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Determination of rock typing in one of carbonate reservoirs in South of Iran by using of MRGC method and hydraulic flow

Atefe Bastani Karizak*, **Majid Nabi Bidhendi**[1]

Department of Geology, Science and Research Branch, Islamic Azad University, Tehran, Iran

[1]*University of Tehran, Tehran, Iran*

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Key words: Rock typing, Electrofacies, Hydraulic flow, Neural network, Log, MRGC, FZI.

Abstract

Find the productive zones in carbonate reservoirs are challenging issues in the petroleum industry. In this study, Determination of Rock Typing by help of petrophysical rock typing (determine electrofacieses type) described by Multi-Resolution Graph-based Clustering method and classification of hydraulic flow. Mechanism of this study is that using of Neural Network, permeability determined in studied reservoir at desired intervals withdata obtained by core simulation and FZI. Then in the next step, by using Matlab software, FZI Clustering was done. According to the core data, seven clusters has been selected for the reservoir. Clusters obtained in this way, as the diagram along MRGC method was also assessed. In continuation of the study of MRGC method, the cluster with 7 Electrofaciese was selected. The results of clustering by MRGC and HFU methods, has shown very satisfactory compliance with the interpretation of the results of petrophysical logs and core analysis. Using these two categories, reservoir zones measured and productive zones are separated from non-productive, and comparing together. The results show that the overlap rate of determining facieses of the reservoir and non-reservoir zones, relative to each other in both ways is very convincing and good.

***Corresponding Author:** Atefe Bastani Karizak ✉ atibastani@yahoo.com

Introduction

Determine the rock categories can be an important step in the reservoir describe. Rock categories are the most important parameters of the reservoir, and represent a particular facies with a certain range of porosity and permeability. Understanding the reservoir rock types and their spatial distribution is an essential step in the exponential nature process of hydrocarbon reservoirs. With determine the classify-cation of reservoir rocks, the primary parameters of three-dimensional geological modeling and reservoir flow simulation provided. Classification given in this paper with use of clustering techniques such as clustering of Multi-Resolution Graph-based Clustering (MRGC) and hydraulic flow unit (HFU), in the carbonate reservoirs compared and evaluated. The implementation of this method leads to an accurate estimate of the geological features of the intervals have not been coring, and also presented a good profile of the dynamic behavior and reservoir production performance. Classification of reservoir rock with use of Electrofacies determine method (MRGC), and the hydraulic flow units, classified reservoir rock according to hydrocarbon production capacity and provides a visual approximation to the distribution of reservoir areas. *(*Kharrat *et al., 2009).*

In this study with use of Geolog software environmental corrections are done on charts and then petrophysical evaluation was applied by multi-min method. In the second step, using a neural network, permeability in the wellbore model, and FZI set at the core, and clustering are done by using MATLAB software. Finally, FZI clusters of MATLAB software, move to Geolog software, and is evaluated as along diagram in MRGC method. The goal of cluster analysis is to put a set of data in different clusters, as the data within each of these groups were not different from each other and to other groups is heterogeneous. Due to the mentioned criteria, seven clusters in MATLAB software. The purpose of this study was Determination of Rock Typing in one of carbonate reservoirs in south of Iran by using of MRGC method and hydraulic flow and The results show that the overlap rate of determining facieses of the reservoir and non-reservoir zones, relative to each other in both ways is very convincing and good.

Material and methods

Classification of reservoir rocks method

Neural network

Neural network, is a pattern classifier (Lim, 2005) . Using neural networks in this study, permeability in the wellbore is modeled. For the purpose of this evaluation, three logs: RHO, NPHI, DT, in the model call, and using the permeability of the core, permeability of the well predicted and is used in the calculation to get the FZI.

Determining the hydraulic flow units using FZI

In definition of the current units, all attention is on geological and petrophysical characteristics, depending on the pore geometry and fluid flow portion of the rock. FZI parameter is a base for the current flow measure, which is dependent on the pore throat geometry. Generally points to close or equal FZI to each other, to have equal pore radius, and fluid flow capacity in them is similar, and are considered as a single stream (Abbaszadeh *et al.*, 1996). For calculate this parameter is used the following relations:

$$FZI = 1/\sqrt{F_s \tau^2 S_{gv}^2} \qquad (1)$$

$$RQI = 0.0314\sqrt{\frac{K}{\emptyset_e}} \qquad (2)$$

$$\emptyset_z = \frac{\emptyset_e}{1-\emptyset_e} \qquad (3)$$

The goal of cluster analysis is to put a set of data in different clusters, as the data within each of these groups were not different from each other and to other groups is heterogeneous. Due to the mentioned criteria, seven clusters in MATLAB software, was selected for this reservoir. In Fig. 1. Distribution of this 7 clusters is shown.

Determine of Electrofacies by MRGC method

Facies consists of a set of graphs response that characterize a layer and to distinguish it from other layers is (Serra, and Abbotte., 1980).

