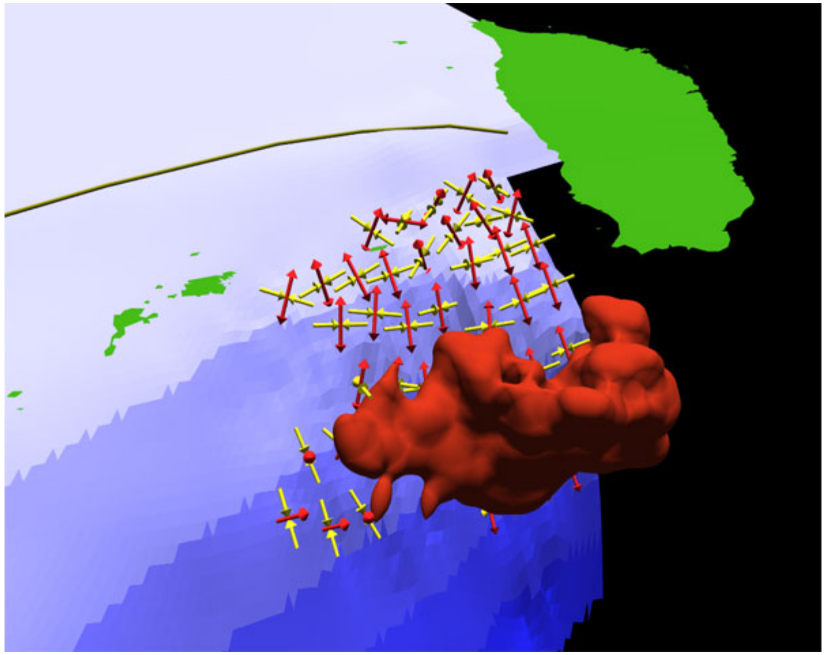
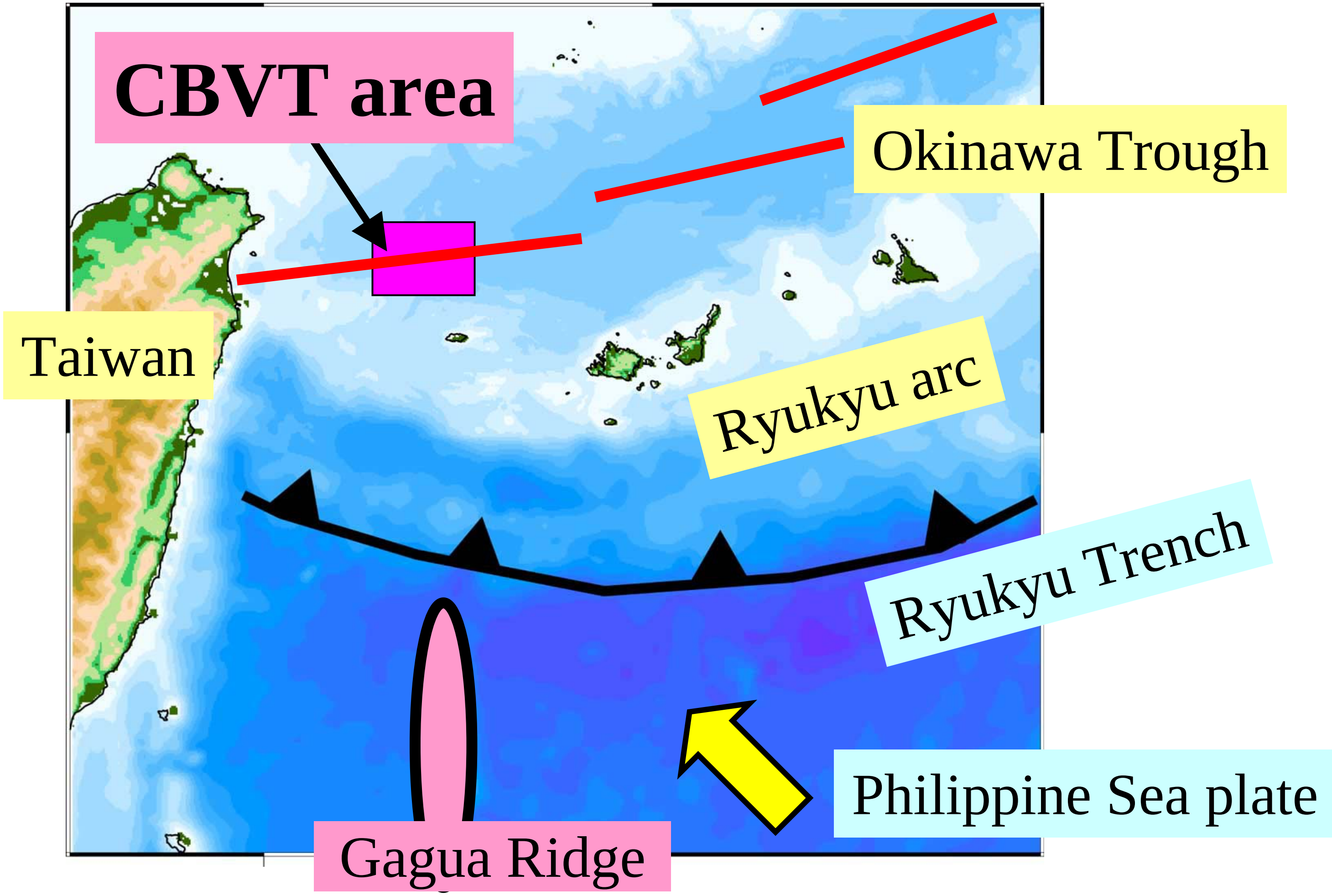
Geometry of the subducted Philippine Sea slab and 3D velocity structure beneath Taiwan-Ryukyu arc junction area

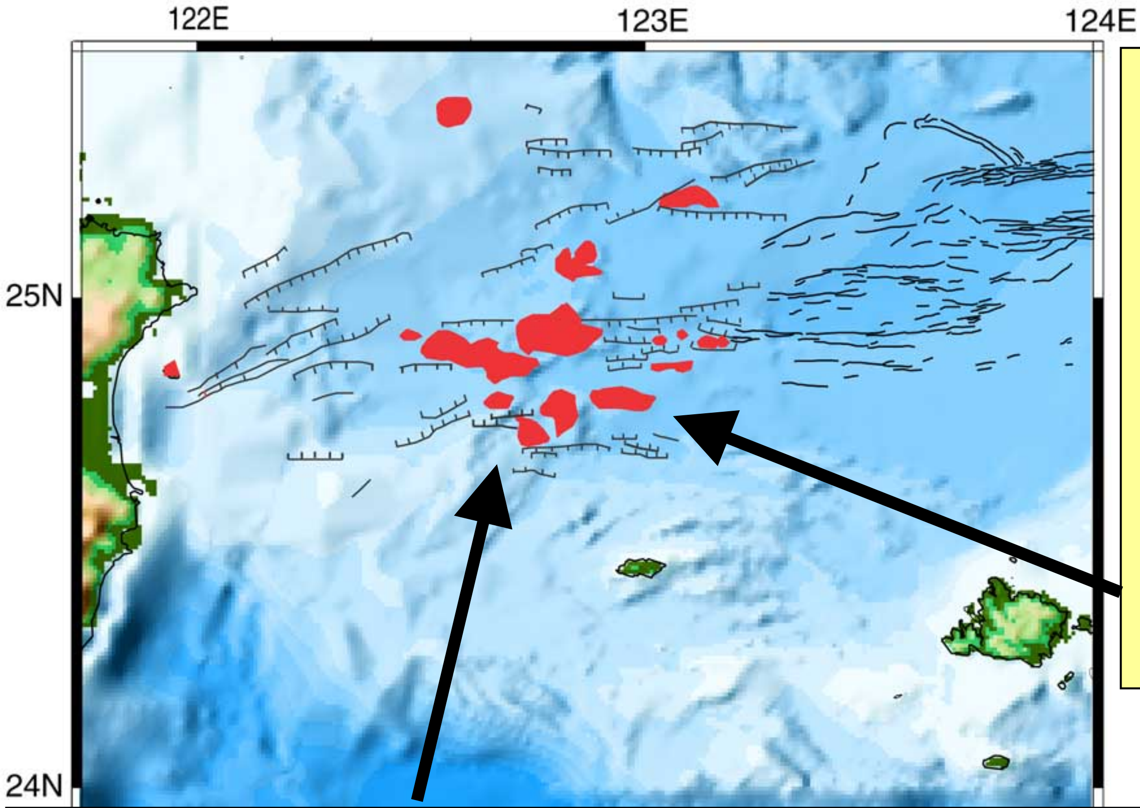


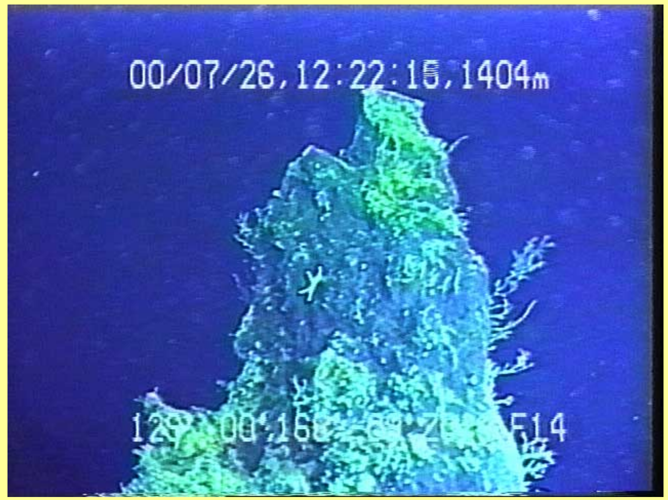
Mamoru Nakamura (*Univ. Ryukyus*)
Cheng-Horng Lin (*Academia Sinica*)
Yih-Min Wu (*National Taiwan Univ.*)
Masataka Ando (*Nagoya Univ.*)

