Geo-Science

Jurnal Geologi dan Sumberdaya Mineral
Journal of Geology and Mineral Resources
Center for Geological Survey, Geological Agency, Ministry of Energy and Mineral Resources
Journal homepage: http://jgsm.geologi.esdm.go.id
ISSN 0853 - 9634, e-ISSN 2549 - 4759

A *Stegodon* Mandible from Cipanaruban, Subang, West Java; Description and Its Position in the Java Vertebrate Biostratigraphy

Sebuah Rahang Bawah Stegodon dari Cipanaruban, Subang, Jawa Barat; Deskripsi dan Posisinya dalam Biosostratigrafi Vertebrata Jawa

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Naskah diterima : 2 November 2016, Revisi terakhir : 06 Oktober 2017, Disetujui : 02 Januari 2018, Online : 02 Februari 2018

DOI: http://dx.doi.org/10.33332/jgsm.geologi.19.1.9-14

Abstract - This paper describes a fossil of a right mandibular ramus with nearly complete molar M2 of Stegodon from a cliff of a hill of Cipanaruban River, near Pasir Cabe, about 6 km to the East of Subang City, West Java, Indonesia. The specimen is a surface collected, however the attached matrix on mandible indicated that this specimen is mostly derived from the sandstone unit of the Citalang Formation. The age of this fossil is estimated to be around Late Pliocene to Early Pleistocene based on the mammalian biostratigraphy of Java.

Keyword : *Stegodon,* mandible, Late Pliocene - Early Pleistocene, fossil, Subang.

Abstrak *- Artikel ini mendeskripsikan fosil fragmen rahang bawah Stegodon bagian kanan dengan molar M_2 yang hampir utuh yang ditemukan di sebuah tebing di Sungai Cipanaruban, dekat Pasir Cabe, sekitar 6 km ke arah timur dari kota Subang, Jawa Barat, Indonesia. Spesimen merupakan temuan permukaan, tetapi berdasarkan matriks sedimen yang masih menempel di rahang ini mengindikasikan berasal dari Formasi Citalang. Umur fosil disimpulkan sekitar Pliosen Akhir sampai Plistosen Awal berdasarkan biostratigrafi mamalia Jawa.*

Kata Kunci : *Stegodon, rahang bawah, Pliosen Akhir – Plistosen Awal, fosil, Subang.*

INTRODUCTION

In 2010, a team from Geological Museum of Bandung visited the Pasir Cabe paleontological site, which located administratively at Wanareja Village, Cibogo District, Subang Regency, West Java. Pasir Cabe and the surrounding area are known for its vertebrate fossils were found from these areas. This survey has focused on the vertebrate fossil-bearing deposit of the Citalang Formation.

On April 5th, 2010, the team discovered a right mandible of *Stegodon* (MGB collection number 12SBG2010) at a cliff of the Cipanaruban River near the Pasir Cabe paleontological site, about 6 km to the East of Subang City. Here, we describe the 12SBG2010 specimen and compared with the other dental elements of *Stegodon* from Java.

