

# **Tectonic Interpretation of Active Fault Extending in Myanmar, Laos and China by Relief Map of ASTER GDEM and Harmonized Geological Map**

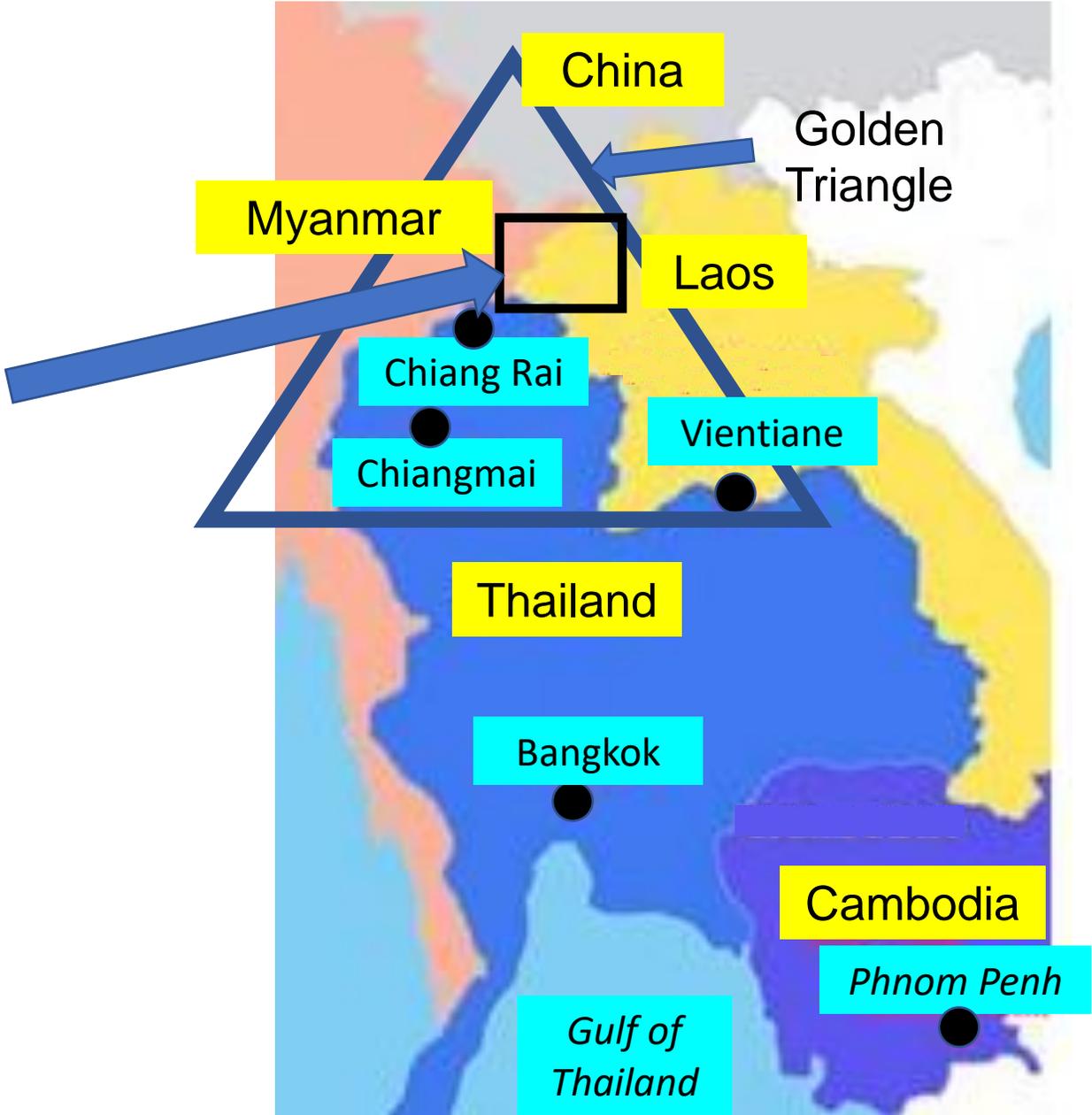
Yasukuni OKUBO, Yutaka TAKAHASHI, Myint SOE, Sompob  
WONGSOMSAK, Masaru FUJITA

IG12 Global and Societal Impacts of Geohazards

7/31/2019 8:30 AM - 10:30 AM

AOGS 16th Annual Meeting  
28 Jul to 2 Aug, 2019  
Singapore

Study area



# Neo-tectonics

Region of complex geodynamic evolution

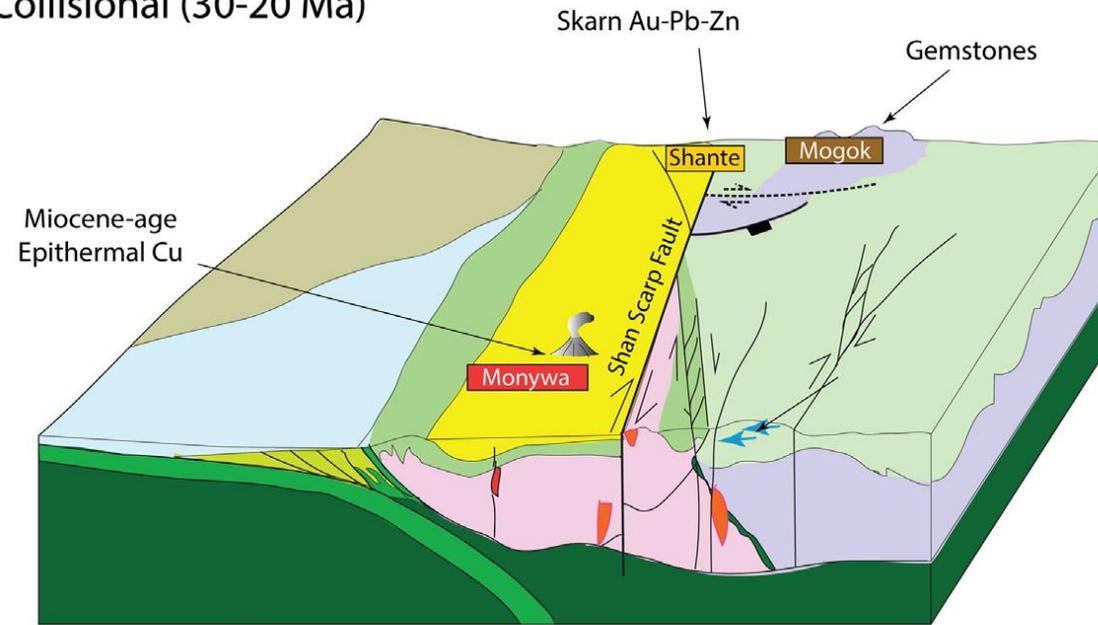
Two major Tethyan plate collisions

The Indian plate drifts northward

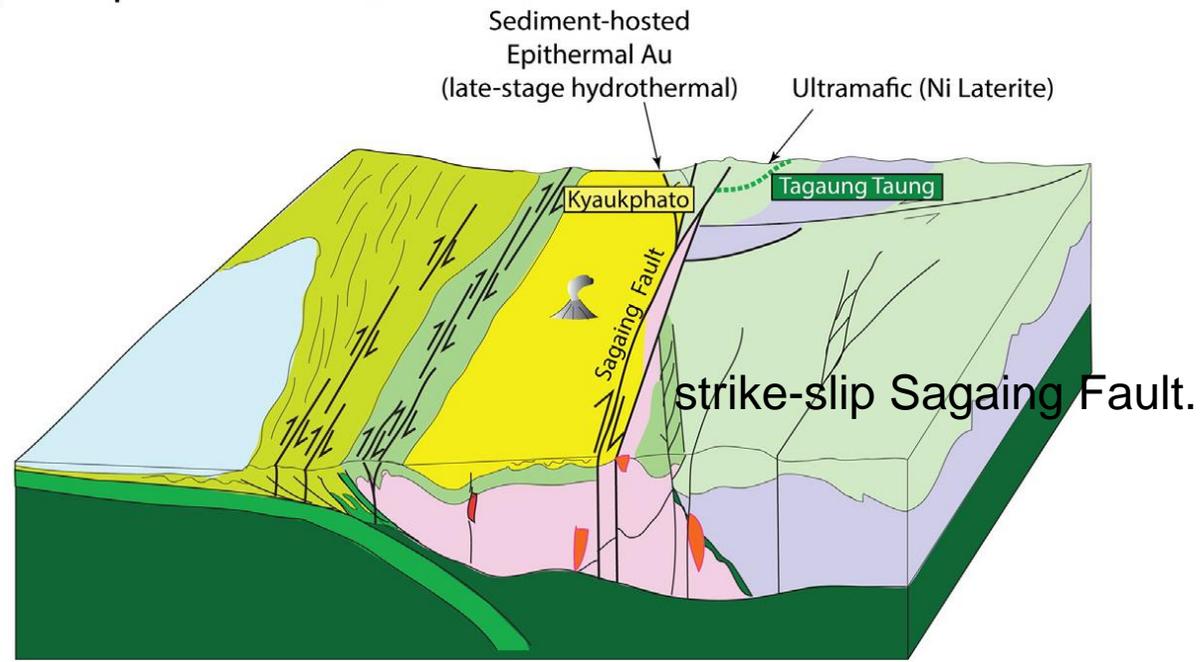
Closure of the Neo-Tethys

Nicholas et al. (2016)

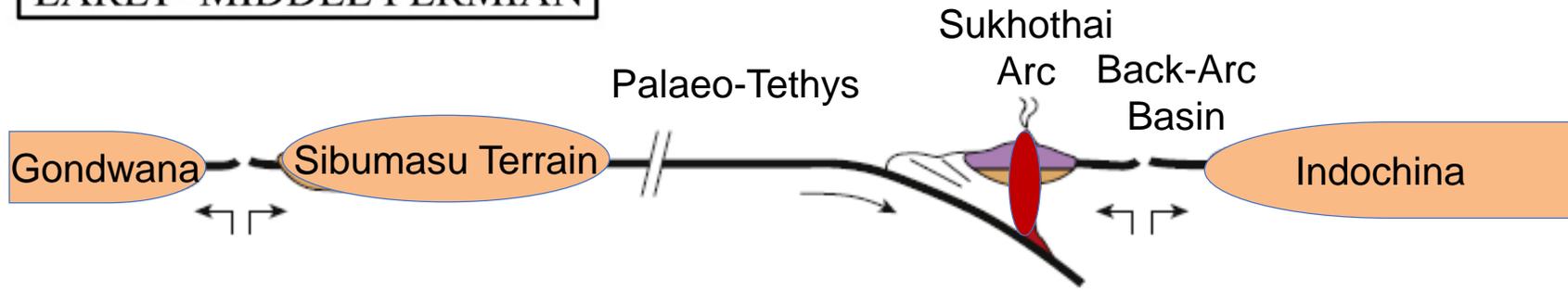
c) Late Collisional (30-20 Ma)



