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RESEARCH ARTICLE

# The origin and evolution of the Menui Basin, part of the Matarombeo Terrain, Southeastern Arm of Sulawesi, Based on Geological and Geophysical Data

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**Abstract.** Menui Sub-basin is a part of Matarombeo terrain, located in south-east arm of Sulawesi Island – Indonesia. Matarombeo terrain geologically is bounded by Matano Fault, Lawanopo Fault, and Tolo Trust. Different from western part of Matarombeo Terrain that consist of Mountain, Menui Sub-basin is located at eastern part of Matarombeo Terrain, covered by sea water of Tolo Bay. The aim of this research is to interpreted basin formation and evolution of Menui Sub-basin, based on geomorphological and geological observation, further than stratigraphic and structural analysis. Research method included IFSAR image interpretation, geological field observation, and laboratory analysis such as petrography, paleontology, structural geology and sub surface analysis. Geologic and structural geology data were collected from surface mapping in land of Matarombeo, but sub-surface interpretation beneath Tolo bay were taken from gravity and seismic data. Stratigraphically, study area consist of Cretaceous – Oligocene ophiolite series which thrusted above Mesozoic sedimentary rocks from the continental crust origin. Unconformably above those two rock groups deposited molasse group on Miocene. The study area has been affected by three different tectonic stress phases. Formation and evolution of Menui Sub-Basin is characterized by several distinct events. The events begin from its history as part of Australia (pre-rifting sequence), the detachment from Australia (syn-rifting sequence), movement to its present location (syn-drifting sequence) and during and after the collision with SE Sulawesi (syn-orogen and post-orogen sequences).



## 1. Introduction

Eastern Indonesia represents one of the most structurally intricate regions within the global tectonic system, shaped by the long-term interaction of the Australian, Eurasian, and Pacific–Philippine Sea plates (Hamilton, 1979; Hutchison, 1989; Hall, 2012). The region's geological architecture reflects a protracted history of subduction initiation, arc–continent collision, microcontinental accretion, and strike-slip fragmentation, producing a highly heterogeneous crustal framework that continues to evolve through active deformation (Ali & Hall, 1995). Within this broader tectonic mosaic, Sulawesi occupies a particularly complex position: its present configuration is a composite of ophiolitic fragments, metamorphic cores, volcanic arcs, and continental blocks assembled during successive Neogene convergence and transcurrent motions (Hall, 2012; Surono, 2013).

The Matarombeo area is located in the southeast of Sulawesi, Indonesia. The southeast arm of Sulawesi geologically is a part of the Continental Terrain geologic province, which originated in Australia-New Guinea during the Cenozoic era. It is bordered to the northeast by the Eastern Sulawesi Ophiolit Belt, to the southeast by the Buton Terrain, to the east by the Tolo Trench, and to the north by the Banggai Sula microcontinent (Surono et al., 2013; Serhalawan & Chen, 2024). Matano Fault, Lawanopo Fault, and Tolo Trust encircle the Matarombeo region (Figure 1). This intricacy highlights the necessity of an integrated strategy that integrates stratigraphic analysis, field geology, and geophysical interpretation to improve the region's geodynamic history.

The Menui Sub-basin is located on the southeast edge of the Matarombeo Terrain, which is characterized by the interaction of intricate structural, stratigraphic, and tectonic aspects that define the larger Southeast Arm of Sulawesi (Surono, 2013). The Tampakura and Eemoiko carbonate formations are found across the basin and have reservoir-quality features such favorable porosity and internal layering, according to geological observations and seismic data (Samodra et al., 2018). These units seem to have formed in reaction to the raised Matarombeo block's structural highs and active faulting. According to complementary gravity data, the Southeast Arm's structural segmentation and tectonic inheritance are reflected in the region's heterogeneous crust, which is made up of varying thick crustal chunks delimited by large faults (Triani et al., 2021; Mirnanda et al., 2023). Despite significant regional reconstructions (Hall, 2012), the Menui Sub-basin still lacks an integrated tectonostratigraphic model that combines stratigraphy, structural geology, and geophysical interpretation. Therefore, the purpose of this study is to describe the lithostratigraphic framework, outline the structural architecture, and recreate the tectonic evolution of the basin. A crucial context for comprehending the basin's development is provided by the region's larger configuration, which consists of uplifted mountains in the northwest and a subsiding marine depocenter in the southeast under the control of significant structures like the Matano and Lawanopo faults .

## 2. Materials and Methods

This research combines various geological and geophysical datasets to reconstruct the formation and development of the Menui Sub-basin. Geological field data includes measurements of stratigraphic sections, descriptions of lithofacies, structural mapping, and orientation data (such as bedding, fault planes, and shear indicators) gathered from specific exposures in the Southeast Arm of Sulawesi. These outcrops, mainly located in the Matarombeo Mountains and coastal areas of Menui Island, offer direct insights into lithostratigraphy, deformation styles, and tectonic history.

The classification of lithostratigraphy adheres to established methods for sedimentary basin analysis, integrating macroscopic lithology, sedimentary structures, bed contacts, and facies associations. Facies analysis is performed

