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Research Article

LITHOFACIES AND SEQUENCE STRATIGRAPHY OF BAHRAM FORMATION (LATE DEVONIAN) IN NORTHWEST OF KERMAN PROVINCE, SHAMSABAD SECTION

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ABSTRACT

A section of Bahram Formation (Late Devonian) in Northwest of Kerman (Shamsabad) with 123m thickness was studied from point of view of litho facies and sequence strat igraphy. This section is composed from fossilferous limestone, dolostone, sandstone and shale. Microscopic examinations showed that there are five facies belt in this section: Shore face, Tidal flat, Lagoon, Shoal and Open marine. Bahram Formation was deposited in mixed Siliciclastic – Carbonate low depth marine environment. Sequence stratigraphy studies showed that Bharam Formation is composed of three 3th sequence and limited between SB1 in base and on top. Sequence 1 composed of TST and HST parasequences, Sequences 2 composed from TST and HST parasequences and Sequences 3 composes of TST, Early HST, Late HST and FSST.

Key Words: *Sequence Stratigraphy, Late Devonian, Bahram Formation, Lithofacies, Shamsabad*

INTRODUCTION

Mountains in North and Northwest of Kerman are a key region for the study of Late Devonian and Carboniferous Sedimentary evolution of Iran deposits.

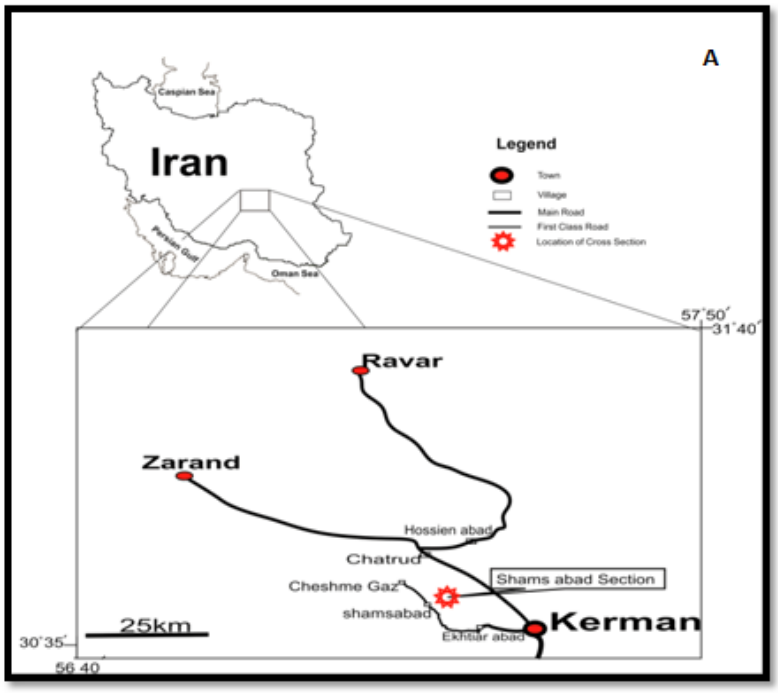
The first detailed studies of the geology on Devonian sequences of the Kerman Province were performed by Huckriede *et al.,* (1962). Many researchers have studied stratigraphy of on Devonian Bahram Formation in Kerman including (Dastanpour and Aftabie, 2002), (Flugel and Ruttner, 1962) (Wendt *et al.,* 2002, 2005), (Webster *et al.,* 2003), (Bahrami *et al.,* 2011) and (Gholamalian *et al.,* 2007). However, sedimentary and sequence stratigraphy studies of Bahram Formation is limited. In this review, we aim to study the facies and environments, identifying facies and recognizing sedimentary cycles (System Tracts, Sequence Boundaries and Depositional Sequences).

Geographic and Stratigraphic Position of the Studied Section

The studied section is located adjacent to about a 1 km away the Shamsabad village with a thickness of 123 meters. At the lower boundary it's unconformable on igneous rock of Late Precambrian Rizu Series (Wendt *et al.,* 2002; Gholamalian *et al.,* 2007). The top separates with paraconformity from the informal Hutk Formation (Tournaisian).

