A Convolutional Neural Network for Vuggy Facies Classification from Borehole Images

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Abstract

Identification of vuggy intervals and understanding their connectivity are critical for predicting carbonate reservoir performance. Although core samples and conventional well logs have been traditionally used to classify vuggy facies, their efficiency and performance were limited by either labor intensity or lack of resolution. With the recent evolution of GPU computing and development of Convolutional Neural Network (CNN) algorithms computer-based methods approach humans performance at multi-image classification and identification tasks. In this study, a supervised deep-learning CNN approach was used to identify vuggy facies. Borehole images were pre-processed and separated into a half-foot interval as input samples; this complete dataset was culled by removing poor-quality images to generate a cleaned dataset for comparison. Conventional well logs, core descriptions, and nuclear magnetic resonance T2 distributions were used to generate output facies labels. This new approach was tested on a well from the Arbuckle Formation in Kansas. Training, test, and validation datasets were split into an 80%/10%/10% ratio. After hyperparameter optimization, median accuracy for vuggy/non-vuggy facies classification was 0.847 for a cleaned dataset. This research illustrated the robustness of using microresistivity image logs in a deep-learning method to classify facies as either vuggy or non-vuggy.