The study of natural fracture carbonate reservoirs of IRAN

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Abstract: In this research, studies of underground gas storage (UGS) and studies of underground liquid storage (U L S) were performed on a partially depleted, naturally fractured gas and liquid reservoir through compositional simulation. according to the data of a reservoir production permeability and porosity were studied. The results showed that distribution of fracture density affects on fluid flow and production of water, but not that of gas, through porous medium However because of high mobility of gas, the gas production and reservoir average pressure are insensitive to fracture shape factor. Also, the data showed that uniform fracture permeability distribution enhances communication within reservoir and consequently more pressure support is obtained by water bearing of aquifer. Also the effect of aquifer on the reservoir performance was studied. And the result showed that we have reduce condensate drop out around the well bore if we have an active aquifer. On the other side we have an important issue which may kill the well that is water invasion. Also the results showed that use of horizontal wells is superior to vertical wells in order to avoid detrimental effects of active aquifer.

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Key words: underground gas storage, Naturally fractured reservoir, Fracture shape factor, aquifer, horizontal well, matrix, dual-porosity, dual permeability.

1. Introduction

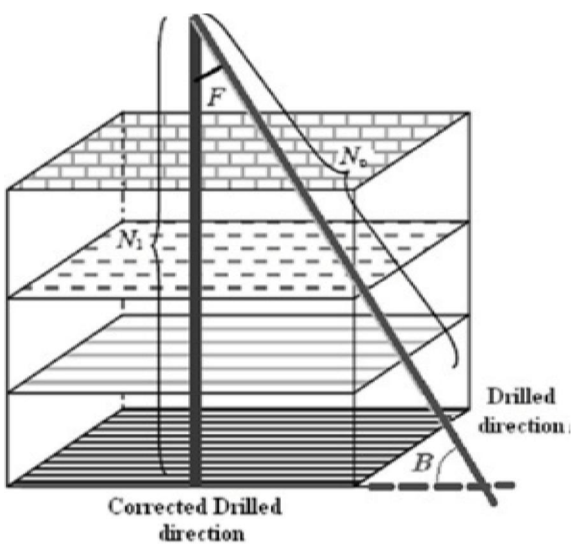


Fig. 1: effect of well orientation on fracture density. No is the number of observed fracture and N1 is the number of correct fracture.

Characterization is dual-porosity and dual – permeability model that have introduced by Warren & Root, where the reservoir consider is considered as the rock matrix and fractures. NFR is the short of Naturally Fractured Reservoirs that containing two porosity system, that of rock matrix.

Many details studied have been done and lots of paper published on productivities of artificially fractured wells. All have investigated the effect of fracture length and conductivity on post - fracture or steady – state flow in the reservoir and fracture height equal to the reservoir thickness. A NFR is the one in which fractures have direct effect on fluid flow, reservoir anisotropy, hydrocarbon recovery and storage. The most common model normally used for fracture.

With respect to the orientation. This method consist of weighting each directional data as a function of the cosines of the angel between the core axis and the fracture pole vector (fig1).

Here N1=No/sin (B)

Now you can see some of the figs (fig2,3,4,5) of Asmari and Gachsaran formations.

Phenomenon of naturally fractured reservoir well:

The multi-rate well testing data indicated that production rate is not directly proportional to pressure drawdown near wellbore. Engineers further realized that even with a very small range of pressure drawdown, the well productivity becomes smaller while the pressure drawdowns increase. Flowing bottom hole pressure is lower than the fluid bubble point pressure. Gas starts to come out from the oil reservoir condition, so two – phase flow exists in reservoir. The relative permeability of oil decreases and oil viscosity becomes large, both of which reduce the oil mobility and in turn result in productivity decrease. Because of the pressure drawdown near wellbore, the pressure difference between overburden pressure and reservoir porous pressure increase, which decreases the opening of fracture and further lower the fracture permeability.

Fracture density:

In the complect fracture network simulation of the fracture density is required. In a study, determining the spacing distribution for each fracture set can be obtained from image log and core data. Fracture spacing is the distance between the fracture planes. In order to obtain mor accurate fracture density, a correction method proposed by Terzaghi (1965) to evaluate thr error related to the orientation of the well trajectory.