THE FINDING LOCATION

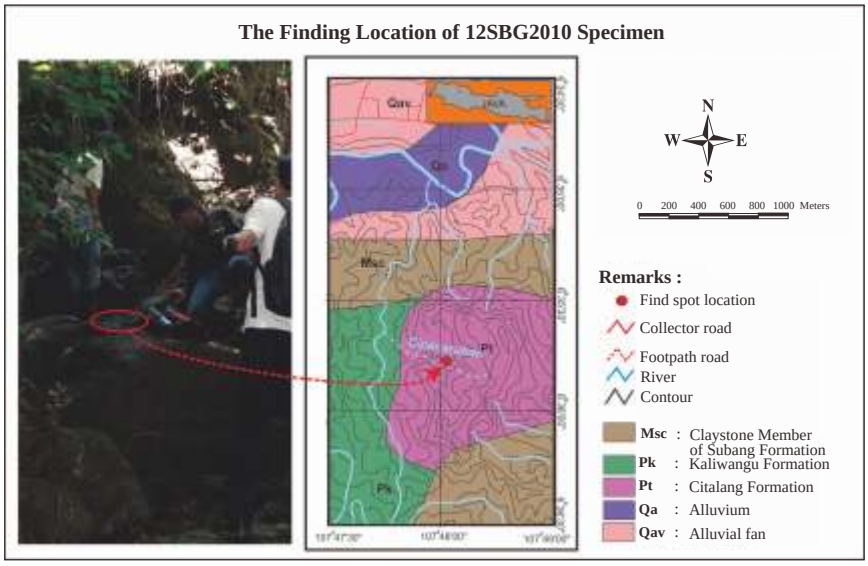
The 12SBG2010 specimen was discovered as a surface find at S 06° 35' 44.6'; E 107° 47' 54.7" in Cipanaruban area near the Pasir Cabe paleontological site (Figure 1).

Based on the geological map, the outcrops in Cipanaruban area belong to the Citalang Formation characterized by a coarse sandstone-conglomeratic sandstone (Silitonga, 2003). This sandstone-conglomeratic sandstone is known as vertebrate fossil bearing deposit in Subang area (von Koenigswald, 1935). The matrix attached on the 12SBG2010 specimen consists of coarse-grained sandstone is very similar to sandstone unit of the Citalang Formation.

DESCRIPTION OF THE SPECIMEN

Order Proboscidea Illiger, 1811
Family Stegodontidae Osborn, 1918
Genus *Stegodon* Falconer and Cautley, 1846
Stegodon trigonocephalus Martin, 1887

The 12SBG2010 specimen is a dextral mandibular of *Stegodon trigonocephalus* with a molar attached on the ramus. This statement based on the reason that the horizontal ramus which broken just at symphysis is located on the left side of this mandible on the occlusal view (Figure 2). On the buccal side a foramen mentale still recognizable. Posteriorly the mandible is broken before the mandibular foramen so the condyle and the superior process are missing (Figure 2). Although the mesial part is missing, we estimate the ridge formula of this specimen is x9x (Table 1). All the ridges are worn to such a degree that makes all ridges are exposing the dentine, thus, no tubercle appears. This condition makes the measurement of ridge height is impossible because the unworn ridge is needed as a requirement of ridge height measurement. The first ridge of the molar is missing, only a small dentine that still can be recognized belongs to this first ridge. The second and third ridges are also incomplete and leaving only a few part of the ridges. The maximum width seems to be belong to the first or the second ridge. Due to the incompleteness of both ridges, the exact width cannot be measured. The lamellar frequency (LF) measured along the crown-base amounts to 8.6 on the lingual side and to 9.2 on the buccal side. The average of these two values, which represents the LF along the basal longitudinal axis of the



Source : Geological map modified from Silitonga (2003).

Figure 1. Plan view showing the finding location of 12SBG2010 specimen.