The difference between the upper and lower boundaries of lithologic discontinuity is indicative. Cross section that selected for study is located in Northwestern city of Kerman.

The age of studied section is Late Frasnian to Middle Fammenian (Bahrami *et al*. 2011, Gholamalian *et al.* 2007). It's base is at N 30˚ 21′ 55.9″, E 56˚ 46′ 43.8″, It's top at N 30˚ 21′ 49.9″, E 56˚ 46′ 49.5″ (WGS84 System). Kerman – Cheshme Gaz road is the best direction to go to the studied section (figure 1, A).



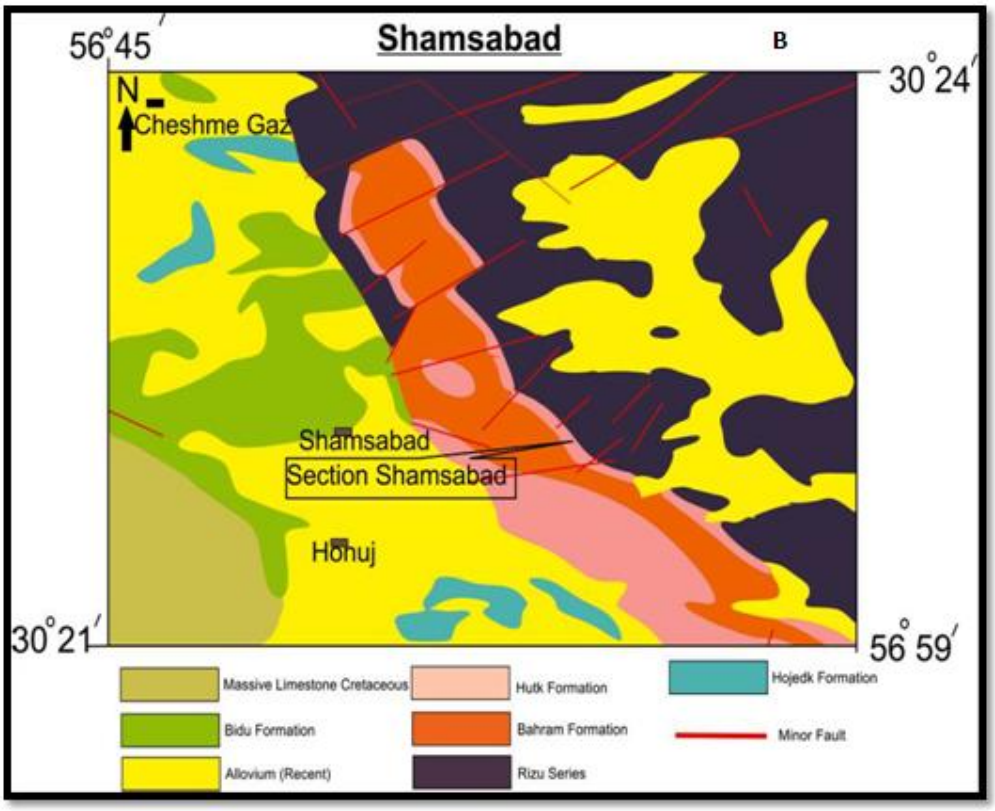


Figure 1: A- access to Shamsabad Section, Kerman province. B- Geological map and geological position of Shamsabad Section

MATERIALS AND METHODS

Bahram Formation at Shamsabad section was examined by using the conventional field survey of sedimentary geology. Fifty samples were selected from this section and thin sections were prepared from samples and then studied. Finally Bahram Formation petrofacies and microfacies were identified. Siliciclastic petrofacies named after the (Pettijohn *et al.*, 1987) method and carbonate microfacies named on naming method of (Dunham, 1962). Microfacies interpretation and their sedimentary environment based on (Flugel, 2010) arrangement of facies and microfacies and sedimentary environment obtained. Sequence stratigraphy analysis and identification of sequences boundaries were based on (Emery and Myers, 1996) and (Van Wagoner *et al.*, 1988) methods.