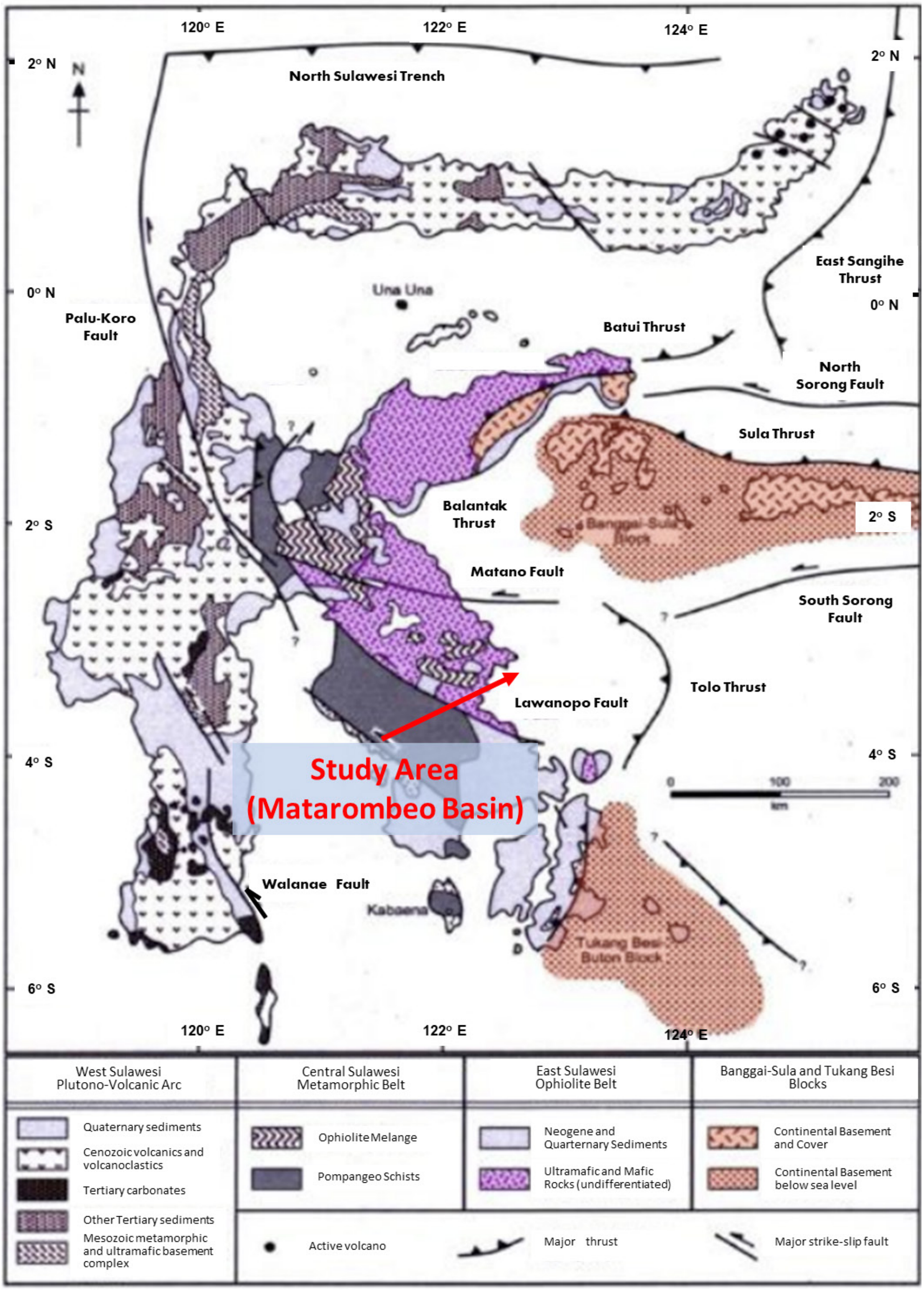


Figure 1. Location of the study (Matarombeo Terrain) in geological province of Sulawesi and adjacent Islands Map (Moss and Wilson, 1998). The Menui Sub-basin is located on the southeast edge of the Matarombeo Terrain where geologically bounded by Matano Fault, Lawanopo Fault, and Tolo Trust.

through a process-based interpretation, categorizing facies into depositional environments like deep-marine turbidites, shallow-marine carbonates, or syn-tectonic siliciclastics.

Structural analysis encompasses field structural measurements, geological maps (Surono, 2013), and interpretations derived from remote sensing. Kinematic indicators, including slickenlines, drag folds, fault gouge fabrics, and fractured zones, are utilized to deduce stress regimes and the history of fault movements. Balanced and restored cross-sections are created along representative geological transects to assess structural styles and the chronology of deformation.

Fault kinematics are examined through stereonet-based stress inversion, which includes principal stress orientation and fault-slip indicators, facilitating the identification of extensional, compressional, or strike-slip phases pertinent to basin formation.

The geophysical dataset comprises gravity data, 2D seismic reflection profiles, and SRTM DEM that traverse the Menui Sub-basin. A remote sensing method was employed to obtain preliminary geological information about the region. The analysis of IFSAR imagery data, supplemented by secondary data and ground verification, culminated in the geological map of the study area (Figure 2). Subsurface interpretations beneath the Menui Sub-basin were derived from gravity and seismic data. This information, combined with literature reviews from previous researchers, contributed to the development of a model for the formation and evolution of the Menui Sub-basin.

Seismic interpretation adheres to a systematic workflow utilizing industry-standard software. Initially, seismic profiles undergo preconditioning through the application of basic filters and checks for velocity consistency. Horizon picking is executed by analyzing reflection terminations, amplitude patterns, and seismic facies boundaries. Fault mapping employs vertical and lateral discontinuities, reflector offsets, and coherence attributes to identify normal, reverse, and strike-slip faults.

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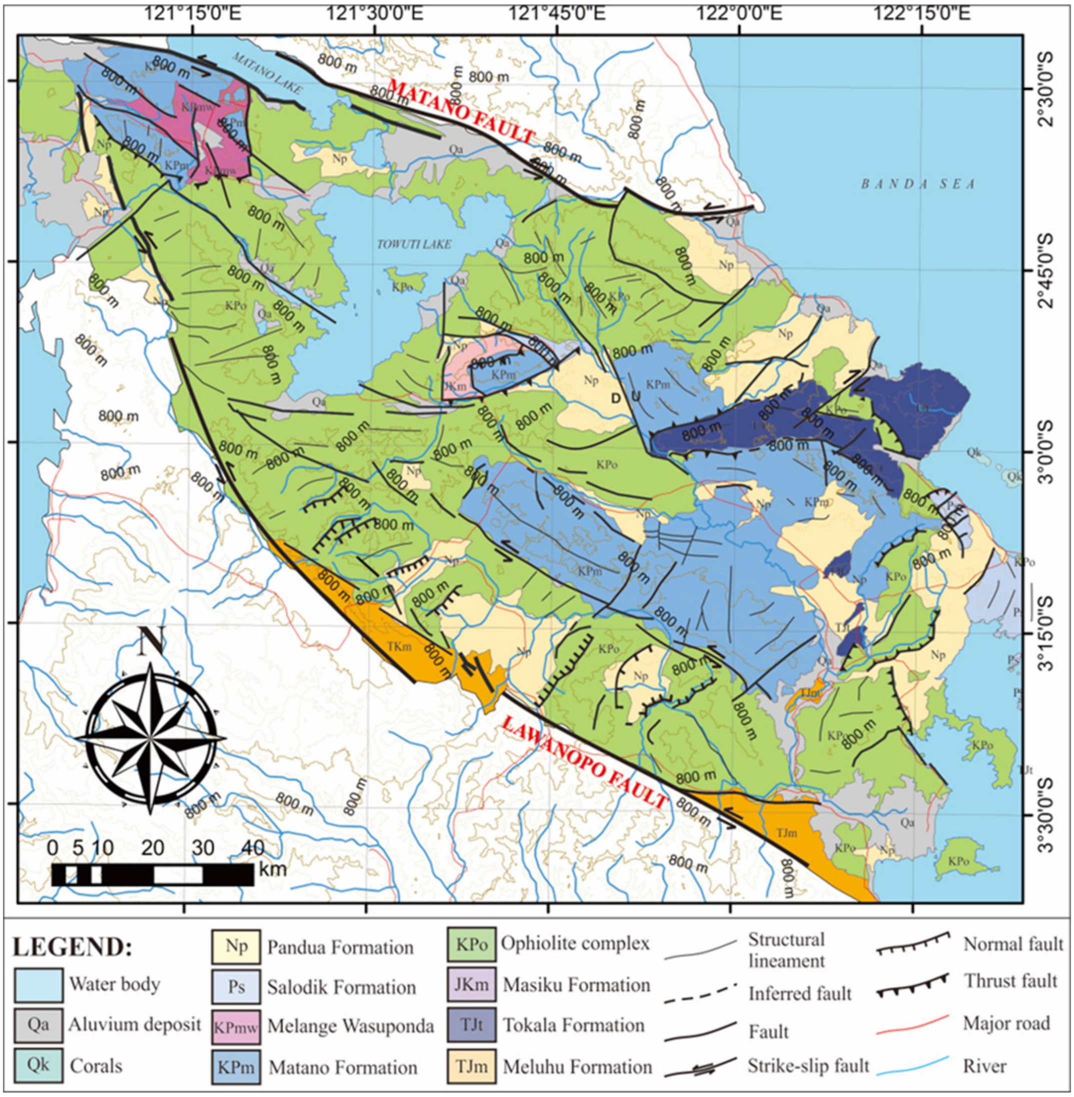

Figure 2. Geological map of the Matarombeo Basin, Southeastern Arm of Sulawesi. The map highlights contrasting lithostratigraphic domains, including ophiolitic complexes, sedimentary formations (Pandua, Tampakura, Tokala, Masiku, and Wasuponda), mélange zones, and alluvial deposits.

