Numerical simulation of the observed strain field in the south Ryukyu region

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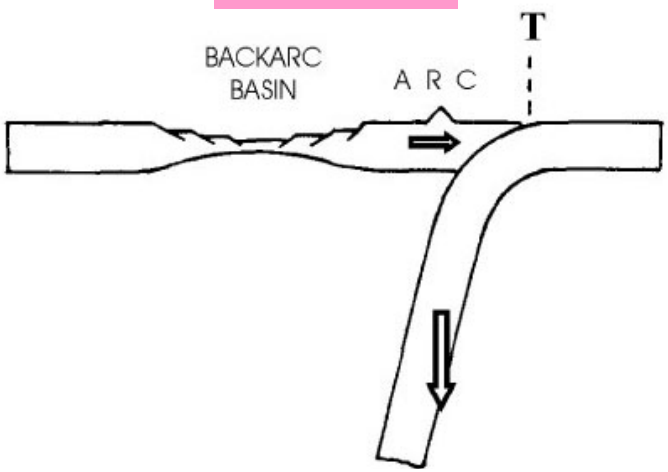
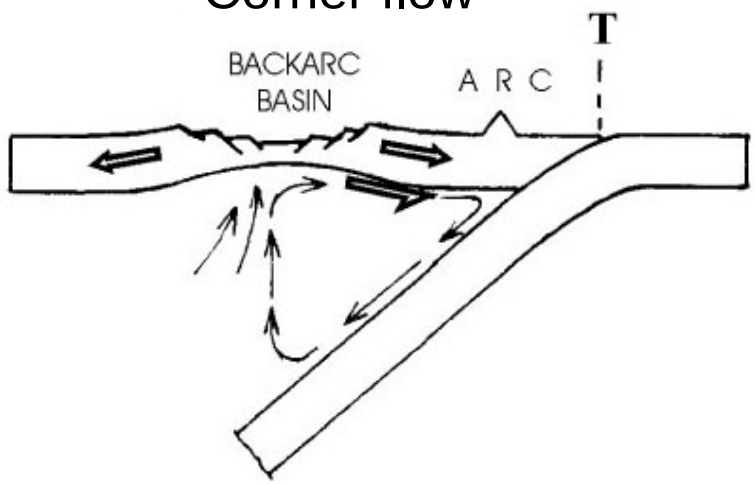
Subduction-related driving mechanism of backarc extension

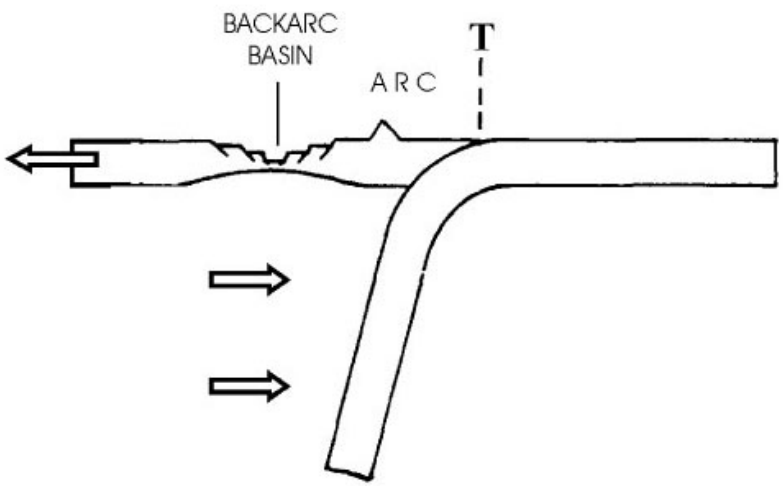
Slab pull



Corner flow

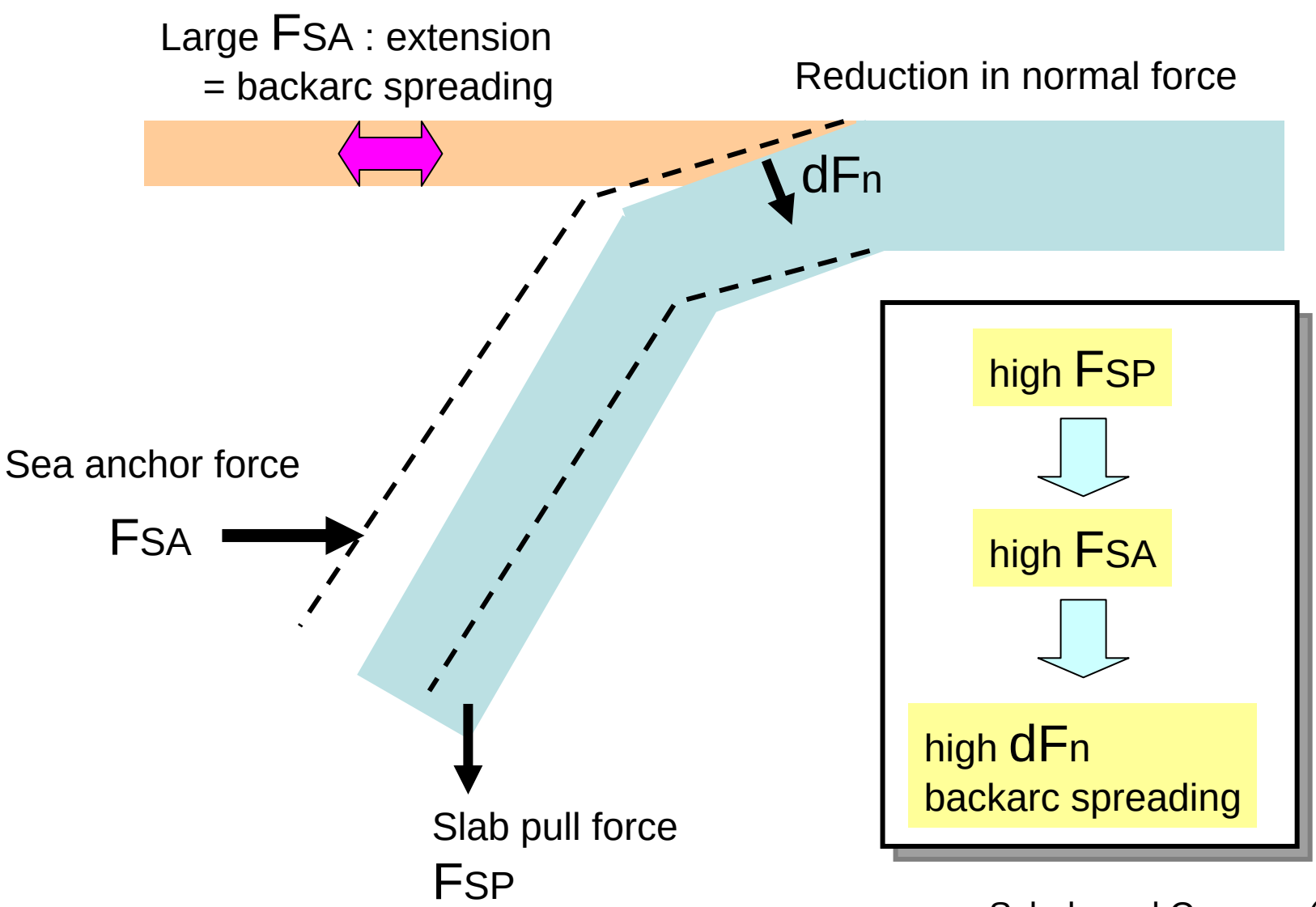


Sea anchor



Mantovani et al. (2002)

