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Research Article

CHARACTERIZATION AND CLASSIFICATION OF THE BASAL CONGLOMERATE FORMATION ALONG TYRSAD-WEILOI TRANSECT, MEGHALAYA, INDIA

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ABSTRACT
The study focuses on the characterization and classification of the Basal conglomerate formation from Tyrsad and Weiloi area based on four parameters i.e., texture, clast composition, clast size and source after the nomenclature of Selley, 2000 classification. Out of the eight sampling sites along Tyrsad and Weiloi area. Umnongrim outcrops actually stands out different as the only Paraconglomerate or matrix supported conglomerate as well as categorized under pebble conglomerate (4-64mm) based on clast size and is an Monomictic or oligomictic based on its clast composition. Whereas all the remaining sampling sites from Weiloi, Lumspong, Umlangmar, Kyrphei, Nongmadan, Um-Maria and Umkaber-Lyniong are Orthoconglomerate or clast supported conglomerate, categorized under cobble conglomerate (64-256mm) for clast size categorization and polymictic based on its clast composition. The one common character of the outcrops is that all are categorized under intraformational conglomerate based on their source region. The matrix of the conglomerate of Tyrsad-Weiloi area are mostly arkosic in nature and cementing material of siliceous (quartz) and ferruginous material. Basal conglomerate formation of the Khasi Group of Rocks from Tyrsad and Weiloi region holds a significant Geo-Heritage potential. The need for community awareness and preservation of this conglomerate formation becomes very crucial in this point of time as they holds a key potential of becoming an important Geo-heritage site.

Keywords: *Basal Conglomerate Formation, Geo-Heritage potential, Intraformational conglomerate*

INTRODUCTION
'Conglomerate' is derived from the Latin word '*conglomeratus'* meaning heaped or pressed together. It was first used in the late eighteenth century. It is a coarse-grained clastic sedimentary rock consisting of clasts (granules, pebbles, cobbles and boulders) larger than 2 mm in diameter embedded in a finer-grained sedimentary matrix. The present study is carried out on the Basal conglomerate formation belonging to the Khasi Group of rocks from Meghalaya Plateau. The region has a unique geology representing the North-east extension of the detached part of the Deccan plateau of India. Many significant contributions have been made in the region from the earliest geological work (Oldham, 1858; Medlicott, 1869; Palmer, 1923; Mathur and Evans, 1964; Barooah and Goswami, 1972; Geological Survey of India, 1974 and 2009; Barooah, 1976; Bhattacharya and Bhattacharyya, 1981; Mishra and Sen, 2001; Khonglah, *et. al.,* 2022). The unique geology of the plateau continues to enrich the scientific community like the recent mega discovery of the Meghalayan Age from the Mawmluh cave through the study of the speleothems. The discovery of dinosaurs bones at Dirang village, West Khasi Hills District within a grained purple-coloured sandstones horizon belonging to the Mahadek Formation of Late Cretaceous period (Mishra and Sen, 2004). Indeed, the geological dynamics of the plateau has a huge potential for many more scientific endeavours as geologists, scientists, and researchers continue to dive deeper into its studies.
The present study was carried out on the Basal Conglomerate of Tyrsad and Weiloi area to understand the Paleo-environmental deposition of the conglomerate where the characterization and classification of the conglomerate based on its texture, grain size, matrix and clast according to Selley's classification of conglomerate (2000) was carried out. The study area holds a significance geological importance as it has

the potential of becoming an important Geo-Heritage site much needed to be protected and preserved. Awareness is deeply lacking about the importance of these conglomerate outcrops among the communities for which continuous quarrying and extraction of these conglomerate rocks for construction purposes have been continuing all these decades. Thus, altering the profile of the conglomerate outcrops for which in a matter of no time these beautiful and important outcrops can be over exploited and fear of destroying these beautiful Geological monument. With enough community sensitizing about these conglomerate outcrops it can be preserved as an important Geo-heritage site which will also help in promoting Geo-tourism benefitting the community at large.

