Cenozoic Geodynamic Evolution of the Burma-Andaman Platelet*

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Abstract

The Burma-Andaman platelet is a complex shear zone extending from the northern tip of Sumatra to the Assam belt developed during the Cenozoic along the India-Sundaland plate boundary. Into the west, the India sub-continent attached to the rigid and undeformed Bengal oceanic basin and plateau is brushing the western margin of Sundaland. Two GPS networks were measured both in central and northern Myanmar and have revealed the main Sagaing-Shan fault has a constant, instantaneous strain rate (1,8 cm/yr) in both areas. This fault absorbs half of the estimated active motion between India and Sundaland (3.5 cm/yr). The Andaman sea-spreading center and the connected Sagaing-Shan fault in the north, and the the Semangko fault in Sumatra, has absorbed the same rate of motion (2 cm/yr) since the early Pliocene. Retained motion was localized along subsidiary right-lateral faults present within the Indo-Burma wedge, but also southwards along the East Andaman fault. The central Myanmar basins, filled with up to 10 km of dominantly clastic sediments deposited from the Eocene to the late Miocene, have en echelon right pull-apart basin pattern, inverted during the last 10 my. The Indo-Burma Ranges and their southern extension along the Andaman Nicobar islands and northern Sumatra reveal obliquely accreted volcanic ridges (~90°E) associated with exotic continental terranes (Kampetlet Schist, Triassic Chin Flysch), all of which drifted from Antarctica during the northern motion of India. The Yadana gas field is located on one of these scalped and partially accreted ridges topped by Cenozoic neritic carbonates transferred to the accretionary wedge. Along the eastern flank of the Indo-Burma wedge, mélanges, containing blue schist and Lower Cretaceous ophiolite, outline the wedge of the Tethys Mesozoic subduction zone, extending north of great India This Kabaw suture zone is disconformably sealed by Maastrichtian clastics, the basal formation of overlying Central Myanmar basins. In northern Burma the Eastern Tibet Plateau crustal flow has affected the northern motion of the platelet since 10 Ma, inducing large gravity sliding in the northern Bengal basin. This evolution of the Burma-Andaman platelet illustrates the complexity of a hyper-oblique convergent zone, present along the 2200-km-long India Sundaland plate boundary.

This work was conducted in cooperation with Myanmar universities and Myanmar Oil and Gas Enterprise, sponsored by Total.

References

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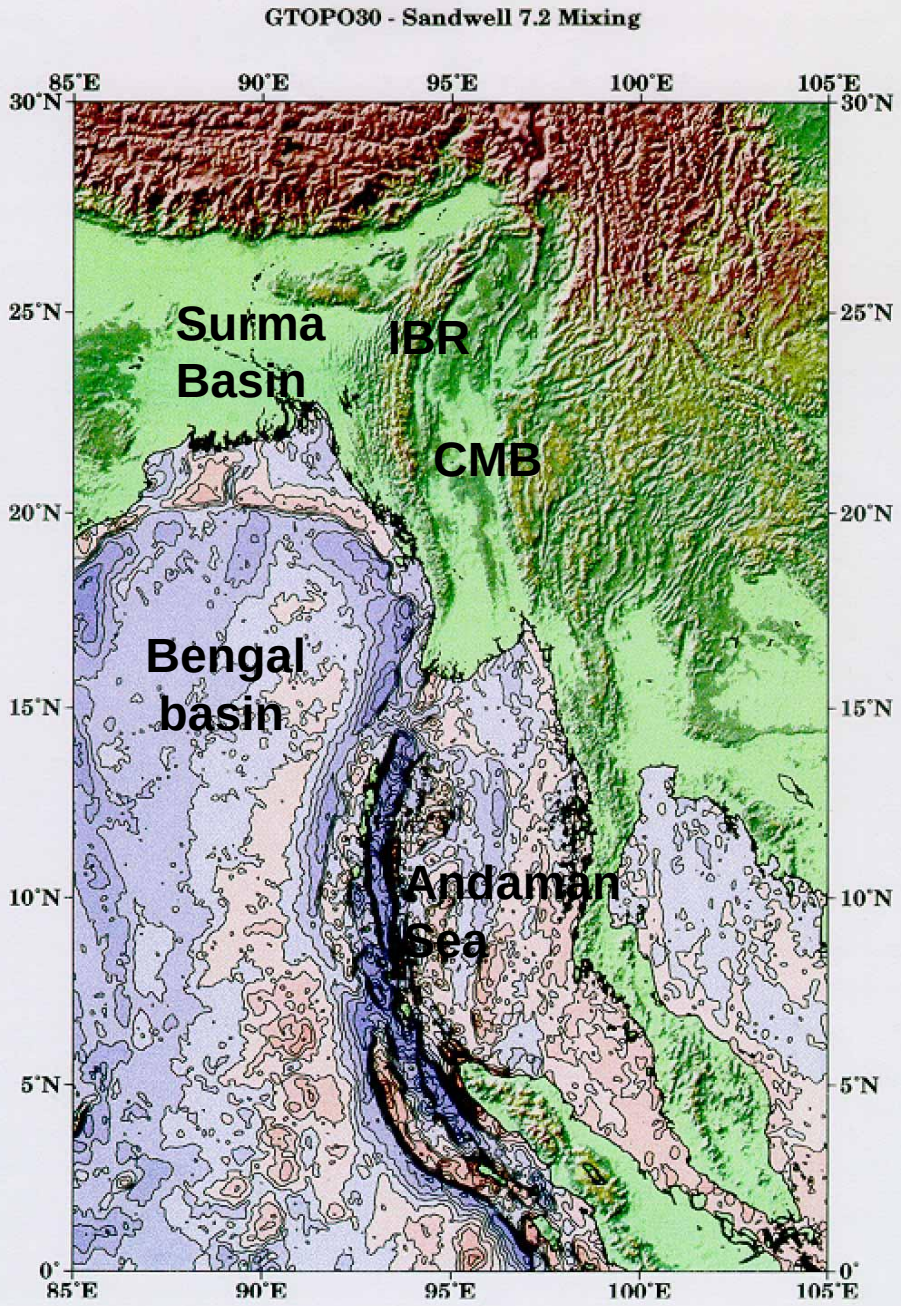