Cross section of subduction zone

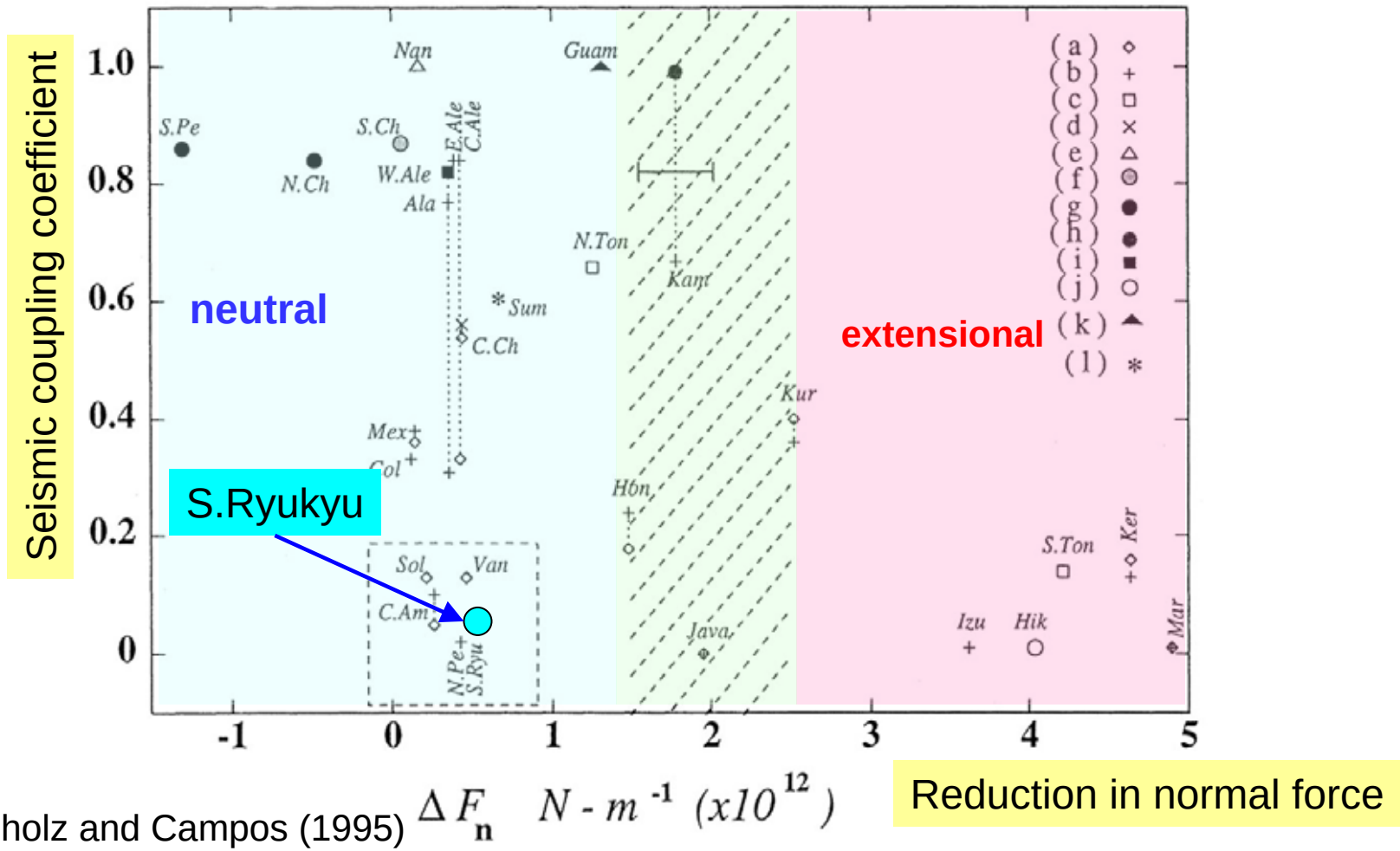


Scholz and Campos (1995)

Anomalous S. Ryukyu subduction zone

Backarc extension occurs when dFn exceeds a value of 2×10^{12} N/m.

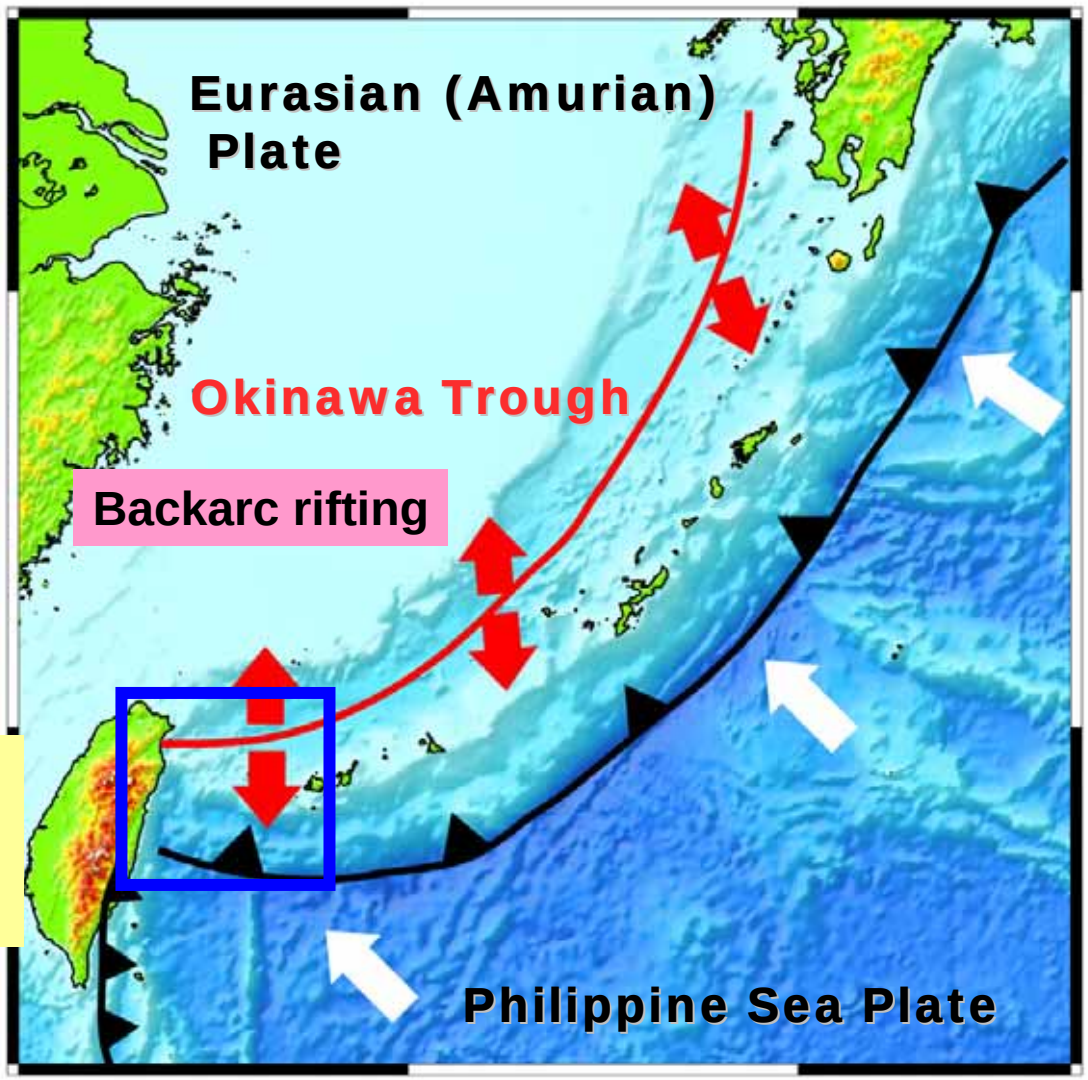
low dFn and F_{SA} in the S. Ryukyu.



