

## A New Record of *Chalicotherium* from the Irrawaddy Formation in Migyaungye Area, Magway Region

Chit Sein<sup>1</sup> and Tin Thein<sup>2</sup>

### Abstract

A mandibular fragment of *Chalicotherium* was collected from the lower part of Irrawaddy Formation in Tebingan area, Mygyaungye Township, Magway Region, central Myanmar. The specimen belongs to the characters of *Chalicotherium salinum* from the Chinji Formation of India (Middle-Late Miocene) and from Kaulial, the Nagri Formation of the Potwar Plateau in Pakistan. The discovery of *Chalicotherium salinum* is firstly recorded in the Irrawaddy sediments of central Myanmar. The finding of chalicotheriine in the present locality indicates the closed wooded habitats.

**Key words:** *Chalicotherium*, Chalicotheriinae, Tebingan area, Magway Region, Irrawaddy Formation, wooded habitats

### Introduction

The sediments of the Irrawaddy Formation in central Myanmar has yielded numerous terrestrial mammal remains since the 19<sup>th</sup> century (Noetling, 1897; Pilgrim, 1910; Colbert, 1935, 1938; Osborn, 1942). Later, more workers described many terrestrial mammalian fossils such as proboscideans, rhinos, suids, giraffids, and bovids (Moe Nyunt, 1987; Thaug Htike et al., 2007; Takai et al., 2006; Chit Sein et al., 2006, 2009; Chavasseau et al., 2006, 2010). Unfortunately, the family Chalicotheriidae is poorly documented in fossil record from the Irrawaddy sediments of Myanmar and Southeast Asia.

Recently, a fragmented mandible with lower M<sub>1</sub> was collected from the outcrop of the Irrawaddy Formation at the fossil locality in Tebingan (west of Tebingan Village, about 8 km from north-northeast of Migyaungye Township), Magway Region, central Myanmar (Figure 1). The present study aims to describe this new chalicothere mandibular fragment and to contribute both to the knowledge of the *Chalicotherium* species from Myanmar and other regions.

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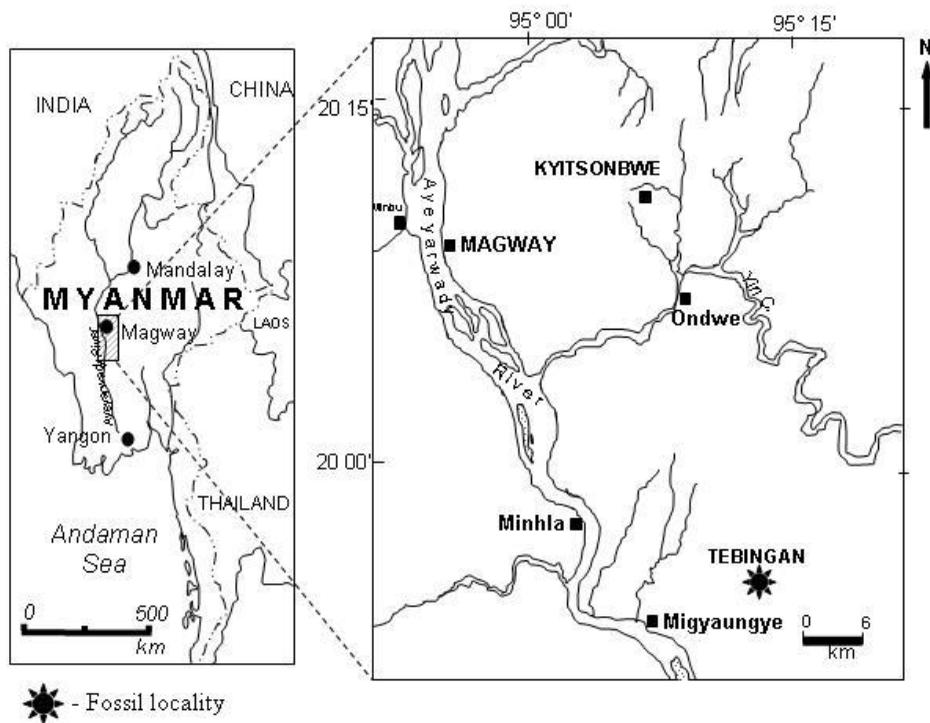