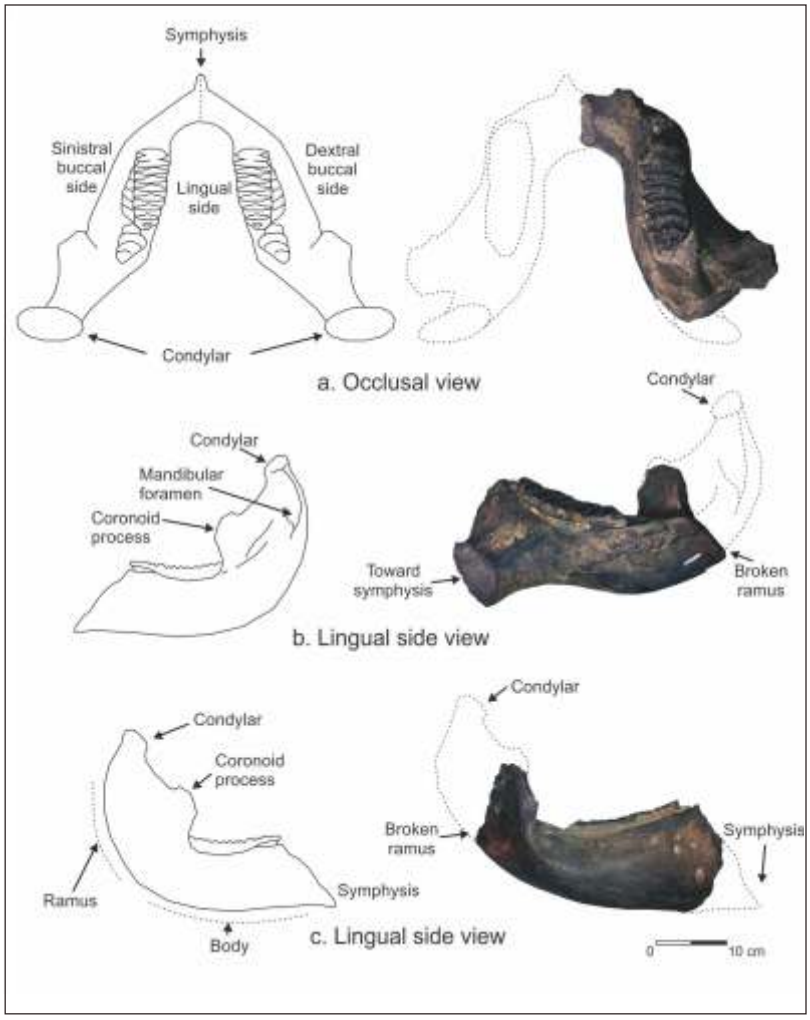


Figure 2. The half mandible of Stegodon trigonocephalus MGB col. number 12SBG2010 from Pasir Cabe Subang, West Java.

crown, is 7.4 (Table 1). The enamel thickness (ET) is 4.5mm and considerably wrinkled with a frequency of 3-5. The LF values are obtained using the following equation that used by van den Bergh (1999):

$$\text{Lamela frequency} = \frac{\text{n lingual + n buccal}}{2}$$

Remarks
n: amount of lamella in 10 cm

Table 1. Measurements of individual molar ridges of the molar in the 12SBG2010 specimen (in mm).

Ridge	talon	1	2	3	4	5	6	7	8	9	talon
Width	-	?	X+	X+	69.5	67.5	65	64.5	61.5	52	-
Height	-	-	-	-	-	-	-	-	-	-	-
Hypsodon Index	-	-	-	-	-	-	-	-	-	-	-
Length	195										
Laminar Frequency	7.4										
Enamel Thickness	4.5										
Ridge Formula	x9x										

The crown-base of this specimen is well exposed as seen in the posterior part. This molar is not markedly tapering in posterior direction. So, its does not belong to a M3. The buccal and lingual margins of this specimen are gently convex. The length measured along the basal length is approximately 195mm, which marks the upward concave curvature of molar. The widths and other parameters of molar are given in Table 1.

The 12SBG2010 specimen is not a milk-molar. This statement based on two reasons, the first reason is the largest width appears in the anterior part of molar instead of at the most posterior ridge and the second reason is the vertical grooves on the buccal and lingual surfaces of the ridges are not developed. The ridge formula of 12SBG2010 which has 9 ridges (Table 1 and 2) also indicates it is possible M_1 or M_2 because *Stegodon trigonocephalus* has x8x or x9x ridges in the M_1 while the M_2 has x9x or x10x ridges (Aziz and van den Bergh, 1995).

Table 2. Comparision of individual molar ridges M1 and M2 of the Stegodon trigonocephalus of Java specimen collections (in mm).

