Facies Analysis, Depositional Environments and Diagenesis of the Sarvak Formation in Azadegan Oil Field

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Abstract

The Sarvak Formation (Albian-Turonian) was measured 822 m in type section and mainly consists of carbonate rocks. This Formation forms the important hydrocarbon reservoir in southwest of Iran. In this research the Sarvak Formation with Cenomanian age has been investigated in some wells in Azadegan oil field in the north of the Dezful Embayment in south west Iran. This research has been focused on facies analysis, depositional environments and diagenetic processes in the Sarvak Formation. The thickness of the Sarvak Formation is varied from 608 to 637.5 meters in Azadegan wells. In these wells the Sarvak Formation is overlain by the Ilam Formation uncomfortably. It is underlain the Kazhdumi Formation with conformable contact. Based on detail sedimentological analysis over the Sarvak formation four facies associations including tidal flat, lagoon, barrier and open marine have been recognized. The detailed microfacies analysis and sedimentological criteria suggest the Sarvak was deposited in rimmed shelf carbonate setting. The most important diagenetic processes include dolomitization, calcitization, cementation, pyritization, micritization, neomorphism, compaction, dissolution and biotorbation influenced Sarvak. From the petrophysical point of view, the porosity is the most important diagenetic process in the Sarvak Formation and fracture, vuggy and moldic types are dominant porosity types in this Formation.

Keywords: *Azadegan field; Sarvak Formation; Cenomanian; Facies; Rimmed shelf*

1. Introduction

The Azadegan oil field is located in Khuzestan province in southwest of Iran. This structure is near the boundary between Iran and Iraq and it is 60 km far from Abadan city. The Azadegan structure was explored by geophysical operations in Abadan plain. The Sarvak Formation with Cenomanian in age forms main reservoir unit in this structure. This formation is a part of Bangestan group includes Kazhdumi, Sarvak, Surgah and Ilam Formation (James and Wynd 1965). The lower boundary of Sarvak Formation is conformable with Kazhdumi Formation. The upper contact with Ilam Formation is recognized by a discontinuity surface. In Dezful embayment and a part of Abadan plain an argillaceous unit (Laffan or Surgah Formations) separate carbonates of Sarvak from Ilam Formation. The microfacies and depositional environment of Sarvak Formation have been studied by different authors (Farzdi, 1371; Keyvani,1372; Jalilian, 1375; Lasemi and Jalilian, 1376; Teymorian, 1383; Ale-Ali, 1386). In this study, microfacies analysis, depositional setting and diagenetic processes of Sarvak Formation in the wells A, B, C of Azadegan oil field have been investigated.

2. Methods of study

Totally about 380 thin sections have been adopted from the cored interval. Sampling had been taken systematic and very dense (one sample in each 30 cm.). Thin sections were treated with Alizarin Red-S following Dicsone (1966) for discrimination of calcite from dolomite. Classification of carbonate rocks has been carried out based on Dunham (1962) classification and recognition of facies belts and sedimentary profile are based on Lasemy and Carrozi (1981) and Carrozi (1989).

