

Sedimentology and Stratigraphy of Phu Sung Fossil Site of the Lower Cretaceous Sao Khua Formation, Sakon Nakhon Province, Northeastern Thailand

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Abstract

“Phu Sung”, a new fossil site in Sakon Nakhon Province was recently reported. Phu Sung fossils are very complete and in very well-preserved condition. They were found in reddish micaceous silty mudstone. The stratigraphy and sedimentology show that Phu Sung succession is a continental deposit in the fluvial system and it is in the Early Cretaceous Sao Khua Formation of the Khorat Group. According to lithology, fossils were deposited in a quiet environment, such as overbank deposit, small pond or oxbow lake margin. Sedimentary structures such as desiccation crack and calcrete indicate semi-arid to arid paleoclimate condition which probably corresponds to the taphonomy or preservation of the fossils.

Keywords

Fluvial Deposits, Sao Khua Formation, Lower Cretaceous, Northeastern Thailand

1. Introduction

The Khorat Group is the Mesozoic non-marine deposit. It is dominated by reddish classic sedimentary rocks including mudstone, siltstone, sandstone and conglomerate [1]. The Lower Cretaceous Sao Khua Formation of the Khorat Group is well exposed in northeastern Thailand (**Figure 1**) and has yielded various vertebrate remains. Stratigraphy and palynology indicate that the Sao Khua Formation is Early Cretaceous in age (Barremian) [2] [3]. Some Sao Khua

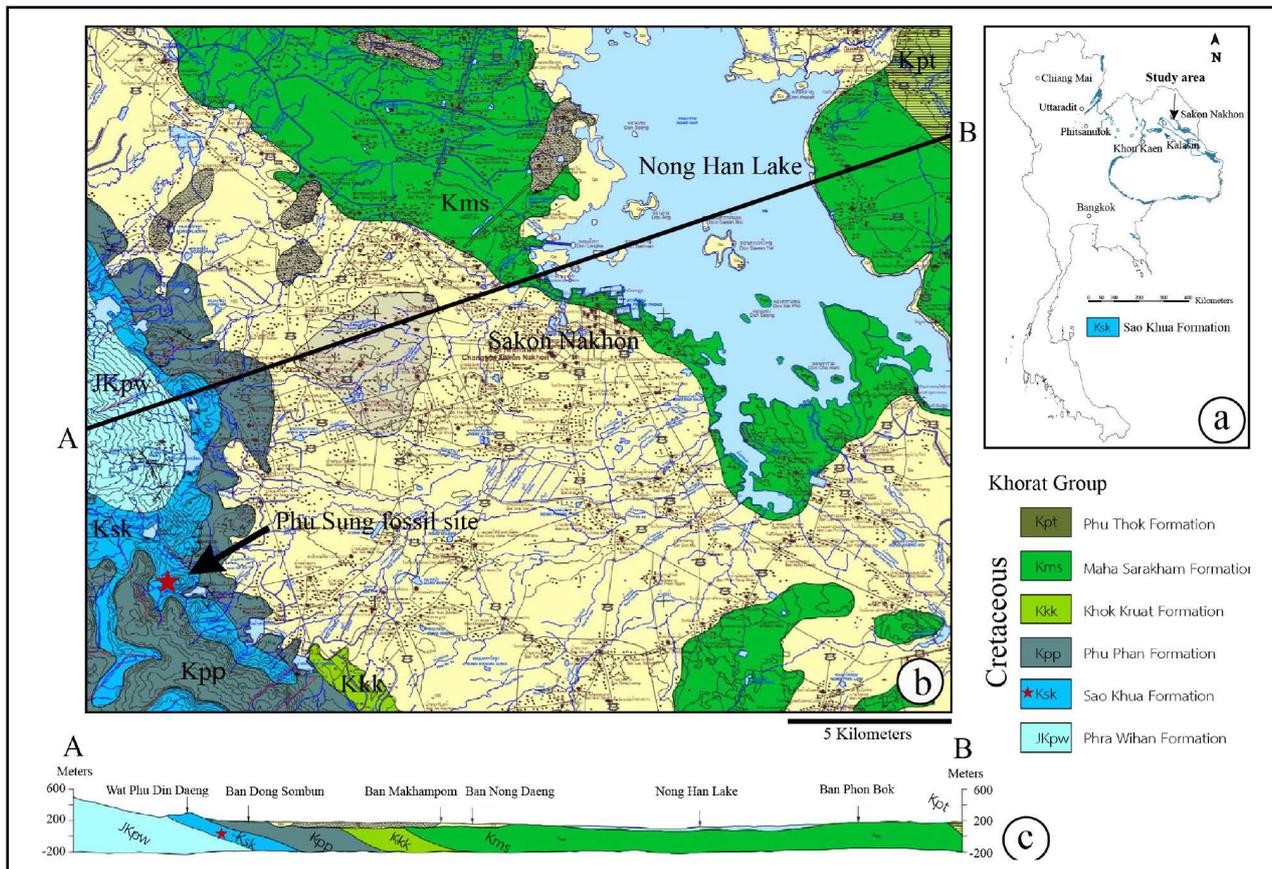


Figure 1. Study area, (a) distribution of the Lower Cretaceous Sao Khua Formation (Ksk), (b) the Phu Sung fossil site, showing in red star and (c) the cross section (line A-B) shows Ksk is underlain by white quartzitic sandstone of Kpw and it is overlain by the sandstone dominated Kpp (Modified from [4]).

vertebrate fossil sites in Sakon Nakhon were previously revealed, however, most of the fossils such as fresh water shark, bony fish, turtles, crocodiles, pterosaurs, dinosaurs and lizard eggs were fragmentary. Most recently, a new vertebrate fossil site “Phu Sung” with a good fossil preservation was found near Muang Sakon Nakhon District, Sakon Nakhon Province (**Figure 1**). In this work, we are interested in the sedimentology and stratigraphy of the site to interpret the paleoenvironment of the Phu Sung fossil site.