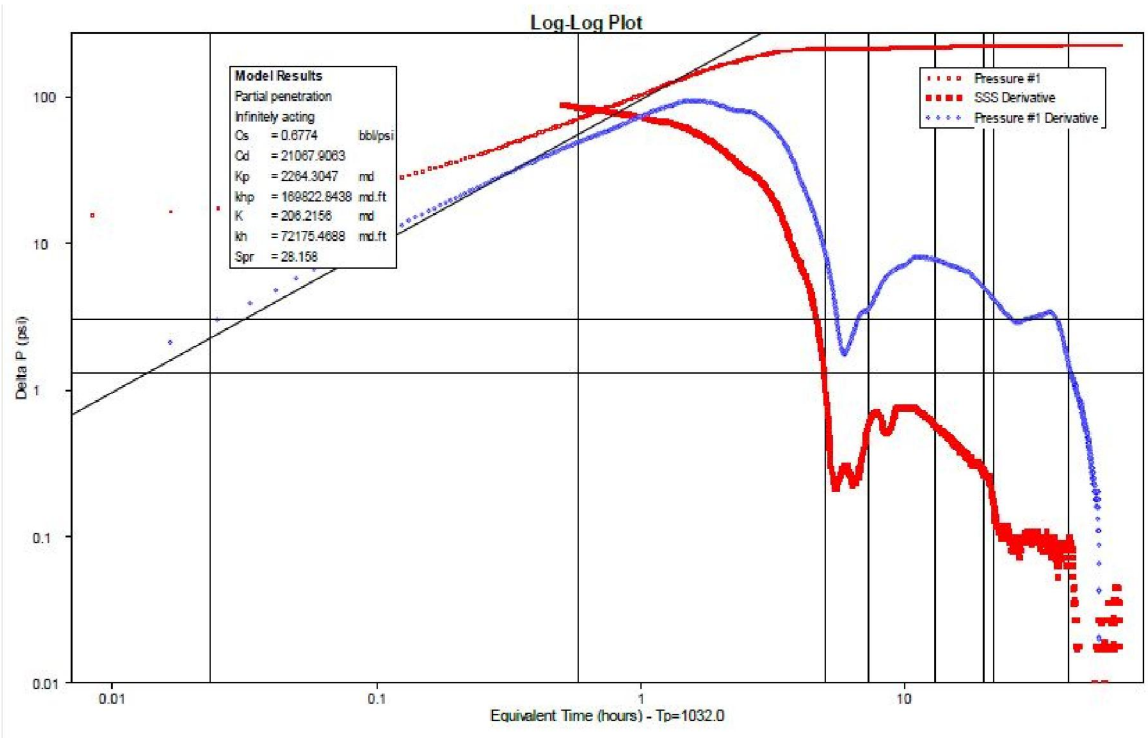


Fig 2

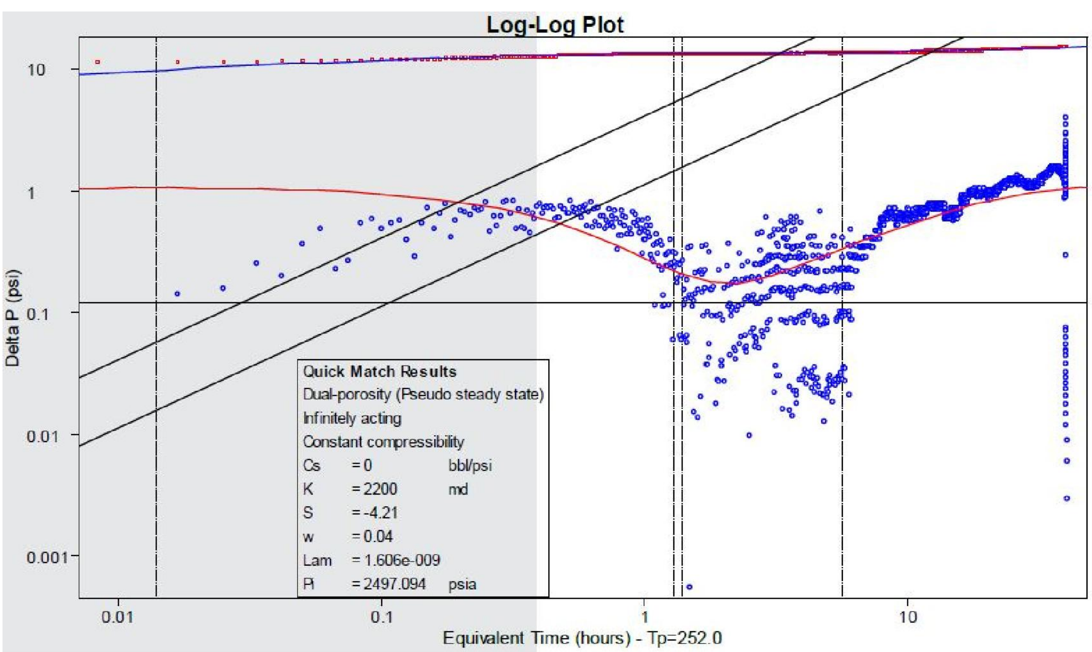


Fig 3

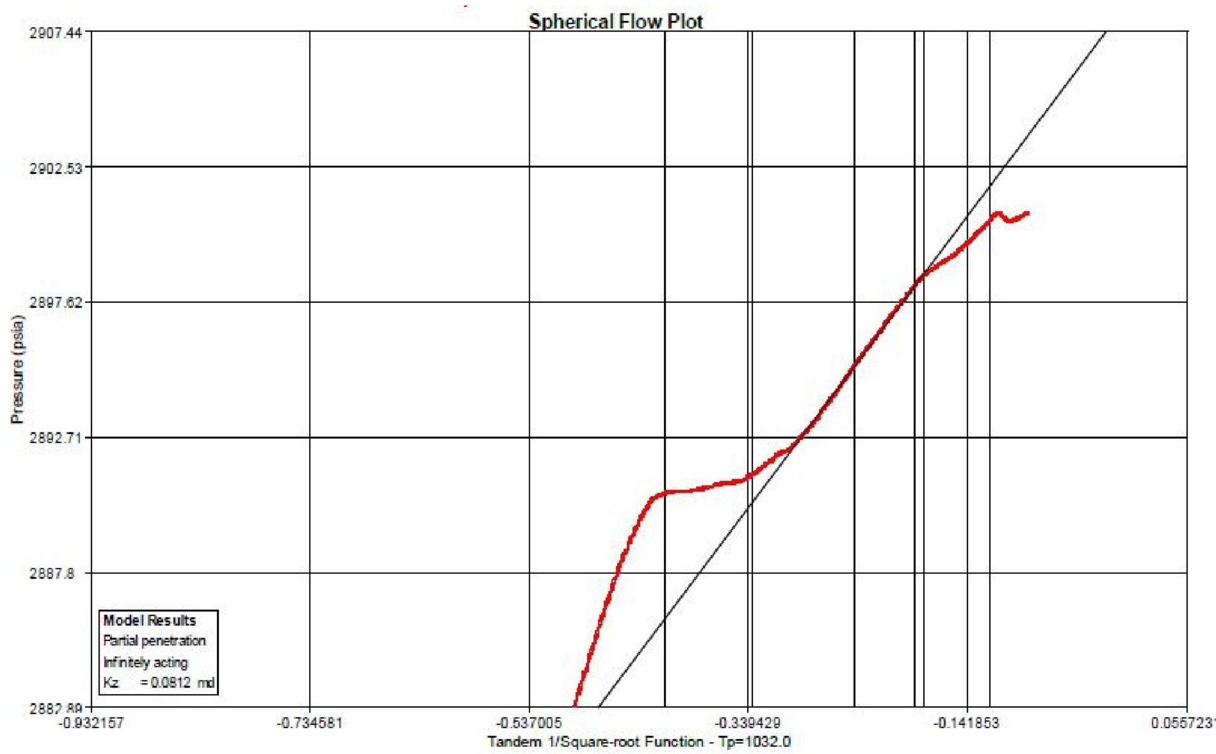


Fig 4

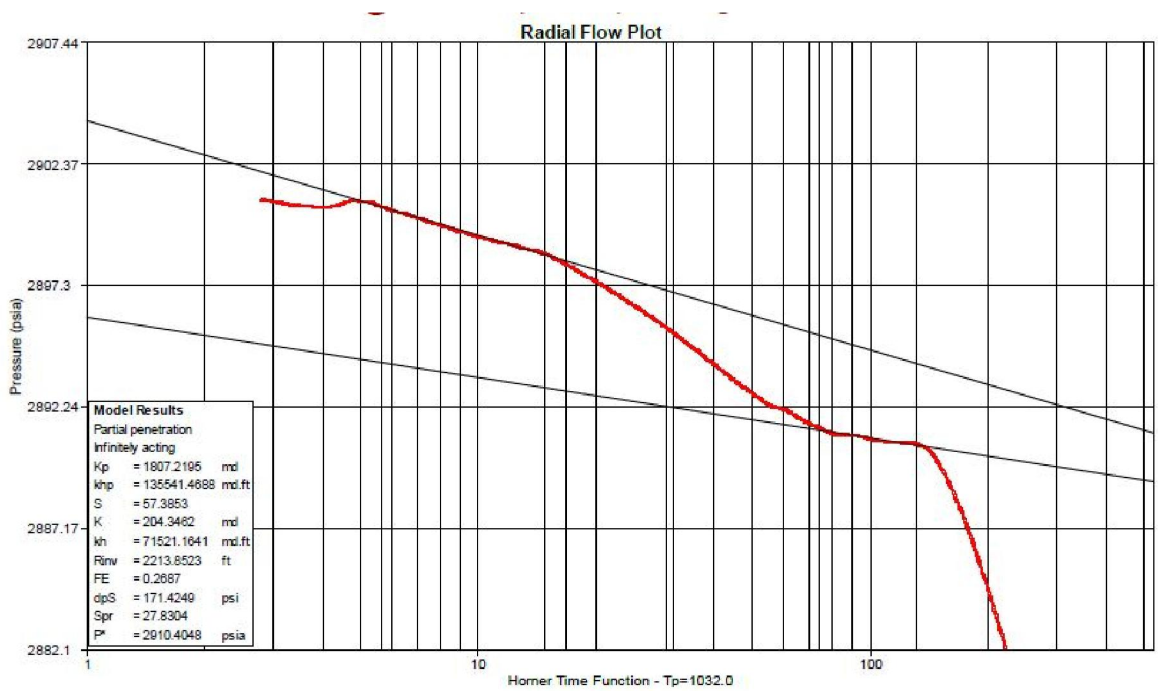


Fig 5

A comprehensive fracture study revealed that the reservoir contains a network of fractures which contribute to production. The