Reduction in normal force

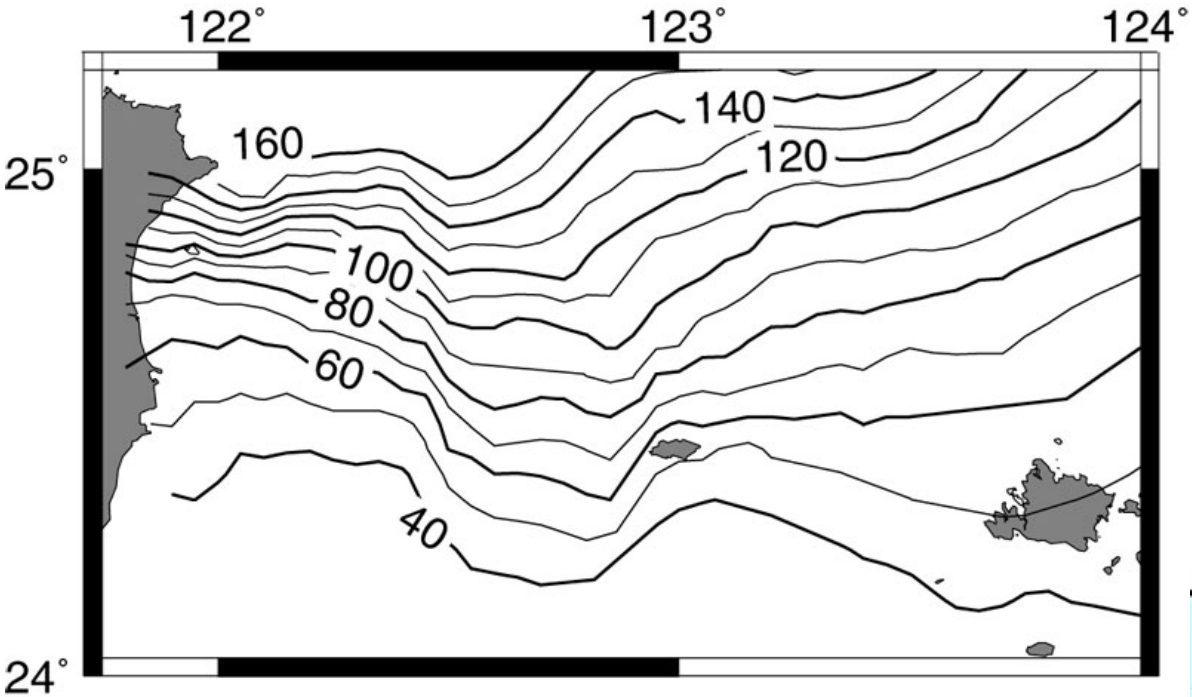
Scholz and Campos (1995)

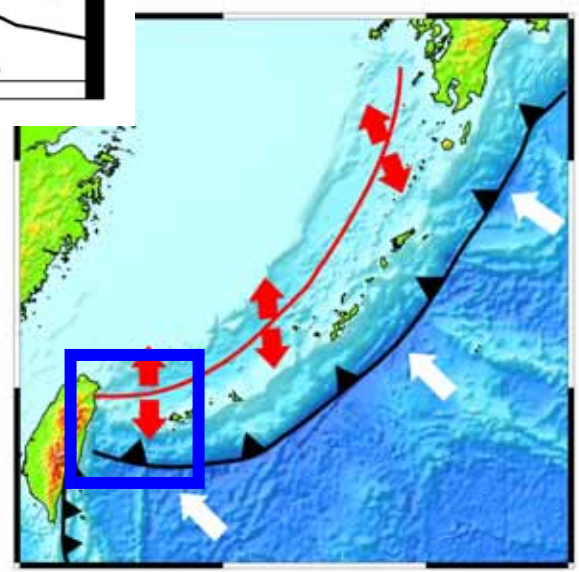
Geodynamic framework around Ryukyu arc



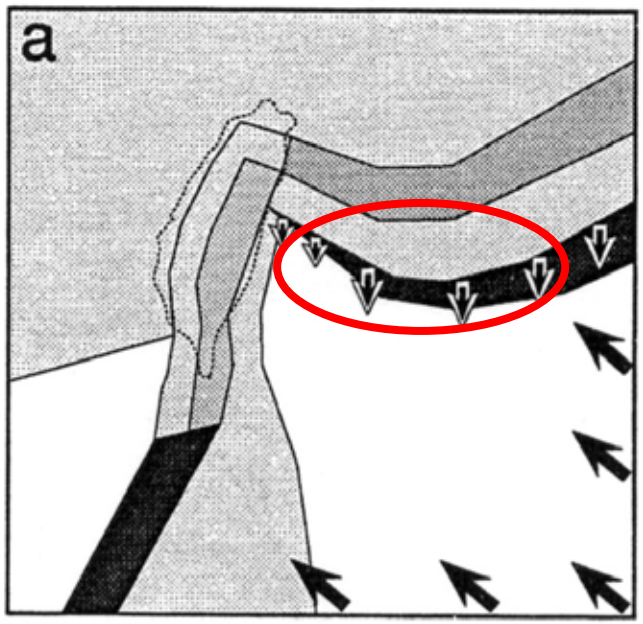
Collision in Taiwan

Deformation of subducted plate near Taiwan

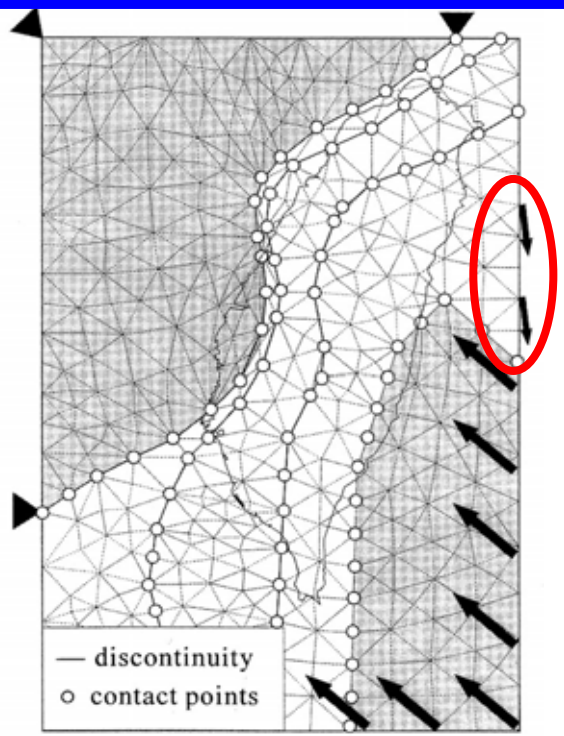




Previous FEM study in the Taiwan-Ryukyu arc area



(Hu et al., 1996)