Tectonic background in the southwestern Ryukyu arc



Tectonic framework (1)
CBVT area at the southern Okinawa Trough

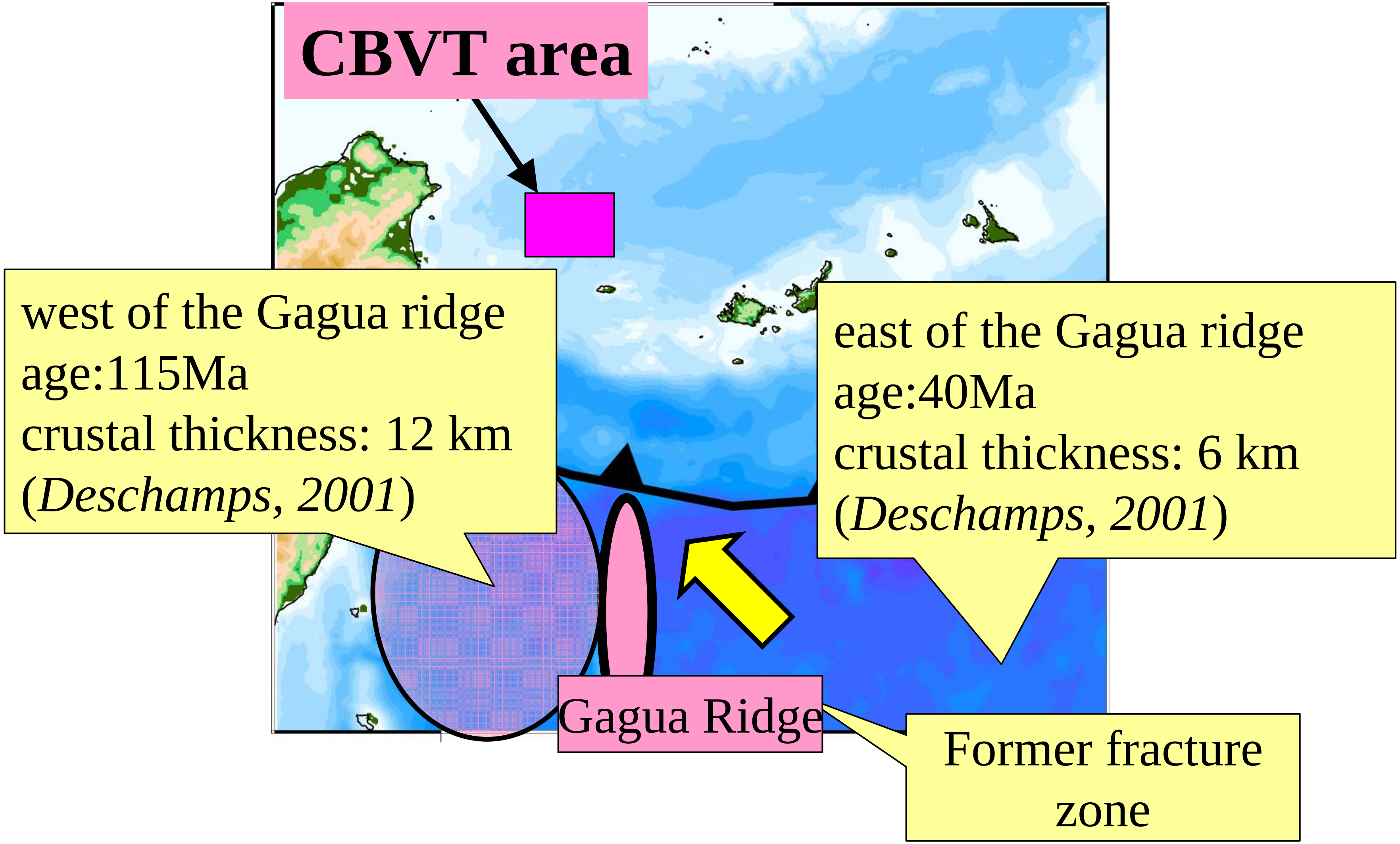




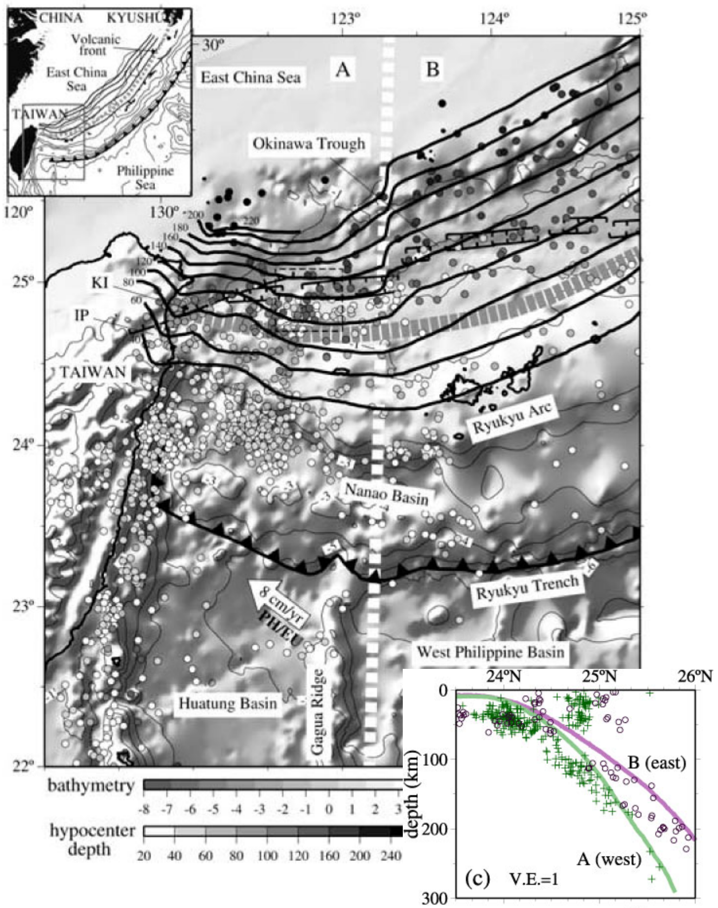
Hydrothermal area

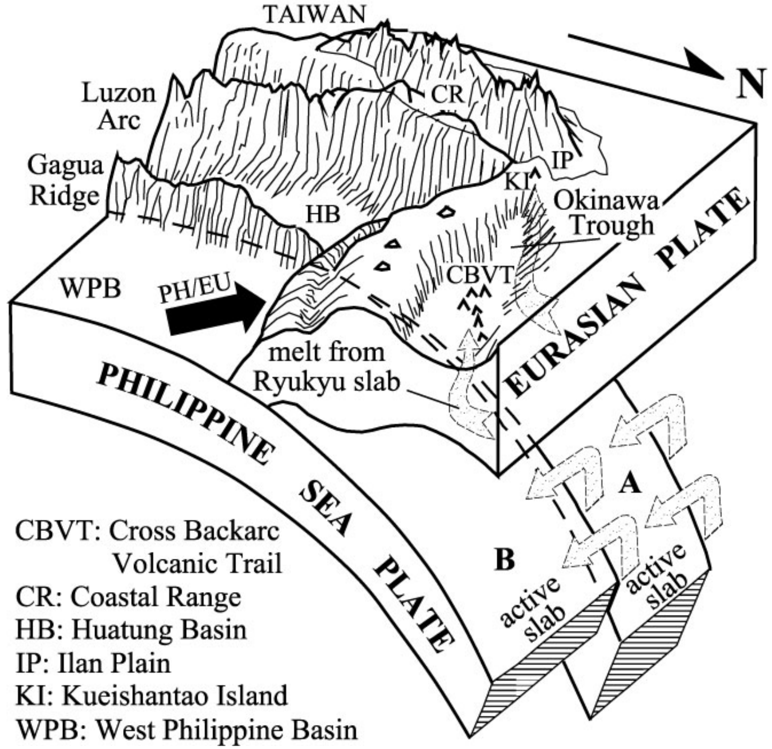
CBVT (cross-backarc volcanic trail):
excess of volcanism (*Sibuet et al., 1998, Lin et al., 2004*)

Tectonic framework (2)
Subduction of Philippine Sea Plate



Tear fault in the Philippine Sea slab?





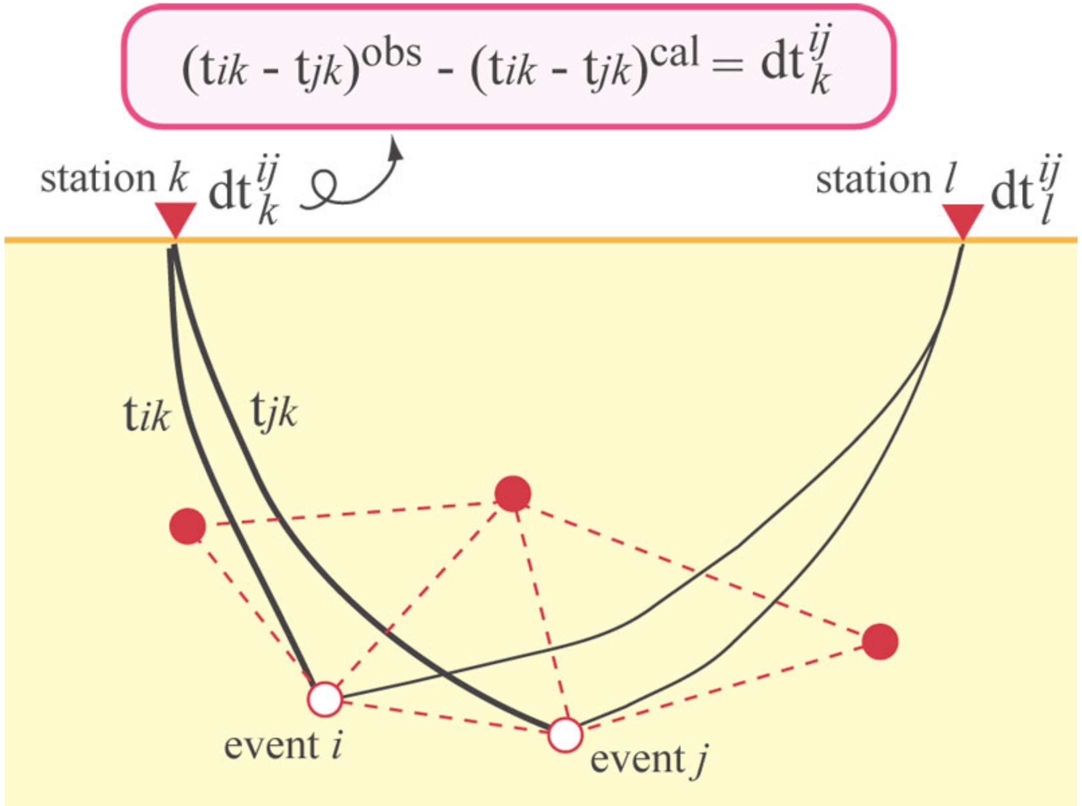
Lin et al., 2004

The slab tear beneath the CBVT.

