Microbiostratigraphy and Lithostratigraphy of Fahliyan and Gadvan Formations in Kuh-e-Surmeh (Zagros Basin, Southwest Iran).

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ABSTRACT

Fahliyan and Gadvan Formations belong to Lower Cretaceous formations of Zagros basin. Fahliyan is the third formation of Khami Group which is amongst the most important oil and gas reservoirs in southwestern Iran. This formation in accompany with Gadvan and Dariyan Formations form Upper Khami. In this research, Fahliyan and Gadvan Formations with Lower Cretaceous (Neocomian-Aptian) age in Kuhe-e-Surmeh section were studied in order to evaluate lithostratigraphy and microbiostratigraphy. Microbiostratigraphical studies led to identify 54 genera and 86 species of foraminifers and algas. According to these microfossils, two biozones of Pseudocyclammina lituus-Dukhania Arabica-Algal zone II with Neocomian age and Orbitolina-Choffattella-Salpingoporella dinarica zone I with Barremian-Aptian age were suggested.

Key words: Fahliyan, Gadvan, Zagros, Kuh-e-Surmeh

Introduction

Zagros orogenic belt is placed in middle part of Alpine orogenic belt such that this Fold-Thrust belt is known to be a consequent to collision of the Arabian lithospheric Plate and Iranian lithospheric Block (southern edge of Euroasia supercontinent) in the end of Cretaceous or in beginning of Paleocene [30,5,3,4]. Type section of this formation is located in southern flank of Kuh-e-Dal, in vicinity of Fahliyan village 90 km east, southeast of Gachsaran. Its age is Neocomian, Hith or Surmeh Formations are its lower boundary and is overlaid by Gadvan or Dariyan Formations [15]. Gadvan Formation with late Neocomian- Aptian is extended (with weathering) as an alternation of shale and Limestone between rough Limestones of Dariyan above and Fahliyan below [25]. Its type section were selected in ending of Khavaran Mountain in 39 km, east, northeast of Shiraz in Fars province [15].

Due to significant oil reservoirs existing in Zagros Mountains, geology of this region has been investigated by enormous world geologists from past till now. Among them, study of Fahliyan Formation by Gollesstaneh [10], Wynd [32], Kheradpir [18], Kalantari [17], Shakib [28], Moallemi [22], Mohammad-Khani [23], Aghah [2], Lasemi & Feyzi [19], Hosseini & Conrad [11], Rastegar Lari [26], Mosadegh & Shirazi [24], Adabi et al. [1], Jamalian et al. [13], Feghhi [9], Maleki & Lasemi [21] and study of Gadvan Formation by Wynd [32], Wells [31], Kheradpir [18], Kalantari [17], Setudehnia [29], Motiei [25], Shakib [28], Jahami et al. [14] can be mentioned.

Method of Study:

After choosing section and determining the upper and lower boundaries of Fahliyan and Gadvan Formations in field visit, systematic sampling was done. After preparing samples and making thin sections, lithostratigraphical and biostratigraphical studies were precisely performed. The existing foraminifera were evaluated based on these studies: Kalantari, [17], Gollesstaneh [10], Wynd [32], Kheradpir [17], Dragstan [6], Dragstan [7], Dieni & Radoicic [8], Loeblich & Tappan, [20], Husinec & Soka [12], Hosseini & Conrad [11], Additionally, For recognizing biozones, biozonation of Gollesstaneh [10] was applied.
Discussion:

Geographical Position of Study Section:

Kuh-e-Surmeh section is located in south of Firooz Abad and east of Ghir Va Karzin in Fars Province. Its geographical coordinates are N 28° 34’ 08”, E 52° 34’ 54”. Aerial distance of this section from Firooz Abad is almost 34 km and is approximately 40 km far from Ghir Va Karzin. The mentioned section is placed in 1:250000 Jahrum map provided by National Iranian Oil Company (NIOC) and in 1:100000 Mozaffari and Firooz Abad maps provided by Geological Survey of Iran (GSI). Location of this section is shown in Fig. 1.

Fig. 1: B: Location map of the Kuh-e Surmeh section in Zagros (SW Iran) (adapted from Sherkati and Letouzey, 2004).

