

Apr 20th, 11:00 AM - 2:00 PM

Laboratory Determination of Porosity for a Vugular Carbonate Core Section by Water Immersion Method - Is It Effective Porosity?

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Shula, Nolan, "Laboratory Determination of Porosity for a Vugular Carbonate Core Section by Water Immersion Method - Is It Effective Porosity?" (2016). *The Research and Scholarship Symposium*. 47.

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Laboratory Determination of Porosity for a Vugular Carbonate Core Section by Water Immersion Method - Is It Effective Porosity?

Porosity is one of the most vital characteristics in hydrocarbon reservoir evaluations, affecting the methods implemented in the completion process and the efficiency of the production process. Several methods are used for porosity calculations, but due to both lithologic and downhole drilling factors, these values can range more than $\pm 5\%$. Also, most limestone reservoirs contain multiple-porosity systems, which lead to effective porosity concerns, especially when secondary porosity is a significant factor. Therefore, through both geophysical wireline log analysis and basic laboratory analyses, this project compared total and effective porosity values of a vugular Onondaga Limestone pinnacle reef core section from Cattaraugus County, New York. For the geophysical method, a bulk density value was taken from a formation bulk density log; total porosity was then calculated both graphically using a cross plot and numerically. For the laboratory analyses, first the measured dry weight of the sample and the known grain density were used to calculate total porosity. Next, volumetric porosity analysis was completed by determining the total displacement of the core in a water bath (after prolonged immersion) subtracted from the total calculated volume of the core. The wireline log method provided total porosities of 10.8% to 13.0%, while the weight based total porosity calculation was 15.0% and the volumetric analysis provided an average value of 7.4%. It was found that the best method for determining total porosity involved the use of the dry weight and grain density values. Also, due to the nature of the vugular carbonate core, the volumetric analysis failed to determine the total porosity, but instead provided the effective porosity of the core. While this study produced calculated total porosity and laboratory-derived effective porosity values, a total porosity from a simple immersion test could not be determined with the laboratory tools at hand.