Geology of the Study area

The Meghalaya plateau represents a remnant of an ancient plateau of Pre-Cambrian Indian Peninsular

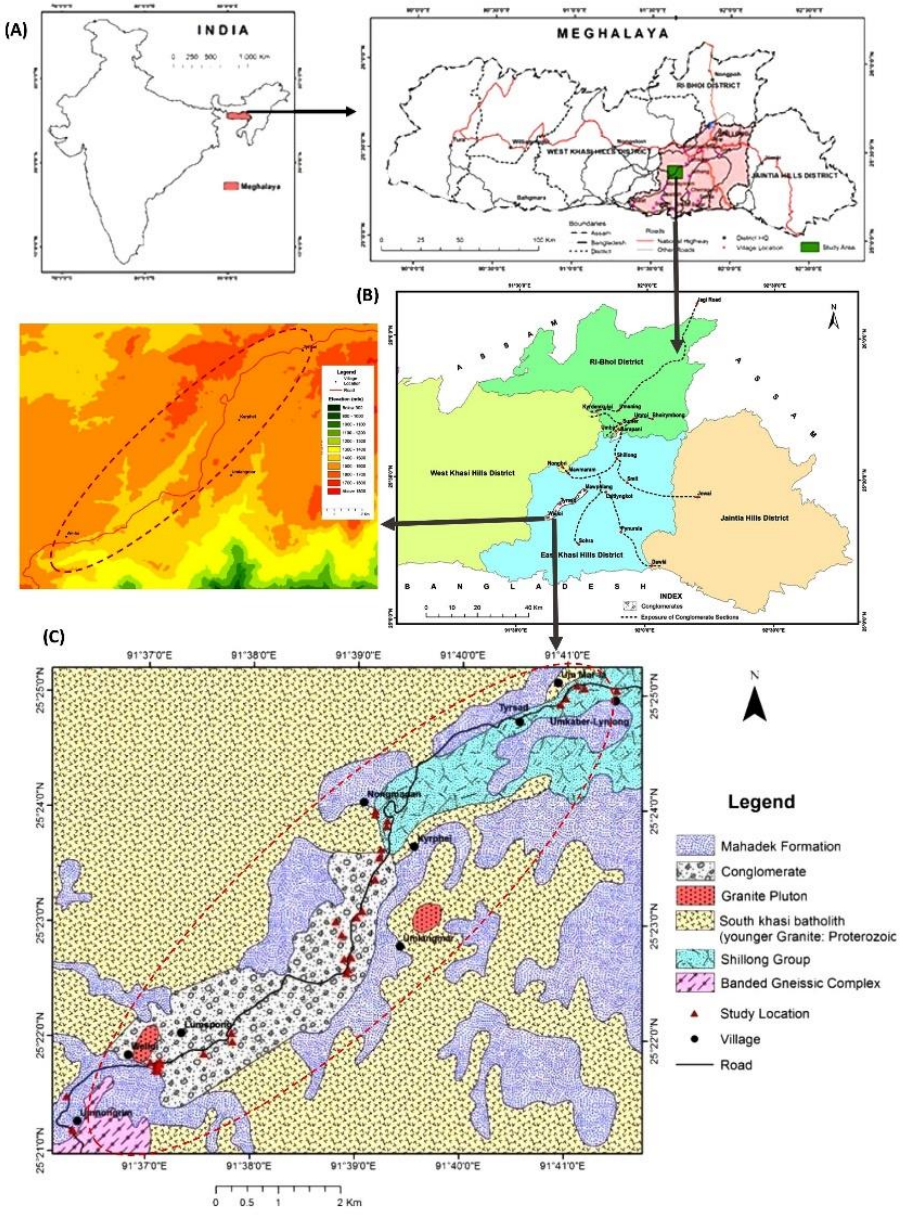

Figure 1: Location of the study area map a) Study area location b) Distribution of the conglomerates along the North-South profile c) Geology of the study area.

shield, the block uplifted to its present height as represented in figure no.1. The present physiographic configuration of the plateau had attained through different geologic events as indicated by the polycyclic erosion surfaces at various levels. Palaeo-meso- Proterozoic Shillong Group of rocks unconformably overlie the Gneissic complex and is predominantly composed of quartzite, phyllite, and quartz-sericite schist. The lower metapelitic formation and upper quarzitic formation has an intraformational conglomerates which has undergone no or little strain. The study area contains outcrops of conglomerate (sedimentary deposits) of tertiary/cretaceous age. The Predominant Geological Formations present in the study area are Archaean Gneissic Complex-Granitic, Gneissic and Schistose rocks and Shillong Group-Quartzites and Phyllites.

MATERIALS AND METHODS

For the present study conglomerate outcrops along Tyrsad and Weiloi transect have been delineated for nomenclature and classification based on Selley's classification (2000) as shown in table no.1. Based on texture, composition, dominant-clast size and source. Field study has been conducted along with Senior Petrologist Medard Khonglah from Geological Survey of India who have contributed a lot in understanding the geology of the region.