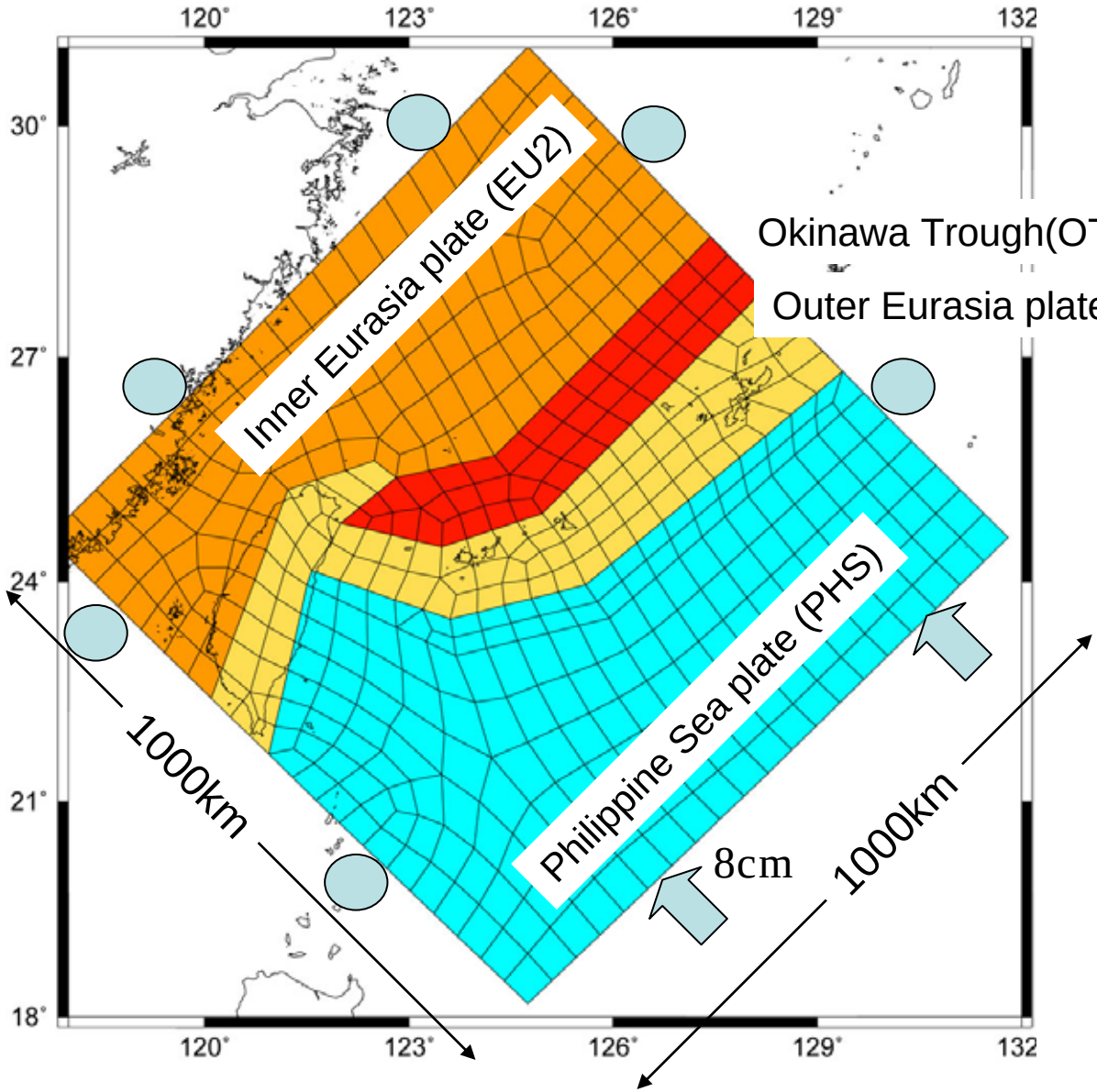


(Hu et al., 2001)

Trench retreating rate (=slab pull effect) has been set in the initial FEM model apriori.

Compute the trench retreating rate!

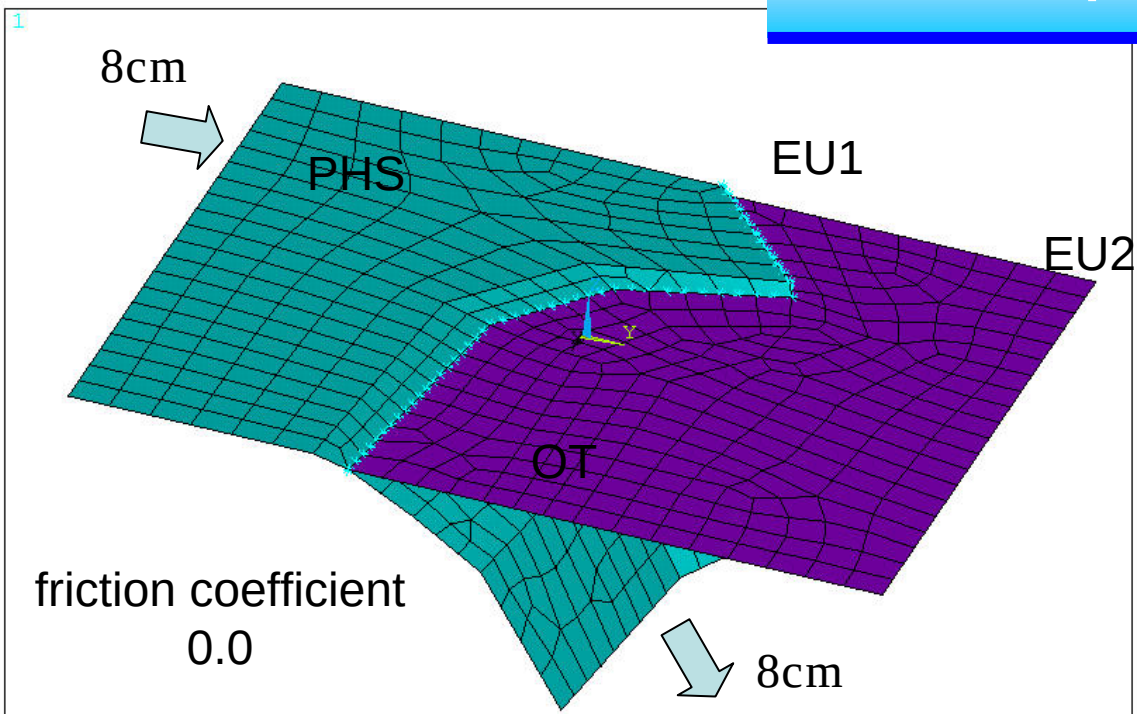
FEM model (3D shell structure)



