Identification and Ranking of Smackover Formation Reservoirs in Little Cedar Creek, Brooklyn and Fishpond Fields, Based on Their Core's Derived API Gravity

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Abstract

The HAWK instrument's Petroleum Assessment Method (HAWK-PAM) coupled with Total Organic Carbon (TOC) determination, was used to analyze cores of the Smackover Formation in the Little Cedar Creek, Brooklyn and Fishpond Fields of the Conecuh sub-basin, Alabama, USA. The objective was identification and ranking of Smackover Formation reservoirs based on their core's derived API gravity. The 5 wells from which 246 core samples were analyzed are the Pugh 22-2; Little Cedar Creek Field (26 samples in a 92ft depth interval); the Amos 36-3; Brooklyn Field (5 samples in a 9ft depth interval); the Pate 33-11; Brooklyn Field (28 samples in a 74ft depth interval); the Hamiter 32-3; Brooklyn Field (82 samples in a 298ft depth interval); and the CCLT 10-5; Fishpond Field (105 samples in a 2010ft depth interval). The Geological Survey of Alabama generously provided the cores. The samples were ground, then roughly 70mg of each, was analyzed using HAWK-PAM which is a pyrolysis method that utilizes helium as carrier gas while heating over a 50°-650°C range at a rate of 25°C thereby generating 5 petroleum peaks that correspond to 5 carbon # groupings; C4-C5, C6-C10, C11-C19, C20-C36 and C37+. The C37+ peak gives Tmax-maturity. After pyrolysis, air serves as carrier gas for measurement of CO and CO2 to a maximum temperature of 750°C. TOC is also determined. Using a derivation of the 5 petroleum peaks, API gravity was determined on cores whose sum of C4-C36 was equal to or greater than 2 mgHC/g rock.

Recoverable oil reserves were determined by restoring 80% of the C19- fraction to the C23- fraction. Core photos were taken together with the construction of sedimentological logs. Resistivity logs were also used in this study. Previous studies show that the produced Smackover oils are in 30°-55° API range. HAWK-PAM API gravity values were obtained from Smackover cores stored for over ten years, thus undergoing evaporative loss of light hydrocarbons. Previous HAWK-PAM API gravity analyses on Smackover cores stored over ten years after retrieval from producing oil intervals in Permit #'s 15496-B, 14181 and 13472 yielded 17°-22°, 18°-23° and 16° API respectively. The API gravity prediction values that are greater or equal to 15° are therefore deduced to represent produced oils whose API gravity is in 30°-55° range. On the basis of porosity and permeability ranking of reservoirs for the 15 lithofacies documented in previous Smackover literature, one would assign the 1st rank to the reef's microbial boundstone. 2nd in rank would be the shoal's oolitic grainstone. However, it is not possible to assign a unique reservoir ranking to any of the other documented 13 lithofacies because their respective porosity and permeability values occur in a wide range. In view of this limitation to the use of lithofacies description to rank reservoirs in the Smackover, this study postulates the use of API gravity values to identify and rank the reservoirs. This ranking has yielded 4 groups; API Gravity: > or = 17, 10-16, 5-9 and 0-4 with subsequent Smackover reservoir ranking of 1, 2, 3 and 4 respectively. Those ranked as 1st include the microbalite lithofacies. Those ranked as 2nd include oolitic grainstone lithofacies. The resistivity wireline log profiles correlate to the ratio of extractable to non-generative organic matter. It is therefore recommended that the application of API gravity ranking usage be considered in selecting the depth intervals for production perforations.

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