A Short Note on Sedimentary Rocks of the Barru Area, South Sulawesi

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ABSTRACT

Barru area comprises four sedimentary sequences that include Cretaceous *flysch* sediment of Balangbaru Formation in the lower part, overlain by Tertiary terrestrial sediments of Mallawa, shallow-marine-redeposited carbonate of Tonasa and volcaniclastics sediment of Camba Formations in the upper part. Three of these sequences show characteristics of deep-marine depositional system that are associated with turbidite – debris flow facies and post-depositional deformation structures. Their occurrences are interpreted to have been controlled by regional tectonics, in particular during the redeposition of the Tonasa Formation carbonates and also the volcaniclastic-epiclastic of the Camba Formation. The difficulties in defining sedimentary basin in this area might possibly be, in part, due to the basin was modified during or after the depositional period. Therefore, it is very hard to trace the basin continuously in only one site.

Introduction

Several efforts have been carried out to study sedimentary rock sequences in the Barru region. Four sedimentary rock units have been recognized in this area, which include, in younging order, the Cretaceous *flysch* sediments of Balangbaru (Hasan, 1991), terrestrial sediment of Mallawa Formation, shallow marine and mixed carbonate rocks of Tonasa Formation (Wilson & Bosence, 1996), and volcaniclastic sediments of Camba Formation (Sukamto, 1982). Such lithologic units have their own characteristics. The above authors have given more detailed explanation on sedimentary rock styles and they also have interpreted the formation mechanism of these sequences. Hence, sedimentary rocks in the Barru region become the reference to explain the geological setting of South Sulawesi.

