

ラオス紀行 -はじめてのラオス-

Lao People's Democratic Republic

Lao-Thai-Japan

タートルアン寺
院That Luang



Tectonic Setting, Magmatism, and Mineralization of Lao PDR: A new Scenario with Reference to Thailand

Charusiri, C., Osanai, Y., Hisada, K., Hara, H., Nakano, N., Kamata, Y., Charoenthitirat, T., Kampawong, K., and Laochou, S.

Co-research Institutes

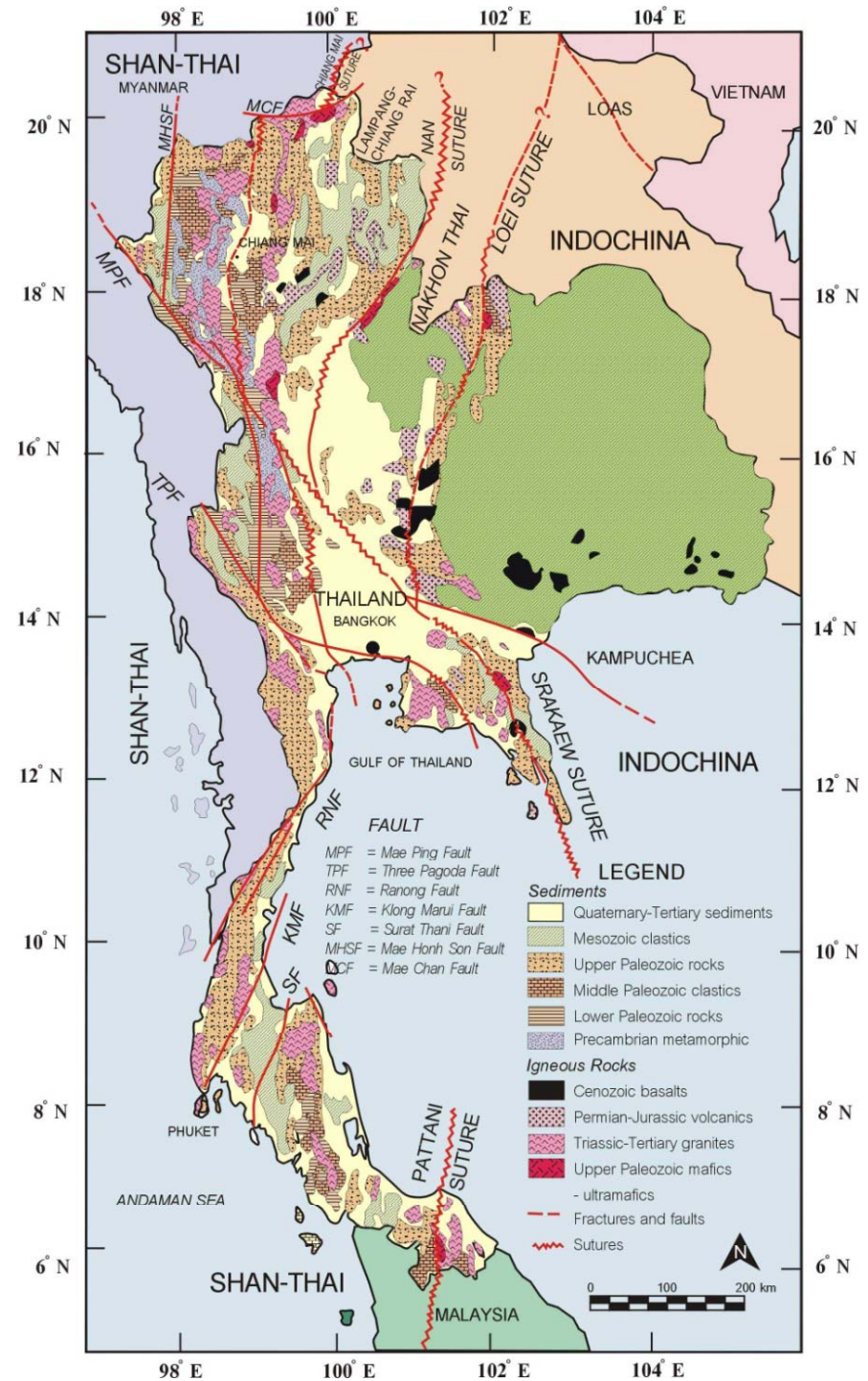
- Earthquake and Tectonic Geology Research Unit (EATGRU), c/o Department of Geology, Chulalongkorn University, Bangkok, Thailand
- Division of Evolution of Earth Environment, Kyushu University, Fukuoka, Japan
- Graduate School of Life and Environmental Science, University of Tsukuba, Tsukuba, Japan
- Department of Mines, Vientiane, Lao PDR
- Department of Geology, Vientiane, Lao PDR
- Geological Survey of Japan, AIST, Japan



Location of Lao PDR in SE Asia



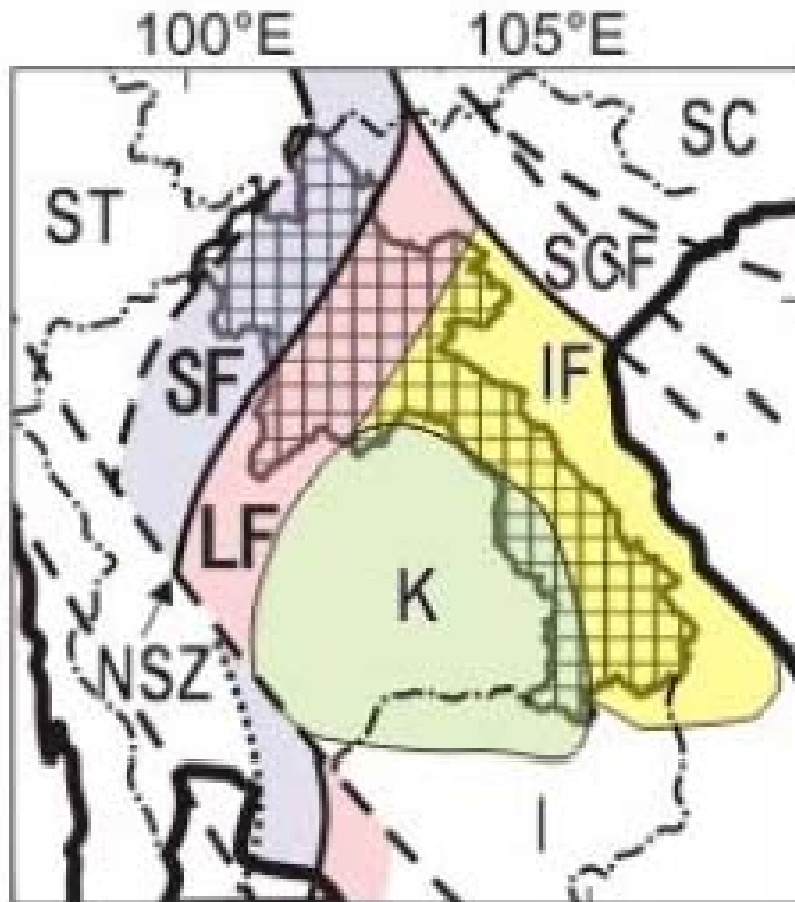
Tectonic Framework of Thailand by Charusiri et al. (2002) in Geol. Soc. of Thailand



Location of the study area



Previous study of Tectonic setting of Lao PDR



K : Khorat Plateau

SF : Sukhothai Fold Belt

LF : Loei Fold Belt

IF : Indosinian Fold Belt

SCF : South China Fold Belt

SC : South-China Terrane

ST : Shan-Thai Terrane

I : Indosinian Craton

NSZ : Nan River Suture Zone

Indochina geologic setting

(Modified after Copper *et al.*, 1989)

Ealier
work for
tectonic
division
in Lao
PDR by
Vilaihongs
et al.
(1997)

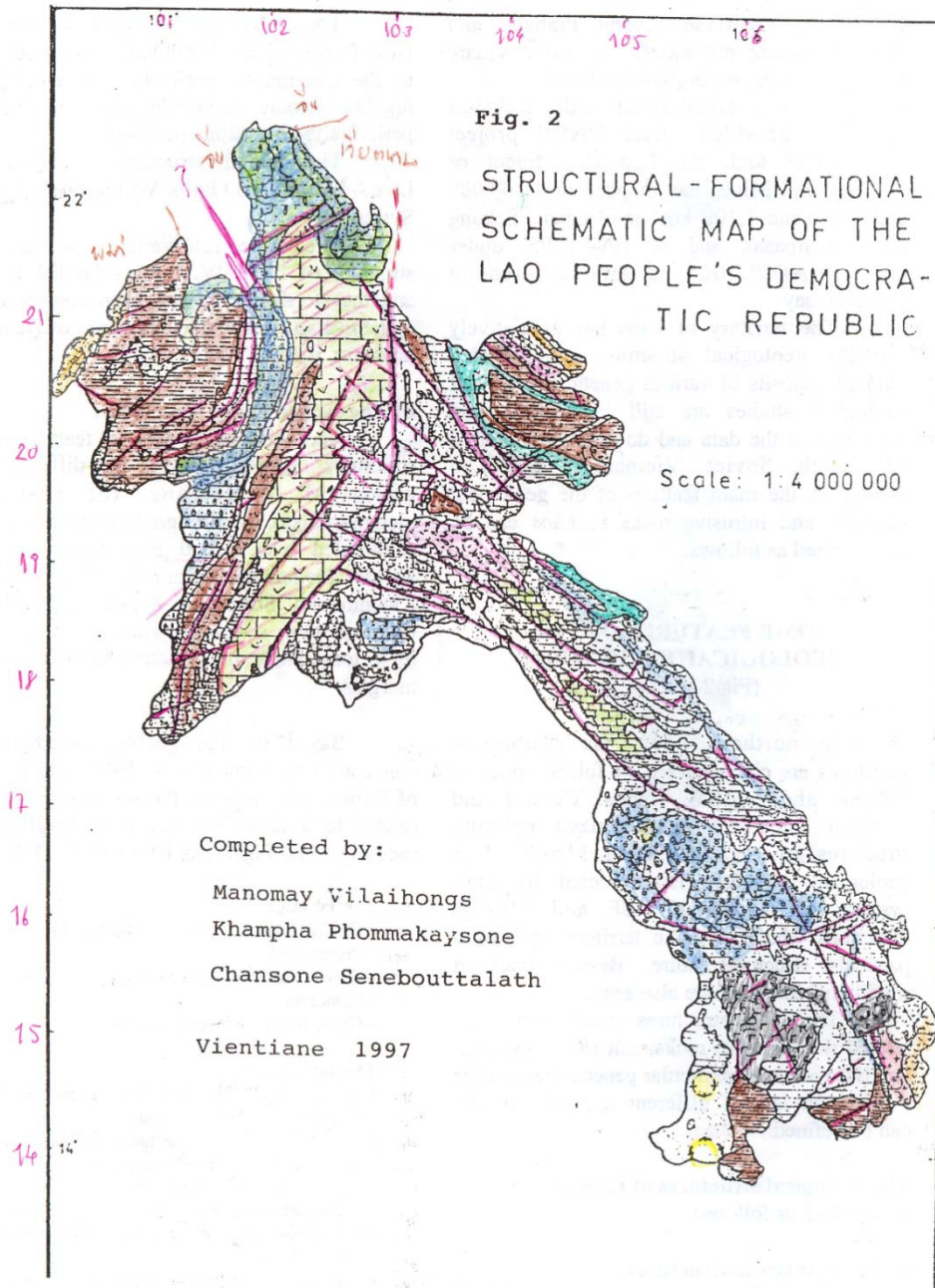
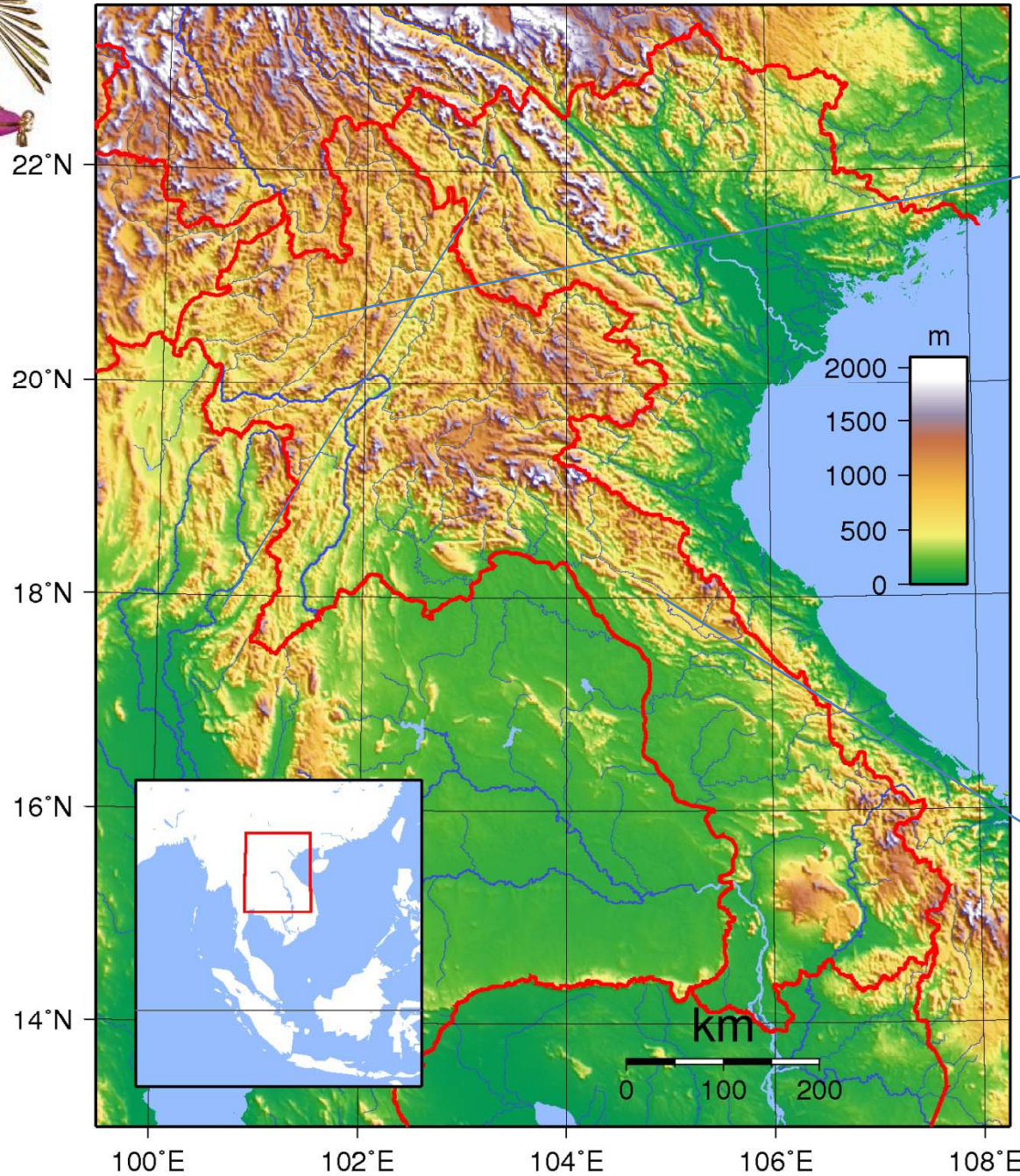