The survey of India topographic sheet number 78 O/11, with a mapping on 1:50,000 scale was used for detailed disposition of the conglomerate. Base map preparation of the study area was done using Arc GIS. Sediments samples were each point geo-referenced on the basis of field inspection. The sampling starts from Tyrsad, Umkaber-Lyniong, Nongmadan and Um Ma-ria conglomerate, Kyrphei, Umlangmar, Weiloi, Lumspong and Umnongrim. Along these sampling sites the Basal conglomerate formation are well exposed and one can observed a good profiling of the outcrop due to heavy quarrying activities on the conglomerate.

Table 1: Nomenclature of Conglomerate (after Selley, 2000)

I	Texture	Orthoconglomerate	Clast Supported
		Paraconglomerate	Matrix Supported
II	Composition	Polymictic	Composed of several types of clasts
		Oligomictic	Composed of only one type of clasts
III	Source	Intraformational	Originate within the basin
		Extraformational	Extrabasinal in origin
IV	Dominant clast-size	Granule conglomerate	2-4 mm
		Pebble conglomerate	4-64mm
		Cobble conglomerate	64-256mm

RESULTS AND DISCUSSION

The four parameters of texture, clast composition, source and clast size based on Selley's classification of 2000. The Basal conglomerate formation of Tyrsad and Weiloi area can be characterized and classified into the following types as shown in the table no.2.

Table 2: Characterization of Tyrsad-Weiloi conglomerate based on clasts, source and texture

Sl.no	Location	Texture	Clast Size	Clast composition	Source
1	Umnongrim	Paraconglomerate/Matrix supported	Pebble (4-64mm) conglomerate	Monomictic/ Oligomictic	Intraformational
2	Weiloi	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
3	Lumspong	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
4	Umlangmar	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
5	Kyrphei	Orthoconglomerate/clast conglomerate	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
6	Nongmadan	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
7	Um-Ma-ria	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational
8	Umkaber-Lyniong	Orthoconglomerate/Clast supported	Cobble conglomerate (64-256mm)	Polymictic	Intraformational

Characterization and Classification based on Texture

Tyrsad –Weiloi conglomerate can be further classified into two types based on their texture viz., Paraconglomerate and Orthoconglomerate.

*Paraconglomerate***:** Umnongrim sampling sites is the only conglomerate outcrop which can be classified as paraconglomerate or matrix supported conglomerate as shown in figure no. 2 (A). The space between the gravel-clasts of conglomerate is filled by a varying composition of silt, sand and clay which are known as matrix. As the gravel clasts in a conglomerate are separated from each other such that the clasts are not in contact with each other and float within the matrix known as paraconglomerate.

