

# **Late Paleozoic Carbonates and Foraminiferal Faunas in Northern Lao PDR :Their Geotectonic Implications**

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## **Introduction**

Recently, it is widely accepted that Southeast Asia geologically comprises several continent blocks that had originated from Gondwanaland by stepwise riftings and subsequently collided and amalgamated to form this region during Paleozoic-Mesozoic time (e.g., Metcalfe, 1999). In past decades, the geotectonic subdivisions and evolution model in mainland Thailand and West Yunnan, China, discussed based on concrete geologic data (Ueno, 1999, 2002; Ueno and Hisada, 1999) make geologic information from northern Lao PDR situated

between mainland Thailand and West Yunnan increasingly significant. In the last years, we had field investigations in northern Lao PDR to understand the fundamental geotectonic structure in this area, and gain more data on Late Paleozoic carbonates and their foraminiferal faunas.

## **Foraminiferal fauna in northern Lao PDR**

We consider the geotectonic continuities from northern Thailand to northern Lao PDR based mainly on the characteristics of Late



Paleozoic carbonates and their foraminiferal faunas. In this study, we collected limestone samples from a total of 30 localities in the Pak Lay, Sayabouli, Pak Beng, Phou Khoun, Vang Vieng, and Luang Prabang areas. Based on foraminifers, the Mississippian/Early Carboniferous (Visean-Serpukhovian), early Pennsylvanian/early Late Carboniferous (Bashkirian-Moscovian), late Pennsylvanian/late Late Carboniferous (Kasimovian-Gzhelian?), and Guadalupian/Middle Permian (Kubergandian?-Murgabian) are recognized in carbonates of these areas. The foraminiferal faunas and their comparison with those from northern Thailand have been made as follow:

Visean-Serpukhovian carbonates are widely distributed in the north and south of Luang Prabang, forming a large-scale carbonate platform. They consist of thick-bedded dark-gray limestone and contain abundant foraminifers such as *Mediocris*, *Archaeodiscus*, *Paraarchaediscus*, *Neoarchaediscus*, *Zellerinella*, *Endothyranopsis*, *Endothyra*, *Valvulinella*, and others. Moreover, these carbonates often associate with pillow basalts in the field although their original relationship is not very clear. In northern Thailand, the distribution of broadly coeval limestone is restricted in the north of Loei and the west of Phetchabun (Fontaine et al., 1981, 1983), which are both situated on the margin of the Indochina Block.

Bashkirian-Moscovian carbonates, containing *Profusulinella*, *Fusulinella*, *Beedeina*, and *Fusulina*, are found from the northeast of Sayabouli, north of Vang Vieng, and north of Luang Prabang. Among them, those in north of Luang Prabang are represented by platform slope sediments consisting of calcareous turbidites and debris flow deposits. Similar sediments are also distributed in the north of Vang Vieng. In northern Thailand, coeval calcareous sediments with fusuline foraminifers are only developed in Loei area (e.g., Igo, 1972; Ueno et al., 1994, 1996).

Kasimovian-Gzhelian? (including potentially Cisuralian/Early Permian) carbonates are recognized in the southwest of Pak Lay and the Vang Vieng area. They yield *Montiparus?*, *Triticites*, and *Quasifusulina* in the *Kasimovian*, and *Daixina?* and in the Gzhelian. Of them, conglomeratic limestone intercalated within siliciclastics in the southwest of Pak Lay is similar in occurrence and foraminiferal composition to Gzhelian limestone exposed at Ban Na Din Dam in the Loei area of northeast Thailand (Charoentitirat, 1999 MS).

Kubergandian?-Murgabian limestone is rather widely distributed in the Vang Vieng and Phou Khoun areas and the south of Sayabouli. They are generally represented by large-scale platform carbonates, forming typical karst tower, and contain such fusuline



genera as *Yangchienia*, *Wutuella*, *Laosella*, *Parafusulina*, *Neoschwagerina*, *Afghanella*, *Presumatrina*, *Armenina*, and *Verbeekina*. Field occurrence and fusuline composition of these carbonates are suggestive that they are correlated with the Saraburi Limestone (late Early-Middle Permian) widely distributed in northeast-central Thailand along the western margin of the Indochina Block. Particularly, they are very similar to what we can see in the Loei area in terms of fusuline faunal composition.

