4th International Congress on Earth and Geological Sciences

July 21-22, 2025 | Paris, France

Chengfei Luo[a,b*], Huan Wan[a], Shengli Gong[a], Tongyao Zhang[a], Turong Wu[a], Jinding Chen[a], Jungan Qin[a], Zhiqiang Shi [b]

[a]CNOOC EnerTech-Drilling & Production Co., Zhanjiang, 524057, China
[b]Chengdu University of Technology, Chengdu,610059, China

3D Permeability Estimation through Fluid-MLP Workflow Utilizing 2D Thin-Section Images

Using thin section images to estimate core permeability is an economical and less-time-consumed method for reservoir evaluation that many petroleum developers aspire to achieve. Although three-dimensional (3D) pore volumes have been successfully applied to train permeability models, it is very expensive to be carried out. In this regard, deriving permeability from two-dimensional (2D) images presents a novel approach that directly fits data on pore-throat characteristics ex-tracted from more cost-effective thin sections. This work proposed a fluid-MLP workflow for esti-mating 3D permeability models. We employed DIA technology combined with artificial lithology and pore classification to calculate up to 110 characteristic parameters of pore-throat structure on 2D rock casting thin sections. The MLP network was adopted to train the permeability prediction model, utilizing the 110 parameters as input. However, the accuracy of the conventional MLP network could reach only 90%. We proposed data preprocessing using fluid flow simulations to improve the training accuracy of the MLP network. The fluid flow simulations involve generating a pore network model based on the 2D pore size distribution, followed by employing the lattice Boltzmann method to estimate permeability. Subsequently, six key structural parameters, includ-ing permeability calculated by LBM, pore type, lithology, two-dimensional porosity, average pore-throat ratio, and average throat diameter, were fed into the MLP network for training to form a new Fluid-MLP workflow. Comparing the predicted results of this new fluid-MLP workflow with the original MLP network, we found that the fluid-MLP network exhibited superior predictive performance.

Keywords: Pore network model, Lattice Boltzmann, Fluid simulation, Pore throat characteristics, MLP network

ISBN: 978-1-917892-13-1

doi.org/10.51219/URForum.2025.Chengfei-Luo