IBR= Indo Burma Ranges **CMB**: Central Myanmar Basins

CENOZOIC GEODYNAMIC EVOLUTION of the BURMA-ANDAMAN PLATELET

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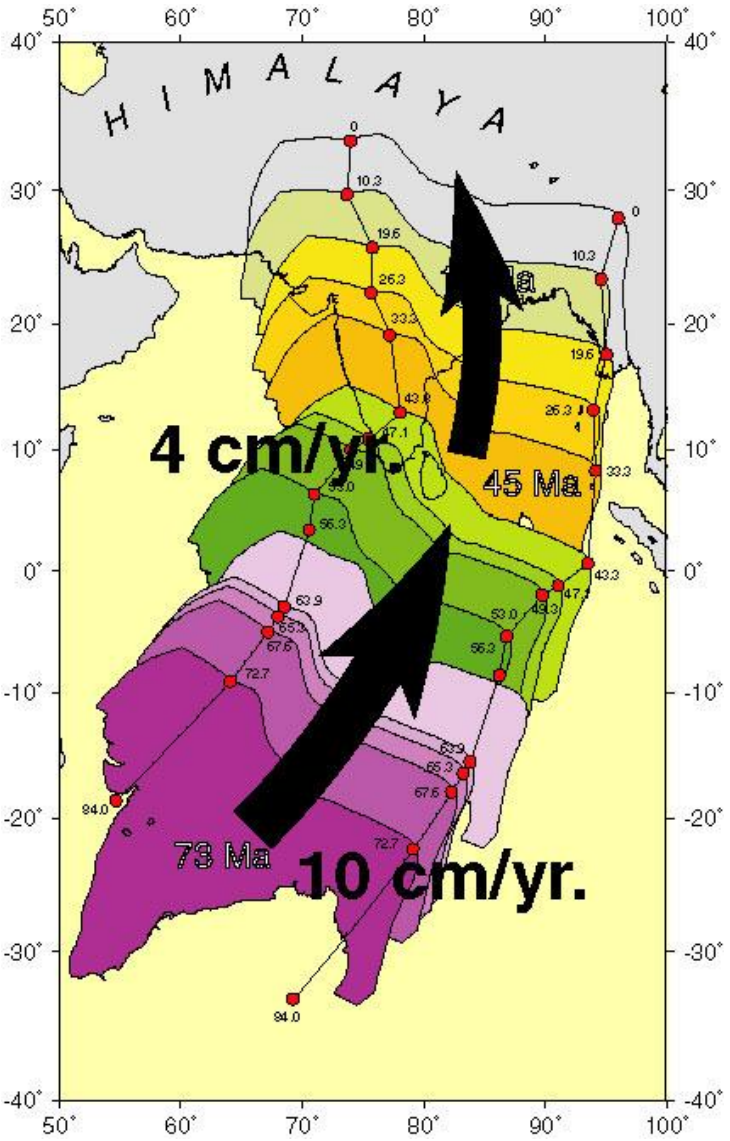
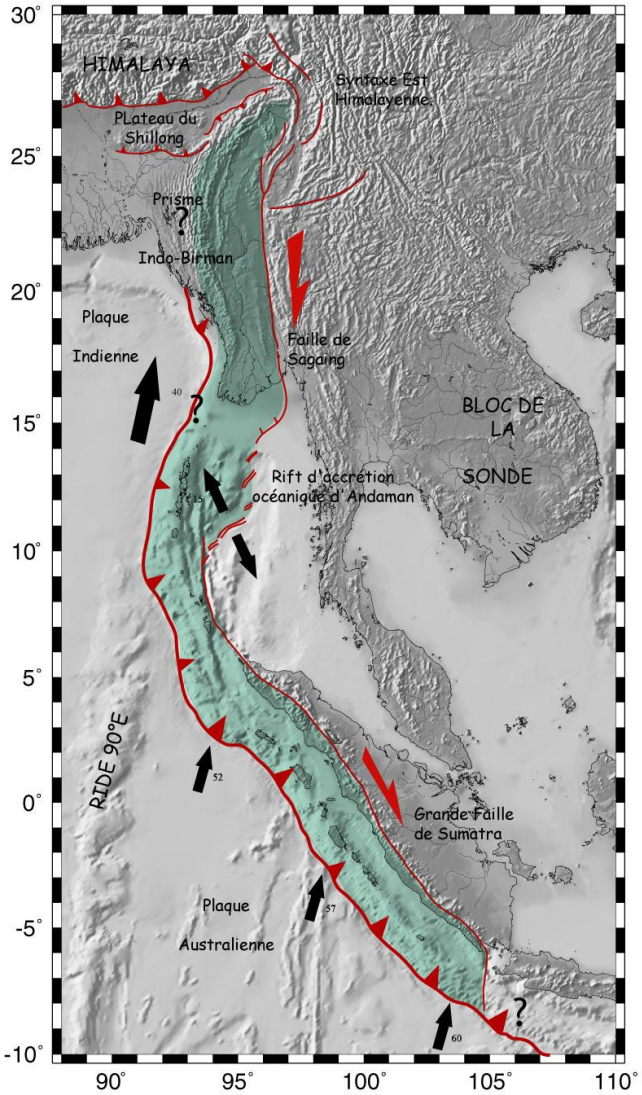
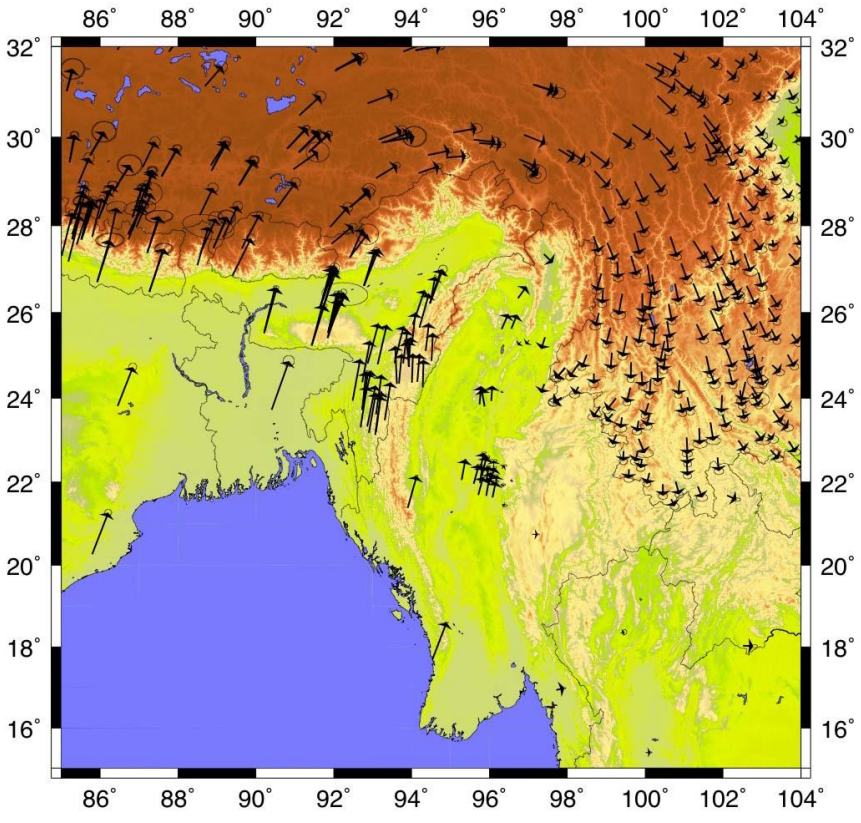


Motion of India/ fixed stable Eurasia

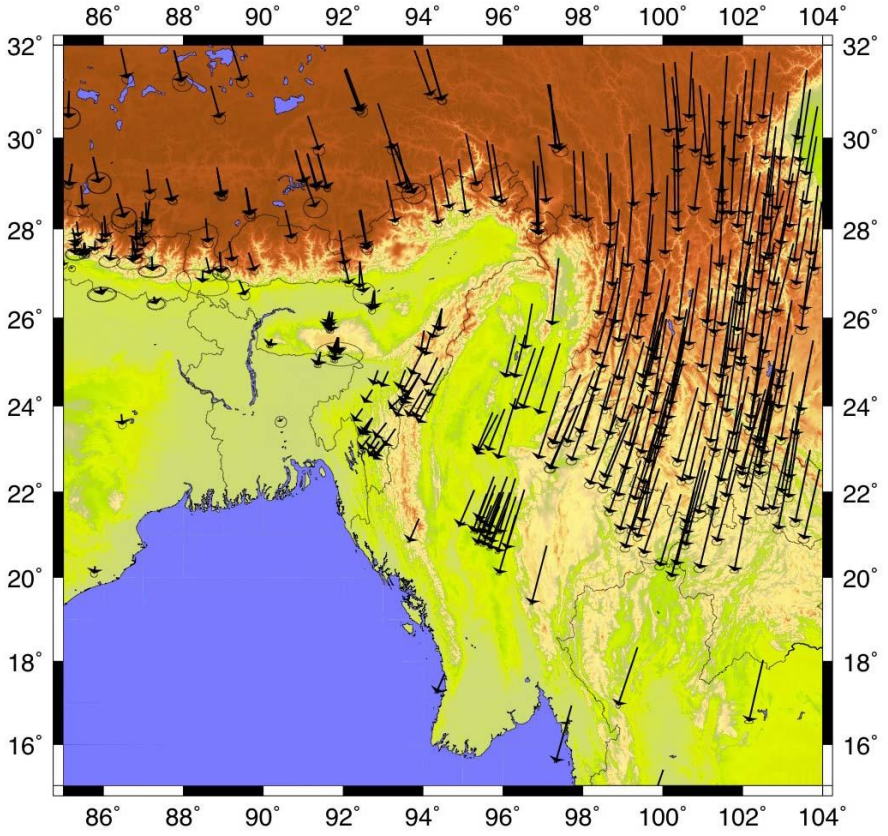


Burma-Andaman Platelet (in green)

The actice geodynamic setting
Velocity field derived from compiled GPS measurements



