretation of geophysics logs, 13 Microfacies and one shaly facies were recognized which comprise four facies associations. These from shoreline to basin are Tidal-flat, Lagoon, Bar and Open marine Facies Association. Combination of sedimentology, tectonic records and vertical facies changes of the Fahliyan Formation in the studied sections and in comparison with ancient and modern depositional environment, indicate the facies of this formation have been formed in shallow parts of a carbonate shelf platform. Sequence Stratigraphy of Fahliyan Formation indicate two depositional sequence (3rd - order cycles) in this research.

Keywords: *Fahliyan Formation; Depositional Environment; Sequence Stratigraphy; Dezful Embayment; Iran*

1. Introduction

The Fahliyan Formation is part of the Lower Cretaceous deposits (Neocomian) of southwest Iran. This formation is one of the important hydrocarbon reservoirs for Khami group in southwest of Iran. Lithologically, the Fahliyan Formation at the type section consists of 332m of mainly limestone and argillaceous limestone (James and Wynd, 1965).

It was deposited on a carbonate platform developed across the Zagros Basin. Little work has been done on the effects of relative sea level changes during deposition of the Cretaceous carbonate sediments in the Zagros Basin. In this research, Fahliyan Formation was investigated in subsurface section of Azadegan borehole in the Dezful Embayment. Lower boundary of Fahliyan Formation with Garau Formation is continuous and there is an unconformity between upper Fahliyan Formation with Gadvan Formation (Sabouhi, 2009). The main objectives of this paper are to (1) describe and interpret the depositional environments represented by the Fahliyan Formation and (2) describe and

interpret the origin of sequences that developed in the study area mainly based on the distribution of the well data.

2. Geological setting:

Dezful Embayment is located in southwest Iran, bounded to Balarud flexure towards northwest, Izeh fault zone towards southeast, and Mountain front fault towards north and Zagros front flexure towards south, and consists of thick sedimentary sequences from Mesozoic to Cenozoic (Fig.1). The lithostratigraphic section of the Jurassic – Cretaceous interval is shown in (Fig.2). This zone is characterized by intense structural depression. Several potential source rock units and reservoir rocks with different geological ages were deposited in this tectonically developed depression making this area as the most prolific region in the Middle East (Alsharhan 1989).

3. Methods and study area:

This study is based on thin section descriptions from two wells and the interpretation of

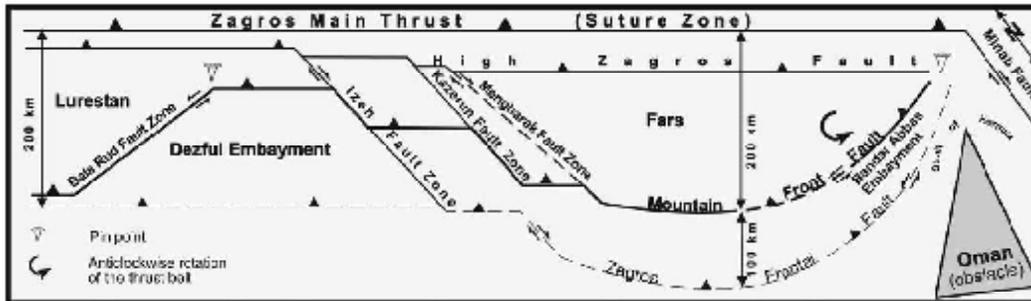


Fig.1. Sketch map showing the structural framework of the Zagros and significant role of the Kazerun, Izeh, Bala Rud and Mengharak Fault Zones as transfer faults or lateral ramps. (Sepehr and Cosgrove,2004).

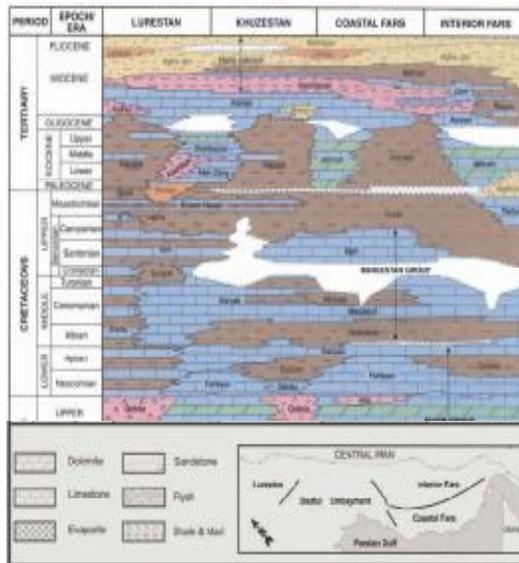


Fig.2. Mesozoic–Cenozoic Stratigraphy correlation chart of the Iranian Sector of the Zagros basin showing the lateral lithology and facies changes along and across the Folded Belt, modified from Beydoun et al. (1992) and Motiei (1993).

well log data from three wells. The study comprised of four steps. The



Fig.3. Azadegan oil field location.

first consisted of a detailed description of the bedding, texture, lithology, faunal content and diagenetic processes in cores and thin sections. The identification of important surfaces, such as sequence boundaries and maximum flooding surfaces, and the interpretation of depositional environments were emphasized. The second step was a one-dimensional sequence analysis of cored intervals. The increasing and decreasing trends in the accommodation/carbonate production ratio are based on palaeobathymetrical interpretations of depositional environments, and the relationship between sequence development and diagenetic processes was also investigated. In the third step, the sequences were tied to the well logs (gamma ray) by correlating sequence boundaries and maximum flooding surfaces. The fourth and final step involved well log-based correlation throughout the field, which is illustrated by examples from one well.

