Porosity characterisation of the Silurian succession in Middle Lithuania: A comparative analysis

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Porosity variation within the Silurian succession of Middle Lithuania, a key stratigraphic unit in the Baltic region was studied. Understanding porosity distribution is crucial for various geological applications, including hydrocarbon exploration and carbon storage. We employed two established porosity estimation methods: (1) laboratory measurements from core samples and (2) acoustic-derived porosities obtained from well log data using advanced petrophysical techniques. We focused on six wells distributed across two distinct regions: Bliūdžiai and Lapgiriai.

Depthwise comparisons were conducted to evaluate the trends and variations in porosity between the two measurement methods. In the Bliūdžiai region, a weak correlation (R-squared=0.09) was observed between acoustic-derived and laboratory porosity measurements for well Bliūdžiai 151. The Bliūdžiai 152 well exhibited a moderate correlation (R-squared=0.23), while data limitations precluded analysis for the Bliūdžiai 156 well. Similarly, the Lapgiriai region displayed weak correlations in wells Lapgiriai 122 (R-squared=0.06) and Lapgiriai 124 (R-squared=0.09). However, the Lapgiriai 123 well showed a moderate correlation with a value of 0.20. Overall, our findings suggest a trend where laboratory porosity values tend to be higher than acoustic-derived porosity values, with laboratory measurements exhibiting greater fluctuations throughout the wellbore. Conversely, acoustic-derived porosity values demonstrate relative stability across the analysed intervals.

This work contributes significantly to our understanding of the correlation between acoustic-derived and laboratory porosity measurements in the Silurian succession of the Baltic region. The observed discrepancies between the two methods highlight the importance of incorporating both techniques in porosity assessments. Laboratory measurements provide highly accurate, point-specific data, while acoustic logs offer continuous porosity profiles throughout the wellbore. By combining these approaches, geologists gain a more comprehensive understanding of porosity distribution within a geological formation, enabling them to make informed decisions in various applications.

Furthermore, the utilisation of data science and machine learning techniques in analysing the R-squared correlations enhances the rigor and depth of our findings, facilitating a more comprehensive understanding of the complex interplay between porosity estimation methodologies.

Keywords: acoustic-derived porosity, laboratory porosity, correlation, R-squared, porosity measurements, Silurian succession.