Figure 2 Structural-formational schematic map of the Lao People's Democratic Republic

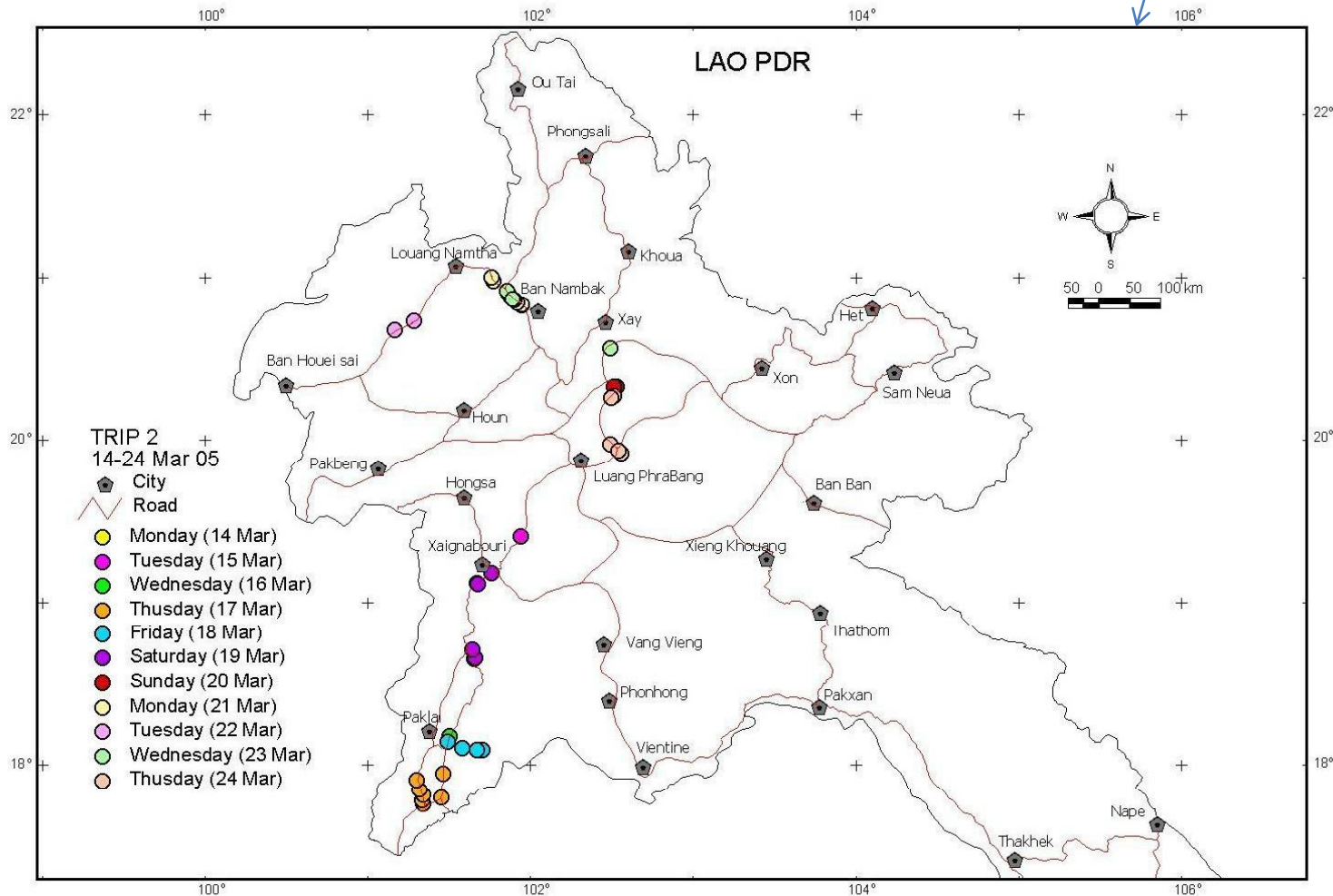


NE-SW
lineaments

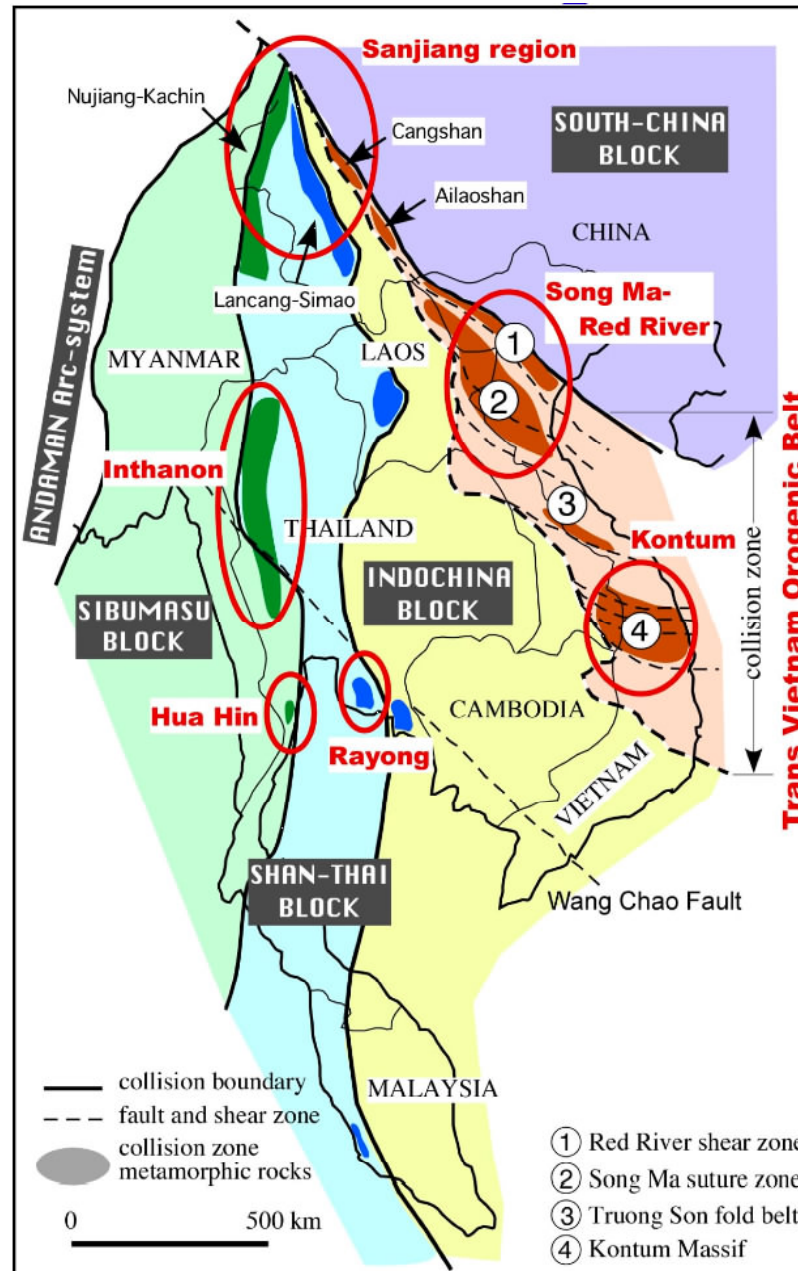
Lao
Satellite
Image
DEM data

NW-SE
lineaments

short-period investigations during 2002 (Vang Viang), 2005 (N), 2007 (NE), 2008 (S), 2009 (NC) were made



Tectonic
framework
of SE Asia
by
Osanai et al.
(2011)



2 minor blocks

Luang Namtha Block

Xam Nua block

4 major tectonic units:

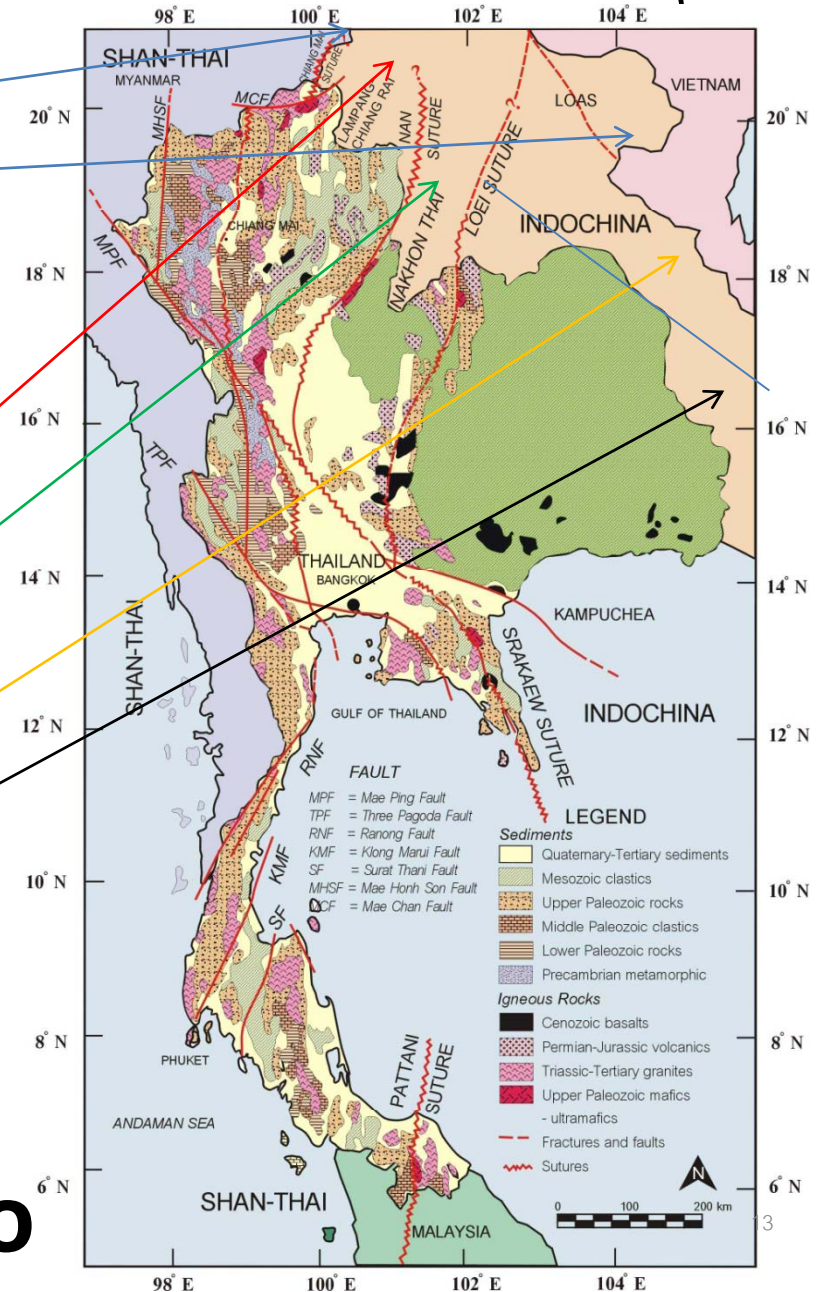
Oudomxai block -W,

Paklay block - C,

Xiangkhoang block - E

Indochina block-S

6 tectonic blocks in Lao



1. Bo Kaeo
E Tr S.

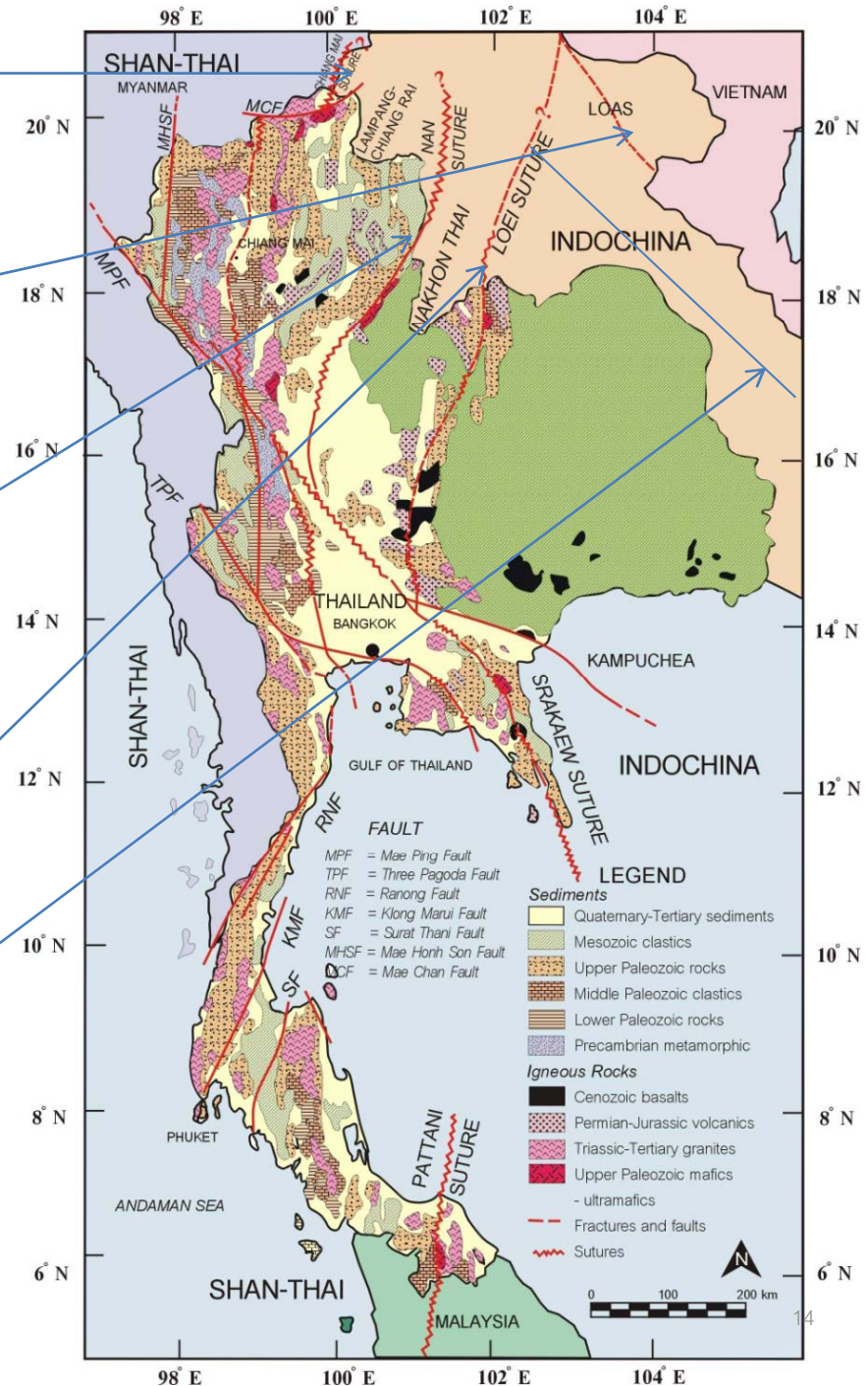
2. Nam Ma
P-Tr S.