Eurasia fixed

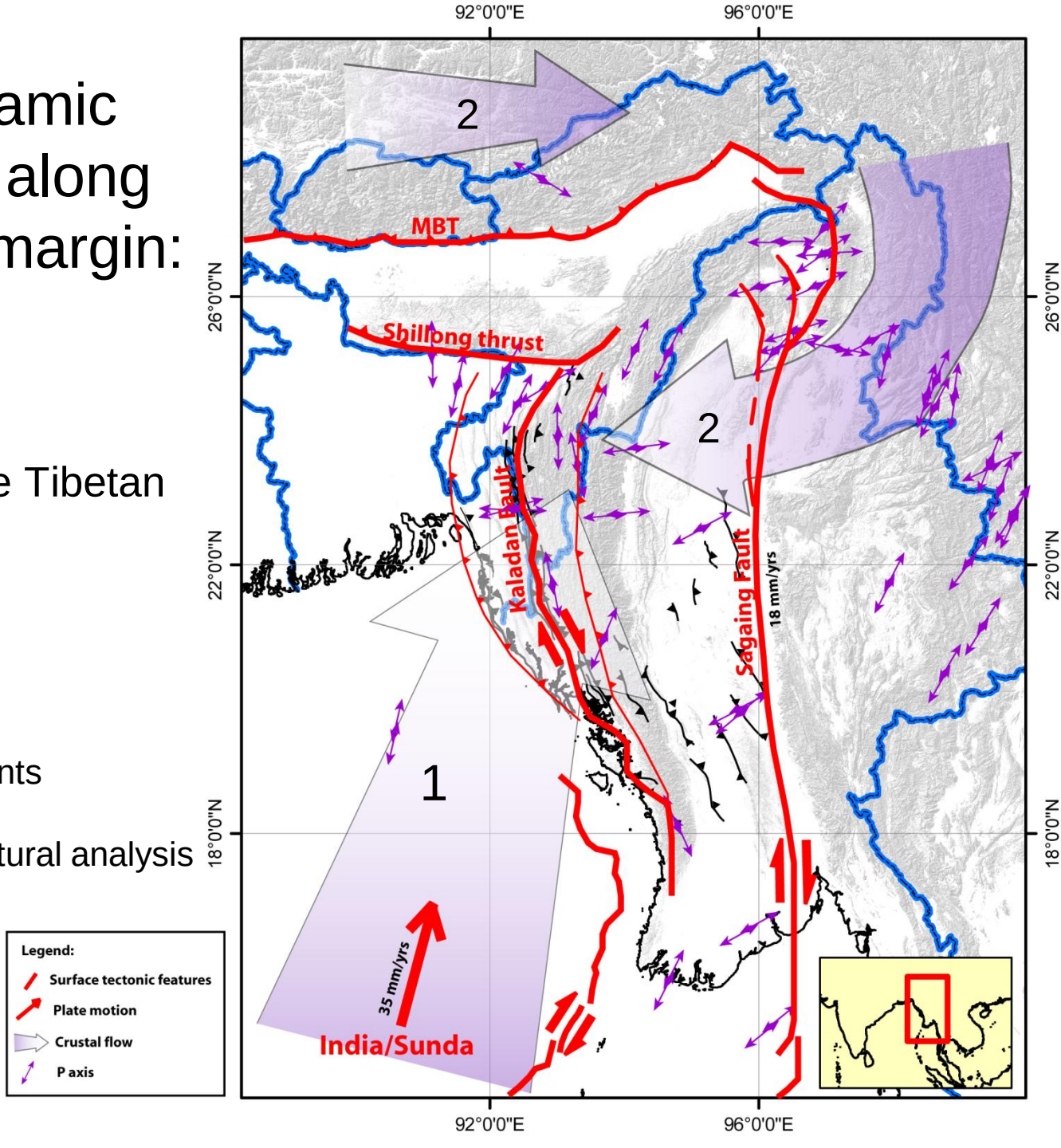


India fixed

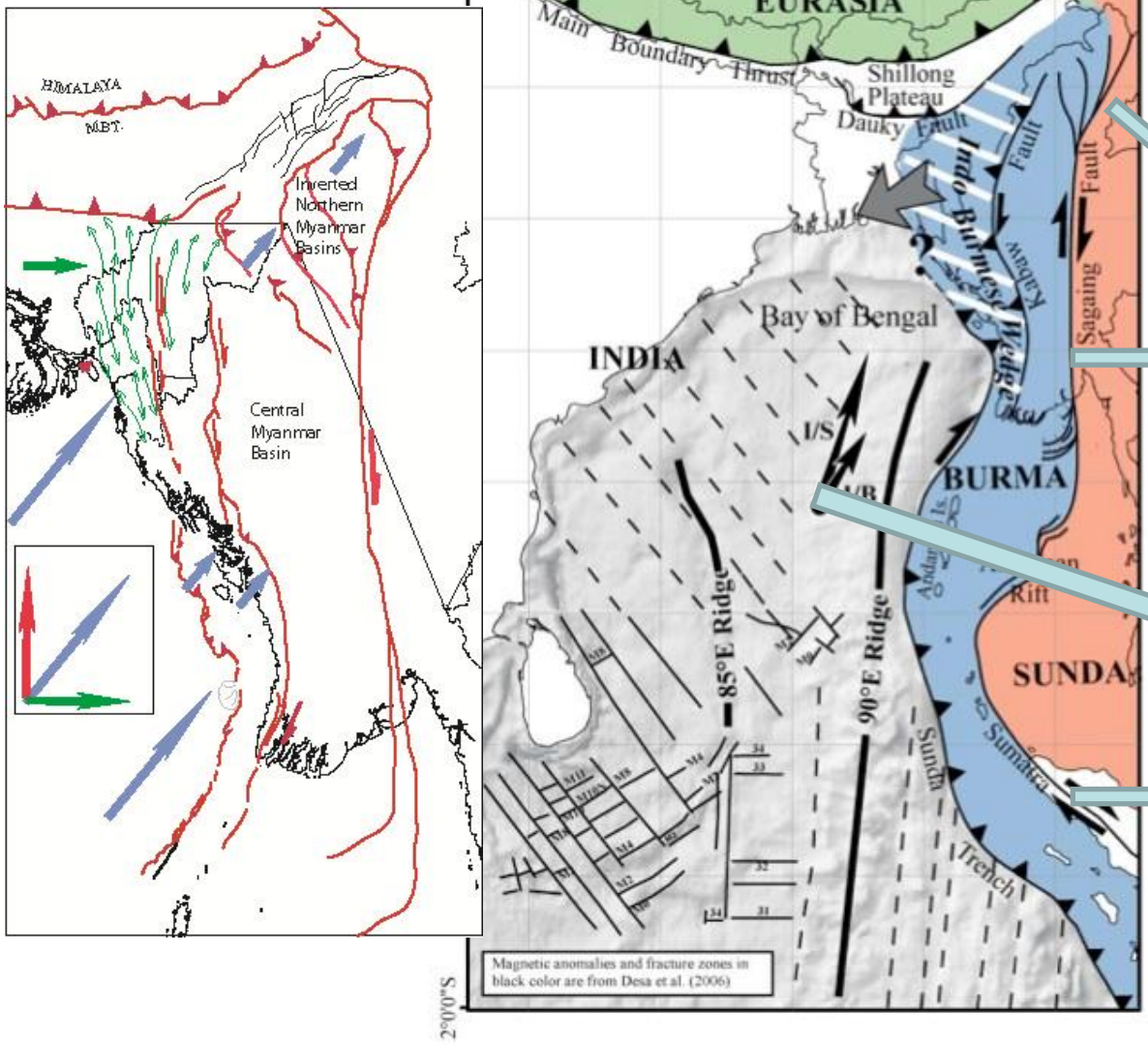
2 distinct geodynamic processes active along the West Sunda margin:

1: India Sunda oblique convergence
2: Gravity collapse of the Tibetan Plateau.

<u>Approach :</u>
- GPS geodetic measurements
- Seismicity analysis
- Onland and Offshore structural analysis



Oblique India Sunda convergence= strain partitioning between NNE dextral shear and E-W subduction?



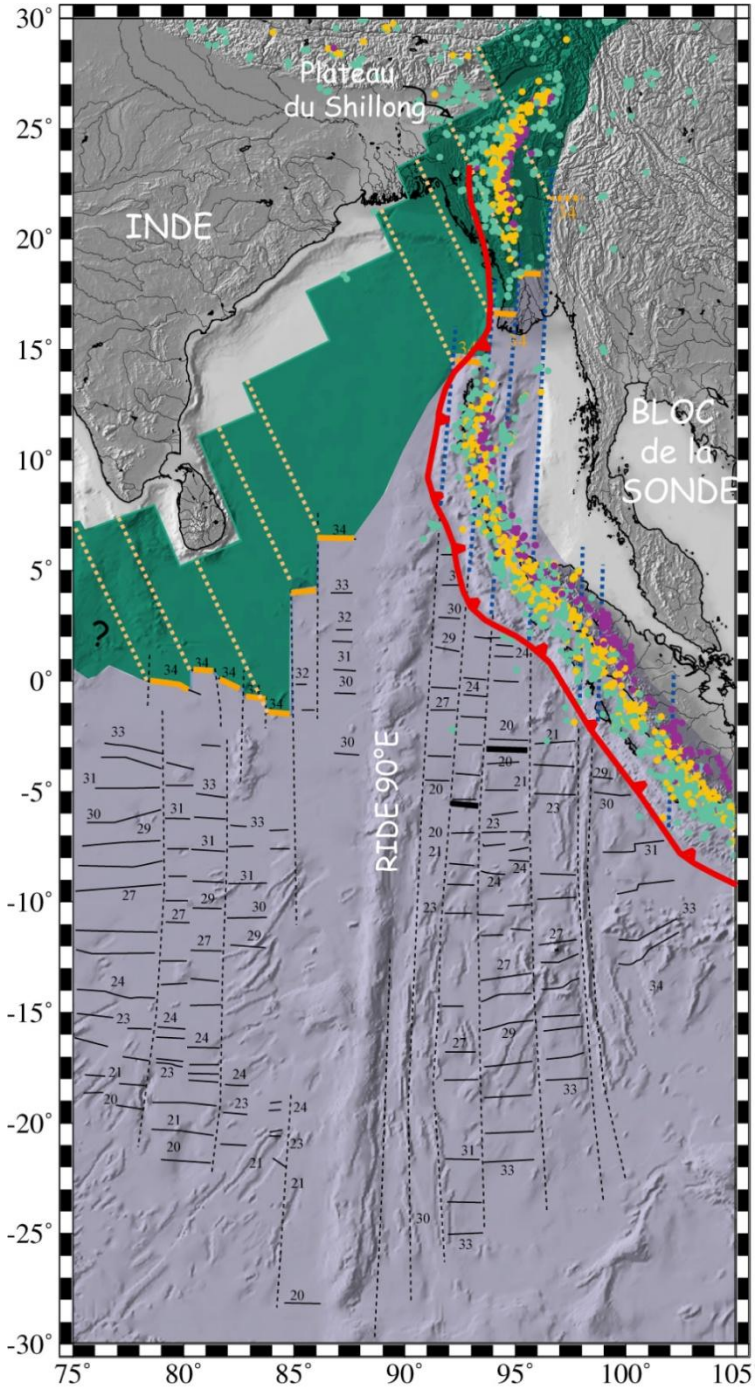
Half of India/Sunda Motion absorbed along Dextral Sagaing Fault.

