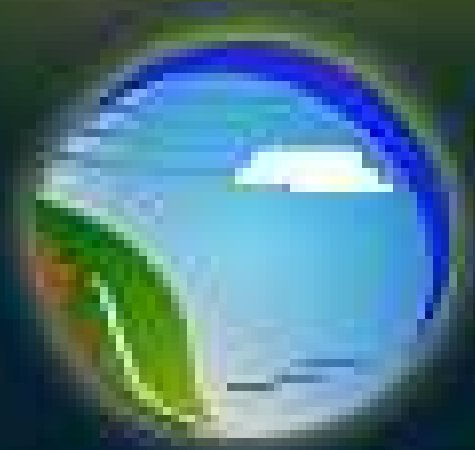




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Focus and Scope

Jambura Geoscience Review (JGEOSREV, P-ISSN: [2623-0682](#), E-ISSN: [2656-0380](#)) is an open-access journal, which publishes original papers about all aspects of the Earth and Geosciences. This comprises the solid earth, the atmosphere, the hydrosphere, and the biosphere. In addition, it provides a particular place, and an advanced forum, for contributions on natural hazards, geoscience-related environmental problems. The scope of the articles listed in this journal relates to various topics, including:

Geography; The subject related to physical process and spatial patterns at the earth's surface, physio-geographical elements and their interaction, global change and its regional response, characters and management of natural resources, landscape ecology and environmental construction, remote sensing, geographic information system and their applications in geographical research.

Geology; The subject covers variety of topics including geodynamics, sedimentology and stratigraphy, volcanology, engineering geology, environmental geology, hydrogeology, geo-hazard and mitigation, mineral resources, energy resources, medical geology, geo-archaeology.

Hydrology; The subject related to research addressing issues in integrated water management, surface water hydrology, groundwater hydrology, ecohydrology, hydrometeorology, water quality.

Meteorology and Climatology; The research includes topics such as weather modification, satellite meteorology, radar meteorology, boundary layer processes, physical meteorology, air pollution meteorology, agricultural and forest meteorology, mountain meteorology, and applied meteorological numerical models. Climatological research includes the use of climate information in impact assessments, seasonal climate forecast applications and verification, climate risk and vulnerability, development of climate monitoring tools, and urban and local climates.

Biogeography; Appropriate topics include innovative applications or methods of species distribution modeling or identifying the agents of global change, including how climate change, land-use change, and invasive species affect the abundance, distribution, and range boundaries of native species.

Geodesy; The Subject covers the whole range of geodetic and reports on theoretical and applied studies in research areas such as positioning, reference frame, geodetic networks, modeling and quality control, gravity fields

Geophysics; The subject covers variety of topics including earthquakes and seismology, size and structure of the earth, gravity, geomagnetism, mineral physics.

Remote Sensing; The subjects related to research on remote sensing include: remotely sensed data collection, surveying from space, imaging and related sensors, image processing, use of remotely sensed data, drones section: remote sensing with unmanned aerial systems.

unmanned aerial systems.

Geographic Information System; The subject research covers innovations in GIScience and novel applications of GIScience in natural resources and the built environment, as well as relevant developments in computer science, cartography, surveying, geography.

Geomorphology; The subject related to fluvial sequences, fluvial processes and landforms, hillslopes and soil erosion, weathering, karst and soils, coastal dunes and arid environments; coastal and marine processes, estuaries and lakes, modelling, theoretical and quantitative geomorphology.

Natural Hazards and Risk; Approaches and case studies using geospatial and remote sensing techniques to study monitoring, mapping, risk mitigation, risk vulnerability, and early warning of natural hazards.

Environment; The subject covering several topics of environmental studies including environmental policy and management, disaster mitigation, regional planning, land resources evaluation, systems modelling and sciences, water pollution, air pollution, environmental technology.

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✔ Peer Reviewed

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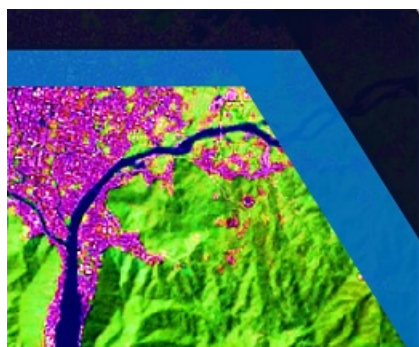
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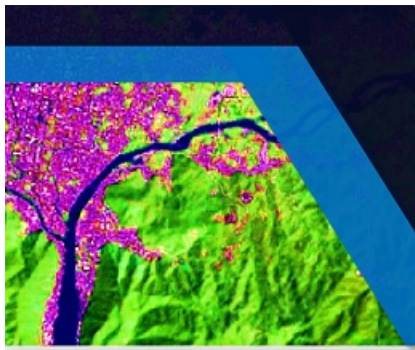


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Geologi Daerah Dimito dan Sekitarnya Kabupaten Boalemo Provinsi Gorontalo

Alifia Widya Warapsari Badaru, Fitriyane Lihawa, Intan Noviantari Manyoe

Abstract

Administratively, the research area covers two districts, Wonosari Sub-district and Dulupi Sub-district, Boalemo District, Gorontalo Province. Based on the physiography of the Gorontalo region, the research area which is included in the southern mountain zone of Bone-Tilamuta-Modello generally consists of ancient volcano-sedimentary rock formations in Gorontalo, the Eocene-Oligocene. The purpose of this geological research is to discover the geological order that developed in the area of Dimito and surrounding are as covering several aspect such as geomorphology, stratigraphy, geological structure, and geological history. The result shows that the geomorphology of the research area divided into three geomorphic units, namely the units of the Alluvial Plain, Volcanic Hills, and Denudasional Hills. Stratigraphy of the research area divided into five types of units sorted from the early Miocene to the Holocene, i.e., Lava Basal Dimito (Early Eocene), Wackestone Dimito (Early Eocene), Andesit Kalidingin (Middle Miocene), Granodiorite Bualo (Middle Pliocene), and Alluvial Buaolo (Recen). Geological structures that work on the location of the research area relatively trend from northeast-southwest to northwest-southeast. Fault working on the location of the research area from the data processing consists of Normal Left Slip Fault Kalidingin and Lag Left Slip Fault Bualo.