(1) double difference hypocenter relocation

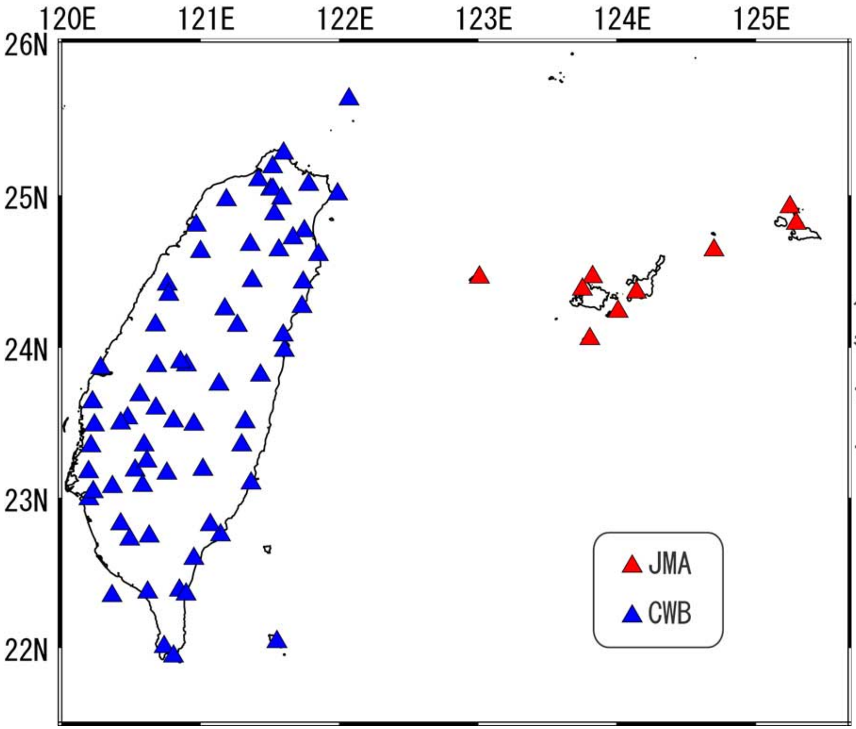
- Period： Jan. 1, 1996 - May. 31, 2005
- Used events: 8091 earthquakes, M>2.5
- Stations: JMA (9 stations) and CWB networks
- Method: double difference hypocenter determination (*Waldhauser & Ellsworth, 2000*)

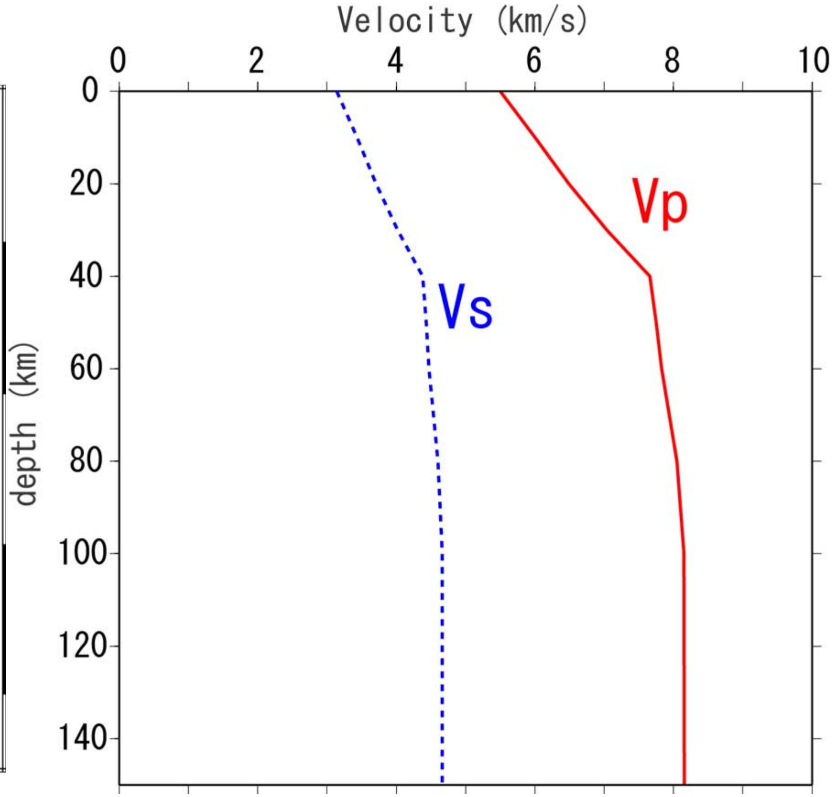
double difference hypocenter relocation



Minimize the residuals between observed and theoretical travel time differences for pairs of earthquakes at each stations.

station distribution and initial velocity model

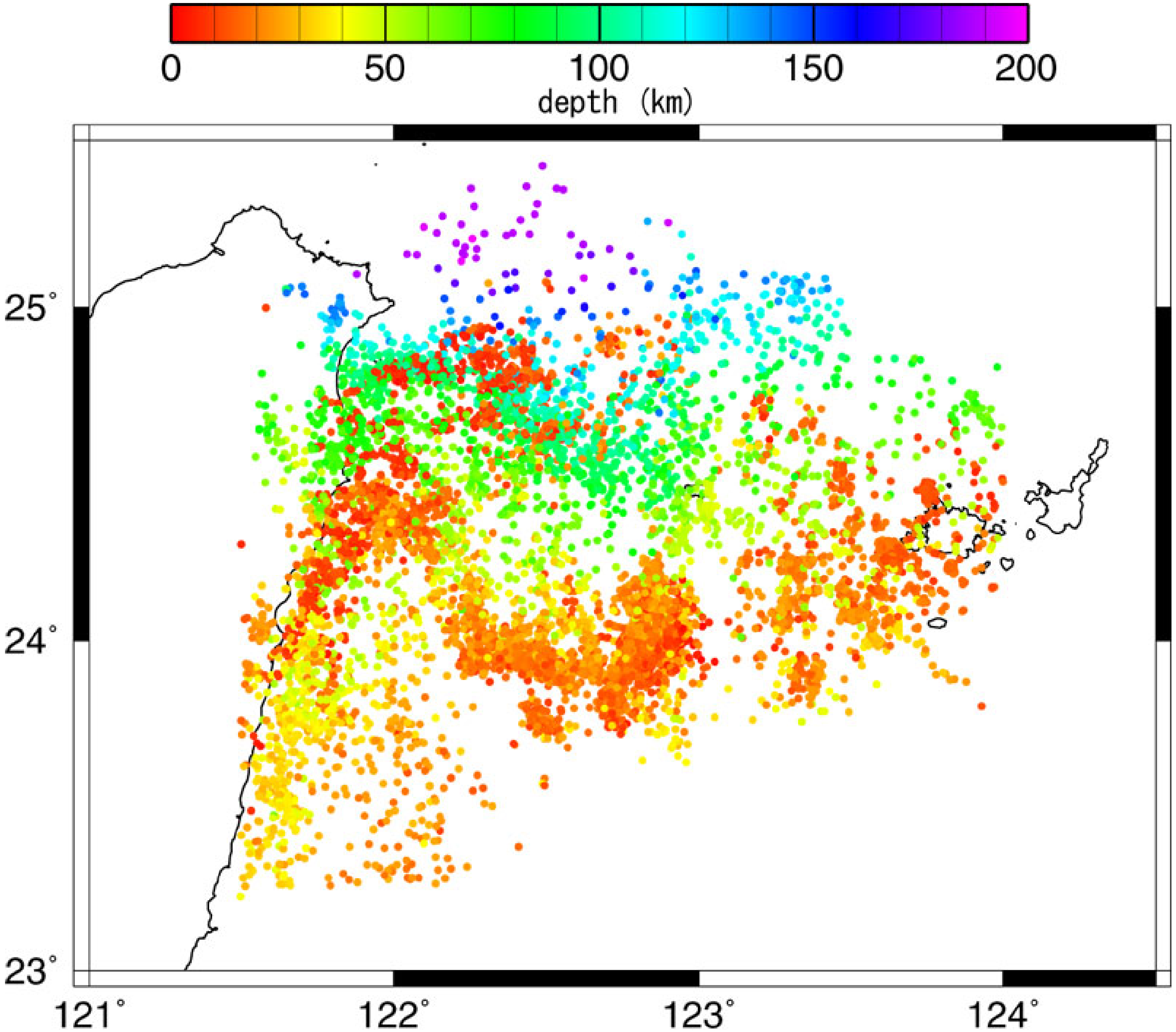




JMA: 9 stations
CWB: 64 stations

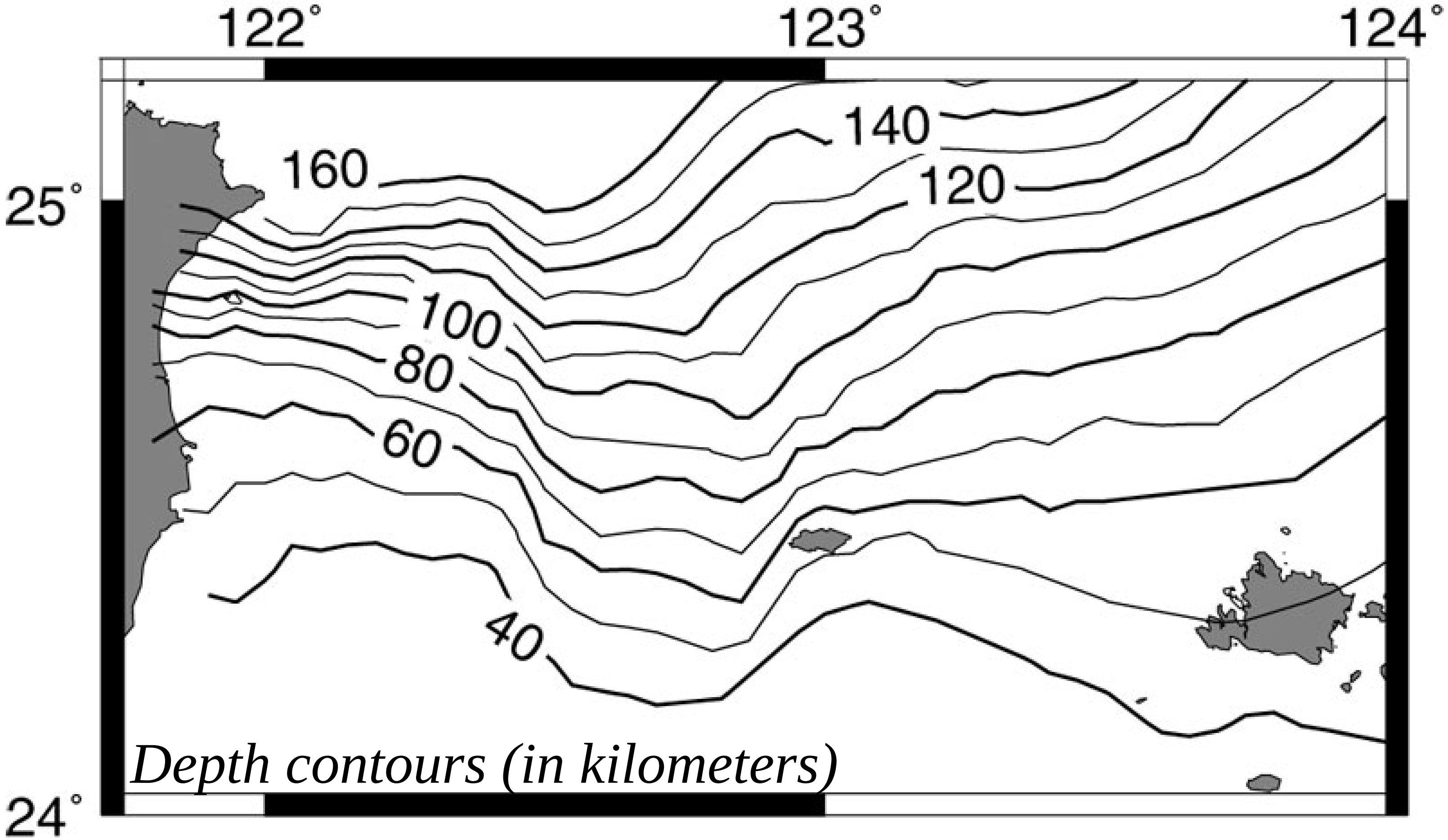
1-D model in northern Taiwan
(*Rau and Wu, 1995*)

