

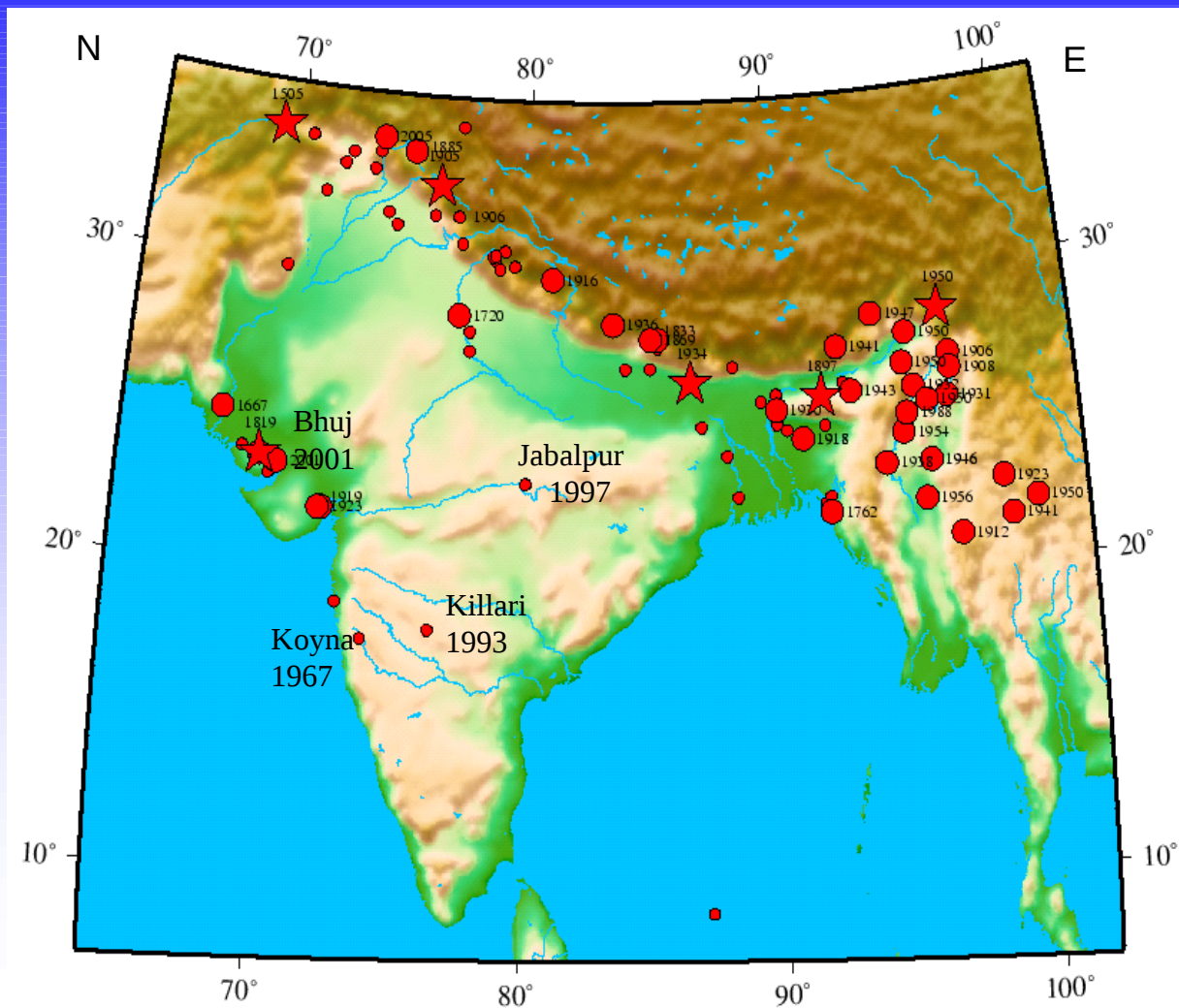
Recent Large Earthquakes in India: Seismotectonic Perspective

J. R. KAYAL

Formerly: Head, Geophysics, Geol Surv India, Kolkata

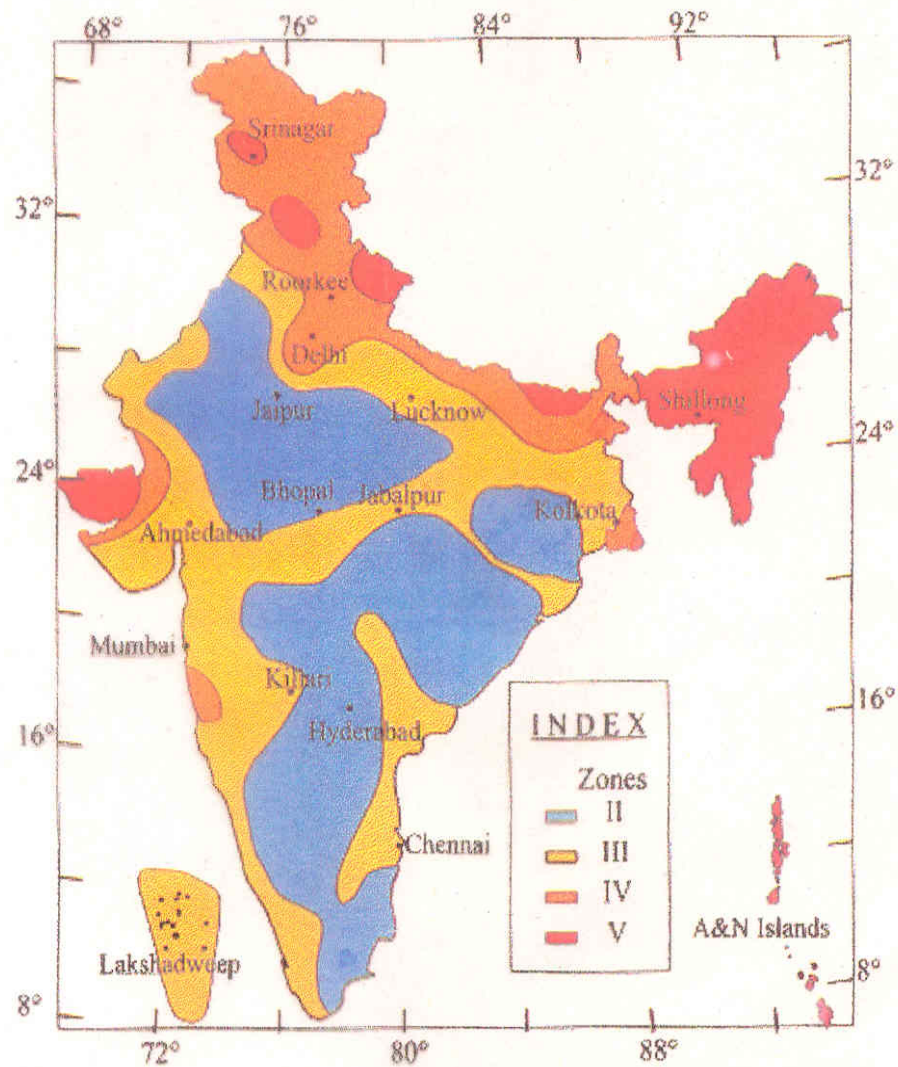
Presently: CSIR Emeritus Scientist, Jadavpur University, Kolkata;
Adjunct Professor: Indian School of Mines, Dhanbad;
Manipur University, Imphal, & Tezpur University, Assam
Email: jr_kayal@yahoo.com