Total node
1973

Total elements
807

FEM model

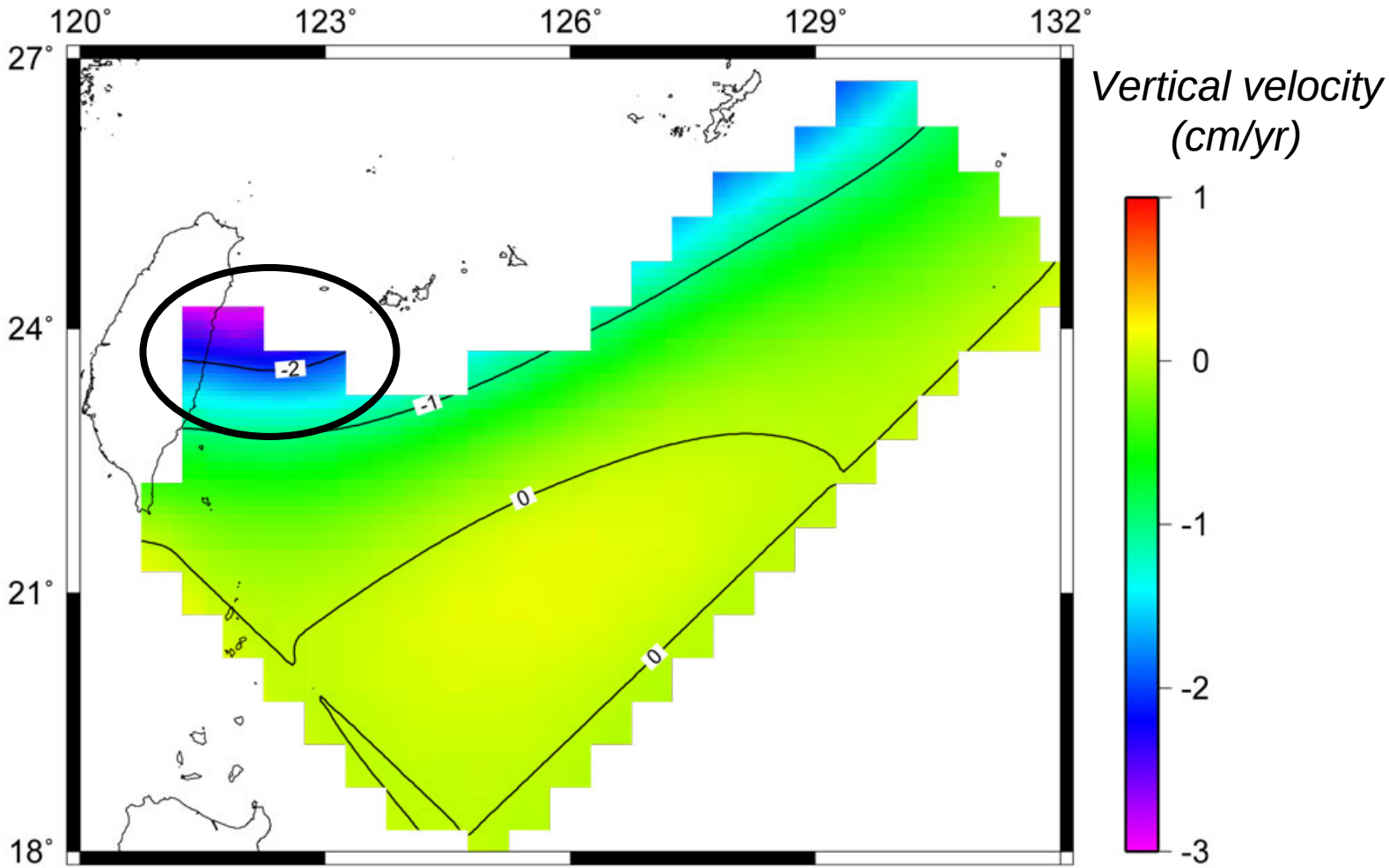


3D shell structure

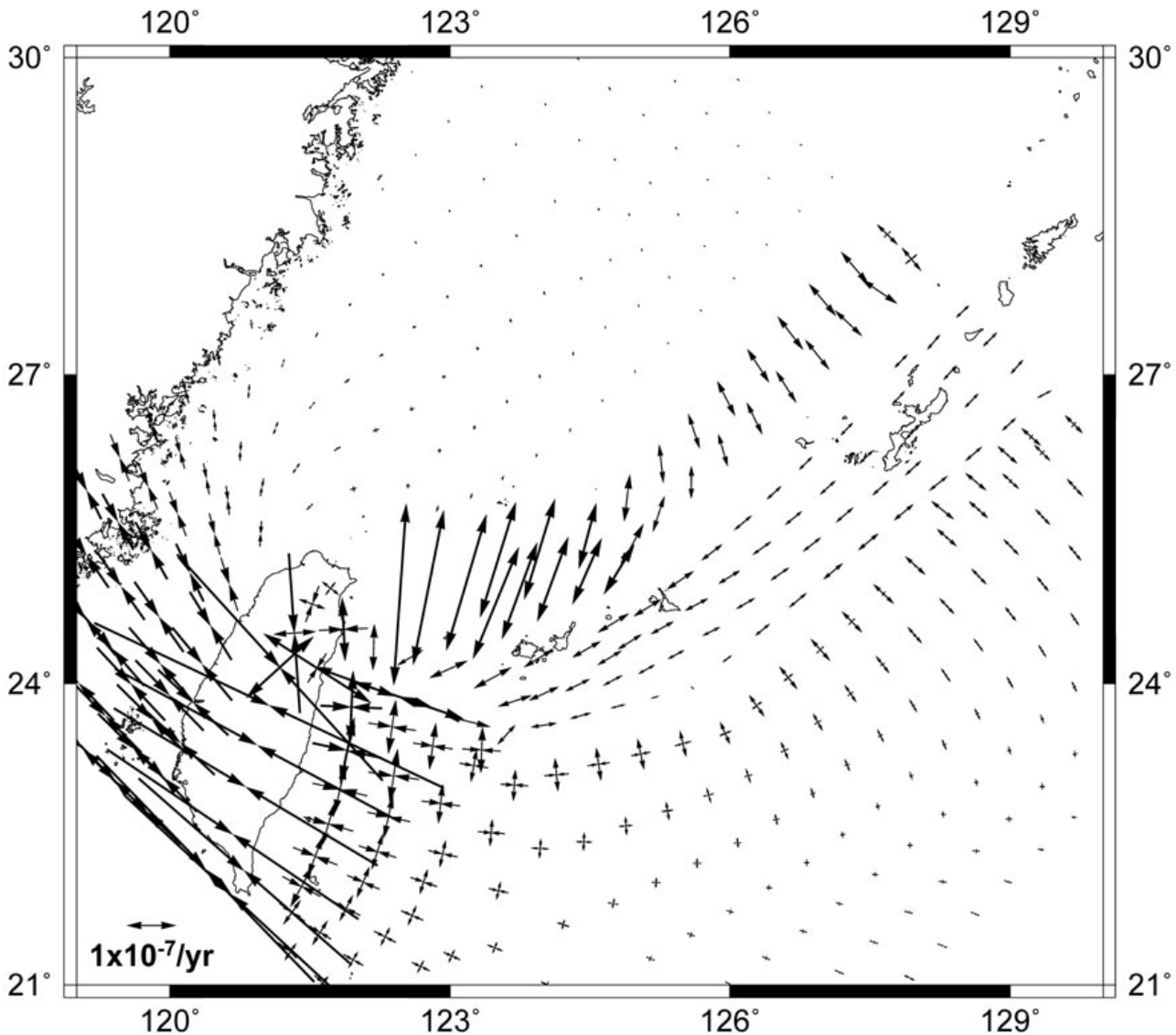
	Young's modulus [GPa]	Poisson's ratio	Thickness (km)	vertical displacement
PHS	60	0.25	60	free
EU1	30	0.25	15	fix
OT	10	0.25	5	fix
EU2	40	0.25	40	fix