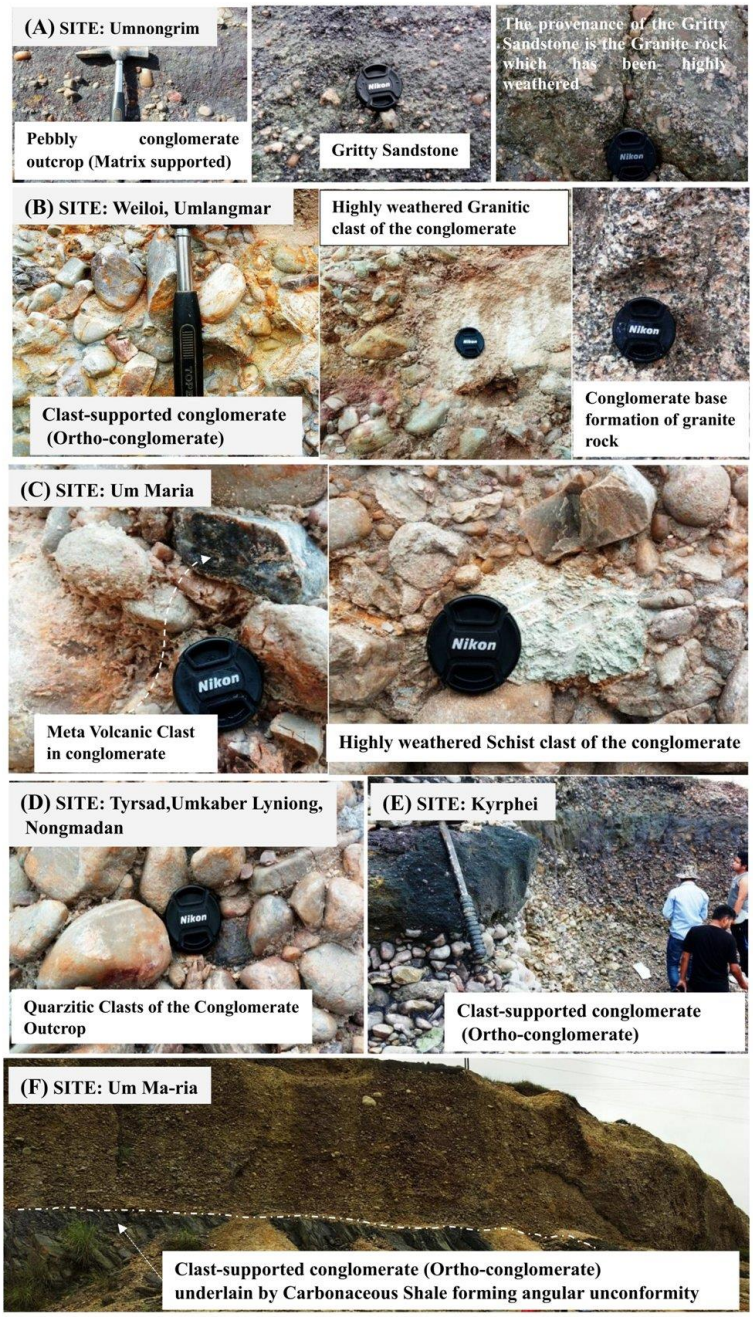

Figure 2: Represents the Basal Conglomerate formation of Tyrsad-Weiloi transect
A. Umnongrim conglomerate outcrop, B)Weiloi and Umlangmar conglomerate outcrop, C) Um Maria conglomerate clasts, D) Tyrsad, Umkaber-Lyniong and Nongmadan conglomerate outcrop, E) Kyrphei conglomerate outcrop, F) Um Maria conglomerate outcrop
B. Orthoconglomerate: The sampling sites starting from Umkaber-Lyniong, Um Ma-ria, Nongmadan, Kyrphei, Umlangmar, Lumspong and Weiloi are all classified as an orthoconglomerate figure no.2 (B, C, D, E, F). As the gravel clasts of a conglomerate are in contact with each other. Unlike paraconglomerate, orthoconglomerate are often well-cemented and lithified by calcite, hematite, quartz or clay.

Characterization and Classification based on Clast Composition

Conglomerates are classified into two major types based on their clast composition. They are Monomictic or Oligomictic conglomerate and Polymictic conglomerate which is again further classified into Petromictic conglomerate.

Monomictic or Oligomictic Conglomerate: Conglomerate or any clastic sedimentary rock that consists of a single rock or mineral is known as either a monomict, monomictic, oligomict or oligomictic conglomerate. From the study area only Umnongrim conglomerate sampling sites can be categorized as a Monomictic or Oligomictic conglomerate.

Polymictic Conglomerate: Conglomerate clasts consisting of two or more different types of rocks, minerals or combination of both and is known as polymict or polymictic conglomerate. From the study we can infer that all the sampling sites except Umnongrim others like Umkaber-Lyniong, Um Ma-ria, Nongmadan, Kyrphei, Umlangmar, Lumspong and Weiloi conglomerate can be classified as polymictic conglomerate because the conglomerate clasts comprise of different types of rocks like quartzites, schist, meta volcanic clasts and granite.

Characterization and Classification based on Source

Conglomerates by their source can be characterized into two types known as extraformational and intraformational conglomerate as indicated by the lithology of the gravel-size clasts. The conglomerate of the study area are all characterised and classified as an intraformational conglomerate which suggested that the clasts of the conglomerate consist of rocks and minerals that are same or consistent with the lithology of the enclosing matrix and thus penecontemporaneous (process occurring immediately after deposition of a particular stratum) and derived from within the basin of deposition, and therefore is known as intraformational conglomerate. If the clasts consist of rocks and minerals that are significantly different in lithology from the enclosing matrix which is older and derived from outside the basin of deposition, the conglomerate is known as an extraformational conglomerate.

Characterization and Classification based on Dominant Clast-Size

The conglomerate of the study area can be characterised and classified based on their Dominant clast size comprising as Granule (conglomerate composed largely of granule-size 2-4mm), Pebble (pebble-size of 4-64mm), and Cobble conglomerate (cobble-size of 64-256mm). The results suggested that only Umnongrim conglomerate can be classified as a pebble conglomerate and all the other conglomerate sampling sites from Tyrsad to Weiloi can be characterised as a cobble conglomerate.

General Description of Basal Conglomerate Formation from Tyrsad-Weiloi area

A general description of the Basal conglomerate formation is discussed here to summarised each sampling sites in details

*Umnongrim conglomerate sampling sites***:** Umnongrim conglomerate are dominated by pebble size-clast of 4-64mm and are classified as pebble conglomerate based on their clast size as shown in figure no.2 (A). Based on their texture they are characterized as a matrix-supported or paraconglomerate. Based on their clast they are characterised as monomictic or oligomictic as the clasts are dominated mostly by only one major type of clast basically the quartzite. The area has a huge extensive exposure of the Mahadek sandstone with a thin bed of pebbly beds within the gritty sandstone figure no.2 (A). The deposition of these sandstone beds must have taken place in a much lower level of energy deposition. The matrix is made of argillaceous material.