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Seismic facies analysis employs reflection geometry, amplitude, continuity, and frequency content to infer depositional processes, following the classical framework of Mitchum et. al. (1977). Key stratigraphic sequences are correlated to regional formations such as the Basement, Tampakura, and Eemoiko, based on reflector character and well-seismic tie processed.

Gravity datasets are processed using upward continuation and 2D forward modelling. These geophysical models help constrain basement depth, crustal heterogeneity, and major fault boundaries not fully resolved in seismic lines.

Reconstruction of the tectonostratigraphic evolution of the Menui Sub-basin employs qualitative and semi-quantitative basin modelling techniques. Stratigraphic sequences are arranged chronologically based on field data, seismic interpretation, and regional geological frameworks (Hall, 2012; Wilson & Moss, 1999). Basin-forming mechanisms are identified using diagnostic criteria including subsidence patterns, sedimentary facies shifts, and syn-tectonic thickening.

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## 3. Result and Discussion

### 3.1. Geological and Lithofacies Characteristics

The Matarombeo Terrain exhibits a significant contrast between its northwestern and southeastern areas (Figure 3). The northwestern part is defined by the rugged Matarombeo

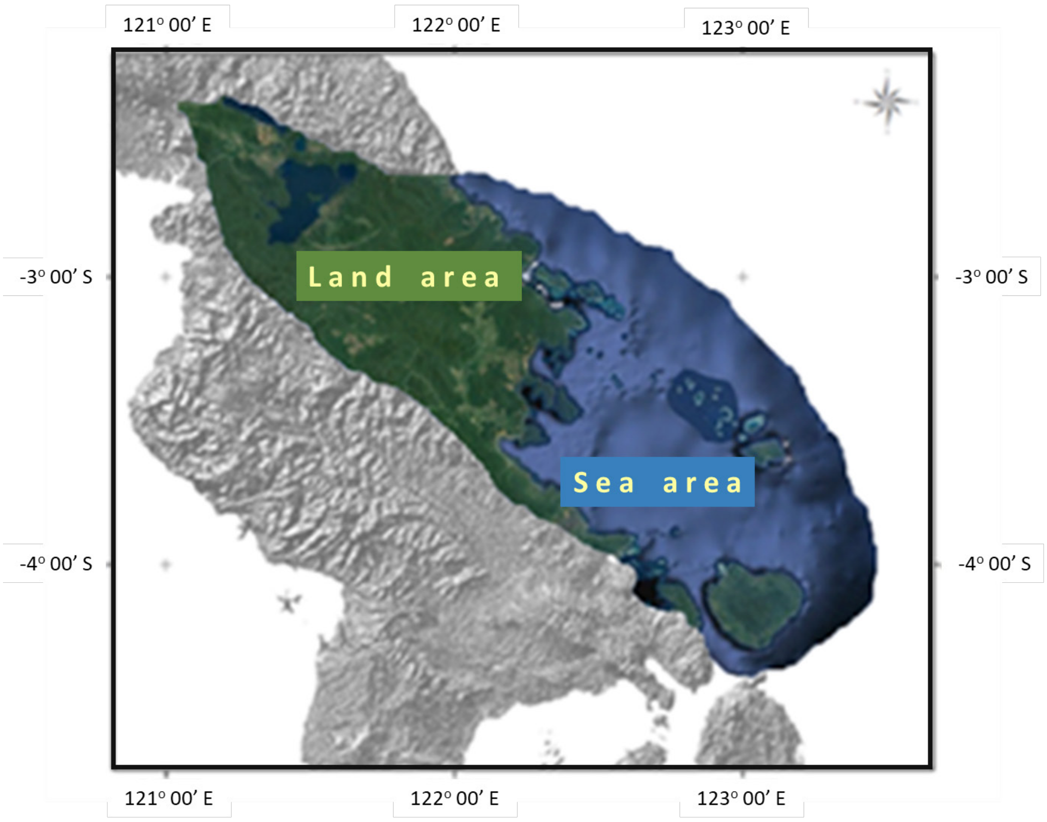


Figure 3. The Matarombeo Terrain is divided into two primary domains: the northwestern onshore sector, noted for its rugged mountainous landscape, and the southeastern offshore sector, which encompasses the Menui Sub-basin. This sub-basin features depositional regions and a series of islands that are integral to the basin-margin system.

Mountains—an elevated, structurally intricate region primarily composed of metamorphic, ophiolitic, and sedimentary formations (Surono, 2013). Conversely, the southeastern area is marked by transitions towards the sea and encompasses the Menui Sub-basin, which serves as a marine depocenter that is structurally located next to the plifted terrain.

Significant physiographic characteristics encompass the Matarombeo Mountains, which constitute a notable structural elevation made up of metamorphic and ophiolitic blocks, as well as the Menui Island–Bone Bay margin system, which delineates the seaward transition from an uplifted terrane to a marine depocenter. The Matarombeo high serves as the terrestrial manifestation of the terrain's intricate assembly and plays a crucial role in influencing sediment provenance and basin geometry; in contrast, the Menui Sub-basin captures the marine deposition of sediments originating from these elevations and from upstream catchments during periods of active deformation (Surono, 2013; Samodra et. al., 2024).

Stratigraphically (Figure 4), study area consist of Cretaceous – Oligocene ophiolite series which thrusted above Mesozoic sedimentary rocks from the continental crust origin. nconformably above those two rock groups deposited molasse group on Miocene (Figure 4.) (Darman & Sidi, 2000; Rusmana et. al., 1993; Rusmana & Sukarna, 1985; Simandjuntak et. al., 1991; Simandjuntak et. al., 1993: Surono, 2010).

The Triassic–Jurassic Meluhu Formation crops out along a north–south belt on the eastern coast of Southeast Sulawesi and consists of shale, sandstone, and calcareous sandstone (Simandjuntak & Surono, 1994; Surono, 2013). The lithological sequence exhibits a distinct coarsening-upward pattern. The lower section is primarily composed of well-sorted quartz sandstone, succeeded by layers of carbonaceous shale interspersed with quartz sandstone. In the upper section, calcareous sandstone is present. Outcrop structures include scour marks, cross-bedding, ripple marks, graded bedding, and cross-lamination, while wavy bedding at the base indicates deposition in a tidal-flat setting (Bishop, 2000).

The Triassic–Jurassic Tokala Formation, distributed in the northern and southern parts of the study area, interfingers with the Meluhu Formation (Simandjuntak & Surono, 1994). It comprises calcareous oil shale, wackestone, and mudstone. The lower calcareous shale contains oil-rich beds interpreted as potential source rocks. Up-section, it coarsens upward into interbedded calcareous shale and mudstone, with graded bedding and cross-bedding commonly observed.