Earthquakes in Indian Sub-continent



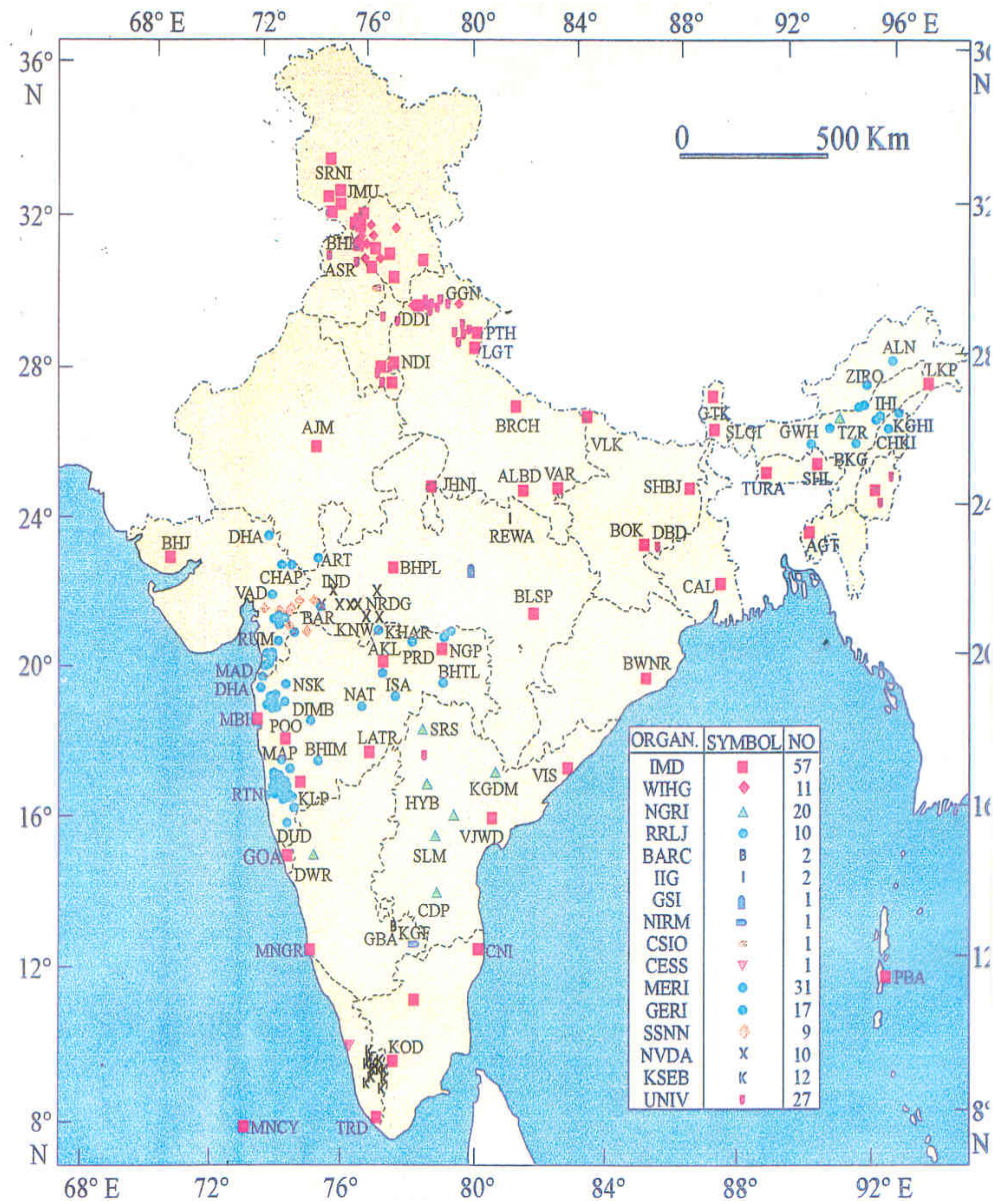
Kayal, 2008

SEISMIC ZONATION MAP

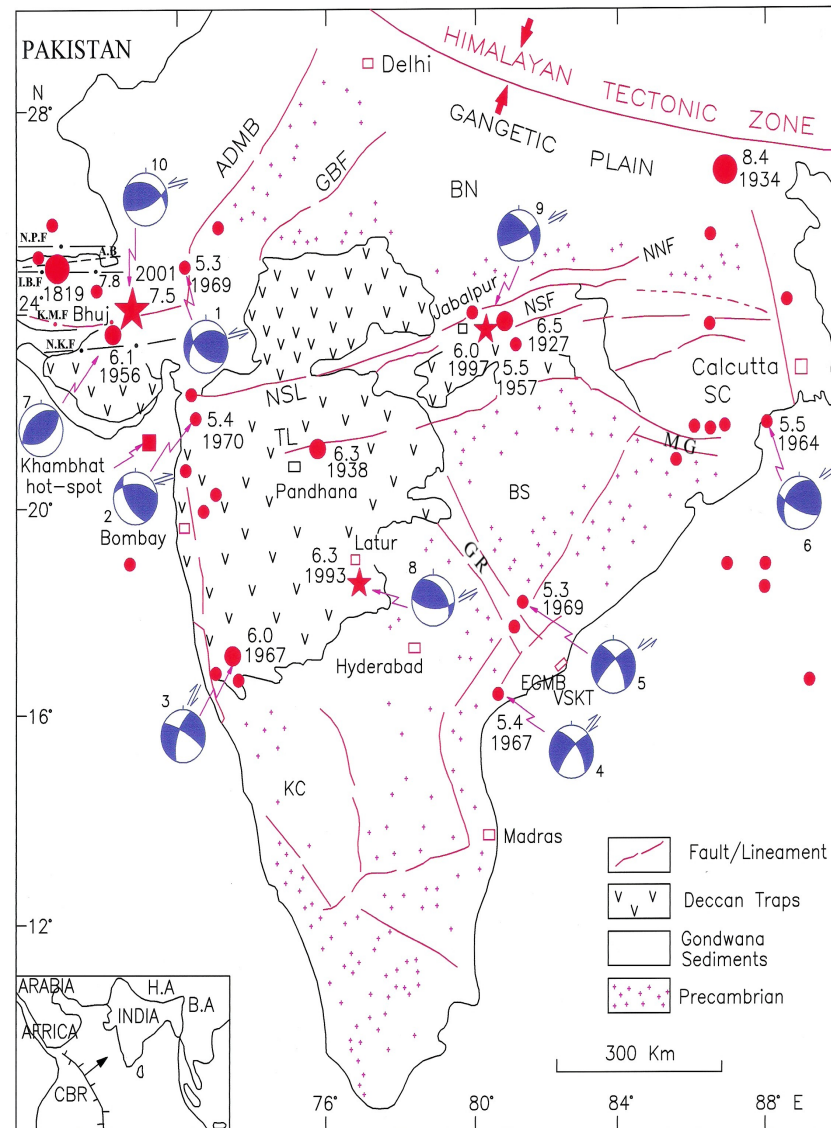


Source: IS 1893-2002

National Seismological Network

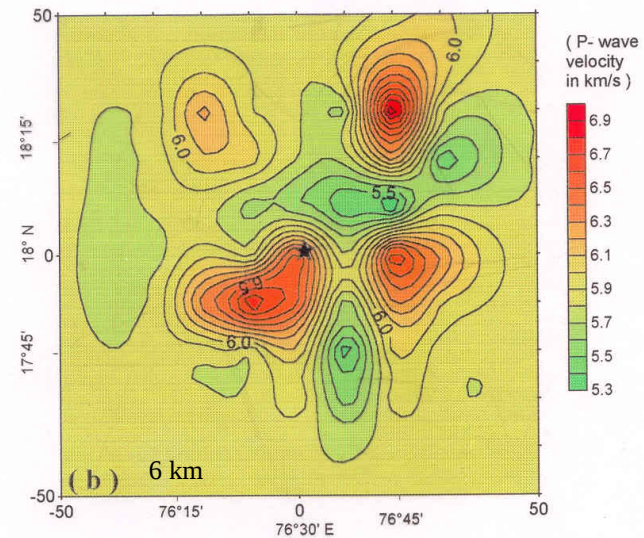
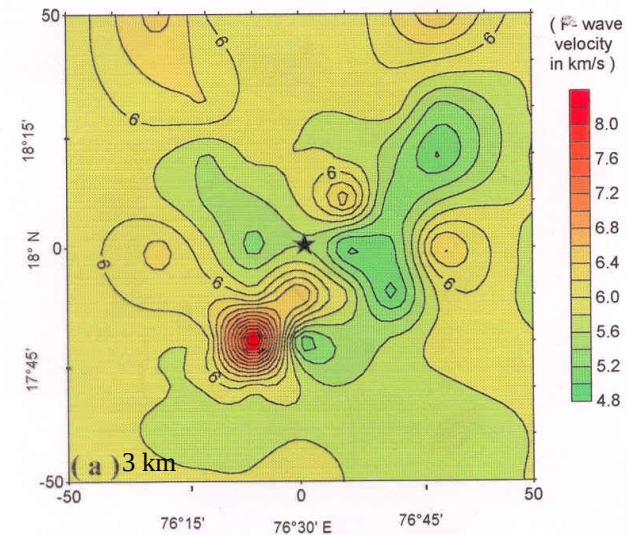
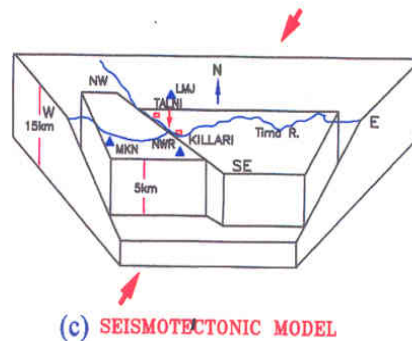
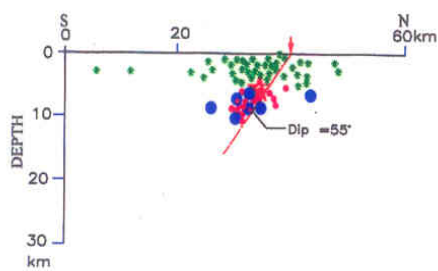
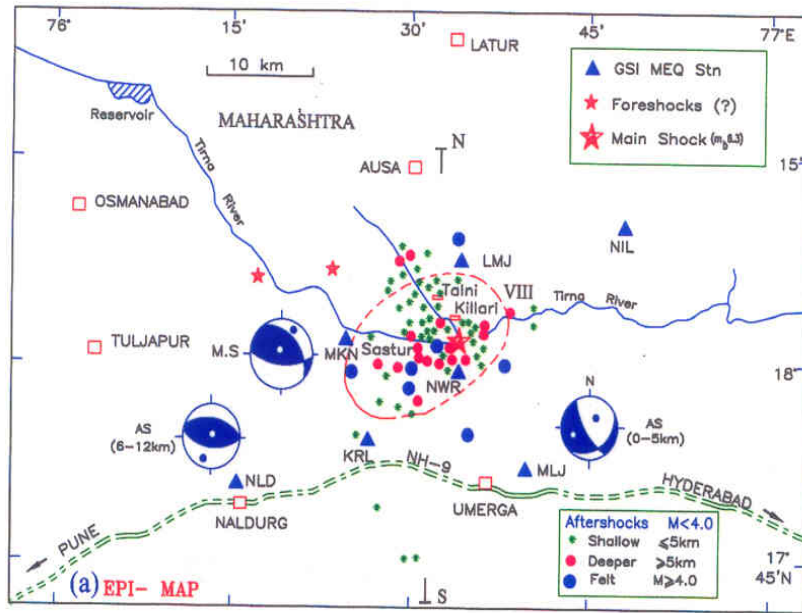


Tectonic Map of Peninsular India: Recent SCR Earthquakes

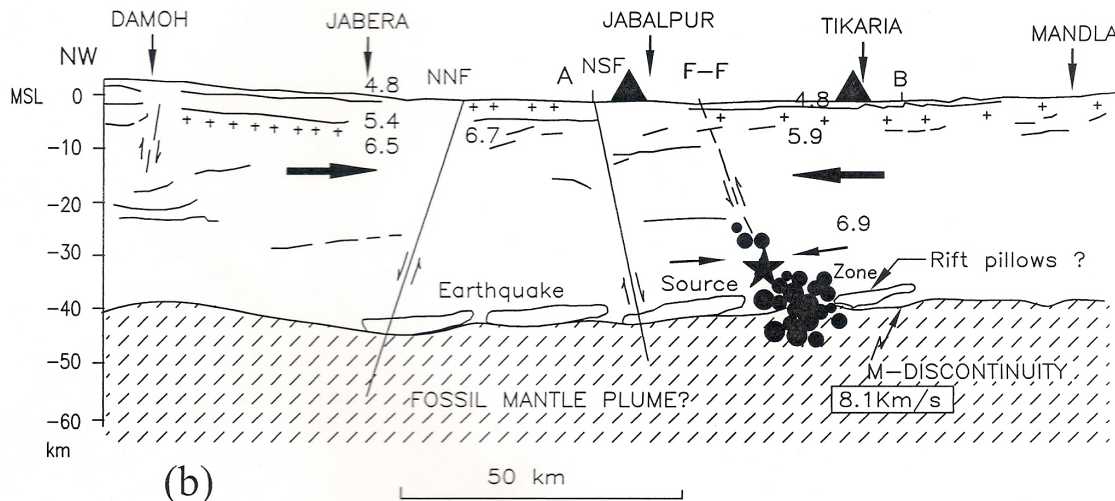
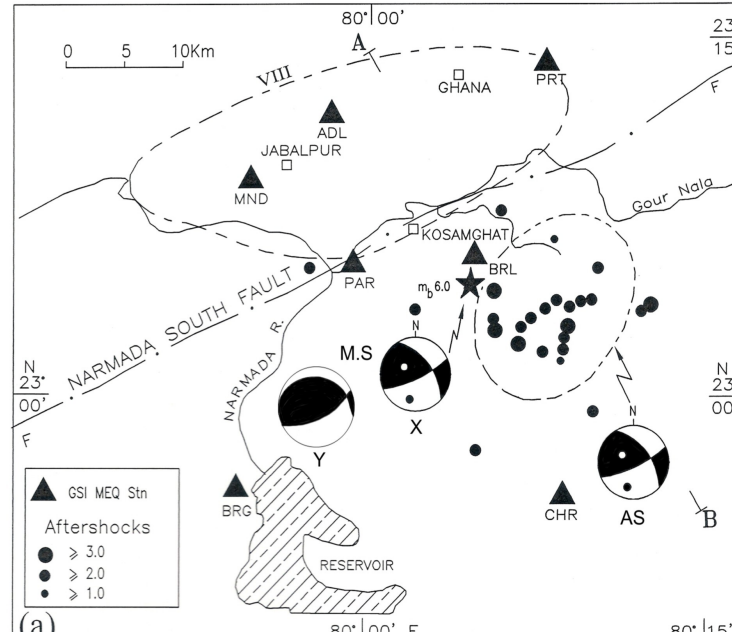
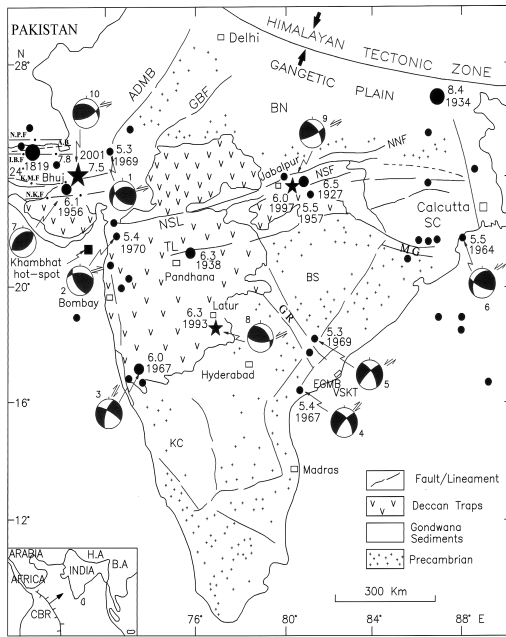


(Kayal 2000, JGS)

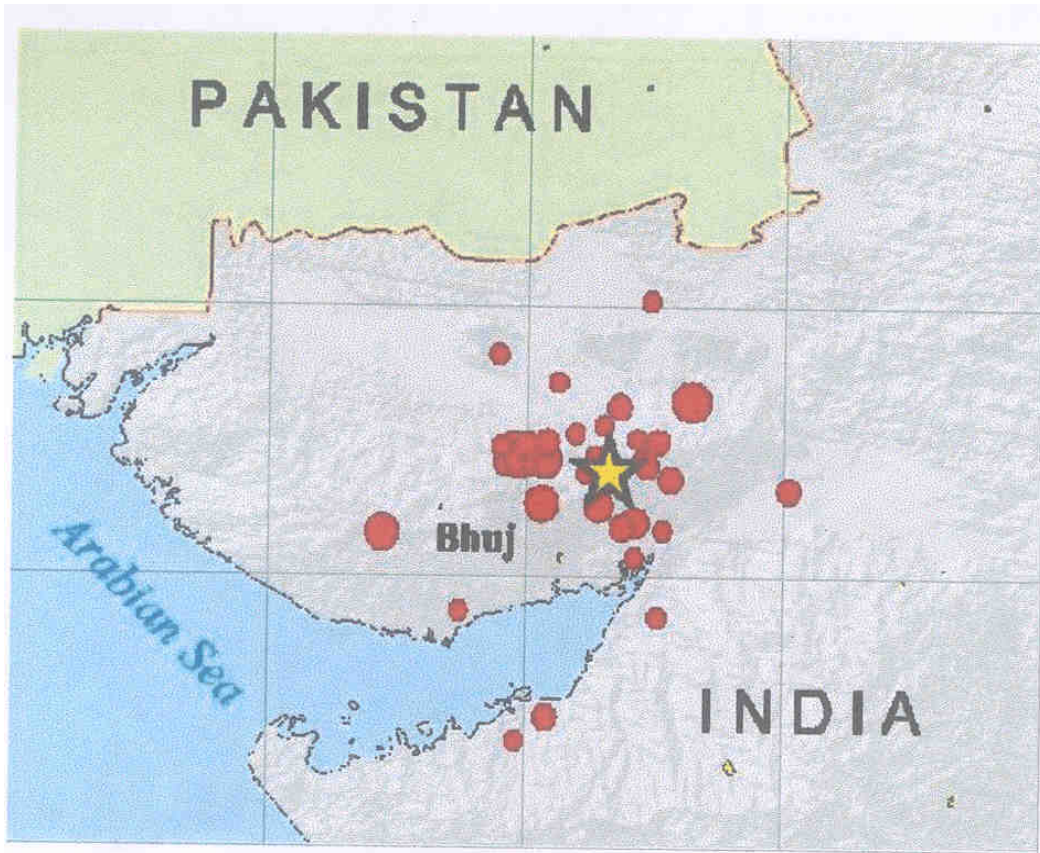
1993 KILLARI EARTHQUAKE SEQUENCE



1997 Jabalpur Earthquake Sequence



The 26th January 2001 Bhuj Earthquake Mw 7.7

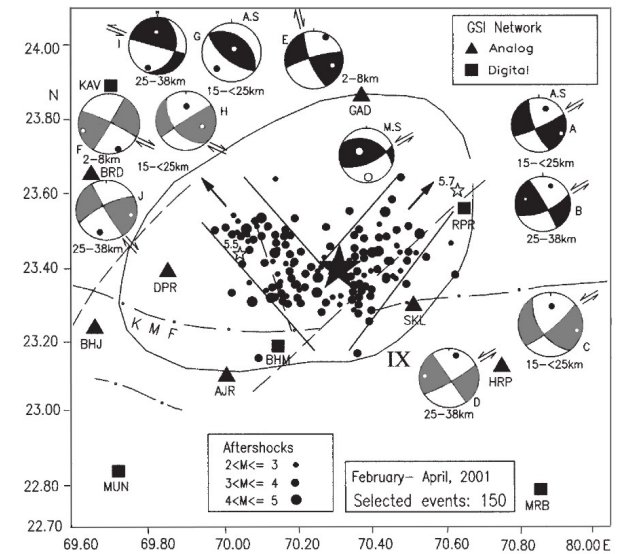
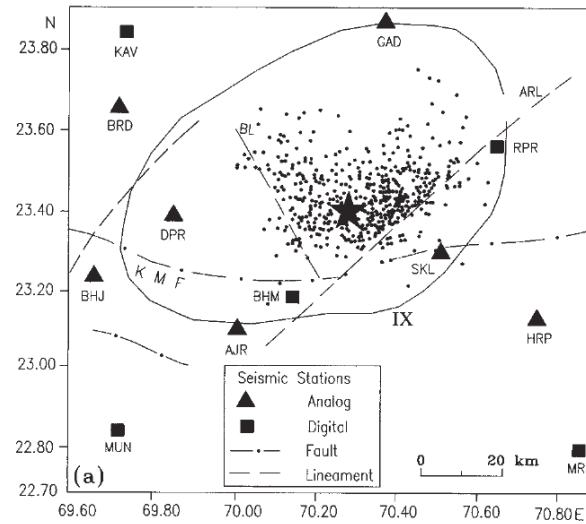
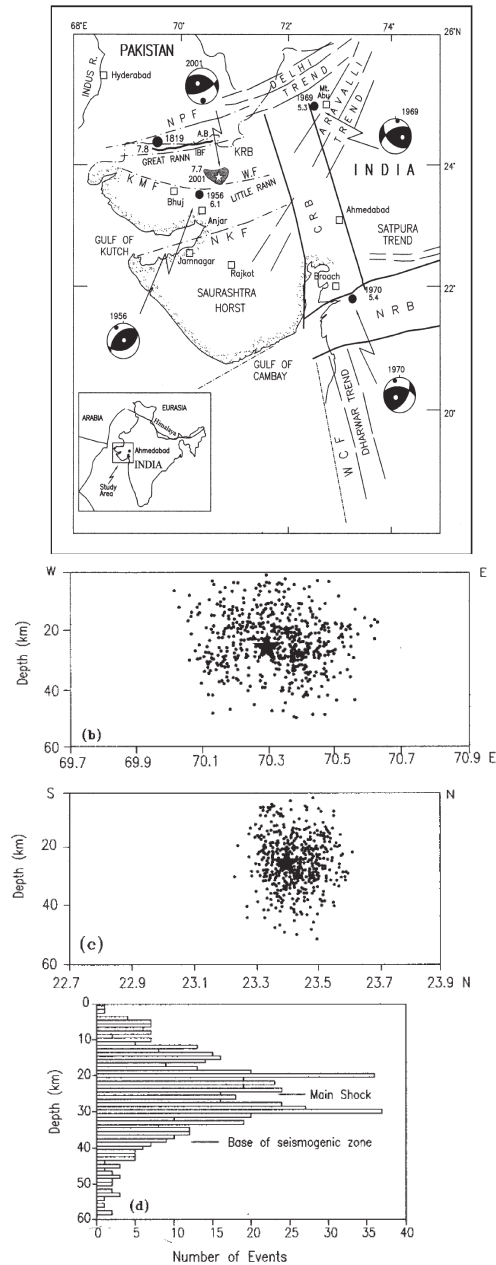