Lithostratigraphy of Kuh-e-Surmeh Outcrop Section:

Surmeh anticline is placed in Zagros Folded Belt and below Outer Fars Province (Sub Coastal Fars). Fahliyan Formation is 162 m thick in this section. Its lower boundary with Hith anhydrite Formation is unconformable. Sectional layer at top of Hith Formation confirms this matter. The Fahliyan’s upper boundary with Gadvan Formation is conformable. Age of Fahliyan formation in Kuh-e-Surmeh section is Neocomian due to existing fossil association. Lithological succession of this formation from base to top is as below:
- Limestone and massive dolomite with yellow weathered color, containing black chert
- Alternation of dolomite and thick-bedded Limestone containing pellet, ooid, intraclast
- Alternation of Limestone and thick-bedded dark dolomite
- Massive buff-colored Limestone having ooid and intraclast
- Thin-bedded Limestone with yellow weathered to buff color
- Massive Limestone with yellow weathered to buff color
- Massive Limestone, containing pellet, ooid and pyritic balls
- Massive Limestone with buff weathered color
- Thick-bedded Limestone with yellow weathered to buff color and in some cases pink to red having radiolaria, saccocoma, tintinid and sponge spicule
- Thick-bedded Limestone, yellow weathered to buff color having radiolaria and sponge spicule
- Thick-bedded Limestone, yellow weathered to buff color containing alga and foraminifer to high extent

Fig. 2: Foraminiferal distribution of the Fahliyan and Gadvan Formations in Kuh-e-Surmeh.
Fig. 3: Algal distribution of the Fahliyan and Gadvan Formations in Kuh-e-Surmeh.

Gadvan Formation with thickness of 47 m overlay Fahliyan Formation. Its lower boundary with Dariyan Formation is conformable.

Microbiostratigraphical assessments didn't lead to identify the Khalij Member in this section because of highly eroded sediments of this formation and covering huge part of formation's layers. Based on fossil content, age of Gadvan Formation in Kuh-e-Surmeh section is considered as Barremian-Aptian. Lithology of Gadvan Formation is composed of argillaceous Limestone including foraminifera (e.g. Choffatella decipiens) and algae (e.g. Salpingoporella dinarica).

Microbiostratigraphy: Precise microbiostratigraphical evaluations caused to recognize 54 genera and 86 fossil species in this section amongst which 28 genera and 41 species belong to foraminifera, 21 genera and 41 species belong to algae and the rest are linked to other fossil groups. Microfossils below were distinguished in Fahliyan Formation:
Foraminifers:


Other microfossils:


According to fossil assemblage above and also based on biozonation of Gollesstaneh [10], “Pseudocyclammina lituus - Dokhania Arabica - Algal zone II” biozone, was offered for Fahlilany Formation in this section which indicated Neocomian age for this formation’s sediments. This zone starts with appearance of *Pseudocyclammina lituus* and *Dokhania arabica* and ends with first appearance of *Choffatella decipiens* (foraminifer) and *Salpingoporella dinarica* (algae). Sediments of this zone are 162 m thick.

The reason for choosing biozonation of Gollesstaneh [10] is high presence of algae and his emphasis on algae in biozonation. Also, because Wynd [32] didn’t use algae as the main element of biozonation, it was preferred to apply Gollesstaneh [10] in this section. Actually, the introduced biozone is equivalent to “Pseudocyclammina lituus-Trocholina Ass. Zone 14” biozone [32].

Also the following microfossils were recognized in Gadvan Formation:


*Permocalculus inopinatus* \textit{ELLIOTT}, *Permocalculus* sp.

**Algae:**

Salpingoporella sp., *Salpingoporella dinarica* \textit{RADOIĆIĆ}, *Clypeina* sp., *Clypeina dragastani* DIENI & \textit{RADOIĆIĆ}, *Lithocodium aggregatum* \textit{ELLIOTT} and *Bacinella irregularis* \textit{RADOIĆIĆ}, *Iranella inopinata*, *Permocalculus* sp.
Plate 1: Benthic foraminifera of the Kuh-e-Surmeh section
A- Pseudochrysalidina arabica HENSON, sample Wynd 3478, scale: 200 µm
B- Pseudocyclammina lituus YOKOYAMA, sample Wynd 3462, scale: 200 µm
C- Nautiloculina oolithic MOHLER, sample Wynd 3402, scale: 100 µm
D- Trocholina cf. elongata LEUPOLD, sample Wynd 3418, scale: 100 µm
E- Charentia cf. cuvillieri NEUMANN, sample Wynd 3441, scale: 100 µm
F- Siphovalvulina sp., sample Wynd 3462, sample Wynd 3428, scale: 100 µm
G- Pseudochrysalidina (Dokania) sp. and Trocholina alpine LEUPOLD, sample Wynd 3430, scale: 200 µm
H- Glomspira sp., sample Wynd 3439, scale: 100 µm
I- Lenticulina sp., sample Wynd 3453, scale: 100 µm
J- Trocholina campanella ARNAUD-VANNEAU et al., sample Wynd 3465, scale: 100 µm
K- Trocholina cf. gigantea GORBATCHIK, sample Wynd 3473, scale: 100 µm
L- Trocholina delphinensis ARNAUD-VANNEAU et al., sample Wynd 3434, scale: 100 µm
M- Trocholina cf. chouberti HOTTINGER, sample Wynd 3462, sample Wynd 3434, scale: 100 µm
N- Mayncina sp., sample Wynd 3468, scale: 100 µm
O- Choffatella decipiens SCHLUMBERGER, sample Wynd 3400, scale: 100 µm
Plate 2: Calcareous algae of the Kuh-e-Surmeh section.