The Matano Formation is widely exposed in the northern area (Surono, 2013; Sukido et al., 1993). It consists of limestone, shale, and polymict conglomerate. Two facies occur: (1) a conglomeratic limestone unit that fines upward; and (2) interbedded mudstone–wackestone with claystone

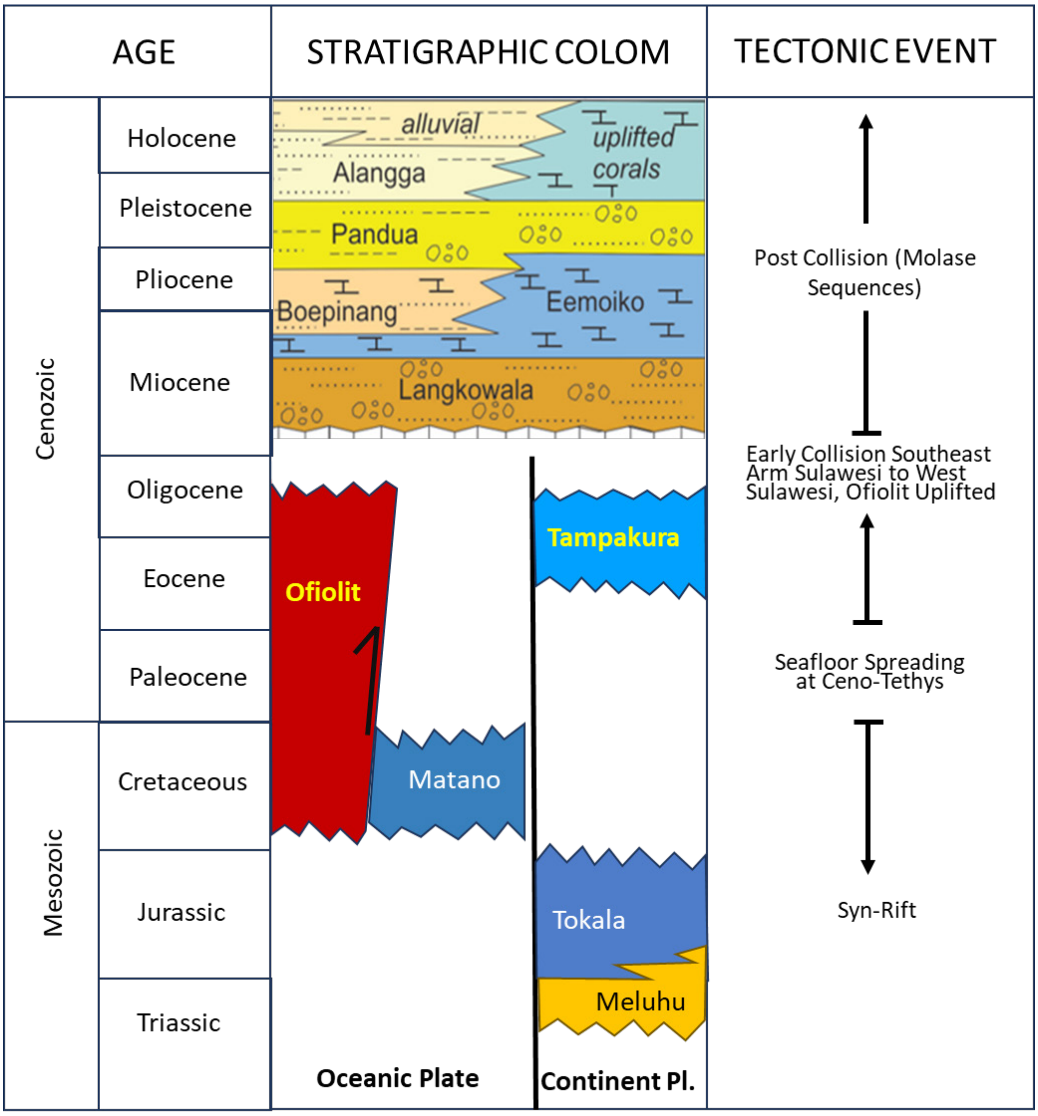


Figure 4. Stratigraphic column of Matarombeo Terrain

and carbonaceous layers. Graded bedding and basal scours are common, and the limestone is compact and highly cemented.

The Ophiolite Complex, forming part of the East Sulawesi Ophiolite Belt, is exposed in the central and northern regions and includes gabbro, dunite, peridotite, and serpentinite (Monnier et al., 2003; Surono, 2013). Peridotite is medium weathered and holocrystalline, whereas serpentinite is greenish-black and moderately weathered. Many outcrops are highly fractured and filled with secondary magnesite and malachite minerals.

The Tampakura Formation, exposed along the Laronai Coast and Sambalangi, comprises interbedded limestone and calcareous sandstone (Samodra et al., 2018; Surono, 2013). The limestone is fine-grained and well cemented, while the calcareous sandstone is matrix-supported and poorly sorted. Both units show graded bedding and parallel lamination.

The Langkowala Formation, exposed in Atarilama and Landipa, unconformably overlies the Tampakura Formation (Sukamto, 1982). It contains conglomerate, sandstone, claystone, and local calcarenite. The formation shows a coarsening- and thickening-upward trend. Conglomerates are poorly sorted, quartz-rich, and compact; sandstone is well-sorted quartzose; and calcarenite contains mollusk fragments and is petrographically classified as micritic sandstone.

The Eemoiko Formation, found in Wasana and Wolasi, interfingers with the Boepinang Formation and is dominated by rudstone (Samodra et al., 2018). The Wasana section is dominated by coral fragments, whereas the Wolasi section includes pelecypod, gastropod, echinoderm, and algal fragments. Petrography confirms a rudstone classification with large foraminifera.

The Boepinang Formation, covering the Moramo and Wolasi areas. It consists of marl, conglomerate, calcareous sandstone, and local breccia (Simandjuntak & Surono, 1994). Its succession fines upward, beginning with marl–calcareous sandstone interbeds, followed by calcareous sandstone with marl and conglomerate, and capped by conglomeratic marl-rich intervals. Structures include scours and graded bedding.

The Pandua Formation, overlying the Boepinang Formation conformably, is dominated by interbedded sandstone–conglomerate (Surono, 2013). Sandstone is well-sorted quartzose, while conglomerates are matrix-supported with quartz and lithic clasts and show normal grading and scouring.

The Alangga Formation, distributed in the southern area, overlies the Boepinang Formation and comprises sandstone, siltstone, and conglomerate (Sukido et al., 1993). It shows a coarsening-upward succession from conglomerate at the base to interbedded sandstone–siltstone, then to thick conglomerate and sandstone–shale interbeds. Common structures include scours and planar cross-beds.

The Buara Formation, exposed in the southeastern study area, interfingers with the Alangga formation (Surono, 2013). It consists of reefal limestone, floatstone with molluscan fragments, interbedded rudstone, and shale. The youngest sediments cover all lowland area are alluvial deposits, consist of clay, sand, and gravel.

Several outcrops of lithological variations found in the research area are shown in Figure 5.

### 3.2. Structural Framework

Major geological structures on the study area are the sinistral Matano and Lawanopo faults that formed after the collision event (Surono, 2010; Hamilton, 1979), and Tolo thrust (Figure 1 & Figure 2). These three geological structures are part of the main structures on the island of Sulawesi.