fracture density on top of structure where dip is high is higher than flanks.

On the picture 1, 2 you can see that when the fracture is going to open and a schematic of Persian Gulf petroleum system.

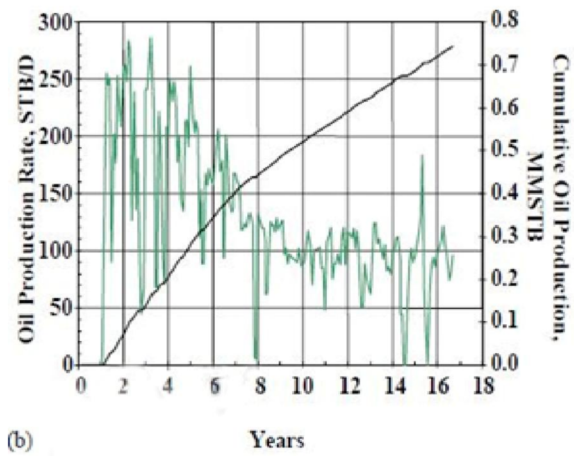


Fig. 6.

Methodology:

In this work simulation study was conducted on an Iranian gas reservoir using compositional module of Geo Quest software, eclipse 300, version 2004**.** The reservoir was initially at 3130psia and 171 °F, and contained about 1 TCF original gas in place. It has produced for about 16 years with a single well. Fig 2 illustrates the daily and cumulative production history from the reservoir.