Sourch	Specimen	Molar Position	Length	Widht	Laminar Frequency	Ridge Formula
(Hooijer 1955)	Coll. Dub. No. 2231	M_2	188	68	6	x10x
	Coll. Dub. No. 2432-33	M_2	210	80	5.5	x10x
	Coll. Dub. No. 145	M_2	213	76	5	x9x
	Coll. Dub. No. 3502	M_2	185	69	6.5	x10x
	Coll. Dub. No. 2893	M_1	164	60	6.5	x9x
	Coll. Dub. No. 144	M_1	143	64	6.25	x8x
(Hooijer, 1972)	Coll. Jacob No. S216	M_1	138	55	?	x8x
This research	12SBG2010	?	195	Ca.70	7.4	x9x

Ca: Circa or approximately

The comparasion data, for which both the identified molar as well as the 12SBG2010 specimen are included (Table 2), supports the assumption that the 12SBG2010 specimen is a M_2. The regression analyses graph of widht and length shows that the 12SBG2010 specimen share the same location with molars that were identified as M_2 (Figure 4). In summary, based on it's morphological characters and biometry (measurement), we suggest that the 12SBG2010 molar most likely represents a M_2.

For the individual age estimation based on molar wear patterns we applied the method used by Jachmann (1988) which refines by Lee *et al.* (2011) and based on studies of the African Elephant. When estimating the relative age of an individual based on dental wear patterns as developed for the African elephant, it is customary to speak of African Elephant Years (AEY).

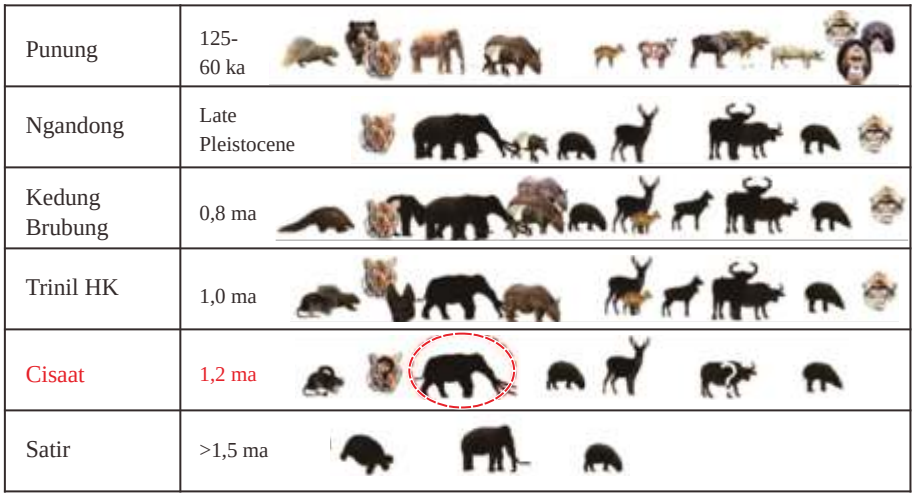


Figure 3. Fauna biostratigraphy in the Pleistocene of Java (Sondaar, 1984). Biostratigraphy levels age mostly based on Leinders, et al. (1985). Schematic picture was taken from Hertler and Rizal, (2005) which Stegodon trigonocephalus in Cisaat fauna level is in red circular colour, shaded animals represent fossil species were coloured animals represent extant species.