Figure 1. Map of the chalicothere fossil locality

### Regional Geologic Setting

The fossil locality of the present area is situated in the southern part of the Central Sub-basin of the Inner-Burman Tertiary Basin which is filled with Paleogene and Neogene sediments (Bender, 1983). The Ayeyarwady River is flowing through the basin from north to south. On both sides of the Ayeyarwady River the Irrawaddy Formation is widely distributed and it includes fluvial channel deposits associated with over bank deposits (Figure 2). This formation consists mainly of light grey to yellowish brown, medium to thick bedded, coarse-grained, gritty, and loosely consolidated sandstones with intercalated siltstones and light grey coloured claystone or mudstone.

Most of the vertebrate fossils are occasionally found in pebbly sandstones. Specimens of fossil wood and sandstone concretions are abundant. The fossil mandibular fragment (YUDG-Mge 096) was found in the lower

part of the Irrawaddy Formation, where the sandstone beds and thin-bedded clay layers were exposed. The sandstones are less cemented than those in the lower parts. The clay layers gradually decrease towards the upper parts, while the sandstone beds become thickening and coarsening upward sequences. The Irrawaddy Formation disconformably overlies the Obogon Formation of the Upper Pegu Group (Middle Miocene) in these localities.

### **Material and Method**

A fossil mandibular fragment was collected from the lower part of Irrawaddy Formation at west of Tebingan Village, Migyaungye Township, Magway Region, was stored in the Department of Geology, University of Yangon. The measurements of the present specimen are shown in Table 1. Abbreviations used in the text are as follows: YUDG-Mge –Yangon University, Department of Geology, Yangon, Myanmar; MFI – Myanmar-French Irrawaddy Mission Collection deposited at Department of Archaeology, Ministry of Culture, Mandalay, Myanmar; AMNH–American Museum of Natural History, New York, USA; GSP – Geological Survey of Pakistan Museum, Quetta, Pakistan; YPM - Yale Peabody Museum; other alphabets and numbers cited from Zapfe (1979 & 1989).

In this paper, the dental terminology of *Chalicotherium* proposed by Thenius (1989) (Figure 3 ) is used and the classification of the Chalicotheriidae proposed by McKenna & Bell (1997) is applied in studying the present specimen.

