

ABSTRAK

ANALISIS INVERSI *ACOUSTIC IMPEDANCE* (AI) DAN MULTIATRIBUT *PROBABILISTIC NEURAL NETWORK* (PNN) UNTUK KARAKTERISASI RESERVOIR PADA LAPANGAN “*ULTRAMAN*”

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Lapangan “*Ultraman*” merupakan salah satu lapangan gas di Cekungan Jawa Timur yang memiliki reservoir utama pada *Globigerina Limestone* di Formasi Mundu dan Paciran. Penelitian ini bertujuan untuk mengidentifikasi persebaran litologi, porositas, dan fluida hidrokarbon dalam reservoir menggunakan pendekatan inversi *Acoustic Impedance* (AI) berbasis model dan prediksi multiatribut berbasis *Probabilistic Neural Network* (PNN). Data yang digunakan meliputi seismik 3D hasil *Post-Stack Time Migration* (PSTM) dan empat data sumur. Interpretasi seismik mengungkap keberadaan antiklin asimetris berorientasi barat–timur yang dipotong oleh sesar normal, dengan zona puncaknya diduga sebagai lokasi akumulasi gas biogenik.

Hasil inversi AI dan prediksi PNN berhasil memetakan distribusi properti bawah permukaan, yaitu AI, *volume clay* (VCL), dan porositas efektif (PHIE), secara spasial. Distribusi VCL menunjukkan dominasi *Globigerina Limestone* berpori pada interval T60U dan *Globigerina Limestone* padat (*tight*) pada T60L, sementara interval T65 didominasi oleh *shale* pelagik yang berfungsi sebagai segel regional. Zona prospek pada T60U ditandai dengan nilai AI 3000–4000 g.m/cm³.s, VCL 0–15%, PHIE 0.38–0.50 ft³/ft³, serta saturasi air (SW) 0–0.2, menunjukkan indikasi kuat kehadiran gas biogenik di kedua puncak antiklin. Adapun interval T60L memperlihatkan indikasi gas hanya di antiklin barat, dengan nilai AI 4000–5000 g.m/cm³.s, VCL 0–5%, dan PHIE 0.4–0.45 ft³/ft³. Integrasi seluruh metode ini menunjukkan efektivitas kombinasi inversi dan PNN dalam karakterisasi reservoir karbonat di lingkungan geologi kompleks.

Kata kunci: Batugamping *Globigerina*, Gas Biogenik, Inversi AI, Multiatribut PNN

ABSTRACT

ANALYSIS OF ACOUSTIC IMPEDANCE (AI) INVERSION AND PROBABILISTIC NEURAL NETWORK (PNN) BASED MULTI- ATTRIBUTE APPROACH FOR RESERVOIR CHARACTERIZATION IN THE “ULTRAMAN” FIELD

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The “Ultraman” Field is one of the gas-bearing fields located in the East Java Basin, with its main reservoirs found in the Globigerina Limestone of the Mundu and Paciran Sequences. This study aims to identify the distribution of lithology, porosity, and hydrocarbon presence in the Globigerina limestone reservoir using model-based Acoustic Impedance (AI) inversion and multi-attribute Probabilistic Neural Network (PNN) prediction. The data used includes 3D marine seismic data processed with Post-Stack Time Migration (PSTM) and four well logs. Seismic interpretation reveals an asymmetrical anticline structure trending west–east, cut by several normal faults, where the crest zones are interpreted as the main biogenic gas accumulation sites.

The AI inversion and PNN multi-attribute predictions successfully provided spatial estimations of subsurface physical properties such as AI, VCL (volume of clay), and PHIE (effective porosity). Lithological distribution from the VCL model indicates a dominance of porous Globigerina Limestone in the upper reservoir zone (T60U) and tight limestone in the lower zone (T60L), while thick pelagic shale in the T65 interval acts as an effective regional seal. The prospect zone in T60U is characterized by AI values from 3000 to 4000 g.m/cm³.s, VCL between 0 and 15%, PHIE starting from 0.38 to 0.50 ft³/ft³, and SW between 0 and 0.2, indicating biogenic gas presence at both anticline crests. In contrast, T60L shows gas indication only in the western anticline with AI values from 4000 to 5000 g.m/cm³.s, VCL less than 5%, and PHIE between 0.4 and 0.45 ft³/ft³. The integration of AI inversion and PNN modeling demonstrates high effectiveness in reservoir characterization within a structurally complex carbonate setting.

Keywords: Globigerina Limestone, Biogenic Gas, AI Inversion, Multiattribute PNN