3-1. Azadegan oil Field

The Azadegan Field is located near the national border with Iraq in the Khuzestan province of Southwestern Iran (Fig.3). The area is topographically flat with ground level of several meters and called the Abadan (Mesopotamian) Plane, while most of the Iranian oil fields are situated in the mountainous Zagros area. The field is on an N-S trending anticline structure where oil was discovered in 1999 by NIOC.

4. Previous work

The Fahliyan Formation has already been documented in previous articles and in several unpublished internal reports of the National Iranian Oil Company (NIOC), For Example Ali Gollestaneh, 1965; Wynd, 1965; GOLLESTANEH, 1974; SETUDEHNIA, 1978; WELLS, 1969; KHERADPIR, 1975.

5. Facies description and depositional environment

The Microfacies of the Fahliyan Formation are studied and interpreted in detail by using of the classification of Dunham (1962). The interpretation of depositional environment was carried out based on Wilson (1975), Carozzi (1989), Reading (1996), and Flügel (2004).

Tidal-flat Microfacies group:

This group consist of (MF1, Dolomudstone with evaporate cast), (MF2, Dolomitic stromatolite boundstone), (MF3 Algal peloid packstone with keystone vug), (MF4 Bioclast peloid grainstone with keystone vug).

Lagoon Microfacies group:

This group consists of (MF5, Peloid wackestone/packstone), (MF6, Bioturbated bioclast lime mudstone), (MF7, Mudstone).

Barrier/Shoal microfacies group:

This group consists of (MF8, Ooid grainstone), (MF9, Peloid grainstone), (MF10, Oncoid/ooid grainstone), (MF11, Intraclast Ooid grainstone).

Open marine microfacies group:

This group consists of (MF12, Bioclast wackestone) and (MF13, Mudstone).

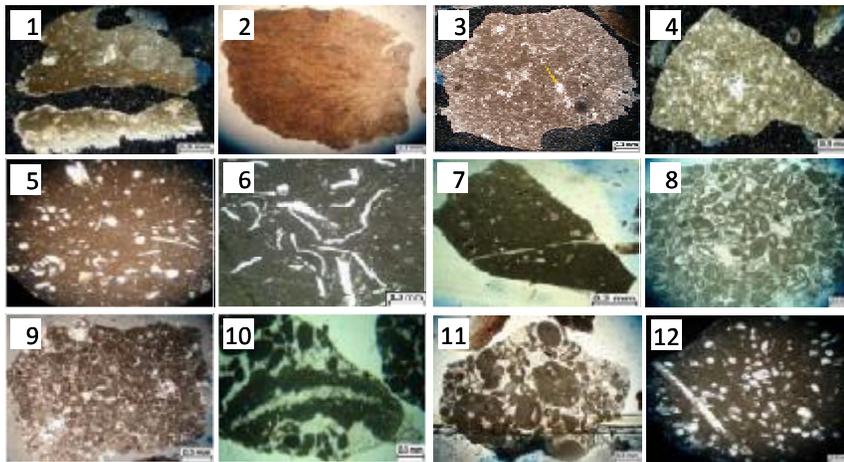
6. Depositional Environment

After recognition and detailed study on the microfacies and their classification, regarding Walter rule and the arrangement of overlaying microfacies over each other, their comparison with present and older environment (Carozzi,1989; Reading,1996 and Nichols,1999), evidences such as lack of daislaced and reworked deposits, absence of slides and slumps facies that indicate high slope of depositional environment during sedimentation, it can be concluded that the microfacies of Fahliyan Formation is involved in shallow depth marine environment.

Regarding the studies conducted on the profiles on Fahliyan Formation (Khazaie,2003 ; and Lasemi and Nourafkan,2008) some evidences have been found on the reworked facies therefore, it is believed that the depositional model of Fahliyan Formation is a carbonate shelf and the profile studied was situated at the shallowest part of the platform. The proposed model includes tidal-flat, lagoon, Barrier and open marine which are distinguished from each other based on the sedimentary characteristics, difference in energy level, salinity, rate of sedimentation and diversity in the biological assemblage, reconstructed based on facies group continuity.