relocated hypocenters



Seismic clusters at the forearc and subducting slab

geometry of the Philippine Sea slab



The slab is bending (or torn) between 122.5-123.0E

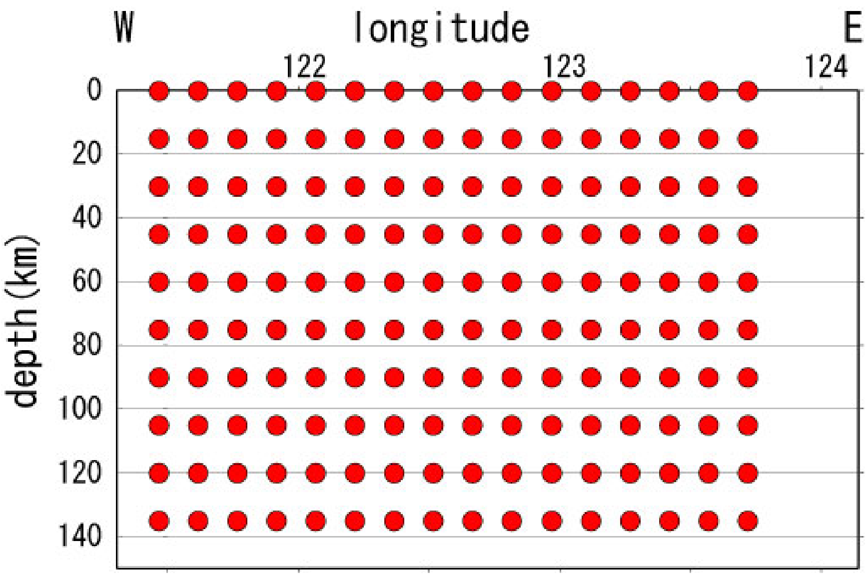
(2) 3-D seismic tomography

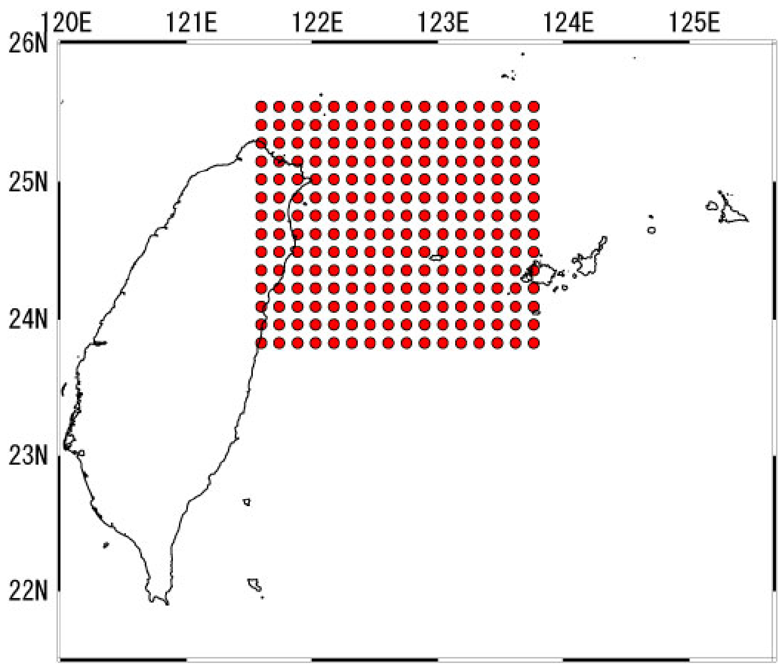
- Period： Jan. 1, 1996 - May. 31, 2005
- Used events: 8040 earthquakes, M>2.5
- Stations: JMA (9 stations) and CWB networks
- Program code: simulps12
- Compute *Vp* and *Vs*
- Initial velocity model