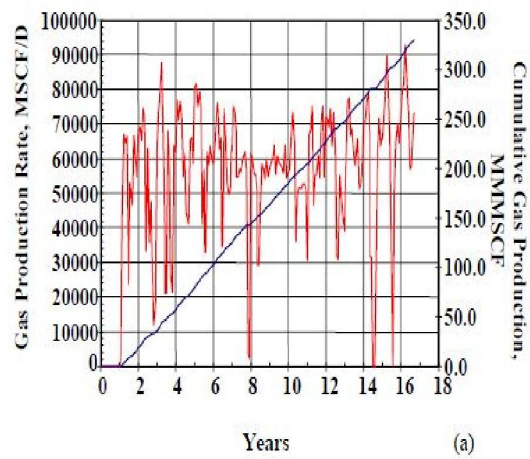
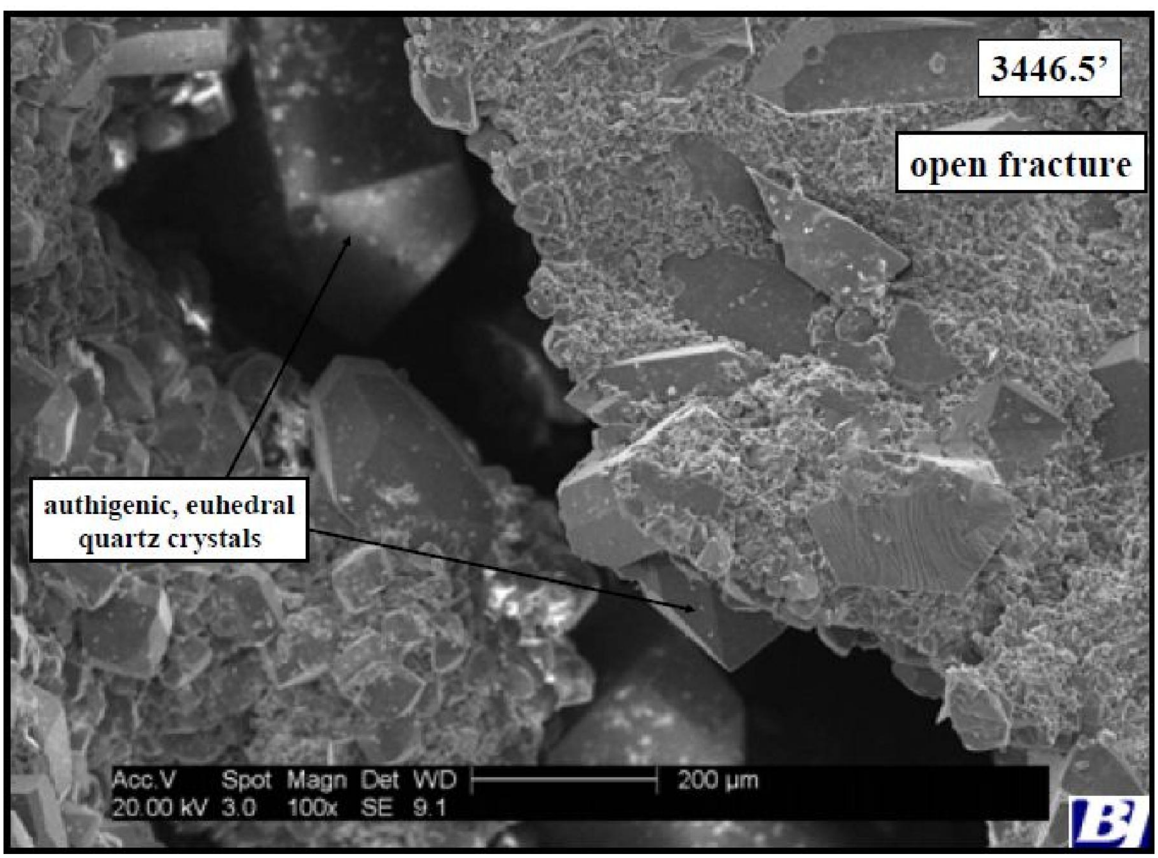
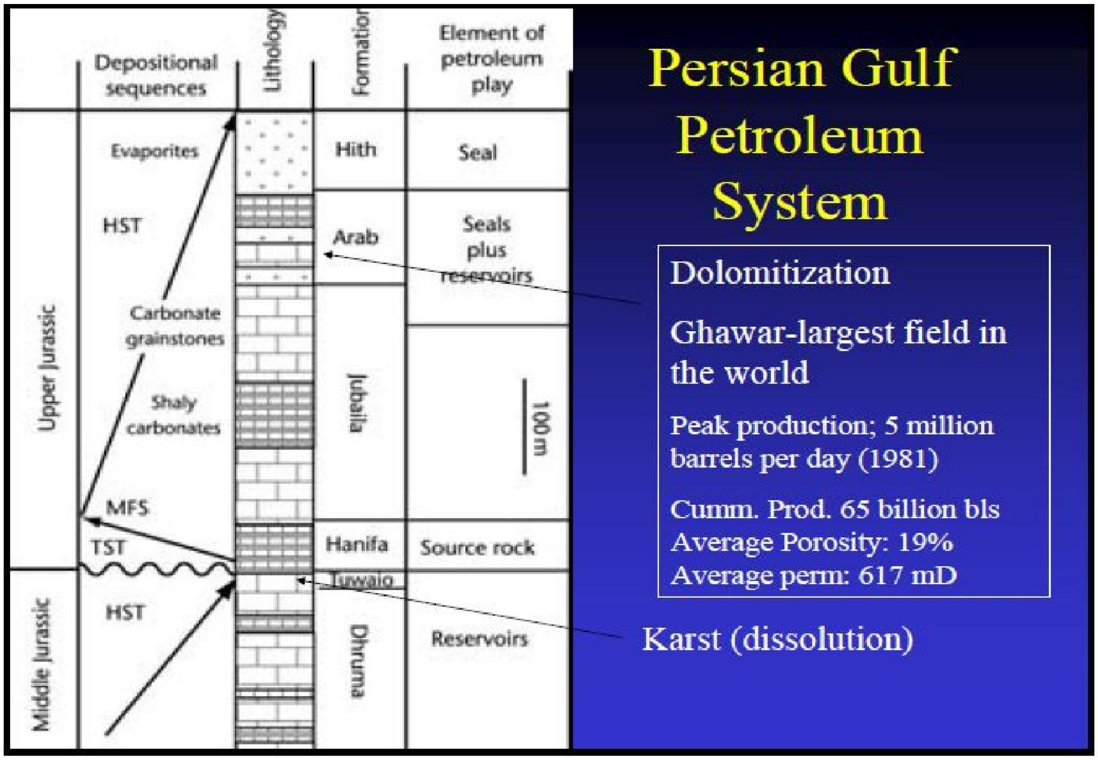


