

# **Imaging Fault Structure Beneath the Yogyakarta Basin with Terrestrial Gravity: Multi-Attribute Edge Detection and Seismicity Constraints**

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The 2006 Yogyakarta earthquake (Mw ~6.4), which caused more than 5,700 fatalities, highlighted the seismic significance of the densely populated, sediment-covered Yogyakarta Basin in south-central Java. Although the Mataram Fault is included in the national earthquake-source model (PuSGeN 2024), its subsurface expression and relationship to other structures within the basin remain unresolved. We investigate the basin's structural architecture using newly acquired terrestrial gravity observations from 180 stations, integrated with relocated aftershock hypocenters and an updated regional seismicity catalog. The gravity data were reduced to a terrain-corrected complete Bouguer anomaly, and the residual field was separated from the regional component using upward continuation, with the continuation height selected from the radially averaged power spectrum. Structural boundaries were identified using four complementary edge-detection attributes, namely tilt angle of the horizontal gradient (TAHG), improved total horizontal derivative (ITDX), enhanced horizontal gradient amplitude (EHGA), and fast sigmoid-based edge detection (FSED). The attributes were evaluated across multiple analysis scales, and lineaments persisting across attributes and scales were treated as robust indicators of density boundaries. Several persistent boundaries coincide with mapped segments of the Mataram Fault, while additional coherent lineaments extend beyond the current fault map and are interpreted as candidate buried structures. A depth-weighted 3D density inversion, cross-checked against independent seismic tomography, constrains the depth and geometry of these boundaries. Seismicity clusters within zones of high lineament density, with the clearest correspondence observed in the Ngalang/Oyo sector. Multi-attribute, multi-scale gravity analysis thus reveals structural boundaries beneath thick sediment cover and provides independent constraints on mapped faults and candidate buried structures in the Yogyakarta Basin.