Keywords

Boalemo, Dimito, Geology, Gorontalo, Stratigraphy, Structure

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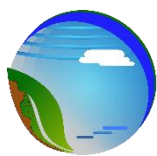
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GEOLOGI DAERAH DIMITO DAN SEKITARNYA KABUPATEN BOALEMO PROVINSI GORONTALO

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ABSTRACT

Administratively, the research area covers two districts, Wonosari Sub-district and Dulupi Sub-district, Boalemo District, Gorontalo Province. Based on the physiography of the Gorontalo region, the research area which is included in the southern mountain zone of Bone-Tilamuta-Modello generally consists of ancient volcano-sedimentary rock formations in Gorontalo, the Eocene-Oligocene. The purpose of this geological research is to discover the geological order that developed in the area of Dimito and surrounding are as covering several aspect such as geomorphology, stratigraphy, geological structure, and geological history. The result shows that the geomorphology of the research area divided into three geomorphic units, namely the units of the Alluvial Plain, Volcanic Hills, and Denudational Hills. Stratigraphy of the research area divided into five types of units sorted from the early Miocene to the Holocene, i.e., Lava Basal Dimito (Early Eocene), Wackestone Dimito (Early Eocene), Andesit Kalidingin (Middle Miocene), Granodiorite Bualo (Middle Pliocene), and Alluvial Bualo (Recen). Geological structures that work on the location of the research area relatively trend from northeast-southwest to northwest-southeast. Fault working on the location of the research area from the data processing consists of Normal Left Slip Fault Kalidingin and Lag Left Slip Fault Bualo.

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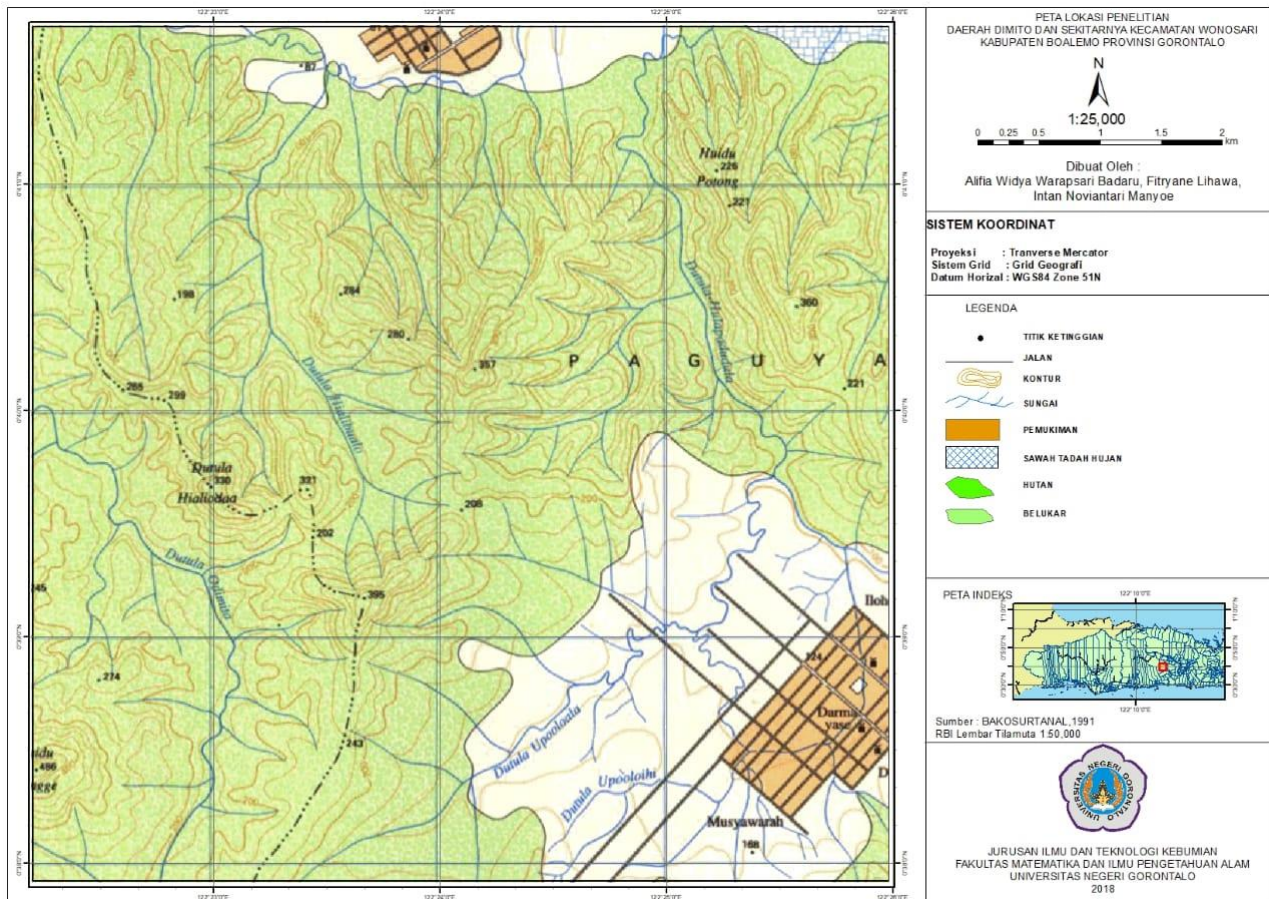
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1. Pendahuluan

Indonesia merupakan wilayah geologi kompleks yang terletak di tepi tenggara benua Eurasia. Indonesia berbatasan dengan zona tektonik aktif yang ditandai dengan kegempaan tinggi dan vulkanisme sebagai hasil dari subduksi (Hall, 2009). Menurut Hamilton (1979) Sulawesi dibentuk dari tiga unit tektonik utama. Sulawesi telah berkembang di zona konvergensi kompleks Eurasia, Pasifik dan lempeng kerak Australia. Bagian barat Sulawesi yang terdiri atas Lengan Utara dan Lengan Selatan, terbentuk dari rangkaian busur gunungapi-plutonik dari Kapur Akhir.

Gorontalo terletak di Lengan Utara Sulawesi. Aktivitas tektonik di Gorontalo diduga telah berlangsung sejak Eosen sampai Oligosen. Selama Eosen terjadi pemekaran dasar samudera yang berlangsung hingga Miosen Awal dan menghasilkan lava bantal yang cukup luas. Aktivitas ini diikuti pula oleh terjadinya retas-retas yang umumnya bersusunan basa dan banyak menerobos Formasi Tinombo.

Berdasarkan pembagian secara fisiografis (Bemmelen, 1949), daerah Dimito dan sekitarnya merupakan Zona Pegunungan Selatan Bone-Tilamuta-Modello yang umumnya terdiri dari formasi-formasi batuan sedimenter gunungapi berumur sangat tua di Gorontalo yaitu Eosen – Oligosen. Hal ini menarik untuk diteliti karena adanya formasi batuan tertua (Formasi Tinombo) dan kegiatan tektonik yang telah berlangsung sejak Eosen di daerah penelitian. Penelitian ini bertujuan untuk mengetahui



Gambar 1. Peta lokasi penelitian

tatanan geologi yang berkembang di daerah Dimito dan sekitarnya mencakup beberapa aspek yaitu geomorfologi, stratigrafi, struktur geologi, dan sejarah geologi.