The Pendulum-clock worked like a seismoscope for the Bhuj Earthquake, January 26, 2001 at the Morbi Guest House

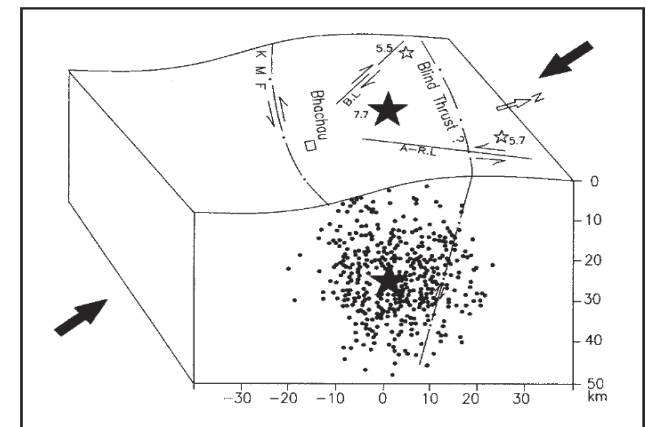
Seismic Hazards: 2001 Bhuj Earthquake



2001 Bhuj Earthquake Sequence



Kayal et al., 2002, JGS



Kayal et al., 2002, GRL

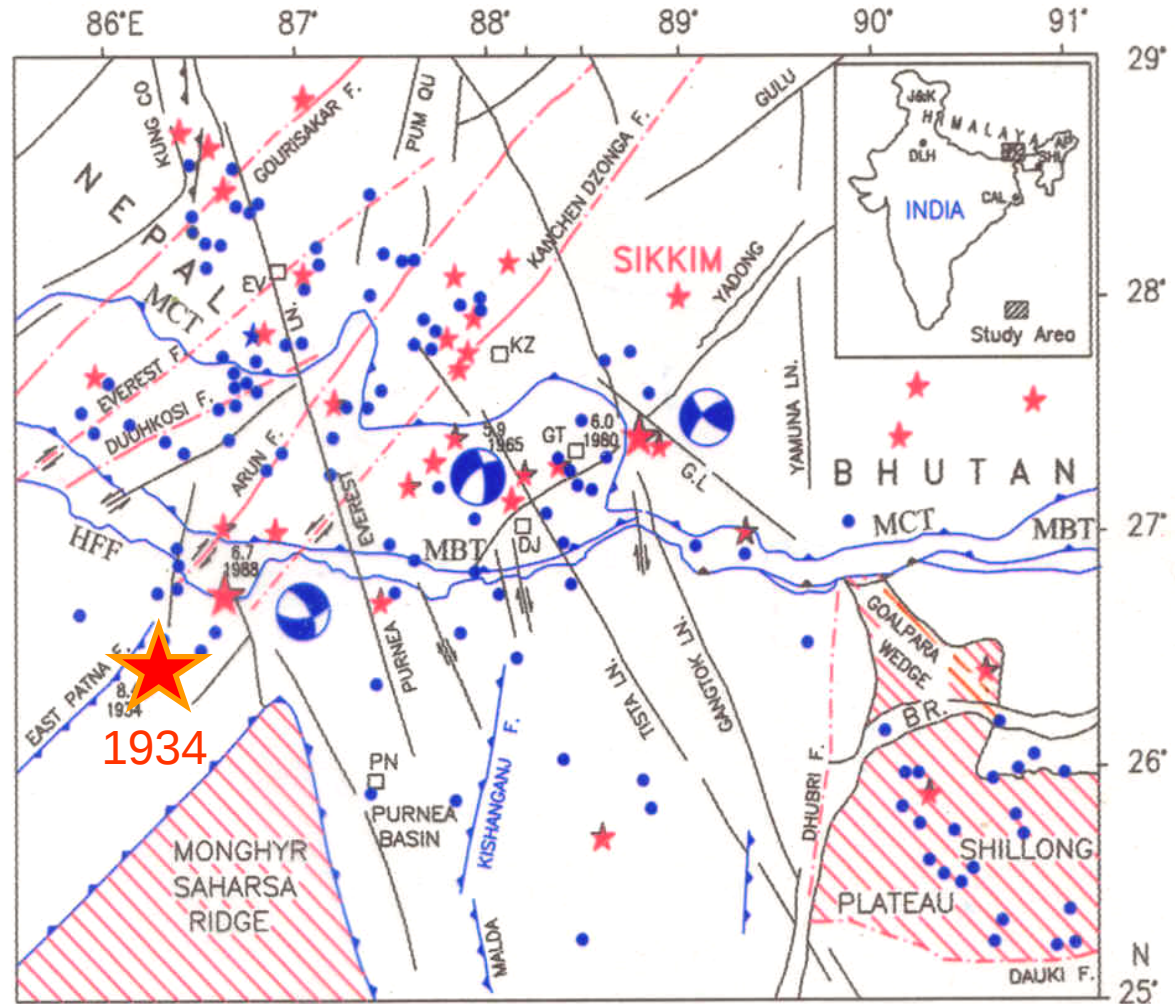
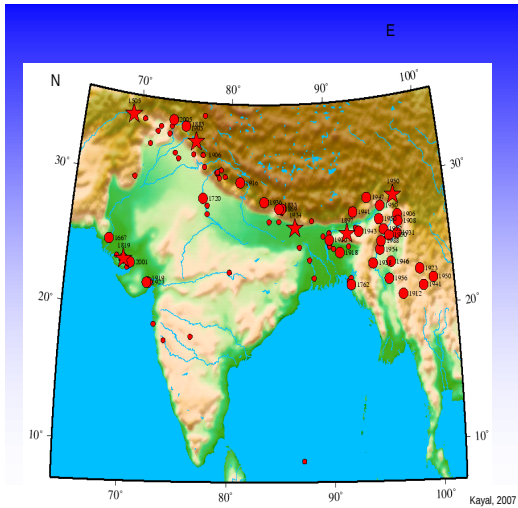


Fig.9. Seismotectonic map of the eastern Himalaya; several transverse faults/lineaments are mapped. Transverse tectonics is suggested for the 1934 great earthquake $M \sim 8.4$ as well as for the 1988 earthquake $M_s 6.6$ (GSI, 1993). The well estimated depth of the 1988 event is ~ 65 km (ERI), and the CMT solution shows strike slip motion. Two significant events $M \sim 6.0$ in the region also show strike slip motion ([Kayal, 2001, Tectonophys](#)).

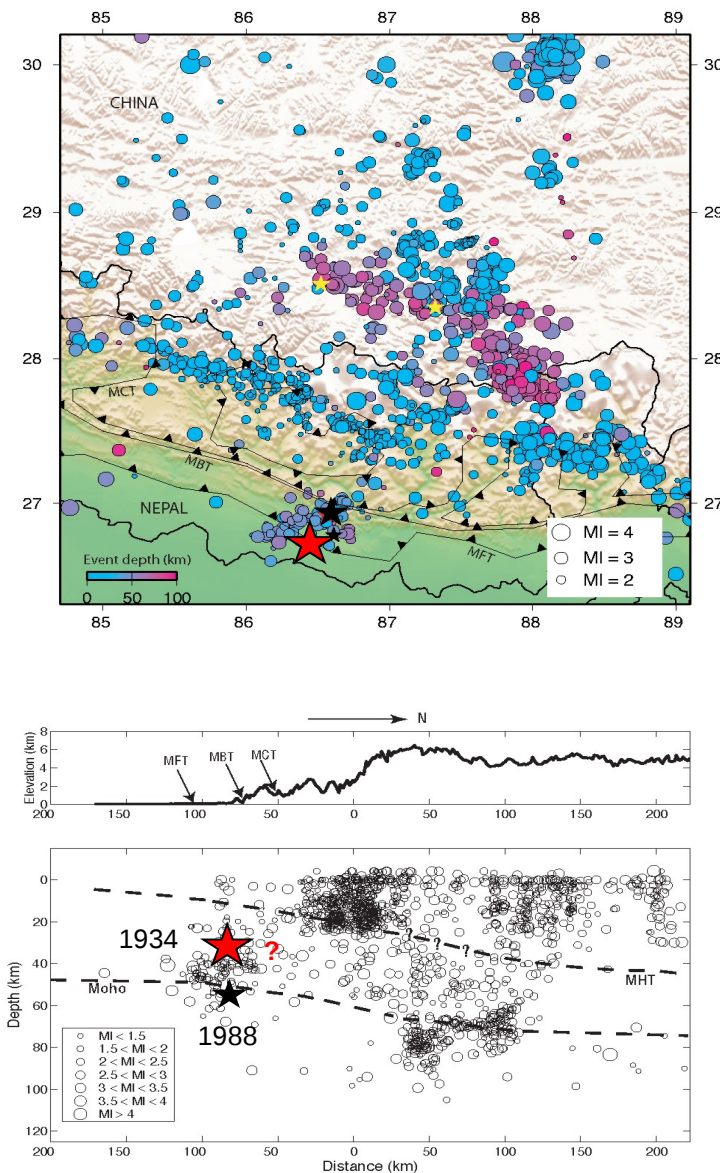
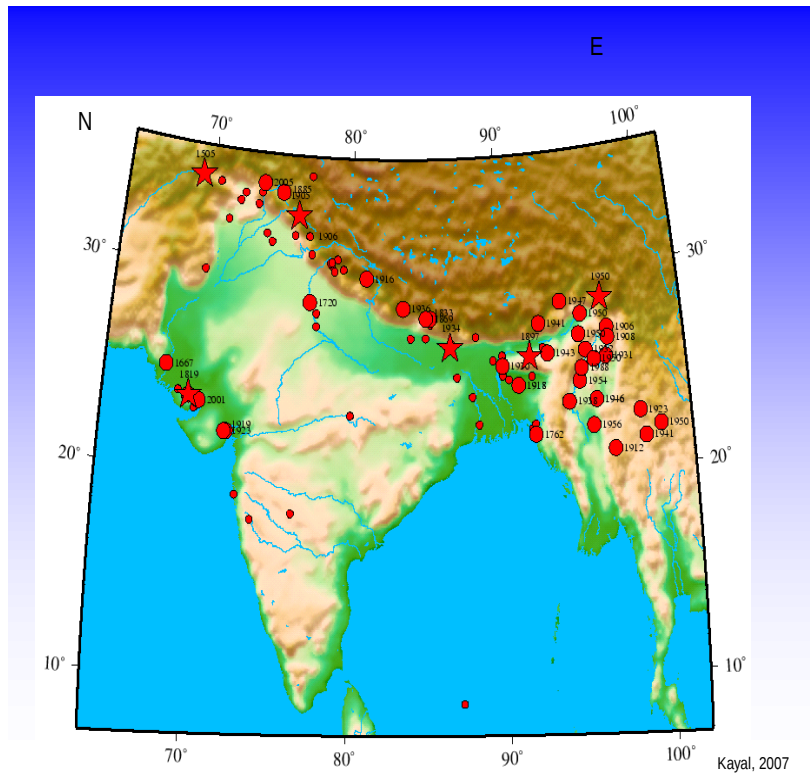
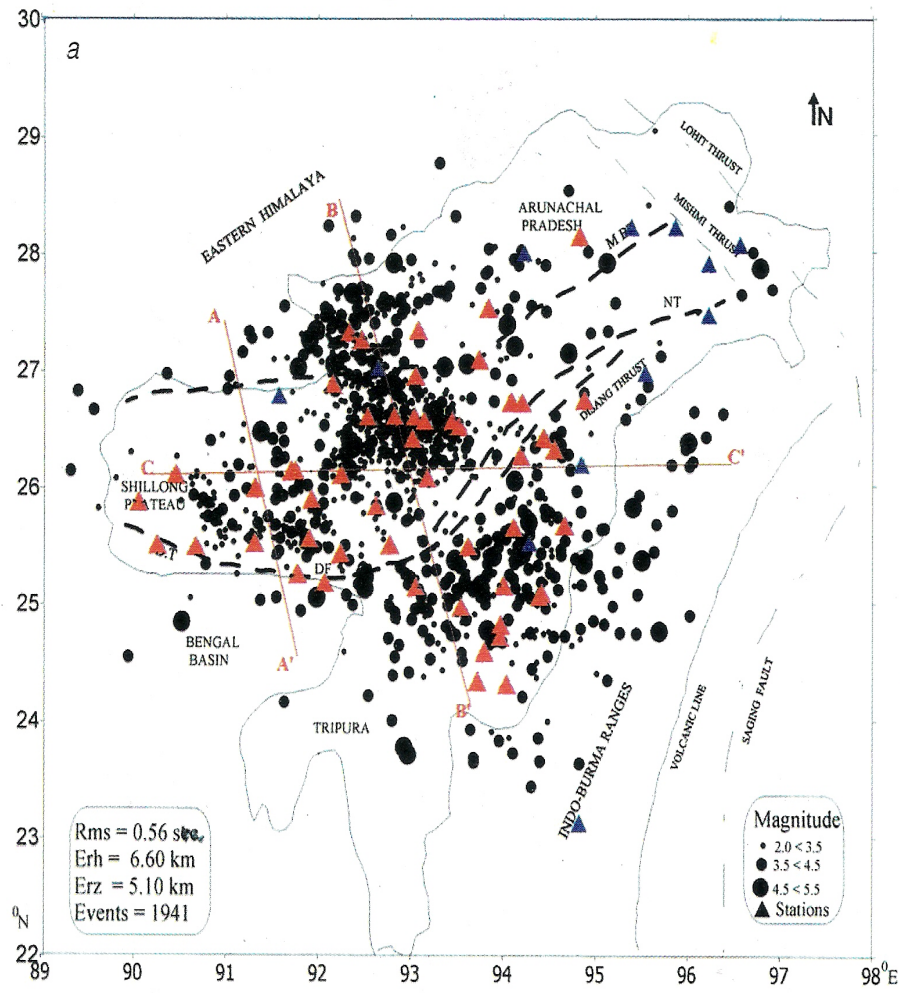