3. Xaiyaboury
E Tr S.

4. Luang Prabang
E Tr S.

5. Nam Thoen
P-Tr S.

5 sutures in Lao



Luang Namtha Block

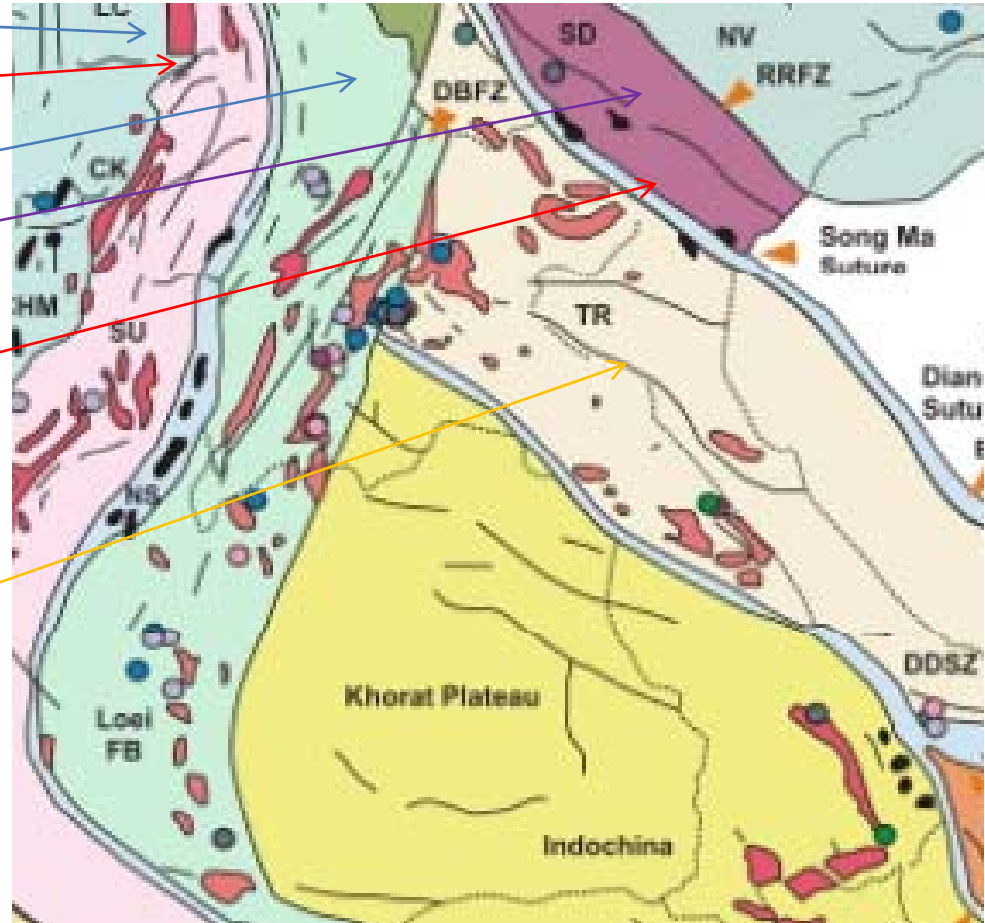
Bo Kaeo S.

Oudomxai block

Xam Nua B.

Nam Ma S.

Phuluang B
(Trung Son B)



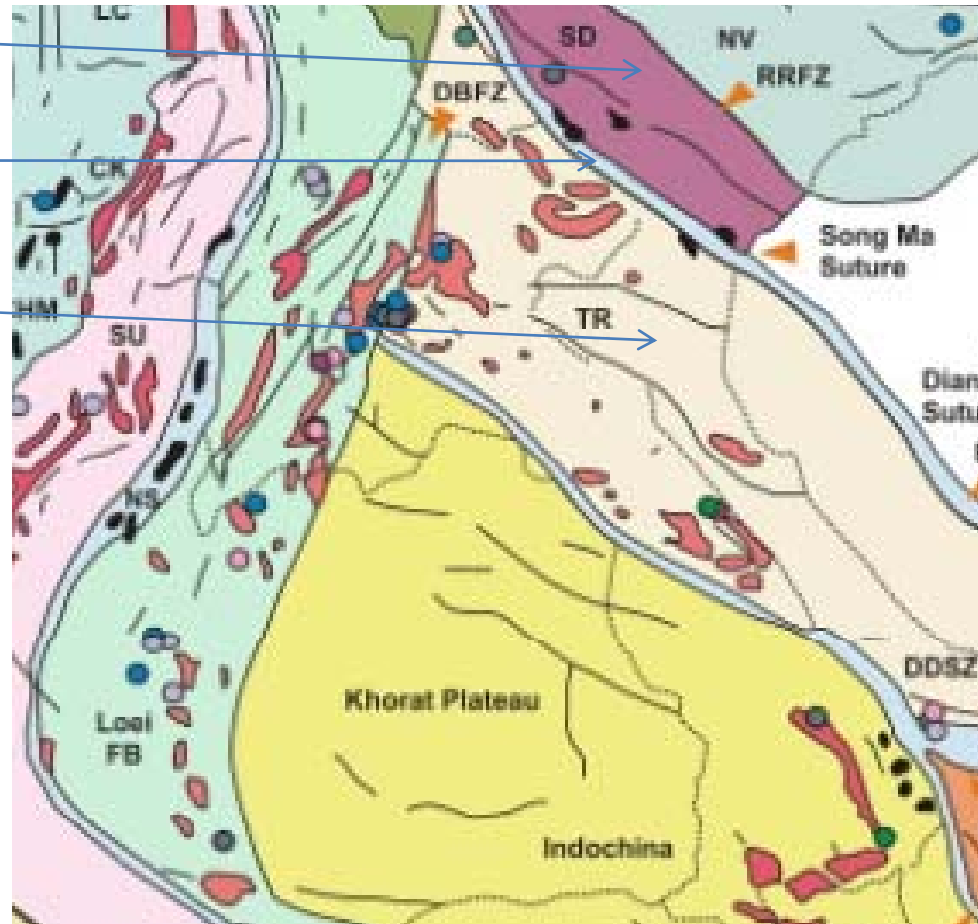
Pillow basalt near Udomsai



Faulted Gabbroic dike rocks cutting granites in Xam Nua area



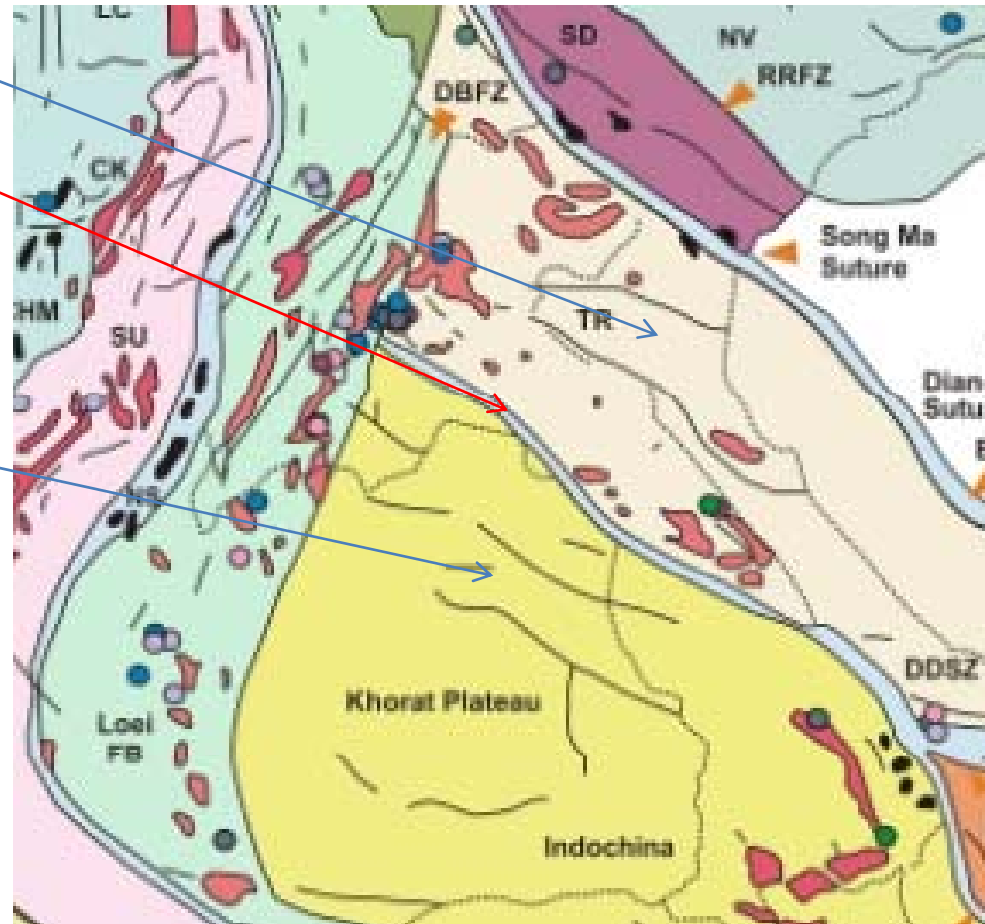
Xam Nua (or Song Ma)
= PTr Nam Ma (or Song
Ma) suture =
Xiangkhoang (or Trung
Son) block



