

ABSTRAK

ANALISIS DISTRIBUSI SPASIAL *B-VALUE* DAN *A-VALUE* KEGEMPAAN DANGKAL DI BAGIAN TIMUR SESAR OPAK TAHUN 2025

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Daerah Istimewa Yogyakarta memiliki aktivitas seismik tinggi akibat posisinya di dekat zona tumbukan lempeng dan pengaruh struktur geologi lokal, khususnya Sesar Opak. Penelitian ini bertujuan memetakan distribusi spasial *b-value* dan *a-value* gempa dangkal di bagian timur Sesar Opak, menganalisis aktivitas seismik dan kerapuhan batuan, serta menghitung periode ulang gempa bumi tahun 2025.

Data yang digunakan berupa 608 katalog gempa dangkal (≤ 30 km) tahun 2025 dari Stasiun Geofisika BMKG Sleman, dengan magnitudo 0,5–3,5 Mw. Magnitude of Completeness (M_c) ditentukan menggunakan metode *Maximum Curvature* (MAXC), *b-value* dihitung dengan metode *Maximum Likelihood*, dan *a-value* dihitung dari turunan persamaan Gutenberg-Richter. Analisis spasial dilakukan pada radius 2 km dan diperkuat dengan data geologi dari penelitian terdahulu.

Hasil penelitian menunjukkan M_c sebesar 1,85 Mw, *b-value* rata-rata 1.54 ± 0.08 , dan *a-value* rata-rata 5.93. *B-value* 0.8–2.9 dan didominasi nilai menengah, yang menunjukkan dominasi gempa bermagnitudo kecil. Bagian utara memperlihatkan *b-value* menengah hingga rendah yang mengindikasikan akumulasi tegangan batuan relatif lebih tinggi dibandingkan wilayah sekitarnya. Distribusi *a-value* 2,75–7,25 dan menunjukkan aktivitas seismik menengah hingga tinggi. Hasil penelitian menunjukkan bahwa variasi *b-value* dan *a-value* mampu menggambarkan karakteristik seismotektonik bagian timur Sesar Opak.

Kata kunci : *a-value*, *b-value*, distribusi spasial, Gutenberg-Richter, sesar opak.

ABSTRACT

SPATIAL DISTRIBUTION ANALYSIS OF B-VALUE AND A-VALUE OF SHALLOW EARTHQUAKES IN THE EASTERN PART OF THE OPAK FAULT IN 2025

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The Special Region of Yogyakarta has high seismic activity due to its proximity to a plate collision zone and the influence of local geological structures, particularly the Opak Fault. This study aims to map the spatial distribution of b-value and a-value of shallow earthquakes in the eastern part of the Opak Fault, analyze seismic activity and rock brittleness, and calculate earthquake return periods in 2025.

The data used consists of 608 shallow earthquake catalogs (≤ 30 km depth) from 2025 recorded by the BMKG Sleman Geophysics Station, with magnitudes ranging from 0.5 to 3.5 Mw. The Magnitude of Completeness (M_c) was determined using the Maximum Curvature (MAXC) method, b-value was calculated using the Maximum Likelihood method, and a-value was derived from the Gutenberg-Richter equation. Spatial analysis was performed within a 2 km radius and validated through geological map overlay.

Results show an M_c of 1.85 Mw, a mean b-value of 1.54 ± 0.08 , and a mean a-value of 5.93. b-values 0.8–2.9 and is dominated by moderate values, indicating the predominance of small-magnitude earthquakes. The northern zone exhibits moderate to low b-values, suggesting relatively higher rock stress accumulation than surrounding areas. The a-value distribution ranges from 2.75–7.25 and reflects moderate to high seismic activity. These findings demonstrate that the spatial distributions of b-value and a-value effectively characterize the seismotectonic conditions of the eastern Opak Fault.

Keywords : a-value, b-value, Gutenberg-Richter, opak fault, spatial distribution.