EBPCM

ENCONTRO BRASILEIRO DE PETROFÍSICA DE CAMPOS MADUROS

Encontro Brasileiro de Petrofísica de Campos Maduros (EBPCM)

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PREFÁCIO

Nos dias 22, 23 e 24 de março de 2022 ocorreu o I Encontro Brasileiro de Petrofísica de Campos Maduros (EBPCM), no formato virtual, reunindo profissionais de operadores, prestadores de serviço, agências regulatórias e associações profissionais, além de membros da academia. O evento foi organizado pela seção brasileira da Sociedade de Petrofísicos e Analistas de Perfil (SPWLA).

O evento nasceu a partir da crescente demanda e interesse de diferentes players do mercado de óleo e gás na revitalização de ativos disponíveis a partir do agressivo plano de desinvestimento implementado pela Petrobras. O baixo fator de recuperação desses campos, quando comparados a média global e o notável histórico de declínio em suas produções, indicam que é crítica a adoção de diferentes técnicas de avaliação de formação, que possam permitir de maneira eficiente e economicamente viável a extensão de sua vida útil. Portanto, O I EBPCM buscou promover o intercâmbio de conhecimento técnico e científico, compartilhando lições aprendidas e divulgando soluções tecnológicas inovadoras e eficientes, com o apoio dos diferentes atores, sejam da indústria ou do meio acadêmico.

Ao longo dos 3 dias de evento, contamos com 28 palestras – incluindo 2 em sessão plenária, 3 minicursos e uma mesa redonda. Foram discutidos técnicas de avaliação de formação a poço aberto e poço revestido, estudos de caso de áreas brasileiras, modelagem para recuperação avançada, aspectos de captura e armazenamento de carbono e aspectos econômicos relacionados.

A sessão plenária, por Mariana Cavadinha (ANP) e Austin Boyd (UFRJ) reforçou a importância do evento. Mariana apresentou o panorama da exploração dos campos maduros brasileiros e como a ANP está agindo para incentivar o setor. No aspecto técnico, Austin apresentou os muitos desafios relacionados a avaliação petrofísica dos campos maduros – corroborando que o aspecto técnico da avaliação desses reservatórios ainda tem espaço para evolução e discussões.

Com foco nos novos rumos da área de petrofísica, uma mesa redonda discutiu a aplicação de inteligência artificial na área, contando com participações de Marcos Amaral e Sylvia Anjos (ABGP), Anna Paula Lougon (Schlumberger), Prof. Cleyton de Carvalho Carneiro (USP), Márcio Martins (Rock Care) e Milena Siqueira (Halliburton).

O balanço dos 3 dias de apresentações e discussões foi altamente positivo. Nas próximas páginas deste livro, o leitor encontrará resumos das apresentações que compuseram o I EBPCM.

Até a próxima edição!

Atenciosamente,

Giovanna Carneiro

Presidente da Comissão Organizadora do I Encontro Brasileiro de Petrofísica de Campos Maduros

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SUMÁRIO

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ABC (ANALYSIS BEHIND CASING)

ARISTIDES ORLANDI NETO

ABSTRACT

The presentation will cover ABC which is a technique to do petrophysical interpretation in mature fields. As an introduction we will point out generalities about the oil industry nowadays as well as the future market of mature fields in Brazil. The ABC technique will be explained in detail and examples will be shown on a mature field from Mara La Paz in Venezuela. There are important differences in the way we treat data from the measurements available to ABC that should be considered on the petrophysical interpretation as well as similarities from a regular interpretation from open hole data. The advantages and pitfalls of the technique will be mentioned for the end user to be able to decide whether it does make sense in a particular mature field considered. ABC has been around for many years and used extensively in some areas with very good results, this presentation does not mean to cover each aspect of the technique but to provide a good understanding and with some few examples as an introductory presentation.

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APPLICATION OF PULSING NEUTRON LOGS IN THE MONITORING OF RESERVOIRS AND IN THE REDEVELOPMENT OF MATURE FIELDS.