Xiang Khoang

Nam Thoen

Indochina

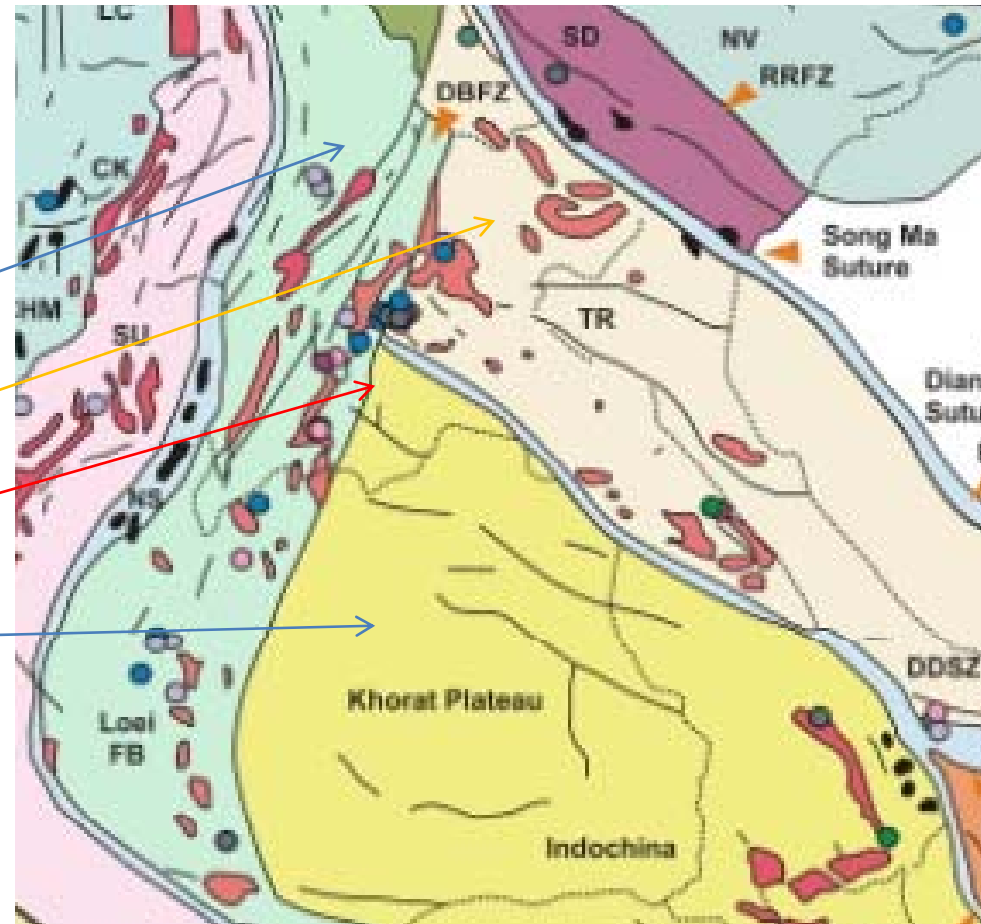


Paklay block - C,

Xiangkhoang block

Luang Prabang (Loei) S

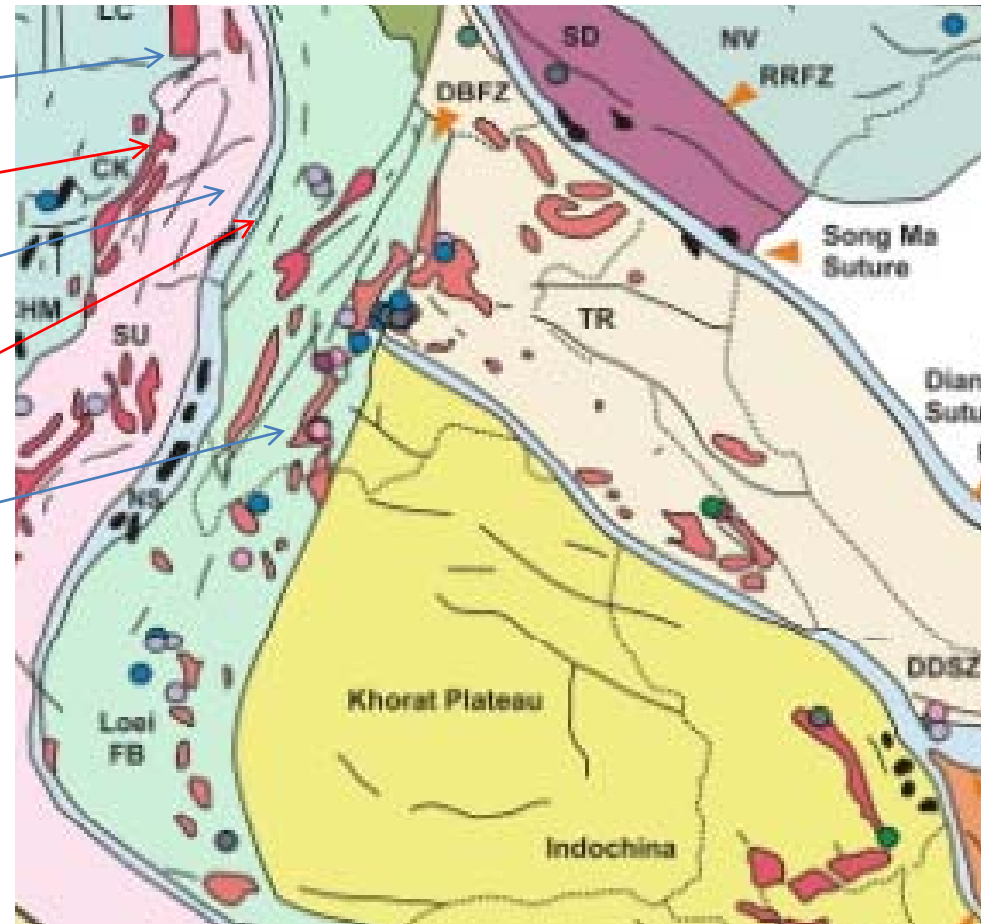
Indochina B-



Karstic Limestone with ore skarns near Kaiso – Vang Vien



- Luang Namtha B.
- Bo Kaeo S.
- Oudomxai B.
- Xaiyaboury S.
- Paklay B.



Late Paleozoic shale/siltstone in Piang basin, Xaiyabour



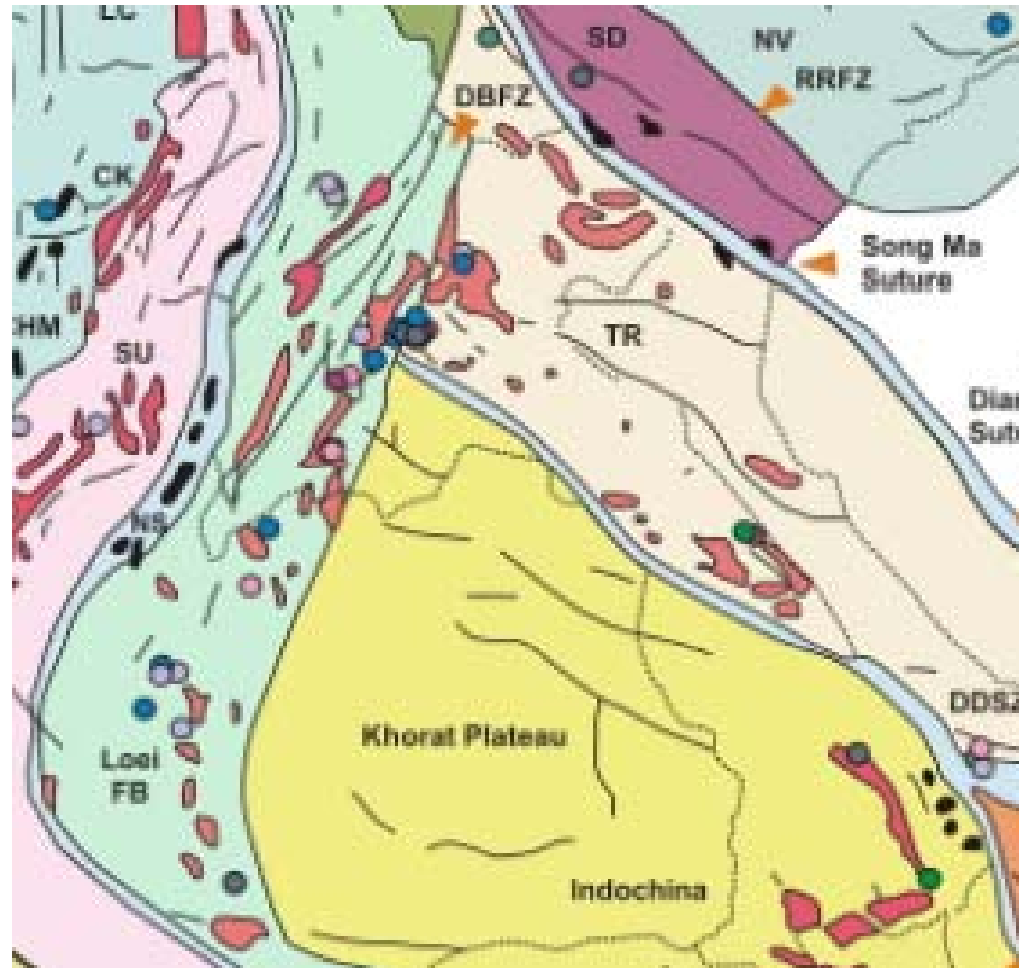
Lp-07 (Basalt) from Udomsai to Luang Prabang



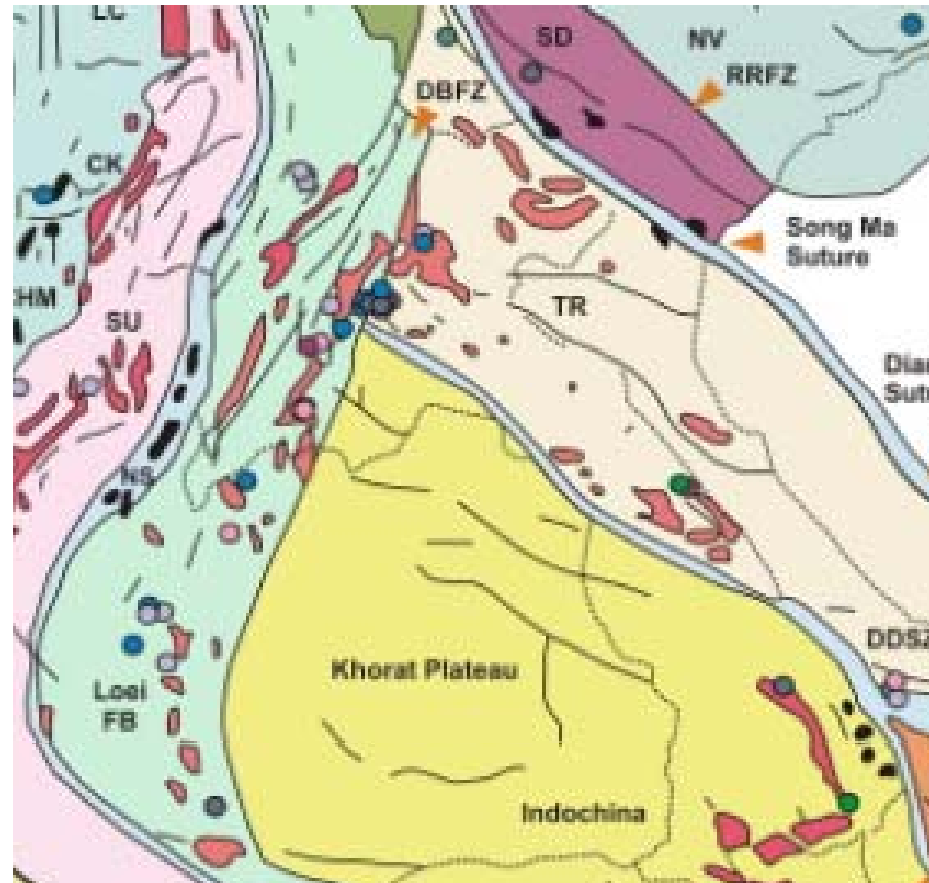
A dirt road to Xaiyabouri, loose blocks of mafic/serpentinized rocks are found in the stream valley



Apart from the Middle Paleozoic, more mafic igneous rocks which are mainly oceanic crustal rocks, most of the more felsic affinities were formed by subduction –related tectonic setting.



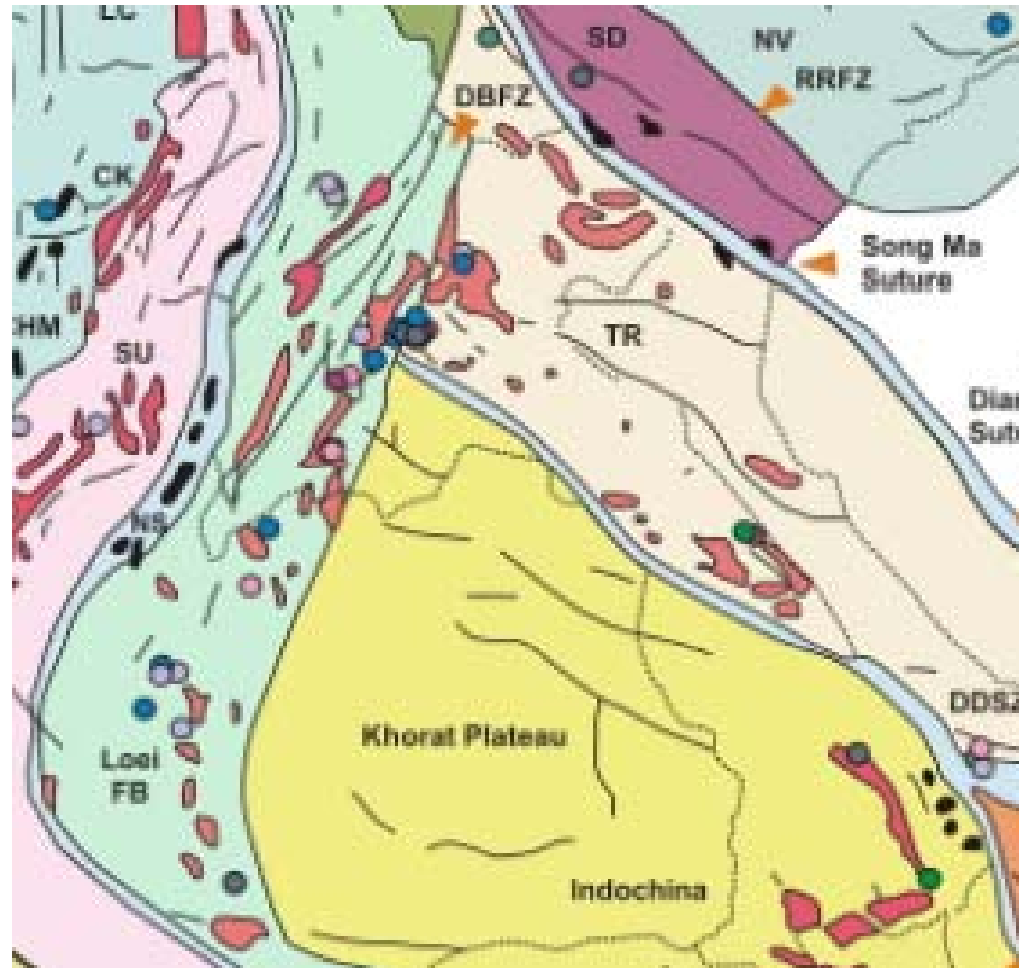
Middle to Late Paleozoic Calc- alkali magmatism in **Xam Nua block** .
Cu-Ni-Co mineralizations formed in association with Middle – Paleozoic (?) mafic oceanic rocks near the **Nam Ma suture in Huaphane** area.
Cu-Fe-Pb-Zn-Au mineralizations may have formed associated with Late Paleozoic, subduction - related, felsic (to intermediate) plutonic rocks



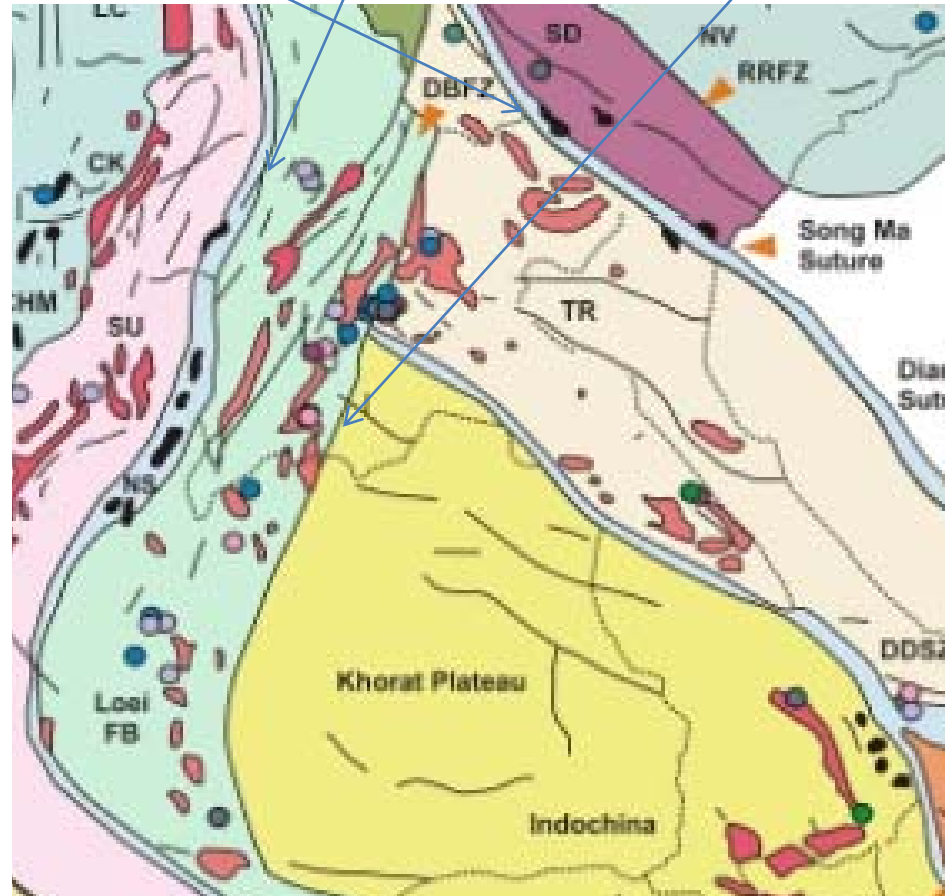
Granite intruding gabbro in Xam Nua area, NE Lao