2. Metodologi

2.1. Lokasi Penelitian

Daerah penelitian terletak pada koordinat $00^{\circ}37'55.2''$ – $00^{\circ}41'42''$ Lintang Utara dan $122^{\circ}22'12''$ – $122^{\circ}25'58.8''$ Bujur Timur dengan luas daerah penelitian ± 49 km². Secara administratif, daerah penelitian mencakup dua kecamatan yaitu Kecamatan Wonosari dan Kecamatan Dulupi, Kabupaten Boalemo, Provinsi Gorontalo.

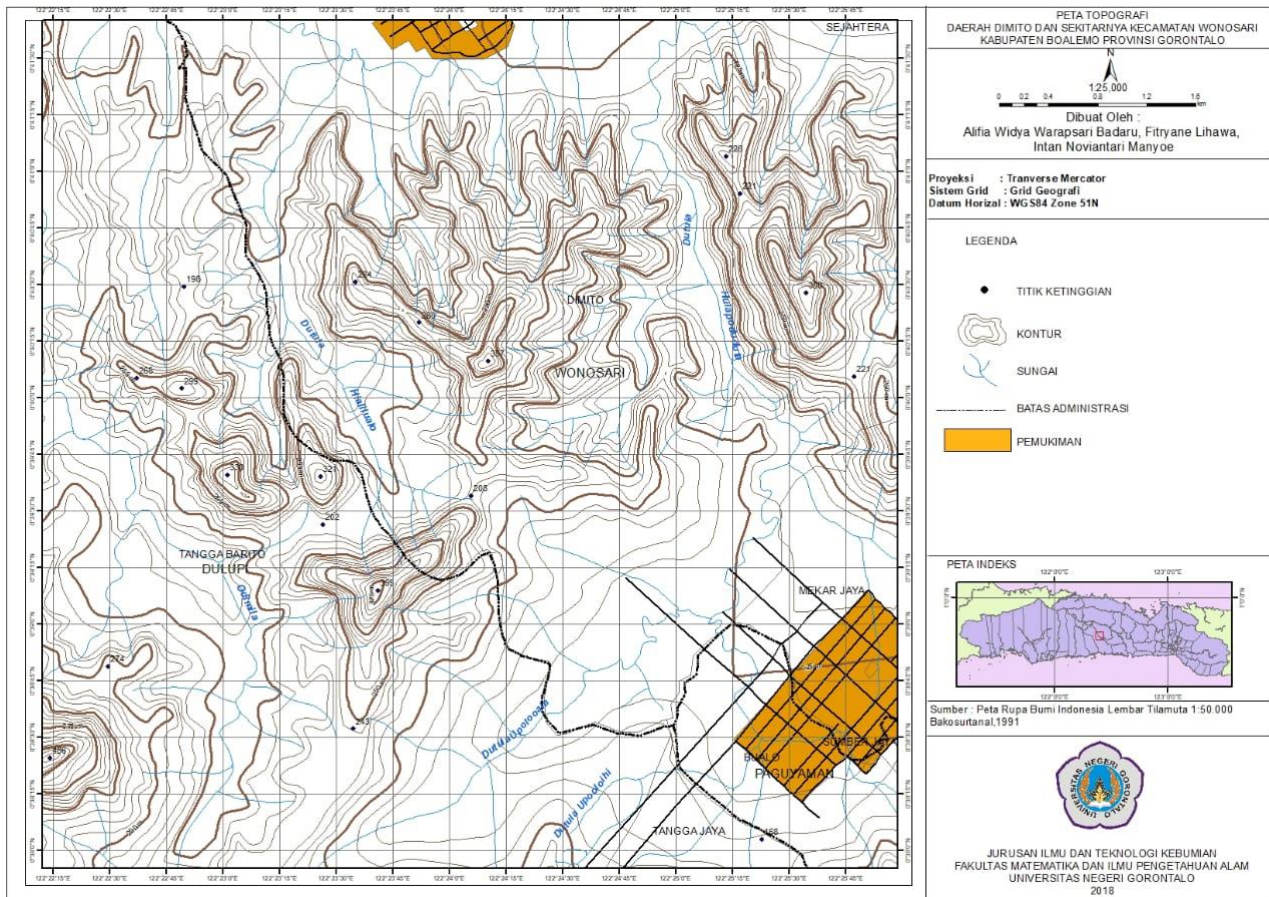
2.2. Pengumpulan dan Analisis Data

Pengumpulan data yang dilakukan dalam penelitian ini berupa pengamatan geomorfologi, deskripsi singkapan, deskripsi litologi, pengukuran struktur geologi, dan dokumentasi. Analisis data yang dilakukan yaitu analisis geomorfologi, petrologi, petrografi, stratigrafi, dan struktur geologi. Klasifikasi yang digunakan untuk analisis geomorfologi adalah klasifikasi Van Zuidam (1985). Klasifikasi untuk analisis petrografi menggunakan klasifikasi Travis (1955), O'Dunn dan Sill (1986), dan Dunham (1962). Klasifikasi untuk analisis petrologi menggunakan Streckeisen (1978) dan Dunham (1962) dan untuk klasifikasi batuan metamorf didasarkan pada kenampakan struktur dan teksturnya. Analisis sesar menggunakan klasifikasi Rickard (1972).

3. Hasil dan Pembahasan

3.1. Geomorfologi

Morfologi daerah penelitian mencakup bentang alam yang didominasi oleh perbukitan dan dataran dengan interval ketinggian antara 50 - 485 mdpl. Titik terendah berada pada bagian selatan daerah penelitian sedangkan titik tertinggi berada pada bagian barat daerah penelitian. Berdasarkan hasil analisis peta topografi (Gambar 2) dan pengamatan lapangan berupa bentuk sungai, arah aliran sungai, kontrol litologi dan stuktur geologi pada daerah penelitian, maka dibagi pola aliran sungai menurut klasifikasi A.D Howard (1967) menjadi 3 (tiga) pola aliran sungai, yaitu subdendritik, parallel, dan