In this study, to determine Electrofaces, those of Petrophysical graphs that have the highest correlation with the target, including: neutron log (NPHI), sonic log (DT), density log (RHO), and the accompanying logs, FZI clusters of MATLAB software, have been selected in Facimage modules of Geolog software. Fig. 2 shows the frequency and numerical range of the desired graphs.

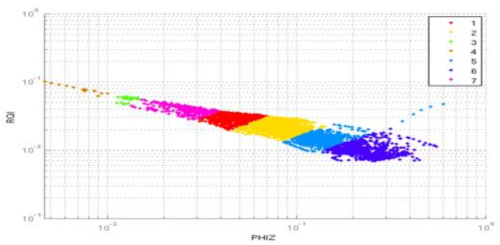

Fig. 1. FZI clusters obtained from MATLAB software.

After calculation and clustering FZI, clusters (HFU obtained from the core) transferred to the Geolog software and is evaluated as along diagram in MRGC.

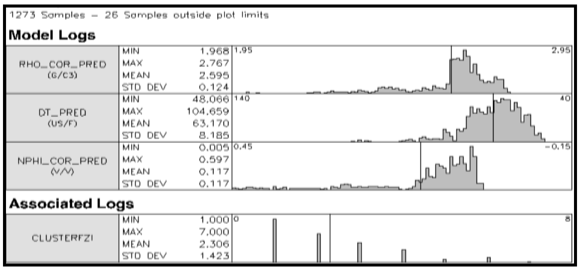

Fig. 2. Frequency of the input logs.

According to the logs used in each cluster, when DT and NPHI is higher, and RHO is lower, The quality of cluster is higher. By virtue of the foregoing, Cluster 1 from the perspective of reservoir quality, has the lowest density, the highest DT, and most of neutrons, So have been selected as the best cluster of reservoir quality. In Fig. 3, the color of each facies and the numerical abundance of each log is specified.

Model | Clusters | Facies | Comparison

	FACIES	WEIGHT	HO_COR_PR	DT_PRED	HI_COR_PR	CLUSTERFZI
1	1	138	2.31	78.53	0.39	2.35
2	2	62	2.44	69.31	0.24	1.44
3	3	510	2.63	65.07	0.07	2.03
4	4	118	2.56	59.47	0.19	2.47
5	5	103	2.61	61.29	0.03	2.06
6	6	51	2.61	53.16	0.04	2.63
7	7	291	2.71	55.16	0.05	2.92

Fig. 3. The color facies and numerical range of input logs.

Results and discussion

Analysis of Electrofacies

After determining the electriofaciesby MRGC, now we must to interpreted them. For facies assessment at this stage ***Box and Whisker*** Chart is used. The best ***Box and Whisker*** used for evaluation, is ***PHIE*** and ***UGAS***.

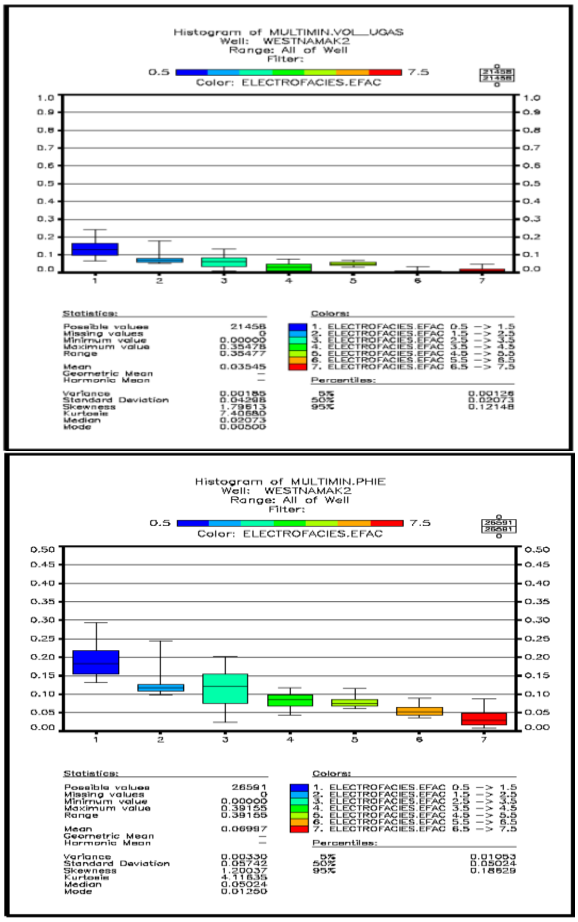

Fig. 4. Gas volume and effective porosity from cluster analysis, from left to right, respectively.

Fig. 4 shows the effective porosity and gas volume to 7 facies from 3 to 22 percent is calculated. Facies 1 dark blue, has shown the highest porosity and gas volume, And the lowest porosity and gas volume is related to facies No. 7 and 6 in red and orange color.

Comparisons between the clusters obtained from MGRC and FZI

After training of data and facies assessment, at this stage, is investigated to comparison of the clusters obtained by both methods by use of Comparative table in Geolog software. As mentioned, the highest quality of facies in MRGC, facies no one was determined, which has the highest rate of compliance with the facies No. 5 FZI. Worst facies from the perspective of reservoir, facies 7 was chosen, which is equivalent to facies No. 2 HFU. Equivalent facies are shown in Fig. 5.