DANIELLE SCHERER

ABSTRACT

The activities of the oil sector in Brazil began more intensively in the 1940s and many oil fields continue with their oil and gas production since then. Several deposits distributed along the Brazilian sedimentary basins are depleted with a good part of their original oil volume already exploited. According to the ANP, mature fields are fields that have been producing for more than 25 years or that have accumulated production of more than 70% of the expected volume to be produced. Given this scenario, the development of mature fields requires deepen studies of the hydrocarbon reservoir, as well as a recurrent monitoring of the current situation of the deposit. A constant update of the static and dynamic model is necessary to maintain a field development project with the best productivity index. Knowledge of the current situation of the well is essential to optimize its production, in addition to supporting the studies of a field and a recovery project that aims to obtain better recovery rates for the deposit. The Pulse Neutron Log (PNL) is an important tool that helps to identify the current saturation of fluids. This tool presents two forms of log, Sigma and Carbon/Oxygen, which help in monitoring the saturations of oil and gas remaining in the well. This information is usually analyzed together with the production history and interventions in the field in order to follow the evolution of the reservoir, whether with regard to the depletion of hydrocarbons or the monitoring of water or gas injections in pressure management. The present work aims to elucidate the theme, as well as to point out technical aspects that enable or discourage the use of these logs. The work presents case studies implemented by the company 3R Petroleum in its onshore assets of mature fields where the application of the tool generated results that could help the monitoring of the reservoirs, as well as indicate operations that contributed to the increase in oil recovery and decrease in production of water, resulting in better strategic planning in the redevelopment of these mature fields.

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CASED HOLE SATURATION LOGS AS A RESERVOIR MANAGEMENT TOOL IN SERGIPE/ALAGOAS BASIN, BRAZIL

ANA L. MACIEL, AUGUSTO P. REGO, FRANCISCO T. A. COSTA

ABSTRACT

The present paper presents guided workover jobs using cased hole water saturation logs (CHWS) in a mature field AA and in a younger and less developed field CC, located in Sergipe-Alagoas Basin, Brazil. CHWS log gives interpretation that permits to identify bypassed oil, marginal oil saturations and fluid contact displacement and allows the decision maker to prioritize wells by the best economic value principles. Besides CHWS acquisition data, we must consider other variables (well production history, reservoir pressure, hydraulic connectivity, volume of oil in place and recovery factor) before choose the hydrocarbon zone for perforation. This multidisciplinary integration involves Petrophysics, Geology and Reservoir/Well Engineering and has shown great results throughout the past two years in Petrobras. In fields of elevated maturity and complexity, the CHWS logs guarantee the non-investment in zones of marginal oil saturation. But also, the mere identification of hydrocarbon zones does not guarantee the economic value of the project, mainly because of the high costs of workover jobs and also by the fact that the oil in place volume must also be considered. As a result, in mature field AA, the economic analysis of the workover jobs, supported by a multidisciplinary group and CHWS logs shows a higher NPV (Net Present Value). On the other hand, in field CC, which is in an intermediary exploitation stage, this methodology of work allows a better management of the reservoirs and optimization of production.

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CORRELATION AND EXTENSION OF WELL RESISTIVITY DATA USING SURFACE ELECTROMAGNETIC IN MATURE FIELDS

KRIEGSHÄUSER, B., DE LUGÃO, P., CORRÊA, E.,
STRATAIMAGE CONSULTORIA LTDA.

ABSTRACT

Mature fields account for over 70% of the World's oil and gas production. Considering the average recovery factor being circa 70% for gas and circa 35% for oil, innovative methodologies, combining new techniques and technologies, are proving that revitalization activities can be economical, and thereby increasing ultimate recovery by 20% or more. The development of these mature assets is significant to the global economy (GaffneyCline, 2020). The Brazilian National Petroleum Agency (ANP) categorizes a field as being mature, if it has produced for over 25 years or if the accumulated production has reached at least 70% of its producible capacity. ANP has conducted various bidding rounds with mature fields to stimulate production. In order to optimize production, it is important to understand the geological setting and plays. In many cases data that are available could benefit from new technologies to produce a better integrated image of the subsurface. Electromagnetic methods, e.g., Magnetotellurics (MT), has been used by many operators to enhance the understanding of the subsurface. In this presentation, we will briefly describe the Magnetotelluric Method (MT) and show various example of its application in mature fields with correlation to well logs. The field case histories and data comparison are from the Recôncavo Basin and the Carmópolis field in Sergipe-Alagoas Basin. Since the MT data coverage is broad and reaches various kilometers in depth, it is an excellent tool to integrate with and complement other data sets, like well log data and also with other geophysical data sets, e.g., seismic and/or potential field data.

