Oil Genetic Behavior of Asmari and Bangestan Reservoirs: Marun Oilfield, SW of Iran

***Telmadarreie, Ali[1], Alizadeh, Bahram[2], Shadizadeh ,Seyed Reza[1], Tezhe, Farid[3]**

[1]Department of Petroleum Engineering, Abadan Faculty of Petroleum Engineering, Petroleum University of Technology (PUT), IR Iran.

[2]Department of Geology, Faculty of Earth Sciences and Remote Sensing, S. Chamran University of Ahvaz, IR Iran.

[3]Geochemistry office, exploration directorate, Seoul st., Sheikh Bahayee sq., Tehran, Iran.

* Corresponding Author; Alitelmadarreie@gmail.com

Abstract

Marun oil field is located in south-west of Iran and it has two separate oil reservoirs named Asmari and Bangestan. Recently some of the wells in Asmari oil reservoir have been shown to be contaminated with Hydrogen Sulfide gas. The main goal of this study is to investigate genetic behavior of the mentioned oil reservoirs focusing mainly on H_2S pollutant. Biomarkers of saturated and aromatic fractions were studied on five polluted, three unpolluted Asmari and two Bangestan reservoir oils of Marun oil field. To determine the chemical composition of the studied oil, triangular diagram was used. The results show relatively higher maturity of both reservoirs oil and the absence of biodegradation. Carbon Preference Index of both reservoir oils is also around one, indicating mature oil samples. Pristane to phytane ratio, Pri/nC_{17} versus Phy/nC_{18}, Terrigenous/Aquatic Ratio (TAR) and finally geochemical data, all show that the source rock for both Asmari and Bangestan reservoirs is one and the same. Meanwhile, star diagram show that a good overlap exists between the amount of normal alkanes of Asmari and Bangestan reservoir oils, implying the fact that these two oils have originated from same marine source rock. This source rock was deposited in reducing environment with algae (kerogen type II) organic matter and without any higher plants. Results reveal that Hydrogen Sulfide gas pollution in Asmari reservoir is originated from Bangestan reservoir. Also thermal sulfate reduction could be the main process for Hydrogen Sulfide formation. Genetic potential studies of probable source rocks in Marun oilfield introduce, Kazhdumi and Garu as main source rocks for petroleum generation.

Keywords: *Marun, Asmari, Bangestan, Hydrogen Sulfide, Biomarker, GC, oil-oil correlation.*

1. Introduction

Geochemical correlation of oils could be used for identifying oil genetics, classification of oil families, probable relation between faults and other problems in petroleum province. The aim of this study is investigation of geochemical characterization of Asmari and Bangestan reservoir oils in Marun oil field. Today, one of the best methods for geochemical evaluation of oils is analyzing biomarkers. In this study, oils from two mentioned reservoirs were used for gas chromatography (GC) analysis for investigation of biomarkers. Despite of petrophysical and reservoir evaluation studies on source of Asmari reservoir contamination with H_2S, up to now the source of this contamination have been debating. Hence based on different study, the best method for identifying source of H_2S in this field is application of geochemical analysis.

2. Procedures

In this study for accurate determining characterization of non-contaminated and contaminated oils of Asmari reservoir and Bangestan reservoir oils, 10 oil samples were gathered from all types (Table1).

For evaluation of n-alkanes and biomarkers distribution in oil samples, saturates, aromatics and polar components of oil must be extracted. Hence, primary analysis such as asphaltene extraction and developed analysis such as GC were used in this paper.

4. Results and Discussions

4.1 Characterizations of Asmari and Bangestan reservoir oils

- For investigation of studied oil identity, Ternary diagram of Tissot and Welte was used, base on percentage of saturate, aromatic and polar components [1]. According to Figure 1 the studied oil samples show paraffinic composition which demonstrates the relatively high maturity and absence of biodegradation phenomenon in both Asmari and Bangestan reservoir oils. Also the high percentage of nC_{15}^{+} component shows the high maturity of these oils (Table1).
- To correlate oil fingerprinting of both reservoirs and evaluate their origins, a sensitive star diagram was used [2]. This correlation accurately shows their unique source from which they have been generated (Figure 2).
- The amount of Pr/Ph ratio [3] (Table 2) for all oil samples (less than 1); demonstrate the reducing condition of source rock deposition environment for both reservoirs.
- The variation of Pr/nC_{17} versus Ph/nC_{18} for investigation of source rock depositional environment [4] reveals that algal source and kerogen type II in high reducing environment and with relative high maturity were produced.
- The low amount of TAR (Terrigenous Aquatic Ratio) [5] from GC analysis of both reservoir oils, show the abundance of marine organic matter with respect to terrestrial organic matter in source rock of these two oils (Table2).
- The Carbon Preference Index (CPI) of all oils from GC analysis (less than 1) demonstrates the high maturity of oil samples which also shows the marine source that is in agreement with previously mentioned results.