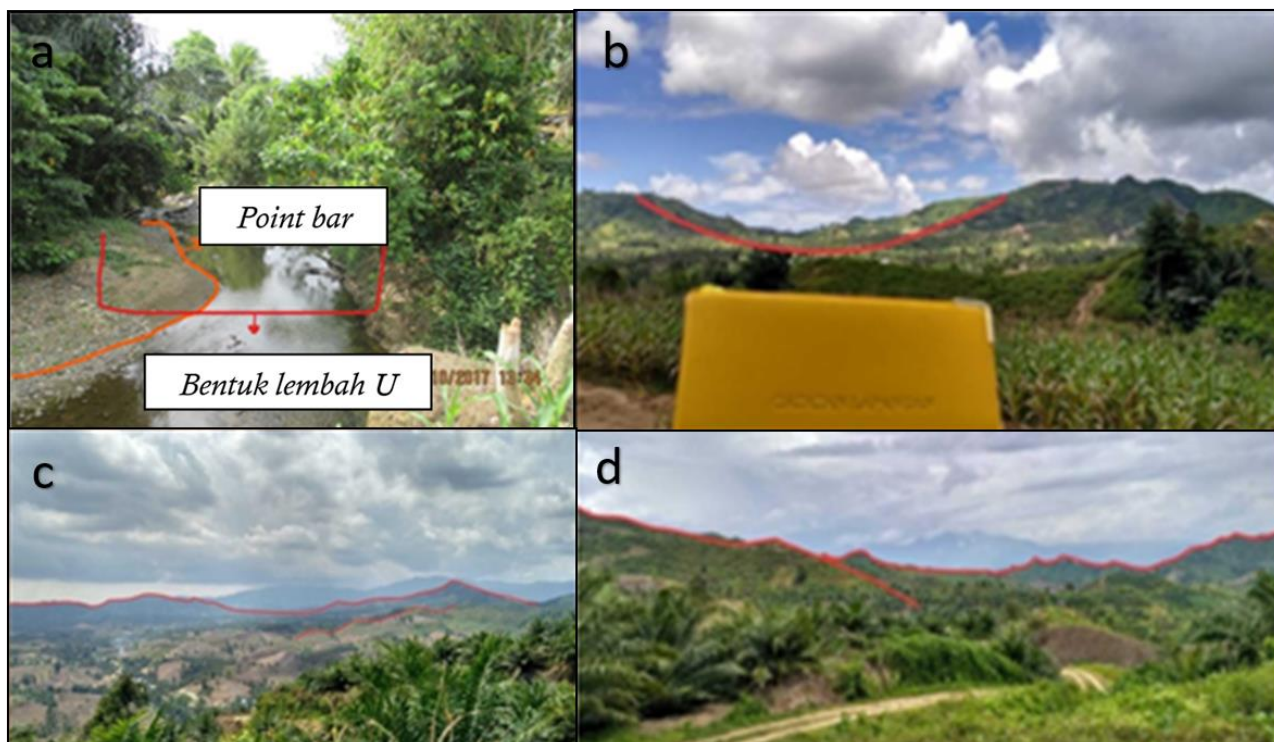
Gambar 2. Peta topografi daerah penelitian

subparalel. Tipe genetik sungai yang terdapat pada daerah penelitian yaitu tipe genetik sungai subsekuen dan konsekuen.

Berdasarkan pengamatan lapangan dan interpretasi peta maka daerah penelitian termasuk dalam stadia geomorfologi muda-dewasa. Stadia geomorfologi muda bisa dilihat pada bentuk profil sungai V, dan adanya arus seimbang antara laju erosi vertikal dan erosi lateral. Pada sungai yang telah mencapai stadium dewasa terdapat dataran banjir yang terbentuk dari pengendapan material klastis yang diendapkan pada daerah di dekat sungai dan lembah, melandai menyerupai huruf U sebagai akibat erosi lateral (Gambar 3a). Relief yang diperlihatkan oleh daerah penelitian adalah bergelombang hingga maksimum dengan bentuk penampang lembah V-U.

Secara umum bentang alam dikontrol oleh faktor litologi, struktur dan proses erosi. Berdasarkan klasifikasi Van Zuidam (1985) yaitu klasifikasi berdasarkan morfografi, morfometri, dan morfogenetik, pembagian bentuklahan pada daerah penelitian menjadi tiga satuan geomorfologi yaitu dataran aluvial, perbukitan aliran lava, dan perbukitan denudasional. Bentuklahan dataran alluvial (Gambar 3b) mempunyai topografi dengan relief datar dan kemiringan lereng landai (2-7%). Luas dataran alluvial sekitar 20% dari keseluruhan luas daerah penelitian. Perbedaan elevasi di daerah ini berkisar 75 – 125 mdpl. Morfologi berbentuk dataran rendah. Tersusun dari material lepas hasil erosi dan pelapukan dari batuan yang berukuran lempung, pasir, kerikil, hingga bongkah yang terendapkan di *channel bar* dan *point bar*. Tata guna lahan pada dataran aluvial adalah pemukiman, pertanian lahan kering dan perkebunan.

Satuan bentuklahan perbukitan Vulkanik (Gambar 3d) menempati luasan lebih dari 40% dari seluruh daerah penelitian. Satuan ini umumnya tersebar dari arah barat ke timur dengan morfologi berupa perbukitan memanjang. Kemiringan lereng curam hingga sangat curam (30 – 70%) dimana sering terjadi erosi dan gerakan tanah dengan kecepatan yang lambat. Elevasi satuan ini adalah 221-357 mdpl. Secara morfogenesis satuan bentuklahan ini dipengaruhi oleh struktur berupa kekar, sesar dan mempunyai bentuk lembah U-V. Litologi berupa basal dan andesit. Pada satuan geomorfologi ini, tata guna lahan berupa perkebunan kelapa sawit dan kawasan terbuka hijau.



Gambar 3. Kenampakan satuan dan subsatuan geomorfologi; a) *point bar*, b) dataran alluvial, c) perbukitan denudasional, dan d) perbukitan vulkanik.

Satuan bentuklahan perbukitan denudasional (Gambar 3c) ditandai dengan morfologi perbukitan bergelombang dengan persentase kemiringan secara keseluruhan curam (15%- 30%). Bentuk lembah mulai dari U tajam hingga V tumpul. Elevasi mulai dari 100-208 mdpl. Satuan ini menempati sekitar 40% wilayah dengan persebaran di bagian tengah daerah penelitian. Litologi penyusun bentuklahan berupa batuan basal, granodiorit, dan sedimen yang terendapkan. Morfostuktur aktif berupa sesar dan kekar. Morfodinamik yang memperlihatkan erosi terbagi erosi ke arah lateral (ke samping) dan vertikal (ke dasar sungai), dan adanya pelapukan. Tata guna lahan berupa perkebunan dan pertanian.