The Matano Fault is a sinistral fault with a northwest-southeast trend through Lake Matano (Surono, 2010; Lukman, et al., 2016). The length of the fault reaches 200 km, from the intersection with the Palu-Koro Fault in the west, to the east to

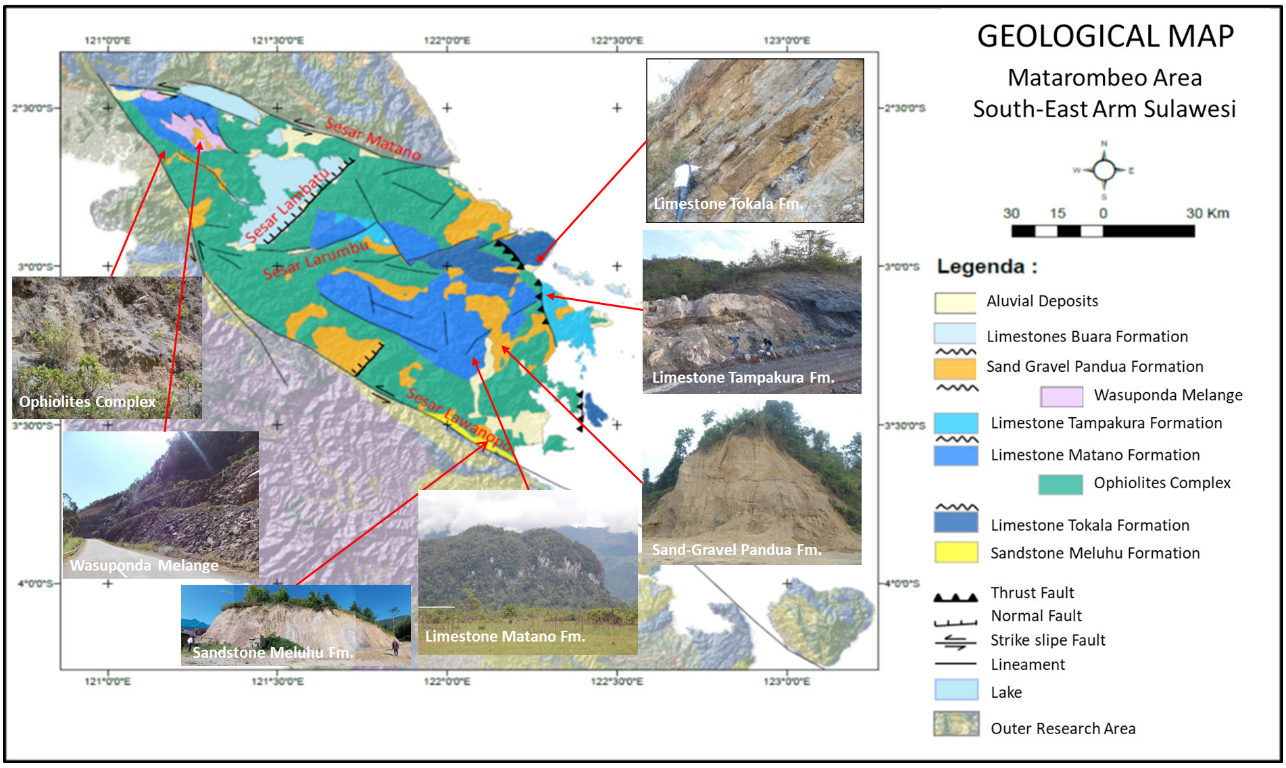

Figure 5. The Outcrop distribution of lithological unit in Matarombeo Terrain.

the Tolo Thrust. The apparent offset of this fault is estimated at 20 kilometers (Hamilton, 1979), based on the distribution of ultramafic rock, Mesozoic sedimentary rock, and metamorphic rock that shifted 19 – 20 km to the left on the opposite side of the lake. This fault is characterized by a rifting zone that affects river flow patterns and forms Matano Lake with a depth of up to 600 m, and is associated with the Palu Koro Fault System in the west and is thought to be associated with the Sorong Fault in the east (Surono, 2010). The fault is still active today based on its seismic activity (Hamilton, 1974 in Hamilton, 1979 and Surono, 2010).

The Lawanopo Fault is part of the main northwest-southeast trending fault that passes through the Lawanopo Plain (Hamilton, 1979; Triani et al., 2021). This fault system extends for about 260 km from the north of Malili to Tanjung Toronipa, connecting with the Matano Fault in the west and the Hamilton Fault in the east. The magnitude of the apparent displacement is estimated at 25 km based on the shift of the Meluhu Formation which is cut off by the fault (Surono, 2010). Hamilton (1979) argues that this fault was active in the Neogene period and is no longer active today. Based on a georadar survey in the area cut by the Lawanopo fault, Natawijaya and Daryono (2015) stated that the Lawanopo Fault is no longer active based on evidence that this fault does not cut Pleistocene – Holocene deposits.

The Tolo Thrust is the boundary between the microcontinent in the Southeast arm of Sulawesi and the northern Banda Sea. This fault is a long fault, curved like an arc that cuts through Tolo Bay. The location and structure of the Tolo Thrust can be well observed as a result of the expeditions of the Mariana 9 and Indopac 10 survey vessels in 1977 and 1979. In the north, the Tolo Thrust merges with the Matano Fault on the mainland, while in the south it splits into several faults that cut the central and eastern parts of Buton Island. The deformation zone associated with this fault is greatest in the middle, and narrows at the ends (Silver et al., 1983). Hamilton (1979) suspected that the Matano Fault intersects the Tolo Thrust, but Silver et al., (1983) stated that the Matano Fault is a continuation of the Tolo Thrust. With this view, there is a continuity of the tectonic zone from Buton to the north to the Matano Fault, then to the northwest along the Palu Fault to the North Sulawesi Trench. The Matano Fault represents the transform system between the Tolo Thrust and the North Sulawesi Trench.

The study area have been affected by three different tectonic stress phases. The oldest phase had N 353° E direction and occurred at least until Cretaceous, the second phase had N 283° E principal stress direction and occurred in Paleocene – Oligocene, and the youngest phase have N 45° E principal stress direction and occurred in Miocene – Holocene (Figure 6.).

### 3.3. Subsurface Architecture

The residual gravity field across southeastern Sulawesi provides an independent constraint on crustal architecture (Nugraha et. Al., 2021) and strengthens the geological and seismic interpretations (Figure 7). A prominent NE–SW-trending gravity gradient delineates a first-order boundary