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FORMATION EVALUATION IN MATURE FIELDS

AUSTIN BOYD

ABSTRACT

Formation evaluation in mature fields can bring many challenges compared to evaluating new discoveries. These include analyzing log data of varying vintages where environmental effects, lower vertical resolution and shallower depth of investigation have a greater impact on the data than with modern logs. If new wells are drilled and logged with modern sensors that are less affected by environmental effects, this can be offset by the uncertainty from the changes in fluid properties of formation water and hydrocarbons due to pressure depletion, water flooding and/or gas injection. If no new wells are drilled, cased hole logging can be used on existing wells to re-evaluate the remaining oil in place, but this can bring additional interpretation challenges due to cement quality issues, perforations, downhole completion hardware and varying well-bore fluids. Even with these challenges, there are many opportunities for enhanced oil recovery in mature fields that justify either cased logging on older wells or drilling new wells to evaluate the remaining oil in place. Evaluating the data from either scenario can be facilitated with recent advancements in Artificial Intelligence and tool response modeling for the expected downhole well-bore conditions and formation fluidsfor both open-hole and cased hole logging and should provide more accurate analysis for mature field development planning.

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INICIATIVAS DE IOR NA EQUINOR

MARIA CLARA COSTA, EQUINOR

ABSTRACT

Improved oil recovery (IOR) is the ultimate discovery in any oilfield. Equinor has a long history of evaluating and implementing IOR projects on the Norwegian Continental Shelf (NCS), where it was observed that infill drilling and well cost reduction are the most important measures, while a holistic approach from all disciplines, collaboration and integrated work is needed for achieving successful results. IOR is also relevant to the climate ambitions to reduce the carbon footprint: it enables CO2 emissions per produced barrel from field extension to be lowered due to higher production, compared to ending the production earlier. Given its history with IOR in the Norwegian Continental Shelf, Equinor brought some of its experience to Brazil, more specifically to Peregrino Field, a heavy oil asset operated by the company, and to Roncador, a partner operated license established with Petrobras in 2017. This expertise is also being applied to the pre-salt projects under development, aiming to prepare the fields for the late life since its startup. The presentation brings some of the techniques used, and how they are incorporated into the company's workflow, so that they can be properly assessed and implemented, showing how it is possible to unlock extra oil from the reservoirs enabling the fields lifetime extension.

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LITHOFACIES PREDICTION STARTING FROM GEOLOGICAL INFORMATION AND BASIC WELL LOGS USING WAVELET TRANSFORM AND BACKPROPAGATION NEURAL NETWORK IN A CARBONATE RESERVOIR IN SOUTHEASTERN BRAZIL

ABEL CARRASQUILLA, UENF/CCT/LENEP - MACAE - RJ, BRAZIL

ABSTRACT

This study proposes a method to determine the connection between lithofacies and electrofacies, through numerical simulations, being the electrofacies those identified in the well log data interpretation. The lithofacies classification using logs has been performed by several authors using a wide range of approaches. It is known that logs are sensitive to fluids and lithology present inside the rocks, but there is hardly a direct correspondence between them. To help clarify this relationship, this work conducted a study that used the boreholes Li10 (reference) and Li03 (blind test) of a carbonate reservoir in Campos Basin, Southeastern Brazil. The lithofacies information was used as input to the process, which was originated from the analysis of conventional cores, together with wireline logs (gamma ray, resistivity, neutron porosity, bulk density, and transit time). Therefore, in order to examine the accuracy and efficiency of determining lithofacies from logs, a different approach was proposed, which explored initially the weight of each log in the estimate. Hereafter, a combination of the wavelet transform with a backpropagation neural network algorithm was used to estimate the lithofacies in each wellbore. In the outcomes, using the cross plot of the bulk density and gamma ray logs, it was possible a separation into five electrofacies in the graph, which coincide with the five lithofacies proposed by Okubo et al. (2015). The great similarity between the lithofacies and the wavelet transforms of the basic logs showed, as is well known in the literature, why the gamma-ray log is one of the most used in the identification of lithofacies. Likewise, when compared with lithofacies, the electrofacies derived from the log gamma-ray wavelet transform showed better results (R=0.83, MSE=0.01) than those derived directly from the gamma-ray log (R=0, 74, MSE=0.63). These results show that these electrofacies are a better choice as input in the simulation process, using the backpropagation neural network algorithm (Bayesian Regularization). The performance of the simulations was evaluated using the statistical criteria of the Pearson Correlation Coefficient (R) and the Mean Squared Error (MSE). The results of this modeling showed that this approach worked fine for the Li10 reference well (R=0.92, MSE=0.02), as well as the Li03 blind test well (R=0.94, MSE=0.04). Thus, it was shown in this work that with this procedure it is possible to derive lithofacies from electrofacies, provided that the logs containing the most relevant lithological information are chosen correctly and, later, submit them as input in an inverse process with an algorithm of backpropagation neural network.