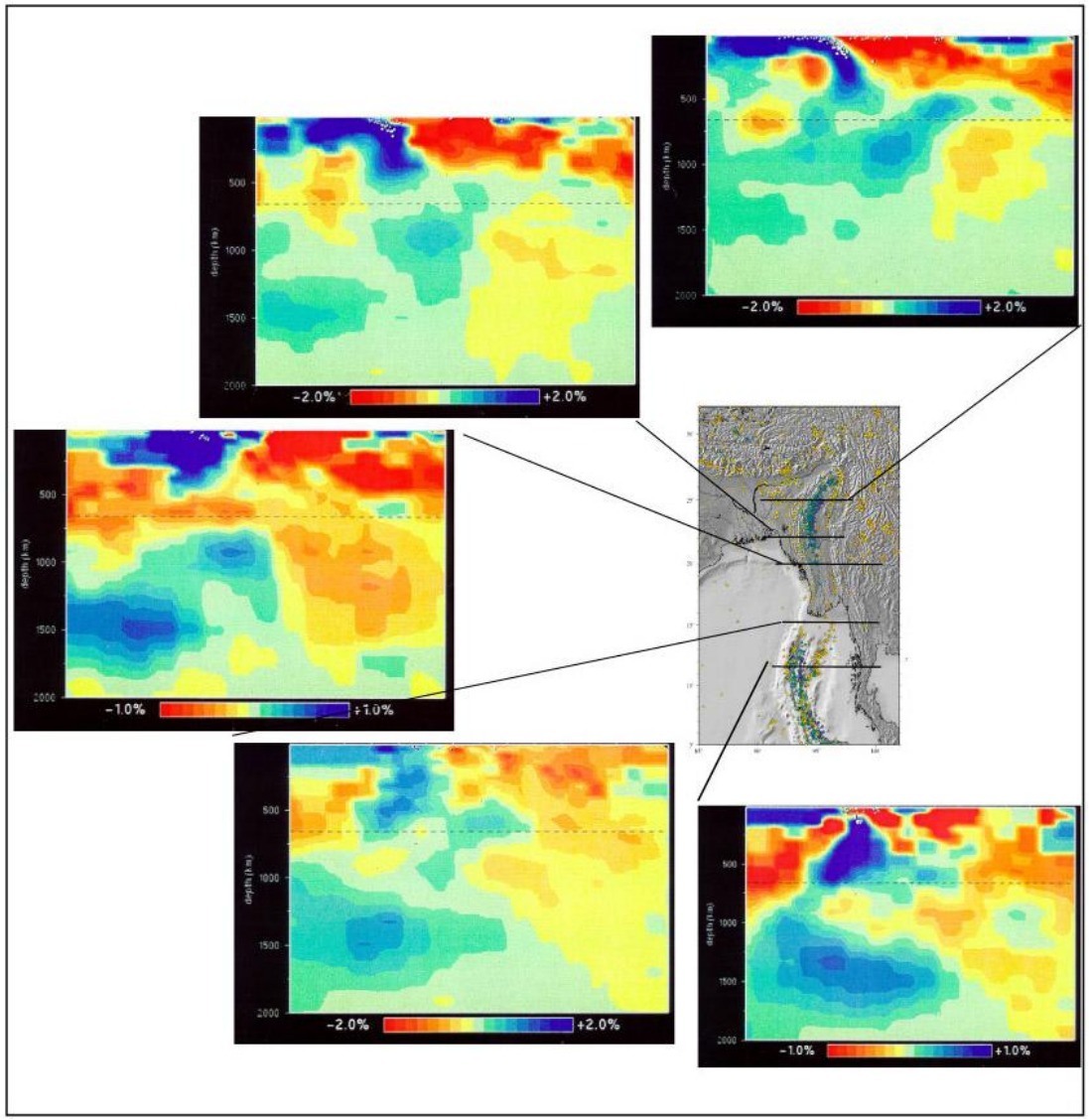
18mm/yr motion along Sagaing Fault (Geodetic measurements, 2 networks)

3.5 mm/yr India/Eurasia Motion ?

20mm/yr motion along Semangko fault

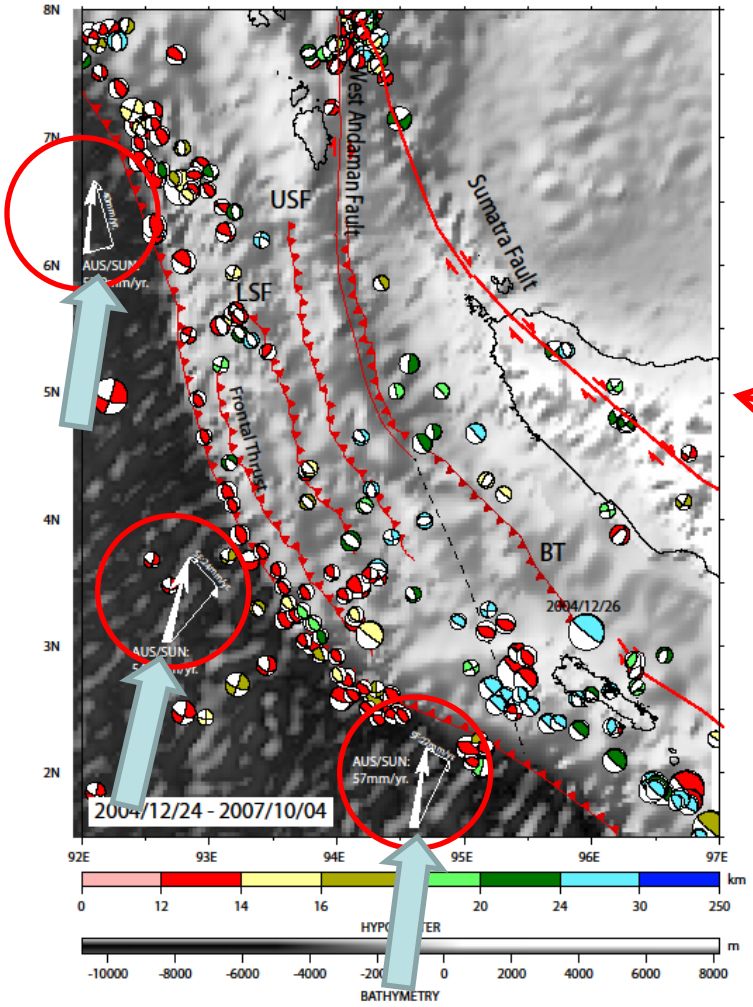
BUT, Tomography all along the West Sunda Margin from Andaman islands to Eastern India, does not image significant subducted slab