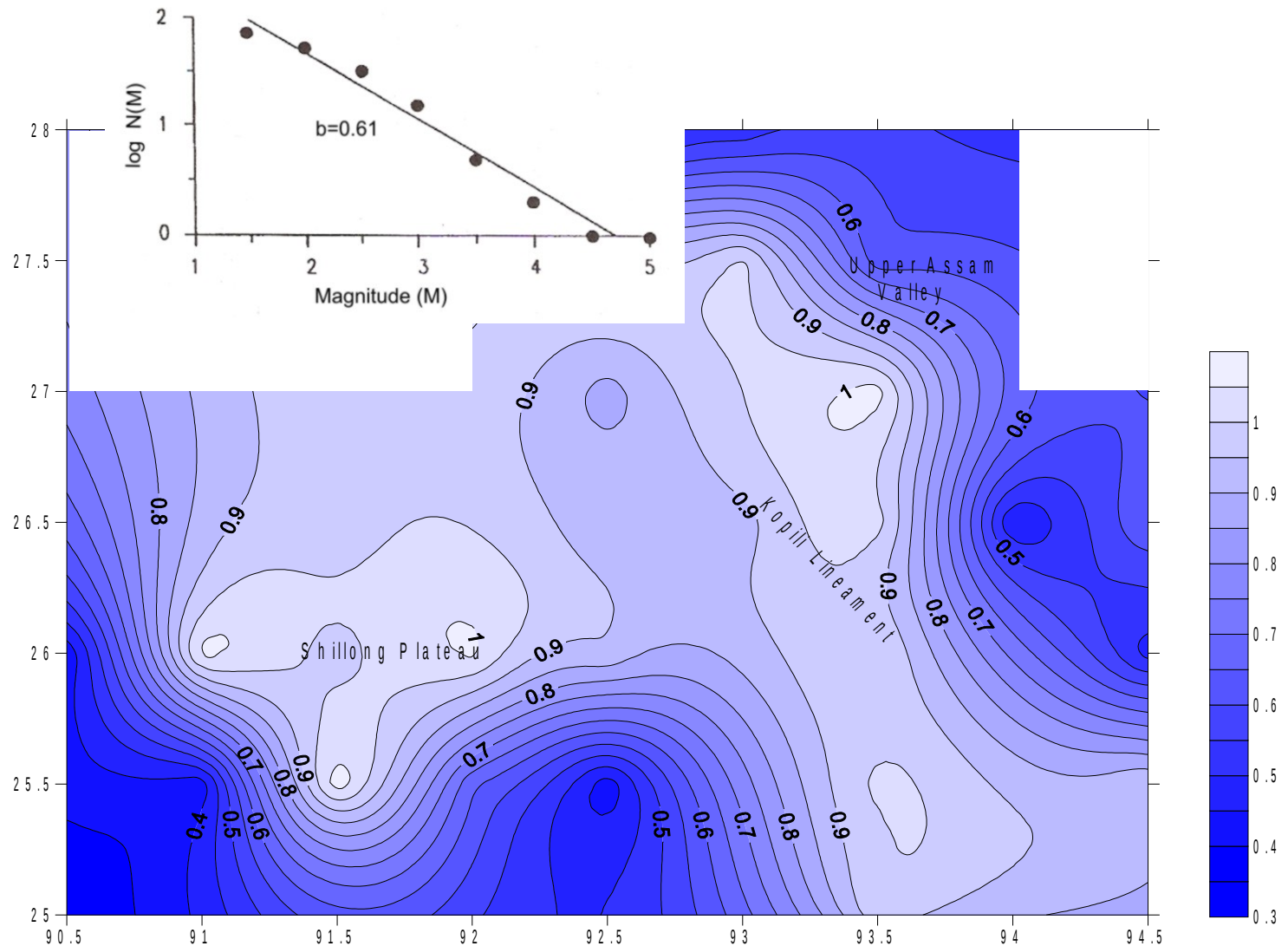
Fig.10. A bimodal seismicity is reported in the central Himalaya that indicates deeper seismic source in the Indian shield ([Monsalve et al., 2006](#), [JGR](#)). Depth of the 1988 earthquake (M_s 6.6) was well estimated at 65 km (ERI). The source zone of the 1934 great earthquake is estimated at ~ 40 km (GSI, 1993). It was also not a MHT shallow earthquake.

Microseismicity Map of NE India (1993-99)

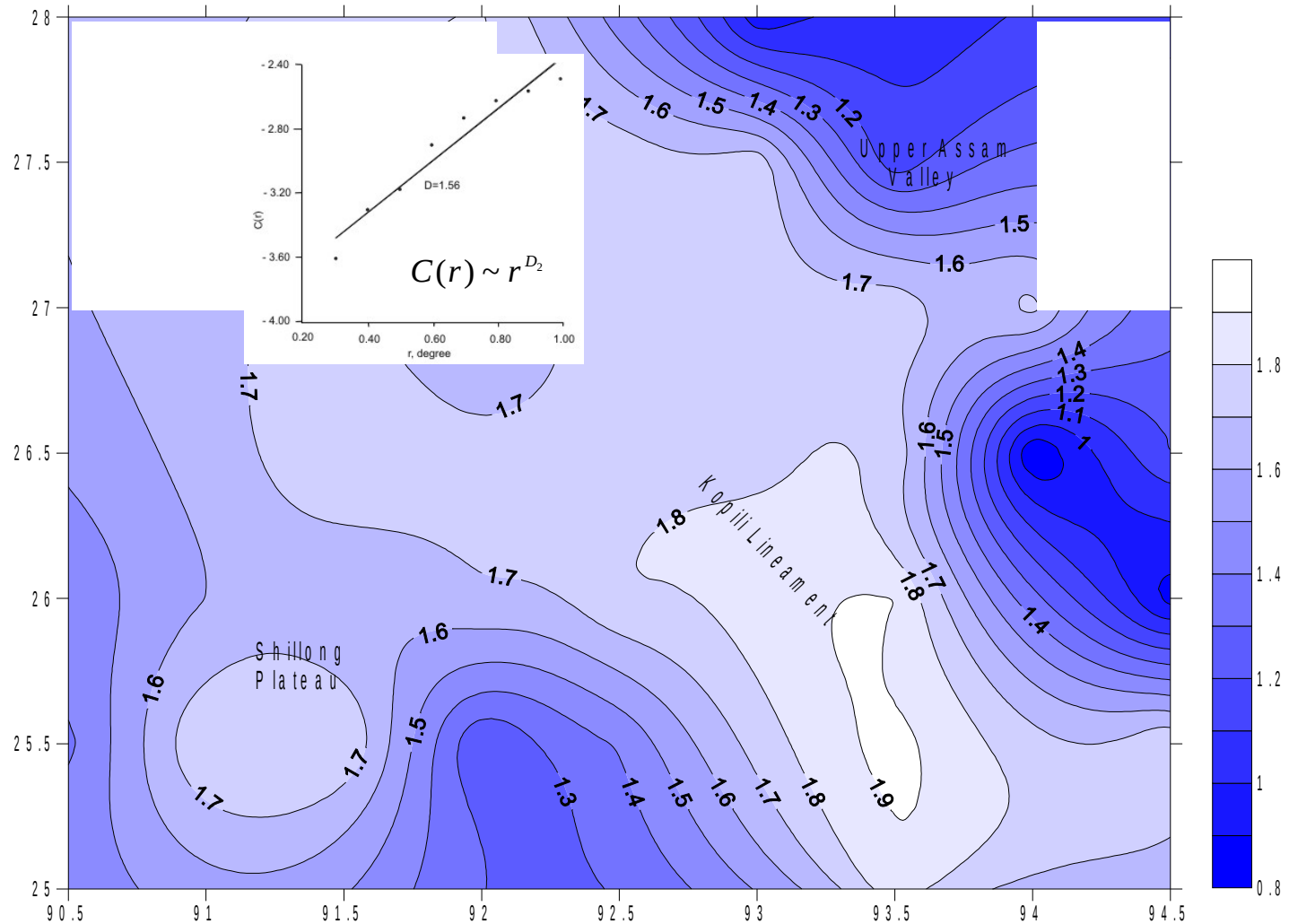


(Bhattacharya & Kayal, 2002, Curr Sci.)

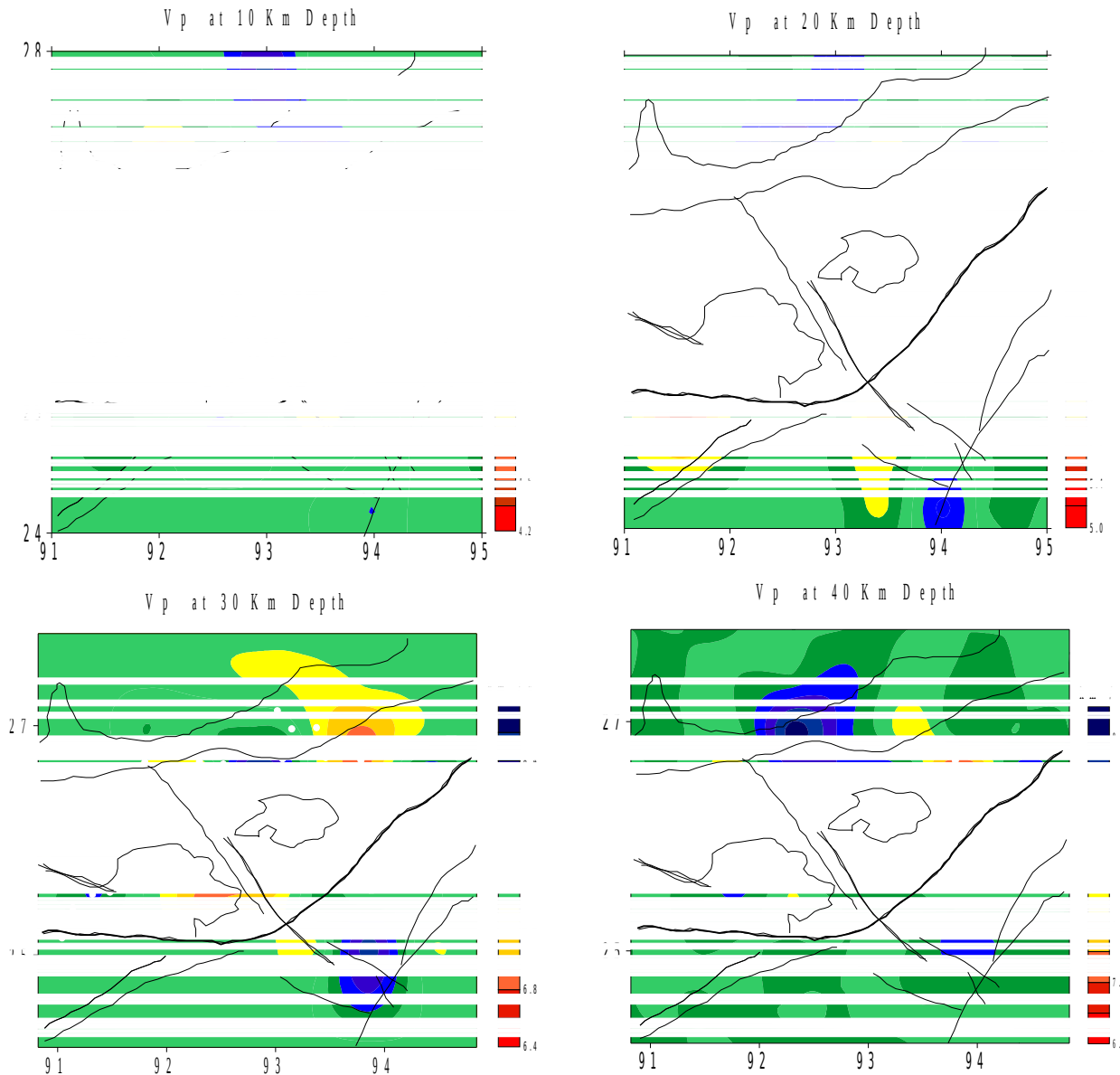
b-value Mapping in Shillong Plateau Region (1993-99)



Fractal Dimension Mapping in Shillong Plateau Region (1993-99)

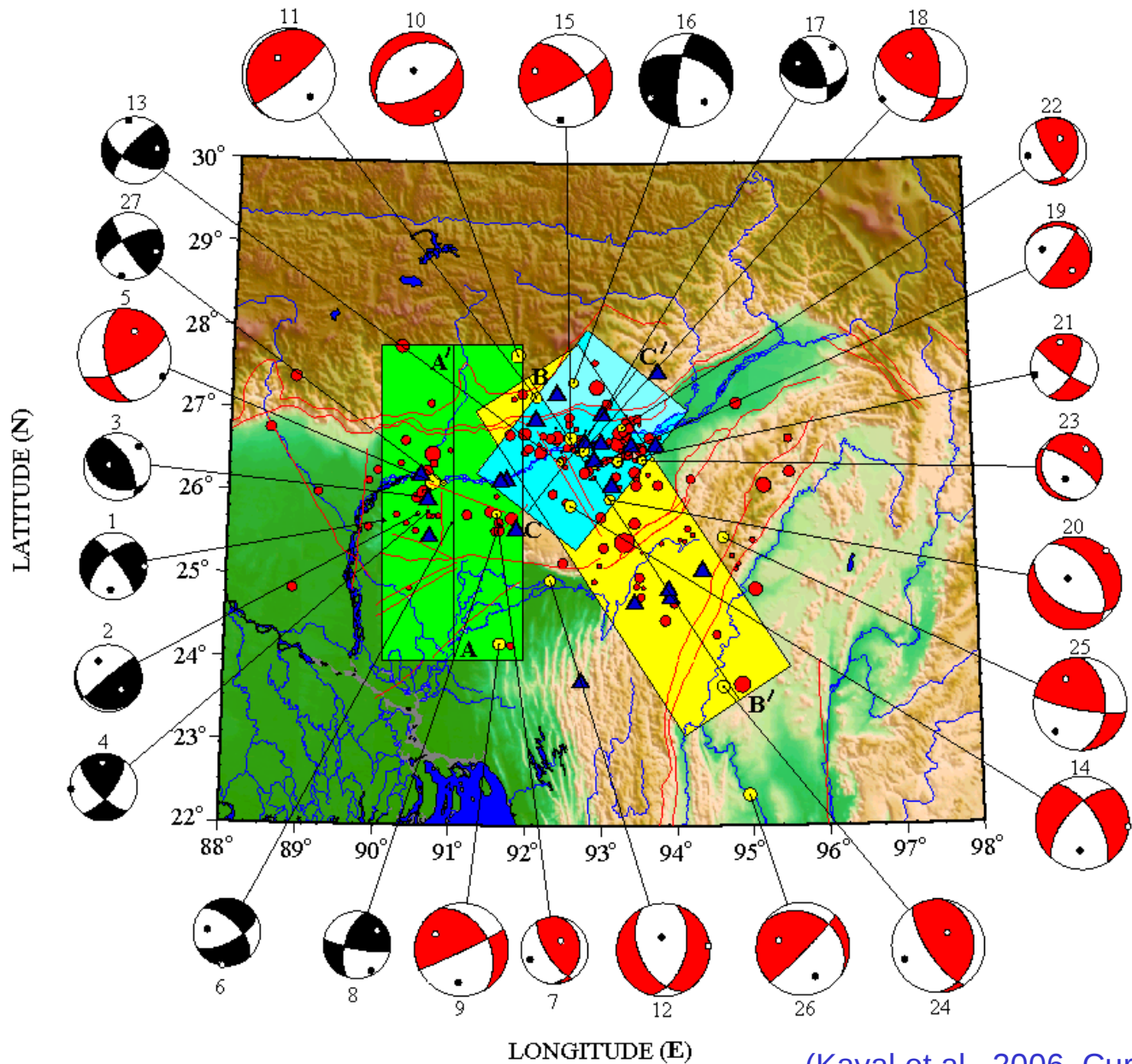


Seismic Images Beneath the Shillong Plateau (1993-99)