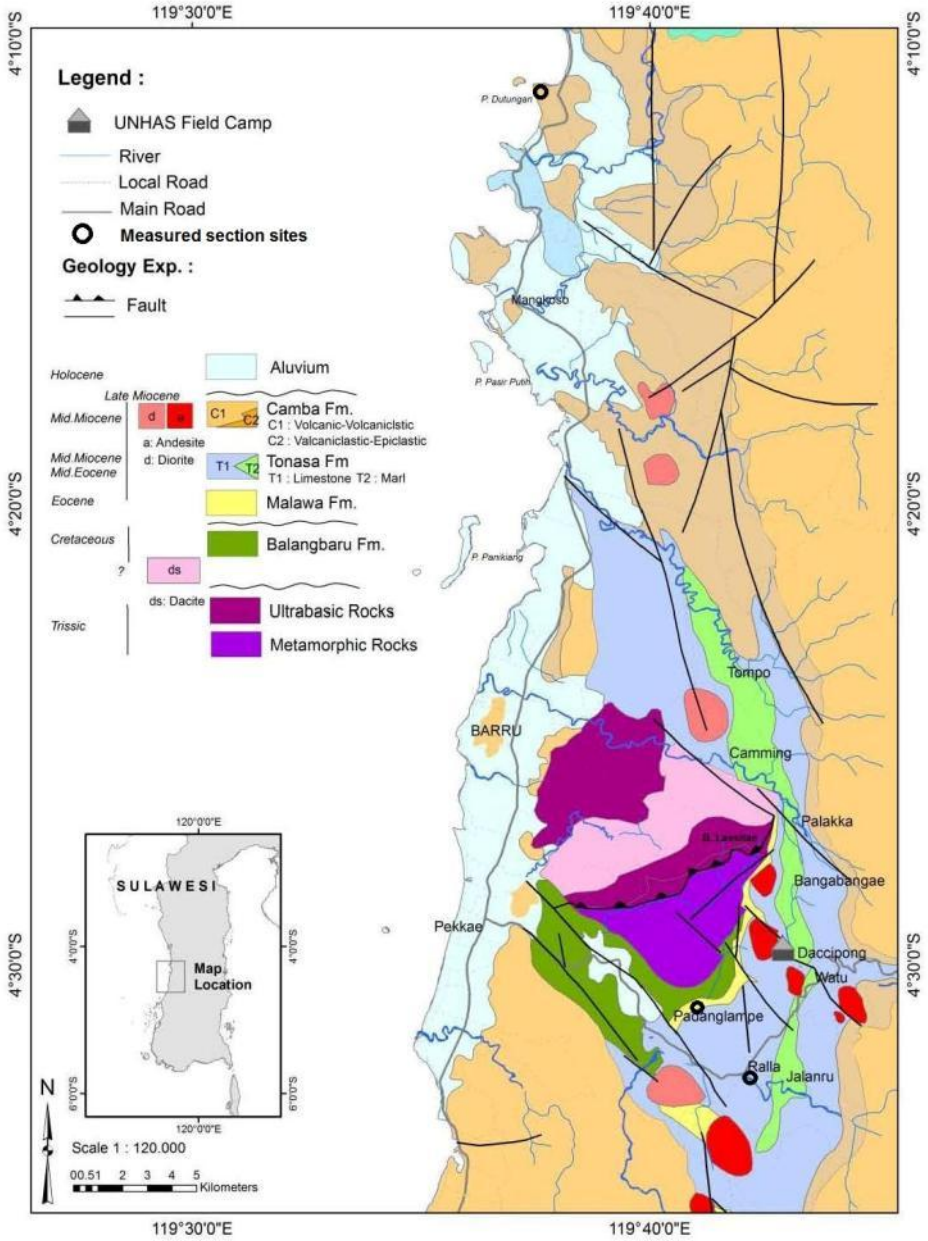


Figure 1. Map showing the sites of measured sections and lithological distribution of the Barru area (Modified after Sukamto, 1982).

In this paper, we discuss three measured sections that represent Tertiary sedimentary sequences in the area, which are located in Padanglampe, Ralla and Dutungan Villages (Fig.1). The discussion will be focused on field description of these sections along with brief explanation about environmental condition and tectonic control on the deposition of these rocks.

General Geology of Barru

Barru is located approximately 120 km to the north of Makassar, capital city of the South Sulawesi province. The area

can be accessed from Makassar by driving four-wheel vehicles for about 2 hours. Geologically, this area has complex lithologies and may possibly represent the complete lithological assemblages that reflect the tectonic and geological condition of South Sulawesi (Figs. 1 and 2) . The oldest outcrop in the area forms part of a basement complex called Barru Block (Berry & Grady, 1987), which consists of ultramafic and metamorphic rocks and are overlain by sedimentary sequences of various age and composition. The lowest part of the outcropped ultramafic unit is serpentinised peridotite and is underlain by quartz-mica schist, then quartzite and chloritic phyllite. The rock assemblages in the Barru Block have a SE-dipping foliation and a S to SW-trending lineation (Maulana, 2009). The upper part of the basement complex is overlain by Cretaceous sediments of the Balangbaru Formation. This sequence is interpreted to have formed in a small fore-arc basin that was located on the trench slope (Hasan, 1991). This is possibly part of the Bua member that can be observed in this area. This rock is predominantly composed of interbedded silt-shale with subordinate of thinly fine to medium grained sandstones.