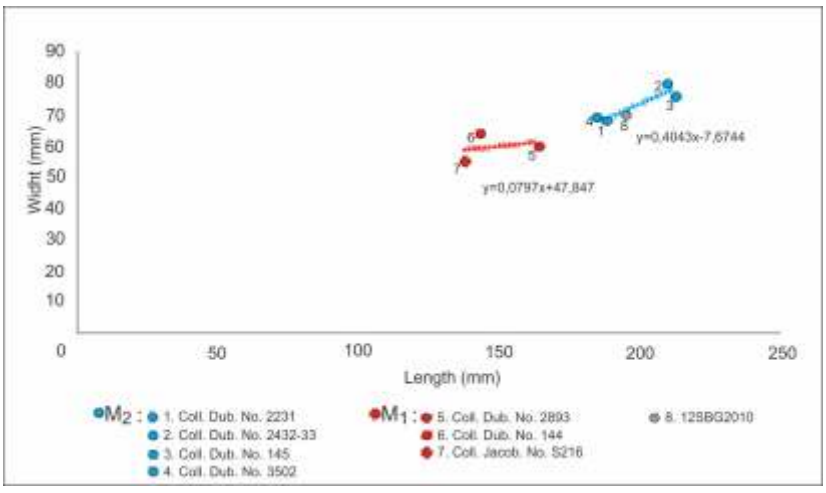


Figure 4. Results of the regression analyses of Widht and Length variables.

In specimen 12SBG2010 the M_1s are completely lost by wear and the succeeding M_2s have 8 lamellae in wear. Based on Jachmann's scheme the estimated age of 12SBG2010 specimen would be around 28 AEY old.

DISCUSSION

Stegodon is a major faunal element of the Quaternary and Neogene of Asia (Saegusa, *et al,* 2005). During Pleistocene, *Stegodon* migrated from southern Asia to the Indonesian and Philippine Archipelagos, to then become extinct in the Pleistocene age (van den Bergh, *et al,* 2001a).

The *Stegodon* is an important element in faunal units of Java, due to their common findings in many vertebrate-bearing strata (van den Bergh, *et al.* 2001b). Based on faunal remains in the vertebrate-bearing strata in Java, a biostratigraphic scheme with six faunal succession of mammals in the Pleistocene of Java was proposed. This faunal succession from old to young are Satir Fauna, Cisaat Fauna, Trinil HK Fauna, Kedung Brubus Fauna, Ngandong Fauna and Punung Fauna (de Vos, 1983; Sondaar, 1984).

The 12SBG2010 specimen was considered as originated from Citalang Formation. Based on the terrestrial fauna biostratigraphy and its dating (Leinders, *et. al*. 1985) the occurrence of *Stegodon trigonocephalus* is at Cisaat fauna level which has age around 1,2 Ma (Early Pleistocene). This age also congruence with the litostratigraphy analyses which mention that Citalang Formation age is estimated as the late Pliocene to Early Pleistocene in age (Setiadi, 2001; Martojoyo, 2003).

The depositional environment of the Citalang Formation indicates a fluvial regime (terrestrial) (Rizal, 2004). This fluvial characteristic congruence with the matrix that still adhere on the specimen. Based on the faunal succession of mammals in the Pleistocene of Java and the age of Citalang Formation, we inferred that the geological age of the specimen 12SBG2010 is Early Pleistocene because the earliest data record of the occurrence of *Stegodon trigonocephalus* is at Cisaat fauna which has age Early Pleistocene (Figure 3). This statement is supported by the discovery of *Hippopotamus sivalensis sivajavanicus* (previously or synonymously *Hexaprotodon simplex*) that was found in the same area and lithology in Subang (Insani, *et al.* 2015). Both *Stegodon trigonocephalus* and *Hippopotamus sivalensis sivajavanicus* are marker species that distinguish the Cisaat Fauna.

CONCLUSIONS

The Proboscidea mandible specimen with the collection number 12SBG2010 belongs to *Stegodon trigonocephalus* and included in the Cisaat fauna, which dated back from the Early Pleistocene. The molar embedded in the mandible is a M_2. This data supports the previous study of the age of the Citalang Formation that deposited around late Pliocene to Early Pleistocene.

ACKNOWLEDGEMENTS

We gratefully acknowledge the Geological Museum for providing us facilities in this research. We would like to express our deep appreciation to Prof. Fachroel Aziz and Prof. Yahdi Zaim for their guidance during the writing of this paper. Many thanks are also forwarded to our colleagues and all Redactional Boards of Journal of Geology and Mineral Resources.

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