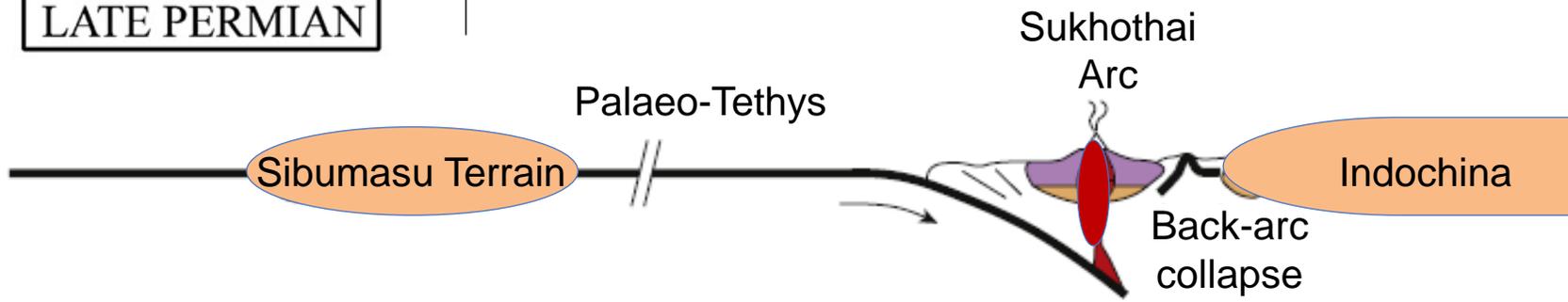
d) Highly-Oblique Collisional (15-0 Ma)



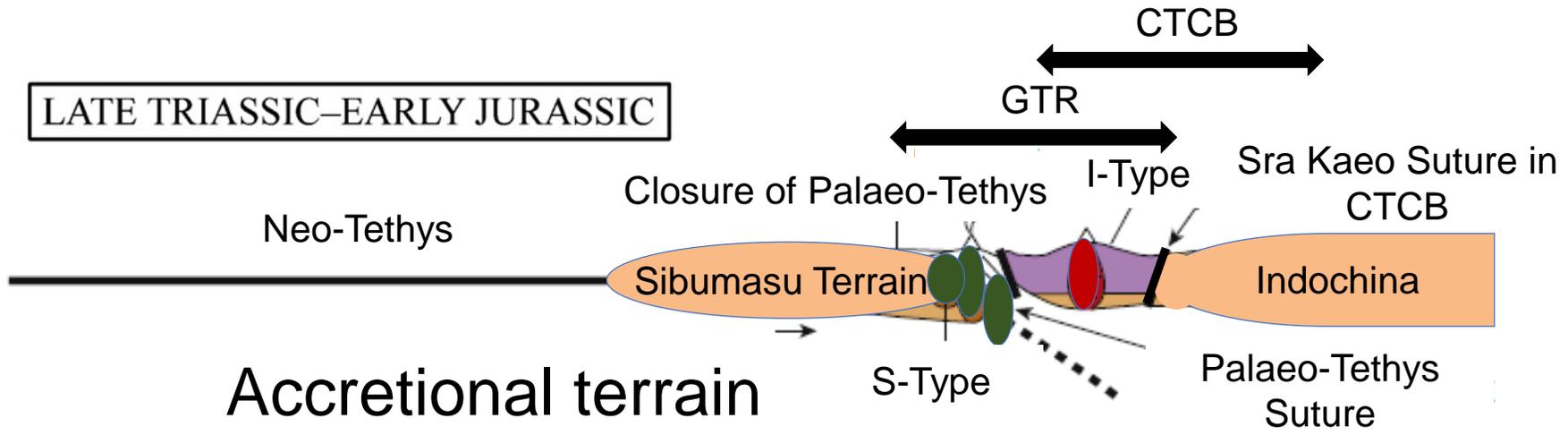
EARLY-MIDDLE PERMIAN



LATE PERMIAN



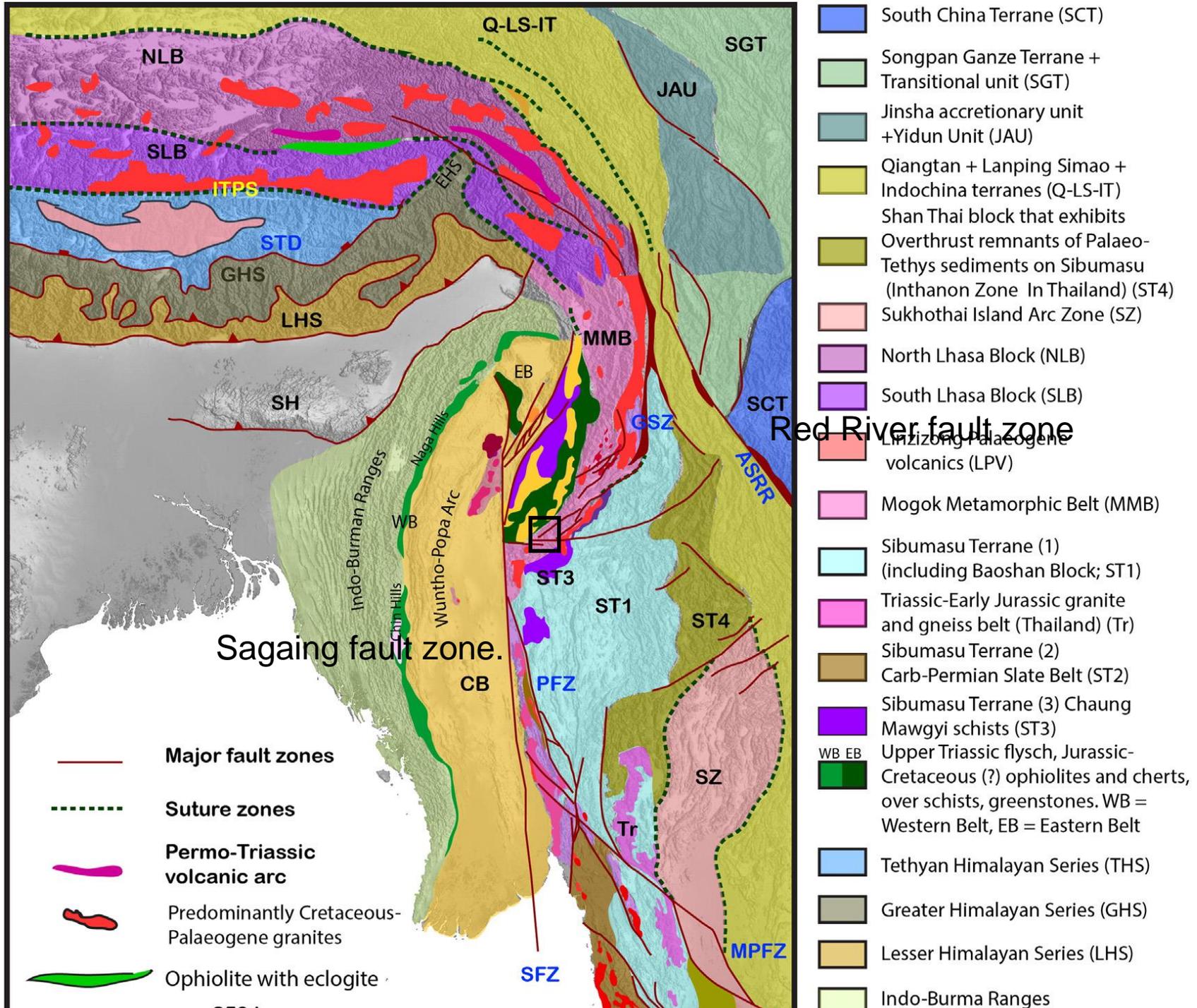
LATE TRIASSIC-EARLY JURASSIC



The tectonic and metallogenic framework of Myanmar: A Tethyan mineral system

Nicholas J. Gardiner a,\*,  
 Laurence J. Robb a,  
 Christopher K. Morley b,c,  
 Michael P. Searle a, Peter A. Cawood d, Martin J. Whitehouse e, Christopher L. Kirkland f, Nick M.W. Roberts g, Tin Aung Myint