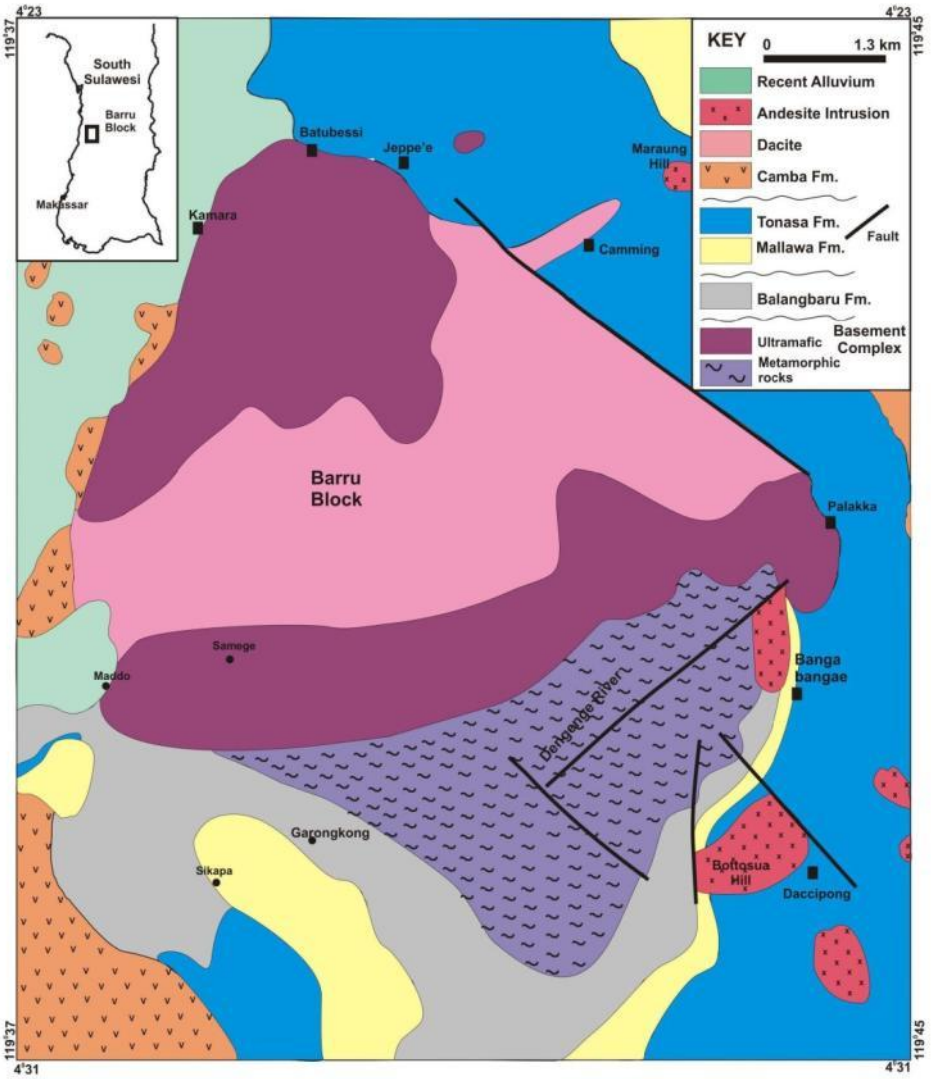


Figure 2. Simplified geological map of Barru area (Modified after Wilson and Bosance, 1996)

The top of the Balangbaru Formation is unconformably overlain by the terrestrial sediment of Mallawa Formation, with a prominent lithological contact that can be found in Lagolla river. In the Barru area, the Mallawa Formation is well-exposed in Padanglampe village. The lower part of the Mallawa Formation is mainly constituted of coarse grained materials, such as quartz sandstones and conglomerates. Toward the upper part of the sequence, the rocks gradually change into finer-grained materials, such as silts, marls, and clays (Hasibuan, 2003). The sequence is also intercalated with coal deposit; and massive, well-bedded and medium-grained limestone is found in the upper part of the formation.

A gradual contact occurs between the Mallawa Formation and the overlying Tonasa Limestone Formation, indicating conformable relation (Sukamto, 1982). The Tonasa Formation is mainly composed of platform carbonates and is overlain by volcaniclastic sediments of Camba Formation. The Camba Formation is mainly composed of marine sedimentary rocks interbedded with volcanic rocks. In some places in Barru, both limestone and volcaniclastic rocks are intruded by diorites, basalts, and trachytes in the form of dikes and sills.