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MACHINE LEARNING APPLICATIONS FOR FORMATION EVALUATION

JOSE MONTERO

ABSTRACT

Methods for automated well interpretation is a development goal for most of the companies in the oil and gas industry. Databases include hundreds of thousands of uninterpreted wells exist globally that would take hundreds of person-years to interpret manually. To accomplish this goal a critical step is to automate the interpretation of wells from wireline log data. Current petrotechnical suite includes machine learning (supervised and unsupervised) tools related to the interpretation of continuous logs and discrete categories (facies, rock typing, flags, etc). These are the Neural Network module (supervised ML method) and the Self Organizing Maps module (unsupervised ML method). Furtheremore, machine learning algorithms require a competent and a consistent training dataset to associate the different petrophysical signals with lithology/categories. Which includes a customizable training data set builder module where the users can create their own models to apply the corresponding machine learning types. In summary, the machine learning applications helps operators to speed up the interpretation process in an agile manner closing the gap between different petrophysics and critical geoscience and engineering disciplines with best-in-class solutions from exploration to production. It gives access to users for a wide range of petrotechncial tools that apply user-friendly workflows that help to interpret well data in a rapid and efficient way with the best-in-class solutions on one single open platform.

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MAKING THE MOST OF DIGITAL CUTTINGS IMAGE DURING OPERATIONS

PABLO MOREIRA

ABSTRACT

Characterising a reservoir is a complex process requiring detailed analysis and processing of acquired data. Rock core extracted from within a reservoir serves as a valuable, first hand insight into the reservoir. The timely description and interpretation of the core can have a major impact on prospect generation and field development. The adoption of a new digital core description and interpretation workflow has improved the delivery speed and accuracy of formation data for reservoir modelling. Historically Sedimentologists expressed their interpretations with creativity, flexibility and personality using pencil and paper. Within the organisation, processes to assimilate these interpretations into a digital workflow required retrospective digitising of the paper sheet. This conversion could take as much as six hours and two separate applications to complete with both geologist and technician involved in the conversion and quality control process. A new application and workflow have been introduced to directly describe the core via a stylus on a tablet. The ergonomics of the process is similar to that of using pencil and paper but the digital output can be fully integrated with geology, petrophysics, and modelling environments. Company standard log templates, including a uniform library of symbols, patterns and structures, provide a common interpretive environment that benefits correlation and retrospective analysis. Prior to addressing the core, geologists load and display logging data, core gamma and plug data where available to orientate and guide the description. Export routines ensure data generated is easily available to the corporate data store and other enterprise level applications in the critical path of reservoir characterisation. As a standard operating procedure within the core laboratory, staff and consultant geologists can deliver a consistent quality of formation data. These technologies have been successfully applied in a Global Major Oil Operator and is a potentially tool to integrate the Lithofacies from core have been correlated with petrophysics data to help guide optimal field development including the re-calibration of hydrocarbon bearing reservoir facies depths that has increased net pay.

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ONSHORE, A NOVA FRONTEIRA ENERGÉTICA DO BRASIL

MÁRCIO FÉLIX CARVALHO BEZERRA, ENP

ABSTRACT

The onshore oil and gas industry is experiencing its greatest transformation. In recent years, important advances, in the most varied areas and fronts of action, have provided the formation of a more plural, dynamic environment with unprecedented opportunities. In this new environment, new technologies and exploratory projects, along with the use of geoscience, will be key pieces to unlock the potential of Brazilian onshore and maximize the life of mature fields. Based on this, EnP believes that solutions that integrate the industry and academy will be the gateway to the reexploration of onshore as the new Brazilian energy frontier.

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PEREGRINO ROCK TYPES: AN ALTERNATIVE FOR PETROPHYSICAL PARAMETERS DISTRIBUTION.