4.2 Investigation of H_2S source in Asmari reservoir

One of the most important problems in Marun oil field is contamination of Asmari reservoir oils with H_2S which is increasing with time. Former studies proved that Bangestan reservoir oil contains high amount of H_2S and is known as sour oil. Based on high temperature gradient of Bangestan reservoir in Marun oil field (110-130^{o}C) [6], which eliminates the bacterial activity, Thermal Sulfate Reduction (TSR) may be the possible source of H_2S in this field. Structural study of Marun oil field proved abundance of fractures in Asmari reservoir which increase the possibility of communication between two reservoirs that cause Asmari reservoir to be contaminated with H_2S.

5. Conclusions

The results from Pr/Ph ratio (less than 1), variation of Pr/nC_{17} versus Ph/nC_{18}, low amount of TAR, demonstrate that Asmari and Bangestan reservoir oils are from a same marine source rock which has deposited in a high reducing environment without any higher plants. Also CPI less than 1 for all oil samples and high percent of paraffin show the high maturity of two reservoir oils. The study of genetic potential of probable source rocks introduces Kazhdomi and Garu with higher potential of oil generation, as main sources of Marun oil field. Furthermore, studying source of H_2S contamination in Asmari reservoir revealed that a good communication between two reservoirs exists. Consequently, the upward migration of Bangestan oils due to high fractured area between two reservoirs caused contamination of Asmari reservoir. Also high temperature gradient of Bangestan reservoir and existence of anhydrite formation (Gotina) in deeper parts of Marun oil field may introduce TSR as a main mechanism of H_2S production in this field.

Reference

1. Tissot, B. & Welte, D. H. (1984). Petroleum Formation and Occurrence, 2nd ed. Heidelberg: Springer Verlag.

2. Alizadeh, B., Adabi, M.H., Tezheh, F. (2005). Oil- Oil correlation of Asmari and Bangestan reservoirs using Gas Chromatography (GC) and stable isotopes of carbon and sulfur in Marun Oilfield, S.W. Iran. Iranian Journal of Science and Technology.

3. Powell, T.G..McKirdy, D.M. (1973).The effect of source material, rock type and diagenesis on the n-alkane content of sediments.GeochimicaetCosmochimicaActa, v. 37, pp. 523-633.

4. Cannan, J., Cassou, A.M. (1980). Properties of gases and petroleum liquids derived from terrestrial kerogen at various maturation levels. Geochimicaet Cosmochimica Acta, v. 3, pp. 53-92.

5. Boubonniere, R.A., Meyerrs, P.A. (1996). Sedimentary geolipid records of historical changes in the watersheds and productivities of Lake Ontario and Erie. Lithology and Oceanography, v. 41, pp. 352-359.

6. Shayesteh, M. (1381). Investigation of hydrogen sulfide contamination of Asmari reservoir in Marun oil field. Report no. 5207, Geology department, National Iranian South Oil Company.

Table 1- Geochemical data and gross chemical composition of oils.

Well No.	Formation	Depth (m)	% C_{15}^{+}	% Sat.	% Aro.	% NSO	% Asph.
# 62	Ban.	3428-3450	93	40.1	25.8	11.8	7.6
#237	Ban.	3316.5-3382	88	53.9	20.7	12.9	2
#35	Asm. (n- cont.)	3212-3415	90	38.1	29.5	16.4	1.3
#173	Asm. (n- cont.)	3120-3215	89	45.0	26.8	13.6	1.4
#200	Asm. (n- cont.)	3212-3415	89	35.7	22.9	13.5	0.2
#208	Asm. (Cont.)	3407-3480	90	36.0	27.9	14.7	1.3
#233	Asm. (Cont.)	2964-3225	91	35.6	26.3	14.4	2.6
#162	Asm. (Cont.)	3501-3722	91	38.4	27.9	13.1	2.5
#69	Asm. (Cont.)	3205-3456	92	38.3	27.8	14.7	2.1
#41	Asm. (Cont.)	2882-2972	93	46.5	29.3	11.8	1.9

Ban.= Bangestan Reservoir; Asm. (n-cont.) = Asmari Reservoir (non-contaminated with H_2S gas);
Asm. (Cont.) = Asmari Reservoir (contaminated with H_2S gas).

Table 2 - Geochemical data of Asmari and Bangestan reservoir oils in Marun oilfield.