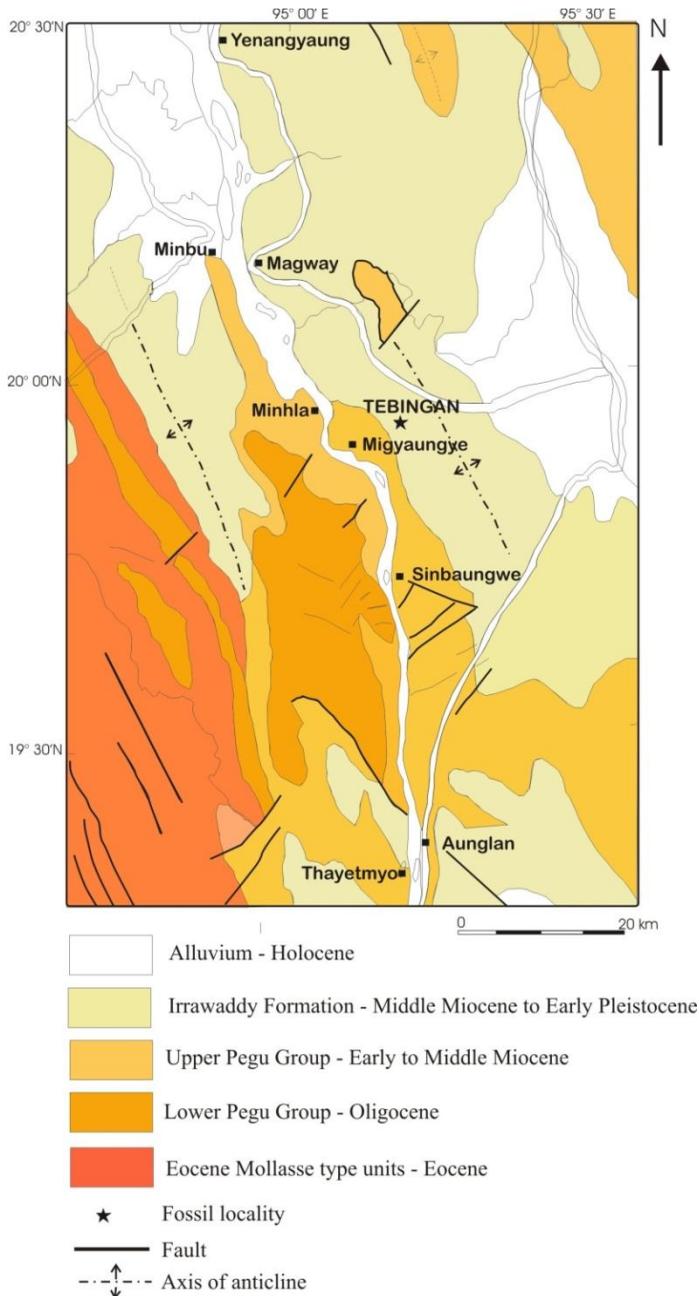


Figure 2. Regional geological map of the fossil locality (Tebingan area) (after Geological Map of the Socialist Republic of the Union of Burma, 1977)

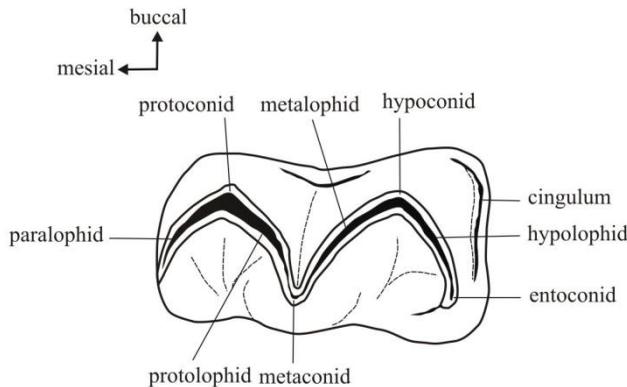


Figure 3. Terminology of the lower molar of *Chalicotherium* according to Thenius (1989)

### Systematic Paleontology

Order PERISSODACTYLA GRAY, 1848

Family CHALICOTHERIIDAE GILL, 1872

Subfamily CHALICOTHERIINAE, GILL, 1872

Genus *Chalicotherium* KAUP, 1833

Type species *Chalicotherium goldfussi* KAUP, 1833

*Chalicotherium salinum* (FORSTER-COOPER) 1922 (Figure 4)

#### MATERIALS

YUDG-Mge 096, right mandibular fragment with M<sub>1</sub>. This fossil specimen is conserved at the Department of Geology, University of Yangon.

STRATUM: Lower part of Irrawaddy Formation

LOCALITY: YUDG-Mge 096 was discovered from Tebingan area (19°57'51.1"N; 95°08'37.8"E), west of Tebingan Village which is situated about 8 km north-northeast of Migyaungye Township, Magway Region, central Myanmar.

#### DESCRIPTION

Specimen YUDG-Mge 096 (Figure 4) is fragment of a right jaw with a broken M<sub>1</sub>. The ramus is a constant in depth and thinner towards posterior.