*Weiloi and Lumspong conglomerate sampling sites***:** Weioi and Lumspong conglomerate have similar physical characteristics and are dominated mostly of cobble size-clasts of 64-256mm and can be classified under cobble conglomerate based on their clast size figure no.2 (B). Based on their texture and clast composition they are characterized as clast-supported conglomerates or orthoconglomerate and polymictic as they are mostly dominated by quartzites and other few clasts like granite.

Umlangmar conglomerate classification: Umlangmar conglomerate is dominated mostly by cobble size clast of 64-256mm and is classified as a cobble conglomerate, clast supported conglomerate or

orthoconglomerate figure no.2 (B) and polymictic (quartzites, highly wearthered granite, schist) as the clast are composed of different types of rocks having granitic origin as the base of the conglomerate.

Kyrphei conglomerate: Kyrphei conglomerates outcrop is located within the coordinates of 25°.38'N to 25°.39'N and 91°.64'E to 91°.65' E. Here the conglomerate are categorized as cobble conglomerate because they are mostly dominated by cobble size clasts (64-256mm) and orthoconglomerate because of their clast supported texture figure no.2 (E). Depending on their clast composition Kyrphei conglomerate are composed of only one major type of clasts basically the quartzites and are known as monomictic or ologomictic conglomerate.

Nongmadan and Um Ma-ria conglomerate outcrop: Nongmadan and Um Ma-ria conglomerate both have similar characteristics based on their texture, clast-size, clast composition and source. The conglomerate of Nongmadan and Um-Ma-ria are orthoconglomerate or clast-supported conglomerate, the clast-size are dominated by cobble size of 64-256mm and classified as cobble conglomerate.

The clasts of the conglomerate are polymictic in nature that is composed of more than one types of clasts like quartzites, granites and schist, figure no.2 (F). Majority of the clast are pre-dominated by quartzitic clasts and quartzitic veins clast. The average thickness of the conglomerates is about 4.6 meters. Um Ma-ria conglomerate is underlain by carboneous ophiolite rock (shale as represented in Plate no.9) of 4 to 5 meters in thickness having a strike of Nº50 east and dipping at 53º towards SE with angular unconformity. The conglomerate exposure is 5 to 6 meters with a thin bed of sandstone (Mahadek Fomation) at the top of the conglomerate outcrop below the top soil.

Umkaber-Lyniong conglomerate outcrop: Umkaber-Lyniong conglomerate are mostly dominated by cobble size clasts of 64-256mm and are known as cobble conglomerate and based on their texture the conglomerate as clast-supported or orthoconglomerate. The clasts are composed of only one type of clasts and are known as monomictic/oligomictic in nature.

CONCLUSIONS

Basal conglomerate formation belonging to the Khasi group of rocks from Tyrsad and Weiloi region holds a significant Geo-Heritage potential. The outcrops can well be observed as one travels from Shillong to Mawsynram. Out of the eight sampling sites along Tyrsad and Weiloi area. Umnongrim outcrops actually stands out different as the only Paraconglomerate or matrix supported conglomerate as well as categorized under pebble conglomerate (4-64mm) based on clast size and is an Monomictic or oligomictic based on its clast composition. Whereas all the remaining sampling sites from Weiloi, Lumspong, Umlangmar, Kyrphei, Nongmadan, Um-Maria and Umkaber-Lyniong are Orthoconglomerate or clast supported conglomerate, categorized under cobble conglomerate (64-256mm) for clast size categorization and polymictic based on its clast composition. The one common character of the outcrops is that all are categorized under intraformational conglomerate based on their source region. The matrix of the conglomerate of Tyrsad-Weiloi area are mostly arkosic in nature and cementing material of siliceous (quartz) and ferruginous material.

The need for community awareness and preservation of this conglomerate formation becomes very vital and essential as heavy quarrying activities are carried out in this exposures, which keeps on changing the profile of the conglomerate depositions in this area. Despite its rich Geo-Heritage potential without proper community sensitizing of this exposures the Basal conglomerate might be extracted out sooner then we think. Thus, it's crucial to be protected and preserved. For this reason, the study focuses on the characterizing and classifying of these conglomerate Formation based on Selley, (2000) classification of their texture, clast composition, clast size and source and focuses on highlighting this important issues.

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