

SARI

Formasi Kais merupakan reservoir karbonat utama pada Cekungan Salawati yang memiliki tingkat heterogenitas tinggi akibat proses diagenesis. Sebagai lapangan tua, Lapangan 'A' menghadapi kendala berupa keterbatasan data *wireline log*, sehingga analisis petrofisika konvensional secara deterministik menjadi terbatas untuk sejumlah parameter. Penelitian ini bertujuan untuk mengetahui kinerja *machine learning* (ML) dalam mengestimasi parameter petrofisika pada kondisi keterbatasan data log, serta menentukan letak *pay zone* pada Formasi Kais berdasarkan penerapan *cut-off*. Data penelitian meliputi log resistivitas hasil digitasi, data *core* (RCAL), data laporan sumur (DST dan *water analysis*), serta data petrografi dan SEM dari sumur pendukung di Lapangan 'B'. Analisis litologi dan diagenesis pada batuan inti dilakukan sebagai *geological judgement* untuk mengevaluasi kewajaran hasil estimasi petrofisika. Estimasi porositas dilakukan menggunakan kelima algoritma ML karena tidak tersedianya log densitas-neutron sebagai metode deterministik pembandingan, sementara *rock typing* ditentukan berbasis FZI pada sumur berdata *core* dan dipropagasikan ke sumur tanpa *core* menggunakan ML. Estimasi permeabilitas dan saturasi air masing-masing dibandingkan antara pendekatan ML dan metode deterministik. Berdasarkan hasil penelitian, kinerja ML dinilai dipengaruhi oleh jumlah data *core* yang tersedia, baik dalam membatasi kemampuan model membentuk solusi pengelompokan yang lebih variatif saat pelatihan, maupun dalam menurunkan keterwakilan nilai koefisien korelasi (CC) pada tahap validasi akibat titik data uji yang sangat terbatas. Berdasarkan penerapan *cut-off* ($PHIE \geq 0.1$ v/v, $k \geq 5.2$ mD, $S_w \leq 0.73$ v/v), *pay zone* pada Formasi Kais hanya teridentifikasi pada Sumur A-001 dengan ketebalan *net pay* 131.98 m dari total *gross* 250.7 m.

Kata kunci: Formasi Kais, Lapangan 'A', *machine learning*, karakterisasi reservoir, petrofisika

ABSTRACT

The Kais Formation is the main carbonate reservoir in the Salawati Basin, characterized by high heterogeneity resulting from diagenetic processes. As a mature field, Field 'A' faces challenges related to limited wireline log data, which restricts conventional deterministic petrophysical analysis for several parameters. This study aims to evaluate the performance of machine learning (ML) in estimating petrophysical parameters under limited log data conditions, as well as to determine the location of the pay zone in the Kais Formation based on cut-off application. The research data comprise digitized resistivity logs, core data (RCAL), well report data (DST and water analysis), and petrographic and SEM data from a supporting well in Field 'B'. Lithofacies and diagenesis analysis on core samples was conducted as geological judgement to evaluate the reasonableness of the petrophysical estimation results. Porosity estimation was performed using five ML algorithms due to the unavailability of density-neutron logs as a deterministic comparison method, while rock typing was determined based on the Flow Zone Indicator (FZI) in cored wells and propagated to uncored wells using ML. Permeability and water saturation estimations were each compared between ML and deterministic approaches. Based on the research results, ML performance is considered to be influenced by the amount of available core data, both in limiting the model's ability to form more varied clustering solutions during training, and in reducing the representativeness of the correlation coefficient (CC) during validation due to the very limited number of test data points. Based on the applied cut-off ($PHIE \geq 0.1$ v/v, $k \geq 5.2$ mD, $S_w \leq 0.73$ v/v), the pay zone in the Kais Formation was only identified in Well A-001, with a net pay thickness of 131.98 m out of a total gross thickness of 250.7 m.

Keywords: Kais Formation, Field 'A', machine learning, reservoir characterization, petrophysics