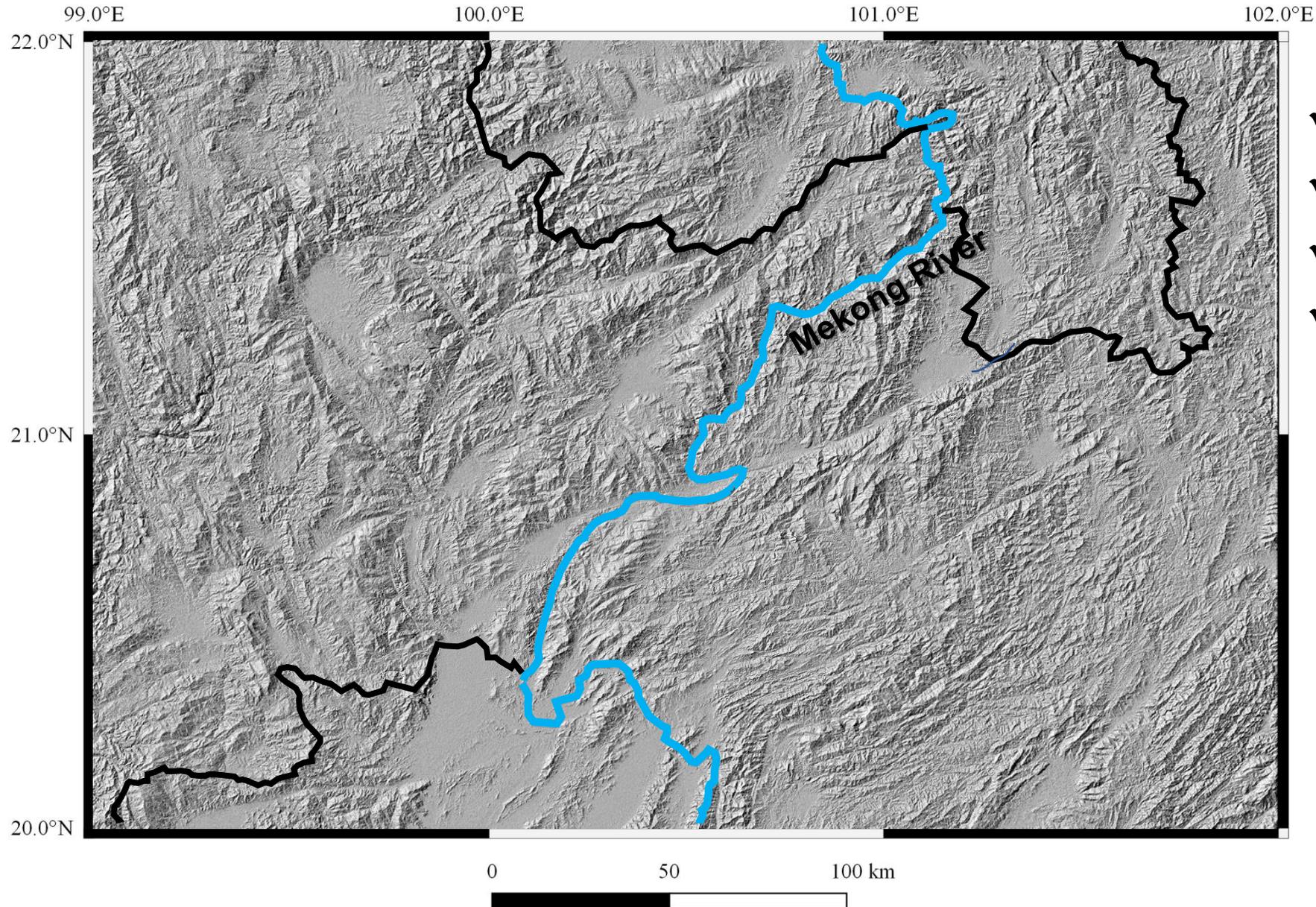
Ore Geology Reviews 79 (2016) 26–45



- Major fault zones
- - - Suture zones
- Permo-Triassic volcanic arc
- Predominantly Cretaceous-Palaeogene granites
- Ophiolite with eclogite

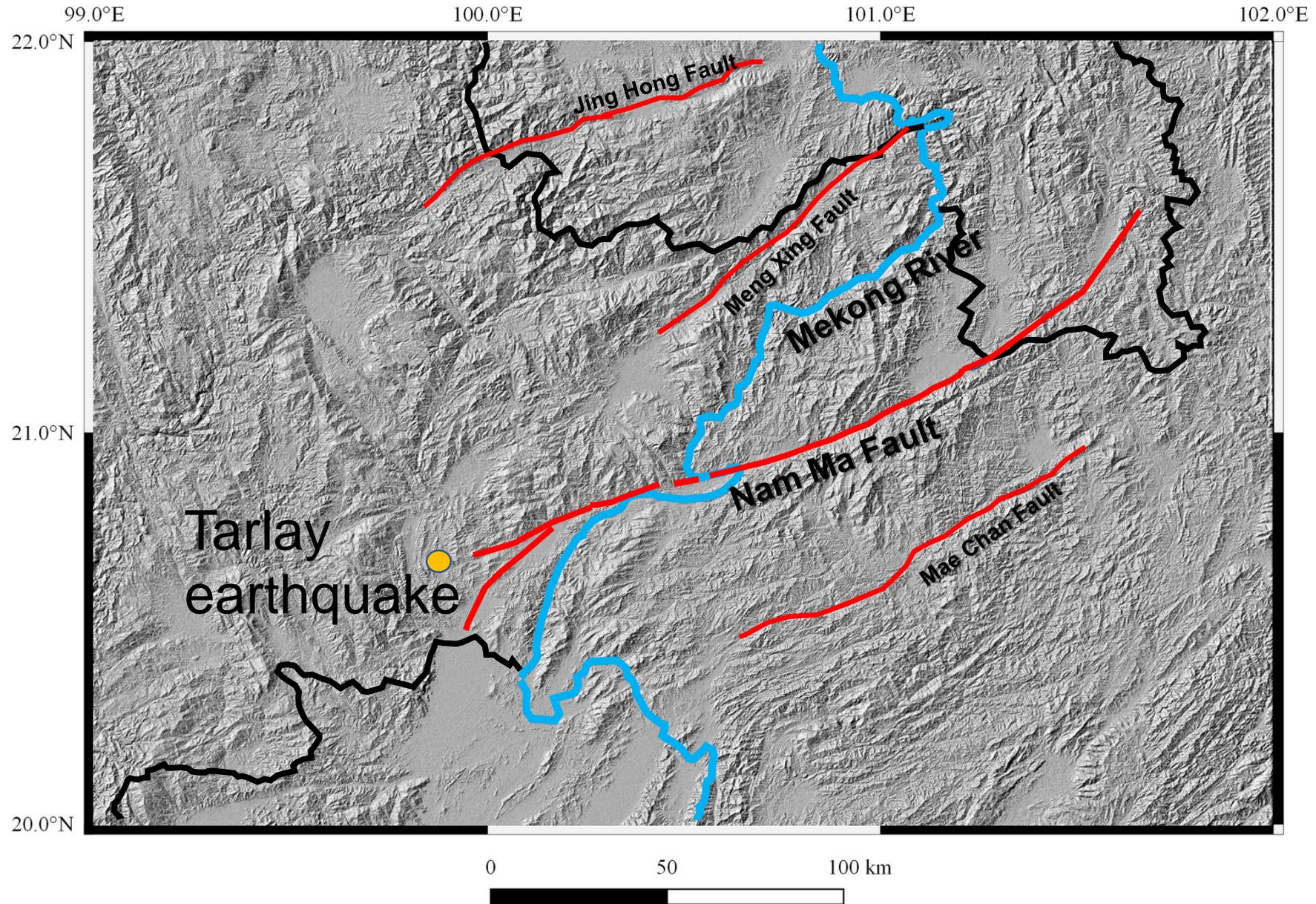
- South China Terrane (SCT)
- Songpan Ganze Terrane + Transitional unit (SGT)
- Jinsha accretionary unit + Yidun Unit (JAU)
- Qiangtan + Lanping Simao + Indochina terranes (Q-LS-IT)
- Shan Thai block that exhibits Overthrust remnants of Palaeo-Tethys sediments on Sibumasu (Inthanon Zone in Thailand) (ST4)
- Sukhothai Island Arc Zone (SZ)
- North Lhasa Block (NLB)
- South Lhasa Block (SLB)
- Linzizong Palaeogene volcanics (LPV)
- Mogok Metamorphic Belt (MMB)
- Sibumasu Terrane (1) (including Baoshan Block; ST1)
- Triassic-Early Jurassic granite and gneiss belt (Thailand) (Tr)
- Sibumasu Terrane (2)
- Carb-Permian Slate Belt (ST2)
- Sibumasu Terrane (3) Chaung Mawgyi schists (ST3)
- Upper Triassic flysch, Jurassic-Cretaceous (?) ophiolites and cherts, over schists, greenstones. WB = Western Belt, EB = Eastern Belt
- Tethyan Himalayan Series (THS)
- Greater Himalayan Series (GHS)
- Lesser Himalayan Series (LHS)
- Indo-Burma Ranges

# Relief map of ASTER GDEM with 30 m spatial resolution



- ✓ Fault scarp
- ✓ Step-over
- ✓ Pull-apart area
- ✓ Bend

# Relief map of ASTER GDEM with 30 m spatial resolution





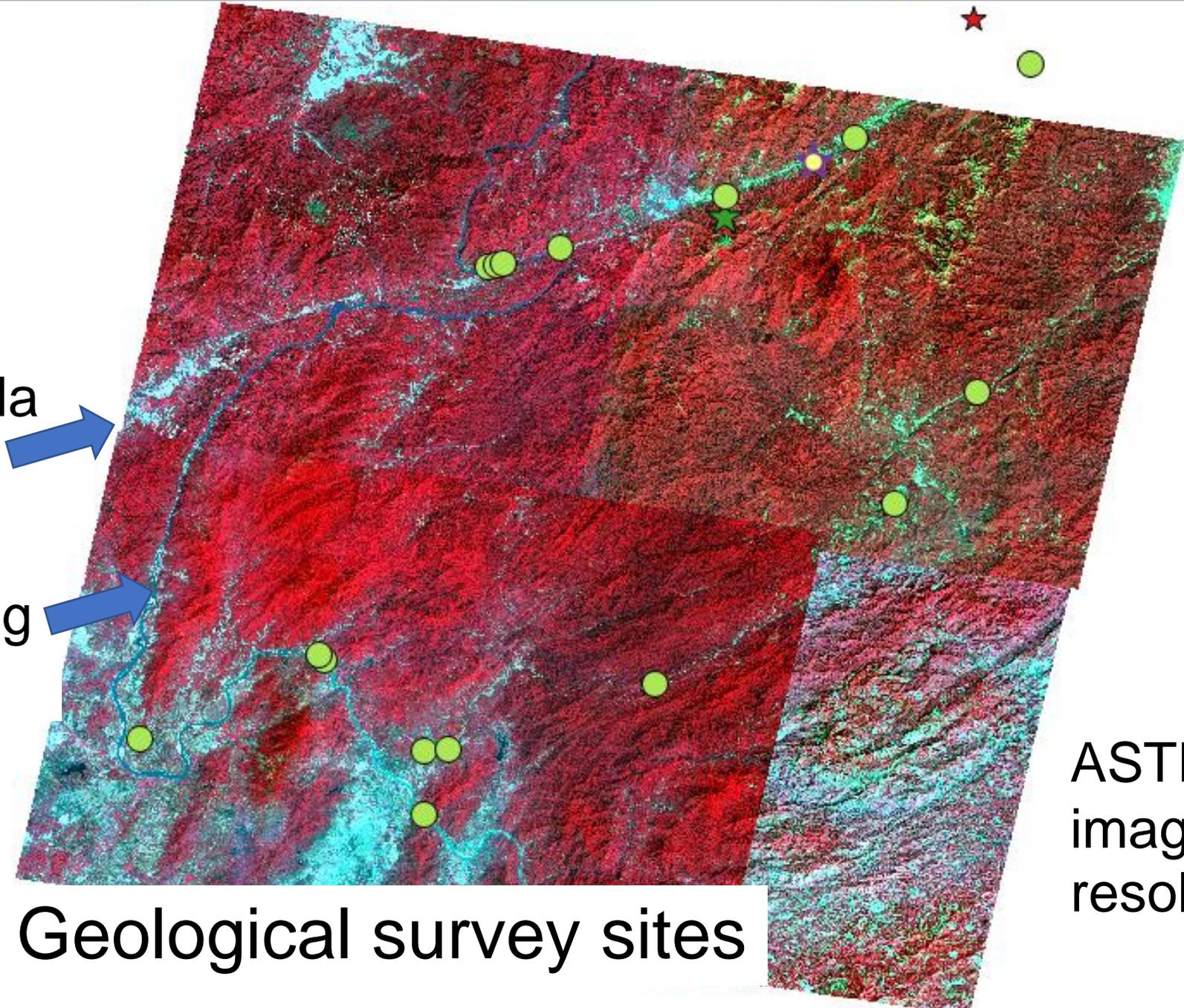
Wooden  
Column

Hard rock

dyPointsrev  
per2  
71004075511, tracks  
71001085824, tracks  
71002080316, tracks  
71003074813, tracks [1]  
SWaypoints\_17-OCT-0---  
per1  
s-Myn-Thai-Geo\_...  
TGTM2\_N21E100\_d  
9  
iefN21E101  
699  
.86  
TGTM2\_N21E101\_d  
8  
iefN21E100  
549  
.33  
ief  
801  
.029  
ief2  
84  
.837  
TGTM2\_N20E101\_dem  
0  
d.