Fig. 7: Daily and cumulative production history from reservoir (a: gas production; b: condensate production).



Pic. 1



Pic. 2

Results & Discussions

Here we got a simple procedure for the evaluation of the matrix block size that is illustrated by generated and field examples. Another point is the variation of fracture opening for the productivity decrease with the increasing of pressure drawdown that is in most of the naturally fractured reservoir. We can effect on water production by the distribution of fracture density. The parameters which impact the well productivity in naturally fractured reservoir are: 1- Rock mechanical properties, 2- reservoir pressure and 3- pressure drawdown. Another point is that increasing in matrix block height cause an increasing in ultimate oil recovery. Also the matrix block weight has an effect on water imbibition mechanism but this is not so Strong.

References:

1. Barton, C.A. and M. D. Zoback, 1992. Self - Similar Distribution and Properties of Macroscopic Fractures.
2. Nelson A.R., “Geologic Analysis of Naturally Fractured Reservoirs”, 2nd ed., Gulf Professional Publishing (2001).
3. Warren. J. E. and Root. P J.: "The Behavior of Naturally Fractured Reservoirs." Soc. Pet Eng. J. Sept. 1963. PP. 245.25.
4. Blunt, M., " Fracture reservoir engineering", course note, Imperial abstract). Natural Hazards Newsletter, 6: 2.
5. Firoozabadi, A. and Markeset, T., " Laboratory Study of Reinfiltration for Gas - Liquid System in Fractured Porous Media", paper SPE 26129 nov. (1992).
6. Lefebvre du Prey, E., "Gravity and Capillary Effects on Imbibition in Porous Media", Paper SPE 1692, 195-206, June (1978)
7. Sajjadian, V.A., Danesh, A. and Tehrani, D.H., "Laboratory Study of Gravity Drainage Mechanism in Fractured Carbonate Reservoir-Reinfiltration", Paper SPE 54003, April (1999).
8. Azin R., Nasiri A., Jodeyri Entezari A. Underground Gas Storage in a Partially Depleted Gas Reservoir, Oil & Gas Sci. Tech. 63 (6), p. 691 (2008).
9. IRAP RMS Software Manual, Version 7. 5. 1", ROXAR (2006).
10. Kazemi H., Numerical Simulation of Water - Oil Flow in Naturally Fractured Reservoirs, SPEJ, p. 317(1976).
11. Geological Society of London Publications: Hydrocarbons in Crystalline Basement, 147: 145 - 162.
12. Terrzagi, R.D., 1965. Source of error in joint surveys. Geo-technique, 15: 287-304. College London (2006).

