Depositional System and Paleoclimate in the Phu Kradung and Phra Wihan formations of the Mesozoic Khorat Group, NE Thailand

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The Mesozoic Khorat Group is widely distributed in the northeastern Thailand. The Khorat Group consists essentially of red clays, siltstones, sandstones and conglomerates. Stratigraphically, the Khorat Group can be divided into seven units in ascending order, namely, Phu Kradung, Phra Wihan, Sao Khua, Phu Phan, Khok Kruat, Maha Sarakham and Phu Thok formations (Racey et al., 1994, 1996). Though occurrence of paleosol is reported in studies of the Phu Kradung, Sao Khua and Khok Kruat formations (e.g. Mouret et al., 1993; Meesook, 2001; Meesook and Wongprayoon, 2001), few studies were focused on the paleosol profile in a sequence. The objective of this study is to characterize depositional system and paleoclimate, based on stratigraphy, paleosol features, paleosol profiles and reworked deposits.

The sequence of the Phu Kradung and Phra Wihan formations in the Nong Bua Lamphu section is composed mainly of sandstones, mudstones and subordinate conglomerates. The stratigraphy is characterized by cycles of fining-upward sequence. More than 8 cycles of fining-upward sequence can be recognized in this section. Depositional system of the studied section is of an anastomosed river. Paleosols in the studied section are developed mainly in floodplain deposits and subordinately in levee and crevasse splay deposits. Several kinds of paleosol features, such as root traces, calcretes, mottles and slickensides, are observed.

Calcretes were formed in red colored and argillaceous soil, and were sometimes accompanied with slickensides. The occurrence of calcrete with slickensides indicates that paleosols in the studied section were formed under semi-arid to sub-humid climate and 100 to 700 mm in mean annual precipitation. The microstructures of calcrete show characteristics of both alpha- and beta-type calcretes and are interpreted to have been formed under semi-arid to sub-humid conditions.

The calcrete horizons vary from 1 cm to 4 m in thickness. The mean annual range of precipitation is estimated to be a range from about 15 to 330 mm, as deduced from the thicknesses of the calcrete horizons. On this basis, it is inferred that the difference in the amount of precipitation between wet and dry seasons were highly variable without periodicity during deposition of the Phu Kradung and Phra Wihan formations. However, in some calcrete horizons, there is a possibility that Bk horizon is partly superimposed and that, as a result, multiple Bk horizons appear as a single thick calcrete profile. The interval thickness between calcrete horizons is highly variable through the studied section. Thus, inflow of fine materials probably occurred randomly in the floodplain, because one calcrete horizon is formed by one period of soil formation. Such a more random deposition results probably from flooding event caused by climatic event. It is concluded that superimposed multiple calcrete horizons were developed during the period of a small amount of sediment-supply.

Reworked calcretes are observed at 11 horizons in the studied section. Some of these horizons occurred as ephemeral channel and sheet flood deposits in interfluvial drainage systems which were formed after sporadically heavy rains. It is probable that the Phu Kradung and Phra Wihan formations in the studied section were deposited under paleoclimates of strong seasonality with sporadic and heavy rainfall events.

References