3. Microfacies

The microfacies analysis of cutting samples of whole the wells in Azadegan oil field is caused to recognize 4 facies belts (depositional environments) including tidal flat, lagoon, bar and open marine. Tidal flat facies zone (A) consist of Fenestral mudstone (A1), Fenestral bioclast benthic foram wackestone. Lagoon facies zone (B) cosist of bioclast mudstone/wackestone(B1), Benthiic foram wackestone/ Packstone (B2),Bioclast intraclast peloid packstone (B3), Orbitolin bioclast packstone/ Grainstone (B4), Intraclast orbitolin benthic foram grainstone)B5). Bar facies zone (C) consist of Rudist boundestone (C1), Peloid grainstone (C2) and open marin facies zone (D) consist of bioclast plagic foram mudstone/ wackestone (D1), Plagic foram wackestone/ packstone (D2), Intraclast bioclast packstone. A: This facies zone is generally formed from lime mud with rare benthic forams and Gastropud with fenestral fabric which are associated with early fine dolomite. Presense of dolomitos indicate internal part of a tidal flat seeting (Shinn, 1983). B: This facies zone is mainly consist of various freavent benthic forams which suggest a lagoon environment in adjacent to tidal flat (Lakhdar,2006). The skeletal allochems are abaoundant with high diversity and their association with pelloids indicate a shallow bathy met with proper saline condition and water circulation which provide a nutrient condition (Bachmann., Harsch 2006).Low diversity of found and increasing of lime mud in some facies suggest a low energy restricted lagoon (Messe,2003;Sandulli, 2004). C: This facies zone is charectrerized with aboundant Rudist. In this facies zone Echinoid, Peloid and Intraclast have been absorved. This assemblage found inparticvior Rudist abundant indicate a very high energy condition in barrier setting (Flugel, 1982; Ross and Skelton, 1993; Wilson, 1975). D: This facies zone is characterized with pelagic forams such as Hedbergella, Oligosteginid, Echinoid fragments and sponge spicules. Which indicate deep open marine setting (Simo and Lehmann, 2000). High frequency of Oligosteginid and Hedbergella suggest a very good nutrient condition in the presence of the sparse lime mud in matrix represent low energy environment in this facies zone (Adachi, 2004; Premoli-Silva and Sliter, 1994; Brasier,1995; Luciani and Cobianchi, 1999; Birkeland,1987). The specific faunal assemblage in this facies zone can survie in normal saline open marine condition (Heckel,1972; Sanders and Hofling, 2000; Flugel, 2004). In sammrized, presence of high amount of lime mud suggest a calm realm with no agitation.

4. Depositional Model

According to the results of Sedimentological studies of the Sarvak Formation in Azadegan field and comparison to previous studies and regarding to Walter's law, it seems that the Sarvak Formation has been deposited in a rimmed shelf carbonate platform.

5. Diagenesis and its Effect on Reservoir Charaterizaiton

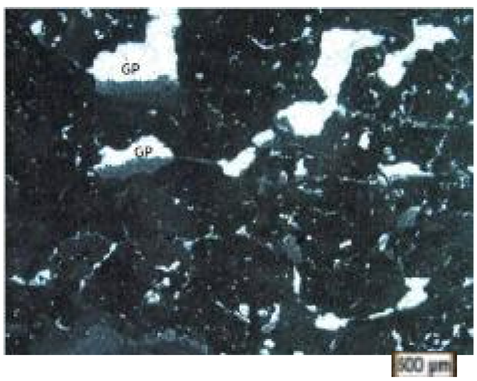
Different diagenetic process affected the studied interval, include compaction, dissolution, calcitization, cementation, neomorphism, bioturbation, dolomitization and fracturing. Among all, dissolution and fracturing are the most important factors which cause to develop porosity and have positive effect on reservoir quality .

6. Conclusion

1-Four facies belts including tidal flat, lagoon, bar and open marin have been recognized.

2-Based on recognized facies association of Sarvak and with comparison of them to modern environments a rimmed shelf carbonate platform setting for deposition of the Sarvak in studied area has been suggested.

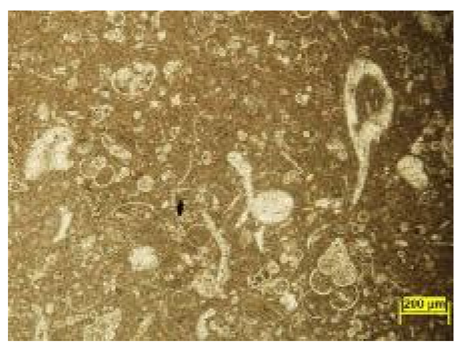
3-The compaction, dissolution, calcitization, cementation, neomorphism, bioturbation, dolomitization and fracturing are main recognized diagenetic process in Sarvak.



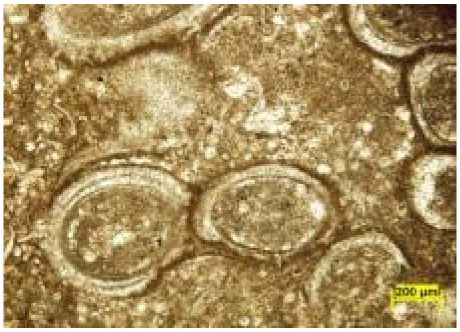
1. Fenestral mudstone

2. Benthick foram wackestone

3. Rudist boundestone



4. Plagic foram wackestone



5. Chemical Compaction (Stylolit)

6. Physical Compaction

7.Drusy Cement

8. Fracture Porosity

References

[1] Adachi., Ezaki, y., Liu, J., The origins of peloids immediately after the end- Permian extinction, Guizhou Province, South China, Sedimentary Geology (2004).