LEONARDO MASUTTI (PRINCIPAL PETROPHYSICIST), STEVENSON HALL (PRINCIPAL GEOPHISICIST), JÁDISON DE OLIVEIRA (PRINCIPAL GEOLOGIST) EQUINOR BRAZIL, RIO DE JANEIRO, BRAZIL

ABSTRACT

The creation of rock types is a process that makes it possible to relate geological facies and petrophysical properties in oil reservoirs. Rock types must also correspond to the dynamic behavior of rocks, controlled by textural features such as porosity type and pore space distribution (pore throat). Rock types interpreted from electrical log responses are commonly known as electro-facies. For reservoir modeling, the rock types are distributed throughout the model, guiding the distribution of petrophysical properties of the rocks present in the reservoir. Flow units can be considered as the connection of similar rock types in the reservoir. In the Peregrino Field, petrophysical parameters such as permeability, saturation and relative permeability are distributed by three main electro-facies. These three electro-facies are defined basically by shale volume cut-off and total porosity amount. However, during the development of this field it has been possible to observe some variability in production(?) inside of these electro-facies, which needs to be accounted for in the model representations. These sub-electro-facies observed have different petrophysical properties but similar electrical response as the main electro-facies initially interpreted. This work presents the rock typing methodology in order to solve this issue, by classifying the Peregrino reservoir rocks into flow units. More than 400 core samples with porosity and permeability measurements had been used for defining the flow units. Special core analyses from MICP also have corroborated the results. The flow units were distributed in the geological model, in turn guiding the petrophysical parameter distributions, such as permeability and water saturation, improving the reservoir heterogeneity. Consequently, it is possible to achieve a static model more faithful to the reservoir geology and subsequently a more predictive simulation model.

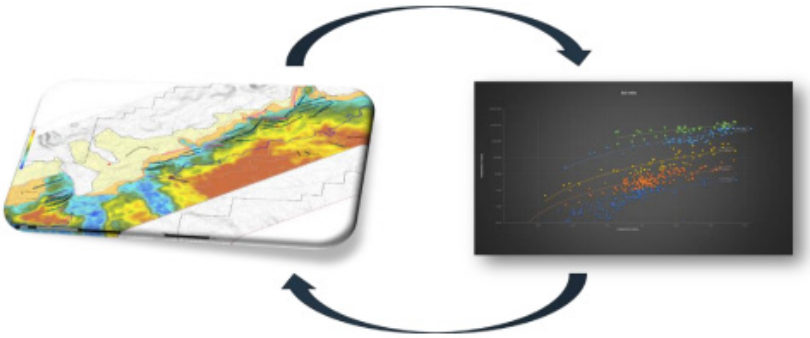

Figure 1: Peregrino Reservoir Model and Rock Typing Interaction, the key for improving dynamics.

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PETROPHYSICAL PROPERTIES AND EVALUATION OF TIGHT GAS SANDS IN POTIGUAR BASIN ONSHORE

ÁLVARO FCO CAMPASSI REIS EXP/TPGG/IPGF

ABSTRACT

Tight gas sands reservoirs were originally described in foreland basins geographically located in the Rocky Mountains in North America. These reservoirs commonly constitute an unconventional petroleum system called BCGS (Basin Centered Gas Systems) whose main characteristics are: low permeability, presence of abnormally static pressure, accumulations not dependent on geological traps, seal by capillarity and absence of gas/water contact downdip, Master (1979) and Davis (1984). Despite having a different geological context, the Potiguar Basin also presents in its depocenters, in the grabens of Apodi and Umbuzeiro, an unconventional gas/condensate system analogous to that originally described in North America. This paper discusses the main characteristics of this system formed by clastic reservoirs of very low permeability and porosity, found in the Pendencia Formation of the Potiguar Basin onshore, below 3 km deep. The Petrophysical interpretation workflow used in the wells, some properties of the reservoirs and the results obtained are described. After the evaluation of the wells it was concluded that the project represented a geological success, once it confirmed the occurrence of an unconventional system in the area, however, due to several aspects among them the costs involved, a commercial success was not obtained.