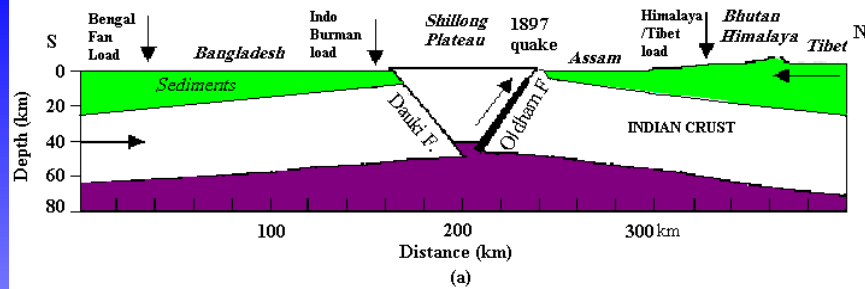


(Bhattacharya & Kayal et al., 2007, AJES)

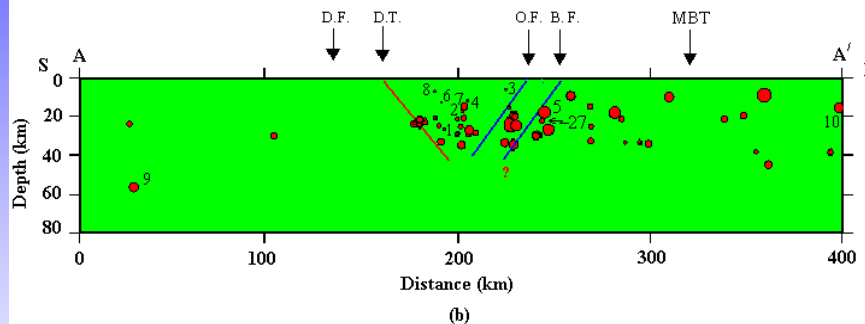
Fault Plane Solutions of the Plateau earthquakes



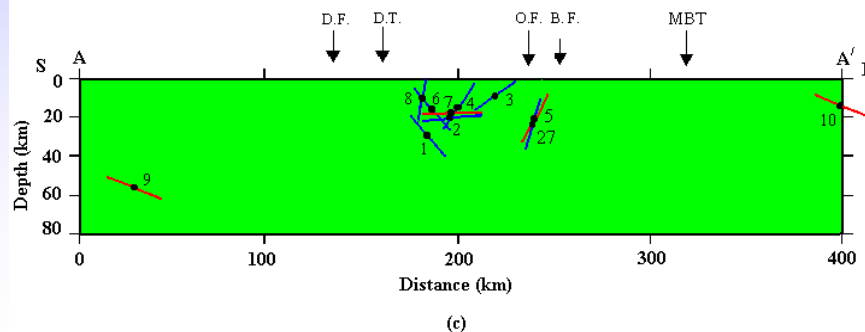
(Kayal et al., 2006, Curr Sci)



(a) Pop-up Tectonic Model
(Bilham & England, 2001, Nature)



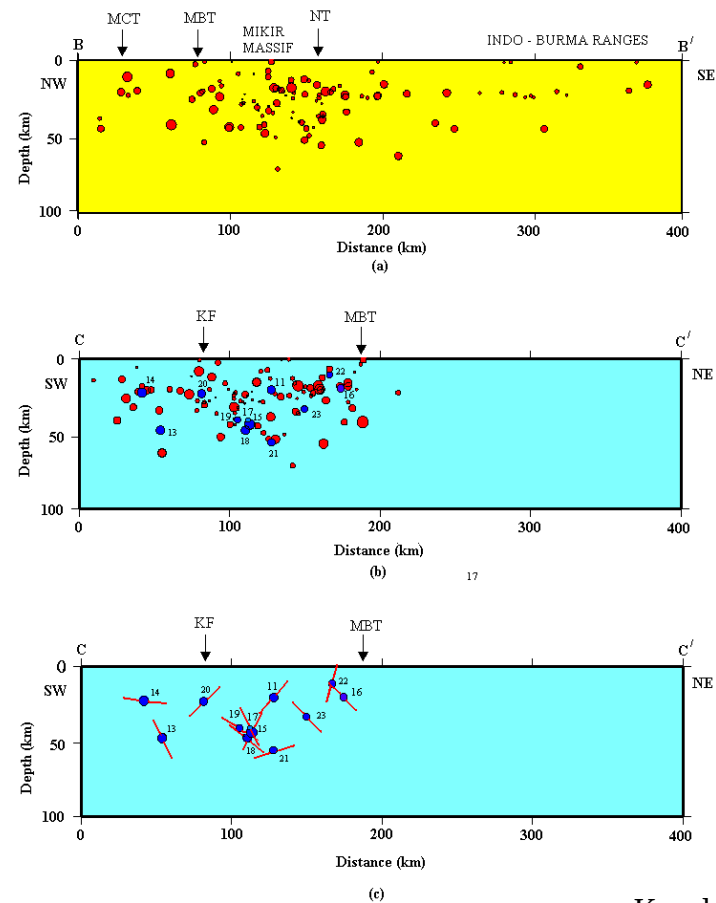
(b) Depth Section of the Earthquakes across the Shillong Plateau



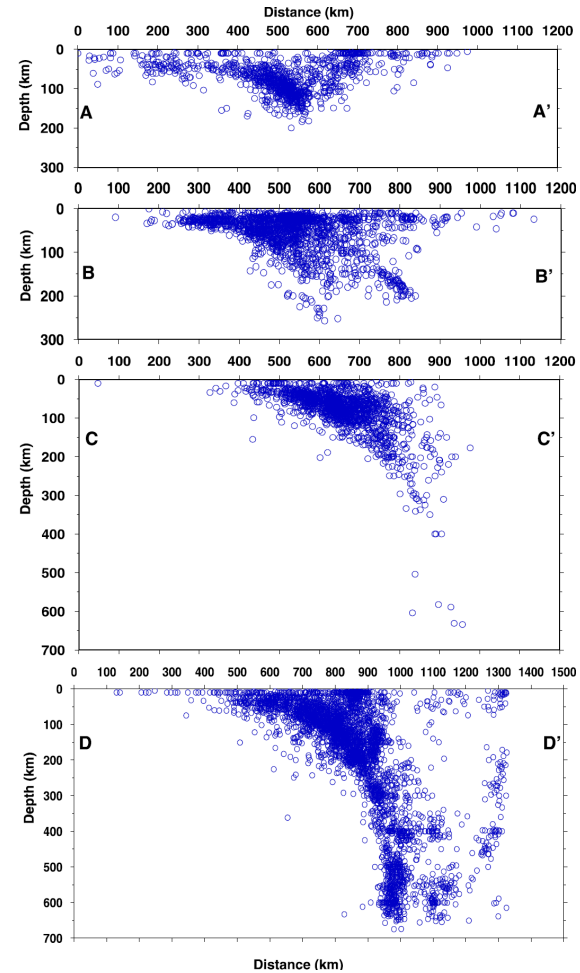
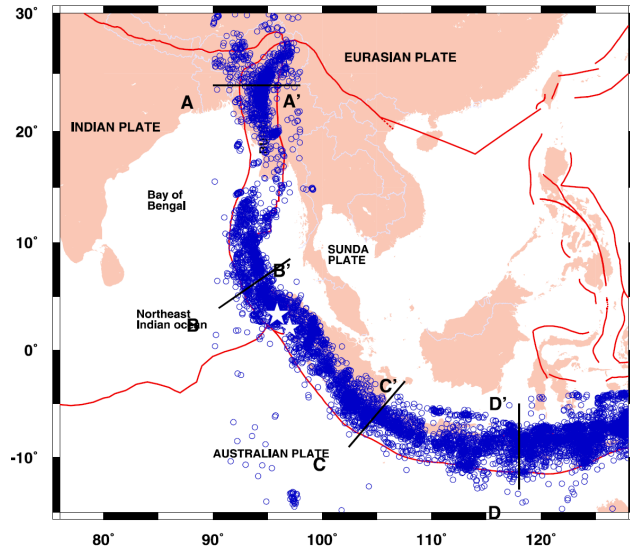
(c) Depth Section of the Fault Planes

(Kayal et al., 2006, Curr Sci)

Transverse Tectonics along the Kopili Fault

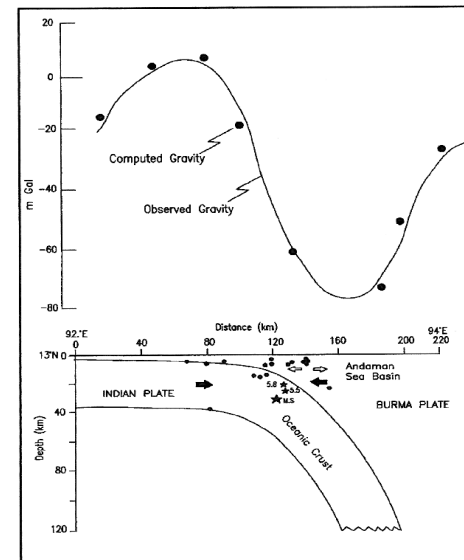
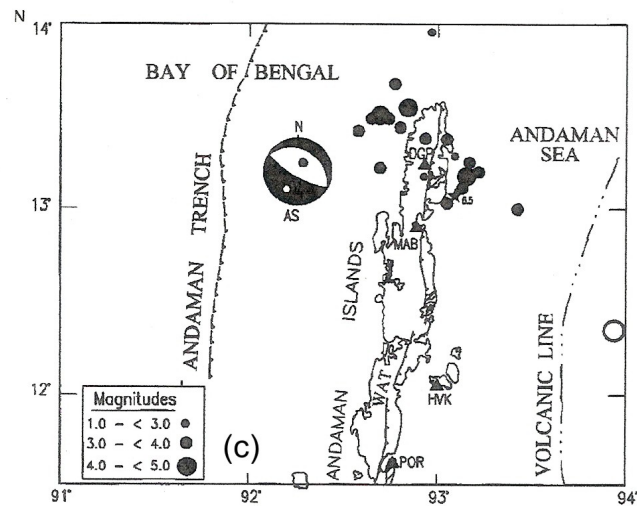
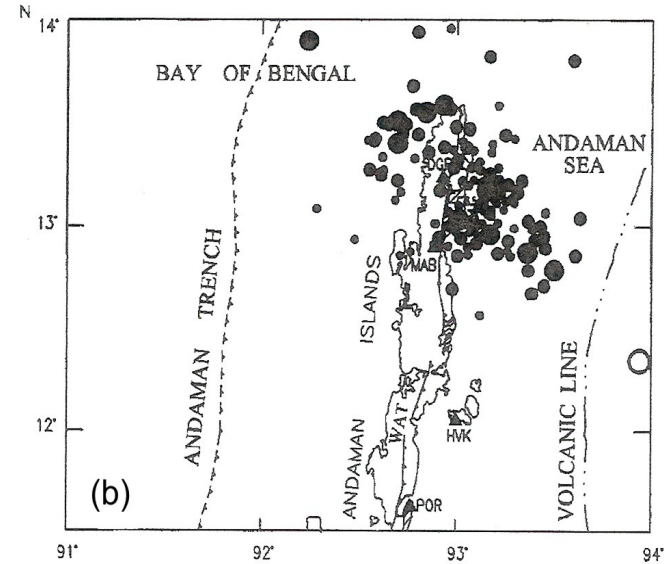
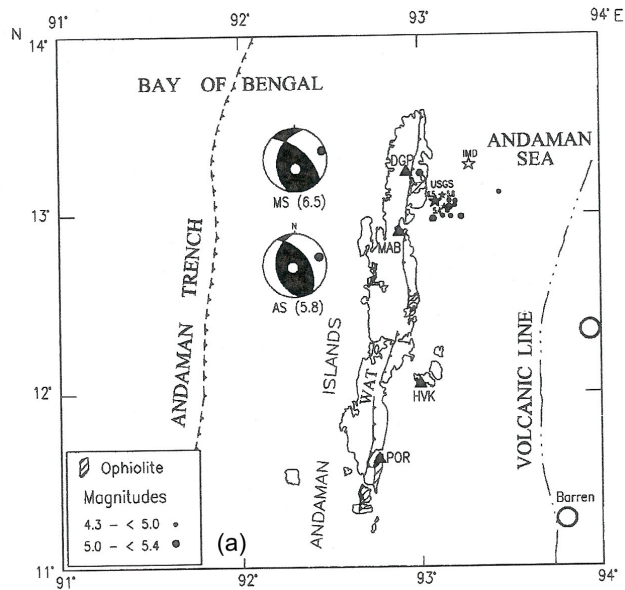


Seismicity along the Burma-Andaman-Sumatra-Java arc



Rao & Chary, 2005

Aftershock Sequence: Andaman Earthquake 2002, Ms 6.8



Tectonic Setting of the Andaman-Sumatra Region

Historic Large / Great Earthquakes

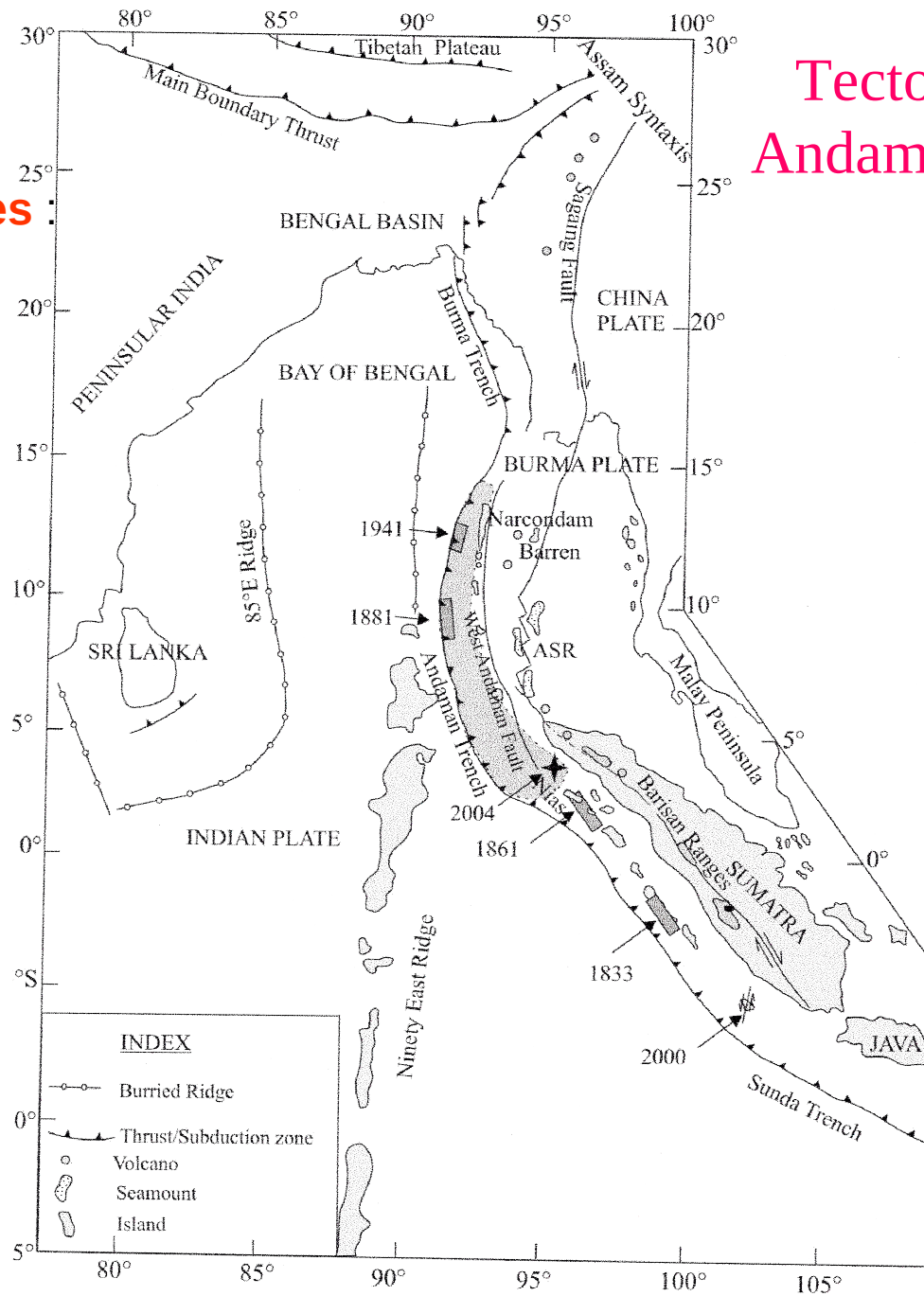
SUMATRA

1833 (M ~ 8.5)
1861 (M ~ 8.5)
2000 (Mw 7.2)