Padanglampe Section

Despite no detailed studies have been published to date about the depositional mechanism of the Mallawa Formation, microfossil analysis undertaken by Hasibuan (2003) suggests that the age of the formation is at least Middle Eocene and the sequence was deposited in a nearshore, mangrove environment, which has high energy with fresh water input such as from the river. This depositional setting is a characteristic of deltaic environment.

The result of measured section conducted in Padanglampe Village (Fig. 3) shows that three sub-sections can be identified, which include lower (a), middle (b), and upper (c) sub-sections. The lower sub-section (a) consists of interbedded conglomerates, conglomeratic sandstones, massive sandstones, siltstones and carbonaceous mudstones with sedimentary structures of graded bedding and cross lamination. The bedding pattern is fining upward with erosional base that has similarity with that of the channel deposit. These features indicate typical fluvio-deltaic channel environment.

In the middle subsection (b), interbedded carbonaceous mudstones, coals calcareous mudstones, and calcareous sandstones were found.

This subsection also contains abundant mollusks with bivalves, gastropods, and coral fragments. Sedimentary structures show wavy, lenticular with the bedding pattern of coarsening upward. These features might be related to lacustrine or lagoonal depositional environment within a restricted area.

The upper subsection (c) is mainly composed of foraminiferal wackestones-packstones with abundant *Nummulites* and *Alveolina*. This rock is interpreted to have been deposited in a backreef–barriers environment.

Ralla Section

The distribution of Tonasa carbonate platforms in South Sulawesi was described in detail by Wilson & Bosence (1996), including those located in the Barru area. A very interesting outcrop has been observed in the Ralla Village, around 10 km to the north of the Barru Town (Fig. 4). The section comprises shallow and mixed deep marine carbonates. This area is known as the strato-type of the Tonasa Formation (Sukamto, 1982).

Umpung river

The section measured at this site represents shallow marine carbonate deposit, starting at the bottom or after the top of the Mallawa Formation where dark gray limestones containing mollusks were noted. Towards the south (the upstream), the gradual contact between the bottom of the Tonasa Formation and the top of the Mallawa Formation was found. This contact is characterized by light-colored wackestones that are composed of large foraminiferas and gastropods and are well-bedded, ranging from 20cm–1m thick (Fig. 4a). The environmental deposition of this deposit was in the restricted area of marine backreef-barrier (Wilson & Bosence, 1996). In the middle part of the Umpung section, massive wackestones and packstones that contain *Nummulites* trapped in coralline algae (Fig. 4d) were found. The rudstone is also composed of fragments of branching corals (Fig. 4c), suggesting shallow marine carbonate (Wilson & Bosence, 1996). The bedding can be recognized in a few cm – meter thick (Fig. 4b) and it shows a lot of stylolites. The initial back reef – shallow marine or platform carbonate depositional environment possibly occurred during the Middle Eocene. The depositional setting changed into a small basin in the Oligocene and was characterized by redeposited sediments.