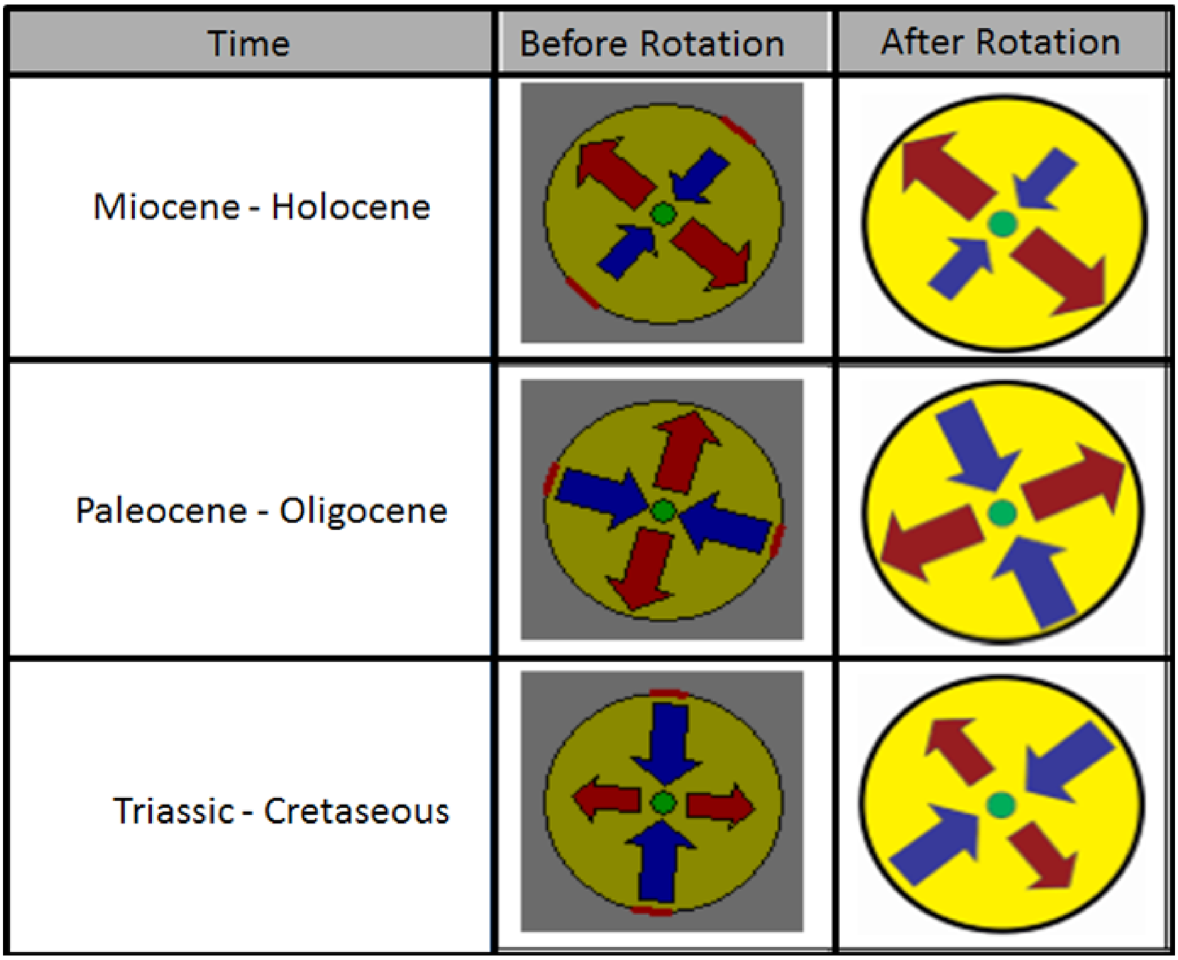


Figure 6. Main tectonic stress in study area based on structural lineament analysis.

between contrasting crustal domains. Low gravity values dominate the northwestern sector, corresponding to the uplifted Matarombeo Terrain and the adjacent Menui Sub-basin. These subdued anomalies reflect mixed metamorphic, ophiolitic, and sedimentary assemblages overlying a relatively felsic continental-type basement, consistent with long-standing models of Sulawesi's composite crust (Hamilton, 1979; Hall, 2012; Surono, 2013).

The strong gravity gradient delineates a major structural boundary separating the uplifted Matarombeo Terrain including Menui Sub-basin from the subsiding North Banda Sea. Coordinates are shown in geographic format, and shading

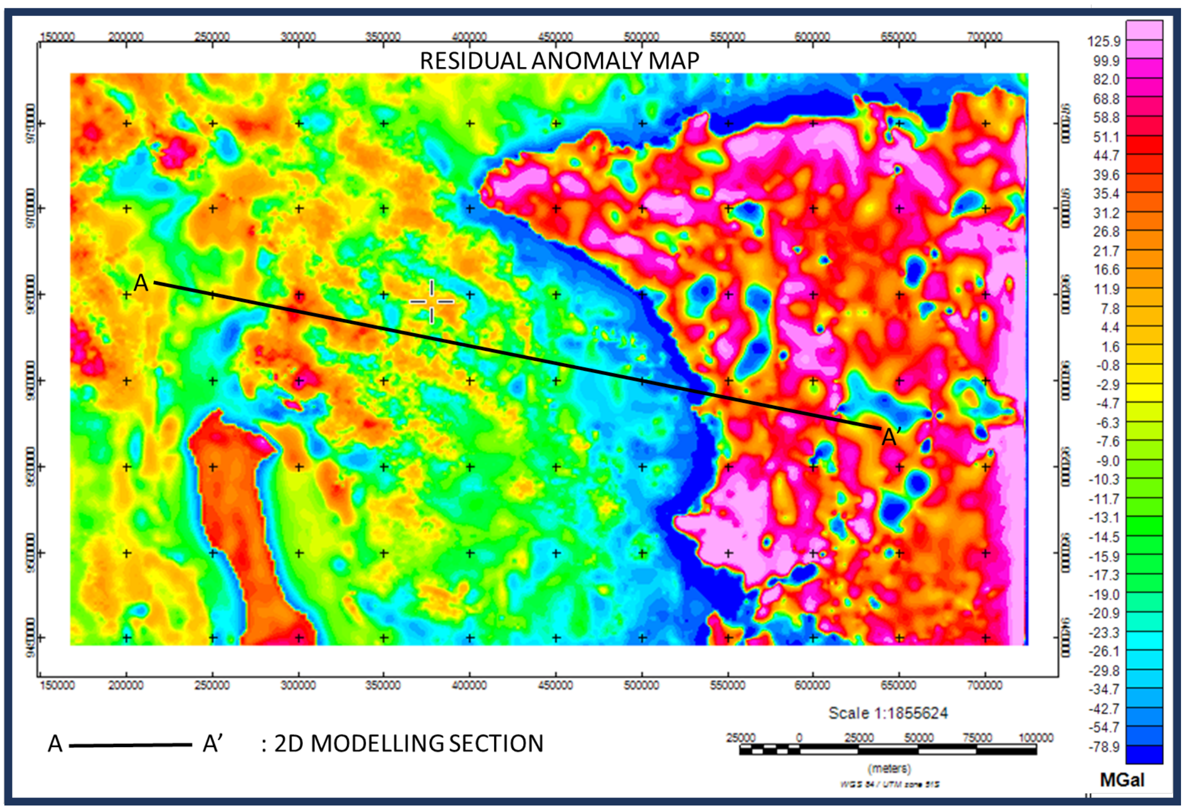


Figure 7. The residual gravity anomaly map for the southeastern region of Sulawesi depicts the spatial differences in residual gravity values. These values range from low anomalies, indicated by lighter shades, which are linked to dense crystalline and ophiolitic sedimentary deposits situated above granitic basement rocks in the northwestern area, to high anomalies, represented by darker shades, that signify the presence of relatively high-density oceanic crust in the southeastern offshore region.