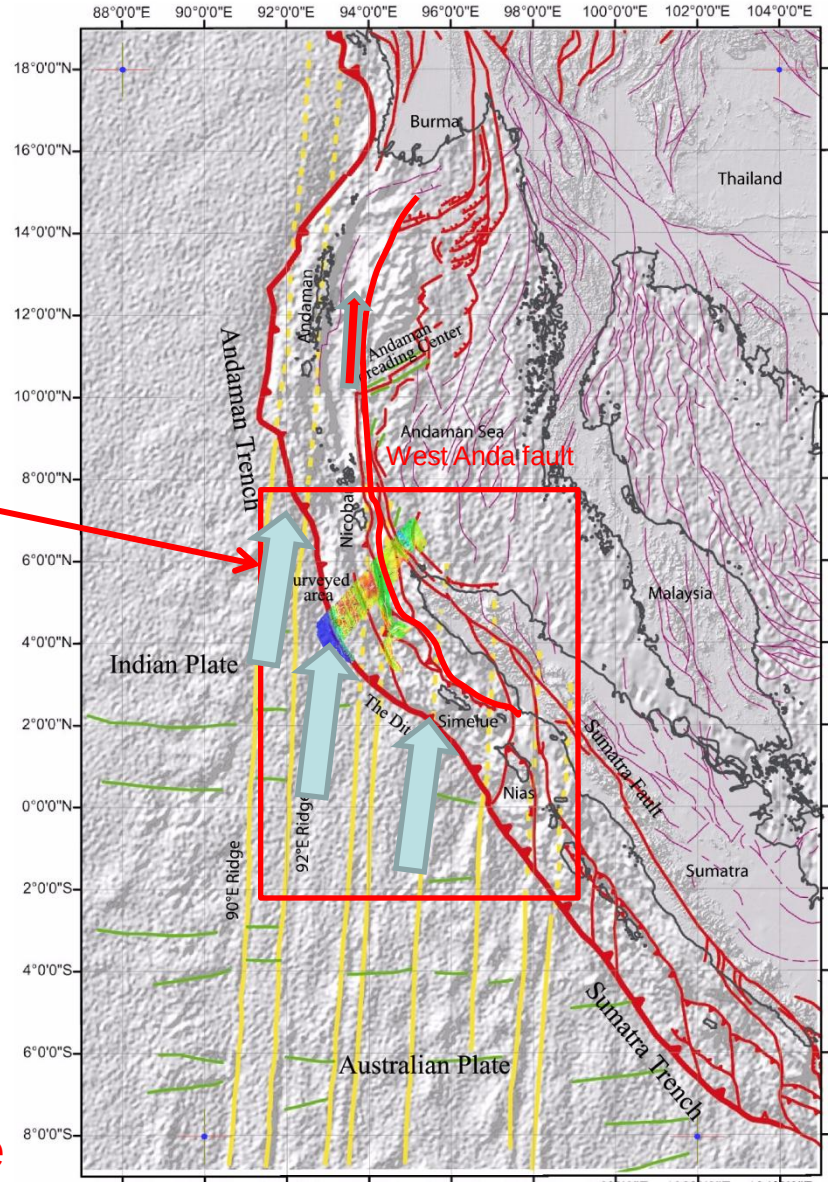




NORTHWARD DECREASING OBLIQUE PLATE CONVERGENCE ALONG THE NORTHERN SUMATRA-SOUTHERN ANDAMAN TRENCH

North Sumatra South Andaman motion between upper and lower plates

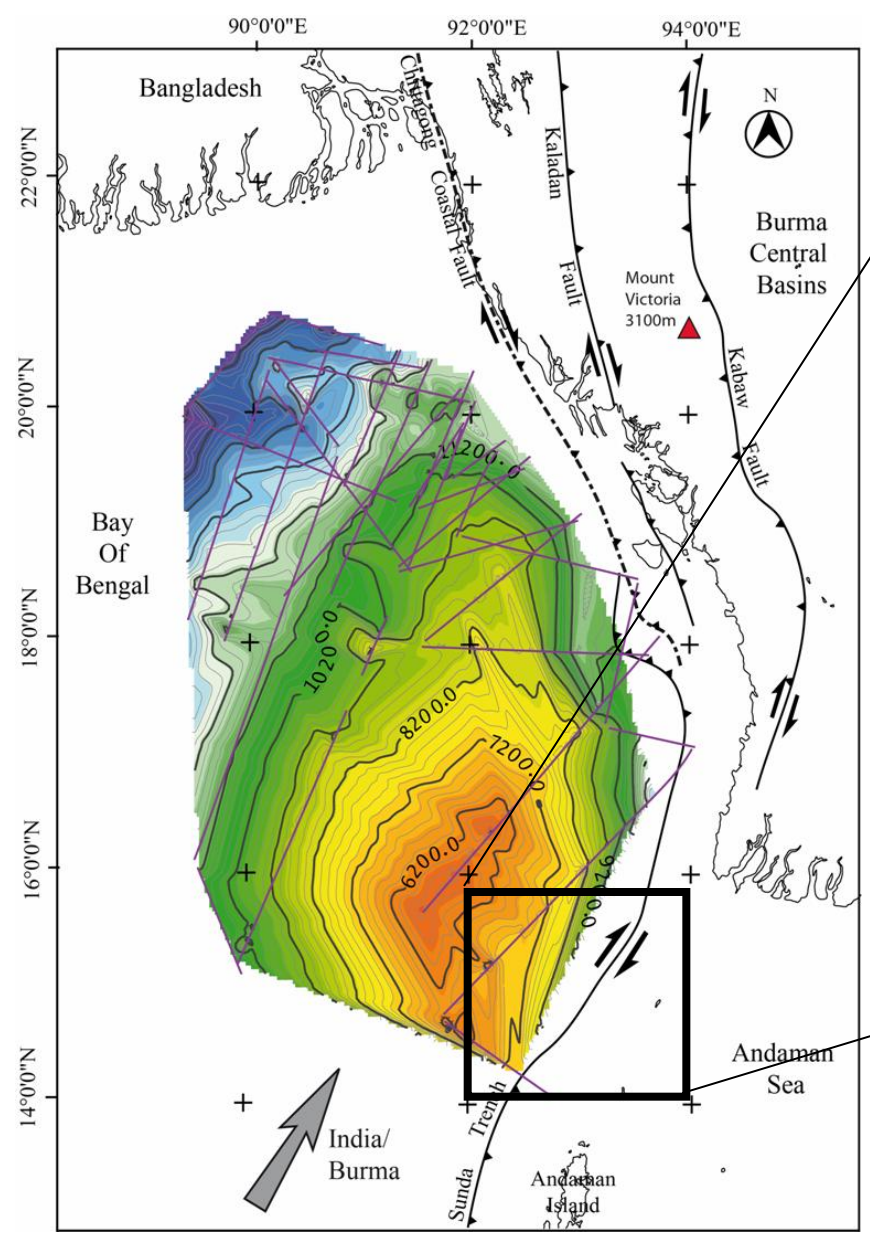


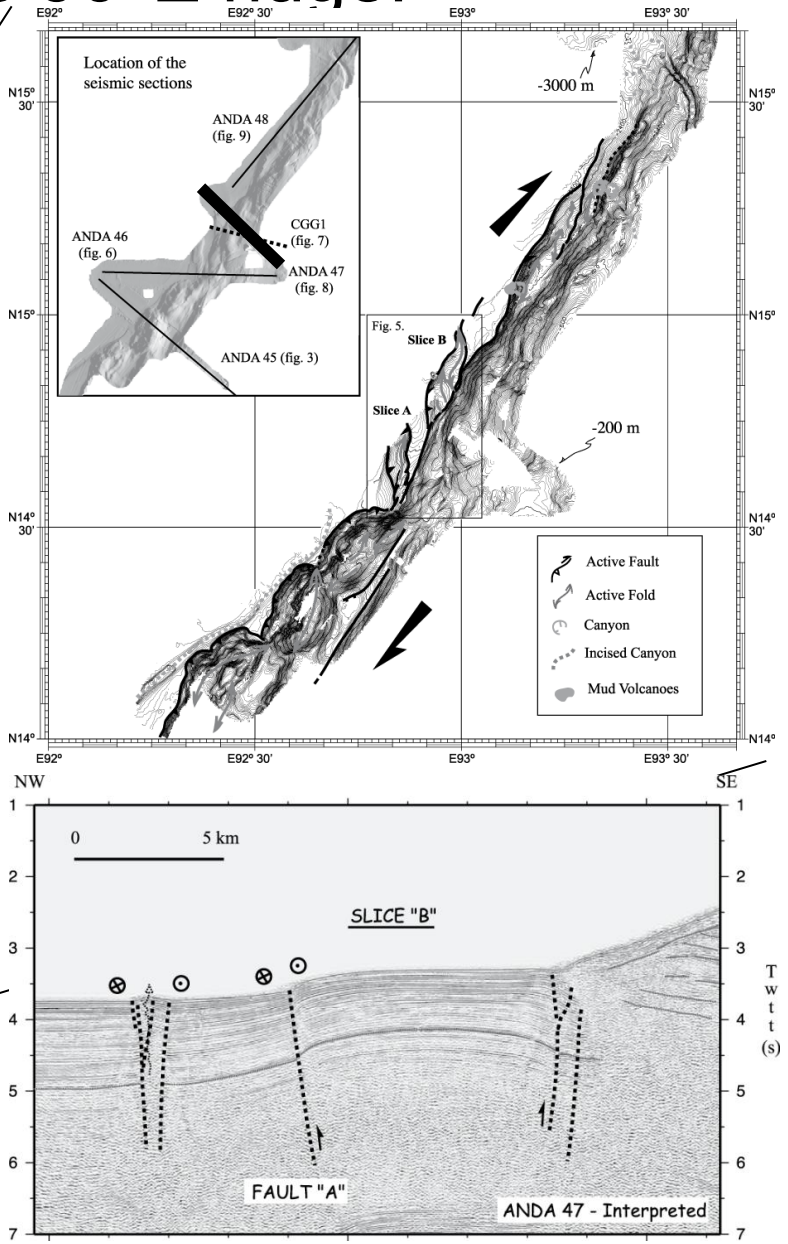


From frontal to hyper-oblique convergence

(Rangin et al., in press)

Pure dextral strike slip in southern Myanmar, the effects of the 90°E ridge:

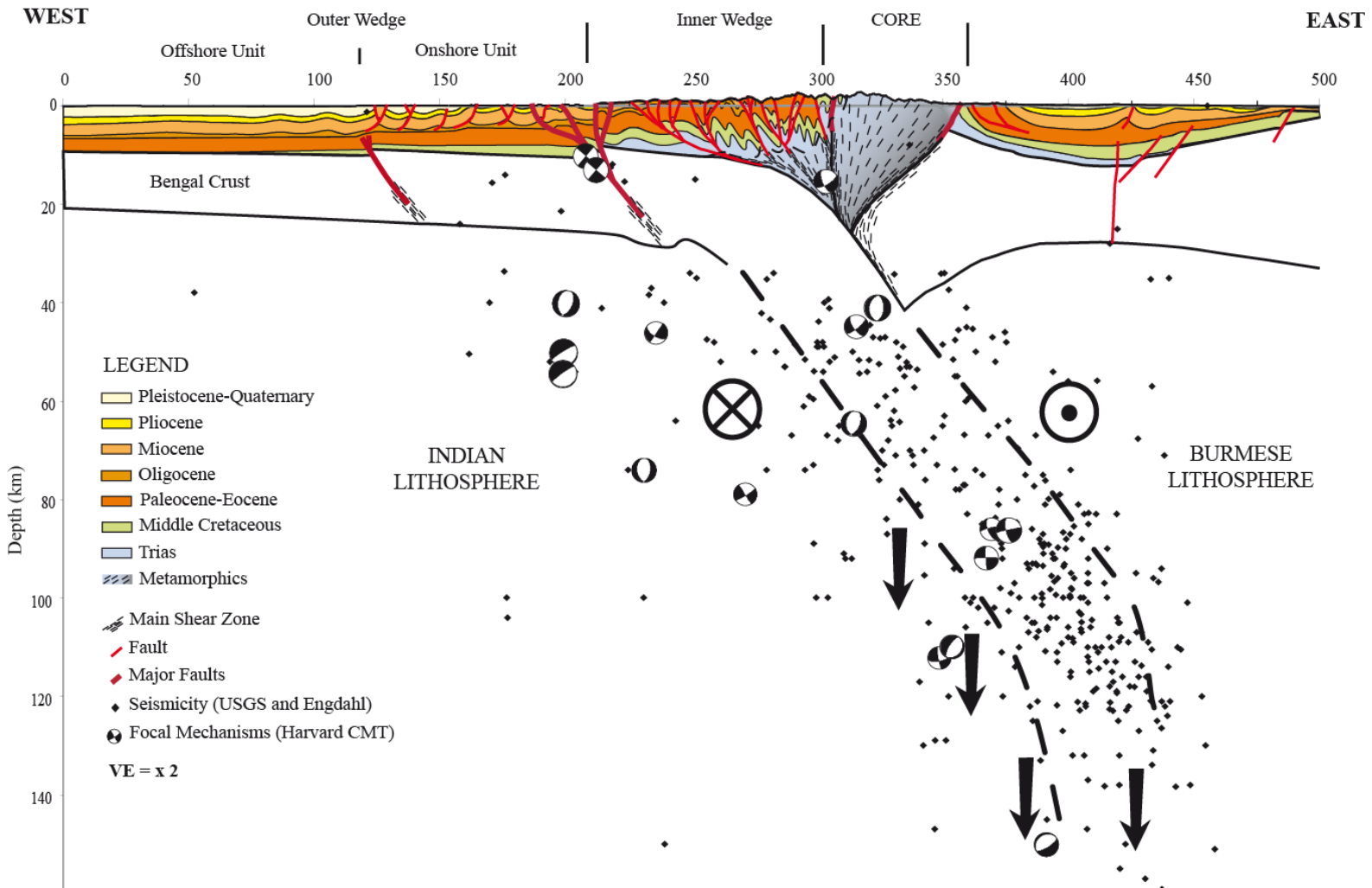


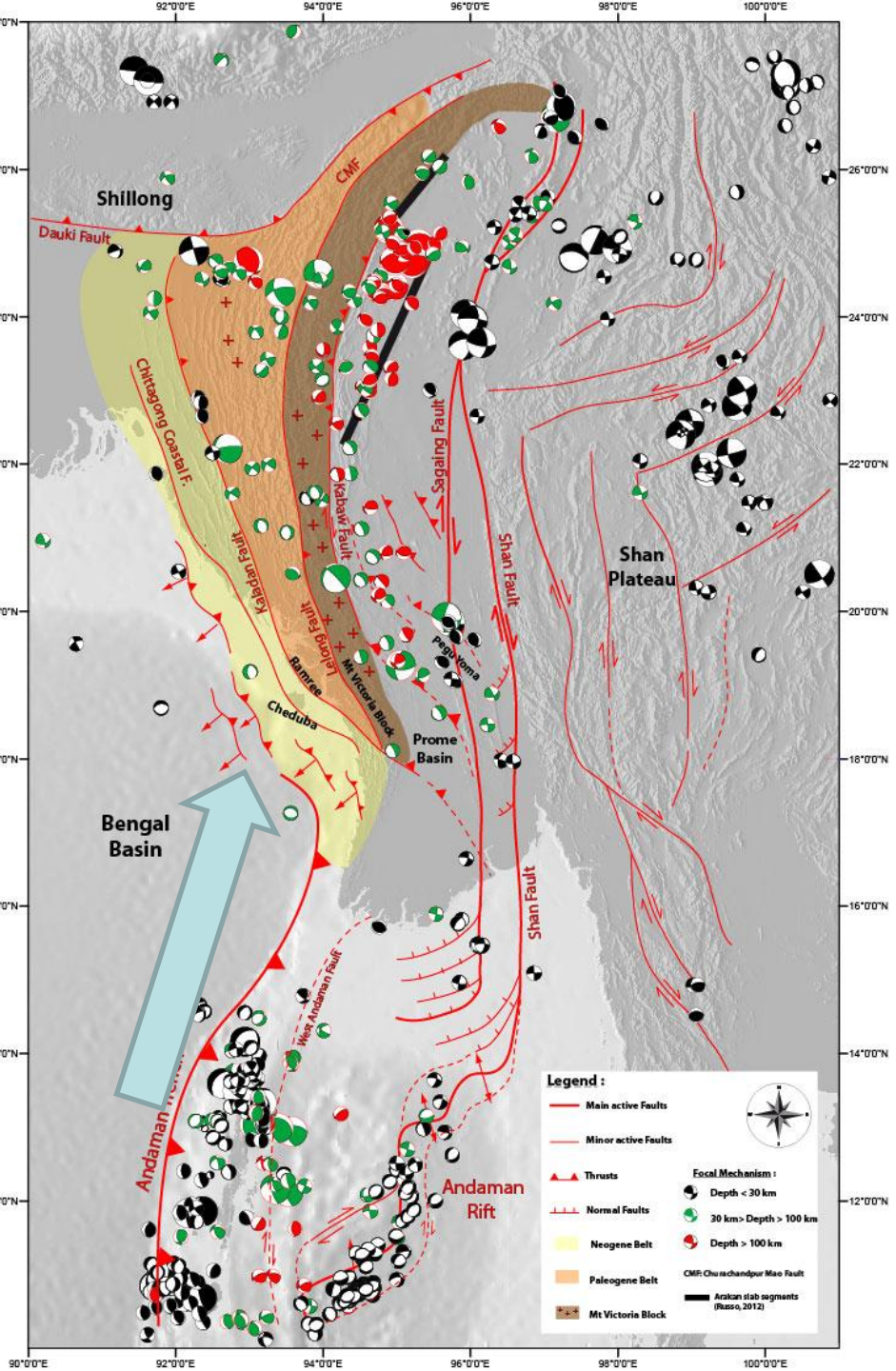


Nielsen et al., 2004

The Indo-Burmese belt is a wide dextral strike-slip pop-up structure lying above an inactive slab in detachment process

(Maurin and Rangin, 2009)





Active subduction in northern Myanmar?

(up 19° to 28°N)

Most of focal mechanisms (from **30km** to **80 km** depth) are indicating sub-meridian dextral shear and affect the whole « wedge»

Dextral shear along Sagaing and Shan faults but also within the Shan Plateau

Deep (>**100km**) focal mechanisms with N-S P axis are close to the deep sinking slab (**black bars**).

Seismicity does not show expected focal mechanisms related to subduction

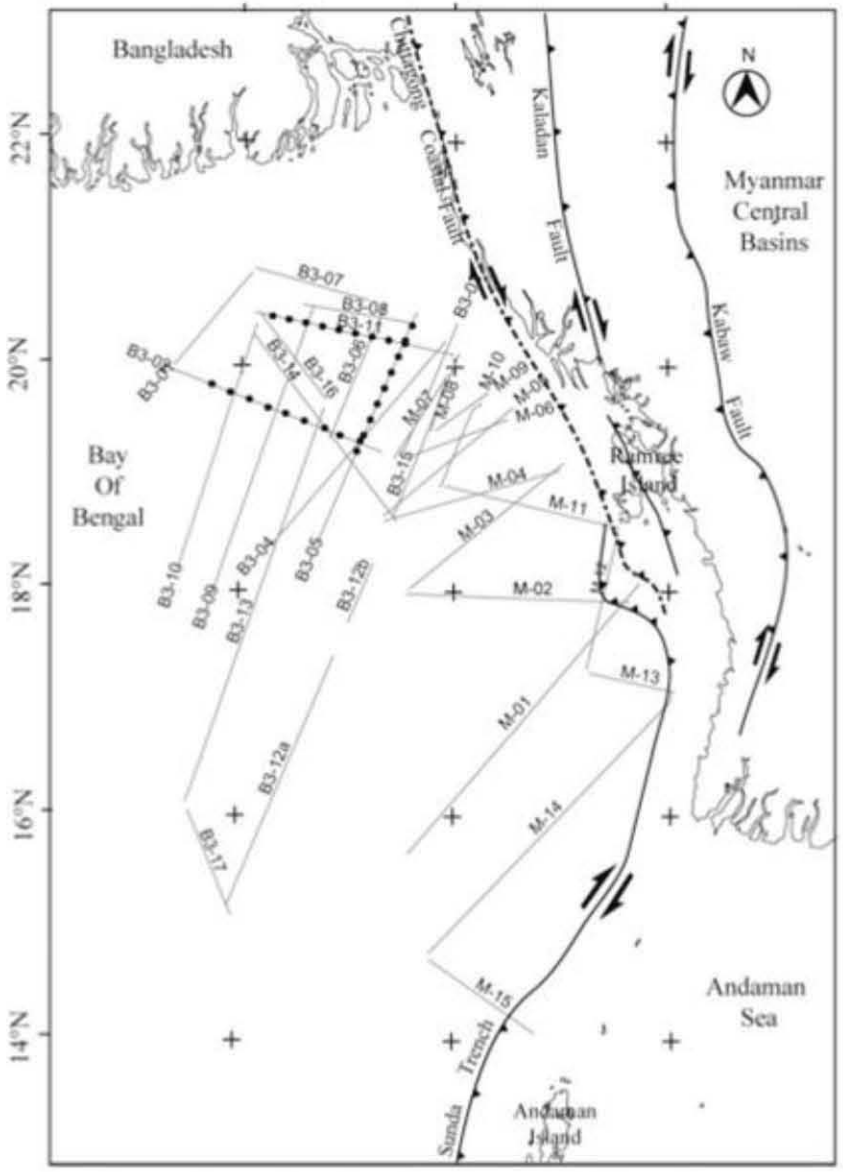
Clear active subduction does not exist along the West Sunda margin?