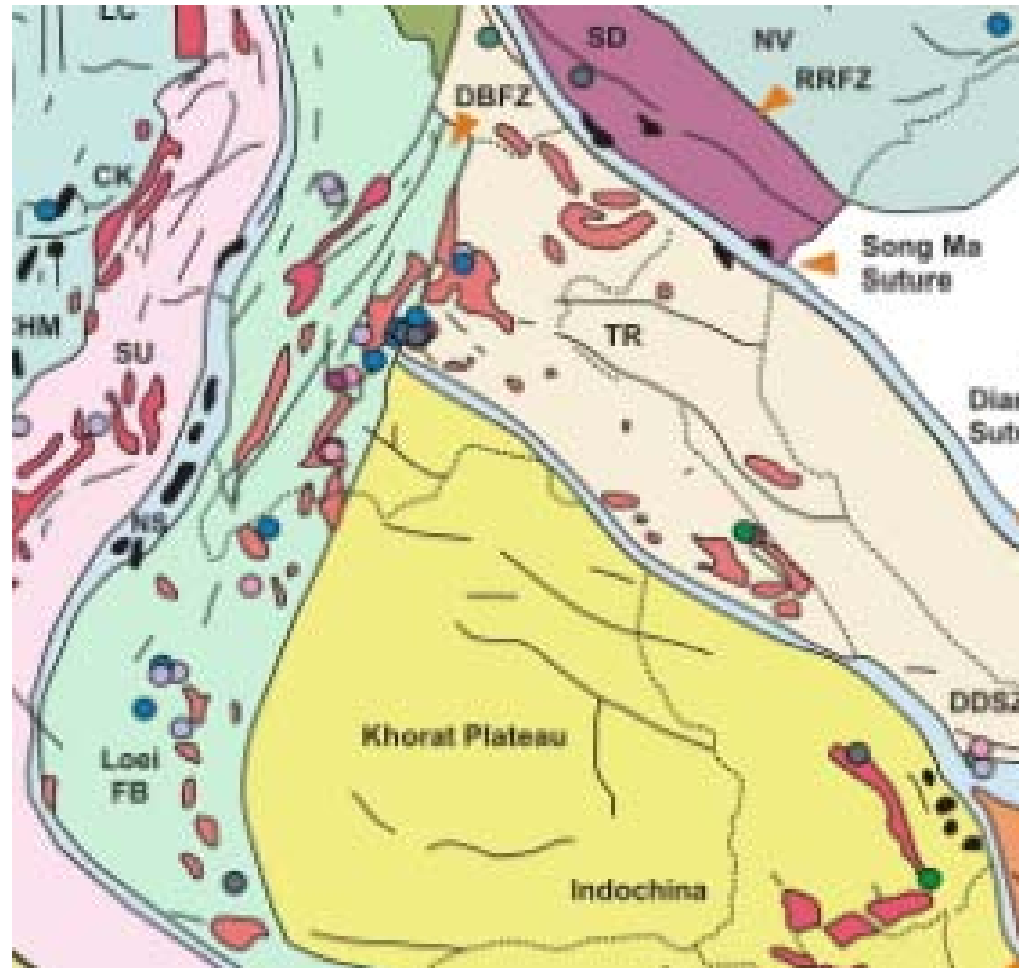
Apart from the Middle Paleozoic, more mafic igneous rocks which are mainly oceanic crustal rocks, most of the more felsic affinities were formed by subduction –related tectonic setting.

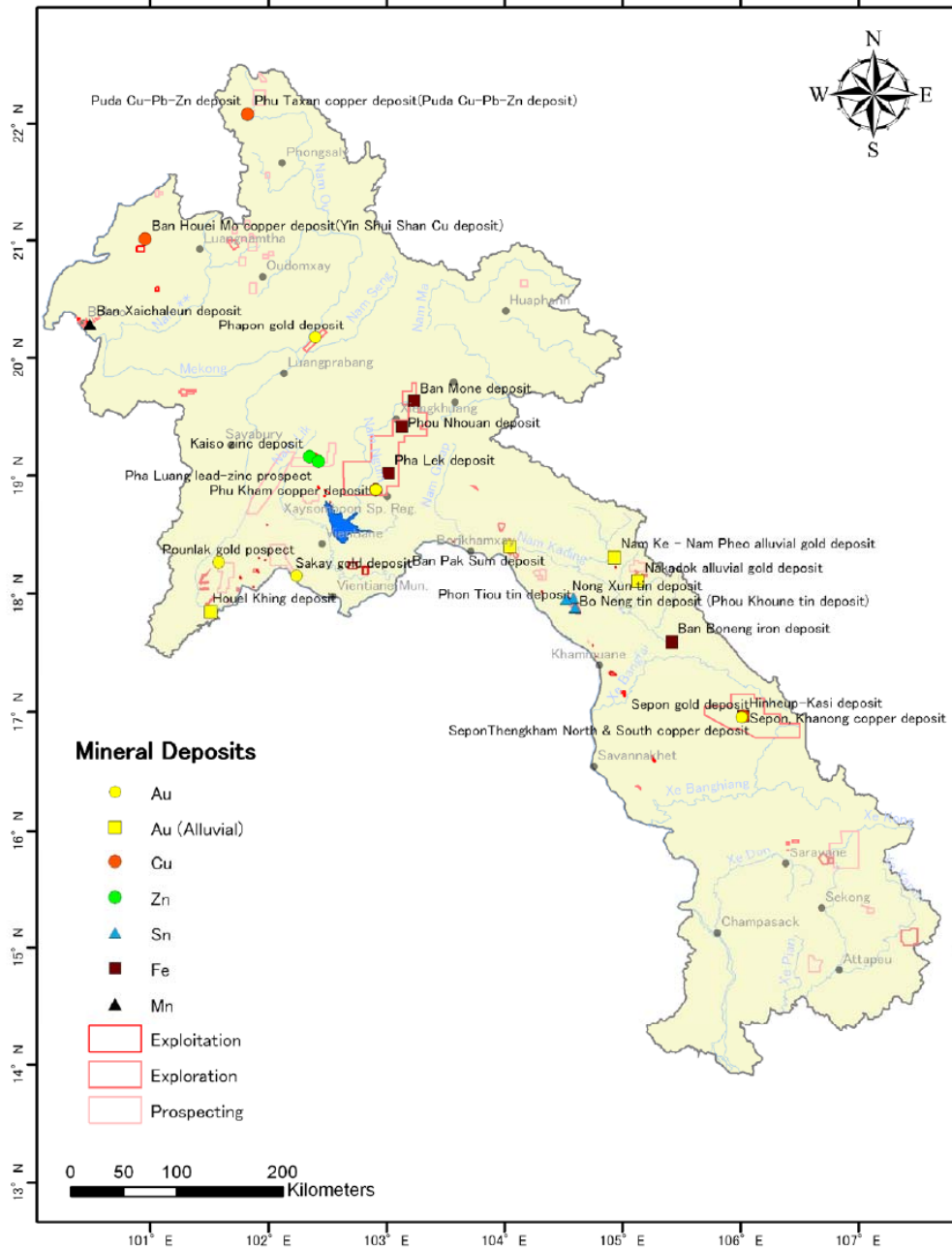


Three narrow zones of Late Paleozoic Cr-Mn-Ba mineralization within the obducted oceanic crustal rocks have been discovered in Nam Ma, Xayabouri and Luang Prabang sutures



Apart from the Middle Paleozoic, more mafic igneous rocks which are mainly oceanic crustal rocks, most of the more felsic affinities were formed by subduction –related tectonic setting.



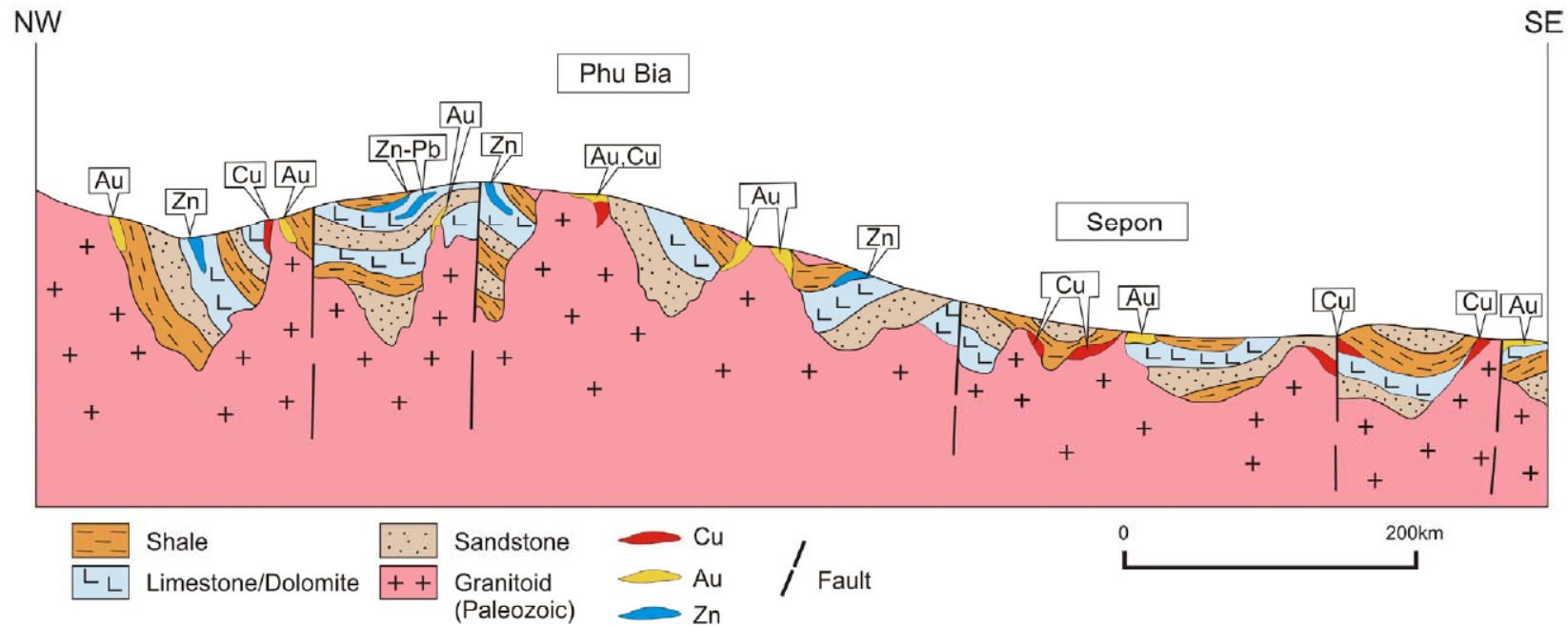


Major mineral deposits of Lao PDR

(Phommakaysone, 2010)

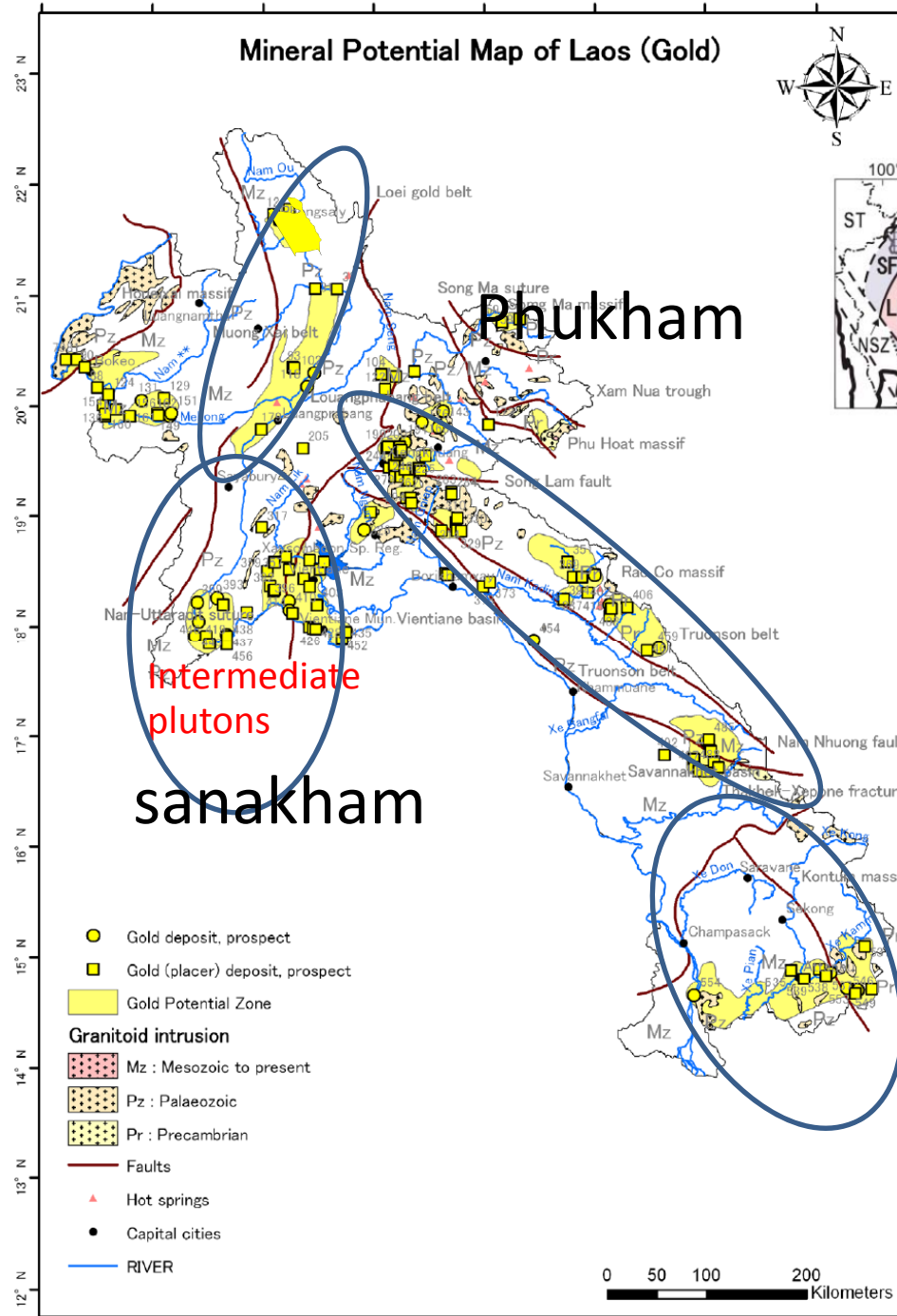
Schematic long section of mineral deposit distribution in Lao PDR