Model Facies Probabilities (Reconstruction Rates)

MRGC_7_CLUST

CORE.CLUSTERFZI	1	2	3	4	5	6	7	TOTAL
facies_6	12%	9%	47%	8%	7%		16%	100%
facies_4	7%	4%	42%	7%	10%	9%	21%	100%
facies_3	6%	0%	40%	10%	14%	9%	21%	100%
facies_5	25%	2%	25%	20%	4%		24%	100%
facies_2	3%	3%	3%	8%			84%	100%
facies_1	8%		25%	3%		5%	58%	100%
facies_7			100%					100%

Fig. 5. Overlap table and matching between clusters in both methods.

Analysis of hydraulic flow

Finally, using AHC method in Geologsoftware, the FZI clusters were drawn by color-coded and have been evaluated. In this evaluation, such as before **Box and Whisker plots** was used and effective porosity and gas volume was calculated for 7 facies.

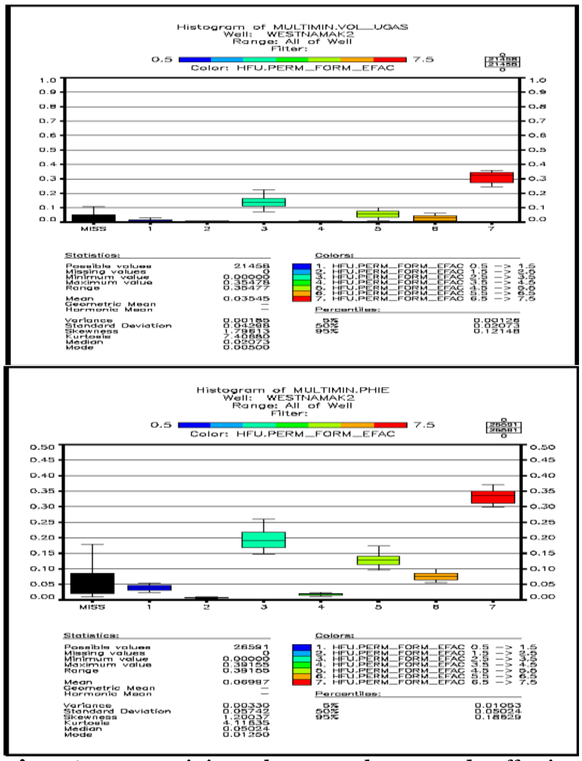

Fig. 6. Determining thegas volume and effective porosity from hydraulic flow units, from left to right, respectively.

In Fig. 6, the effective porosity of FZI clusters are set between 0 and 39%.The highest porosity and gas volume belongs to facies No. 7 and the lowest porosity belongs to facies No. 2.

Show of facies by MRGC and HFU methods besides the Lithological column in the field

Study of Neutron and Density logs, PHIE and SWE and compare them with obtained Electrofacies-confirms the reservoir intervals. In Fig. 7 shown obtained faciesby the MRGC and HFU methods.

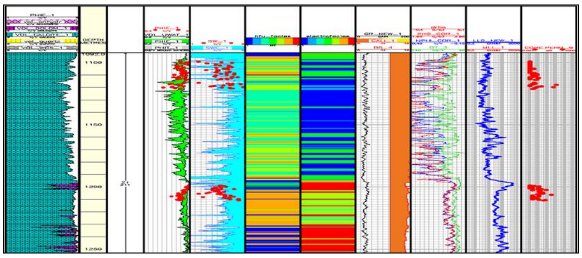

Fig. 7. Display of facies in accordance methods besides Lithological columns and compare the two methods.

Conclusions

Based on the results obtained in the carbonate reservoir, using both methods used in this study, Facies that represent the permeable and impermeable zones were identified. The overlap rate of determinant clusters of reservoir and non-reservoir zones relative to each other in both methods, is very good and convincing. By doing this research, we can conclude that both methods in the field, are accountable. But it seems that due to the inadequacy of core data, MRGC methods, will be more inclusive and functional.

References

Abbaszadeh M, Fujii H, Fujimoto F. 1996. Permeability Prediction by Hydraulic Flow Units-Theory and Applications, SPE Formation Evaluation Journal **11 (4),** 263-271.

Kharrat R, Mahdavi R, Bagherpur M, Hejri S. 2009. Rock Typing Permeability Perdiction of a Heterogenouse Carbonate Reservior Using Artifical

Neural Network Based On Flow Zone Index Approach. SPE.

Lim JS. 2005. Reservoir properties determination using Fuzzy Logic and neural networks from well data in offshore Korea, Journal of Petroleum Science and Engineering **49 (3-4),** 182-192.

Serra O, Abbotte H. 1980. the contribution of Loading data to sedimentololgy and Stratigraphy, 55th Ann. Fall techn. Spe of Aime, Paper spe 9270, and in speJ.In: Serra, o. 1986, Fundamental of well log interpretation **2**.