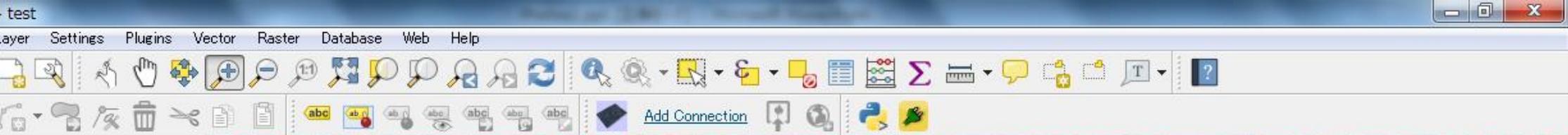
Nam Ma  
Fault

Mekong  
River

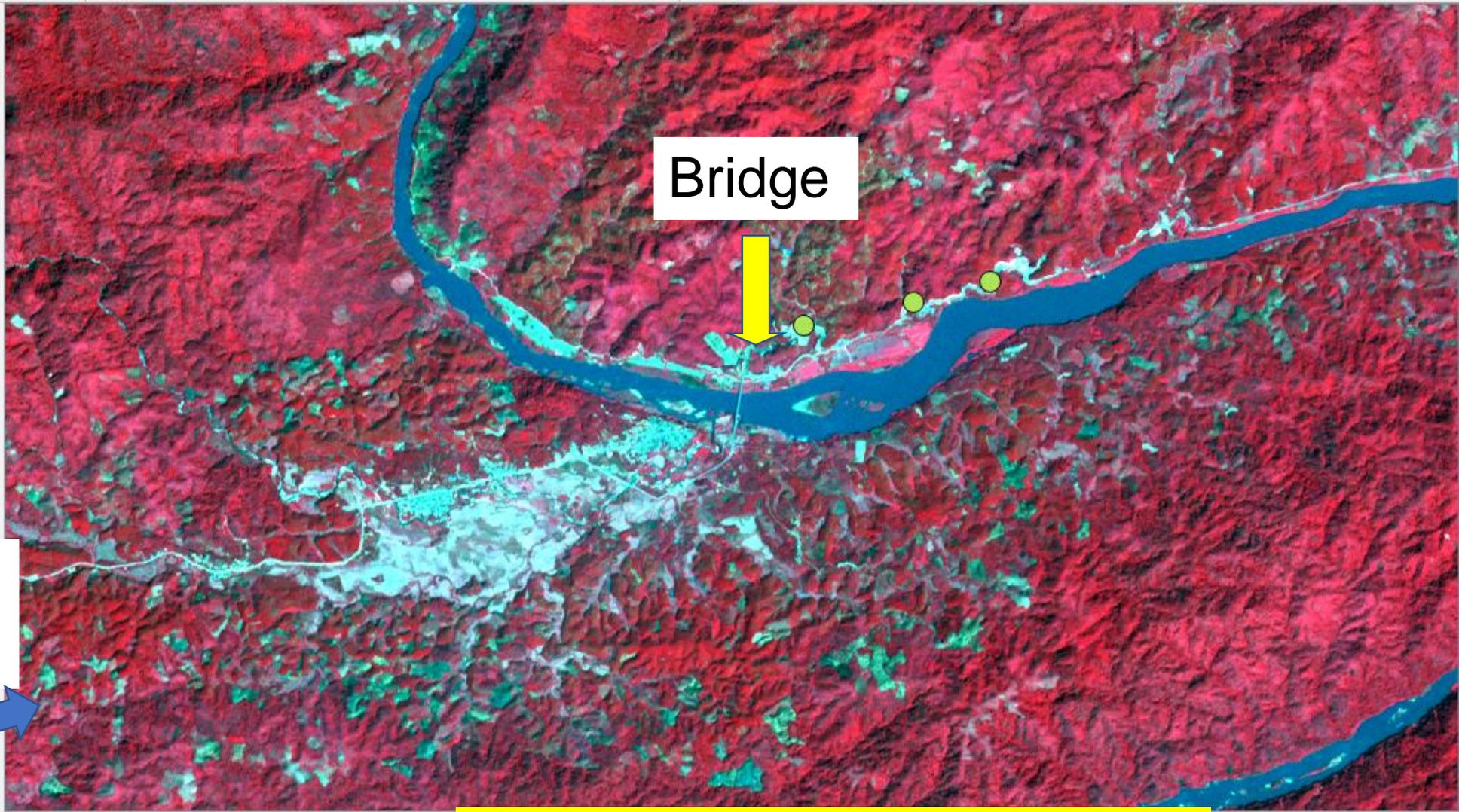


Geological survey sites

ASTER VNIR  
image with 15 m  
resolution



- Pointsrev
- er2
- 1004075511, waypoints
- 1004075511, tracks
- 1001085824, tracks
- 1002080316, tracks
- 1003074813, tracks [1]
- Waypoints\_17-OCT-0---
- er1
- Myn-Thai-Geo\_mod---
- ATM2\_N21E100\_dem
- ATM2\_N21E101
- 99
- 6
- ATM2\_N21E101\_dem
- ATM2\_N20E101 dem