### **Geotectonic implications of Late Paleozoic carbonates in northern Lao PDR**

A basic problem of geotectonics in northern Thailand and northern Lao PDR is how the Nan-Uttaradit Suture (a closed remnant of a Permo-Triassic back-arc basin: Ueno, 1999) in mainland Thailand between the Indochina Block (part of Cathaysia) to the east of the suture and Sukhothai Zone (a Permo-Triassic island arc) to the west of it extends to northern Lao PDR and further to the north/northeast. Metcalfe (2002) suggested that this suture extends northeastward to Viet Nam across northern Lao PDR and finally converges into the Ailaoshan Suture in Yunnan. In this interpretation, the Simao Block in West Yunnan is interpreted as a distinct continental fragment from the Indochina Block, clearly

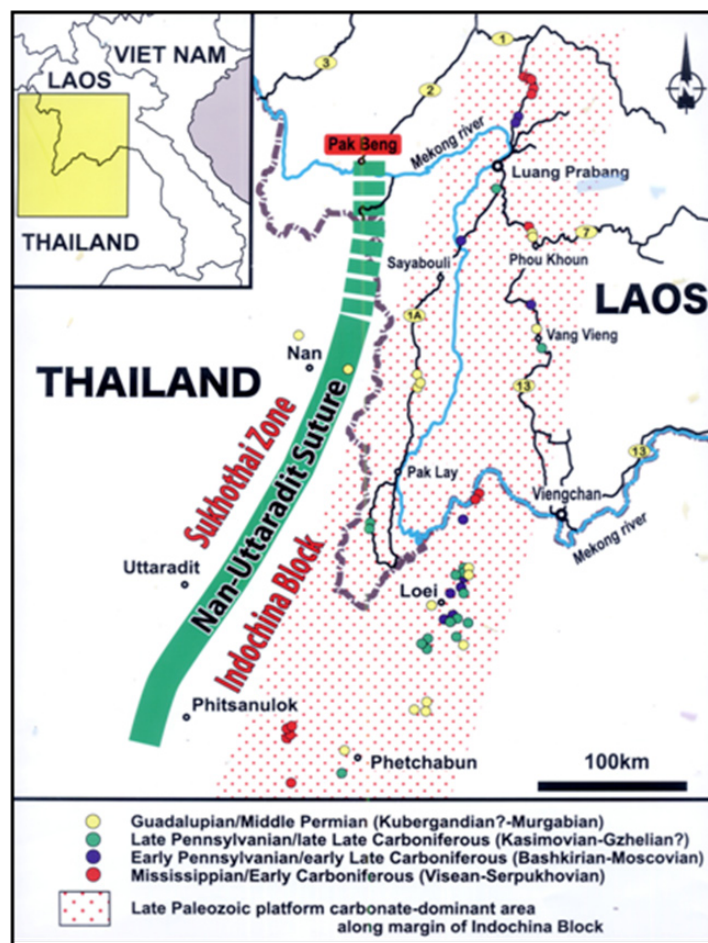
separated by the northeastern extension of the Nan-Uttaradit Suture. In contrast, Ueno (1999, 2002) concluded, based on the comparison of geotectonic subdivisions in mainland Thailand and West Yunnan and the geotectonic properties of each zone, that the Nan-Uttaradit Suture extends up rather northward in northern Lao PDR and continues to the Lancangjiang Suture in West Yunnan, which is situated between the Simao Block (northern extension of the Indochina Block, thus representing part of Cathaysia) to east of the suture and the Lincang Massif (a Permo-Triassic island arc) to the west of it.