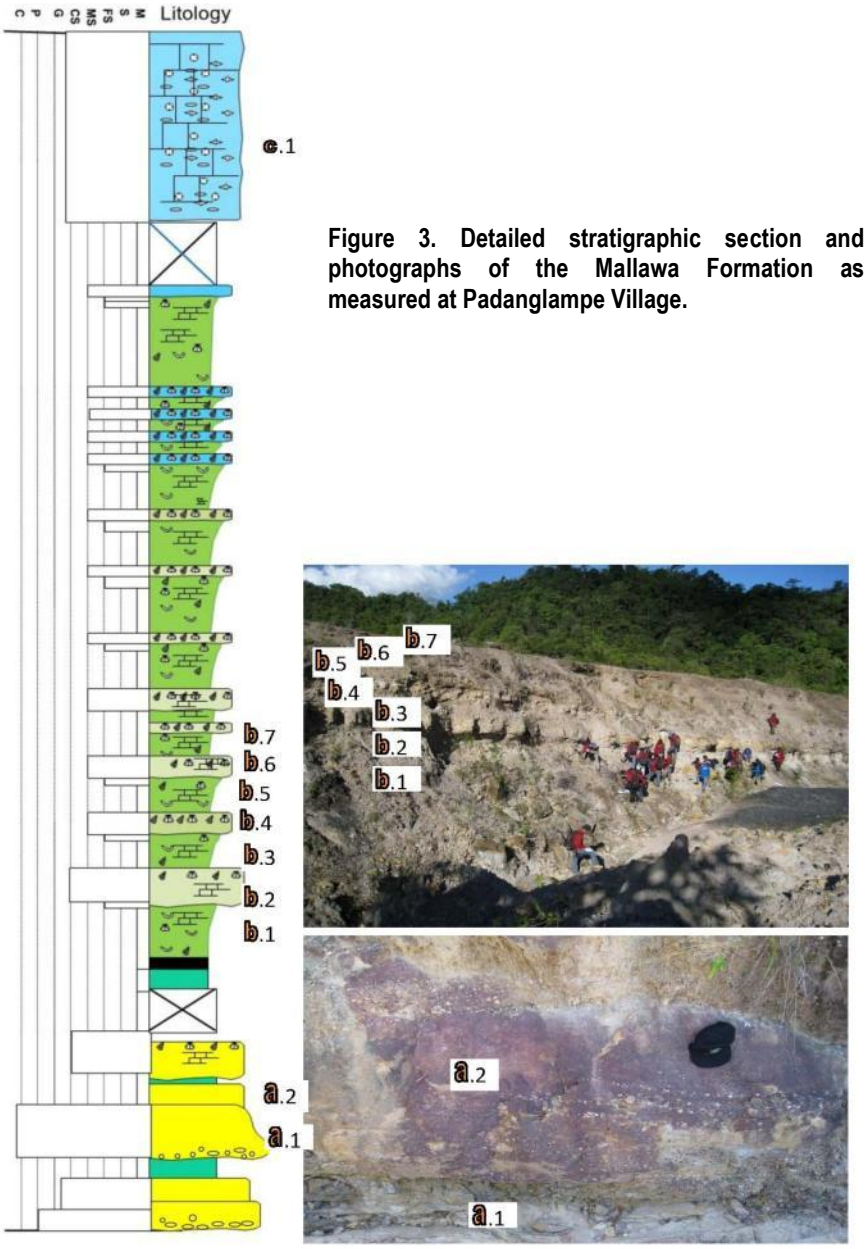


Figure 3. Detailed stratigraphic section and photographs of the Mallawa Formation as measured at Padanglampe Village.

Ralla river

This section, which is part of Tonasa Formation, shows interbedded bioclastic mudstones-wackestones and marls that contain benthic foraminiferas. Below the Ralla bridge, bioclastic limestones containing large foraminiferas with abundant *Discocyclina* were discovered (Fig. 4e). The bioclastic limestones were also interbedded with marls, while the mudstones are interbedded with wackestones and marls. The AB parts of the Bouma sequence can be applied to sedimentary beds observed at this site. The thining-upward succession (Fig. 4f) contains benthic foraminifera and echinoids also can be seen. The Jalanru-Wessae Village section represents redeposited sediments (Fig. 4h, i, j) that consist of debris fragments of carbonates with marl-grain-supported. These sediments also contain terrigenous materials derived from basement rocks, such as schists, cherts, clastic rocks and reworked bioclastics which may be derived from shallow water fossils. Horizontal burrows on the bed surface are abundant (Fig. 4g). All of these suggest deposition in a marine, basinal environment. Extremely further to the south, more extensive grain-supported lithologies such as conglomeratic-impure calcirudites, sandy limestone-