RESULTS AND DISCUSSION

1. Petrofacies, Microfacies and Sedimentary of Bahram Formation in Shamsabad Section

In this study 14 petrofacies and microfacies of the five environments was indentified: shore (for siliciclastic petrofacies), tidal flat (A), lagoon (B), shoal (C) and open marine (D) (for carbonate microfacies) detected.

Silisiclastic Petrofacies belt

The siliciclastic facies belt composed of sandstone and shale.

Sandstone (Quartz arenite): Quartz arenite type of sandstone is observed. The main components of this microfacies are Sorted and rounded moderate to weak rounded quartz. All the detritus are in size of sand. This facies is alternating with shale facies and both belong to the foreshore.

***Shale sub facies*:** Shale and sandstone alternating and somewhere have a carbonate portions. Shale is 13 meters thick in some places and its color is gray.This faces is belong to the mudflat.

Carbonate Microfacies Belt

Group (A) Microfacies of the Tidal Flat:

The facies belt contains five microfacies (A1 to A5). In the field, facies with thin layered to thick, yellow to gray in color and lamination and crass bedding were determined.

A1: Dolomitized mudstone

These microfacies contains fine to medium size crystalline dolomite. Mosaic texture is obvious. Amount of iron oxide in microfacies is 30 percent.

A2: Dolostone

Available dolomite in microfacies is authomorphic and coarse grained. Also, some dolomites are opaque and show zoning.

A3: Sandy Dolostone

These facies contain rounded grains of quartz. Dolomitization of the carbonate components is vanished. Thin sections were stained with iron oxide.

A4: Crystalline Limestone

Dolomitic limestone facies with large crystal size of 0.5 mm to smaller variety. Zoning in dolomite and iron oxide have also accompanies with them. Calcite crystals have cleavage .Fenestral fabric is observed in this facies.

A5: Iron Dolostone

this microfacies composed of well rounded and sorted quartz grains and iron oolites. Some oolites have a core of quartz crystals.

Comparison of characteristics of (A) group microfacies with the (Flugel, 2010) belt, represents the 8 number belt. This indicates the tidal flat. Sandstone and shale facies are characteristics in order to foreshore and mudflat.

Group (B) Lagoon Microfacies

B1: Sandy Lime mudstone

It contains of noncarbonated grains (quartz 10 – 20 percent) in from relatively sorted and well rounded sand.

B2: Bioclastic Packstone – Wackestone

Most important grains of these microscopic facies, are fossil fragments of brachiopods, echinoderms, bryozoans and ostracodas. Those are in micrite to sprites. Quartz particles are rare.

(B) Microfacies group with dark color, few pelloid and fossil fragments are determined. Compared facies belt with (Flugel, 2010) belt, respecting number 7 belts and has a lagoon sedimentary environment.

Group (C) Shoal Microfacies

C1: Bioclastic (Brachiopod) Packstone – Grainstone

Skeletal fragment in this microfacies include brachiopod, echinoid and bryozoans are abundant. Because intense dolomitization of allochems they are not well understood. Brachiopod fossils are more abundant than any others.

C2: Bioclastic Grainstone – Packstone

Skeletal components of this microfacies are brachiopods, crinoids, bryozoans and pelloid. Some of samples have small and rounded quartz.

C3: Bioclastic Packstone

The brachiopods, bryozoans and crinoids microfacies, are different that seen in context of micrite and micro sprites.

C4: Intraclastic Bioclast Grainstone

Components of this microfacies are intraclastic, brachiopods and bryozoans. Dolomitization in the microfacies is locally. Micritic fossil can be seen in the microfacies.

Group (C) microfacies with group (B) microfacies can be seen. With the high frequency fossil fragments are characterized by a shallow sea. They represent number 6 of (Flugel, 2010) belt which shows a carbonate bioclast shoal.