  model A: 1-D velocity model

  model B. 3-D velocity model including subducting slab

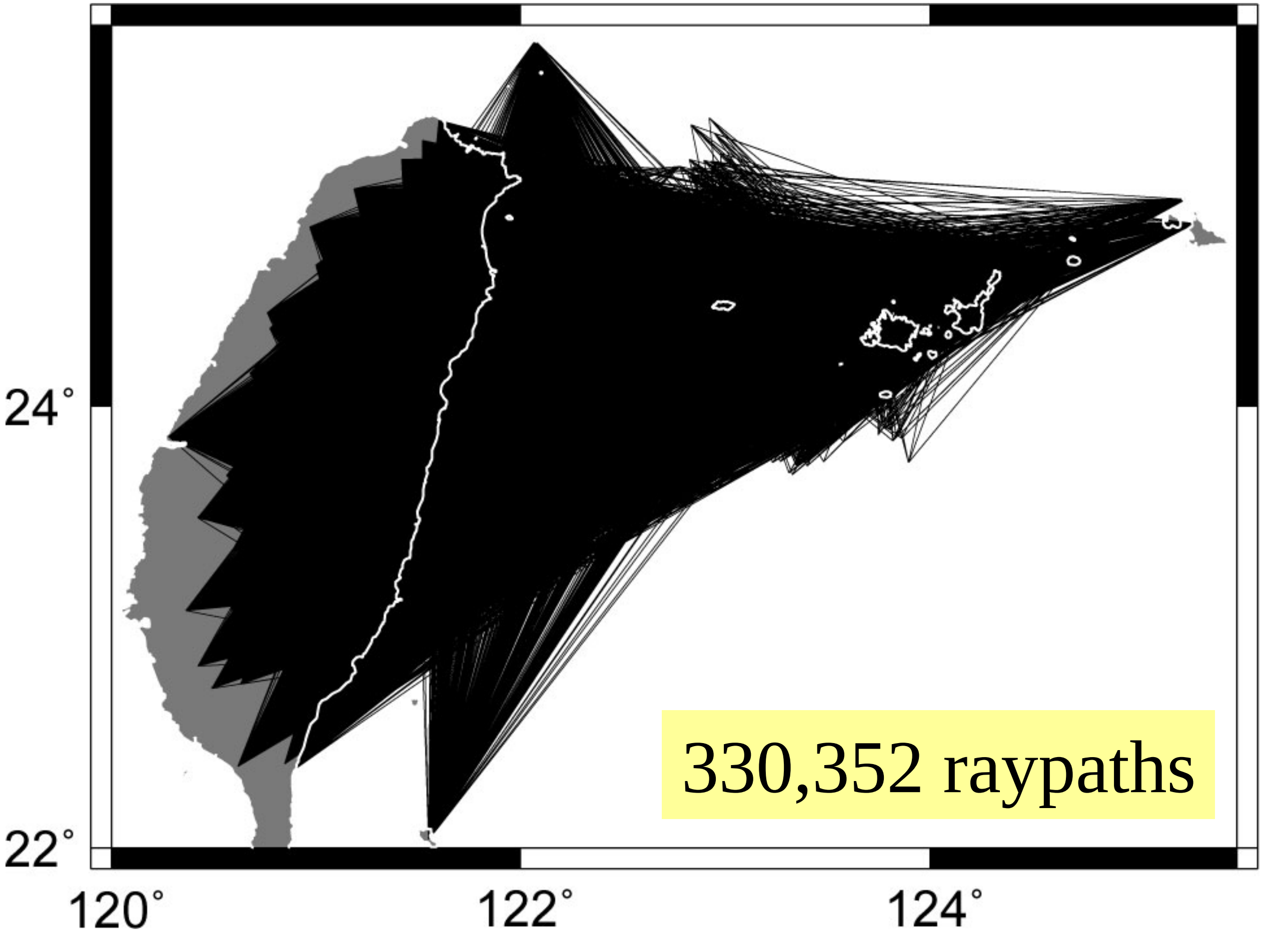
Grid distribution



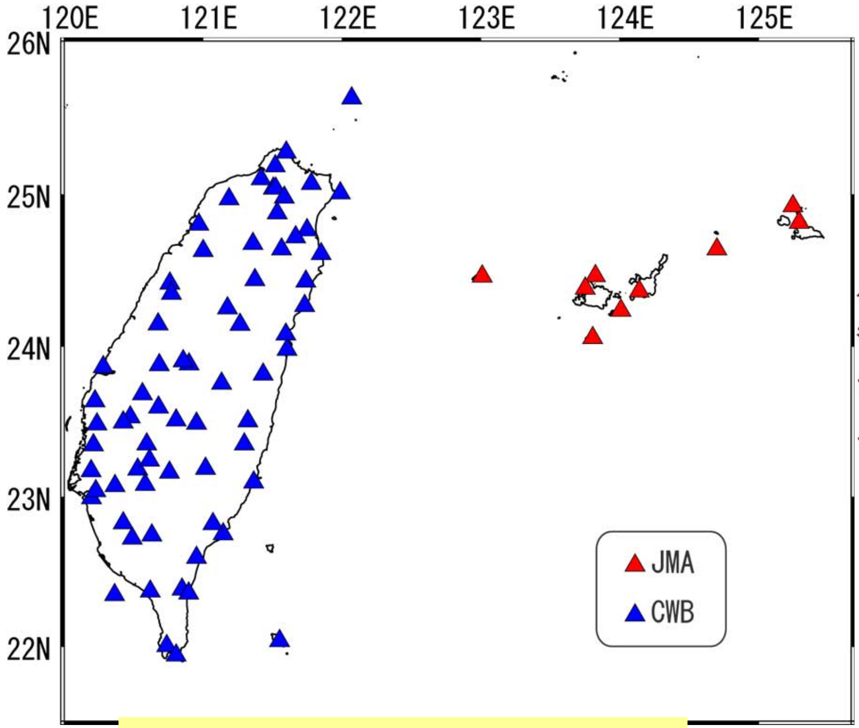


grid interval
horizontal:15km
vertical: 15km

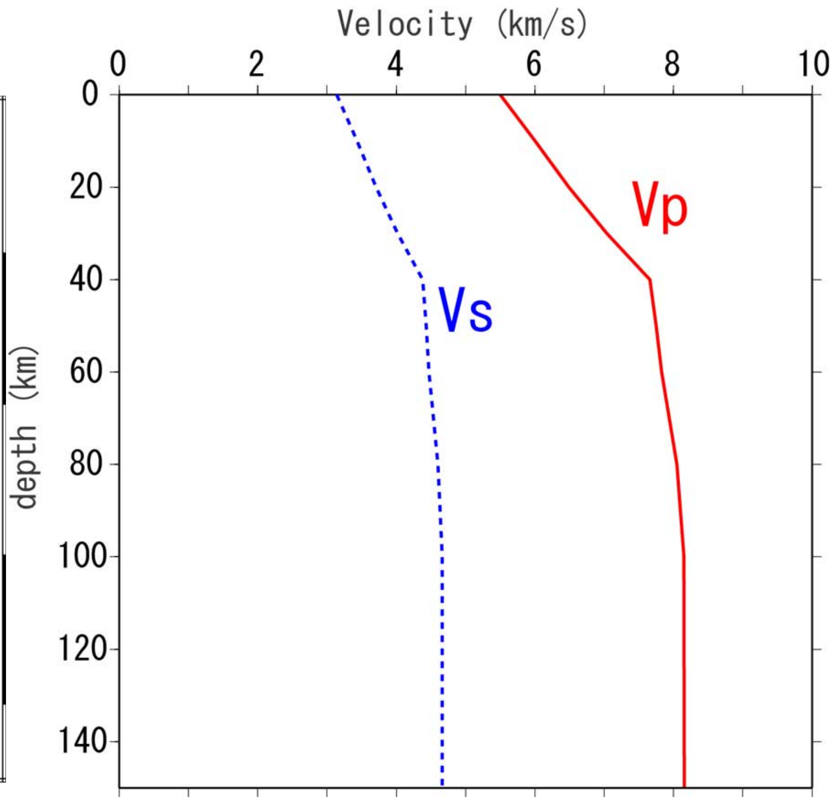
raypath distribution



Station distribution and initial velocity model

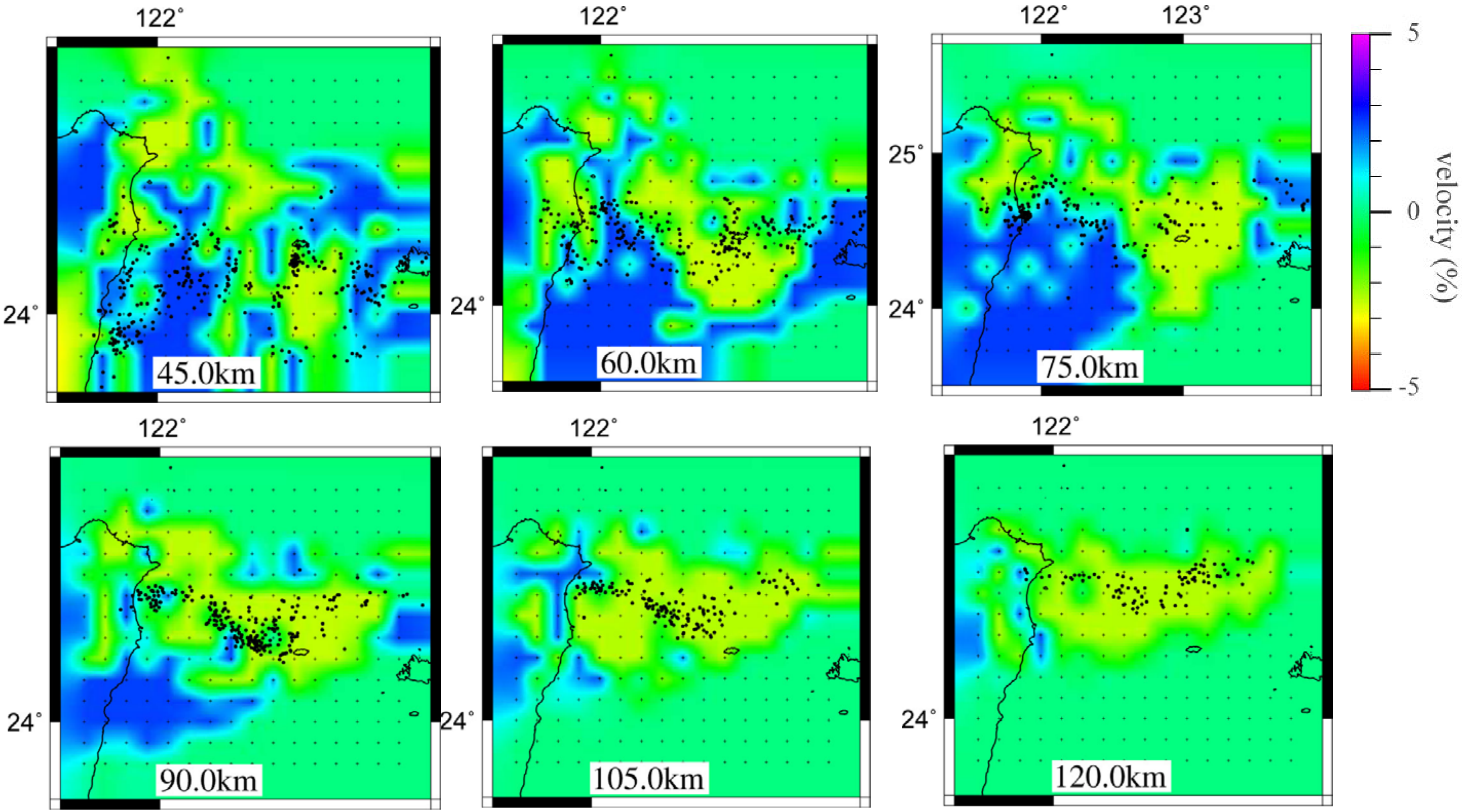


JMA: 9 stations
CWB: 64 stations



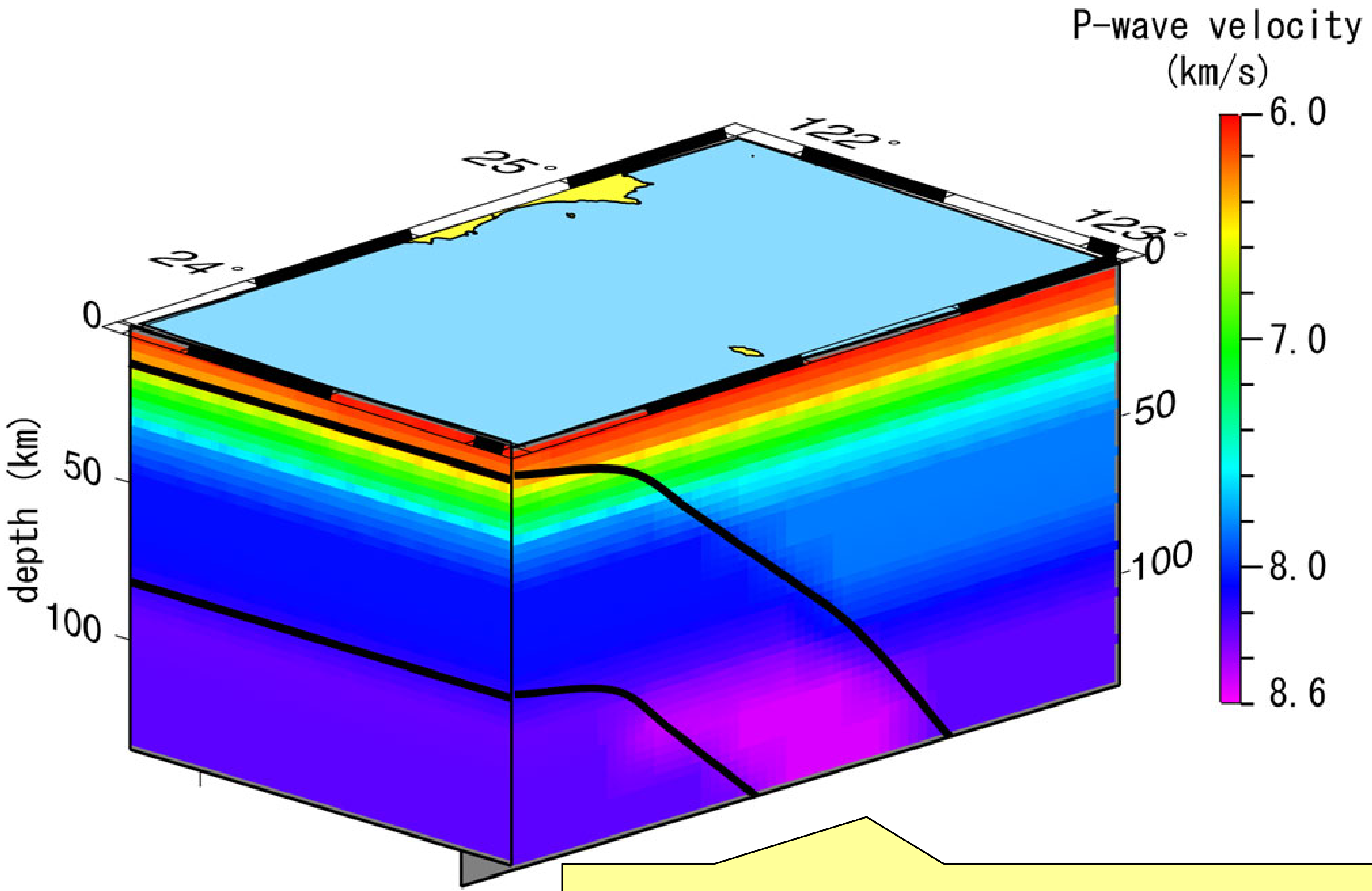
model A: 1-D velocity model

Vp structure (model A)