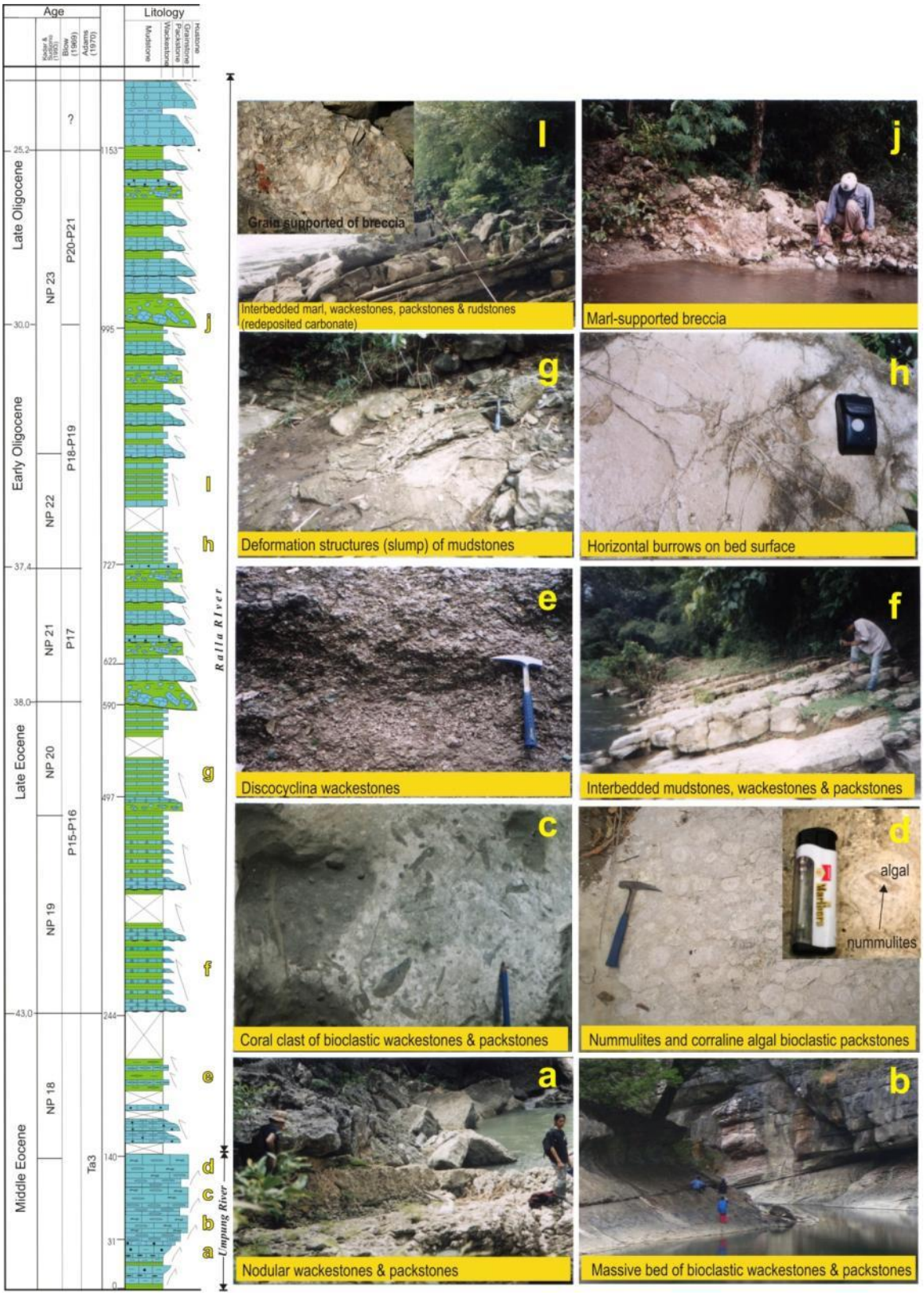


Figure 4. Detailed section and photographs of the Tonasa Limestone Formation observed in Ralla Village (modified after Jaya, 2001).

impure calcarenites, and well-bedded carbonate mudstones were noted.