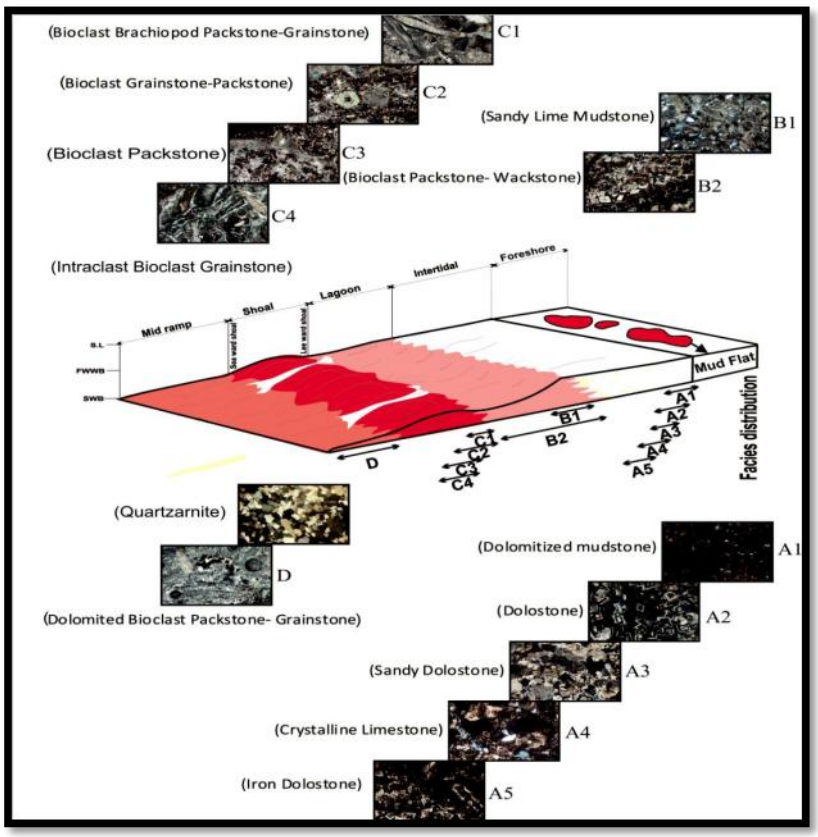


Figure 2: Three – dimensional modeling of sedimentary platform carbonate – Siliciclastic, Bahram Formation suggested Shamsabad section

Group (D) Open marine Microfacies

The main components of this microfacies are crinoids'paticles. This microfacies is alternate to group (C) in the belt number 4 of (Flugel, 2010).