Mekong River

Bridge

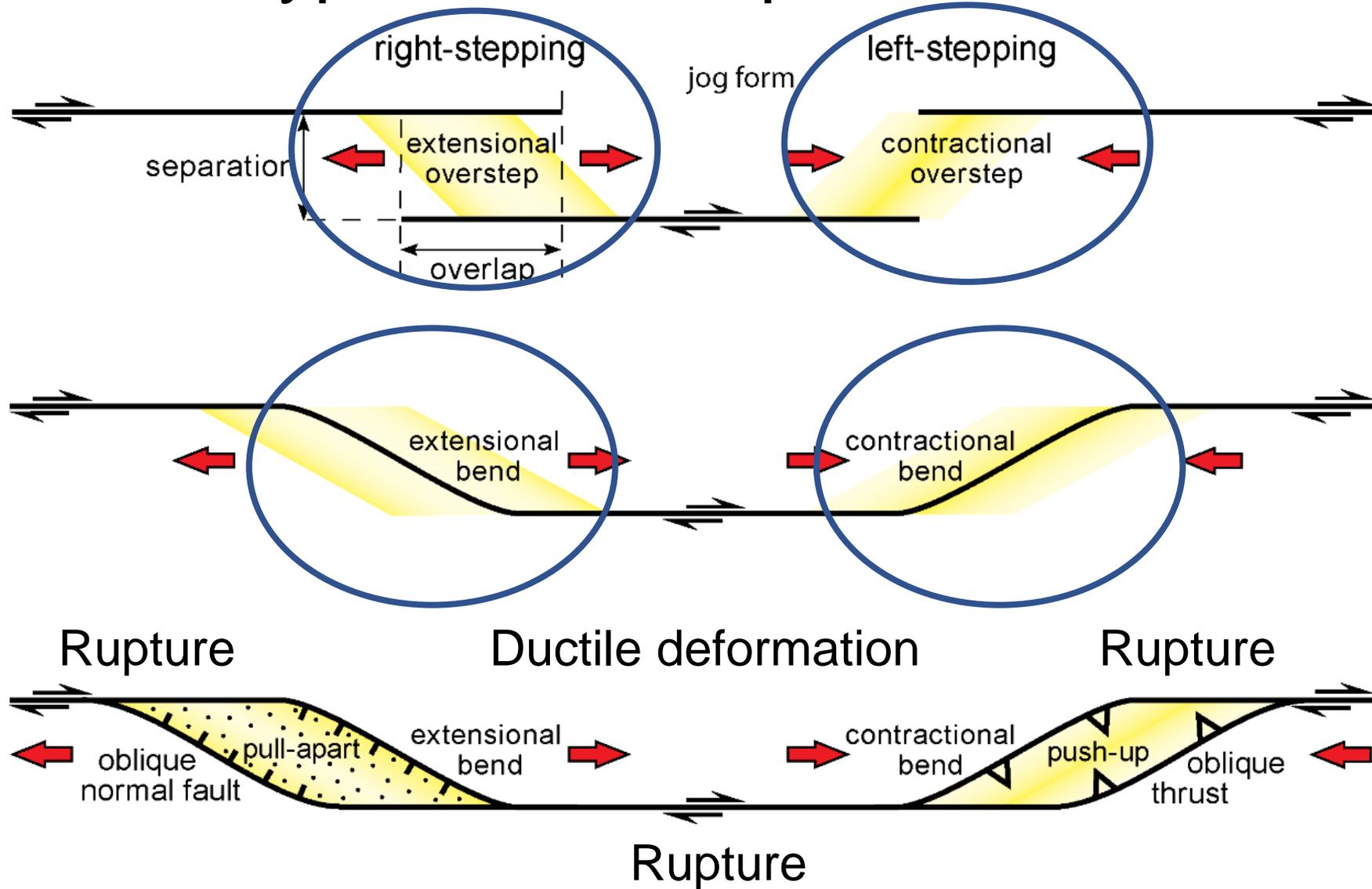
Nam Ma Fault

2017.02.05

# Bridge on the active fault



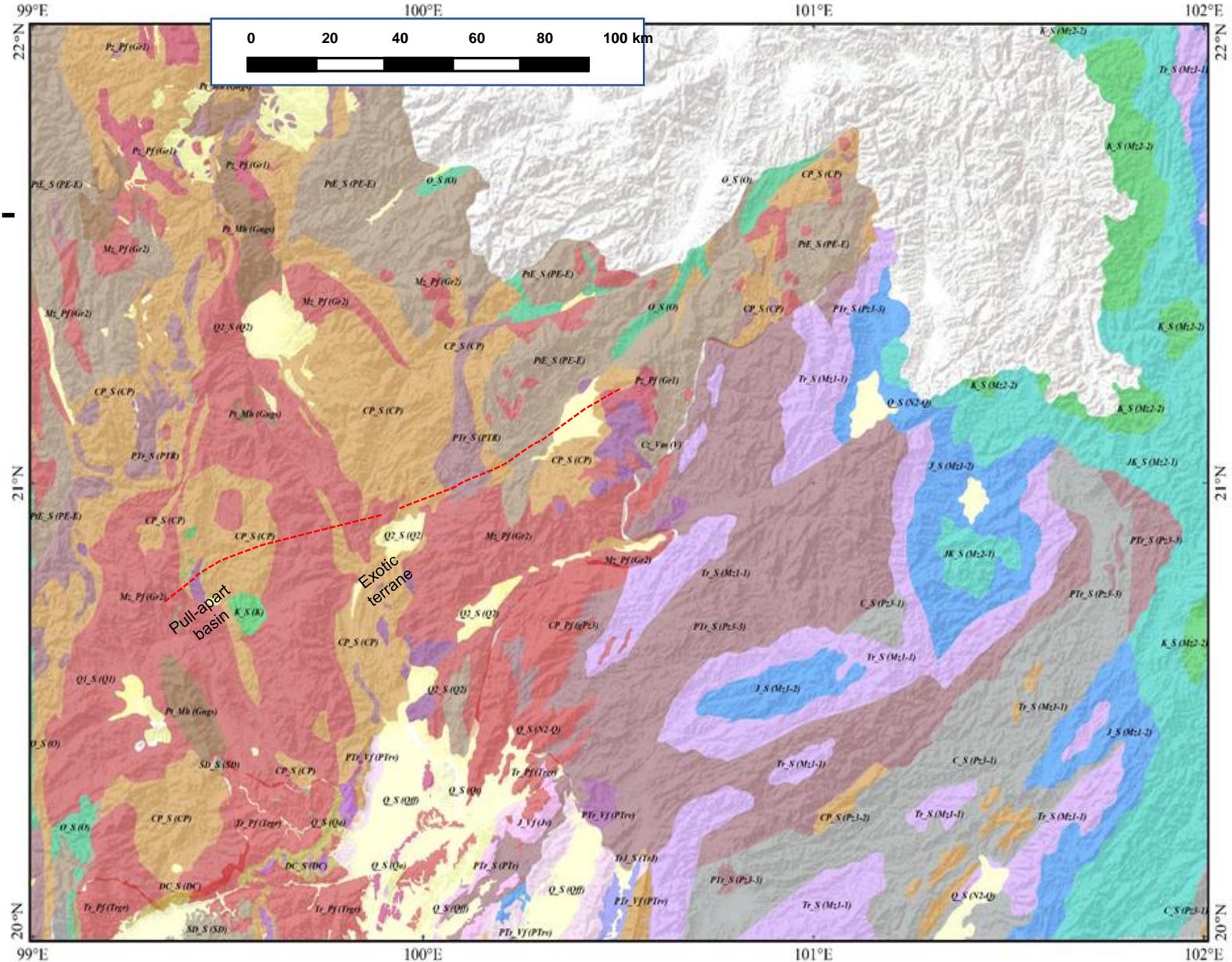
# Typical strike slip structures



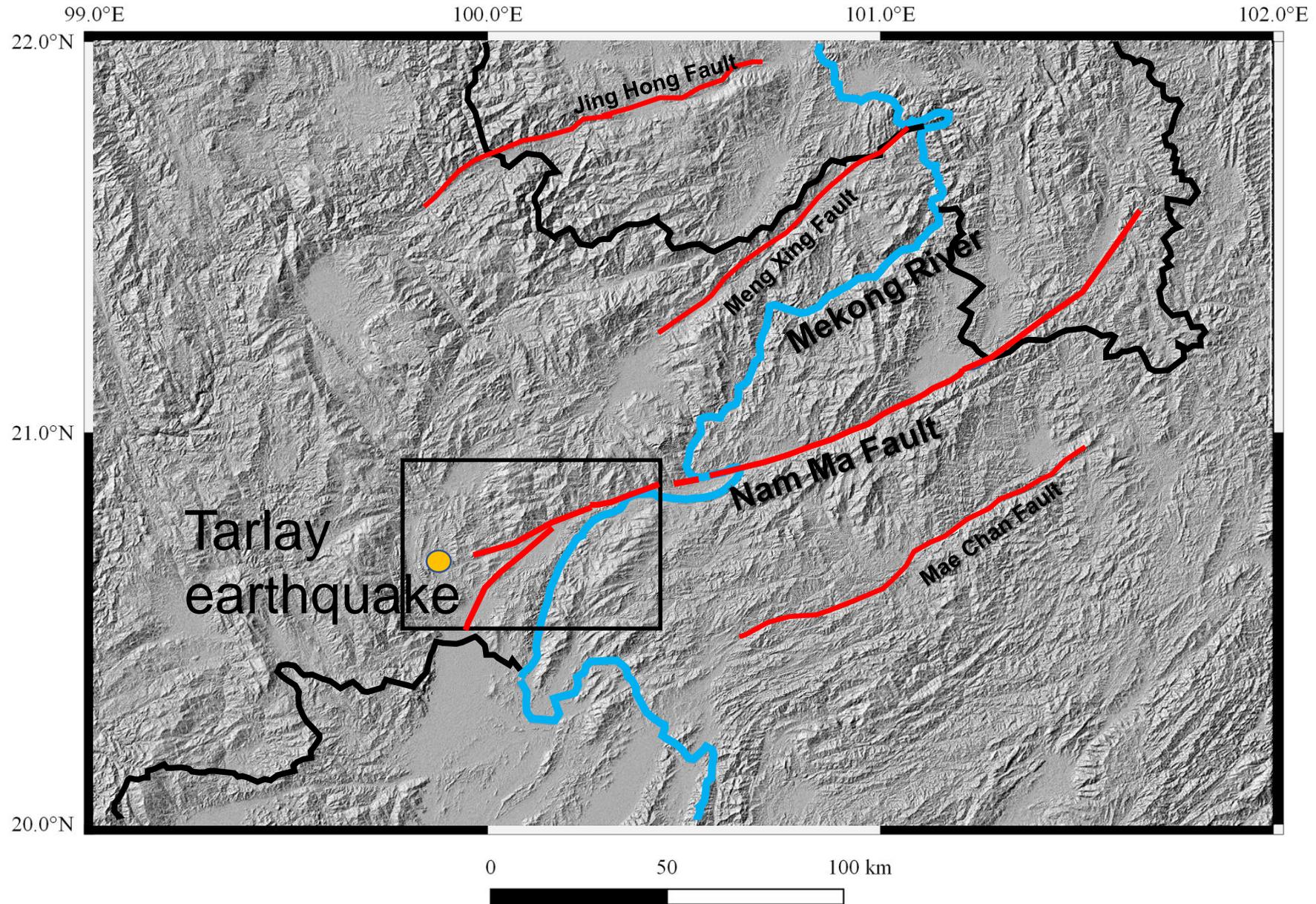
# Harmonized geological map

Harmonized geological map:  
Continuous geology over cross-border areas

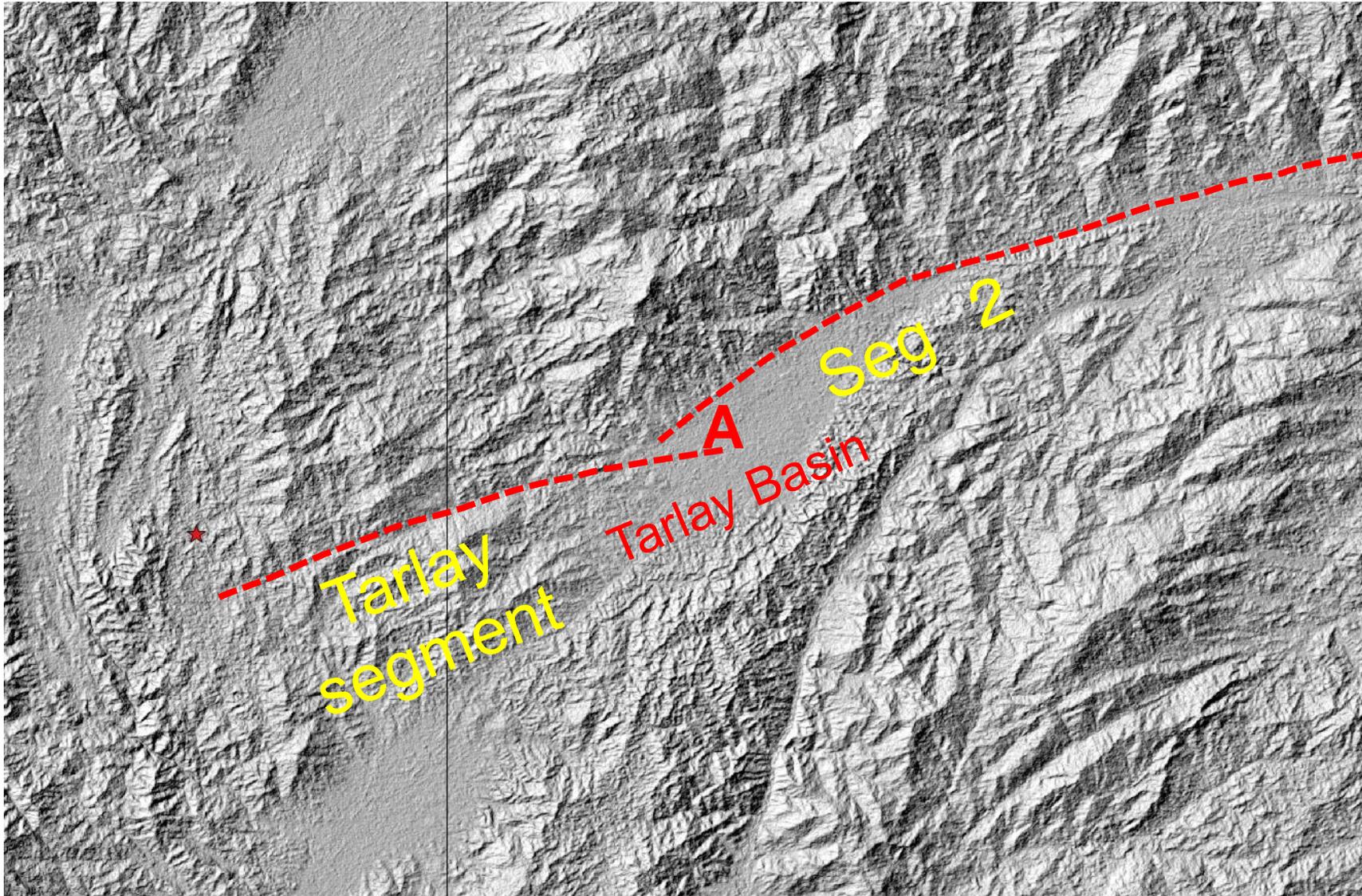
- ✓ Lithologies and their ages
- ✓ Continuous displacement lines crossing countries
- ✓ Exotic terranes