13. H. motiei, 1995, petroleum geology of Zagros: formation of Fars groups, organization of geology of Iran publisher, pp: 136 - 140.
14. B.C. Craft, M.F. Hafwkins, 2007, oil and gas reservoir engineering: saturation oil reservoirs, Sharif university publisher, pp: 221 - 222.
A. Seyrafian, A. Hamedani, 2003, microfacies and paleo environmental interpretation of the lower Asmari formation, north central Zagros basin, Iran, neues jahrbuch fur geologic und paleoontologie, Monatshefte, 3, 164 – 174.
A. Kalantari, 1967, Microbiostratigraphy of the Sarvastan, area southwestern Iran, national Iranian oil company, geological laboratories, publication No 5, 24 P.
15. E. Flugel, 2009, Microfacies of carbonate rocks: microfacies data, springer, pp: 74 – 80.
16. Lisle, R.J., 1994. Detection of zones of abnormal strains in structures using Gaussian curvature analysis. AAPG Bulletin, 78: 1811-1819.
17. Wei, Y., 1990. The ANN-modeling studies on geological hazards and its assessment (in Chinese with English Formation and Interpretation of Dilatant Echelon Cracks, Geological Society of America Bulletin, 93: 1291-1303.
18. Jadhunandan, P.P. and Morrow, N.R., " Effect of wettability on Water - flood recovery for Crude - oil/brine/rock systems", SPE Resevoir Engineering, February, pp. 40-46 (1995).
19. Esfahani, R. and Haghighi, M., "Wettability evaluation of Iranian carbonate formations", J. Pet. Sci. Eng. 42, pp. 257–265 (2004).
20. Santos, R.G., Rahoma, S. M., Bannwart, A.C., Loh, W., "Contact Angle measure - ments and wetting behavior of inner surfaces of pipelines exposed to heavy crude oil and water", Journal of Petroleum Science and Engineering, 51, 1-2, pp. 9-16 (2006).
21. Treiber, L.E., Archer, D.L., Owens, W.W., "A laboratory evaluation of the Wettability of fifty oil - producing reservoirs ", SPEJ, December 531 540 (1972).
22. Seethepalli, A., Adibhatla, B., Mohanty, K. K., "Physicochemical interactions during surfactant flooding of fractured carbonate reservoirs", SPEJ, 9 (4), 411 418 (2004).
23. Vermilye, J.M. and C.H. Scholz, 1995. Relation between Vein Length and Aperture, Journal of Structural Geology, 17(3): 423 - 434.
24. Wei, Y. 1990. The ANN -modeling studies on geological hazards and its assessment (in Chinese with English abstract). Natural Hazards Newsletter, 6: 2.
25. Neural Ware, 1995. Neural Computing, Technical Publications Group, A Technology Handbook for Professional II / PLUS and Neural Works Explorer, Pittsburgh, PA 15275.
26. The Anisotropic Hydraulic Conductivity of Soil, Journal of Soil Science, 8(1): 42-47.
27. Dershowitz, W.S. and H. H. Einstein, 1988.
28. Characterizing Rock Joint Geometry with Joint System Models, In Rock Mechanics and Rock Engineering, Springer - Verlag: Redmond/Cambridge. p: 21- 51.
29. Characterization and Interpretation of Rock Mass Joint Patterns, Geological Society of America Special Paper, 199 -37.
30. New directions in fracture characterization, The Leading Edge, 704-711.
31. Pollard, D.D., P. Segall and P.T. Delaney, 1982.

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