Well No.	Formation	Depth (m)	Pr/Ph	Pr/n-C_{17}	Ph/n-C_{18}	CPI	TAR
# 62	Ban.	3428-3450	0.78	0.37	0.53	0.94	0.18
#237	Ban.	3316.5-3382	0.91	0.42	0.54	0.95	0.18
#35	Asm. (n- cont.)	3212-3415	0.83	0.36	0.5	0.94	0.15
#173	Asm. (n- cont.)	3120-3215	0.89	0.3	0.42	0.96	0.17
#200	Asm. (n- cont.)	3212-3415	0.83	0.37	0.5	0.91	0.18
#208	Asm. (Cont.)	3407-3480	0.85	0.42	0.51	0.99	0.23
#233	Asm. (Cont.)	2964-3225	0.89	0.35	0.45	0.95	0.16
#162	Asm. (Cont.)	3501-3722	0.8	0.32	0.46	0.96	0.17
#69	Asm. (Cont.)	3205-3456	0.91	0.4	0.5	0.9	0.17
#41	Asm. (Cont.)	2882-2972	0.85	0.38	0.54	0.95	0.21

Ban.= Bangestan Reservoir; Asm. (n-cont.) = Asmari Reservoir (non-contaminated with H_2S gas);
Asm. (Cont.) = Asmari Reservoir (contaminated with H_2S gas).

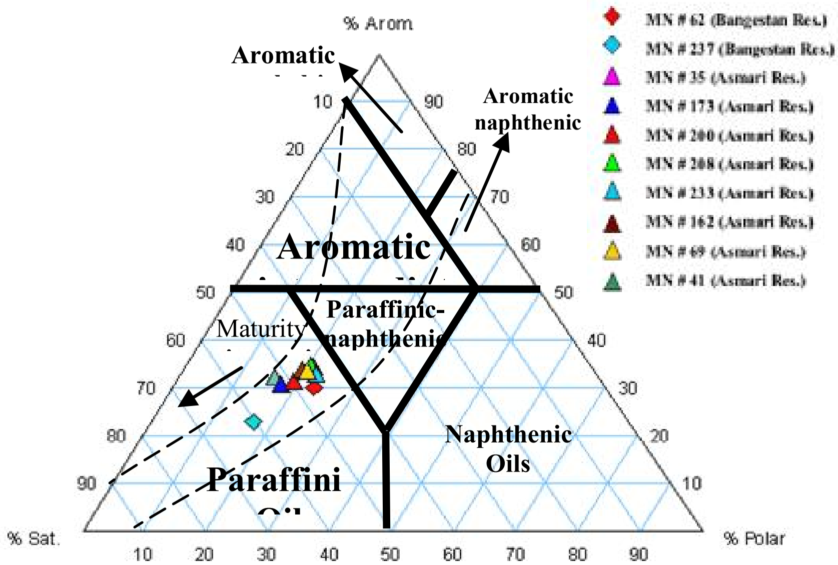

Figure 1. Ternary diagram of Asmari and Bangestan reservoir oils. The dotted line shows increasing in maturity from aromatic to saturate components.

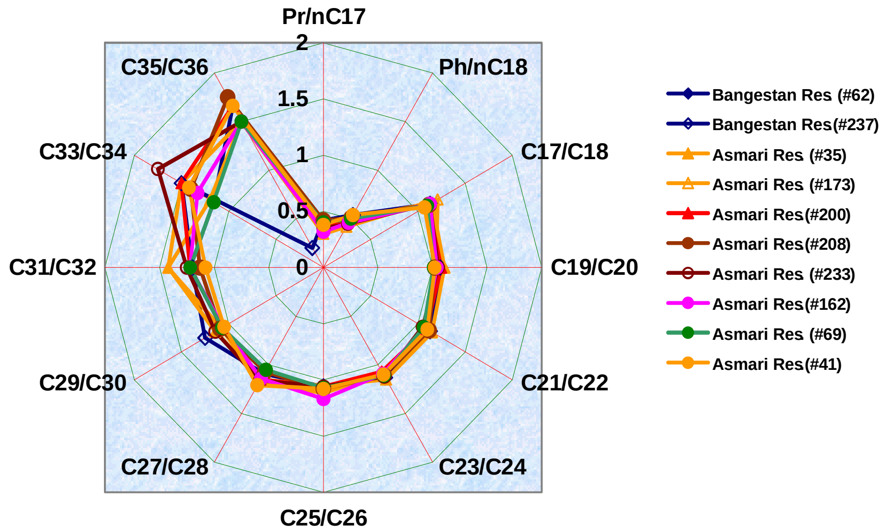

Figure 2. Star diagram of Asmari and Bangestan reservoir oils from gas chromatography analysis.