3.2. Stratigrafi

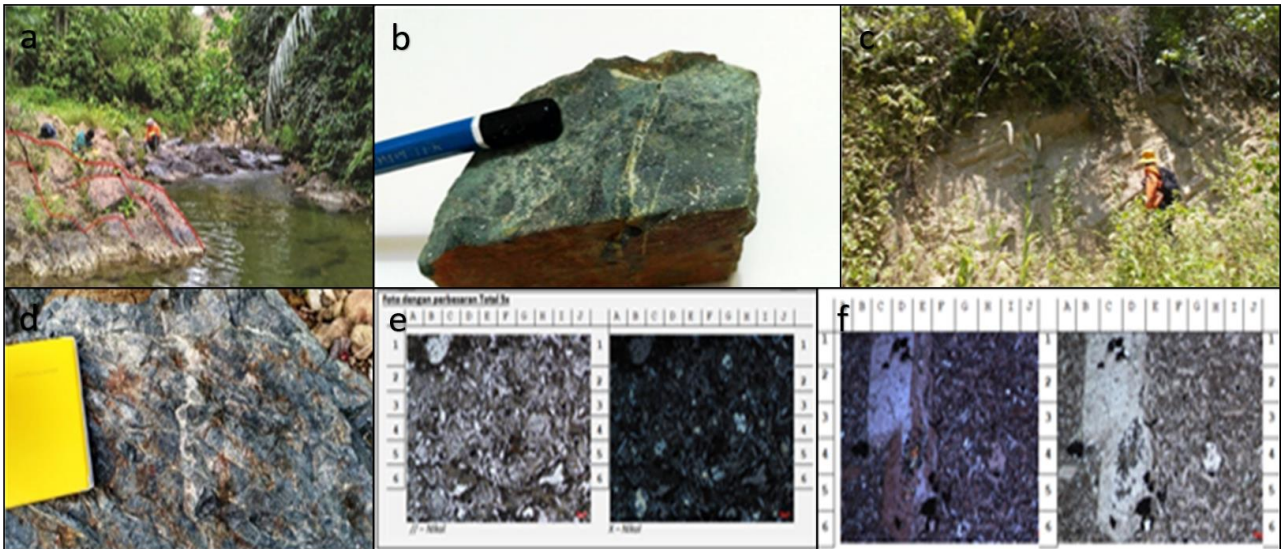
Stratigrafi daerah penelitian diurutkan dari tua ke muda yaitu satuan Lava Basal Dimito, satuan Wackestone Dimito, satuan Andesit Kalidingin, satuan Granodiorit Bualo, dan satuan Aluvial Bualo.

a. Satuan Lava Basal Dimito

Luas penyebaran satuan Lava Basal Dimito sekitar 44.82% atau 21.96 km² dari total luas daerah penelitian. Satuan Lava Basal Dimito terdapat di daerah Tangga Barito, Tangga Jaya, Dusun Kalidingin, dan Dusun Ilomonu. Lava basal pada satuan ini mempunyai ciri litologi berwarna abu-abu tua hingga abu - abu kehijauan. Struktur masif, hipokristalin, porfiri-afanitik, bentuk butir dari euhedral hingga subhedral, dengan hubungan antar butir equigranular. Batuan ini telah mengalami ubahan hidrotermal (Gambar 4b) ditandai dengan hadirnya mineral ubahan kuarsa (berupa *gash*), mineral pirit, epidot dan *zeolite*.

Lava andesit pada satuan Lava Basal Dimito dicirikan dengan warna abu-abu hingga abu-abu kehijauan, porfiri afanitik, dengan fenokris mineral seperti kuarsa, biotit, terdapat struktur *vein* kalsit (Gambar 4d) dan struktur kekar kolom (*columnar joint*) (Gambar 4c). Ciri lain yang ada dalam satuan batuan ini adalah adanya batuan metamorf. Batuan metamorf yang tersingkap di lapangan terbagi menjadi *quartz schist* dan metabasal. Ciri litologi berwarna biru kehijauan hingga warna abu-abu terang, besar butir *fine to medium coarse*, tekstur lepidoblastik, *schistose* dalam petrografi, kompak, dan pada beberapa daerah telah terkekarkan. Mineral yang dapat dilihat berupa kuarsa, hornblende, biotit, dan mineral seperti epidot dan mika. *Protolith* metamorf daerah penelitian berasal dari batuan beku basal.

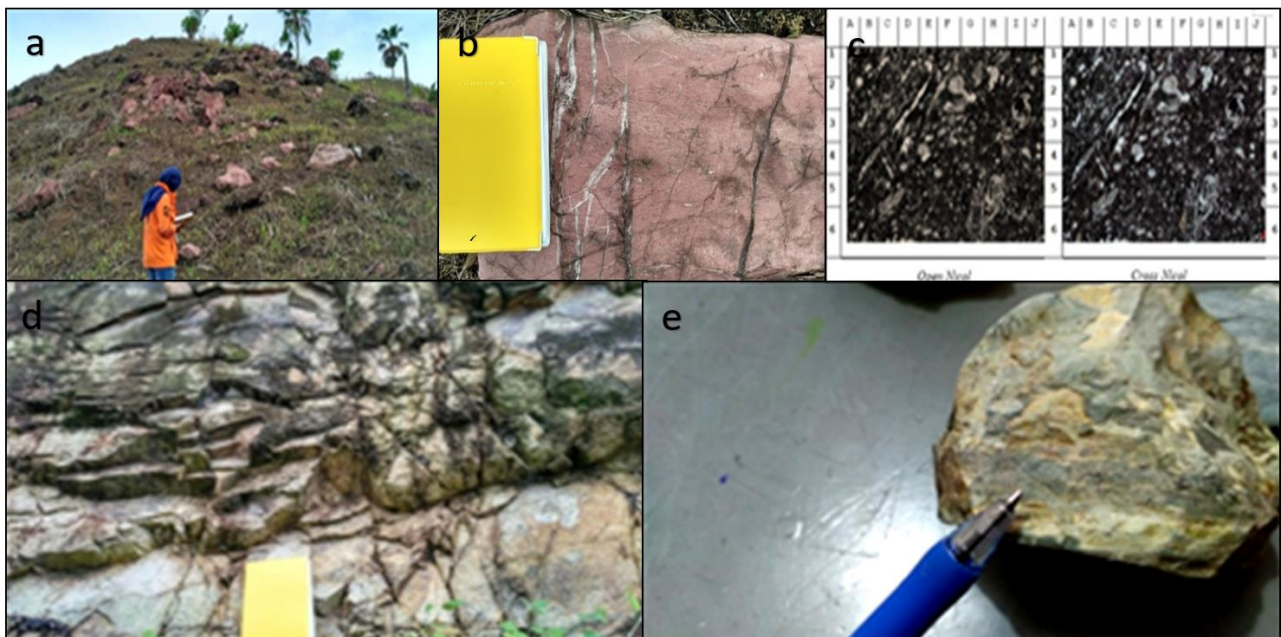
Secara mikroskopis menunjukkan bahwa lava basal (Gambar 4e) berwarna abu - abu gelap hingga *colorless*, tekstur hipokristalin, subhedral-anhedral, dan inequigranular. Terdapat tekstur khusus intersertal dengan persentase mineral biotit 10%, orthoklas sebanyak 5%, kuarsa 15% hadir sebagai fenokris, massa gelas 20%, cordierite 5%, feldspar 20%, dan mineral opak 5%.