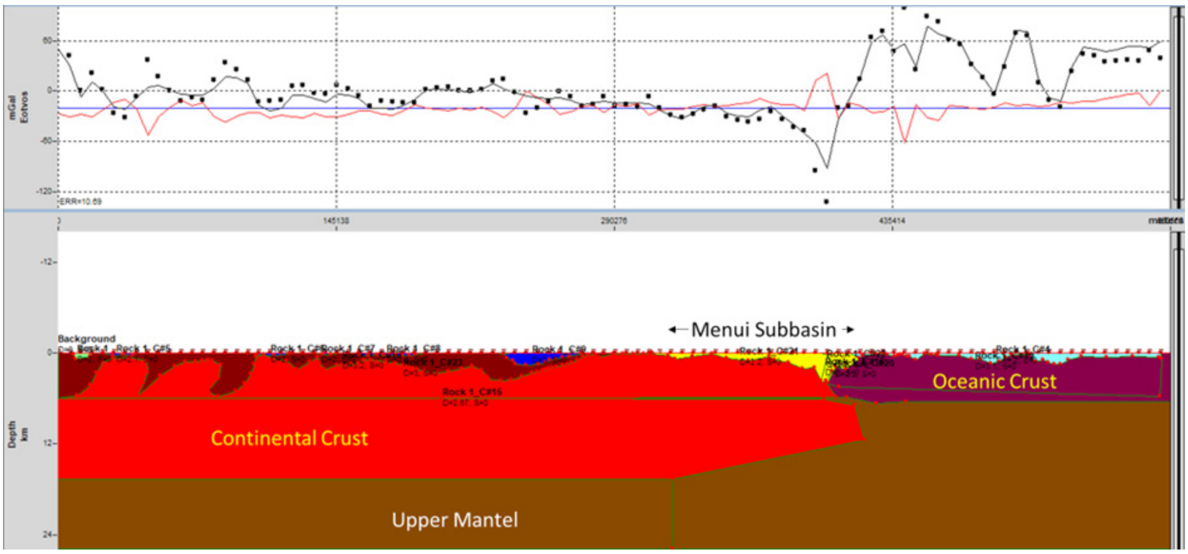


Figure 8. Two-dimensional (2D) cross-section derived from residual gravity anomaly data illustrating the subsurface configuration of the Menui Subbasin. The residual gravity response highlights lateral variations in crustal density, delineating the transition from continental crust to oceanic crust beneath the study area. The Menui Subbasin is characterized by a relative gravity low, interpreted as a sediment-filled depocenter developed above attenuated continental crust and adjacent to the oceanic domain. The modeled section also depicts the geometry of the upper mantle and the crust–mantle boundary, providing insights into the tectonic framework and basin evolution of the Matarombeo Basin.

indicates anomaly magnitude (in mGal), highlighting the fault-controlled nature and asymmetric geometry of the basin.

In contrast, the southeastern offshore region displays significantly higher gravity amplitudes, which are indicative of a dense oceanic lithosphere located within the North Banda Sea. This observation is consistent with geophysical studies that document the properties of oceanic crust and the presence of high-density mantle material in the Banda arc system (Spakman & Hall, 2010; Wessel & Smith, 1998). The 2-dimensional model of the residual gravity map can be seen in Figure 8.

The abrupt transition between these domains signifies a major lithospheric discontinuity that has likely experienced repeated reactivation during the Neogene period. Its alignment with regional fault systems implies a structural influence on subsidence patterns and the formation of the Menui Sub-basin (Panggabean & Surono, 2013; Mirnanda et al., 2023).

Within the central part of this boundary zone, the Menui Sub-basin is distinguished by lower gravity values and a smoother anomaly texture, features indicative of thick accumulations of low-density sedimentary fill within a fault-bounded depocenter (Wessel & Smith, 1998; Mirnanda et al., 2023). To the east, a sharply defined, convex-eastward gradient marks the transition to oceanic crust and mirrors regional models of lateral extrusion and escape tectonics associated with the oblique collision of the Banggai–Sula microcontinent with northern and eastern Sulawesi (Hamilton, 1979; Hall, 2002; Spencer et al., 2017). This geometry implies crustal draping and outward displacement along strike-slip or oblique-convergent structures. Collectively, the gravity patterns support an interpretation in which the Menui Sub-basin formed as an asymmetric, fault-controlled depression along an evolving terrane boundary, shaped by transtensional deformation, differential uplift, and regional plate interactions (Doust & Sumner, 2007; Panggabean & Surono, 2013).

There are nine significant seismic reflections were identified within the 2D seismic data (Figure 9), representing four tectonostratigraphic units. The seismic reflectors defining these units are: top basement (TB – basement Horizon); syn-rift Sequence (SRS – Meluhu Horizon); syn-drift sequence (SDS – Tampakura Horizon); and syn-collosion sequence (SCS – Langkowala, Eemoeko, Boepinang, Pandua and Alangga Horizons).

### 3.4. Formation and evolution of Menui Sub-Basin

Formation and evolution of Menui Sub-basin is characterized by several distinct events, correlated with tectonic development in East Indonesia Regime. According to Davidson (1991), the events begin from its history as part of Australia (pre-rifting sequence), the detachment from Australia (syn-rifting sequence), movement to its present location (syn-drifting sequence) and during and after the collision with SE Sulawesi (syn-orogen and post-orogen sequences) (Figure 10.).

#### *Pre-rift and Syn-rift Sequence*

Pre-rift sediments were deposited before the Middle Triassic when the continent was part of the Australia-New Guinea continent. The pre-rift Triassic stratigraphy comprises continental-derived clastic sediments deposited unconformably on Permian meta-sedimentary rocks. Final separation from Australia happened in the Late Triassic or Early Jurassic, preceded by a transition from pre-rift to syn-rift sedimentation in the Middle – Late Triassic, Meluhu Formation. Meluhu Formation itself is slightly younger and interfingering with Early Jurassic Tokala Formation predominantly consists of limestone. Clastic sediments, mostly shales, are common in the Meluhu Formation.

#### *Syn-drifting Sequence*

A fully open marine environment with passive margin sedimentation commenced in the Late Cretaceous to Early Tertiary with pelagic carbonates as dominant lithology. The sequence begins with the deep-marine siliceous and calcareous mudstones of the Tampakura Formation. Tampakura Formation consists of pelagic limestone with nodule sand stringers of red chert. As a whole, carbonates interval from Tampakura was deposited very slow, and their lithology is consistent with deposition during the drift of an isolated continental fragment. This event is also marked by the decrease in clastic sedimentation derived from the continental area.

