

ABSTRACT

IDENTIFICATION OF HYDROCARBON PROSPECT ZONES USING MULTI-ATTRIBUTE LOW FREQUENCY PASSIVE SEISMIC IN THE “DE” FIELD KUTAI BASIN AREA

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The Low Frequency Passive Seismic (LFPS) method is widely used in oil and gas exploration because it is relatively economical and environmentally friendly. This method is capable of detecting low-frequency anomalies within the 1–4 Hz range associated with hydrocarbon reservoirs. The study was conducted in the DE Field, South Sanggata, East Kalimantan (Kutai Basin), to identify prospective zones in a mature field experiencing production decline. The data were acquired from 62 measurement points with an average recording duration of 110 minutes.

The methods used include spectral and polarization attributes consisting of PSD-Z, PSD-IZ, dominant frequency, V/H ratio (VHSR), dip, and rectilinearity. In the data processing stage, the Short Term Average/Long Term Average (STA/LTA) windowing method was applied to select stable LFPS signals and reduce noise effects in the recorded data. The cut-off values for each attribute were determined through calibration with reference wells using minimum–maximum ranges, namely VHSR 0.81–1.45, peak frequency 2.52–3.36 Hz, PSD-Z 66.58–90.92 dB, PSD-IZ 184.92–239.38 dB, dip 54.99–88.99°, and rectilinearity 0.34–0.80. Furthermore, multi-attribute integration was carried out using a scoring method based on the conformity of attribute values to the cut-off ranges to identify anomaly consistency within the study area.

The results show high multi-attribute values in the western, southern, and eastern parts of the study area, indicating hydrocarbon potential. The main prospective zone is located around point DE-17 and is supported by the presence of WELL-01 in the eastern area. In addition, other potential areas are located around DE-05, DE-06, DE-12, DE-19, DE-27, DE-33, DE-49, DE-50, DE-57, and DE-58. These areas are recommended as priority targets for field development and proposed drilling activities.

Keywords: *Kutai Basin, dip, hydrocarbon, LFPS, microtremor, multi-attribute, PSD-IZ, PSD-Z, rectilinearity, VHSR*

ABSTRAK

IDENTIFIKASI ZONA PROSPEK HIDROKARBON MENGUNAKAN *MULTI ATTRIBUTES LOW FREQUENCY PASSIVE SEISMIC* DI LAPANGAN “DE” AREA CEKUNGAN KUTAI

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Metode Low Frequency Passive Seismic (LFPS) banyak digunakan dalam eksplorasi minyak dan gas karena relatif ekonomis dan ramah lingkungan. Metode ini mampu mendeteksi anomali frekuensi rendah pada rentang 1–4 Hz yang berkaitan dengan keberadaan reservoir hidrokarbon. Penelitian dilakukan di Lapangan DE, Sanggata Selatan, Kalimantan Timur (Cekungan Kutai), untuk mengidentifikasi zona prospek pada lapangan tua yang mengalami penurunan produksi. Data penelitian diperoleh dari 62 titik pengukuran dengan durasi perekaman rata-rata 110 menit.

Metode yang digunakan meliputi atribut spektrum dan polarisasi dengan atribut PSD-Z, PSD-IZ, frekuensi dominan, rasio V/H (VHSR), dip, dan rectilinearity. Pada tahap pengolahan data, metode *windowing* yang digunakan yakni *Short Term Average/Long Term Average* (STA/LTA) untuk menyeleksi sinyal LFPS yang stabil dan mengurangi pengaruh noise pada data rekaman. Nilai cut-off setiap atribut ditentukan melalui proses kalibrasi terhadap sumur acuan menggunakan rentang minimum–maksimum, yaitu VHSR 0,81–1,45, frekuensi puncak 2,52–3,36 Hz, PSD-Z 66,58–90,92 dB, PSD-IZ 184,92–239,38 dB, dip 54,99–88,99°, dan rectilinearity 0,34–0,80. Selanjutnya dilakukan integrasi multiatribut menggunakan metode *scoring* berdasarkan kesesuaian nilai atribut terhadap rentang *cut-off* untuk mengetahui konsistensi anomali pada area penelitian.

Hasil penelitian menunjukkan tingginya nilai multiatribut pada bagian barat, selatan, dan timur area penelitian yang mengindikasikan potensi hidrokarbon. Zona prospek utama berada di sekitar titik DE-17 dan diperkuat oleh keberadaan sumur WELL-01 di bagian timur. Selain itu, area potensial lainnya berada di sekitar DE-05, DE-06, DE-12, DE-19, DE-27, DE-33, DE-49, DE-50, DE-57, dan DE-58. Area-area tersebut direkomendasikan sebagai prioritas pengembangan dan pengeboran sumur usulan.

Kata kunci: Cekungan Kutai, dip, hidrokarbon, LFPS, mikrotremor, multiatribut, PSD-IZ, PSD-Z, rectilinearity, VHSR