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PRODUCTION PETROPHYSICS AND ITS KEY ROLE IN ENHANCED OIL RECOVERY (EOR)

MARCELO ESTEBAN CHIMIENTI (V&P DO BRASIL),
FÉLIX GONÇALVES (SOLINTEC)

ABSTRACT

Enhanced Oil Recovery projects target the resources not capable of being produced with conventional production approaches. They are used to extend the life and improve the recovery of mature oil fields and encompass various technologies and methods, such as water flooding (with or without chemical products) and gas, CO2, or steam injection. The design, implementation, and monitoring of EOR projects is a multidisciplinary task involving practically all the domain expertise in any oil company, from geophysics to well construction. Therefore, various domains' data, information, and efforts must be integrated and focused on defining the best EOR approach to increase oil production rates. In this context, petrophysics plays a crucial role in characterizing the reservoirs and selecting those intervals with adequate rock properties and remaining oil to develop an economically attractive EOR project. In the particular case of Water Flooding projects (by far, the most comprehensive EOR technique), it is necessary to start with the characterization and selection of the reservoir intervals for the injection. Then, additional rock and fluid must be analyzed to assess the interaction among injected water, reservoir rock, and reservoir water. If not accurately diagnosed, such interactions can result in significant permeability reduction, affecting the injection rates and oil recoveries forecasts. In this presentation, we will show the role of petrophysics and its interactions with other disciplines involved in designing, evaluating, and implementing a waterflooding project, highlighting some of the critical points that can make our project succeed or not.

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PROFILING SOLUTIONS IN THE EVALUATION OF MATURE FIELDS

DIEGO RUBEN LACHTER

ABSTRACT

During drilling, evaluation, completion & production of a well in a mature field there are multiple operations that can be accomplished with wireline assistance. This document starts summarizing some of the interventions where the wireline technology is necessary to evaluate integrity, pipe recovery, start production of the well, measure flowrate, identify fluids, assess efficiency of secondary recovery or determine the main & bypassed producing zones. We will specially focus in formation evaluation with pulsed neutron tools. We will describe a real case studio based in two wells from a mature field located in Cuenca del Golfo San Jorge, Argentina. In one of the wells pulsed neutron data and openhole logs were processed to generate a group of neural networks where each set learned to predict an output (Resistivity & Sponteneous Potential) based on a carefully selected group of input variables from a pulsed neutron tool and the real openhole measured curves. The pulsed neutron dataset was also processed to validate the openhole petrophysics analysis. In the second well, constructed with "casing while drilling" procedure, the resulting neural networks from the training well were applied to emulate open hole logs. The process was useful to determine the pay zones and design a completion perforating program in a condition where the "casing while drilling" technique didn't allow to run regular openhole tools

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RELATIVE PERMEABILITY: FROM BASIC CONCEPTS TO CO_2 SEQUESTRATION

KORY HOLMES

ABSTRACT

The program will introduce three topics for flow displacements in reservoir. The first two methods, relative permeability and enhanced oil recovery, will look at methods to evaluate hydrocarbon recovery in petroleum reservoir. The relative permeability section will include the history of waterflooding, the theory behind the data evaluation, what influences hydrocarbon recovery, and the various test methods used to evaluate relative permeability. The second section will introduce the techniques for enhanced oil recovery and help everyone understand the costs involved in planning and implementation of enhanced oil recovery in the field. The third section will discuss a topic that is quickly moving into all energy producing sectors, the ability to safely dispose of captured carbon dioxide in saline aquifers.

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RELEVANT LABORATORY PARAMETERS IN THE ASSESSMENT OF POTENTIAL APPLICATION OF LOW SALINITY WATER INJECTION AS A TERTIARY RECOVERY METHOD

FERNANDA OLIVEIRA HOERLLE

ABSTRACT

Low salinity water injection may be a viable strategy for increasing production in mature fields. Core flood experiments under conditions similar to those of the reservoir are necessary to evaluate the recovery potential of this method, especially in water-oil ratios close to those of real fluids. Carrying out experiments at high injection rate is also important to avoid capillary end. Along with core flood experiments, low salinity water-oil contact tests that assess the presence of micro dispersion (spontaneous emulsification after static contact) have been used to identify fields that can benefit from increased oil production after low salinity injection. Given the relevance of these factors, the objective was to evaluate the influence of the water oil ratio on oil production after tertiary injection of low salinity water, as well as to evaluate the relationship between the presence of micro-dispersions and increased oil production in comparison with results of literature. The methodology used to characterize the performance of this recovery method were core flood test, water-oil contact, interfacial tension and contact angle at high pressure and temperature (1000 psi, 60°C). To achieve a water-oil viscosity ratio similar to that of the field of interest, cyclohexane was used to dilute the oil at a 60/40 v/v ratio. Core flood tests were performed at low and high injection flow rates, 5 cm^3/h and 60-480 cm^3/h, respectively. Results show that, for the studied scenario, the formation of micro dispersion was small and the low salinity water allowed additional oil recovery in the low injection flow system. Low salinity water had the potential to modify rock wettability after a long period of exposure. It was concluded that the micro dispersion water-oil ratio in this studied scenario did not indicate a positive low salinity water response as increase in oil recovery. The low presence of micro dispersion is in agreement with the literature results that demonstrated the absence of tertiary recovery after injection of low salinity water for oils with a micro dispersion content lower than 3, demonstrating that this methodology can be beneficial for fast identification of oils before performing more complex experiments such as core flood. Conducting an experiment with oil with higher micro dispersion content is recommended to validate this theory.