[2] Ale- Ali., Microfacies analysis and depositional environment of the Sarvak Formation in the North of Behbahan,A Symposium, geology of the Iran, (1386).

[3] Bachmann,M.,Harsch,F., Lower Cretaceous carbonate platform of the eastern Levant (Galilee and the Golan Heights): Stratigraphy and second- order sea-level change. Cretaceous Research (2006).

[4] Birkeland, C., Nutrient availability as a major determinant of differences among coastal hard-substratum communities in different regions of the tropics. In: C., Birkeland (ed.): Comparison between Atlantic and Pacific tropical marine coastal ecosystems: community structure, ecological processes, and productivity: UNESCO Reports in Marine Science (1987).

[5] Brasier, M.D., Fossil indicators of nutrient levels. 1: Eutrophication and climate change. In: D.W. Bosence, P.A. Allison (eds.): Marine palaeoenvironmental analysis from fossils, Geological Society Special Publication, (1995).

[6] Burchette, T.P. and Wright,V.P., Carbonate ramp depositional system, Sedimentary Geology (1992).

[7] Carozzi, A. V., Carbonate Rocks Depositional Model. Prentice Hall, New Jersey (1989)

[8] Dunham, R. J., Classification of carbonate rocks according to depositional texture, In, W.H. Ham(ed), Classification of Carbonate Rocks, A Symposium, American Association of Petroleum Geologists Mem (1962).

[9] Farzdi., Depositional environment and microfacies of the Sarvak Formation of the Bangestan group in the Nar anticline, Islamic Azad University North of Tehran Branch, M.Sc Thesis, (1371).

[10] Flugel, E., Microfacies Analysis of Limestones: Springer- Verlag, Berlin (1982).

[11] Flugel, E., Microfacies of carbonate Rocks.Analysis, Interpretation and Application New York, Springer Verlag (2004).

[12] Heckel, P.H., Recognition of ancient sedimentary environments, In: Rigb, J.k. and Hamblin, W.K.(ed).Special Publicatin (1972).

[13] Jalilian., Microfacies and depositional environment of the Sarvak Formation in the Bangestan and Lorestan mounts, M,Sc Thesis, (1375).

[14] James, G.A., and Wynd, J.D., Stratigraphy nomemenclature of Iranian oil Constortium Agreement area, American Assosiation of Petrololeum Geologist Bulletin (1965).

[15] Keyvani., Microfacies and depositional environment and history diagenesis of the Sarvak and Ilam Formations in the North Dezful oil field, Islamic Azad University North of Tehran Branch, M.Sc Thesis, (1372).

[16] Lakhdar, R., Soussi, M., Ben Ismail, M., and Rabet,A., A Mediterranean Holocene coatal lagoon under arid Boujmel SE Tunisia, Palaeogeography, Palaeoclimatography, Palaeoecology (2006).

[17] Lasemi, Y. and Carozzi, A. V., Carbonate microfacies and depositional environment of the Kinkaid Formation (Upper Mississippian) of the Illinois Basin,USA, VIII Congress Geol. Saluis, Actas, II (1981).

[18] Lasemi and Jalilian., Microfacies and depositional environment of the Sarvak Formation in the Khuzestan and Lorestan, Journal of geology, (1376).

[19] Luciani, V. and Cobianchi, M., The Bonarelli level and other black shales in the Cenomanian-Turonian of the northeastern dolomites (Italy): calcareous nannofossil and foraminiferal data: Cretaceous Research, (1999).

[20] Messe, J.P., Fenerci, M., Pernarcie, E., Palaeobathymetric reconstruction of peritidal carbonates late Barremian, Urgonian, sequences of Provence (SE France), Palaeogeography, Palaeoclimatology, Palaeoecology (2003).

[21] Papazzoni, C.A. and Trevisani, E., Facies analysis, palaeoenvironmental reconstruction, and biostratigraphy of the"Pesciara di Boica" (Verona, northern Italy), An early Eocene Fossil-Lagerstatte, Palaeogeography, Palaeoclimatology, Palaeoecology (2006).