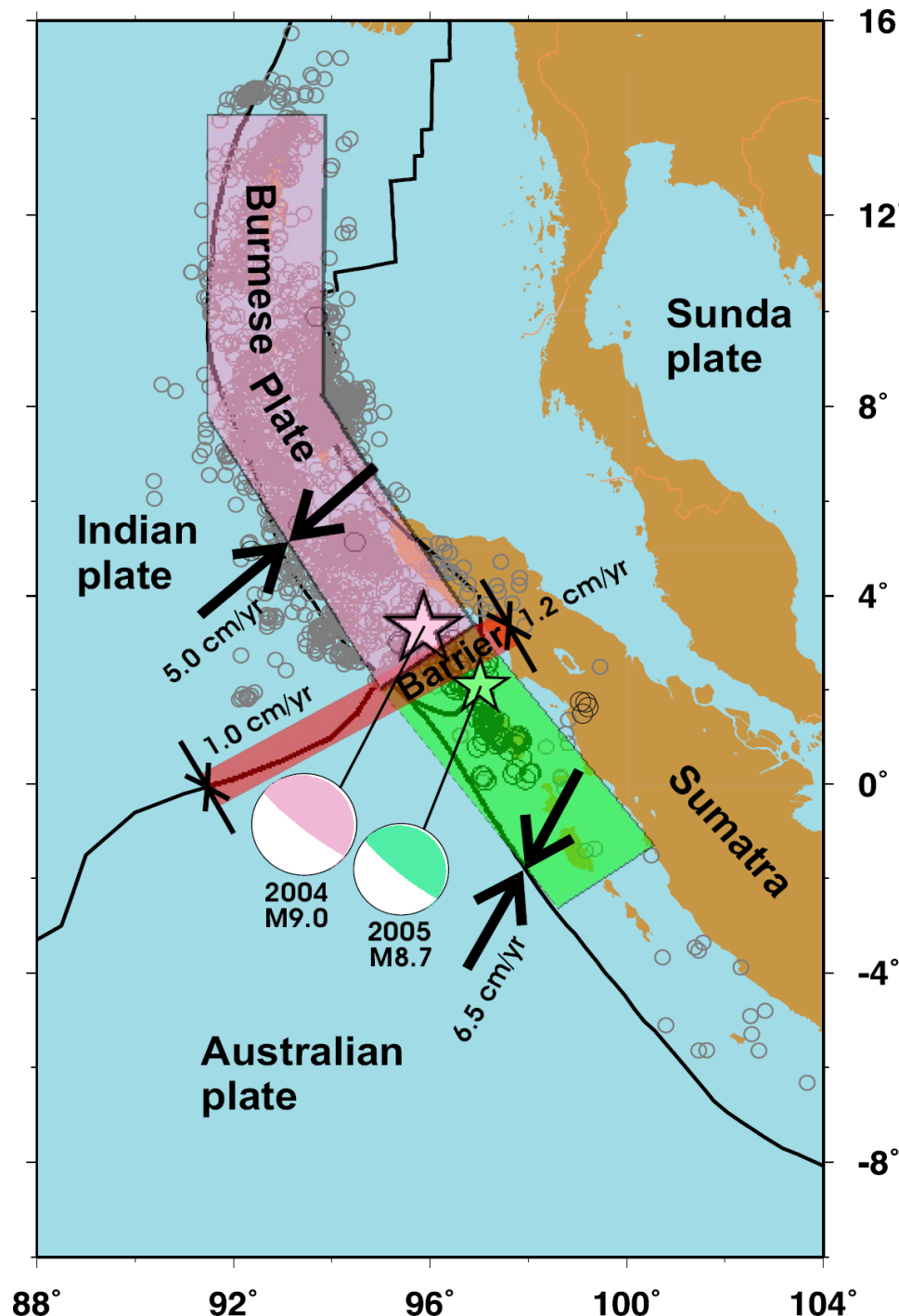
ANDAMAN

1881 (M ~ 7.9)
1941 (M ~ 7.9)

Rupture areas of the Large Earthquakes are shown.