7. Sequence Stratigraphy

The presented sequence stratigraphic model is based on the definition of Vail et al. (1997) and Miall (2000). Herein we have amalgamated possibly low stand and transgressive system tracts as transgressive deposits. Facies analysis led to the definition of two important sequence



F.g.4. 1.Microfacies MF1- Dolomudstone with evaporite casts, 2.MF2- Dolomitic stromatolite boundstone, 3.MF3-Algal peloid packstone with keystone vugs, 4.MF4- Bioclast peloid grainstone with keystone vugs, 5.MF5- Peloid wackestone/packstone, 6.MF6- Bioturbated bioclast wackestone, 7.MF7- Lime Mudstone, 8.MF8- Ooid grainstone, 9.MF9- Peloid grainstone, 10.MF10- Oncoid/ooid grainstone, 11.MF11- Intraclast ooid grainstone, 12.MF12- Bioclast wackestone.

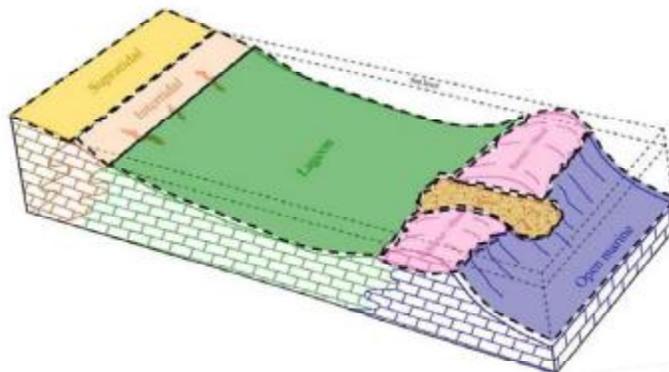


Fig.5. Depositional model of the Neocomian succession at Dezful Embayment, AZN#2.

stratigraphic surfaces that might be helpful for regional correlation. These two surfaces differentiate the lower and upper boundaries of the Berriasian-Valanginian succession (Figs. 6). The first sequence includes HST only and the TST is in the Garau Formation. The upper contact of this sequence with the second sequence is type 2 sequence boundaries (SB2). The second sequence includes TST and HST, and upper contact with the Gadvan Formation is type 1 sequence boundary (SB1). They are part of a third-order sequence. Vertical facies changes and cycle stacking patterns demonstrate that the Fahliyan Formation consists of two depositional sequences that are related to L-UZ (Lower-Upper Zuni) super sequence. These sequences are correlated with the Lower Cretaceous global sea level cycles suggesting eustatic control for their development.

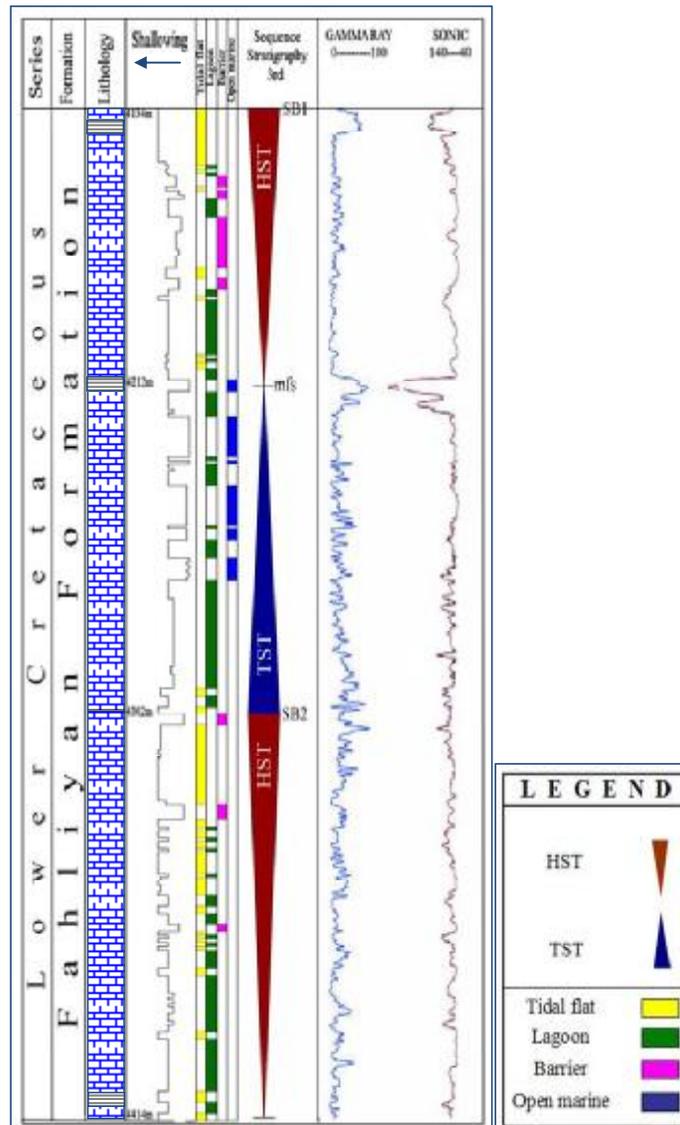


Fig.6. Sequence stratigraphy column of AZN#2 .

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