# Relief map of ASTER GDEM with 30 m spatial resolution

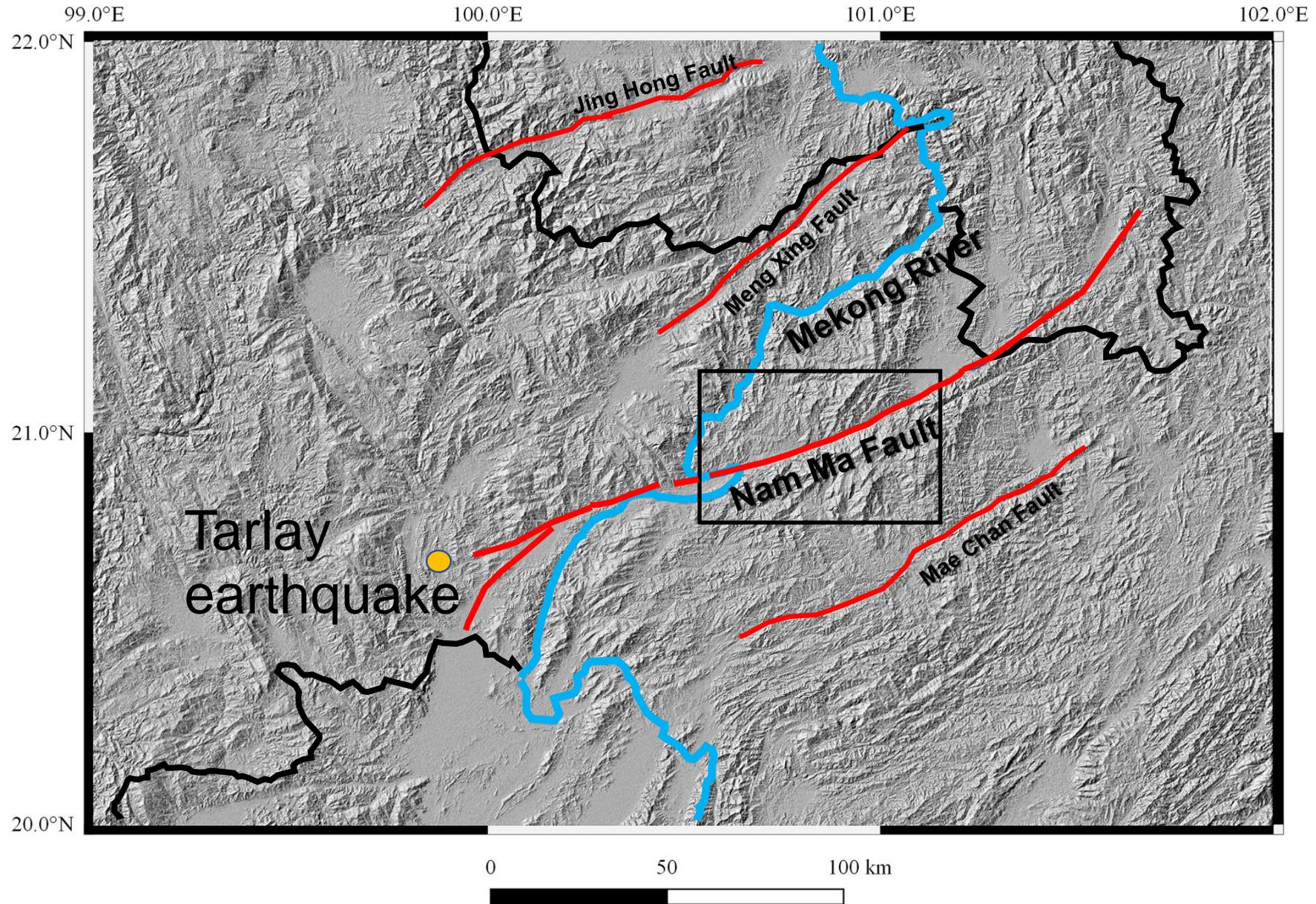


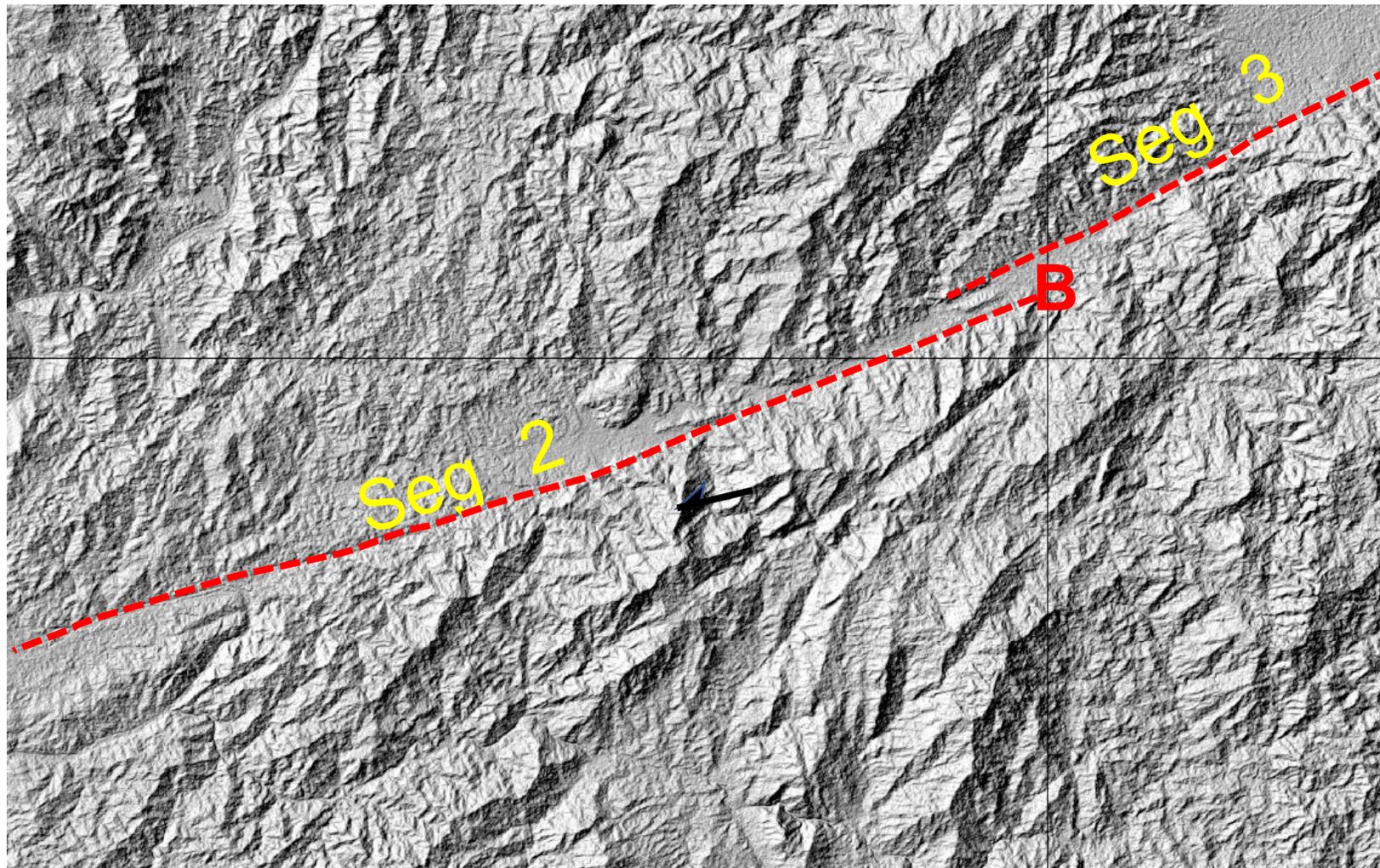
0 5 10 15 20 km



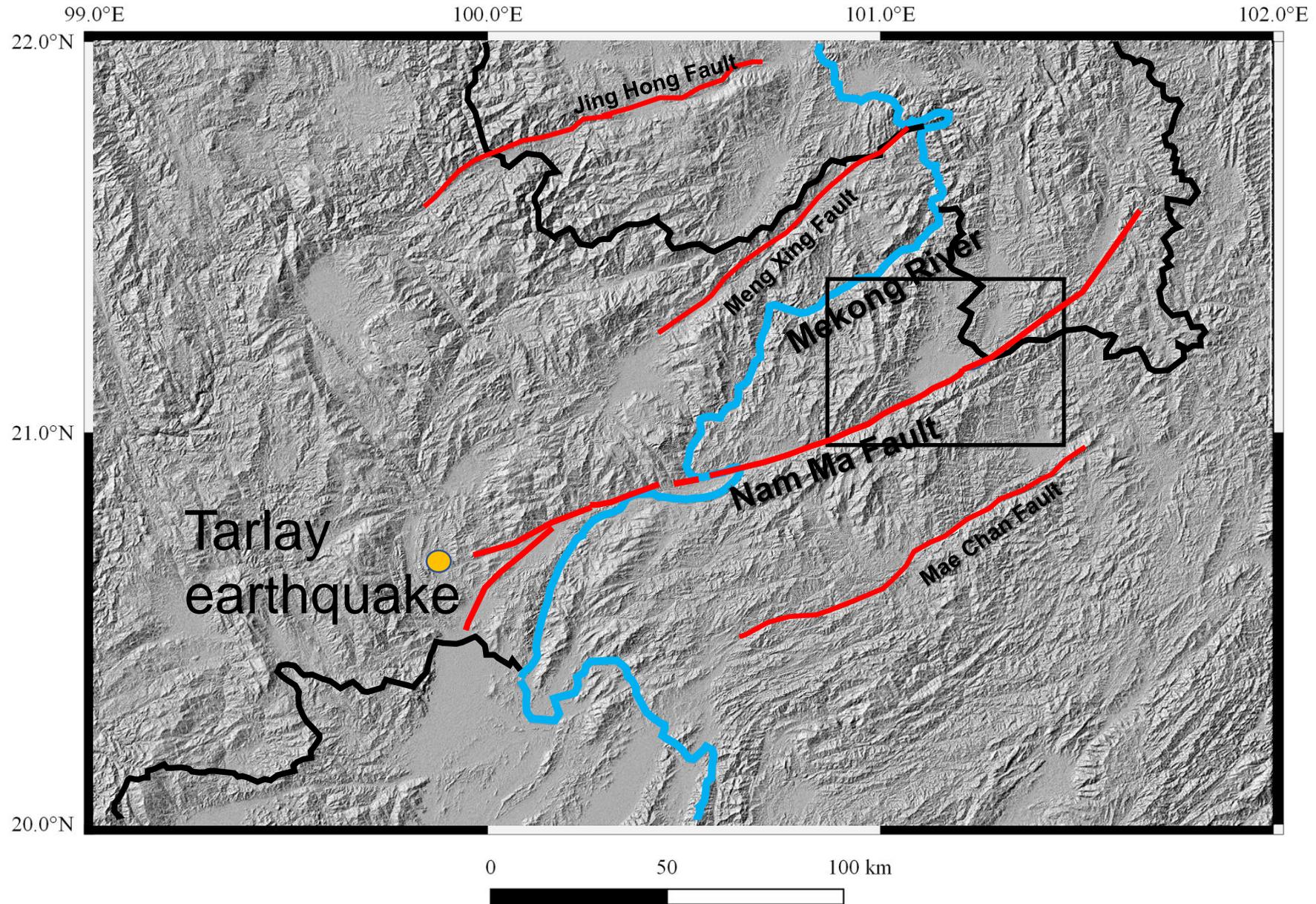
- ✓ Fault scarp
- ✓ Step-over
- ✓ Pull-apart area
- ✓ Bend