Dutungan Section

Volcaniclastic sediments of the Camba Formation are widely outcropped along the west coast of the Barru area. One of the excellent sections was found at Dutungan Village (Fig. 5). This outcrop was described as part of the Mio-Pliocene, marine, volcaniclastic sediments of Camba Formation (Sukamto, 1982).

Vertical sequences show a variety of thin to medium thick successions. Turbidite sequence with massive sandstone units varying between 20 and 50 cm thick show sharp contact at the base of the unit. Normal grading grains and part of the top unit show convolute lamination or contorted lamination (insets in Figs. 5a & d). An interbedded tuffaceous sandstone with thin mud/shale bed and siltstone (which represent AB Bouma

subdivision) was also described. Chaotic structure is present in numerous slump folds and slidings (Fig. 5c). Water escape structures are also present (Fig. 5d). Debris flow unit which contains mud and grain-supported of conglomerate-breccias, basaltic-andesitic fragments, limestones, volcaniclastic primary crystals, and tuffaceous sandstone blocks indicate debris slide. Generally, the unit indicates a debris avalance deposit (Fig. 5b). The bedding pattern of the sequences is fining upward and they are deepening upward successions.

The diagnostic feature of these

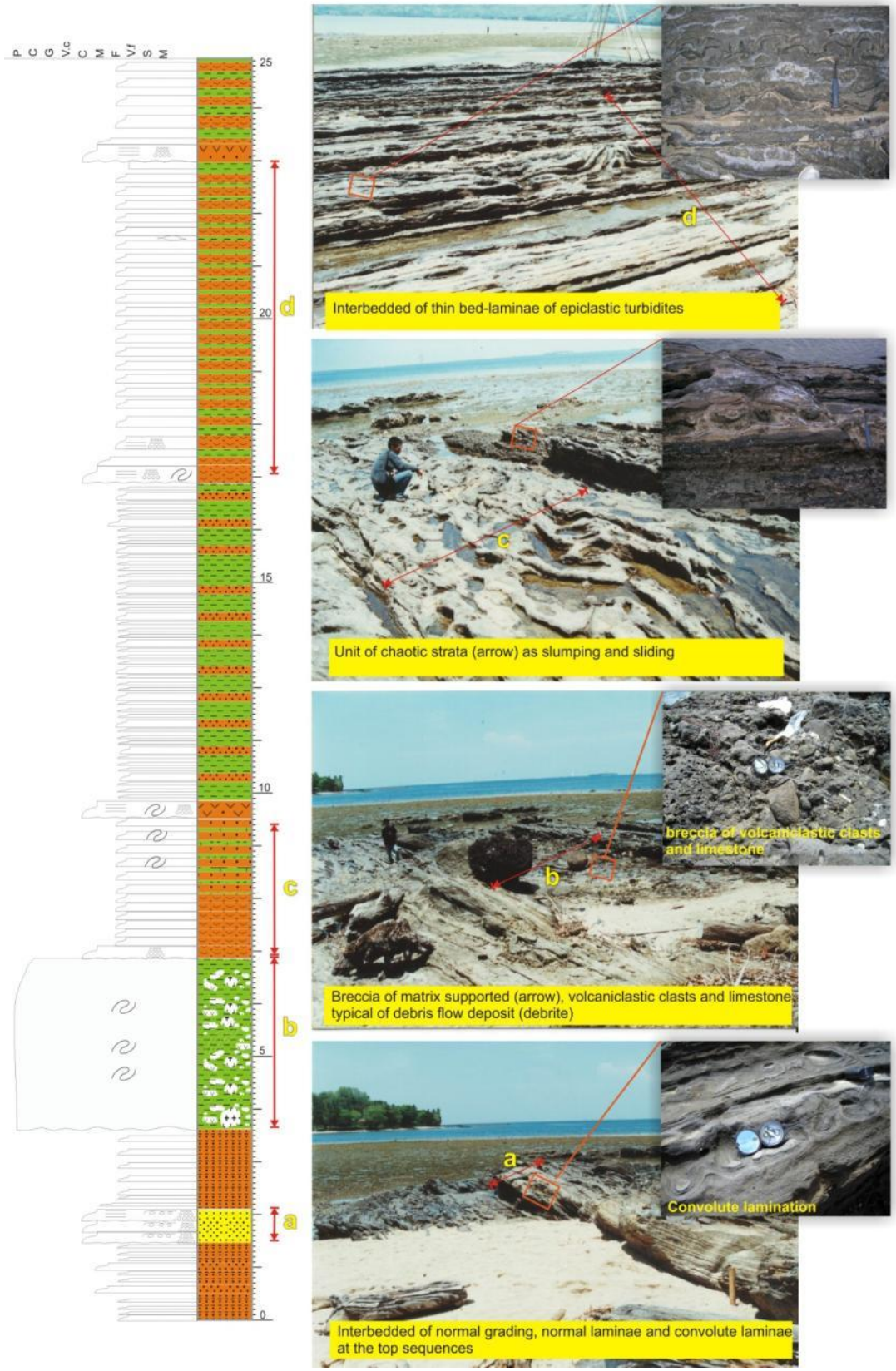


Figure 5. Detailed section and photographs of volcaniclastic sediments of the Camba Formation measured in Dutungan Village (modified after Jaya, 2006).

sediments tends to be more associated with deep marine clastic environment rather than volcaniclastic environment. It was probably formed in the slope apron environment up to the basin plain.

Discussions

The redeposited carbonate facies of the Tonasa Formation in this area might be derived from activities of two fault lines, i.e. Bantimala and Barru blocks. It possibly took place in the Middle Oligocene to Early Miocene (Wilson & Bosence, 1996). The upper part of the redeposited facies of the Tonasa Formation shows conformable contact with the marine, lower Camba Formation, suggesting continuous condition of deepening up that was represented by deep marine shales interbedded with volcaniclastics. The deposition