Gambar 4. Kenampakan pada satuan Lava Basal Dimito; a) Struktur pillow lava pada singkapan basal, b) Urat kuarsa dan pirit pada sampel batuan basal sebagai tanda adanya aktivitas hidrotermal, c) Columnar joint pada singkapan andesit, d) *metabasal*, e) Kenampakan mineral dalam sayatan batuan basal secara mikroskopis dimana Kuarsa hadir sebagai fenokris, f) Kenampakan mineral dalam sayatan *quartz schist* secara mikroskopis dimana plagioklas hadir sebagai *porphyroblast*.

Secara mikroskopis, sayatan *quartz schist* (O'Dunn dan Sill, 1986) berwarna abu - abu kebiruan hingga coklat muda, bentuk mineral idioblastik, struktur foliasi skitose (penjajaran mineral feldspar) dengan tekstur porfiroblas euhedral dengan lebih dari satu orientasi. Mineral penyusun adalah mineral feldspar plagioklas (50%), kuarsa (25%), aegerine-augite (5%), garnet (10%) dan terdapat *vein* kuarsa (Gambar 4f).

Satuan Lava Basal Dimito dapat dibandingkan dengan Formasi Tinombo (Teot) pada fasies gunungapi (Bachri, 2006) dengan dasar kesebandingan pada kesamaan ciri fisik litologi yang khas berupa adanya mineral *zeolite*, tekstur porfiro afanitik, dan ciri khas *pillow lava* (Gambar 4a). Satuan Lava Basal Dimito ditafsirkan terbentuk di lingkungan laut dalam yang merupakan dasar samudra. Hal ini didukung dengan adanya lava bantal dan asosiasi dengan batu gamping merah (Bachri, 2006).



Gambar 5. Kenampakan pada satuan Wackestone Dimito dan satuan Andesit Kalidingin; a) singkapan satuan wackestone di lapangan yang dapat di kenali dengan warna merah yang khas, b) Kenampakan satuan wackestone dilapangan yang terdapat *vein* kalsit, c) Kenampakan wackestone dalam sayatan petrografi, d) Singkapan batuan andesit dengan adanya stuktur *sheeting joint*, e) *Hand specimen* dari batuan andesit dengan tekstur afanitik.

b. Satuan Wackestone Dimito

Satuan ini menyebar setempat di selatan daerah penelitian yaitu di Desa Dimito dengan luas sekitar 2.5% atau 1.24 km² dari total luas daerah penelitian. Satuan Wackestone Dimito mempunyai ciri-ciri yang khas yang bisa ditemui di lapangan (Gambar 5a). Ciri-ciri berwarna merah, struktur *fossiliferous*, tekstur masif, sortasi baik, *rounded*, kemas tertutup dan berbutir sangat halus, terdapat *gash* berupa mineral kalsit (Gambar 5b) yang bersifat karbonatan. Secara mikroskopis (Gambar 5c), tersusun dari 15% fosil berupa bivalvia, crinoid, brasiopoda dan alga, 50% mikrit dan 20% kalsit. Penamaan batuan secara mikroskopis mengacu pada kalsifikasi Dunham (1962) yaitu Wackestone.

Berdasarkan kesamaan ciri fisik litologi, satuan Wackestone Dimito dapat dibandingkan dengan Formasi Tinombo (Teot) pada fasies sedimen (Bachri, 2006) anggota batugamping merah, dimana satuan ini diendapkan pada Eosen hingga Miosen awal (Bachri dkk., 1994). Satuan ini berasosiasi dengan satuan Lava Basal Dimito dan tidak selaras dengan satuan batuan di atasnya, yaitu satuan Andesit Kalidingin. Satuan Wackestone Dimito ditafsirkan terbentuk di lingkungan laut dalam dengan bukti adanya kandungan fosil yang mencirikan pembentukannya relatif pada laut dalam (Bachri, 2006).

c. Satuan Andesit Kalidingin

Satuan ini menyebar luas di daerah barat penelitian. Luas penyebaran satuan ini sekitar 20.8% atau 10.12 km² dari total luas daerah penelitian. Satuan ini terdapat di Desa Dimito, Dutula Hulapoduala, dan Desa Bongo 3. Ciri litologi (Gambar 5e) yang dapat diamati di lapangan pada satuan ini adalah warna abu - abu gelap hingga abu-abu kehijauan, dengan tekstur afanitik, subhedral - anhedral, intermediet vulkanik, terdapat urat kuarsa, bersifat masif dan kompak, namun pada beberapa tempat telah mengalami pelapukan, dan berstruktur kekar berlembar (*sheeting joint*) (Gambar 5d) sebagai salah satu penciri lava. Ciri litologi ini membedakannya dengan satuan Lava Basal Dimito pada anggota lava andesit.

Berdasarkan kesamaan ciri fisik litologi, satuan ini dapat dibandingkan dengan Formasi Dolokapa (Tmd) berdasarkan peta geologi regional Gorontalo lembar Tilamuta dengan umur Miosen tengah hingga Pliosen awal. Ciri yang ditemukan di lapangan seperti adanya kekar berlembar (*sheeting joint*) dan tekstur afanitik. Hubungan stratigrafi satuan ini dengan satuan sebelumnya selaras dengan batuan yang mengintrusinya yaitu satuan Granodiorit Bualo.

d. Satuan Granodiorit Bualo

Satuan ini tersebar di daerah sekitar Desa Bualo hingga Desa Bongo 4 yang tersingkap di tebing maupun di sungai (Gambar 6b). Luas penyebaran satuan ini sekitar 24% atau 11.76 km² dari total luas daerah penelitian. Ciri litologi (Gambar 6c) dari satuan ini adalah berwarna abu-abu terang dan putih,



Gambar 6. Kenampakan pada satuan Granodiorit Bualo dan satuan Aluvial Bualo; a) menunjukkan adanya asimilasi *xenolith*, dimana terdapat *xenolith* batuan basal di batuan beku granodiorit, b) singkapan batuan granodiorit, c) Contoh *hand specimen* dari batuan granodiorit, d) Sayatan petrografi dari granodiorit, e) endapan alluvial yang terdiri dari fragmen batuan beku dan material lepas, f) *shear joint* pada singkapan di Desa Bualo.

berstruktur masif, anhedral-subhedral, dengan homogenitas equigranular, besar butir faneritik, intermediate, dan hipokristalin. Komposisi mineral berupa plagioklas, quartz, ortoklas, biotit dan piroksen. Granodiorit dan monzonit kuarsa (Streckeisen, 1973) merupakan anggota dari satuan ini. Terdapat *xenolith* (Gambar 6a) pada batuan granodiorit yaitu basal.