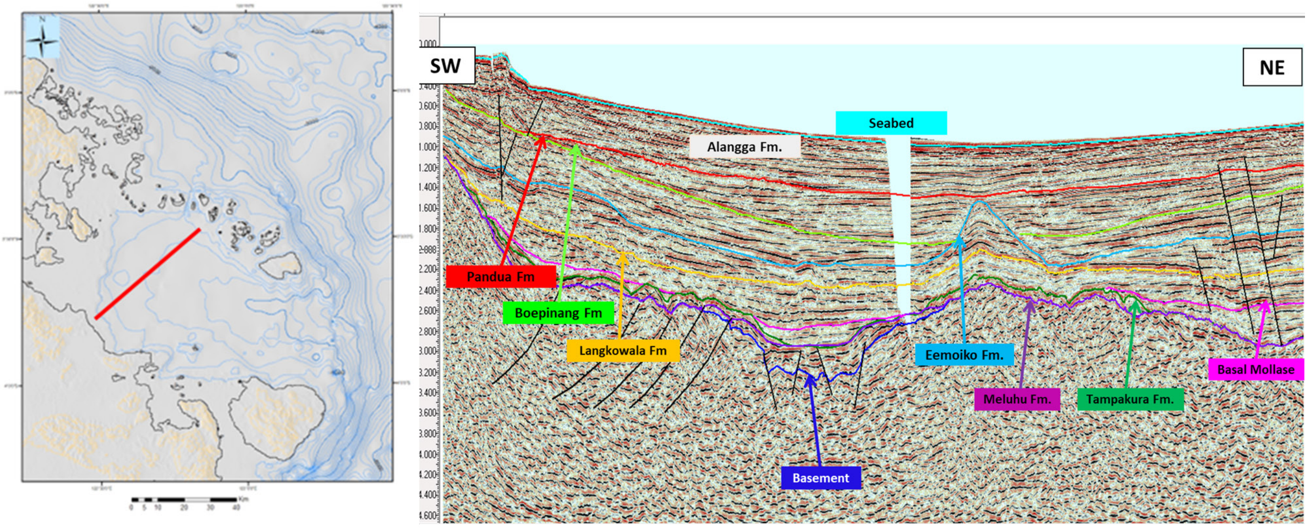


Figure 9. SW-NE orientated 2D seismic line across the center part of study area showing the cross-sectional view of the Menui Sub-Basin. Seismic amplitude character is shown down until 4.6s TWT. A seismic section showing the nine reflectors interpreted in this study that represent four main tectonostratigraphic units

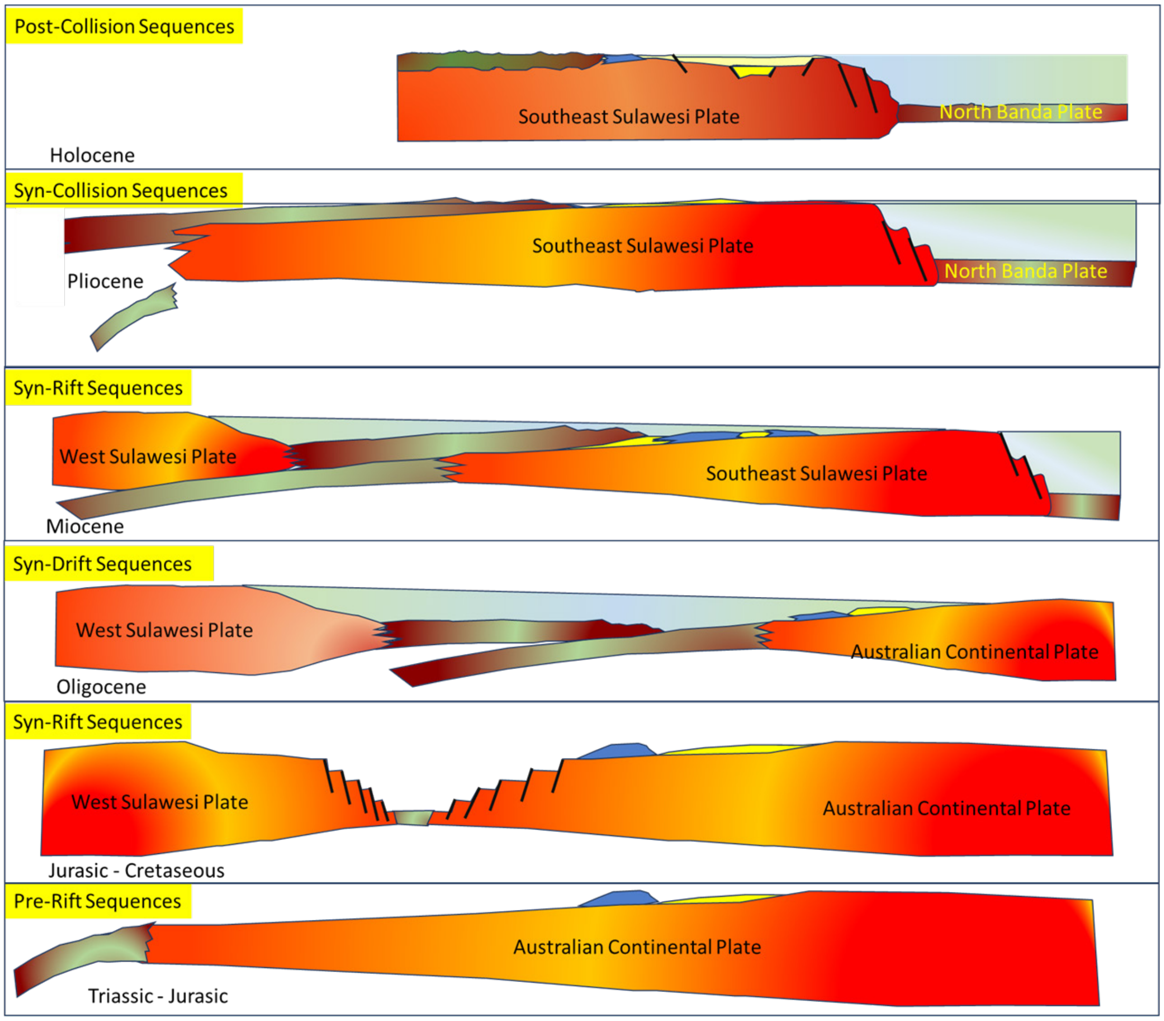


Figure 10. Schematic Origin and Evolution of Menui Sub Basin.

### *Syn-orogeny Sequences*

In the Late Miocene, the collision of microcontinents and SE Sulawesi took place. In this event, Langkowala, Eomoeko, and Boipinang Formation were deposited. A hiatus at the top of the carbonate sequences can be attributed to this collision. After the collision, syn-orogenic sediments were deposited as molasses (Pandua and Alangga Formation).

## 4. Conclusions

The evolution of the Menui Sub-basin is best explained as the product of a dynamically partitioned tectonostratigraphic system situated along the southeastern margin of the Matarombeo Terrain. Its genesis began with fault-controlled subsidence during Neogene transtensional deformation, driven by the progressive uplift of the Matarombeo block to the northwest and coeval crustal thinning toward the North Banda Sea. Residual gravity data support this configuration, suggesting a distinct transition from the low-density continental crust located beneath the basin to the high-density oceanic lithosphere to the east. This transition signifies a significant lithospheric boundary that is linked to lateral extrusion during the oblique Banggai–Sula collision.

Stratigraphically, the basin illustrates the interaction between structural segmentation and sedimentation. The occurrence of carbonate units from the Tampakura and Eemoiko formations—recognized for their reservoir potential—indicates deposition along fault-bounded highs and localized accommodation zones. These successions, together with interfingering siliciclastic units, indicate episodic shifts in base level and sediment supply governed by syn-rift and post-rift tectonics.

The Menui Sub-basin did not develop as a straightforward sag or a standalone depocenter; instead, it emerged as an asymmetric, structurally compartmentalized basin influenced by terrane uplift, transtensional escape mechanisms, and varying rates of subsidence. Its tectonostratigraphic framework illustrates the close relationship between deformation and sedimentation that defines the southeastern margin of Sulawesi.

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