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BİLDİRİLER KİTABI
CONGRESS PROCEEDINGS

Reservoir Characterization of Unconventional Dadaş Formation in Southeastern Turkey

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INTRODUCTION

Unconventional resources are increasingly important in the future of oil and gas industry as they potentially hold substantial amount of hydrocarbon. Economical production from shale reservoirs is still strongly dependent on reservoir characterization of the formations that are generally conducted by using mineralogical content of the rocks and geochemical properties including total organic carbon content (TOC) and maturation of the source rocks. However, the integrated approach by describing, from microscopic to reservoir scales, the sedimentological, petrophysics, geomechanical parameters and structural aspects are also required. The Silurian age Dadaş Shale in the Diyarbakır basin, SE Anatolian Basin are the most prospective unconventional reservoir in Turkey. However, the potential of this unconventional formation still remained ambiguous. Thus, sedimentological analysis on cores and cuttings, petrographic analysis on thin sections and SEM images, well log data interpretation, natural fracture characterization using Borehole Imagers (BHI) and cores are conducted to unlock the potential of Dadaş unconventional reservoir and results revealed that the Dadaş-I member of the Dadaş formation has potential of source rock for the Paleozoic oil system.

METHODS

First, all avaliable wellbore data is collected, checked and harmonized. All required preparation steps like depth shifting, data corrections etc. are done according to the standards. Petrophysical properties, such as TOC, Total and Effective Porosity

(PHIT, PHIE), Water Saturation (SW), Mineralogical Composition, Matrix Permeability, and also Brittleness Index (BI) are estimated based on the custom designed workflow: on the first step TOC estimated based on Delta Log R method, and calibrated on pyrolysis results, after that based on multimineral inversion algorithm reservoir properties are estimated, and on the last step differentRock Types are estimated: “1” - Reservoir + Completion Quality intervals (higher PHIE and BI values), “2” - Completion Quality intervals (higher BI values only), “3” - EOR Quality intervals (higher kerogen content) and “4” - non-producible shales.

Intervals “1” or RCQ are the best candidates for hydraulic fracture operations as they can store and produce hydrocarbons. Intervals “2” or CQ are also meaningful for hydraulic fracturing if they are connecting some RCQ zones as a so called “technical conductors”. Intervals “3” or EORQ could be used on later stages, as a focus for tertiary treatment techniques. Intervals “4” have no potential and should be avoided. Natural fracture characterization analysis was done based on the BHI and core data. All Images were processed, interpreted, and compared with the corresponding core intervals. Fully conductive, partially conductive and resistive fractures were identified, as well faults, beddings, unconformities etc. Critically stressed fractures are identified by integrating 1D in-situ stresses and gemechanical properties of natural fractures. The integration of all the results helps to identify the best perforation intervals for hydraulic fracturing operations and define landing points for planned horizontal wells.

RESULTS

The studied Dadaş-I interval is characterized and divided into four lithofacies (L1, L2, L3, and L4) by using lithological data from logs of the offset wells supported by the core data (porosity, permeability, saturation, pyrolysis, SEM and XRD data). Petrophysical properties of the highlighted lithofacies reveal that L1 (Lower Hotshale) and L3 (Upper Hotshale) have the highest amount of RCQ intervals and hence the highest potential. L4 (Cap Carbonate) has also reasonable properties, but the fraction of CQ intervals is a bit higher. However, hydrocarbon potential of the L2 (Lean Shale) is poor and not considered to be a good candidate for unconventional reservoir. In addition, petrographic analysis indicate Dadaş-I includes kerogen porosity and low amount of fracture porosity. Natural fracture characterization analysis show that fracture orientations are unique in facies L4, striking parallel to an E-W major faults group whereas the rest of fractures are striking NE-SW, parallel to the second group of fault in the area. As the E-W faults are known to be created first, L4 facies seems to be naturally fractured before the rest of facies. The geomechanics parameters calculated for each facies shows that L4 present higher elastic parameter, higher brittleness but also higher strength properties. Since Dadaş Formation has experienced high deformation during the tectonic history of the region, L4 formation could have concentrate more stress due to their higher elastic properties and hence fractured before of the rest of facies. The process of fracturing is also promoted by a higher brittleness. However, further analysis of major controlling parameters of fracture intensity reveal that there is no distinctive correlation with lithological variation such as total clay content, brittle index, total organic carbon, and reservoir properties such as porosity. Moreover, detailed core analysis revealed that some of the fractures characterized as open fractures may be misinterpreted due to limitation in WBI analysis. Geomechanical approach indicates the critically stress fractures that are more prone to impact on production

have higher intensity in L3 and L4 reservoir properties which are also favorable as reservoirs.

CONCLUSİON

For the first time in Dadaş field an integrated workflow for the wellbore data analysis is created. This workflow is focused on the identification of the most producible intervals before fracking operations. It combines variaty of data from core analysis to petrophysical interpretation together with natural fractures characterization and geomechanics modeling. It is worth to mention, that this approach has proven to work better in Dadaş formations based on the recent production results.

Keywords:Reservoir evaluation, Natural Fractures

Fig.1: Example of petrophysical interpretation in Dadaş-I member.