Berdasarkan pengamatan petrografi (Gambar 6d) untuk batuan granodiorit, sayatan berwarna biru ke abu-abuan dan coklat tua, tekstur hipokristalin, euhedral - subhedral, hubungan antar Kristal equigranular, tekstur khusus berupa *intergrowth* mineral. Komposisi mineral plagioklas (20%), ortoklas (10%), anortoklas (5%), quartz (35%), dan hornblende (5%). Berdasarkan kesamaan ciri fisik litologi, satuan ini dapat dibandingkan dengan Diorit Boliohuto (Tmbo) dengan umur Pliosen tengah (Bachri, 2006). Ciri yang ditemukan di lapangan bahwa satuan ini mengintrusi formasi sebelumnya dengan ditemukannya *xenolith*. Hubungan stratigrafi satuan ini selaras dengan satuan sebelumnya dan tidak selaras dengan satuan di atasnya (satuan endapan aluvial).

e. Satuan Aluvial Bualo

Satuan ini tersebar pada bagian utara daerah penelitian dengan luas penyebaran 10.2% atau 5 km² dari total luas daerah penelitian. Ciri litologi (Gambar 6e) dari satuan ini terdiri dari material lepas dan berupa endapan yang belum mengalami kompaksi dengan fragmen batuan beku berupa andesit, granodiorit, dan basal, didominasi oleh tekstur berukuran lempung dan sebagian berukuran pasir – bongkah. Tekstur disusun oleh hasil berbagai jenis rombakan batuan yang belum terkonsolidasi, namun dalam bentuk endapan. Bentuk butir dari *rounded* hingga sub-angular.

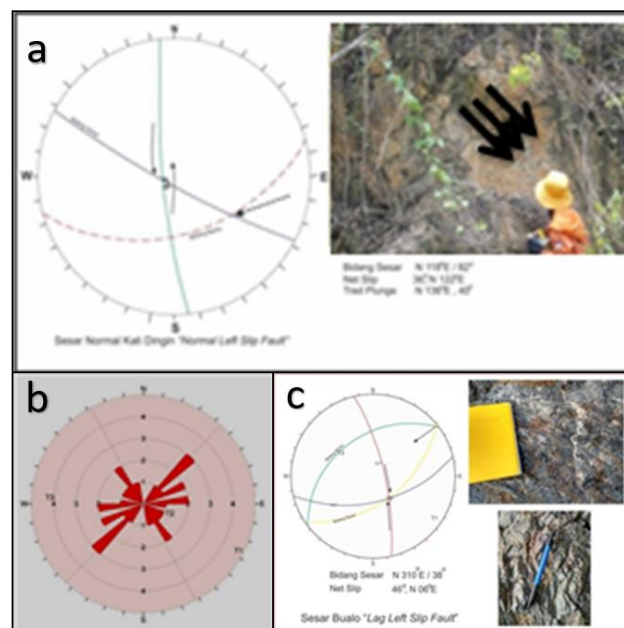
Mengacu pada umur regional maka satuan Aluvial Bualo ini terendapkan pada kala Holosen, dimana terisi oleh material-material lepas dan prosesnya masih berlangsung hingga sekarang. Satuan ini merupakan satuan termuda di daerah penelitian, hubungan satuan ini dengan satuan sebelumnya adalah tidak selaras.

3.3. Struktur geologi

Struktur geologi yang berkembang pada daerah penelitian dianalisis dan interpretasi berdasarkan data dan pengukuran di lapangan. Terdapat data kekar, data sesar (*pitch*, *plunge*, *trend*, dan bidang sesar), zona breksiasi, struktur kekar kolom (*columnar joint*) dan kekar berlembar (*sheeting joint*).

a. Struktur Kekar

Kekar gerus (*shear joint*) (Gambar 6e) merupakan struktur kekar dominan yang ditemukan di lapangan. Hasil analisis menunjukkan bahwa arah tegasan relatif berarah timur laut – barat daya hingga barat laut- tenggara (Gambar 7b). Kekar berlembar mempunyai arah N 48°E. Arah bidang kekar ini relatif ke arah barat. Pada daerah penelitian, *columnar joint* tersingkap di punggung bukit dengan arah N 60° E/76 SE dan dapat diperkirakan arah aliran relatif tenggara.



Gambar 7. Struktur geologi daerah penelitian; a) kenampakan bidang sesar di lapangan dan hasil pengolahan data menggunakan stereonet, b) hasil pengukuran *shear joint* menggunakan diagram roset, c) kenampakan struktur penyerta *gash* dan kekar di lapangan, diolah menggunakan stereonet.

b. Sesar Normal Kalidingin

Kedudukan bidang sesar ini (Gambar 7a) N 118°E/82° SW, nilai *pitch* sebesar 40° serta *net slip* 40°, N 136°E. Berdasarkan hasil analisis tegasan, gaya σ_1 merupakan *stress* terbesar yang mempengaruhi pergerakan sesar dan σ_2 merupakan *stress* yang tegak lurus dengan σ_1 dan memiliki magnitudo kecil (tidak terlalu berpengaruh terhadap pergerakan sesar). σ_3 merupakan *stress* gaya yang tegak lurus dengan σ_1 dan σ_2 dan merupakan hasil dari tekanan yang diberikan oleh σ_1 .

Berdasarkan hasil analisis menggunakan klasifikasi Rickard (1972), sesar ini termasuk dalam *Normal Left Slip Fault*. Sesar terletak pada daerah di sekitar Dusun Kalidingin dan pada kenampakan lapangan terlihat adanya *offset* yang turun serta ditemukannya bidang sesar dan *slickenline*.