Multichannel seismic data acquired along the eastern margin of the Bengal basin?

New seismic reflection data were collected along the supposed West Burma wedge

2 Multichannel seismic reflection surveys:

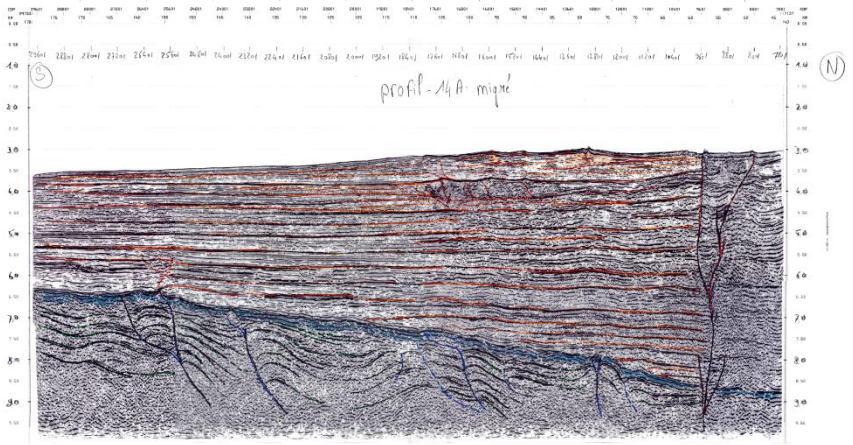
- **2006 survey (Myanmar):**
  - 4.5km long streamer
  - 2600 in^3 source
- **2007 survey (Bangladesh):**
  - 10km long streamer
  - 6180 in^3 source



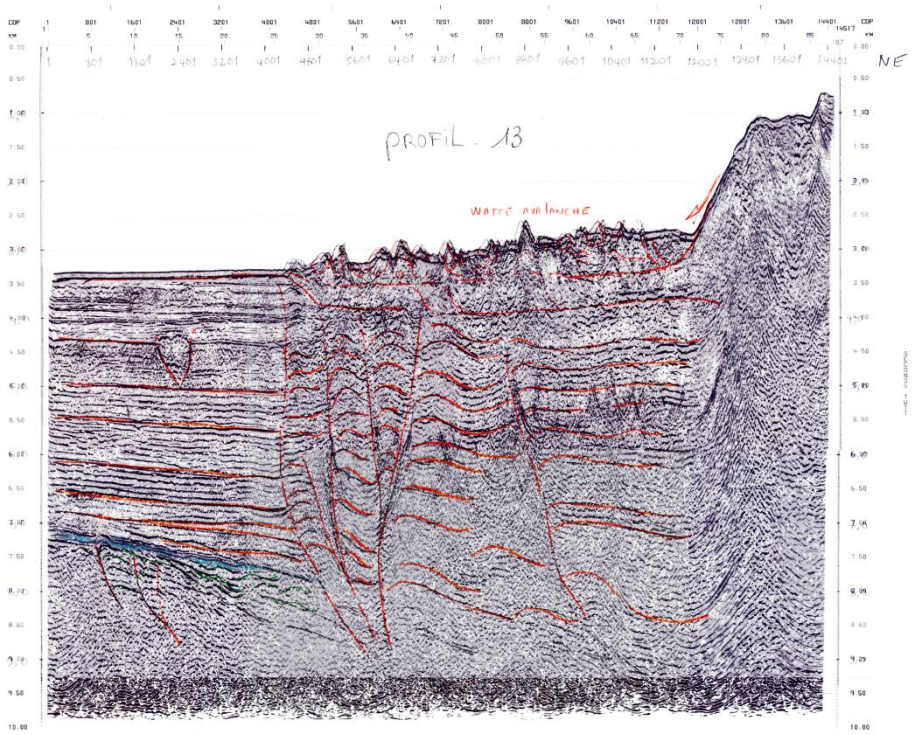
Maurin and Rangin, 2009

Selected MCS lines across the Myanmar western margin

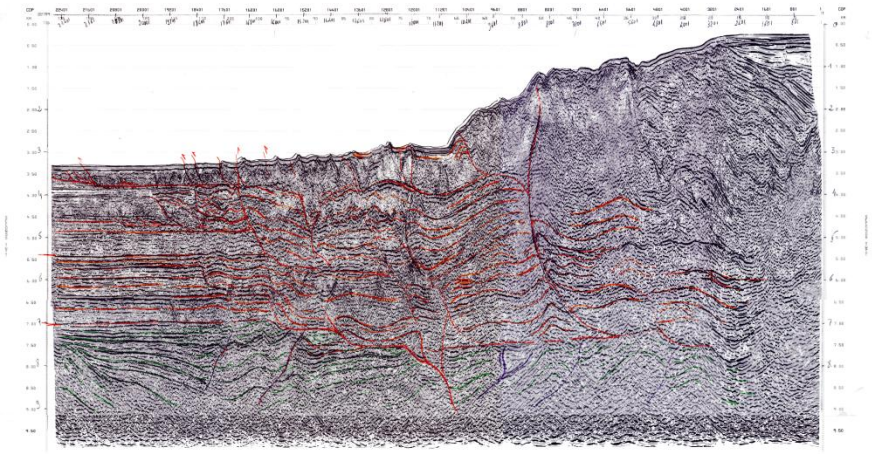
No subduction clearly evidenced.



Horizontal onlapping sediments on 90°E ridge volcanic basement



Sediments affected by stike slip faults.



Detachments and very steep reverse faults

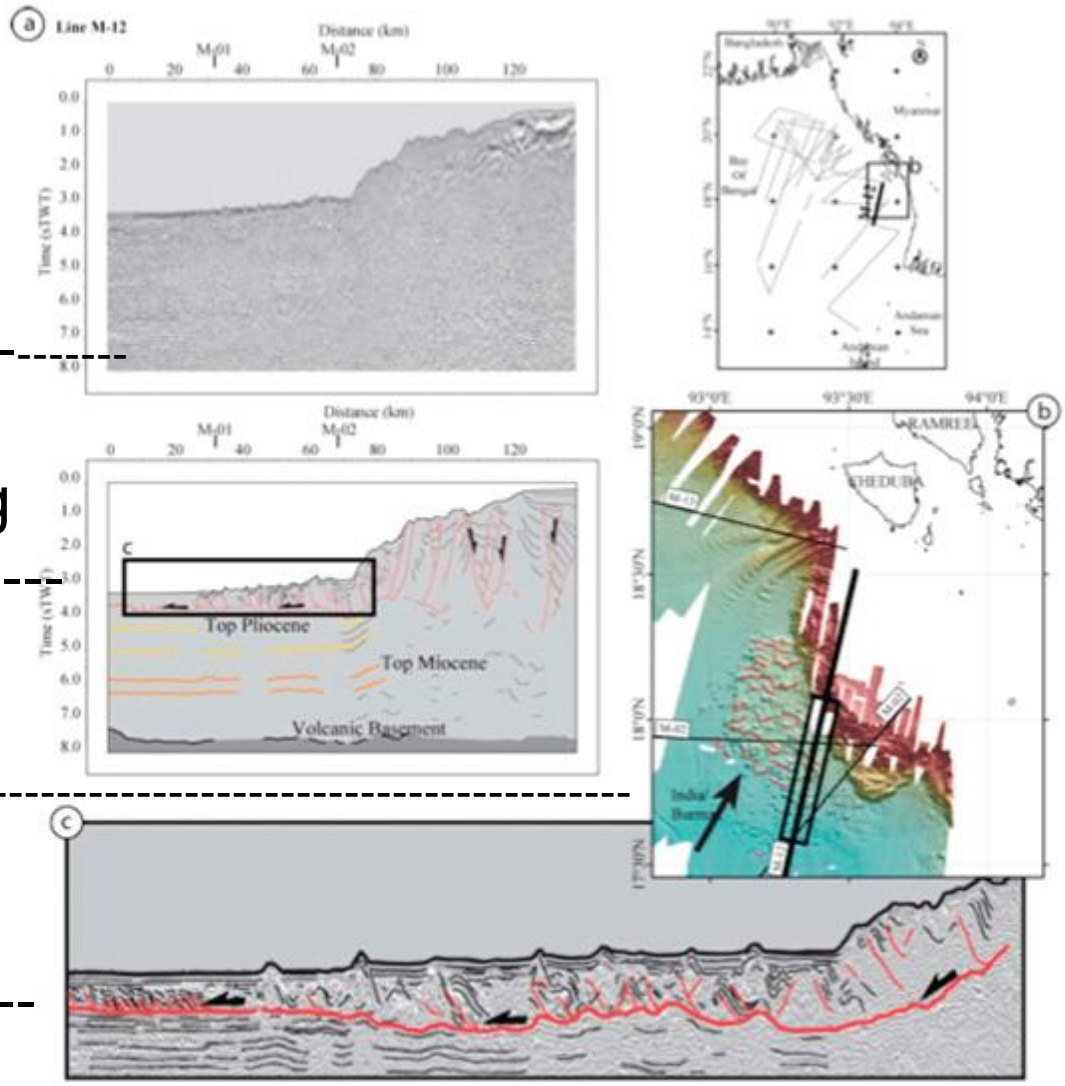
Evidences of large mass gravity sliding
No real accretionary wedge in Northern Burma