# Relief map of ASTER GDEM with 30 m spatial resolution

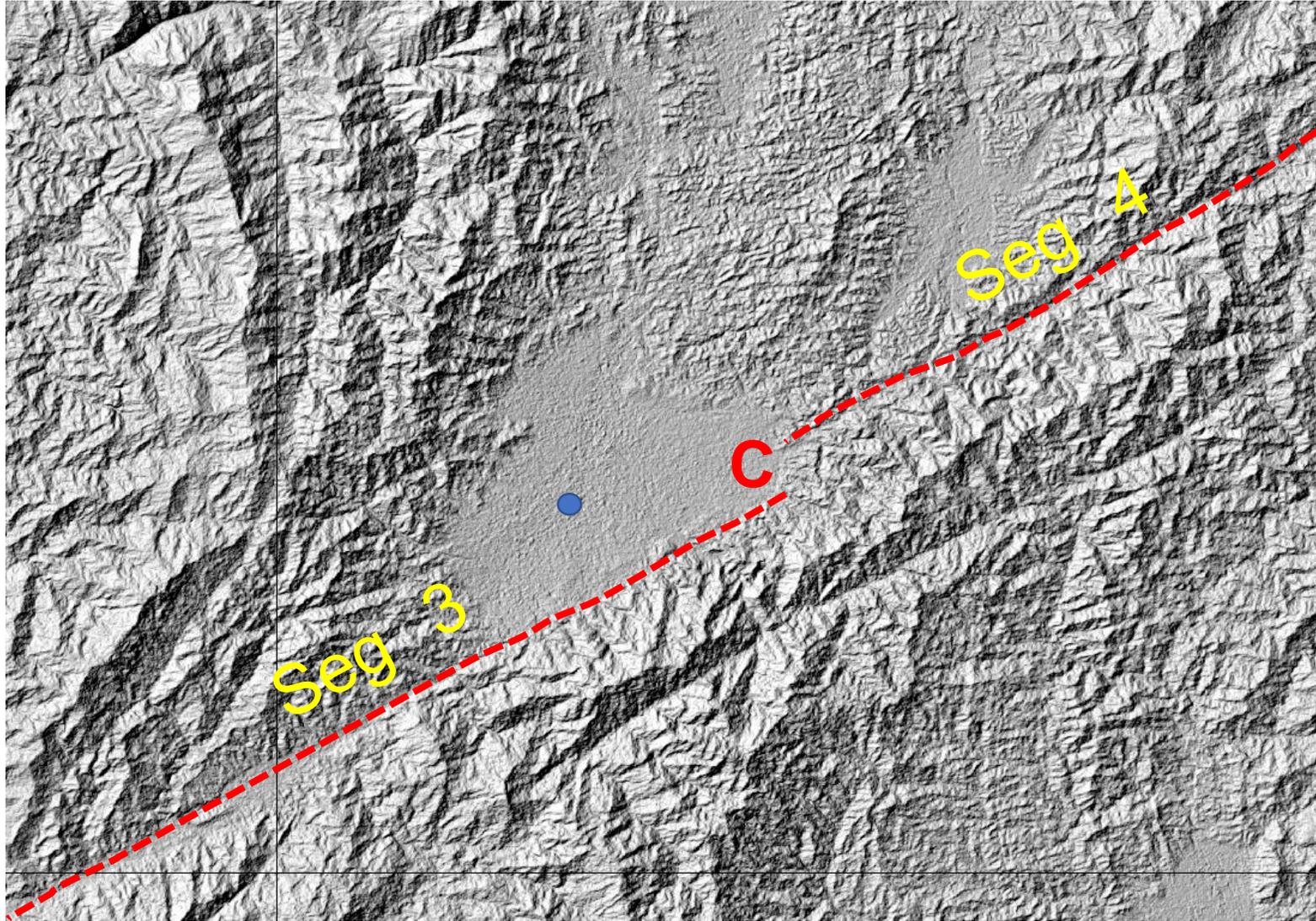




# Relief map of ASTER GDEM with 30 m spatial resolution



0 5 10 15 20 km





Tectonic vertical displacement



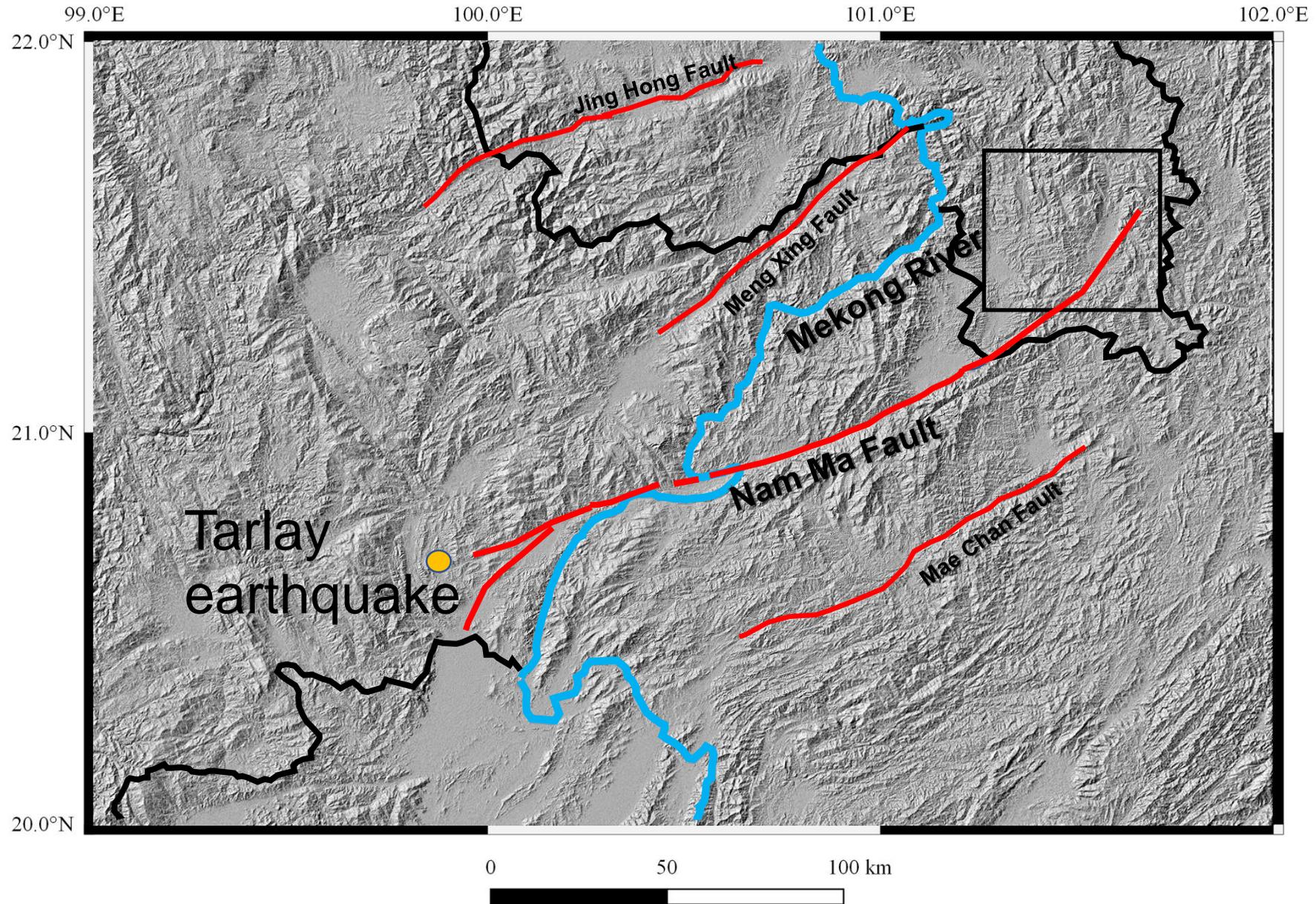
Scarp

Flat land

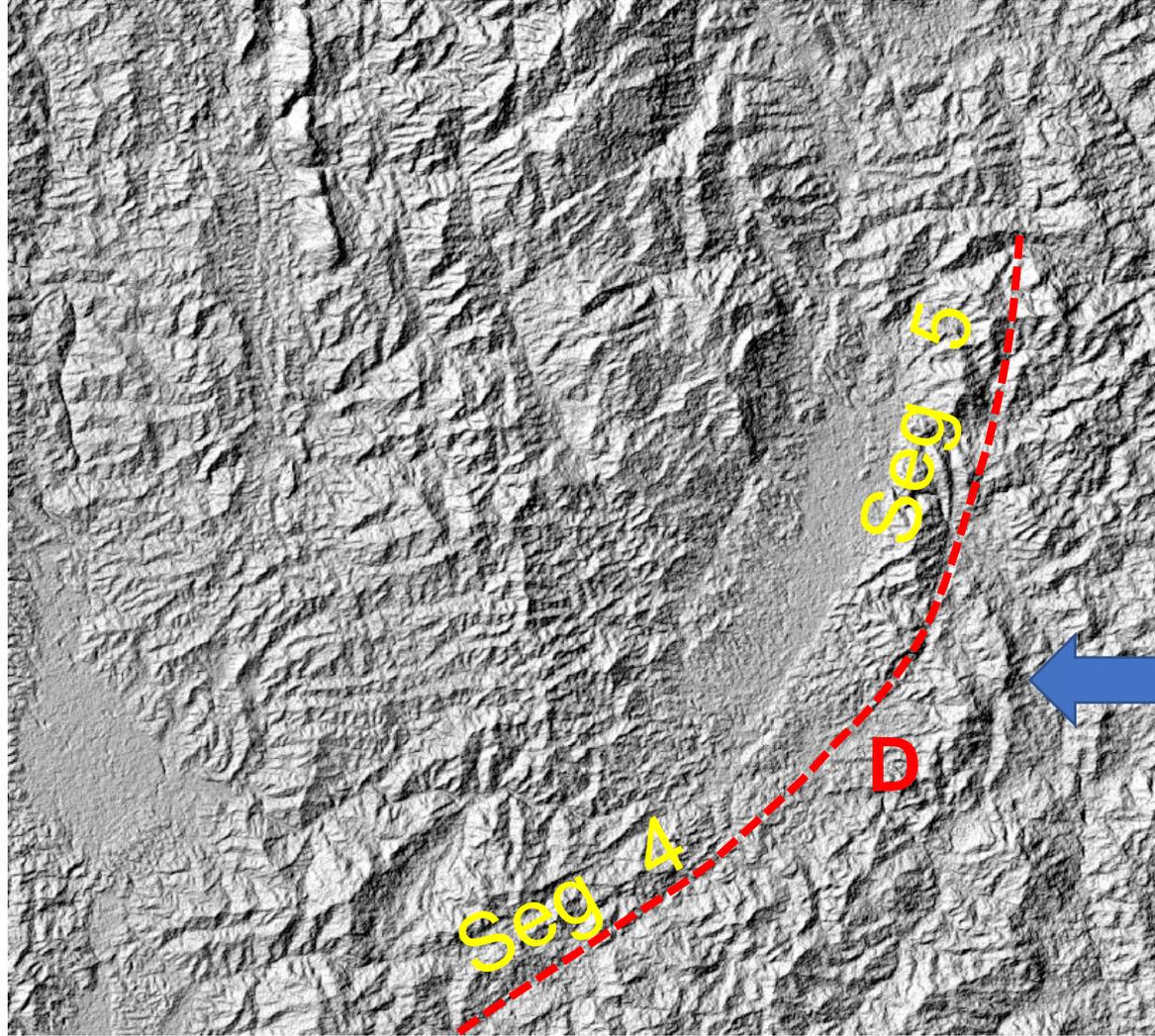


Extensional fan

# Relief map of ASTER GDEM with 30 m spatial resolution

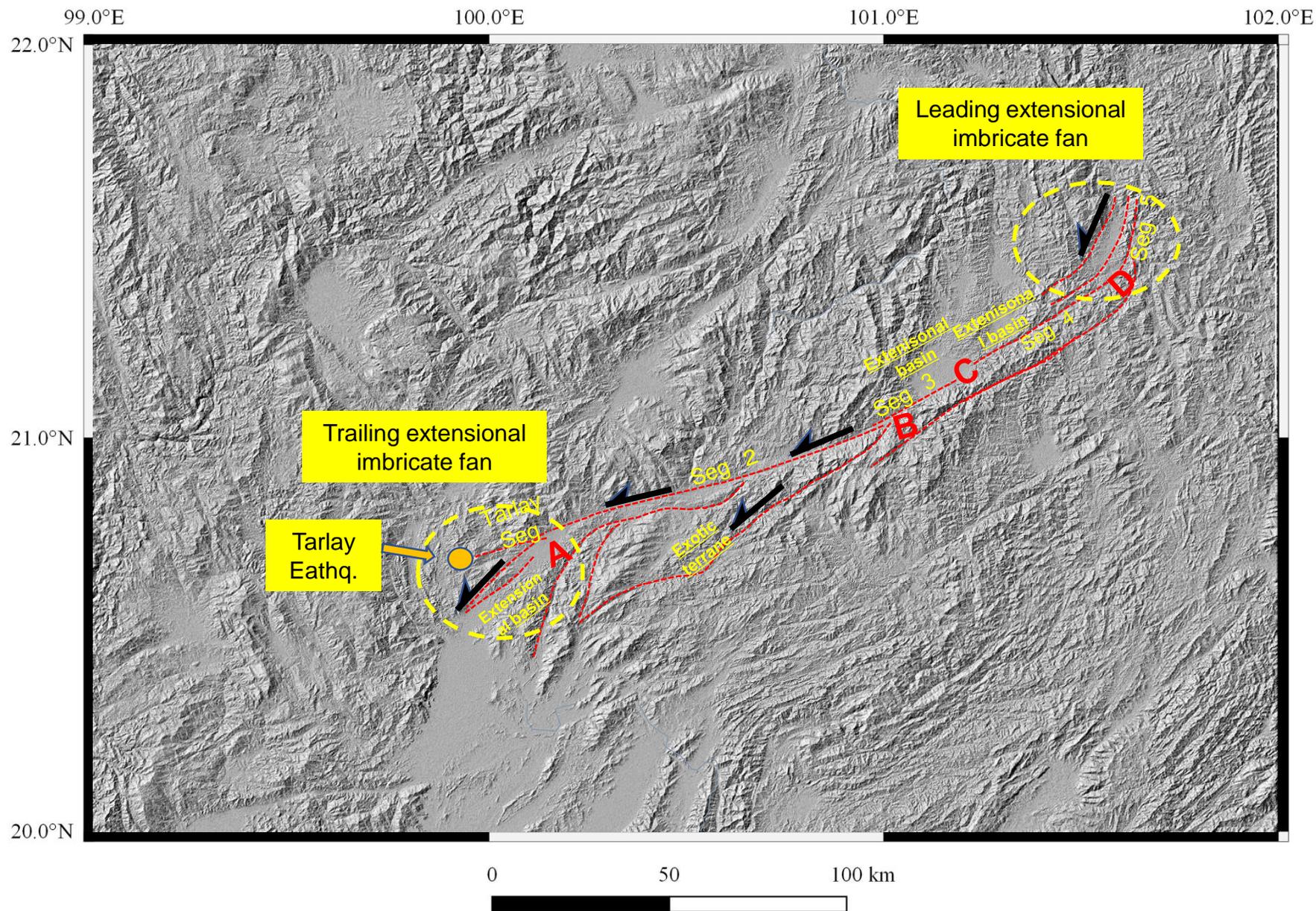


0 5 10 15 20 km



Bend

# Summarized map of the segmented Nam Ma fault



$$\text{Log } M_0 = 1.5 M_w + 9.1$$

$M_w$  : Magnitude of earthquake

Magnitude  
of possible  
earthquake

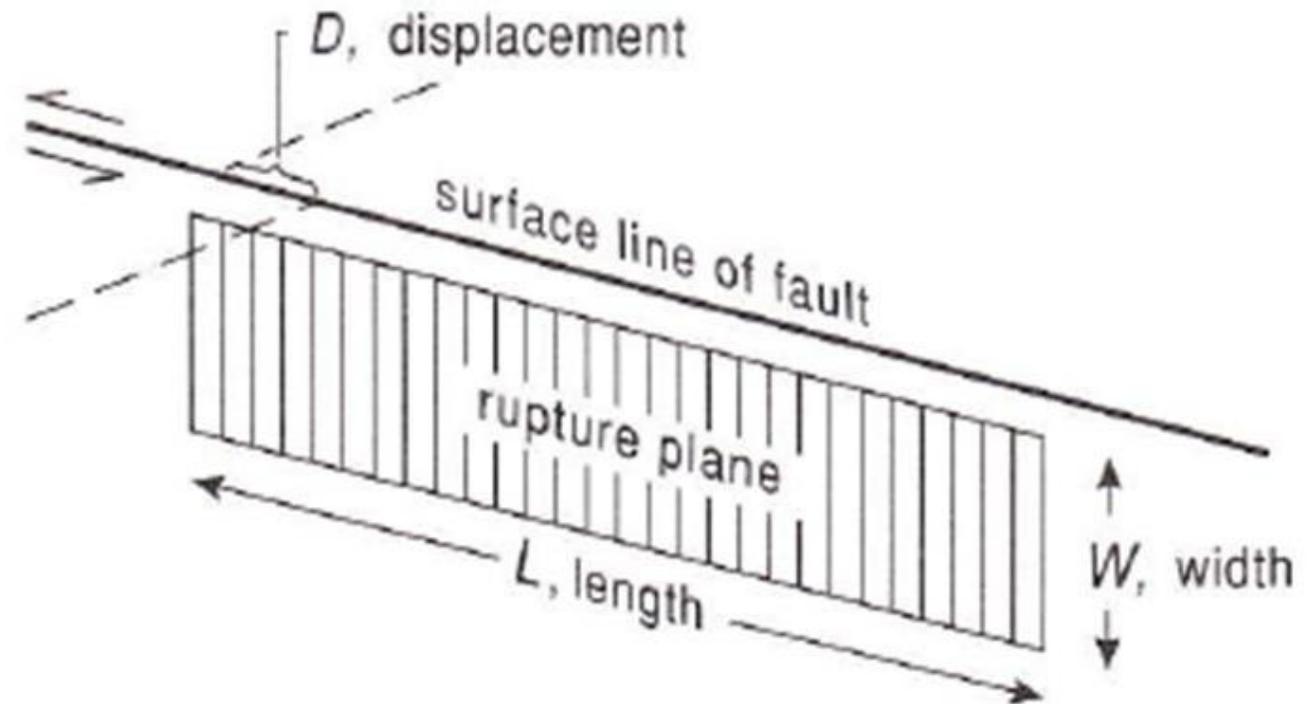


$M_0$ ; Nm : Seismic moment of earthquake

$$M_0 = (S / 4.24 \times 10^{11})^2 \times 10^{-7}$$

$S$ ; km<sup>2</sup> : Slip-plane area

$$S = L \times W$$



Segmentation



Assume



Segment name	Country	Length (km)	Magnitude (Mw)	$M_0$ (N · m)	S (km <sup>2</sup> )	W (km)
Tarlay segment	Myanmar	30	6.8	$2.0 \times 10^{19}$	598.916	19.96386
Seg2	Myanmar-Laos	100	7.5	$2.22 \times 10^{20}$	1996.386	19.96386
Seg3	Laos	30	6.8	$2.00 \times 10^{19}$	598.386	19.96386
Seg4	Laos-China	45	7	$4.49 \times 10^{19}$	898.374	19.96386
Seg5	China	20	6.6	$8.87 \times 10^{18}$	399.277	19.96386
Nam Ma fault	Myanmar-Laos-China	215	7.9	$1.02 \times 10^{21}$	4292.231	19.96386

# Conclusions

- ❑ The ASTER GDEM with 30 m spatial resolution accessible from the open site illustrates linear features suggesting active faults
- ❑ The harmonized geological maps show continuous tectonics including displacement lines and exotic terranes
- ❑ Segments of the Nam Ma fault was mapped by the relief map of ASTER GDEM and the harmonized geological map
- ❑ The greatest magnitude of possible earthquakes is 7.5 to be caused by rupture of 100 km long segment which crosses Myanmar and Laos
- ❑ In conclusion, the harmonized geological maps show continuous tectonics over cross-border areas and the remote sensing data provide regional information over data vacant areas.



Thank you for your attention!