(Phommakaysone, 2010)



Gold deposits in Lao PDR

(Phommakaysone, 2010)



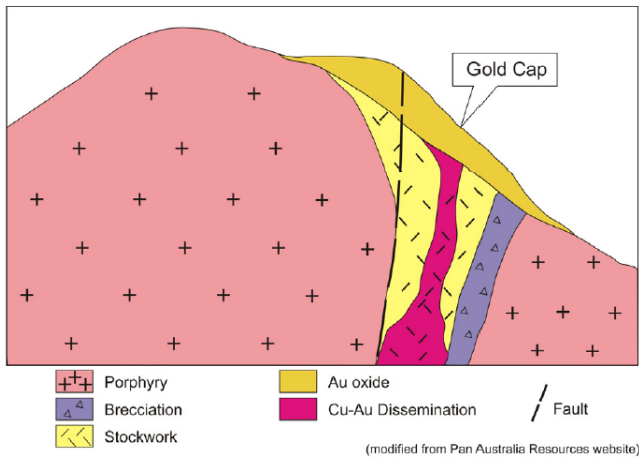
Phukham

Intermediate
plutons
sanakham

Ban Houayxai Au–Ag Epithermal Deposit, Lao PDR

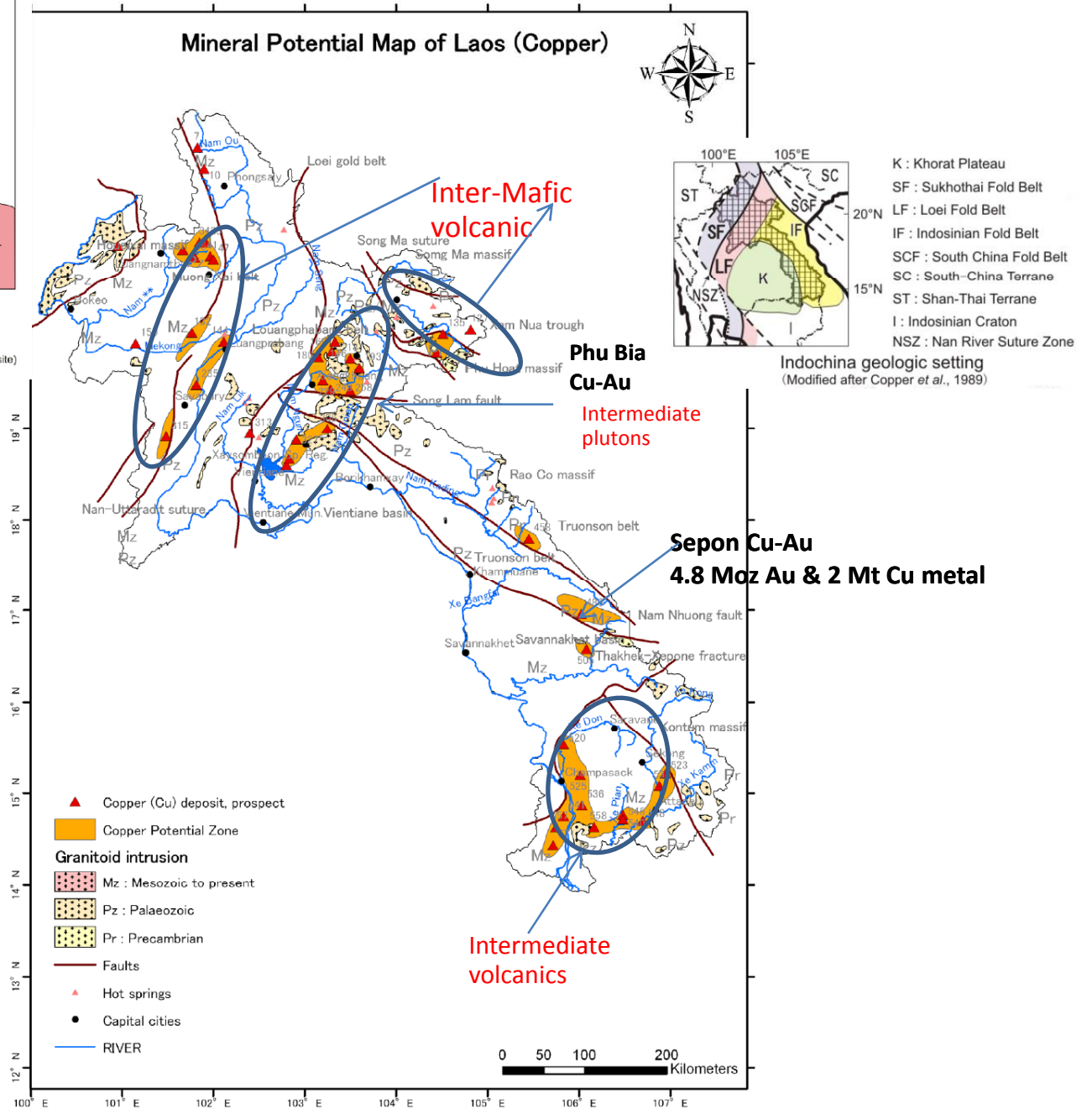


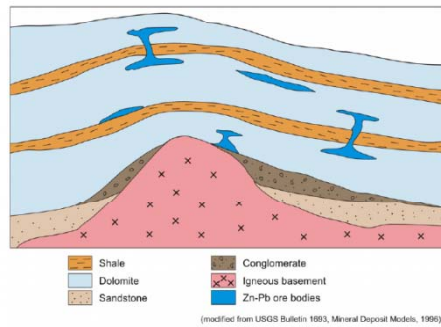
Photo by Takayuki Manaka



Cu potential map of Lao PDR

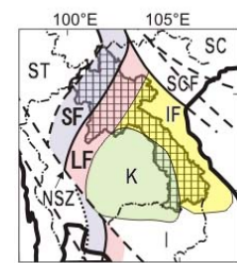
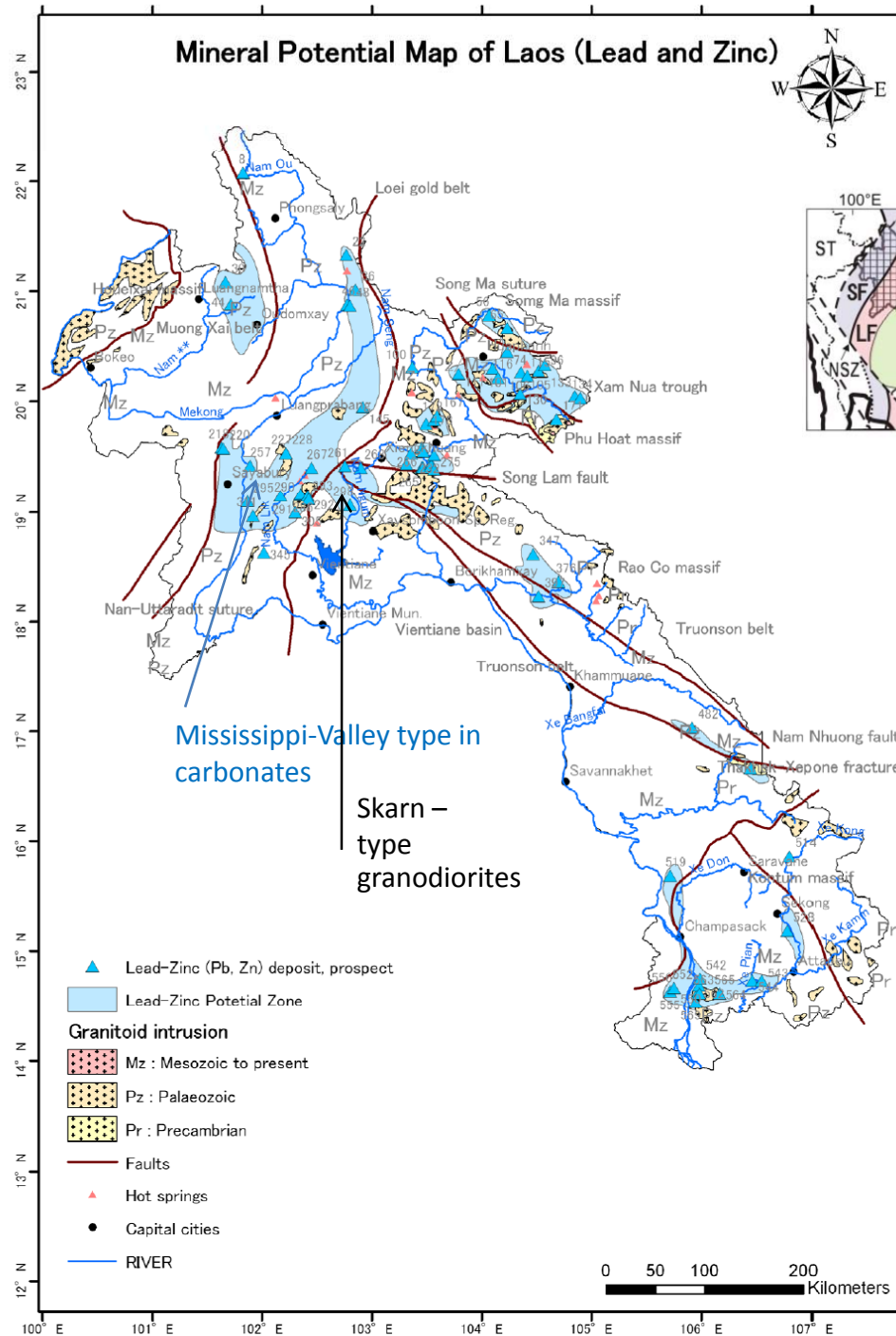
(Phommakaysone, 2010)





Pb-Zn potential map of Lao PDR

(Phommakaysone, 2010)



Indochina geologic setting
(Modified after Copper *et al.*, 1989)

- K : Khorat Plateau
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- SC : South-China Terrane
- ST : Shan-Thai Terrane
- I : Indosinian Craton
- NSZ : Nan River Suture Zone

Mineral Potential Map of Laos (Lead and Zinc)

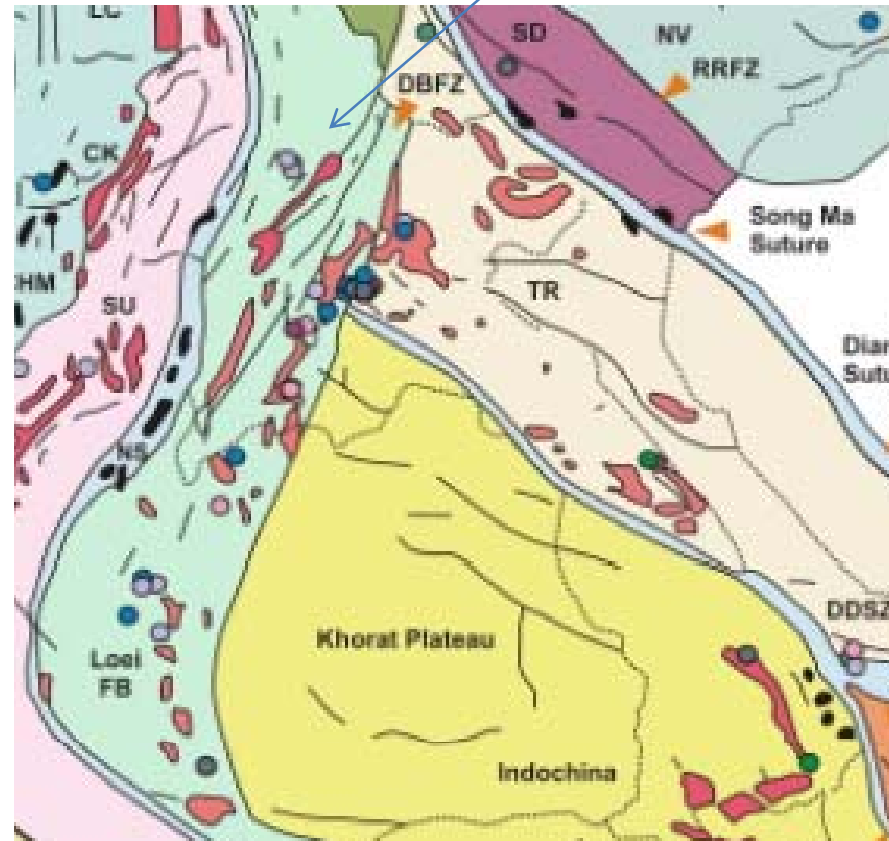
Mississippi-Valley type in carbonates

Skarn – type granodiorites

- ▲ Lead-Zinc (Pb, Zn) deposit, prospect
- Lead-Zinc Potential Zone
- Granitoid intrusion**
- Mz : Mesozoic to present
- Pz : Palaeozoic
- Pr : Precambrian
- Faults
- ▲ Hot springs
- Capital cities
- RIVER

- Tin and some REE minerals have been reported long time ago in **Phon Tieu area** , the north and south of Sayphouluang area **and Ban Boneng, Kham Muan** area of the Xiangkhoang block.
-
- The tin deposits with associated **two mica granites** occurred within the compressive tectonic setting during Late Paleozoic time.