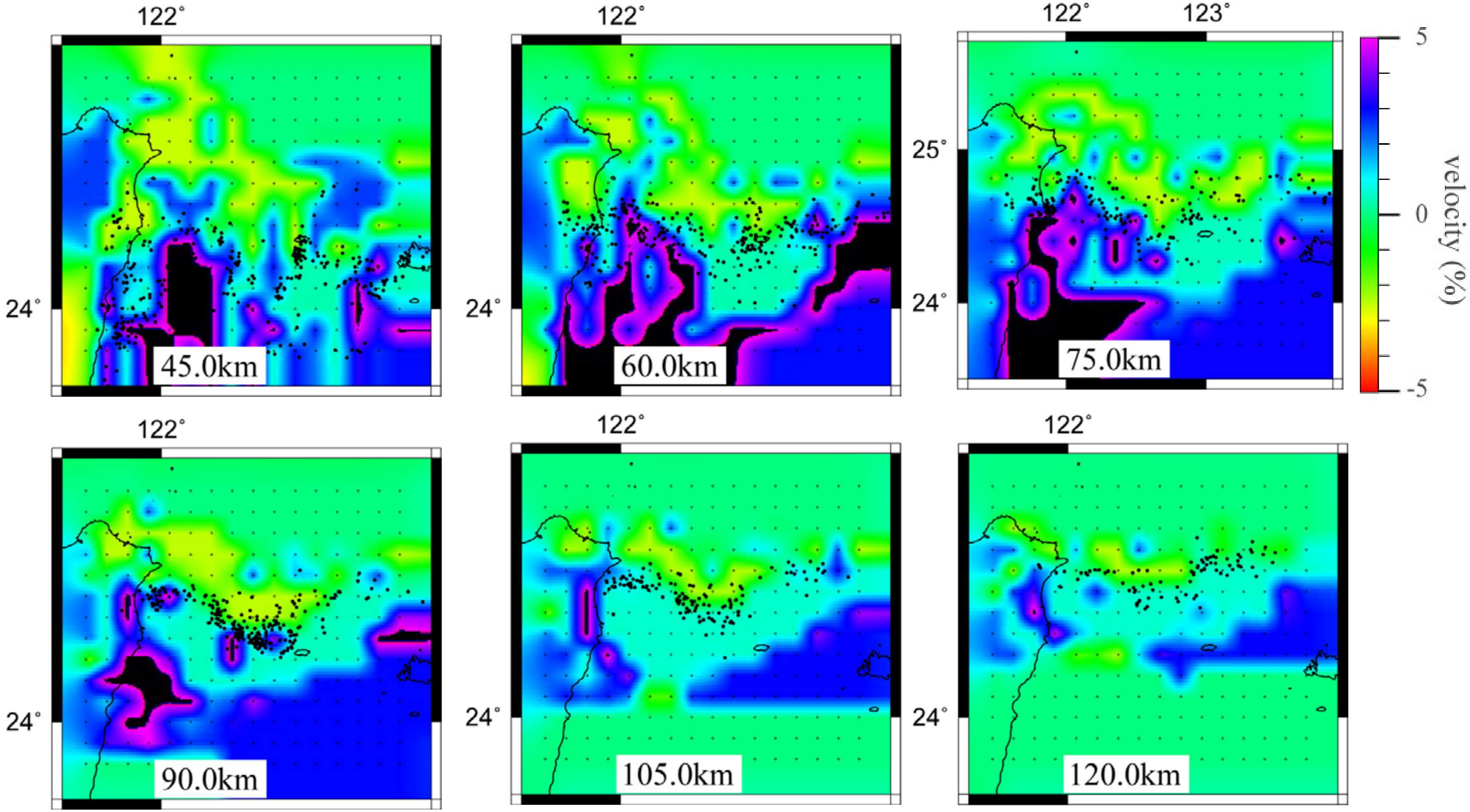
Low *Vp* beneath the CBVT

Model B: 3-D velocity model (including slab)



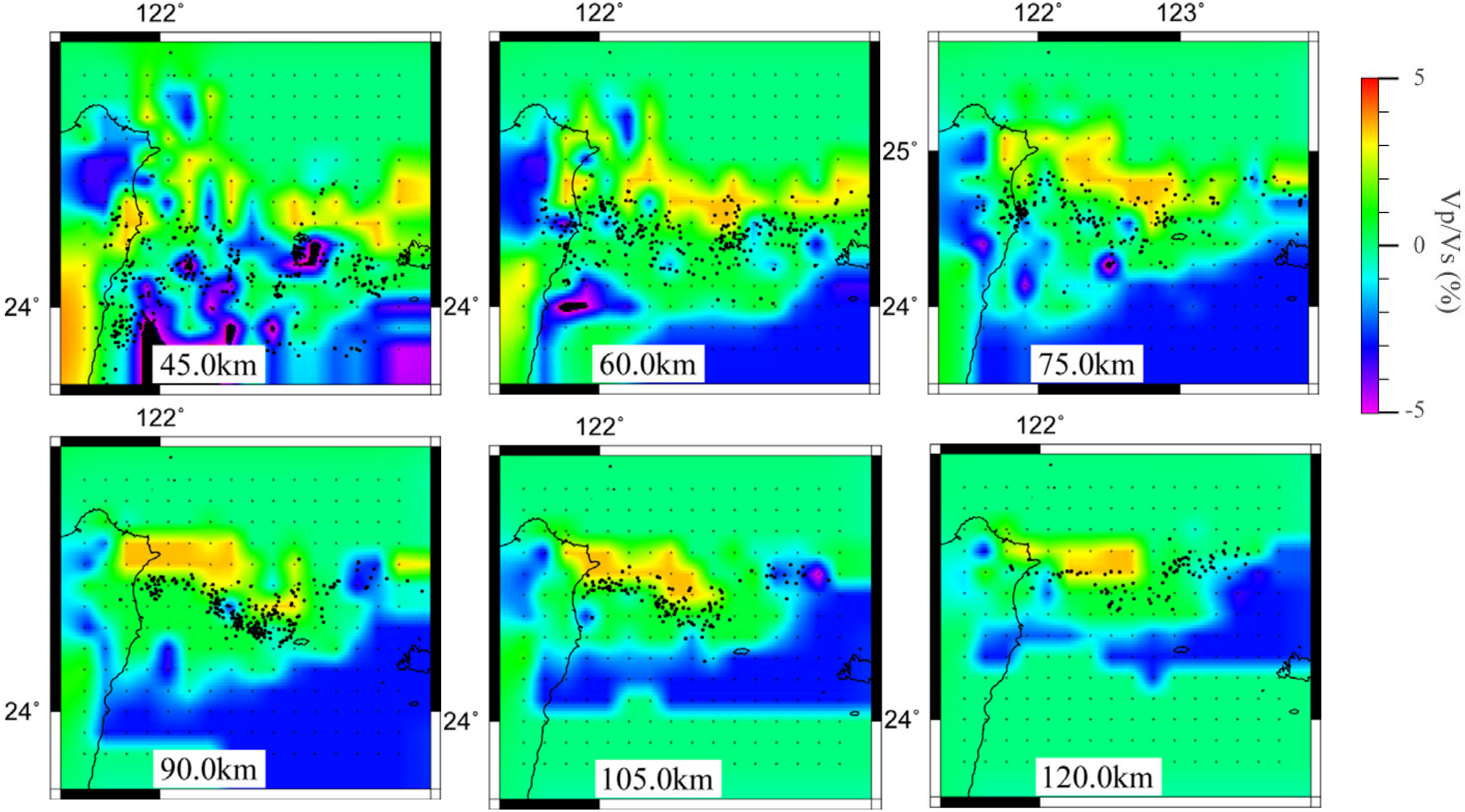
High-velocity (+5%) in the slab

Vp structure (model B)



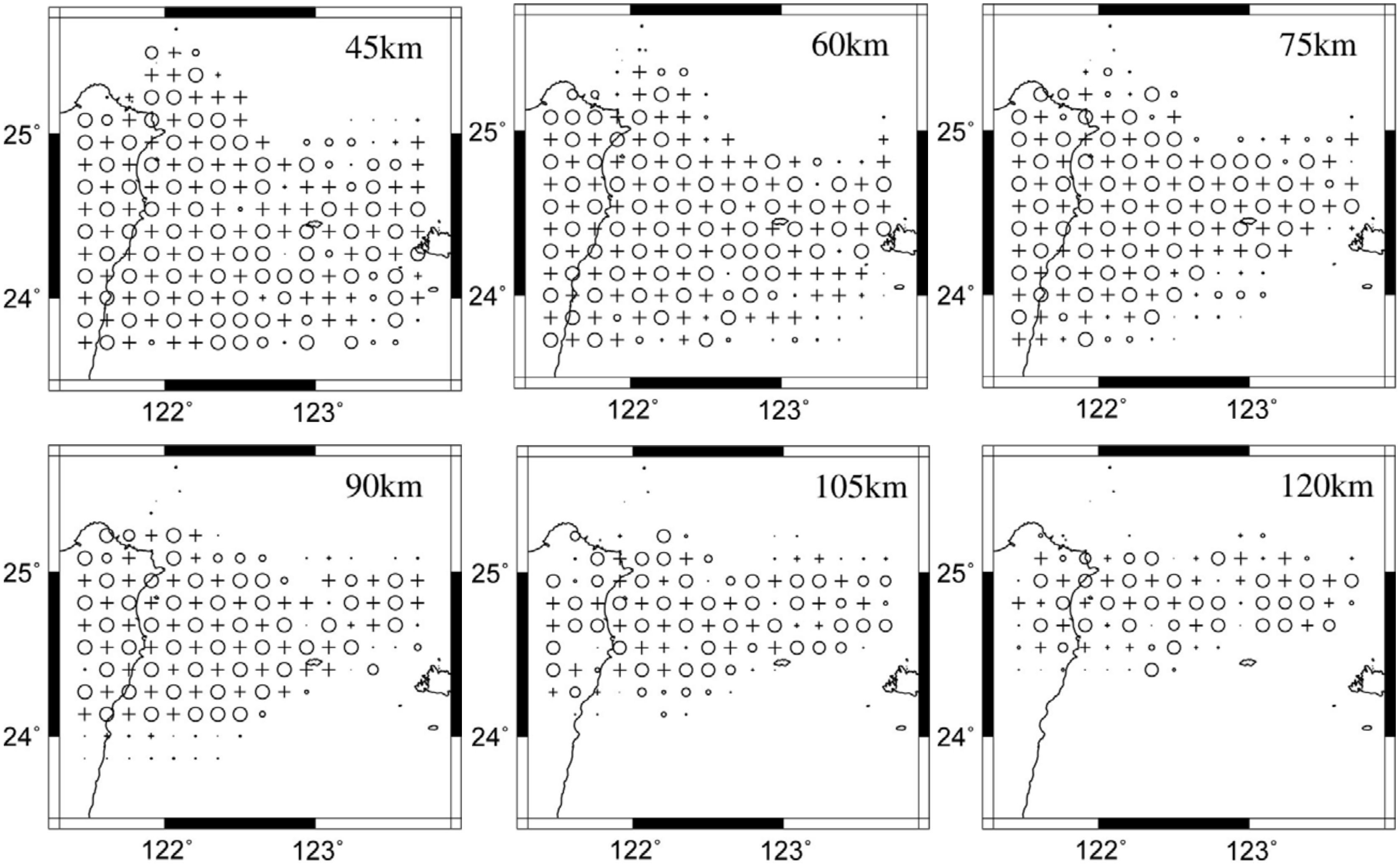
Low *Vp* beneath the CBVT along the slab at the depth of 90-120 km.