2004 (M 9.3) and 2005 (M 8.7) Sumatra Earthquakes



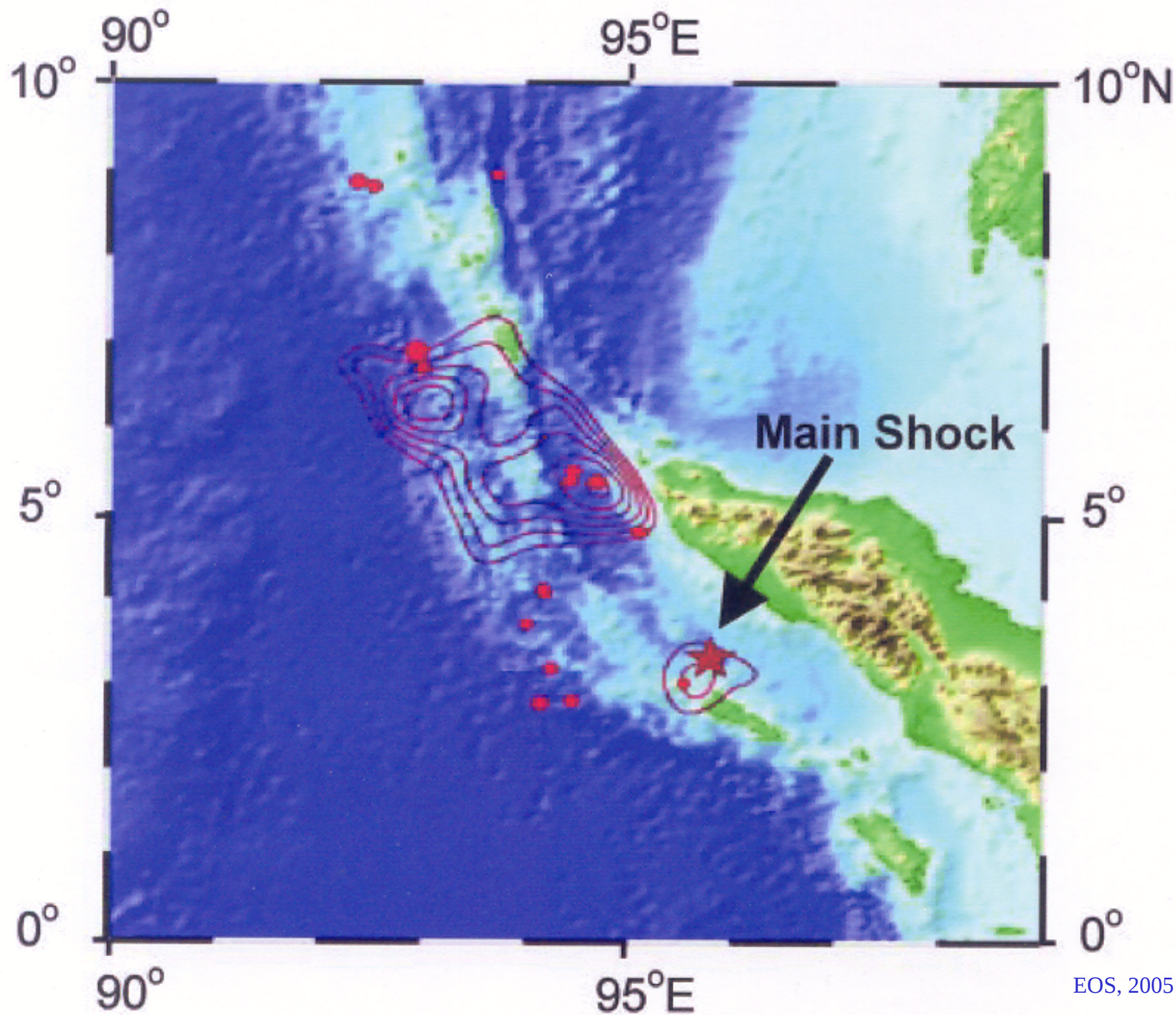
A Barrier that separates

b) Distinct plate pairs

c) Distinct zones of stress build-up

d) Distinct styles of subduction

e) Distinct velocities of subduction



Damages in Andaman – Nicobar Islands: 2004 Sumatra Tsunami Earthquake



Total damage of the Airbase: Car Nicobar Island



Damage of the Jetty : Middle Andaman Island



Mud Volcano, Baratang



Split tree trunk, Baratang, N Andaman



Damage in Little Andaman

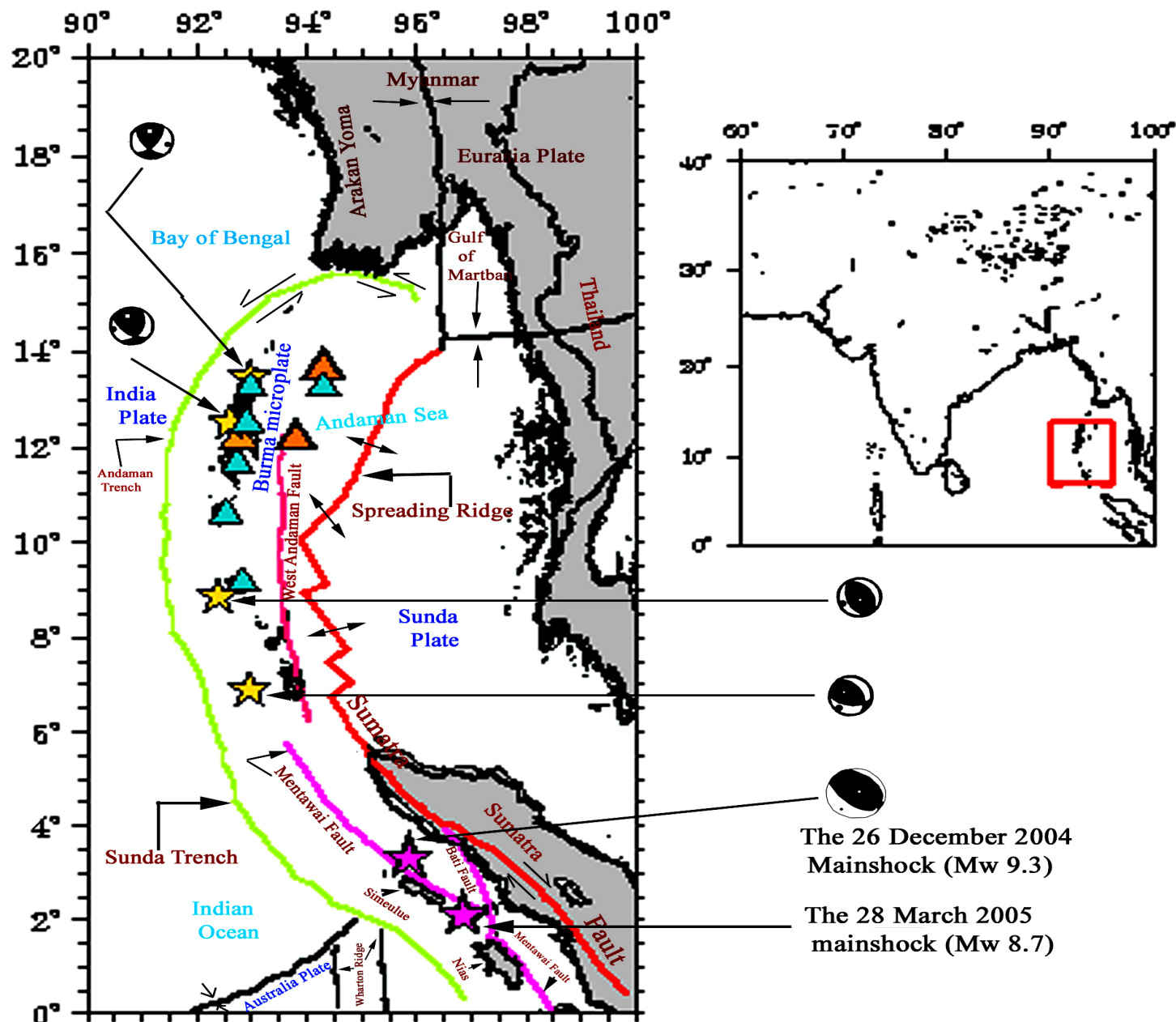


Liquefaction at Port Blair



Aston bridge at
Mayabundar
Andamans

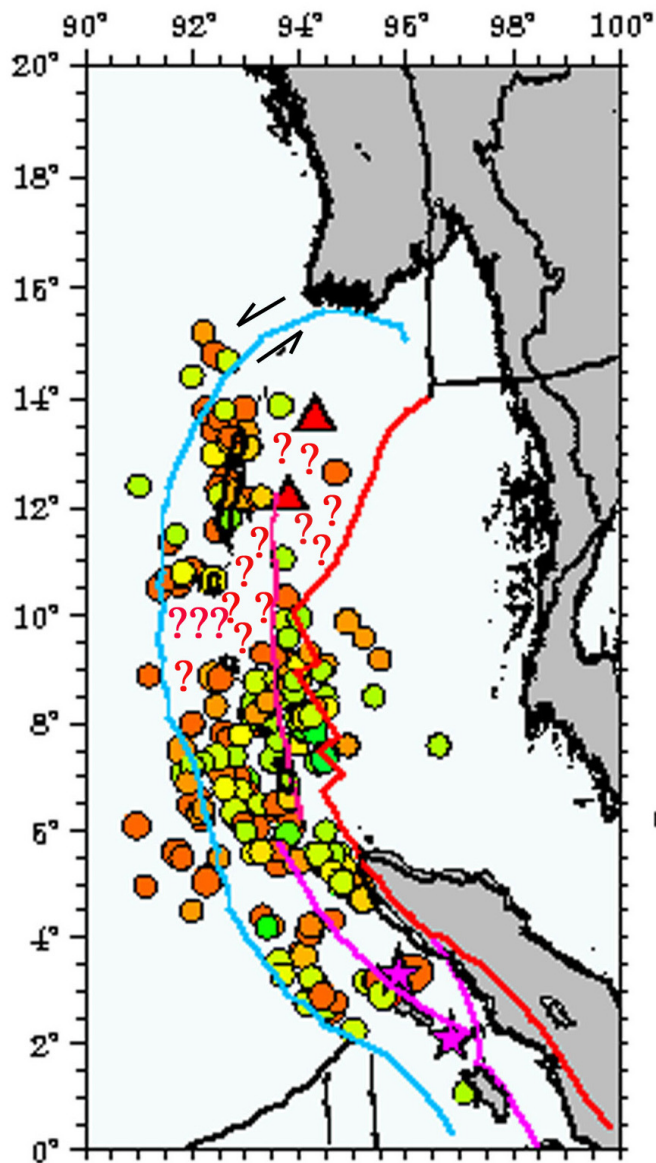
NGRI
12/01/2005



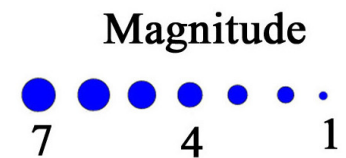
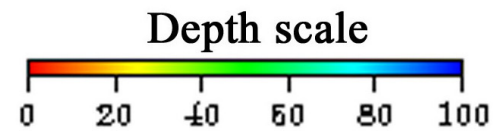
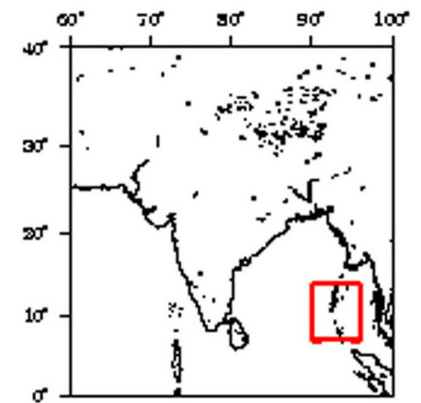
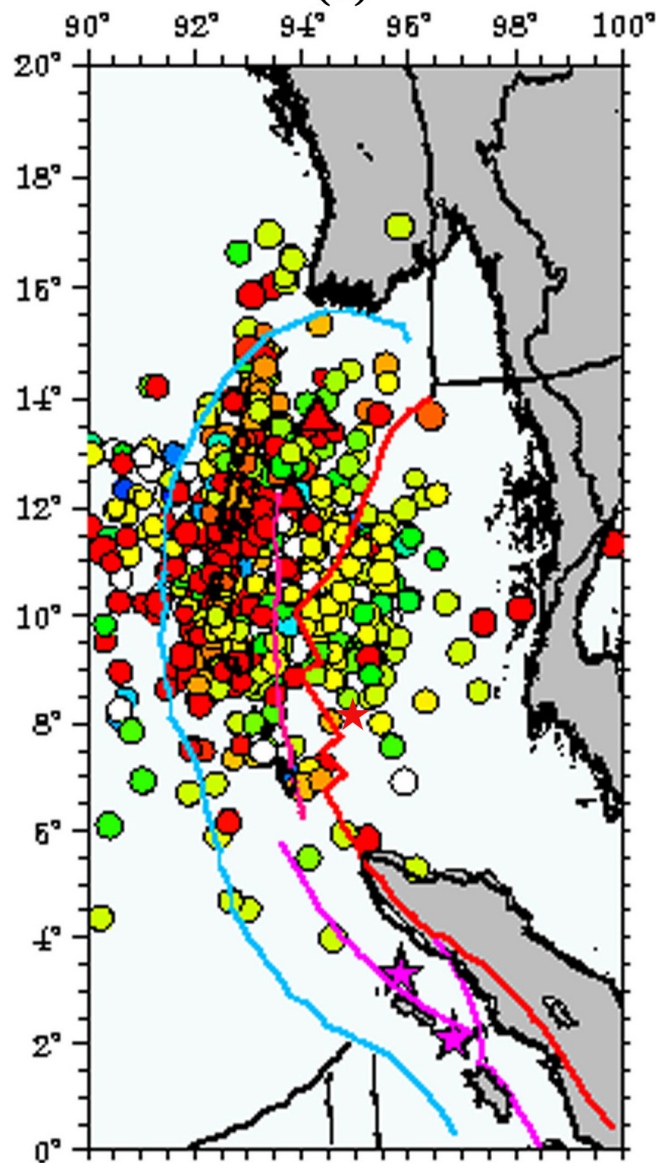
GSI Temporary Network for Aftershock Investigation

Mishra & Kayal et al., 2007, BSSA

(a)



(b)

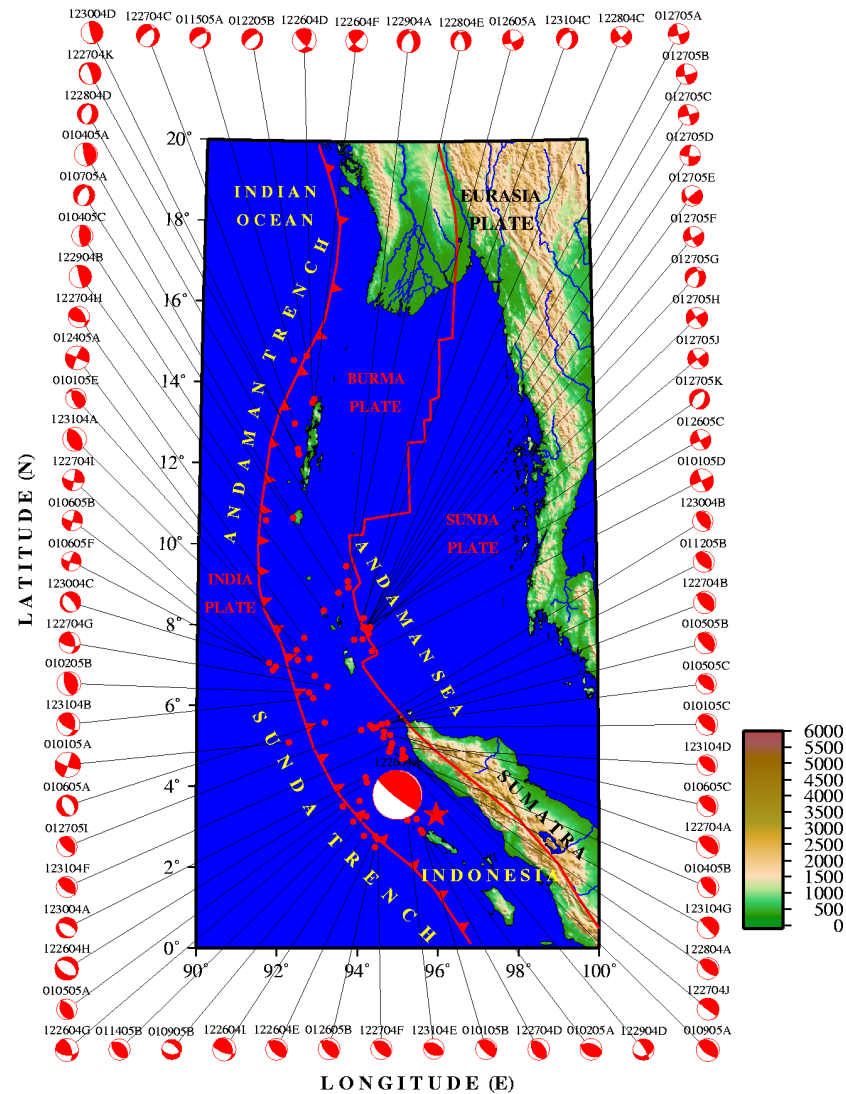


(a) Aftershocks located by Global Network (USGS)