Results(1) deformation of PHS

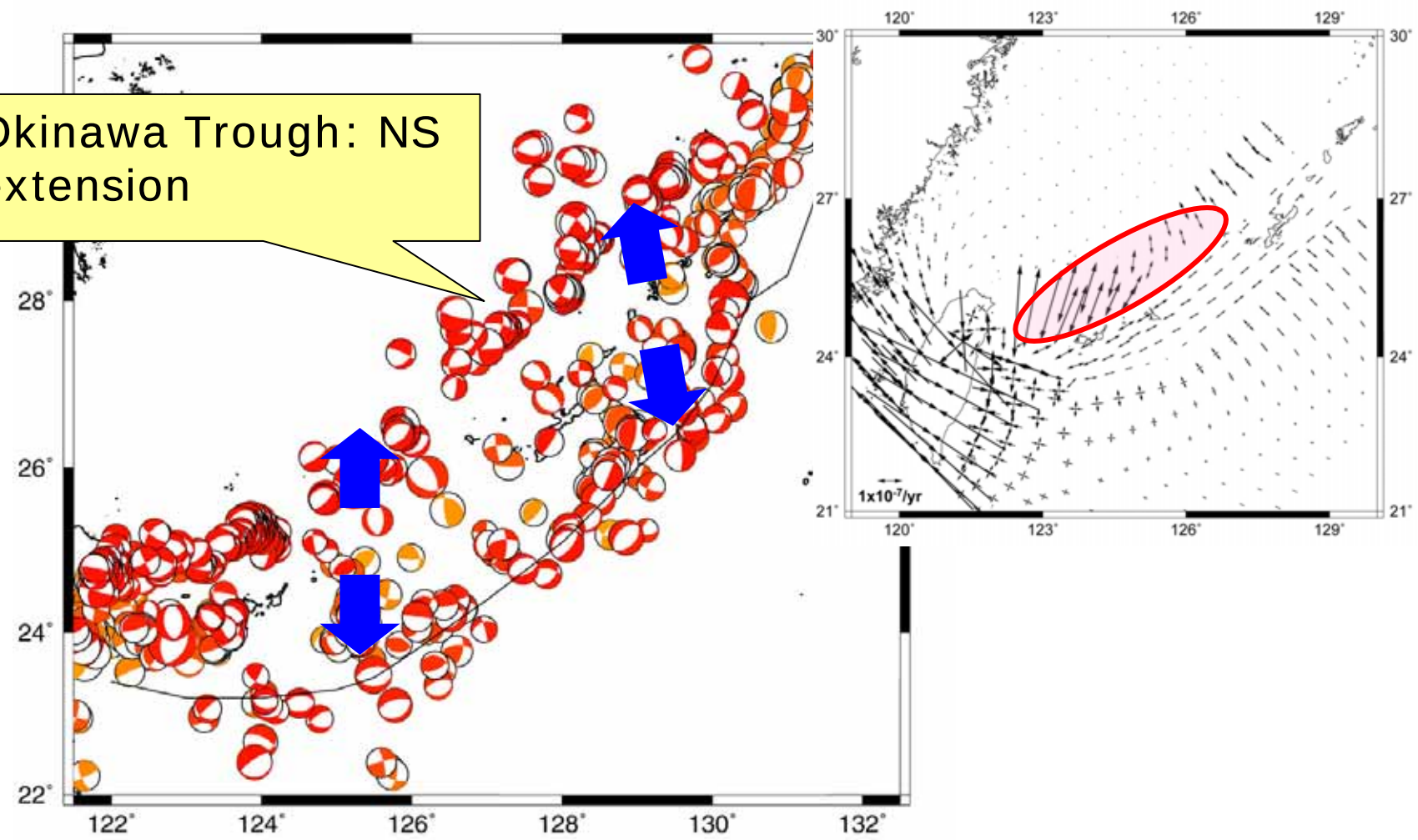
Depression of PHS: -2 cm/yr



Results (2) strain field of EU and PHS