A- Actinoporilla podolica ALTH, sample Wynd 3409, scale: 100 µm
B- Bekhmea wetzelii (Non algae), sample Wynd 3491, scale: 100 µm
C- Neomizza sp., sample Wynd 3409, scale: 50 µm
D- Salpingoporella aff. piriniae CARRAS & RADOIČIĆ, sample Wynd 3420, scale: 100 µm
E- Otternstella lemmensis BERNIER, sample Wynd 3446, scale: 100 µm
F- Otternstella sp., sample Wynd 3446, scale: 100 µm
G- Permocalculus inopinatus ELLIOTT, sample Wynd 3418, scale: 50 µm
H- Clypeina dragastani DIENI & RADOIČIĆ, sample Wynd 3439, scale: 50 µm
I- Salpingoporella? inopinata, sample Wynd 3422, scale: 100 µm
J- Salpingoporella annullata CAROZZI, sample Wynd 3446, scale: 100 µm
K- Zergabriella cf. embergeri BOUROULLEC & DELOFFRE, sample Wynd 3436, scale: 50 µm
L- Terqumella sp., sample Wynd 3416, scale: 50 µm
M- Salpingoporella muhlbergii CAROZZI, sample Wynd 3461, scale: 100 µm
N- Muniera baconica, sample Wynd 3439, scale: 100 µm
O- Iranella inopinata, sample Wynd 3430, scale: 50 µm
P- Clypeina gigantean SOKAČ, sample Wynd 3452, scale: 50 µm
Q- Salpingoporella dinarica RADOIČIĆ, sample Wynd 3395, scale: 50 µm
R- Lithocodium aggregatum ELLIOTT/Bacinella irregularis RADOIČIĆ, sample Wynd 3491, scale: 200 µm
S- Salpingoporella kateri CONRAD & RADOIČIĆ, sample Wynd 3494, scale: 100 µm
T- Salpingoporella pygmaea RADOIČIĆ, sample Wynd 3479, scale: 200 µm
Other microfossils:

Bekhmeia wetzeli, Sponge spicules, Mollusca fragments, Gastropoda, Echinoid remains. Due to biozonation of Gollesstaneh [10] “Orbitolina - Choffattella - Salpingoporella dinarica zone I” biozone was suggested. This biozone mentions Barremian–early Aptian for Gadvan Formation’s sediments whose thickness is about 41 m. This biozone begins with the last appearance of Pseudocyclammina lituus and the first appearance of Choffatella decipiens and Salpingoporella dinarica. With appearing Iraqia simplex, Orbitolina lenticularis, Orbitolina discoidea (foraminifers) and Hensonella dinarica (Algae) the biozone ends. It is in fact equivalent to “Choffatella-Cyclammina Ass. zone 15” biozone [32].

Conclusion:

In Kuh-e-Surmeh section, Fahliyan Formation is placed above Hith evaporitic Formation with an unconformable boundary and below Gadvan Formation with a conformable boundary. Upper boundary of Gadvan Formation with Dariyan Formation is also conformable. Fahliyan Formation is made of carbonate deposits and Gadvan Formation is composed of argillaceous limy sediments. Microbiostatigraphical studies led to identify 54 genera and 86 species of fossils which most of them are foraminifers and algae. Assemblage of microfossils caused to suggest 2 biozones; Pseudocyclammina lituus - Dukhania Arabica - Algal zone II with Neocomian age and Orbitolina – Choffatella - Salpingoporella dinarica zone I with Barremian–early Aptian. The offered biozones are comparable with biozones of Gollesstaneh [10].

References

6. Dragstian, O., 1982. Lower Cretaceous marine algae and Calpionellida from Canada (Sanpedro)-Asturisa province (Spain), Cuadernos Geología Ibérica, 8: 125-143.
9. Feghhi, A., 2010. Study of Microfacies and sequence stratigraphy of Fahliyan Formation in Murun oil field, Southwest Iran, Thesis submitted for the Master of Science at the University of Petroleum University of Technology Exploration and Production Department Tehran, Iran, 83.