The main episode of magmatism along the Paklay block (Loei Fold Belt) is constrained to be Late Permian to Latest Triassic (245-200 Ma) (Khin Zaw et al., 2007),

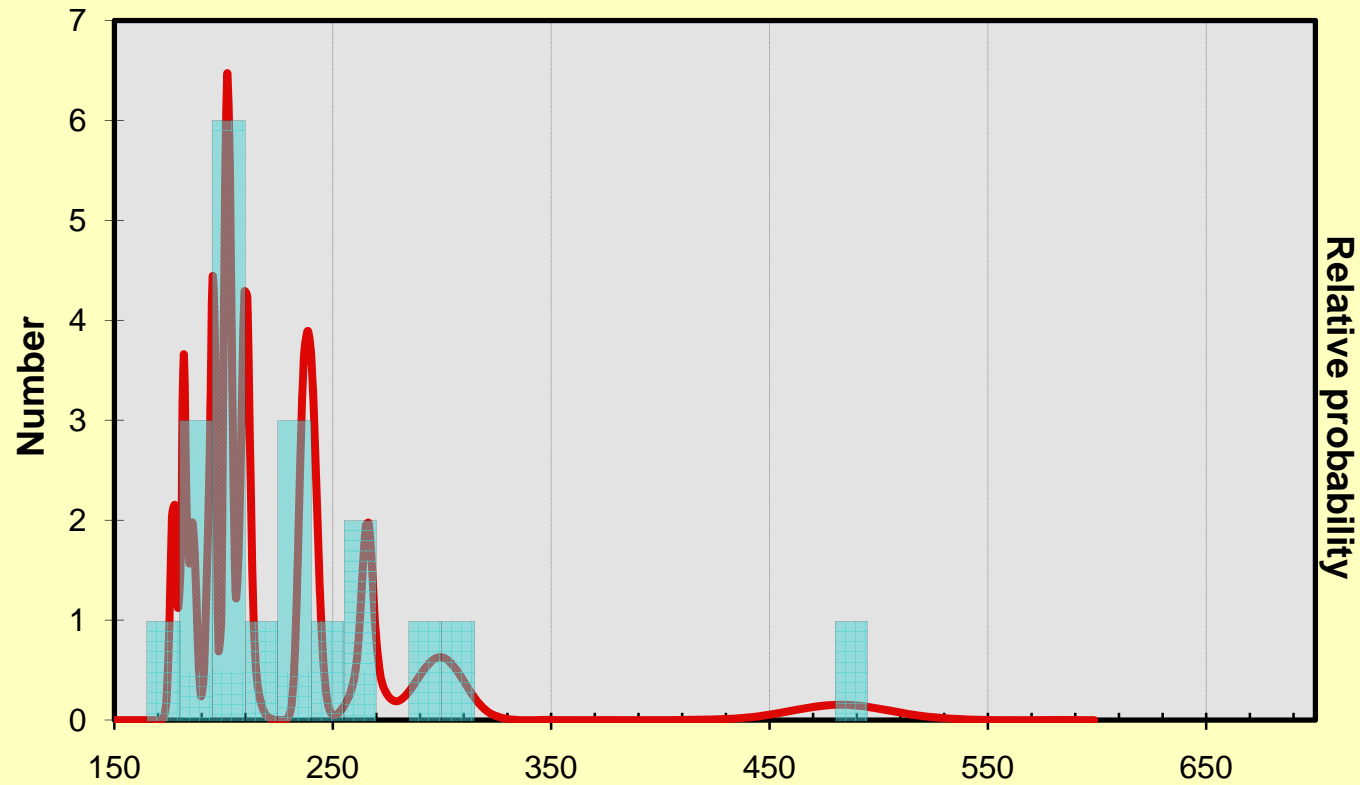


- **Previous Geochronological data**

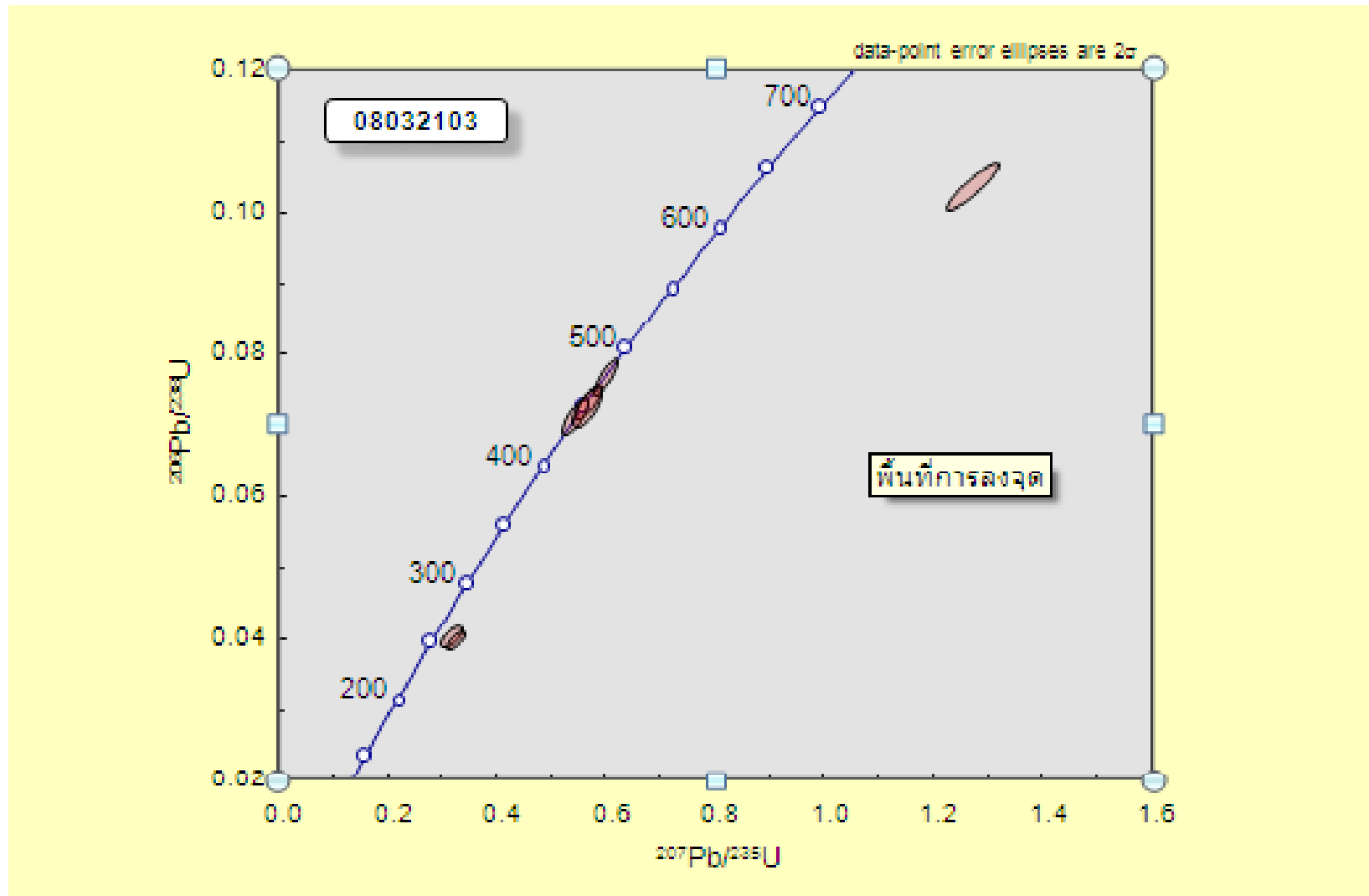
- U-Pb zircon ages of igneous rocks at Sepon Au-Cu deposit and the metamorphism along the Song Ma Suture which are the northern part of the Truongson Fold Belt indicate approximately 300 Ma (Cromie et al., 2007) and 270-260 Ma (e.g., Osanaiet al., 2007) .
- magmatism in Phu Kham, Long Chieng Track and Ban Houayxai areas occurred in the Late Carboniferous to Early Permian (290 ± 20 Ma), whereas the formation of the sedimentary units at Long Chieng Track is probably Early Carboniferous.