The present data obtained from Late Paleozoic carbonates in northern Lao PDR suggest that 1) the area north of Luang Prabang where Mississippian carbonates widely underlie geotectonically belongs to the Indochina Block, and that 2) Late Paleozoic carbonates and their foraminiferal faunas in the north of Luang Prabang and Sayabouli, Phou Khoun, and Vang Vieng areas are essentially similar to those from the Loei area of northeastern Thailand (Figure 1). This further means that broadly north-south trending geotectonic structure prevails in northern Thailand and northern Lao PDR. Wakita and Metcalfe (2005) depicted that the Nan-Uttaradit Suture extends in the Sayabouli and Luang Prabang areas in northern Lao PDR. Our field investigations,

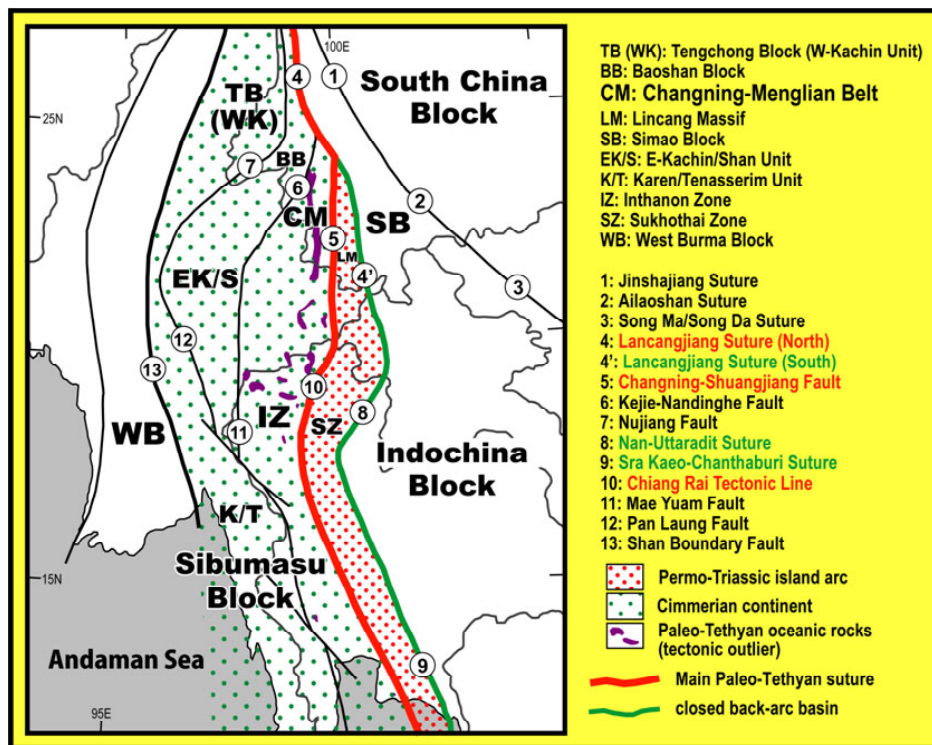


however, revealed that there is no suture-suggesting rock in these areas of northern Lao PDR except for crystalline schist in the further northwesterly Pak Beng area, which is somewhat similar in lithology to that of the Pha Som Group in the Nan-Uttaradit Suture area of northern Thailand. These observations simply suggest the Nan-Uttaradit to be extended northward in northern Lao PDR. Moreover, similar north-south trending geotectonic structure that potentially connects northern Thailand (Loei area), northern Lao PDR, and West

Yunnan (Simao Block) in a geotectonic context has also been demonstrated by data from radiolarian-bearing siliceous sediments of these areas (Kamata et al., 2005). All these lines of evidence support a geotectonic model of Ueno (1999, 2002) that the Nan-Uttaradit Suture extends to the Lancangjiang Suture in West Yunnan through the northwesternmost part of Lao PDR (Figure 2) rather than continuing north-eastward to Viet Nam across northern Lao PDR suggested by Metcalfe (2002).



**Figure 1** Distributions of Late Paleozoic foraminiferal faunas in northern Lao PDR and northern Thailand, and possible northward extension of Nan-Uttaradit Suture to northern Lao PDR.



**Figure 2** Geotectonic subdivisions of mainland SE Asia (slightly modified from Ueno, 2002).

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