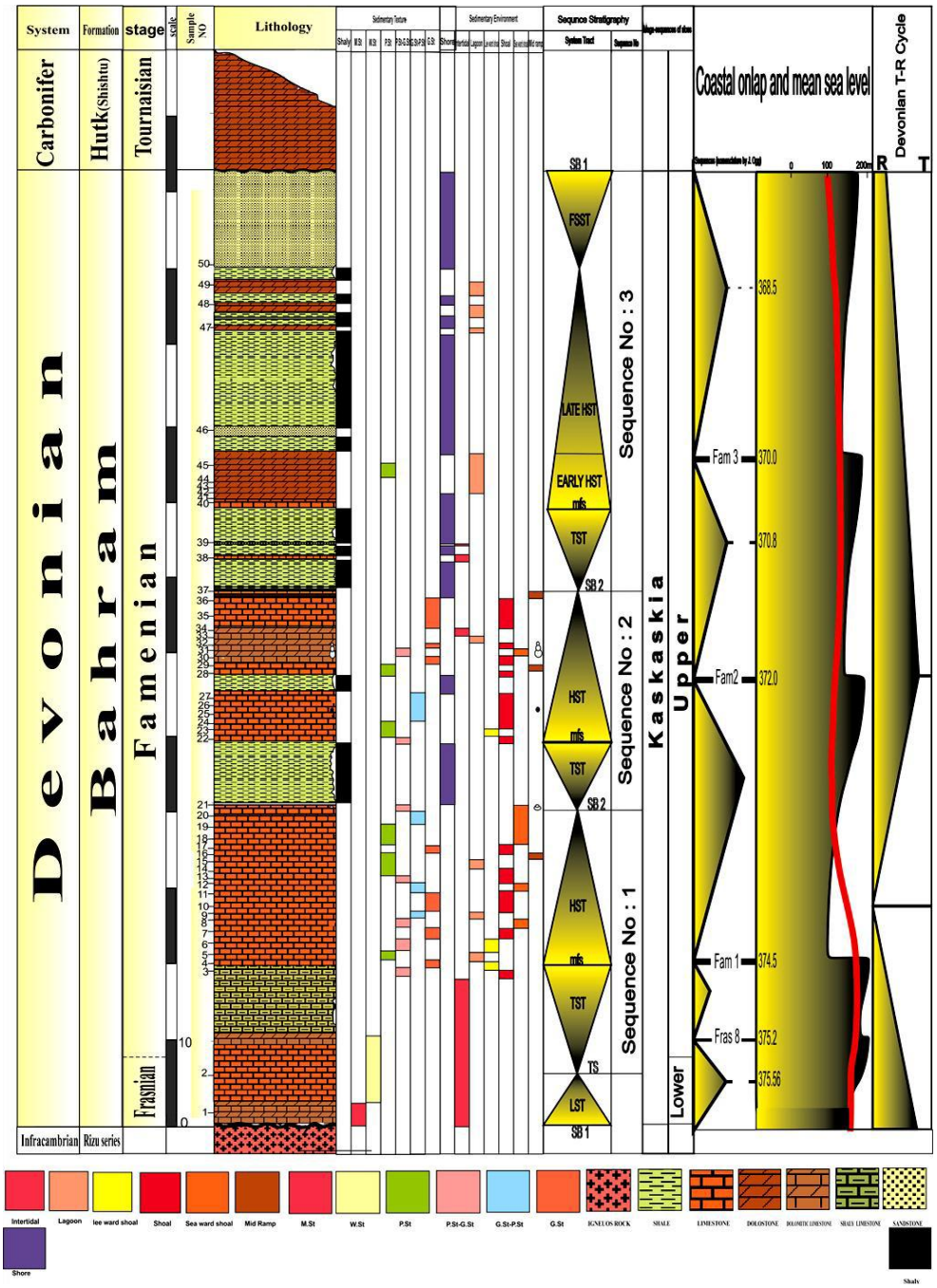


Figure 3: Microfacies and sequence stratigraphic column in Bahram Formation of Shamsabad section

2. Sequence Stratigraphy Describe

According to the principles of sequence stratigraphy and lithostratigraphy studies and microfacies observation, three sedimentary sequences of third order cycle were identified.

First Sequence

The thickness of this sequence is 42 meter and consists of LST, TST and HST system tracts. The lower boundary of sequence is Type I (SB1) and upper boundary is a type II (SB2). The lower boundary is a discontinuity boundary between Bahram Formation and Rizu series. The first system tract (LST) includes tidal flat microfacies. The system tract above the maximum flooding surface (mfs) composed of bioclastic wackestone – packstone, and few intraclast. Transgressive surfaceis separated by LST and TST. TST systems tract shows a progression. The LST also is initially fixed and then progressively. HST is placed on the mfs surface. HST system tract is included lagoon microfacies (figure 4, A).

Second Sequence

Sequence thickness is 26 meter and contains the TST and HST systems tract. This sequence has both upper and lower boundaries from Type II (SB II). Systems tract (TST) in terms of a progression Parasequence HST represents a constant process. In this sequence of system tract TST has clastic facies. HST in sequence mentioned contain the barrier facies with bioclast. Boundary between the two systems tract locates above the maximum flooding surface (mfs) that is composed of bioclastic grainstone - packstone microfacies specified (Figure 4, B).