The tooth is well preserved and nearly unworn. It is brachyo-lophodont with W-shaped lophid pattern in occlusal view. That is the trigonid and talonid valleys are narrow V-shaped. The lingual wall of the metaconid is slightly damaged. The protoconid is small and narrow. The hypoconid and the entoconid are well developed. The paraloophid is reduced and low. The protolophid is slightly damaged. The metalophid and the hypolophid are sharply distinct. The trigonid basin is smaller and opened to the lingual side. The cingulid is strongly developed anteriorly and posteriorly.

Table 1. Measurements of the  $M_1$  of *Chalicotherium salinum* of present material and others. Measurements are given in mm. Breadth Index = (maximum breadth/length)\*100. Data: *Chalicotherium salinum* cited from Zapfe (1979) and Colbert (1935); *Chalicotherium goldfussi* & *Chalicotherium grande* cited from Zapfe (1979 & 1989); MFI-105, Gen. et sp. Indet. cited from Chavasseau et al. (2010).

Material	Species	Length	Breadth	Breadth Index
YUDG-Mge 096 (right)	<i>Chalicotherium salinum</i>	25.3	14.5	57.3
GSP 6006 (right)	<i>Chalicotherium salinum</i>	24.79	14.19	57.2
GSP 9665	<i>Chalicotherium salinum</i>	19.05	10.65	55.9
GSP 23046	<i>Chalicotherium salinum</i>	17.42	10.4	59.7
YPM 19288	<i>Chalicotherium salinum</i>	28.7	15	52.3
AMNH 19577	<i>Chalicotherium salinum</i>	27	17	63.0
K 46/13	<i>Chalicotherium salinum</i>	26	16	61.5
MFI 105	Gen. et sp. indet.	21.99	13.22	60.1
Rheinhessen & Höwenegg	<i>Chalicotherium goldfussi</i>	35.4	23.5	66.4
(12) left	<i>Chalicotherium grande</i>	30.3	19.5	64.4
(C25) left	<i>Chalicotherium grande</i>	30.8	19.5	63.3
(19) left	<i>Chalicotherium grande</i>	33.2	21.2	63.9
(8) left	<i>Chalicotherium grande</i>	32.2	21	65.2

Material	Species	Length	Breadth	Breadth Index
(A34) left	<i>Chalicotherium grande</i>	29.9	16.8	56.2
(21) right	<i>Chalicotherium grande</i>	29.2	18.7	64.0
(13) right	<i>Chalicotherium grande</i>	32.7	21.6	66.1
(A 35) right	<i>Chalicotherium grande</i>	28.1	18.2	64.8
(B28c) right	<i>Chalicotherium grande</i>	30.7	19.7	64.2
(18) right	<i>Chalicotherium grande</i>	32	19.5	60.9

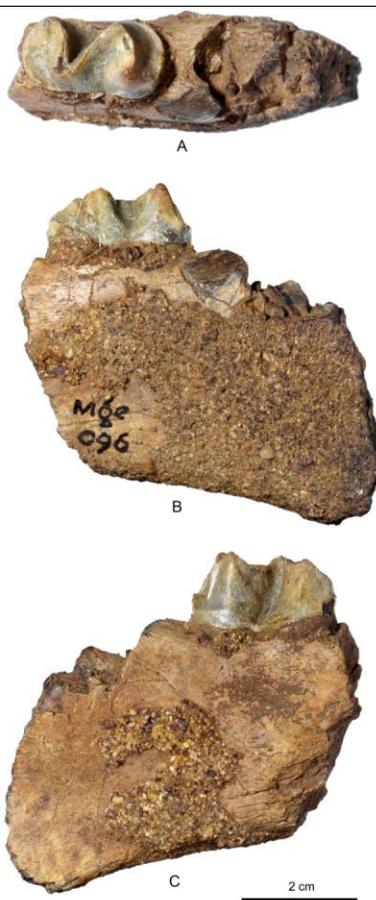


Figure 4. *Chalicotherium salinum* (FORSTER-COOPER), right mandibular fragment with M<sub>1</sub> (YUDG-Mge 096); A, occlusal view; B, lingual View; C, labial view.