(b) Aftershocks Located by GSI Network

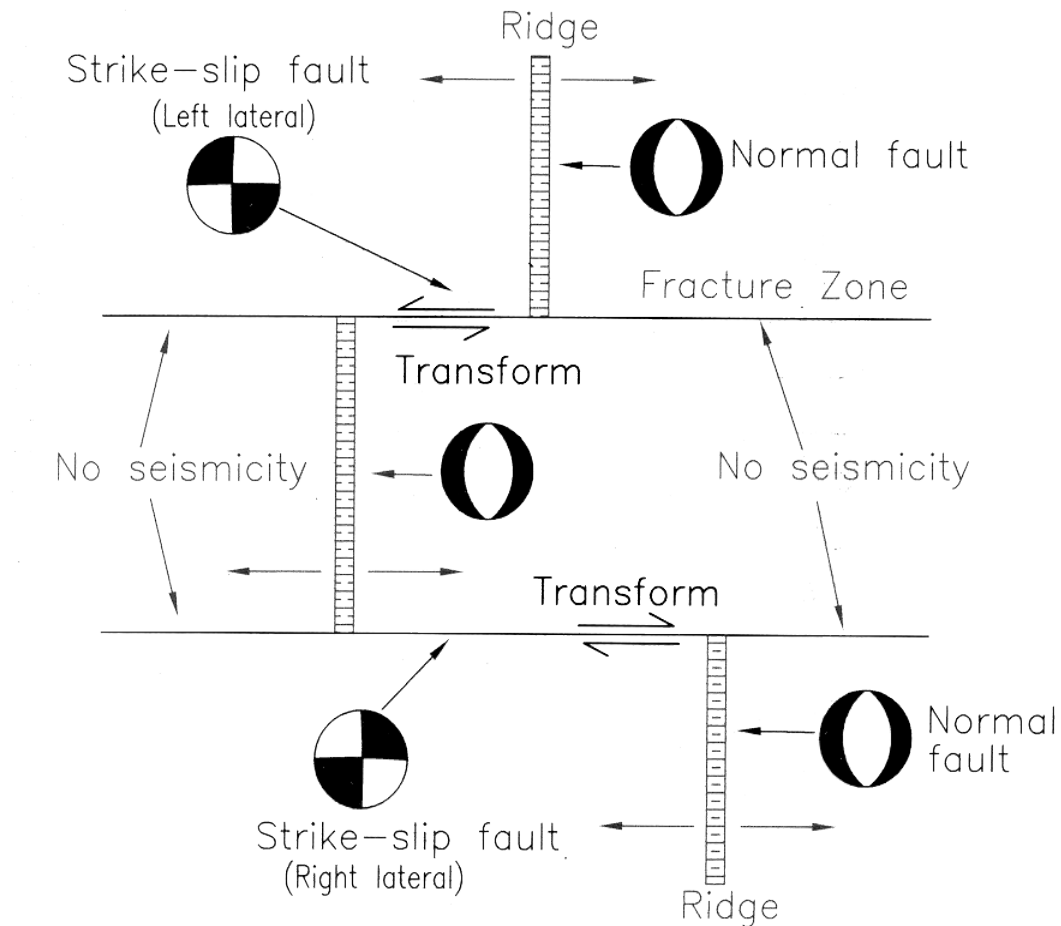
Mishra, and Kayal et al., 2007, BSSA

Larger Aftershocks of the 2004 Sumatra Earthquake

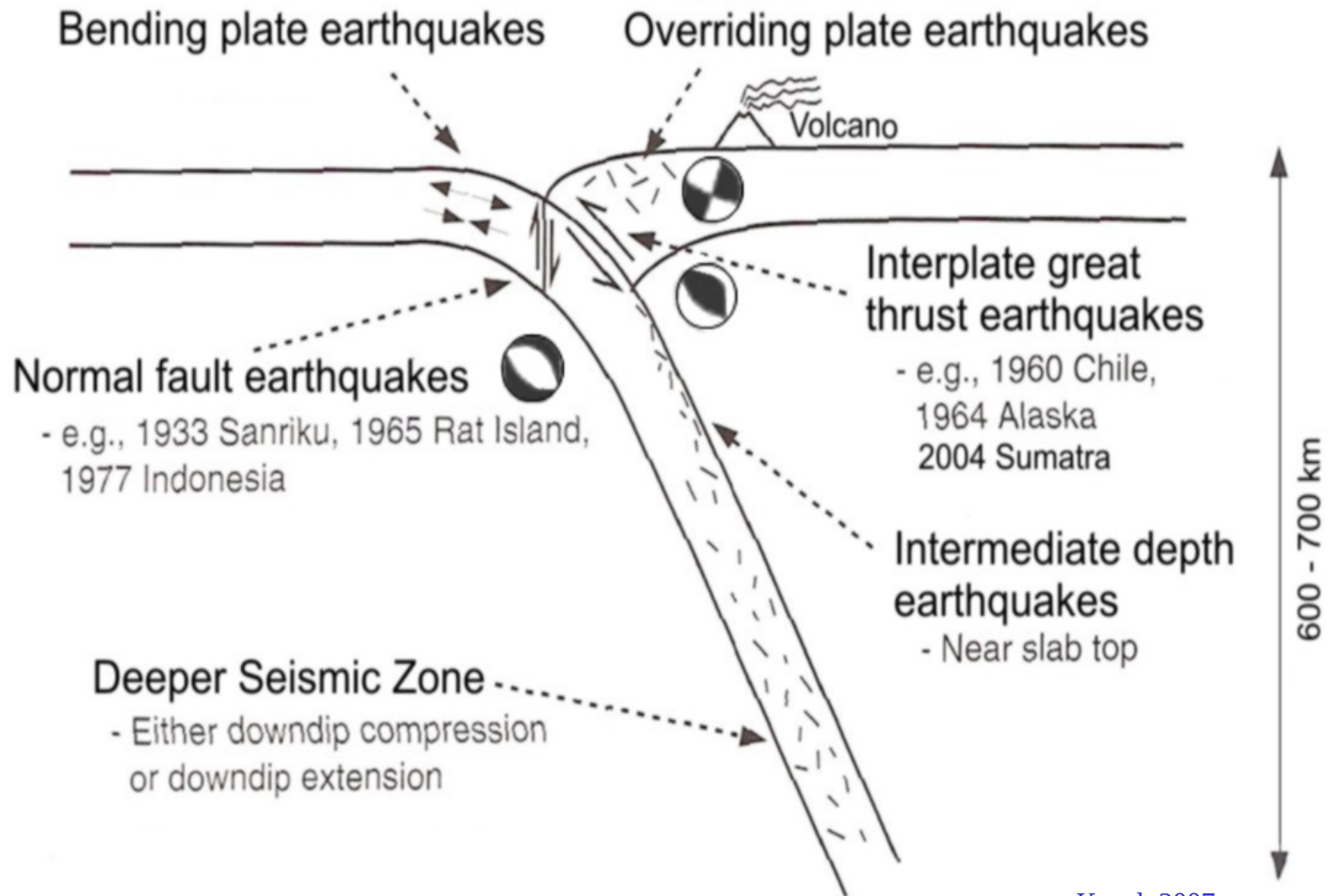


Kayal, 2007, IGRA

Earthquake Mechanisms at Oceanic Spreading Centre



Earthquake Mechanisms at Subduction Zone





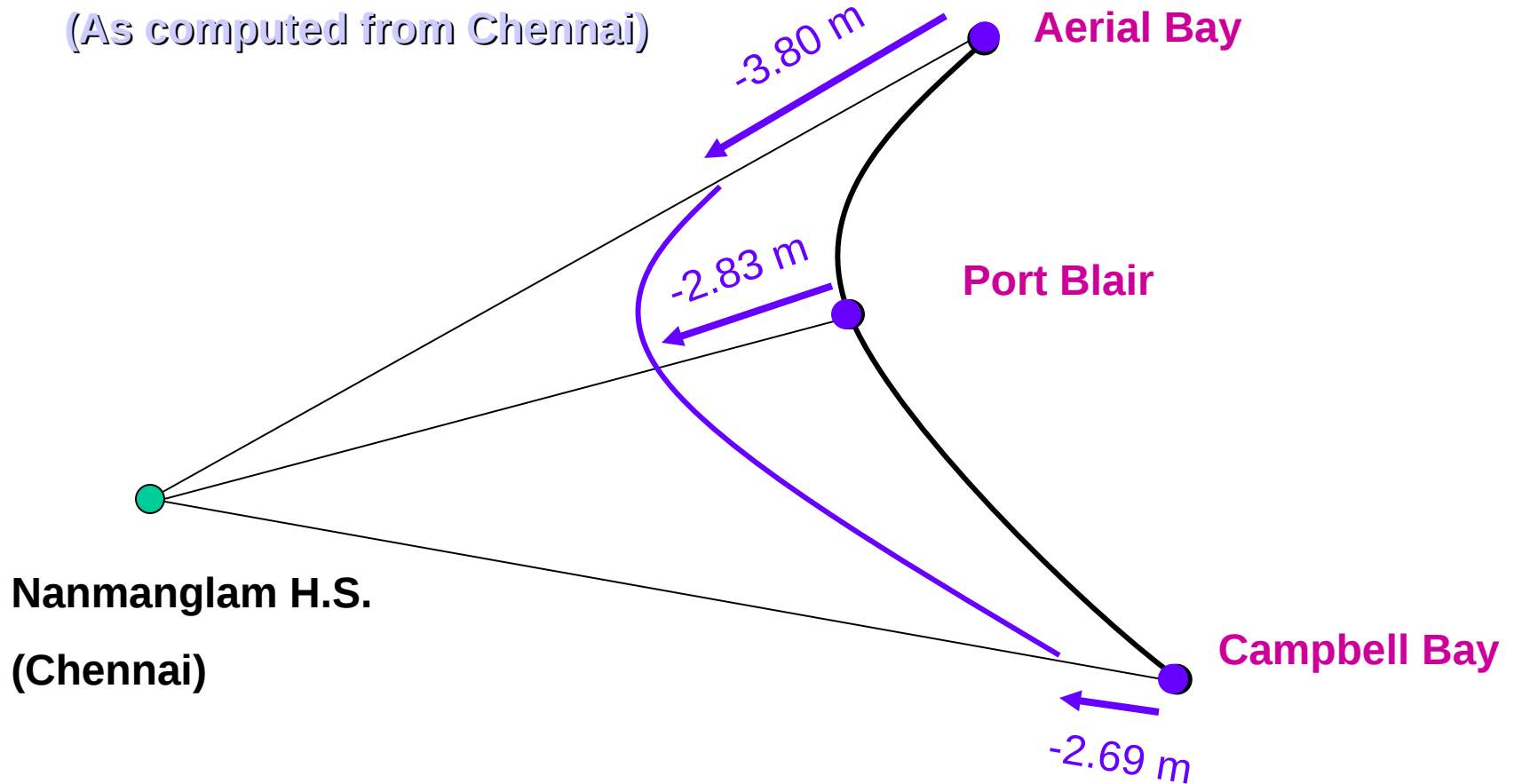
Horizontal movement (SOI, 2006)



Changes in height (SOI, 2006)

Shift in Position

(As computed from Chennai)

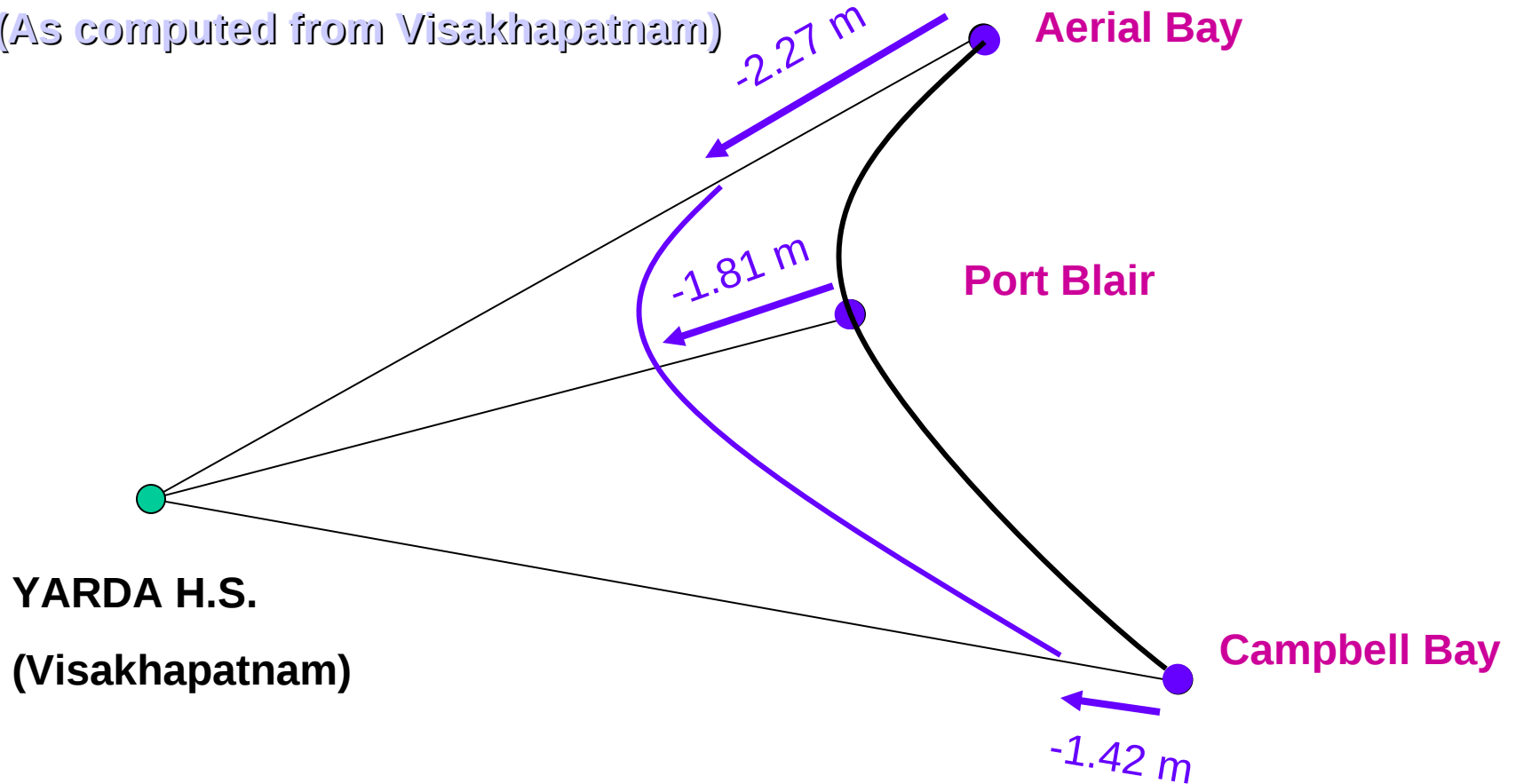


● Pre Tsunami observations (Feb. – April 2004)

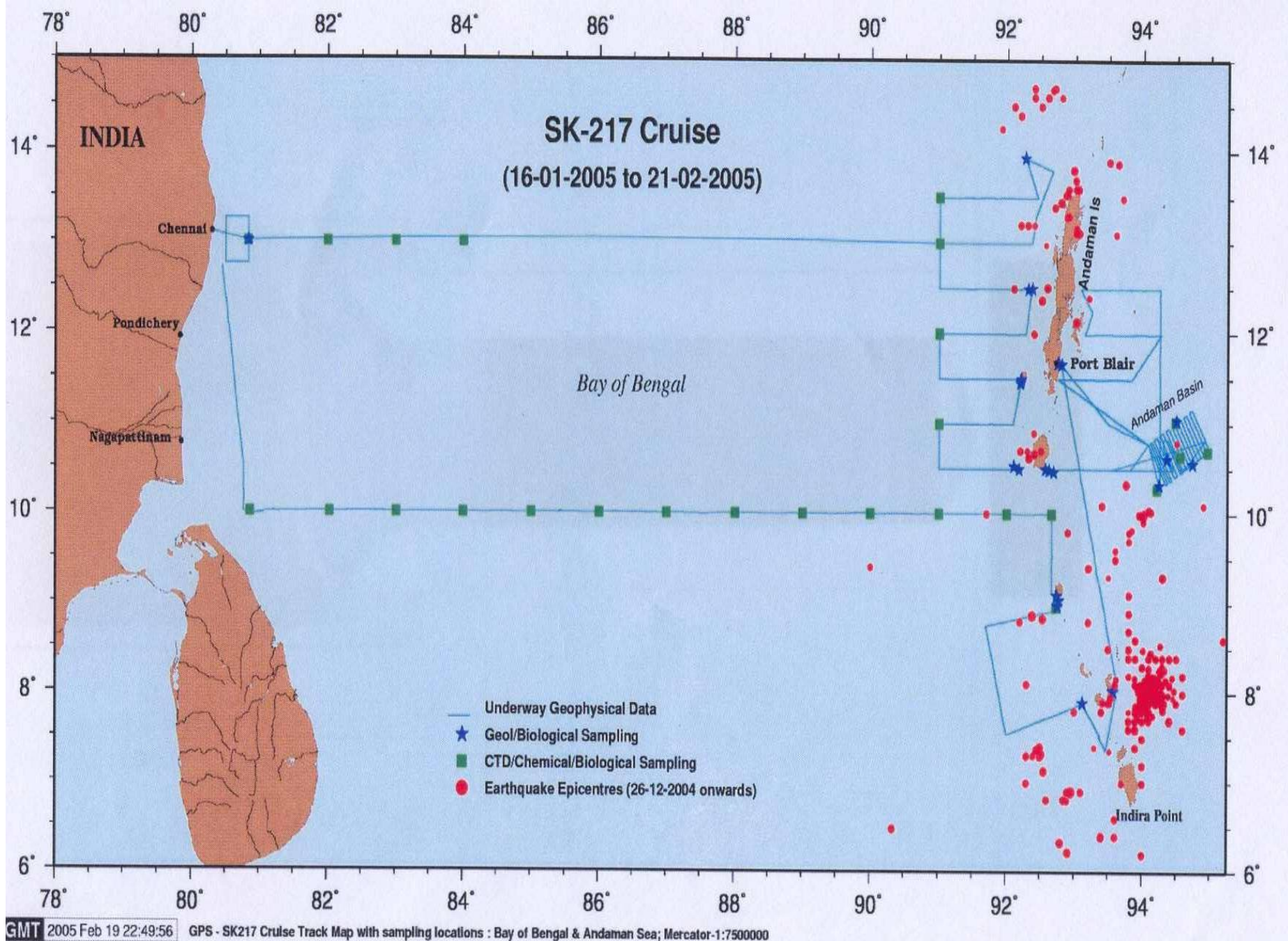
● Post Tsunami observations (Jan. 2005)

Shift in Position

(As computed from Visakhapatnam)



- Pre Tsunami observations (Feb. – April 2004)
- Post Tsunami observations (Jan. 2005)



Cruise track map along with different sample locations

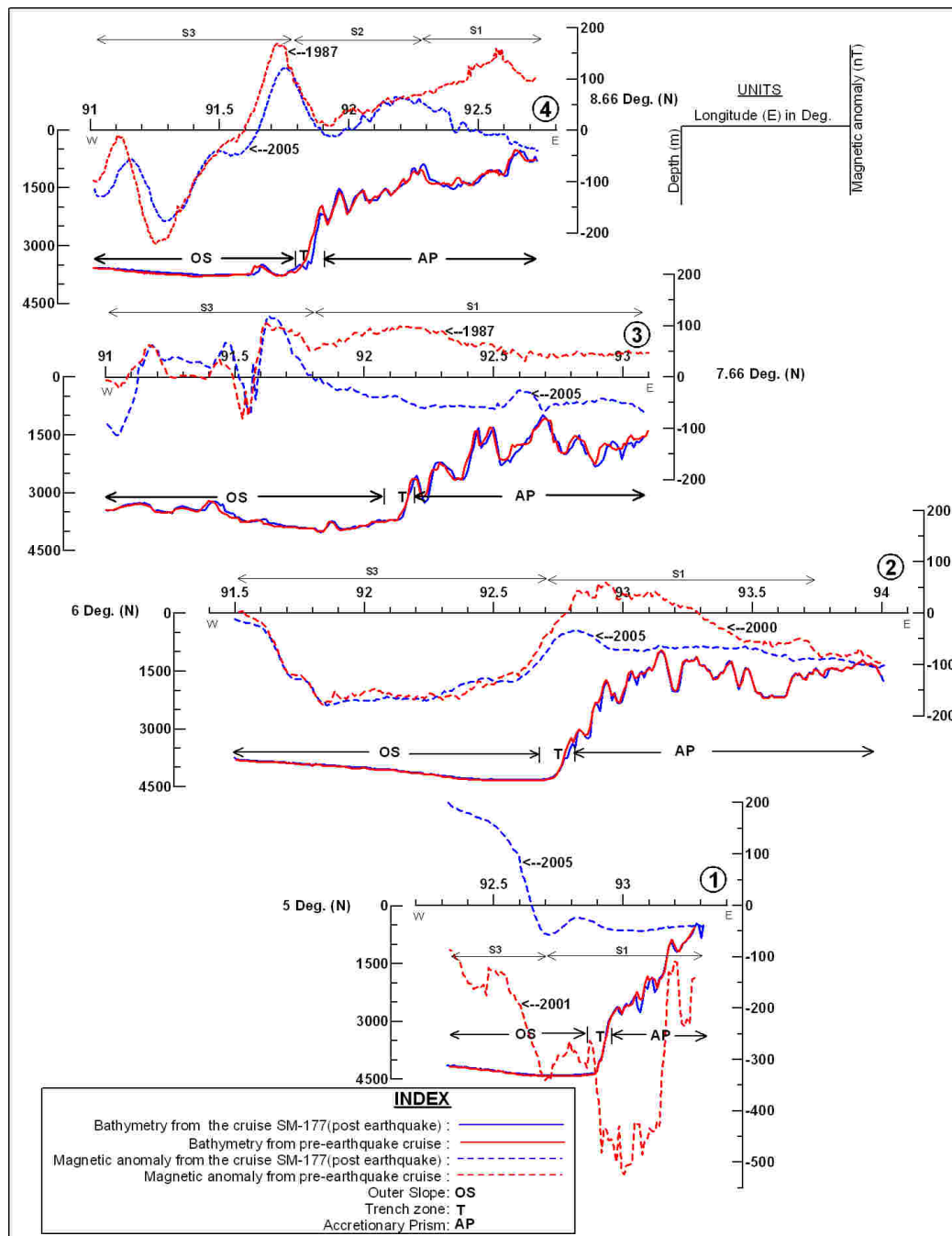


Figure 2. Comparative bathymetry and magnetic anomaly profiles along the transects 1 to 4 recorded during the cruise SM-177 (2005) and the old cruise(s) with year(s) across the Sunda subduction complex.

A photograph of a tropical landscape. In the foreground, there is a body of water, likely a mangrove lagoon, with several palm trees and other vegetation growing in it. The water is a deep blue-green color. In the background, there is a dense forest of palm trees and other tropical plants. The sky is a pale blue with some light clouds. The overall scene is a serene tropical environment.

Thank you !

Port Blair, Andaman