- New Geochronological Data
- From U-Pb and Ar-Ar methods

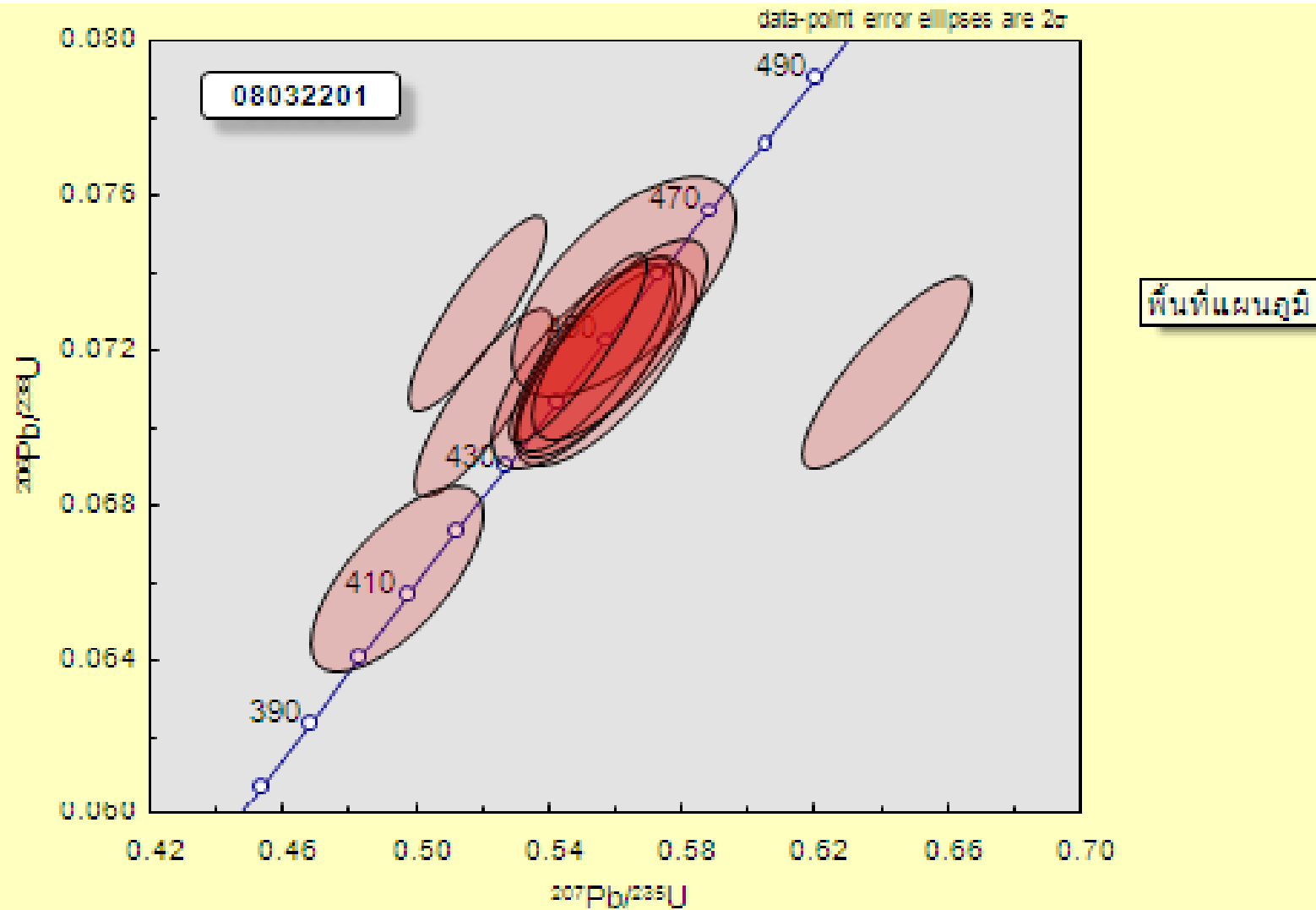
Ar-Ar age data of Sam Nua granite



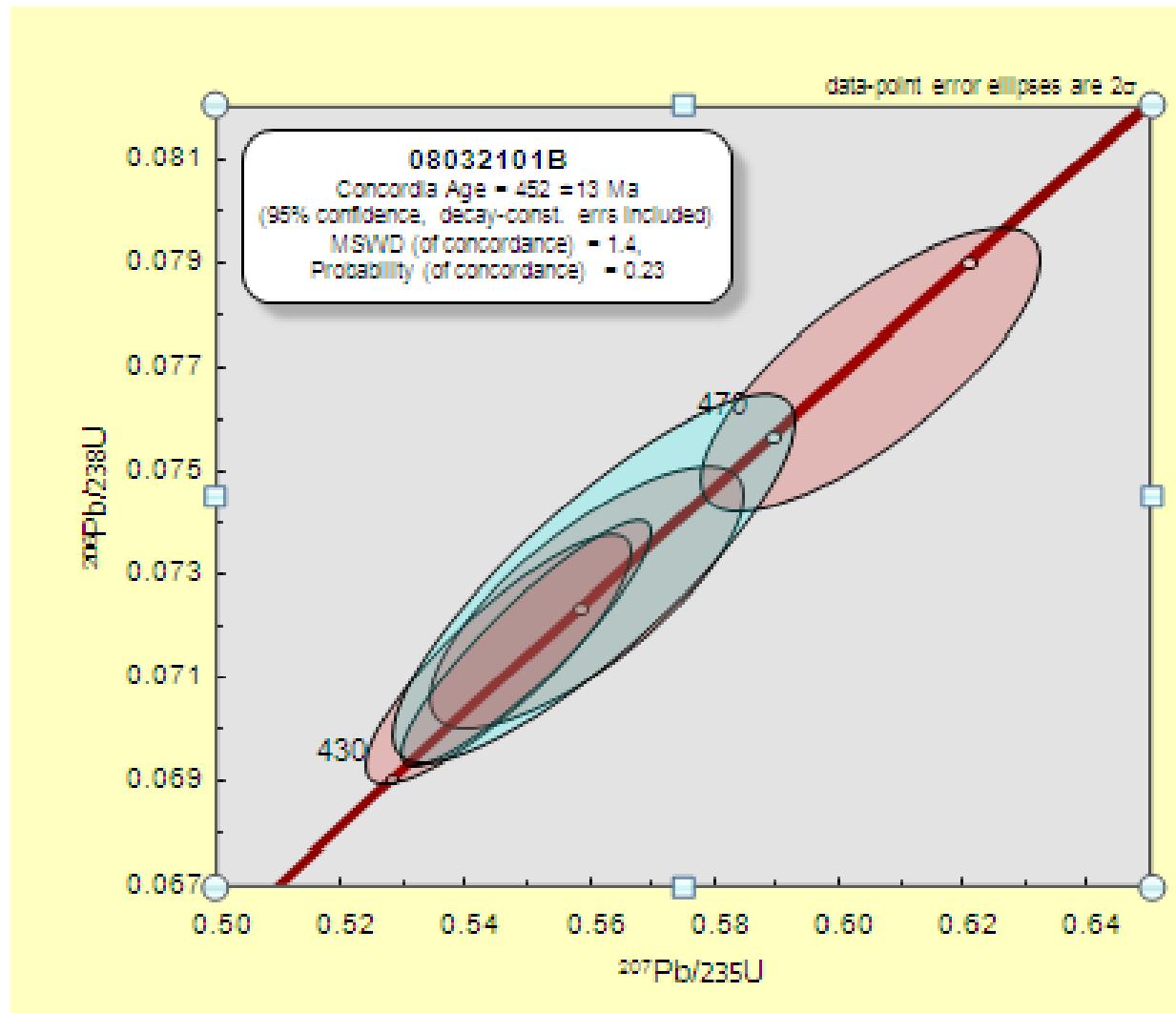
Trungson gneiss



Bi-granite gneiss in Xam Nua area



U-Pb monazite dating age data of Bi granite gneiss



Gabbro and ultramafic clasts in Triassic(?) conglomerate



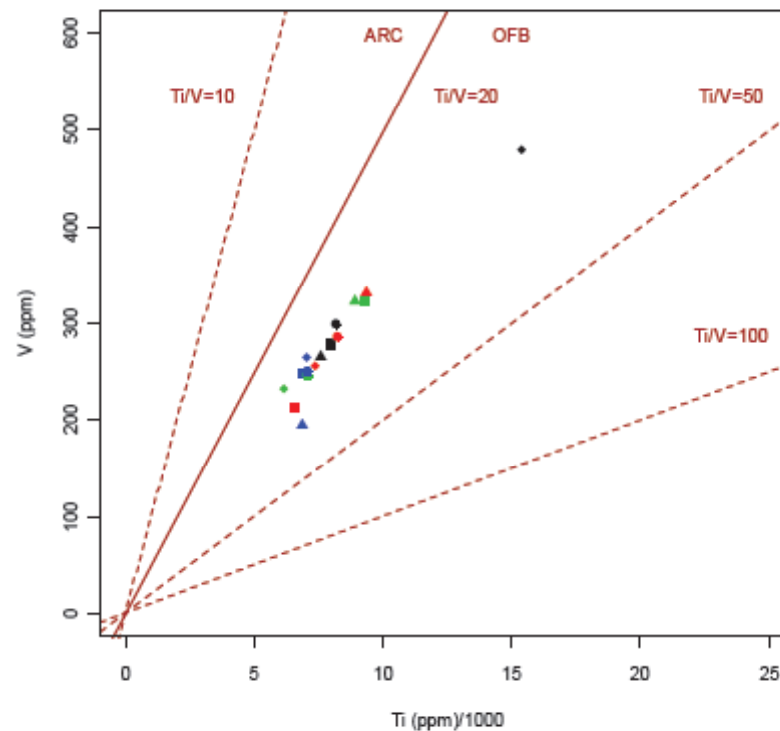
Late Paleozoic Limestone is found nearby the underlying basalt near Luangprabang



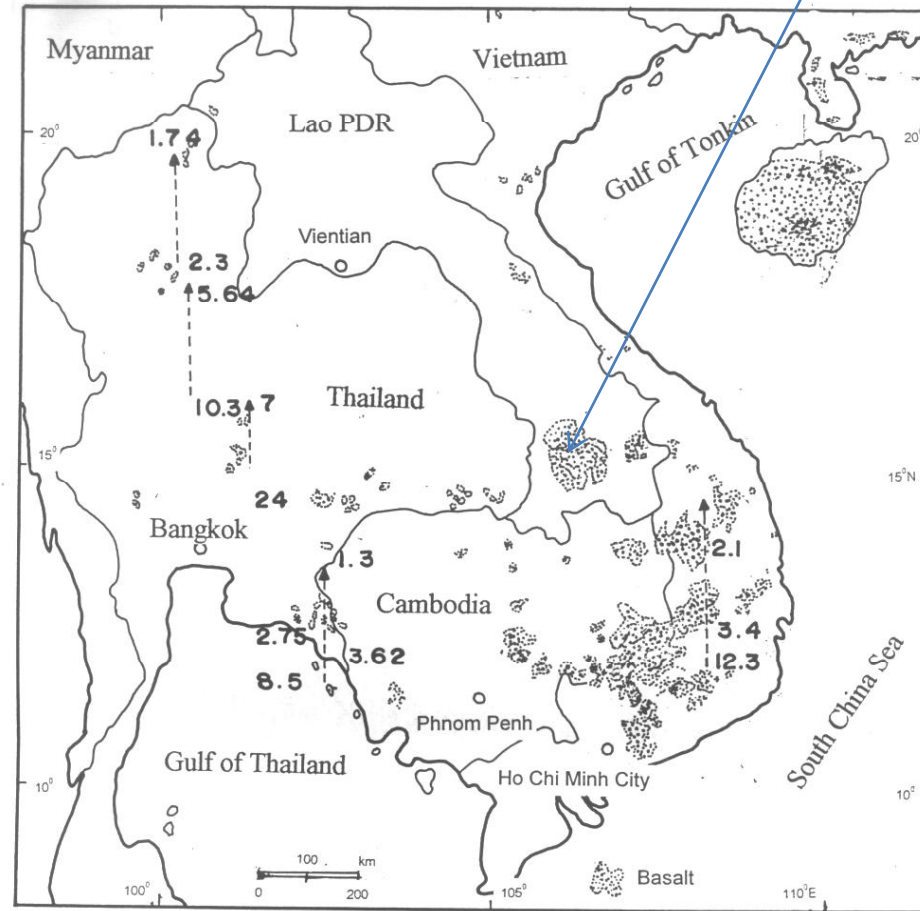
Basalt near Luang Prabang



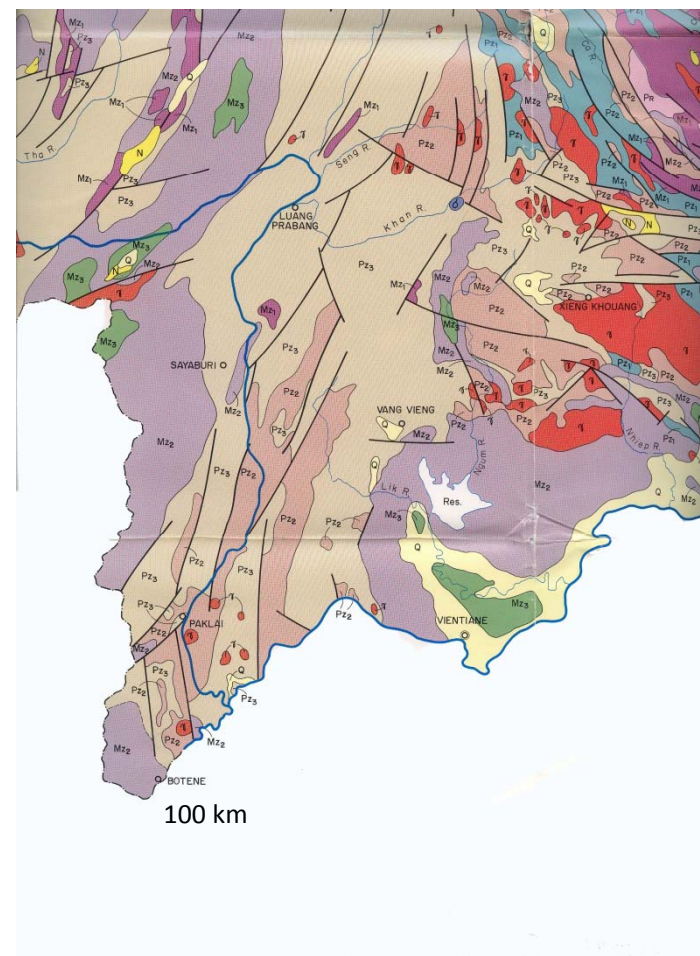
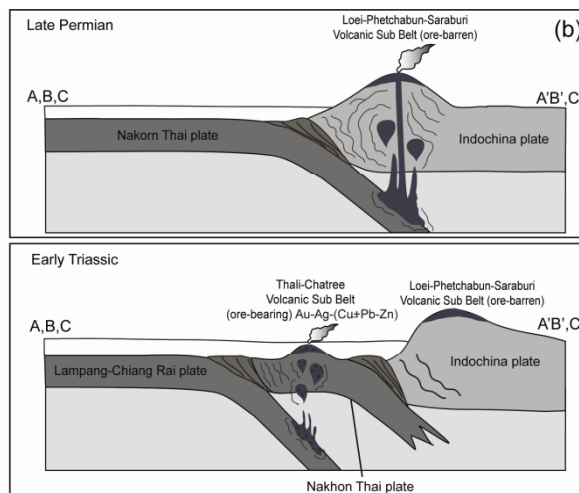
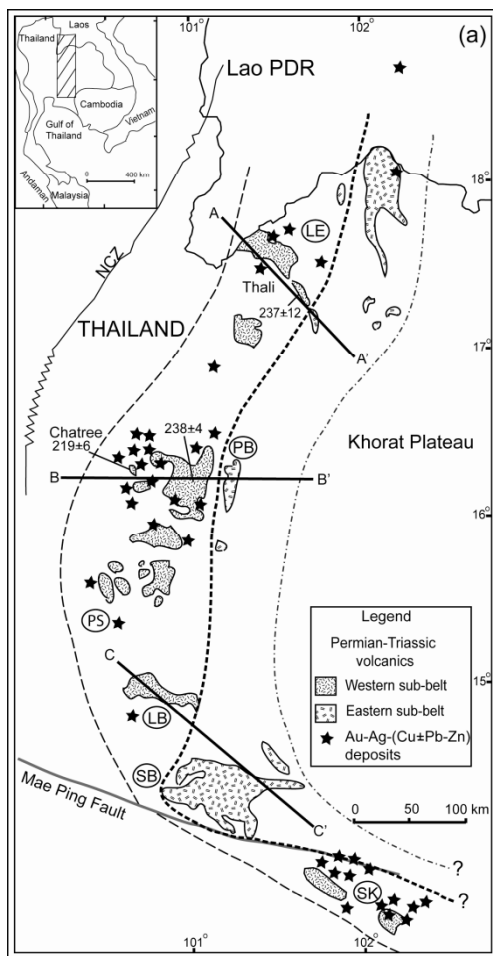
Luang Prabang Basalt geochemistry = oceanic floor basalt



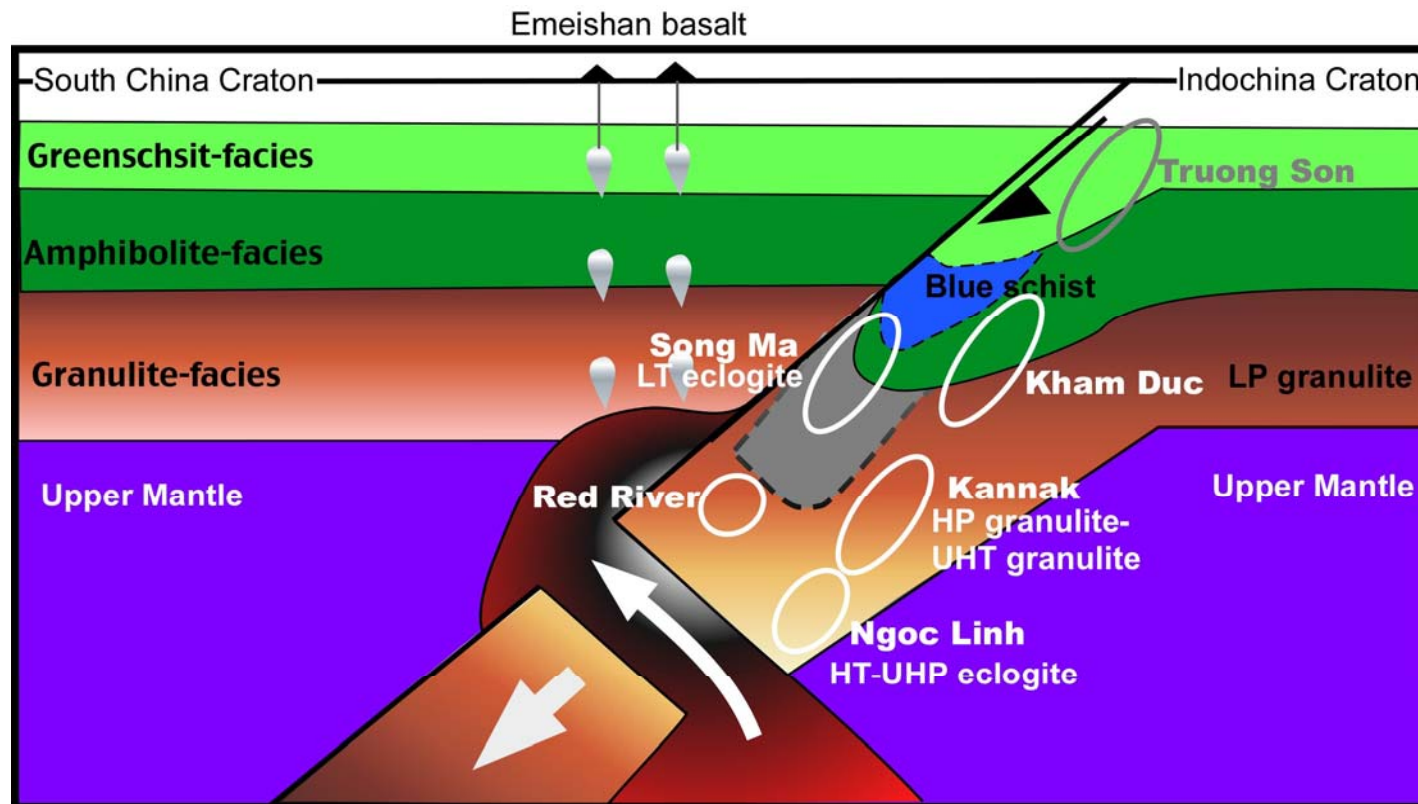
Cenozoic continental rifting, gem-carrying basalt field in Bolevan, southern Lao



Paklay B subducted beneath Indochina B during Permo-Triassic time



Schematic continental collision between South China and Indochina cratons during Permo-Triassic time



Osanai et al. (2011)⁵³

• Thank you

- For joining us to the Thai-Lao Conference



Ban
Huai
Xai