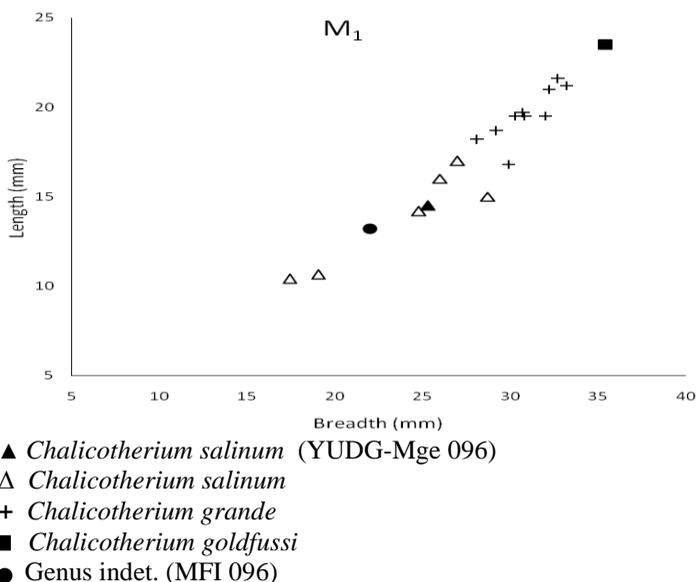


Figure 5. Length and width plot diagram of the  $M_1$  of *Chalicotherium salinum* from the Irrawaddy Formation, Myanmar and from the Siwalik Group in Indo Pakistan.

### Discussion

The Chalicotheriidae is the scarcest mammal recorded from the Irrawaddy Formation and the present described specimen (YUDG-Mge 096) is a newly discovered *Chalicotherium* (Chalicotheriinae) in the sediments of Irrawaddy Formation in Myanmar. Among the chalicotheres, the lower jaws of the Chalicotheriinae are distinguishable from those of the Schizotheriinae by a more robust corpus, and shorter and lower crowned molars. That is the present specimen (YUDG-096) is belonging to the subfamily Chalicotheriinae because of the corpus of YUDG-Mge 096 displays a constant mandibular depth (Garevski and Zapfe, 1983). This specimen YUDG-Mge 096 is assigned to the chalicothere on the basis of its lophodont tooth and its narrow V-shaped lophid pattern. It is morphologically similar to the  $M_1$  of *Chalicotherium salinum* (= *Macrotherium salinum* Forster Cooper, 1922; AMNH 19577, 19437) from the Chinji Formation of India (Middle-Late Miocene) (Table 1) described by Colbert (1935) and that of *C. salinum* (GSP 6006) from Kaulial, the Nagri

Formation of the Potwar Plateau in Pakistan described by Pickford (1982), by its brachyo-lophodont, its W-shaped lophid pattern, reduced paralophid, the strong protolophid, metalophid and hypolophid, and its smaller size (Figure 5). Moreover, a width-length index of 57.3 falls within the range showed by the species of *Chalicotherium salinum* (GSP 6006) (Table 1; calculated from Pickford, 1982; and Chavasseau et al., 2010). The present specimen (YUDG-Mge096) differs from that of *Chalicotherium goldfussi* by Zapfe 1989 by the narrow and V-shape trigonid of the M<sub>1</sub>, i.e., *C. goldfussi* has U-shaped trigonid (Anquetin et al., 2007).

*Chalicotherium salinum* differs from the European species mainly in size, being smaller than *Chalicotherium grande* of the Vindobonian (Middle Miocene) deposits (Zapfe, 1979) and much smaller than the *C. goldfussi* of the Vallesian (Upper Miocene) deposits (Pickford, 1982). *C. salinum* is appreciably larger than *C. rusingense* of the Lower Miocene of East Africa.

