INTISARI

Penerapan Metode *Water Saturation Gradient* (*SWGRAD*) dalam Analisis Log Sumur untuk Identifikasi dan Rekomendasi Zona Perforasi Reservoir Gas di Lapangan Poseidon, Cekungan Browse, Australia Barat

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Peningkatan kebutuhan energi global menegaskan pentingnya kegiatan eksplorasi minyak dan gas bumi yang efisien dan berkelanjutan. Cekungan Browse di lepas pantai barat laut Australia merupakan salah satu wilayah dengan potensi hidrokarbon signifikan, namun interpretasi fluida reservoir di dalamnya, khususnya pada Lapangan Poseidon, menghadapi tantangan akibat variasi salinitas air formasi yang kompleks. Kondisi ini menimbulkan ketidakpastian dalam estimasi saturasi air menggunakan metode empiris konvensional yang bersifat statis. Penelitian ini menerapkan metode Gradient Saturasi Air (SWGRAD) sebagai pendekatan kuantitatif sebagai alternatif dalam identifikasi zona hidrokarbon pada kondisi salinitas yang bervariasi. Data yang digunakan meliputi log sumur dari lima sumur di Lapangan Poseidon (Torosa-1, Kronos-1, Boreas-1, Poseidon-1, dan Poseidon-2). Tahapan penelitian mencakup perhitungan parameter petrofisika dasar, yaitu kandungan serpih dari log Gamma Ray dan porositas dari kombinasi log neutron–densitas. Hasil analisis menunjukkan karakter reservoir yang heterogen dengan nilai kandungan serpih berkisar antara 27–78% dan porositas efektif 2–9%. Nilai saturasi air dihitung menggunakan Persamaan Archie dengan variasi salinitas 1–25 kppm, kemudian diturunkan gradien perubahannya untuk memperoleh nilai SWGRAD. Penentuan nilai ambang batas SWGRAD dilakukan melalui kalibrasi terhadap hasil uji sumur guna mengidentifikasi zona hidrokarbon. Hasil penelitian menunjukkan bahwa metode SWGRAD efektif dalam mengidentifikasi zona gas secara konsisten dengan data uji lapangan. Nilai ambang batas optimum bervariasi antar sumur, dengan zona di bawah ambang batas ini terkonfirmasi sebagai zona gas. Berdasarkan integrasi hasil analisis petrofisika dan SWGRAD, direkomendasikan interval prospektif baru pada Sumur Poseidon-1 (4977–5097 m) pada Formasi Plover sebagai zona gas utama. Secara keseluruhan, penelitian ini menunjukkan bahwa metode SWGRAD mampu mengidentifikasi kecenderungan zona berpotensi hidrokarbon melalui respon saturasi air terhadap dengan kondisi salinitas air formasi yang kompleks serta memberikan dasar ilmiah yang kuat untuk rekomendasi pengembangan lapangan secara lebih efektif.

Kata kunci: *Water Saturation Gradient* (*SWGRAD*), Log Sumur, Petrofisika, Zona Reservoir Gas, Lapangan Poseidon.

ABSTRACT

Application of the Water Saturation Gradient (SWGRAD) Method in Well Log Analysis for Gas Reservoir Identification and Perforation Zone Recommendation in the Poseidon Field, Browse Basin, Western Australia

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The increasing global energy demand highlights the importance of efficient and sustainable oil and gas exploration activities. The Browse Basin, located offshore northwestern Australia, is one of the regions with significant hydrocarbon potential. However, fluid interpretation within its reservoirs particularly in the Poseidon Field—faces challenges due to complex variations in formation water salinity. This condition introduces uncertainties in estimating water saturation using conventional static empirical methods. This study applies the Water Saturation Gradient (SWGRAD) method as a quantitative alternative approach for hydrocarbon zone identification under variable salinity conditions. The data used in this study consist of well logs from five wells in the Poseidon Field (Torosa-1, Kronos-1, Boreas-1, Poseidon-1, and Poseidon-2). The research stages include the calculation of basic petrophysical parameters, namely shale content derived from Gamma Ray logs and porosity derived from the combination of neutron–density logs. The results indicate that the reservoir exhibits heterogeneous characteristics, with shale content ranging from 27–78% and effective porosity values between 2–9%. Water saturation was calculated using the Archie equation with salinity variations of 1–25 kppm, and its gradient changes were determined to obtain SWGRAD values. The SWGRAD cutoff value was established through calibration with well test results to identify hydrocarbon-bearing zones. The results demonstrate that the SWGRAD method is effective in identifying gas zones consistently with well test data. The optimum cutoff values vary among wells, with zones below these thresholds confirmed as gas-bearing intervals. Based on the integration of petrophysical analysis and SWGRAD results, a new prospective interval is recommended in Poseidon-1 well (4977–5097 m) within the Plover Formation as the main gas zone. Overall, this study demonstrates that the SWGRAD method is capable of identifying the tendency of hydrocarbon-bearing zones by analyzing the response of water saturation to complex formation-water salinity conditions, thereby providing a scientific basis to support more effective field development recommendation.

Keywords: *Water Saturation Gradient (SWGRAD), Well Log, Petrophysics, Gas Reservoir Zone, Poseidon Field.*