2. Sedimentology and Stratigraphy

The Phu Sung section is more than 80 meters thick, dominated by reddish micaceous siltstone/mudstone, calcrete horizon and intercalation with sandstone and conglomerate (**Figure 2**). In general, sedimentary strata is NNW-SSE striking ($330^{\circ} - 355^{\circ}$) with gentle dipping ($5^{\circ} - 10^{\circ}$) to NE direction. Although outcrops are not very well exposed, the section seems to be complete and continuous. The Phu Sung section can be subdivided into 3 main parts. 1) The lower part (Log1) consists of medium- to thick-bedded sandstone with cross bedding. Sandstones are thinning upward and passing to siltstone dominated at the top. Some individual sandstone bed shows sharp erosive base with mud clast at the

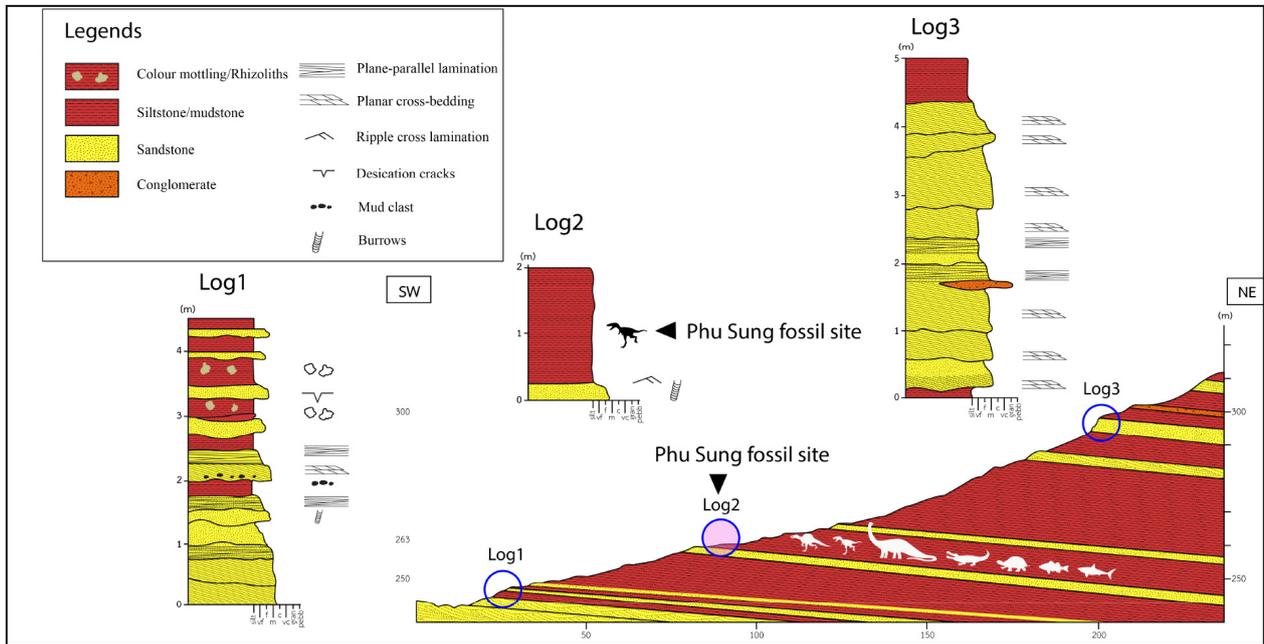


Figure 2. Geological cross section with NE-SW direction and sedimentary logs of the Phu Sung fossil site.

bottom. Vertical bioturbation and desiccation crack can be found. Reddish micaceous siltstone/mudstone with greenish grey to pale grey mottling and rhizoliths present at the top of section. 2) The middle part of the section (Log2), where fossils were found, starts with thin to medium bedded fine-grained sandstone. It is overlain by reddish micaceous siltstone/mudstone. Calcrete nodules are commonly found on recent erosional surface. About 1 meter above a sandstone bed, fossils were found in reddish siltstone. Stratigraphically, fossil-bearing bed is situated approximately 80 - 100 meters below quartzitic sandstone and conglomerate of the Phu Phan Formation. 3) The upper part (Log3) forms as a small cliff of medium- to thick-bedded sandstone. Cross-bedding and planar bedding are commonly found within sandstone. Some lenticular conglomerates present at the base of sandstone. This cross-bedding sandstone is capped at top by reddish siltstone, calcrete horizon and lime-nodule conglomeratic layer. Medium to thick bedded with cross bedding sandstone sets from the lower and the upper part of the Phu Sung succession is interpreted as main channel-filled with high energy environments. While the middle part, where fossils were found in reddish micaceous silty mudstone, is interpreted as overbank deposit with low energy environments.

3. Conclusion

The Phu Sung succession is a continental deposit in the fluvial system. Fossils were found in reddish silty mudstone, indicating low energy quiet environment (overbank, small pond or oxbow lake margin). Sedimentary structures such as desiccation crack and calcrete indicate arid and semi-arid paleoclimate condition. The taphonomy and the extraordinary preservation of Phu Sung fossils

could probably relate to the paleoenvironment and the paleoclimate in the Early Cretaceous.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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