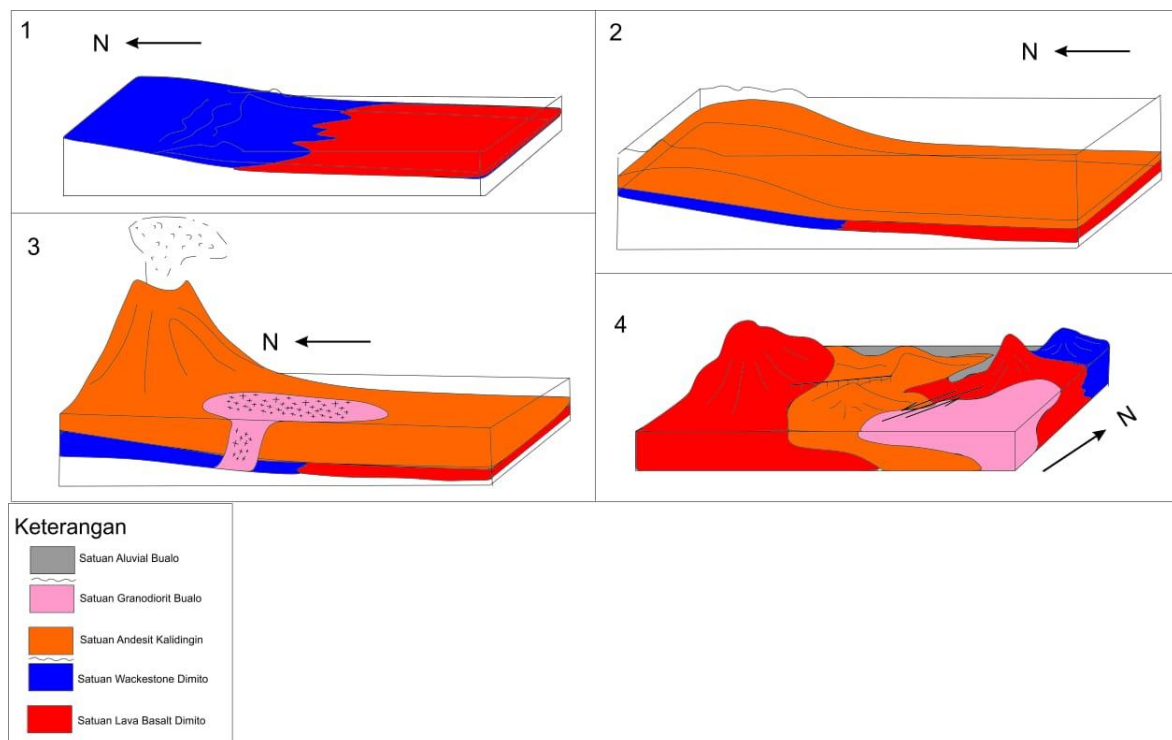
c. Sesar Mendatar Mengiri Bualo

Kedudukan bidang sesar N 310°E/38° NE, nilai *pitch* sebesar 46° serta *net slip* 6°, N 46° E. Berdasarkan hasil analisis tegasan, σ_3 merupakan *stress* terbesar yang mempengaruhi pergerakan sesar. Arah tegasan relatif berarah barat laut – tenggara. Berdasarkan data *pitch* dan kemiringan sesar dan dianalisis menggunakan klasifikasi Rickard (1972), sesar ini termasuk dalam *Lag Left Slip Fault* (Gambar 7c).

3.4. Sejarah geologi

Satuan Lava Basal Dimito merupakan *basement* (Gambar 8.1) dan berasosiasi dengan Satuan Wackestone Dimito dengan susunan yang hampir sama (Silver et al., 1983) yaitu basal dan sedikit gamping yang berasal dari lingkungan laut dalam (Bachri, 2006). Satuan Lava Basal Dimito diperkirakan ditindih oleh andesitik Miosen bawah (Gambar 8.2) yang diperkirakan adalah Satuan Andesit Kalidingin. Satuan Andesit Kalidingin terdiri dari batuan andesit dan batuan basal yang mempunyai ciri berbeda dengan satuan andesit dan basal pada Lava Basal Dimito. Hal ini dipengaruhi oleh adanya kegiatan vulkanisme andesitik dan aktivitas intrusif yang terjadi selama Miosen. Satuan ini diduga diendapkan di daerah lereng relatif curam dengan arus turbidit dan merupakan produk kegiatan gunungapi yang berbeda dengan satuan di bawahnya. Sebagian diendapkan di laut dalam sampai laut dangkal dan menunjukkan pendangkalan secara berangsur dari Formasi Tinombo yang sebelumnya merupakan laut dalam (Bachri, 2006).

Intrusi Granodiorit merupakan hasil kegiatan gunung api yang telah berlangsung selama Pliosen tengah dan menerobos (Gambar 8.3) batuan yang ada pada satuan batuan sebelumnya kemudian menghasilkan aktivitas metamorfisme kontak dengan hidrotermal. Setelah adanya intrusi dari Granodiorit Bualo kemudian terjadi ketidakselarasan yang diakibatkan oleh proses eksogen pada kala Holosen. Proses ini mengubah sifat fisik kimia batuan. Vegetasi dan bentuk morfologi daerah penelitian



Gambar 8. Rekonstruksi sederhana model sejarah geologi daerah penelitian.

yang bisa terlihat adalah adanya bentuk *Roof Pendants* atau atap intrusi karena sebagian dari sisa bukit Satuan Lava Basal Dinito masih tersingkap di lapangan. Batuan yang mengalami erosi dan pelapukan akibat proses eksogen akan mengalami proses perubahan fisik dimana batuan akan menjadi material kecil yang berukuran lempung hingga bongkahan dan terpisah dari batuan asalnya. Material ini dominan diendapkan di daerah sungai sehingga menutupi batuan sebelumnya (Gambar 8.4).

4. Kesimpulan

Secara geomorfik, daerah penelitian dibagi menjadi tiga yaitu Dataran Aluvial, Perbukitan Vulkanik, dan Perbukitan Denudasional. Stratigrafi daerah penelitian terbagi atas lima jenis satuan diurutkan dari Eosen hingga Holosen yaitu Satuan Lava Basal Dinito (Eosen awal), Satuan Wackestone Dinito (Eosen awal), Satuan Andesit Kalidingin (Miosen tengah), Satuan Granodiorit Bualo (Pliosen tengah), dan Satuan Aluvial Bualo (Holosen). Struktur geologi yang bekerja pada daerah penelitian berupa kekar relatif berarah timur laut–barat daya hingga barat laut–tenggara. Sesar yang bekerja pada daerah penelitian yaitu Sesar Normal Kalidingin dan Sesar Mendatar. Sejarah geologi pada daerah penelitian berawal dari kala Eosen yaitu Satuan Lava Basal Dinito yang berasosiasi dengan satuan Wackestone Dinito, di atasnya diendapkan secara tidak selaras Satuan Andesit Kalidingin pada kala Miosen Tengah, kemudian diintrusi oleh Satuan Granodiorit Bualo pada Pliosen Tengah, dan akhirnya tererosi menjadi Satuan Aluvial Bualo yang bekerja hingga sekarang.

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