of marine Camba Formation also seems to be controlled by fault lines. The features showing turbidite that were associated with chaotic and debris flow indicate that their deposition occured in the slope apron environment, as can be seen in the Dutungan section, unlike the Mallawa Formation that typically shows terrestrial to marginal marine siliciclastic deposits. The Mallawa Formation also possibly occur in a series of fault-bounded sub-basins (van Leeuwen, 2010).

We postulate that sedimentary rocks in the Barru area may be representative of the western divide mountain and South Sulawesi used to be situated in basin that was controlled by regional tectonic and was modified to become smaller and restricted in area. Sediment inputs might be derived from the surrounding areas. The deposition of the Tonasa carbonates was probably indicative of the cessation of subduction and volcanism in the Oligocene. New subduction occurred in the east, which was related to Kalamiseng volcanics (van Leeuwen *et al.*, 2010). This has led to regional extension of the western divide mountain. Major tectonic events in the Middle Miocene can be related to the formation of Walanae fault zone and block faulting of carbonate platforms (van Leeuwen *et al.*, 2010). This was also probably coincident with the deposition of marine Camba Formation in the west.

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News from SEPM

Dear Colleagues,

You are cordially invited to submit a talk or poster abstract for consideration in a Symposium focused on Applied Ichnology (Symposium 13.5) in Theme 13 (Sedimentation and Sedimentary Processes), at the 34th International Geological Congress, Brisbane, Australia (5-10 August, 2012).

The Applied Ichnology Symposium will be focused on the role of ichnology in sedimentation and sedimentary processes, particularly in the areas of facies analysis, genetic stratigraphy, and reservoir characterization.

The Abstract and Early Bird Registration site is now open and we encourage you to submit abstracts as soon as possible. The closing date for abstracts is 17 February 2012.

Kind regards,

Kerrie L. Bann and James A. MacEachern (Co-Chairs).

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