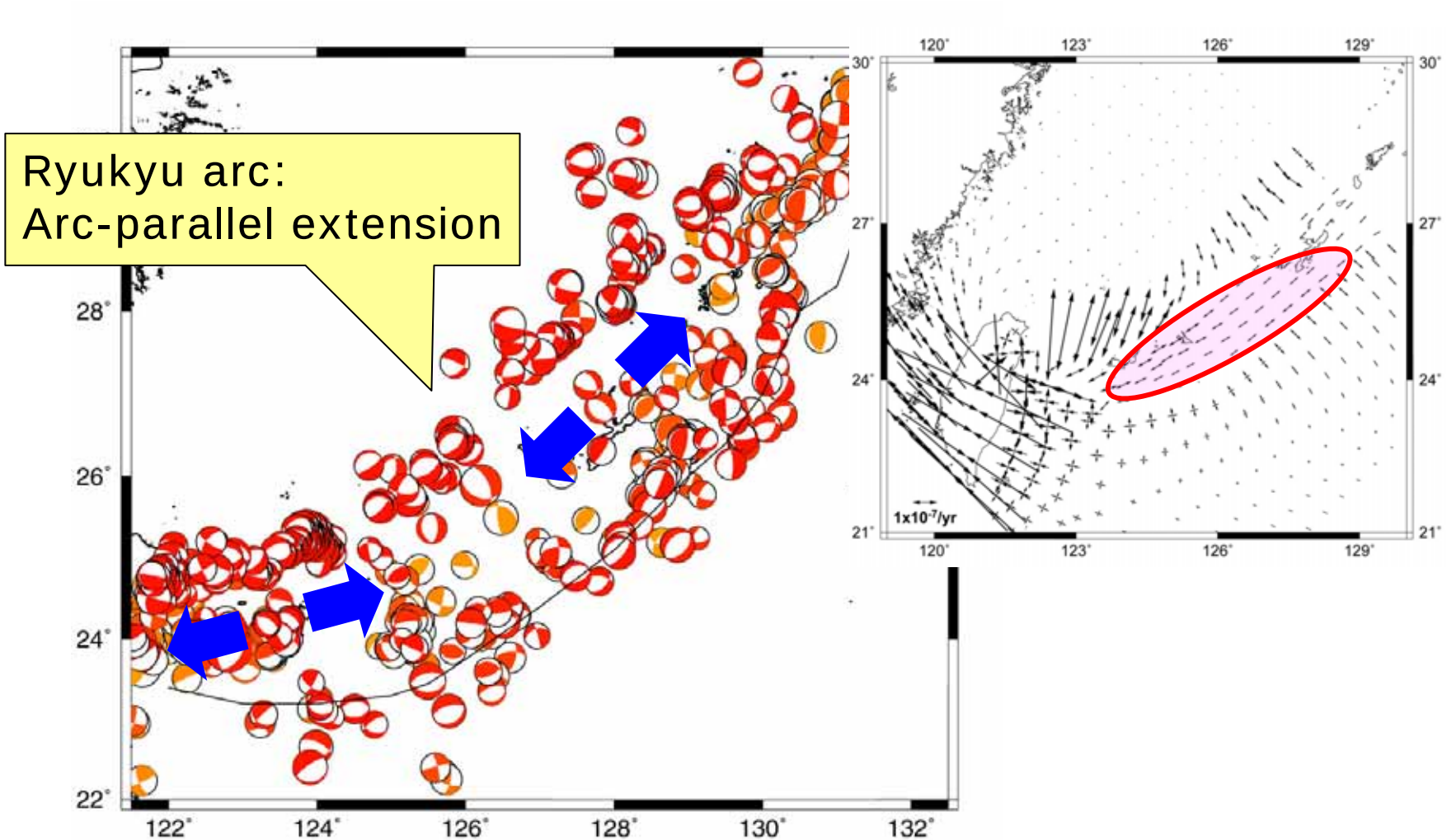


Stress (strain) field in the Okinawa Trough



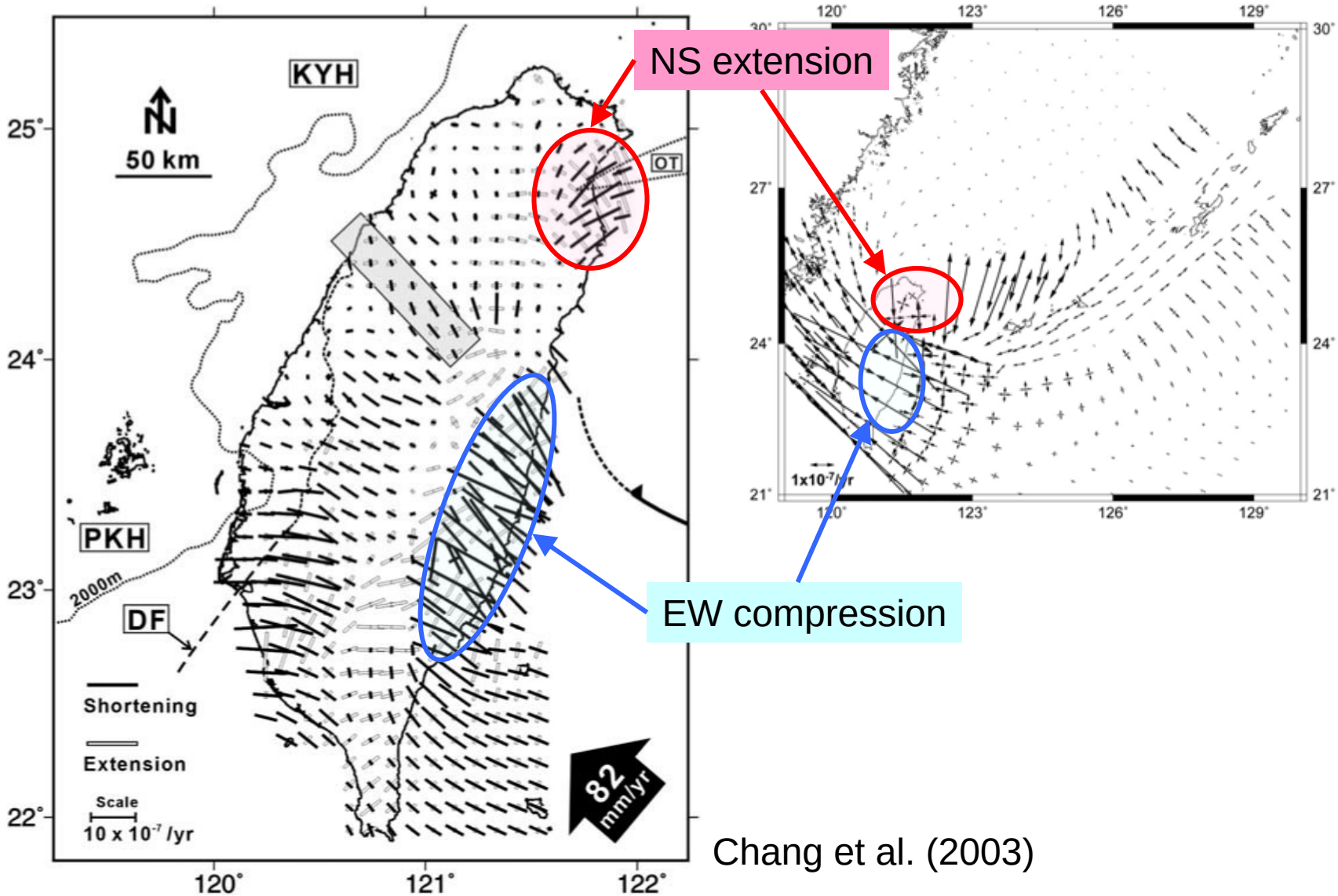
(NIED F-net)