Third Sequence

The thickness of this sequence is 55 meter and contains systems tract TST, Early HST, Late HST and FSST. The lower sequence boundary of type I (SB1) and the upper boundary is sequence boundary Type II (SB2). The upper boundary of sequence is a discontinuity that separates the Bahram formation from Hutk Formation. Systems tract TST Parasequence of a progression type, the Early HST is sign of constant process of growth, Late HST is fixed at the first and then regressive and FSST systems tract is quite regressive. FSST shows return to a shallow sea, then barrier system and finally have a regression in facies.mfs level of the sequence interclastic bioclast packstone microfacies was determined (Figure 4, B).

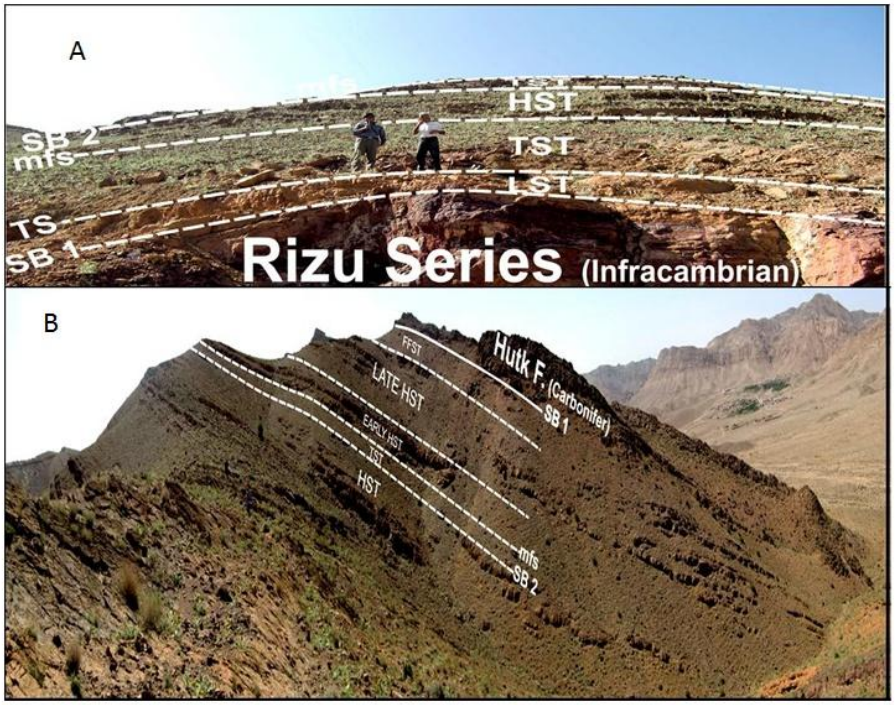


Figure 4: A: View number 1 Sequence and system tract in Shamsabad section. B- View number 2 & 3 sequence and system tract in Shamsabad section

Microfacies vertical changes in comparison with the global changes in sea level curves showed that Bahram formation Sequences (Late Frasnian -Middle Famennian) comprised of three third degree sequences and the total represents a regressive cycles from the base to the top of the studied section(figure 3).

CONCLUSION

Study of Bahram Formation in Shamsabad section, Northwest of Kerman suggests that these bed are mainaly composed of carbonate, shale and sandstone. Based on petrographic studies, 12 carbonate microfacies and 2 clastic facies are identified. The environments change from the shore to the open marine facies. The vertical and lateral facies changes, show shallow marine mixed Siliciclastic - carbonate deposition that represents a carbonate ramp (figure 2). Sequence stratigraphy studies show that the formation is composed of three 3th sequences. Sequence 1 is composes of TST and HST parasequences which the upper boundary of this sequence is SB2. Sequence 2 is fromed of TST and HST parasequences and the upper boundary is of type SB2. Sequence 3 starts with the TST parasequence, after Early HST and Late HST continues with FSST and with upper boundary of formation SB1 will terminate. Finally by comparing the vertical microscopic changes of facies with global change in sea level, be a general regressive sequence for Bahram Formation, the base of the head was considered. The total represents is a regressive cycle from the base to the top of the studied section.

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