Vp/Vs (model B)

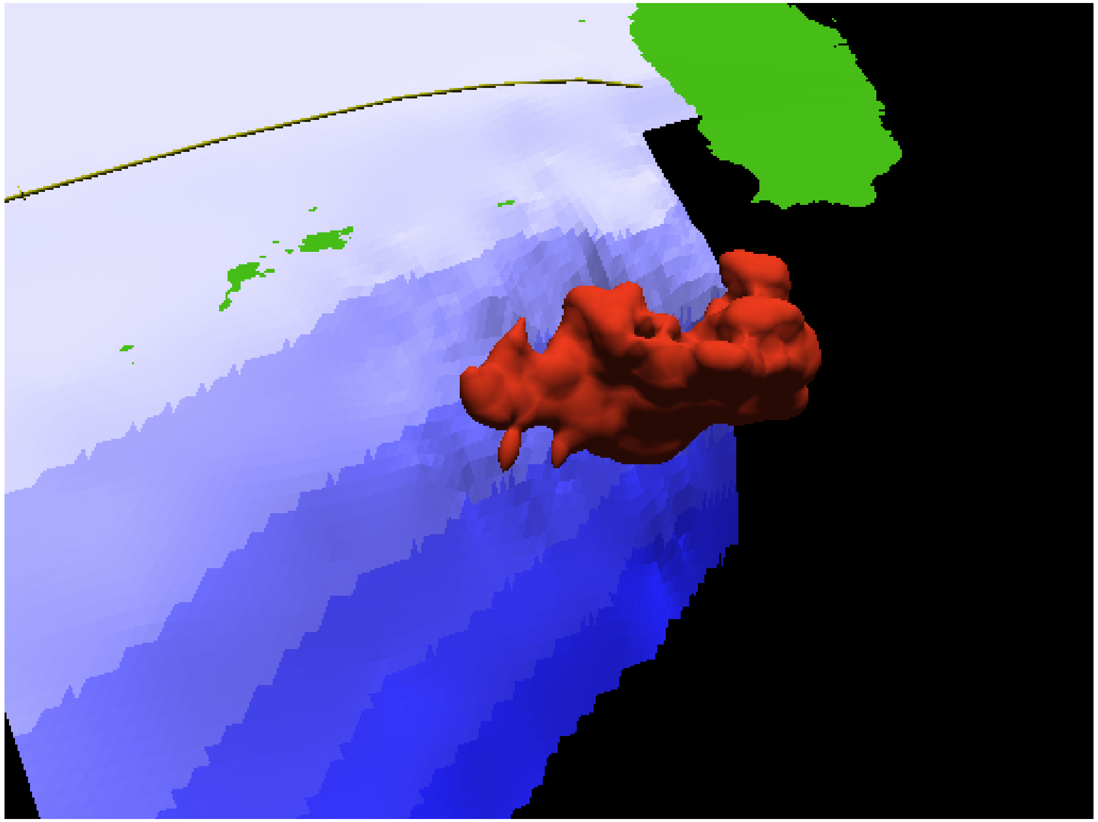


high *Vp/Vs* along the slab at the depth of 90-120 km in the west of 123E.

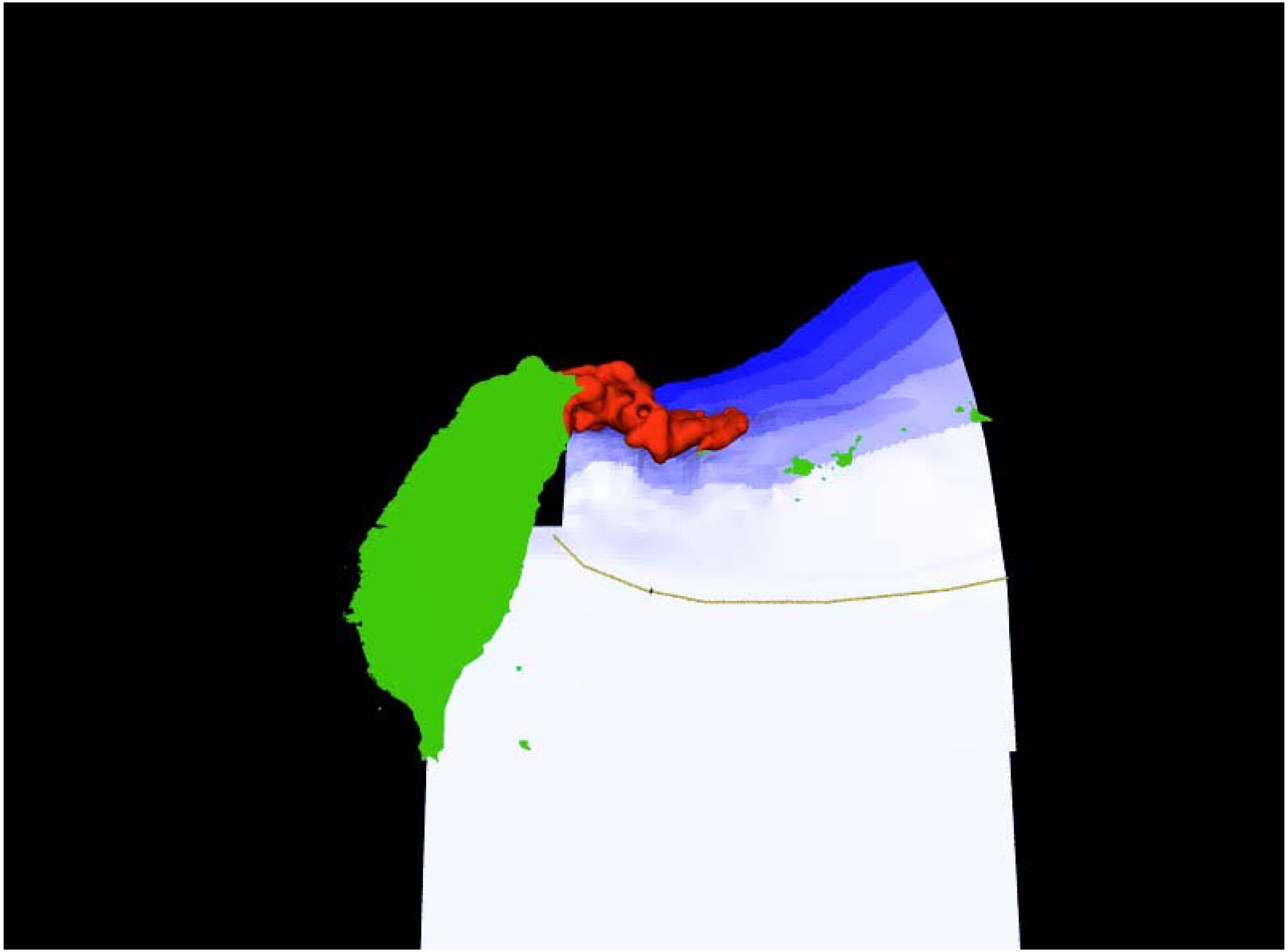
Checkerboard resolution test



subducting slab and low-*Vp* anomaly (model B)

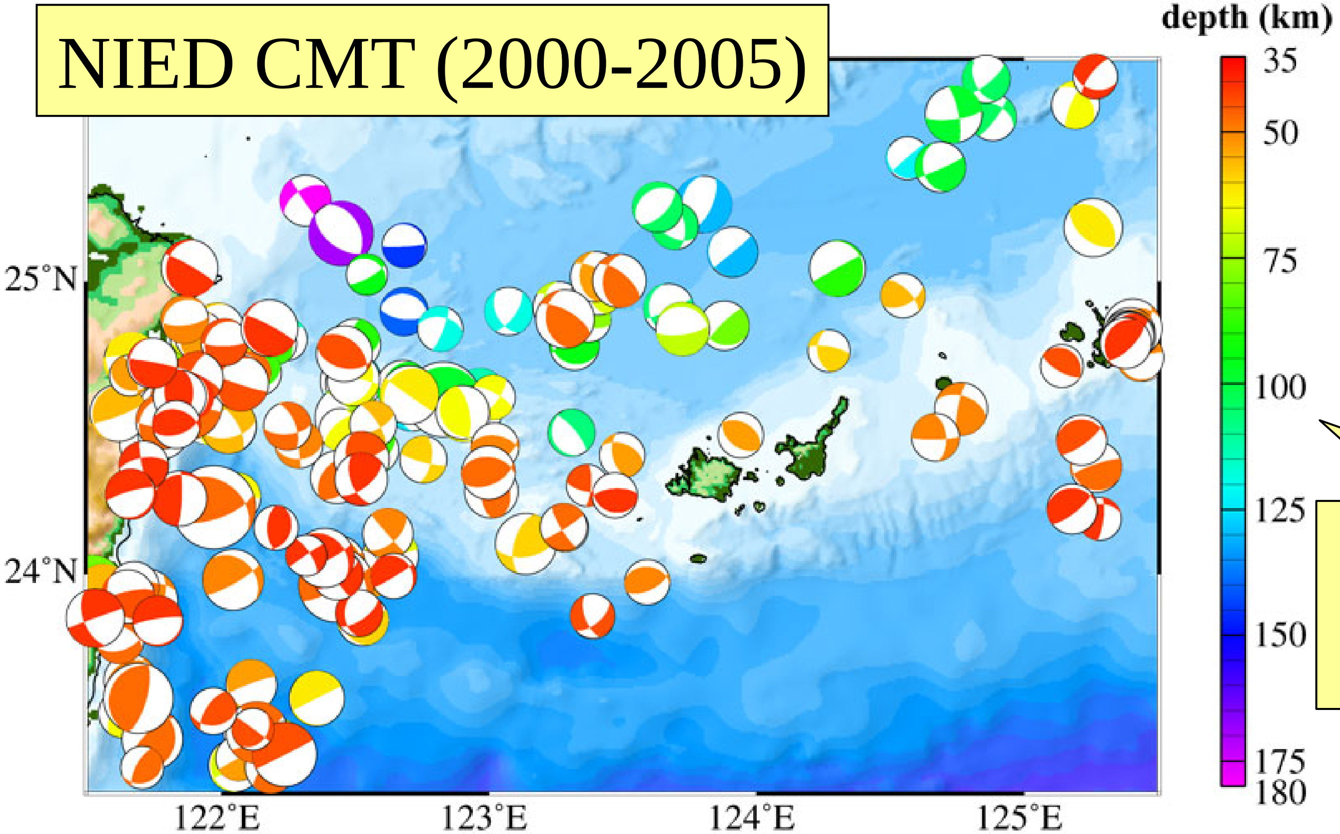


Subducting slab (**blue**) and low-*Vp* anomaly at the wedge mantle(**red**)