[22] Premoli-Silva, I. and Sliter, W.V., Cretaceous planktonic foraminiferal biostratigraphy and evolutionary trends from the Bottaccione section, Gubbio, Italy: Paleontographia Italica, (1994).

[23] Rasser, M.W., Scheibner, C. and Mutti, M., A palaeoenvironmental standard section for Early llerdian tropical carbonate factories, (Corbieres, France; Pyrenees, Spain), Facies (2005).

[24] Ross, D. and Skelton, P.W., Rudist formations of Cretaceous: a palaeoecological, sedimentological and stratigraphical review: Sedimentology Review, (1993).

[25] Sanders, D. and Hofling, R., Carbonate deposition in mixed siliciclastic carbonate environments on top of an orogenic wedge (Late Cretaceous, Northern Calcareous Alps, Austria), Sedimentary Geology (2000).

[26] Sandulli,R., The barremian carbonate platform strata of the Montenegro Dinarids near Podgorica, a cyclostratigraphic study. Cretaceous Research (2004).

[27] Schulze, F., Kuss, J. and Marzouk, A., Platform configuration, microfacies and cyclicities of the upper Albian to Turonian of west-central Jordan, Facies, (2005).

[28] Shinn,E.A., Tidal flat environment, In Scholle,P.A.,Bebout,.G., and Moore, C.H. (eds.), Carbonate Depositional Environments, AAPG Memoir (1983).

[29] Simo (Toni),J.A., and Lehmann, P.J., Diagenetic history of Pipe Creek J.R., Reef, Solurian, North Centeral Indian, U.S.A., Journal of Sedimentar- Research (2000).

[30] Teymorian., Microfacies and depositional environment of the Sarvak Formation in the Khuzestan, A Symposium, geology of the Iran, (1383).

[31] Walter, M.R., Stromatolites: the main geological source of information on the evolution of the early benthos, In: Bengton,S., (ed), Early Life on Earth. Columbia University Press, New York (1994).

[32] Wilson, V.P., Carbonate Facies in Geologic History, Springer- Verlag, New York (1975).

Experiments on Dispersion in a Matrix-Fracture System

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Abstract

Dispersion of fluids flowing through porous media is an important phenomenon in miscible displacement. Dispersion causes instability of miscible displacement flooding; therefore, to obtain and maintain the miscibility zone, the porous medium dispersivity should be considered in displacing fluid volume calculation. Many works have been carried out to investigate the dispersion phenomenon in porous media in terms of theory, laboratory experiments and modeling. What is still necessary is to study the effects of presence of fracture in a porous medium on dispersion coefficient or dispersivity. In this work dispersion phenomenon in a fractured porous medium has been investigated through a series of miscible displacement tests on homogeneous sandstone core samples. Tests were repeated on the same core samples with induced fracture in the flow direction. The effects of fracture on miscible displacement flooding have been studied by comparison of the results of dispersion tests in the absence and presence of fracture. In the presence of fracture, breakthrough time reduced and the tail of effluent S-shaped curve smeared. Moreover, the slope of S-shaped curve at 1 pore volume of injected fluid was lower than homogeneous case which means dispersion coefficient increased. The results presented in this work provide an insight to the understanding of dispersion phenomenon for modeling of miscible displacement process through naturally fractured reservoirs.

Introduction

In most of the enhanced recovery processes such as miscible drives, carbon dioxide flooding, as well as other recovery methods, mixing of two miscible fluids in a porous medium plays a very important role. Many studies have been devoted to mechanics of miscible displacement, focusing on the longitudinal and transverse dispersion.

As one miscible fluid displaces another, the displacing solution continuously mixes with the resident fluid, so that the arrival of the displacing solution at a given point in the porous medium is characterized by a gradual change in the solution concentration from that of the original fluid to that of the invading fluid. This mixing or interfusing of the two fluids, due to both molecular diffusion and convection, is termed dispersion.

1. Need for Research

Dispersion theory is important in the study of the miscible recovery of oil, movement of trace contaminants such as radioactive waste and heavy metals, Infiltration of saltwater in groundwater systems, chromatography, fluid– solid catalytic and non-catalytic reactions, etc.

Diffusion and dispersion in porous rocks are of current interest to the oil industry. Miscible displacement has been used successfully in enhanced oil recovery (EOR) processes. The