### **Paleoenvironmental Implication**

Chalicotheriines are considered as forest-dwelling browsers even though some isotopic data suggest that they might have moved to slightly more open habitats to take water (Nelson, 2007). The presence of a chalicotheriine in the study area indicates reasonably to a significant wooded component in this environment (Chavasseau et al., 2010). In addition chalicotheriines associated with the fauna of a giraffe (Chit Sein & Tin Thein, 2010) and the suids (*Tetraconodon*) (Chit Sein et al., 2006) and Propotamochoerus (Chit Sein et al., 2009) indicates wooded habitats. The evidence for closed habitats in central Myanmar by the early Late Miocene was described by stable isotope analysis performed on suids, rhinocerotids and hippopotamids by Zin Maung Maung Thein (2011).

### **Conclusion**

In this study, we report a new specimen of fossil Chalicotheriinae, *Chalicotherium*, from the Late Miocene to Pleistocene of Myanmar, and discuss its taxonomic status and its paleoenvironmental condition. *Chalicotherium* is a median sized Chalicotheriinae with low crowned, broad upper molars (Heissig, 1999b). This species has not been recorded from the Irrawaddy Formation of Myanmar before. A new discovery of a fragmented mandible (YUDG-Mge 096) is significantly recorded from the sediments of

Irrawaddy Formation in Myanmar in Tebingan area, north-northeast of Migyaungye Township, Magway Region. This specimen is a right mandible with  $M_1$ . This finding of *Chalicotherium* is firstly recorded in the Irrawaddy sediments of central Myanmar except Gen. et sp. indet. of Magway Region (Chavasseau et al., 2010) and Cf. *Nestoritherium* of Takai et al., 2006 and Tsubamoto et al., 2006).

The corpus of the present specimen (YUDG-096) displays a constant mandibular depth which is belonged to the subfamily Chalicotheriinae (Garevski and Zapfe, 1983). It is also morphologically similar to the  $M_1$  of *Chalicotherium salinum* Forster-Cooper, 1922; AMNH 19577, 19437) from the Chinji Formation of India (Middle-Late Miocene) (Table 1) described by Colbert (1935) and that of *C. salinum* (GSP 6006) from Kaulial, the Nagri Formation of the Potwar Plateau in Pakistan described by Pickford (1982), by its brachyo-lophodont, its W-shaped lophid pattern, reduced paralophid, the strong protolophid, metalophid and hypolophid, and its smaller size. A breadth index of 57.3 falls within the range showed by the species of *Chalicotherium salinum* and it also differs from that of *Chalicotherium goldfussi* by Zapfe 1989 by the narrow and V-shape trigonid of the  $M_1$ . *Chalicotherium salinum* differs from the European species mainly in size, being smaller than *Chalicotherium grande* of the Vindobonian (Middle Miocene) deposits (Zapfe, 1979) and *C. goldfussi* of the Vallesian (Upper Miocene) deposits (Pickford, 1982).

The presence of a chalicotheriine in the study area indicates reasonably to a significant wooded component in this environment. In addition chalicotheriines associated with the fauna of a giraffe and the suids indicates the closed wooded habitats.

### Acknowledgements

We are grateful to the personnel of Department of Higher Education (Lower Myanmar), Ministry of Education, for their encouragement to come out the present work. Thanks are also due to Dr. San Linn, Acting Rector of Hinthada University, and Dr. Aung Win, Pro-Rector, Hinthada University, for their encouragement to the manuscript. Special thanks are also due to Professor Dr. Theingi Kyaw, Head of the Department of Geology, Hinthada University, for her kind review and criticism of the manuscript. Finally, we are grateful to the colleagues of the Department of Geology, Hinthada University, for their provide throughout in the preparation work.

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