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THE IMPORTANCE OF PETROPHYSICS IN THE REDEVELOPMENT OF MATURE FIELDS: A CASE STUDY IN THE POTIGUAR BASIN

BRUNO VALLE

ABSTRACT

In the past years the redevelopment of mature fields has become an important theme in Brazil due to the disinvestment plan of the major operator in the country. In this scenario, new players specialized in revitalizing these fields are applying different strategies and achieving important results. The production decline in brownfields is a natural phenomenon and several techniques can be deployed to reverse this decline. In this sense, the integrated approach between many different areas is a key factor, which can result in a more reliable reservoir characterization and field development. The petrophysics play a key role in the redevelopment strategies, acting integrated with geology, reservoir engineering and operations. A good static model is one of the most important premises when studying a reservoir, applying high-resolution stratigraphy techniques, identifying reservoir connectivity and flow units. In addition, the integration between petrophysics and reservoir engineering has a crucial role in the establishment reservoir depletion levels and estimating current water saturation and oil-water contact displacement. The use of cased hole tools such as pulsed neutron logs aid in the reservoir monitoring, in the identification of bypassed oil zones and significantly reduces risks in workover activities. In this presentation it will be described workflows and techniques of how petrophysics was applied in the concept of mature oilfield redevelopment, which led to an increase of reservoir productivity in over 60%.

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THE KEY TO REVITALIZING YOUR FIELD IS HOW DYNAMIC YOUR DATA IS

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ABSTRACT

A revitalized field is one with a new life. It is the operator's expectation that the new behavior of the target reservoirs is one of higher hydrocarbon production rates (Qhc) and better recovery factor (RF), while optimizing costs/barrel and reducing the environmental impact in a safe manner. In contrast to green fields, where an increase in Qhc is associated with a potential decrease in RF, in mature fields these two key performance indicators go hand in hand. Hence, to revitalize a field it is recommended to properly understand the field's hydrocarbon production gap. Since the fields produce from wells, we can narrow our focus in the well's production behavior. A production gap is the subtraction of two values from the nodal analysis plot. The first node is the well's current production rate. This value is measured, has the maximum reliability, and hence is considered "hard data." The second value is the well's theoretical maximum rate, which is calculated using several assumptions and hence is less dependable and considered "soft data". The production gap is therefore, by definition, soft data. Nevertheless, it is this gap, and nothing else, that dictates which kind of well interventions are advisable to revitalize wells and fields. Petrophysicists provide by far the hardest data due to the proximity of the sensors to the reservoir fluid and rock. Cuttings and fluid analysis from mud logging, sidewall or whole cores, conventional or advanced logging via wireline or LWD, provide the geoscientist with permeability, porosity, water saturation, pore and pore throat size, cement-to-casing bond, etc., which are a few of the many inputs needed for the inflow performance ratio curve; whereas roughness, tubing id, flowing bottomhole temperature and pressure, water cut, etc. are crucial for the outflow curve. However, the distinction between soft data and hard is also dependent on the changes with time of the different parameters and assumptions required for proper nodal analysis. Two time-windows become obvious: the observation window and the application window. Some of the parameters mentioned above will remain constant within the observation window but change within the application window, whereas others will remain constant or change in one or both. Therefore, the diagnostic of the causes of the suboptimum production must involve an understanding of whether the data is static, pseudostatic, pseudodynamic or dynamic. In order for proper field revitalization, is not only essential to understand the value of certain parameters, but also how hard or reliable these parameters are with time. The key to revitalizing mature fields is understanding how dynamic your data is.

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