No flexure of lower plate--------

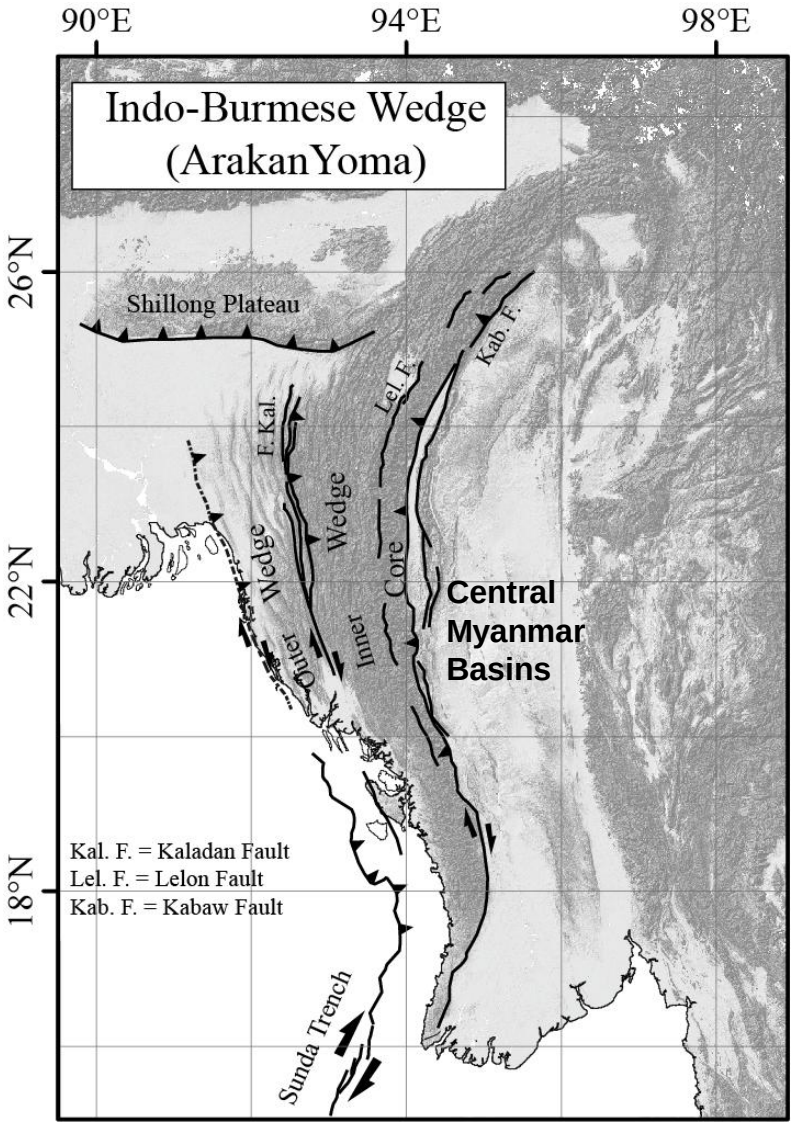
Major gravitational sliding of the margin----------

50-km-wide gravity slide
Mapped by multibeam bathymetry

Detail of detachment at
The base of gravity slide----



The distinct tectono-sedimentary units of the Indo-Burma belt are separated by dextral sub-meridian wrench zones, deposited disconformably on a pre-latest Cretaceous suture zone exhumed within the core of the Indo-Burma Ranges

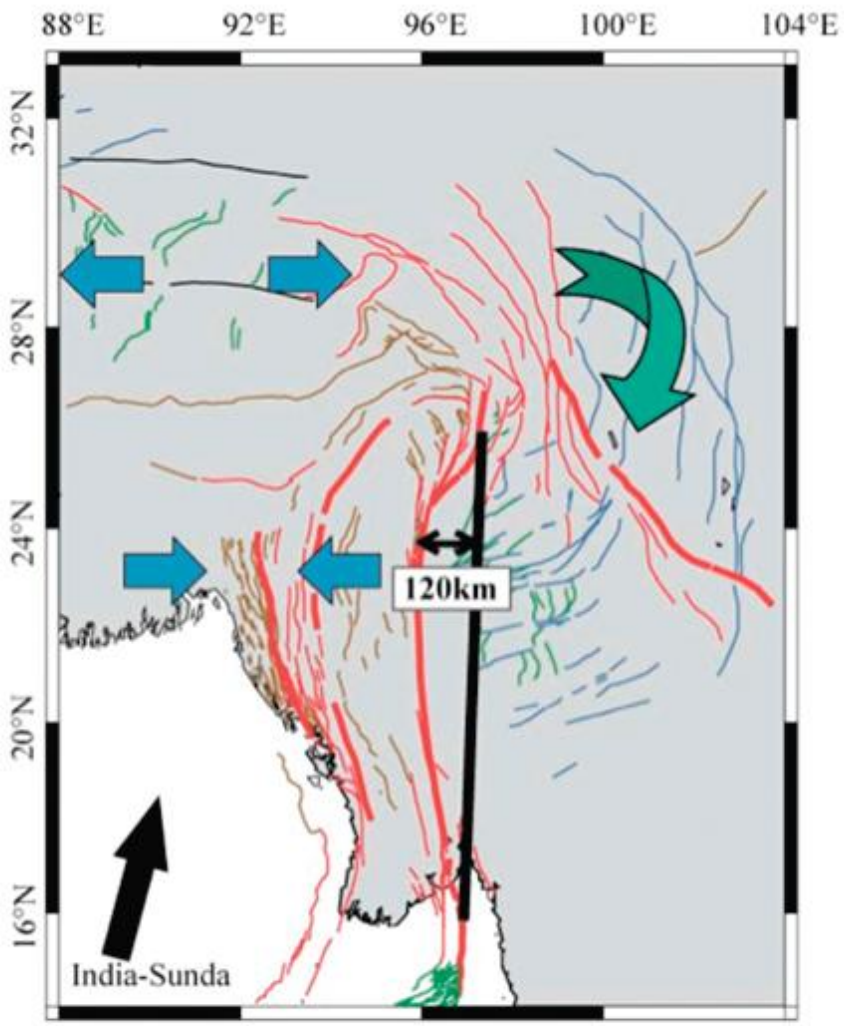


This suture zone present within the core of the belt shows ***Mesozoic ophiolites with a sole of Mesozoic blue schists*** thrusted on a micro-continent = **Burma continental block** formed by pre-Triassic black shales and Cretaceous clastic and carbonate sequences.

The stratigraphy of the Central Myanmar basins is rather similar to the Cenozoic sequence of the Indo-Burma belt, and could be part of the same basin, the Bengal basin.

The Indo-Burma Ranges and the Central Myanmar basins were both deformed and uplifted during the last 10 my.

Westward bending of the recent N-S strike-slip faults is evidence for the collapse of the Tibetan plateau initiated around 10 my. ago.



The extension of the Tibetan plateau crust is compensated by building of a gravitational wedge in northern Myanmar, and the eastern Bengal basin (blue arrows).
The Tibetan crust is extruded around the East Himalaya syntaxis (green arrows) .

This classic couple of extension/ toe thrusts is typical for crustal gravity sliding related to dissipation of potential energy accumulated during the plateau thickening .
This process is unrelated to the Indian plate subduction.

CONCLUSIONS

On the geodynamic point of view, the evolution of the Burma platelet is controlled, since 10Ma, by two distinct forces:

1- Motion of India (and attached Bengal Basin) toward the N or the NNE with respect to Eurasia, after collision of the Mesozoic Burma continental block with Sundaland 70Ma to 45 Ma (Indus suture zone).

- Transtension was dominant afterwards up to 10Ma, generating important depocenters In the Central Myanmar basins but also a main foreland basin along the future Indo-Burma Ranges.

- Both depoceters draining most of the clastics derived from the erosion of the India/Asia collision were inverted in the late Neogene, 10 Ma; main depocenters migrated westward in the present Bengal basin.

2 -The late Miocene-to-present (since 10Ma) collapse of the Tibet Plateau interfered with the sub-meridian India/Eurasia convergence. Crustal flow around the East Himalayan Syntaxis forces the Burma platelet to protrude westward towards in the Bengal basin. The consequence is the presence in northern Burma, Bangladesh, and NE India of a large Neogene gravitational wedge.

Implications for oil exploration are important:

-The Indo-Burma Ranges cannot be considered any more as a classical accretionary wedge related to oblique subduction, but as a gravitational sedimentary mass flow probably thrusted on deep prospects present in the Bengal basin.

Thank you for your attention