Focal mechanism solution in the Philippine Sea slab

NIED CMT (2000-2005)



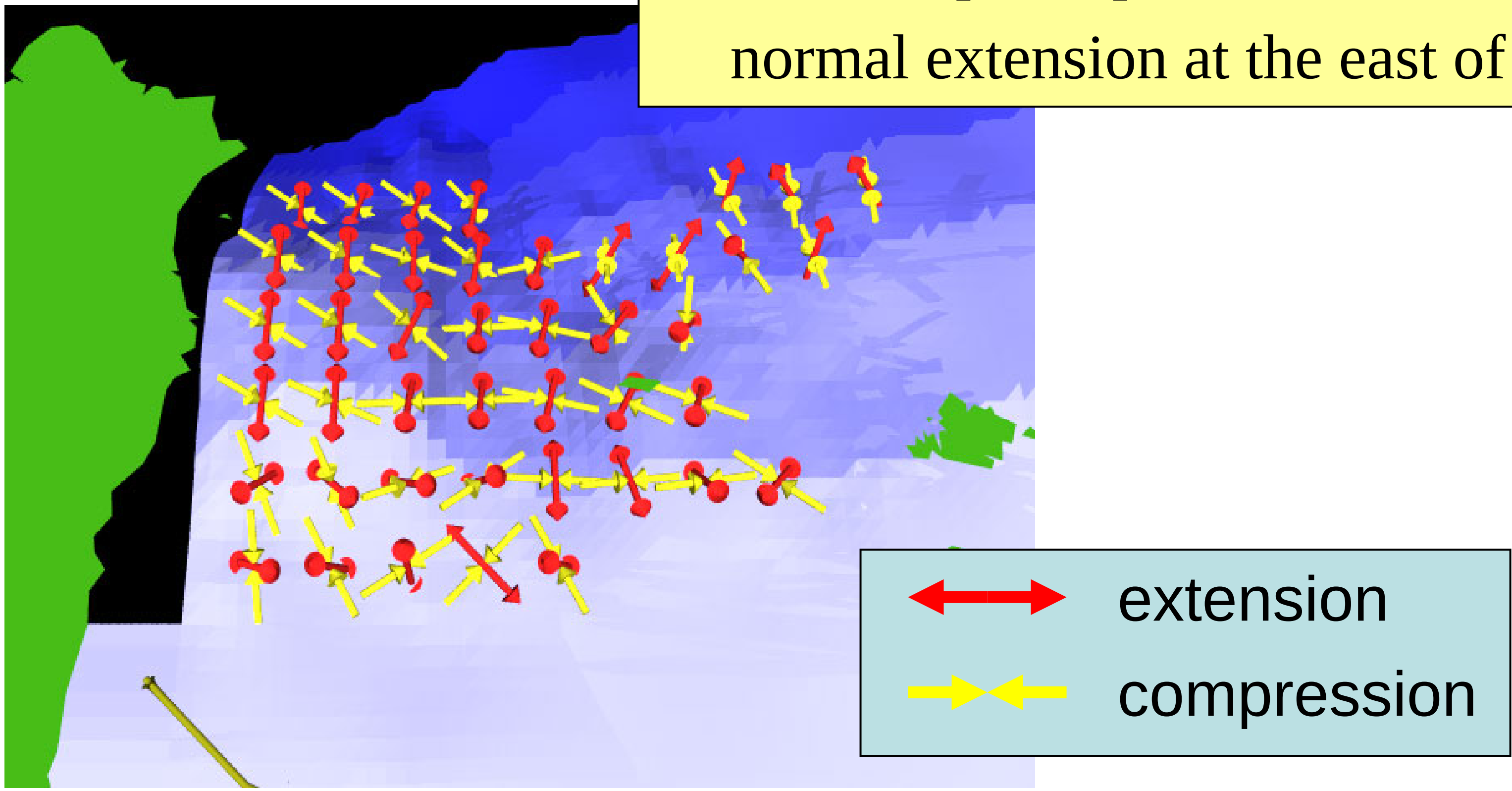
trench-parallel compression

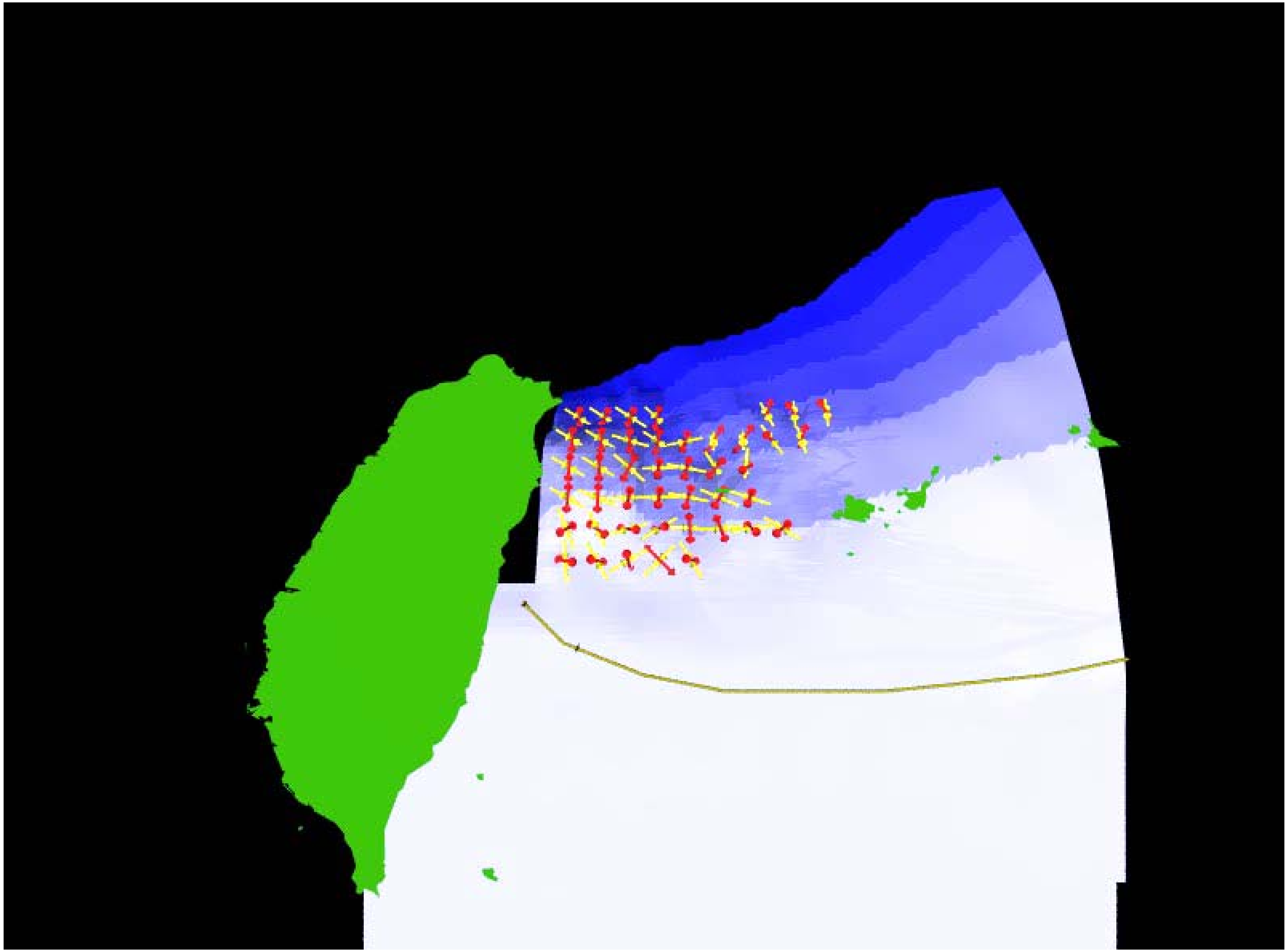
Stress tensor inversion (*Gephart and Forsyth, 1984*)
in the slab

stress tensor in the slab

Depth range 40-200 km:

1. Down-dip extension and trench-parallel compression at the west of 123E.
2. Down-dip compression and slab-normal extension at the east of 123E.





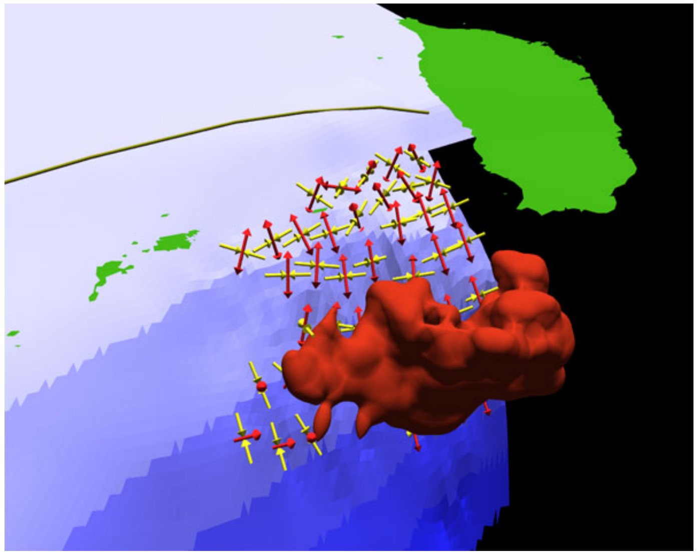
Conclusions

(1) Geometry and stress of the subducted Philippine Sea slab beneath the CBVT area:

•The slab is bending (or torn) at 122.5-123.0E.

•trench-parallel compression at the west of 123.0E.

These would be caused by the collision of the Philippine Sea slab to the Eurasian plate (Taiwan).



(2) 3D velocity structure beneath the CBVT area:

•low *Vp* and high *Vp/Vs* anomaly along the slab beneath the **CBVT**

It would be related to the melt supply to the CBVT.