Stress (strain) field in the Ryukyu arc



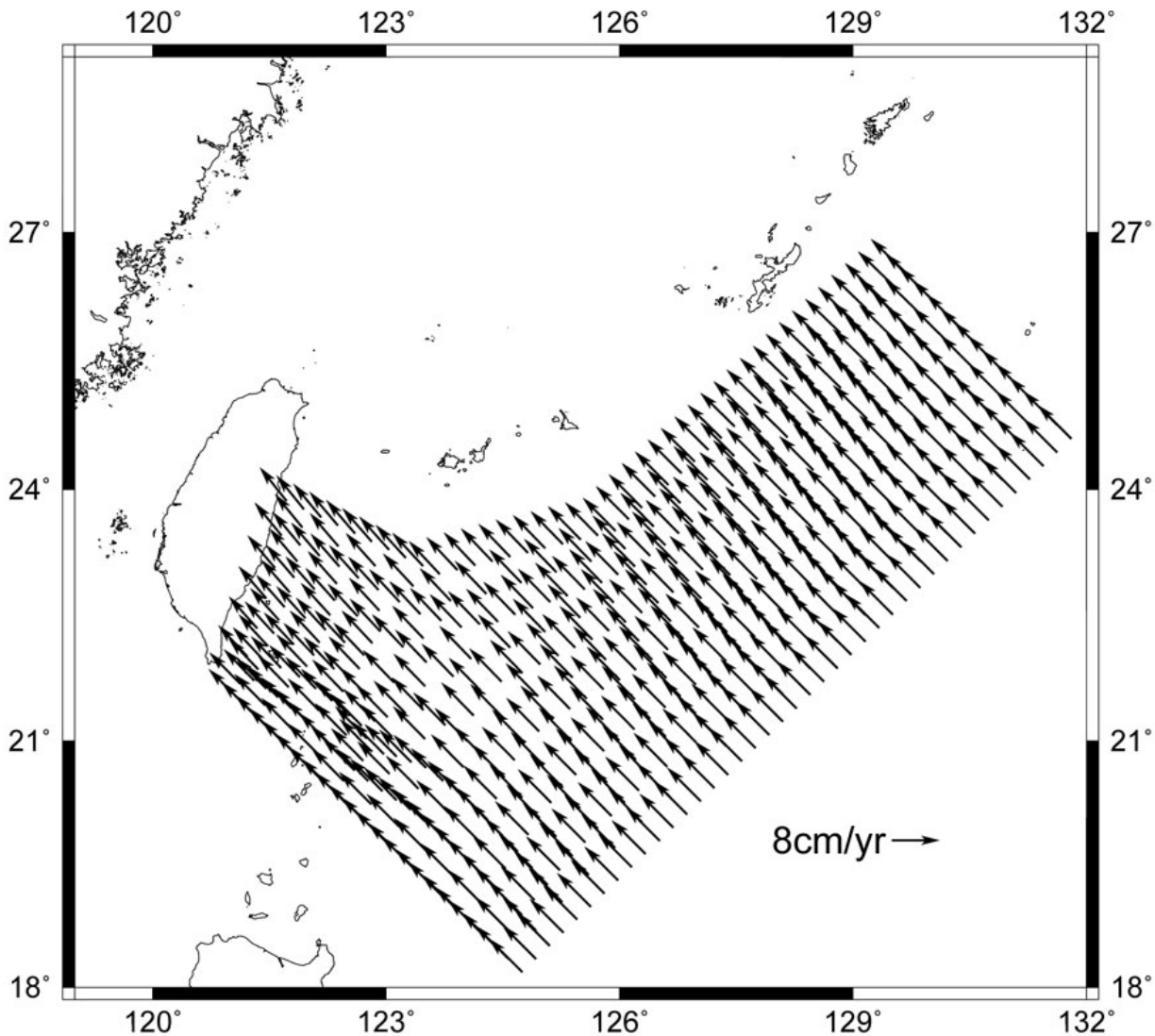
(NIED F-net)

Strain field in the Taiwan

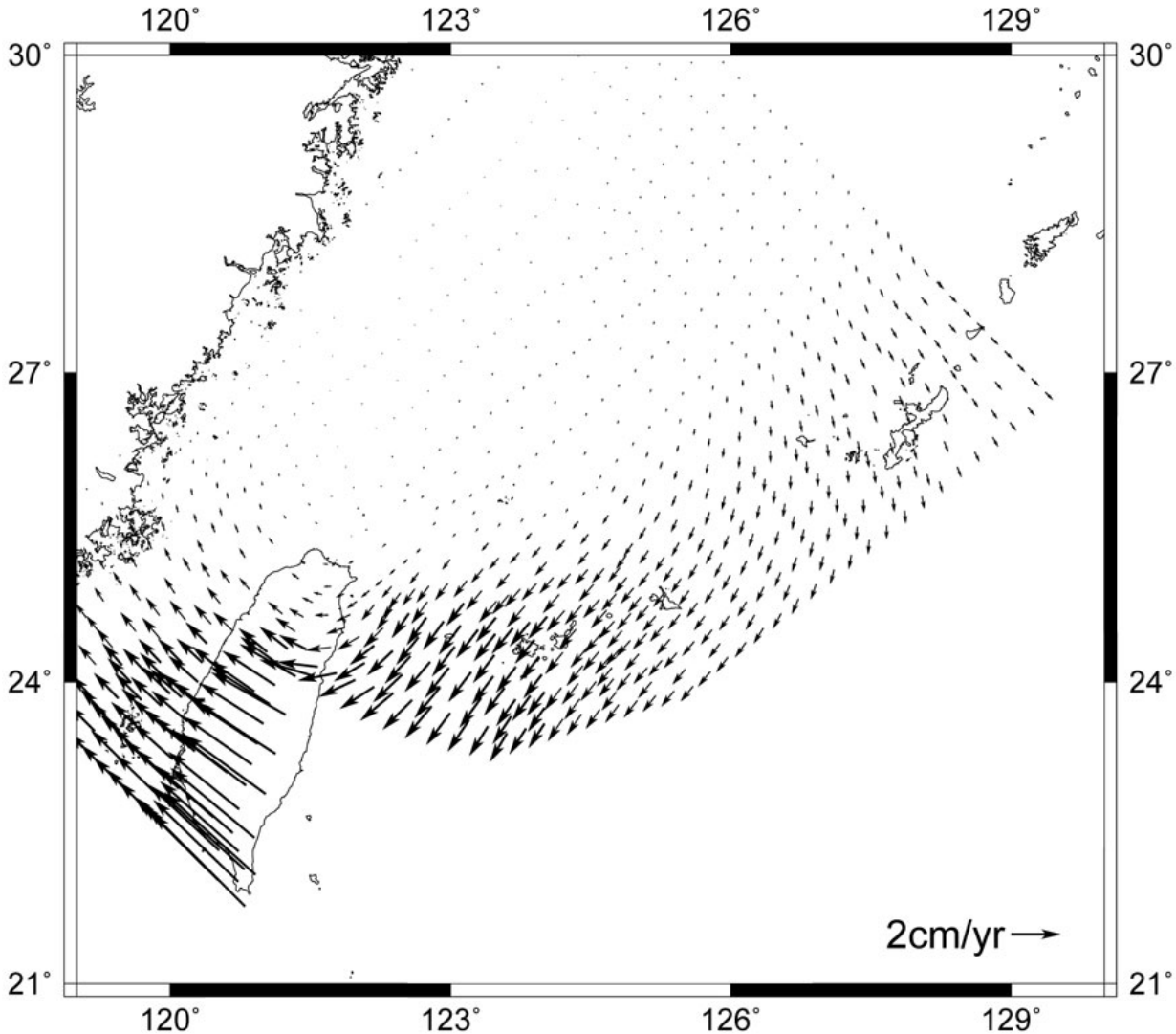


Chang et al. (2003)

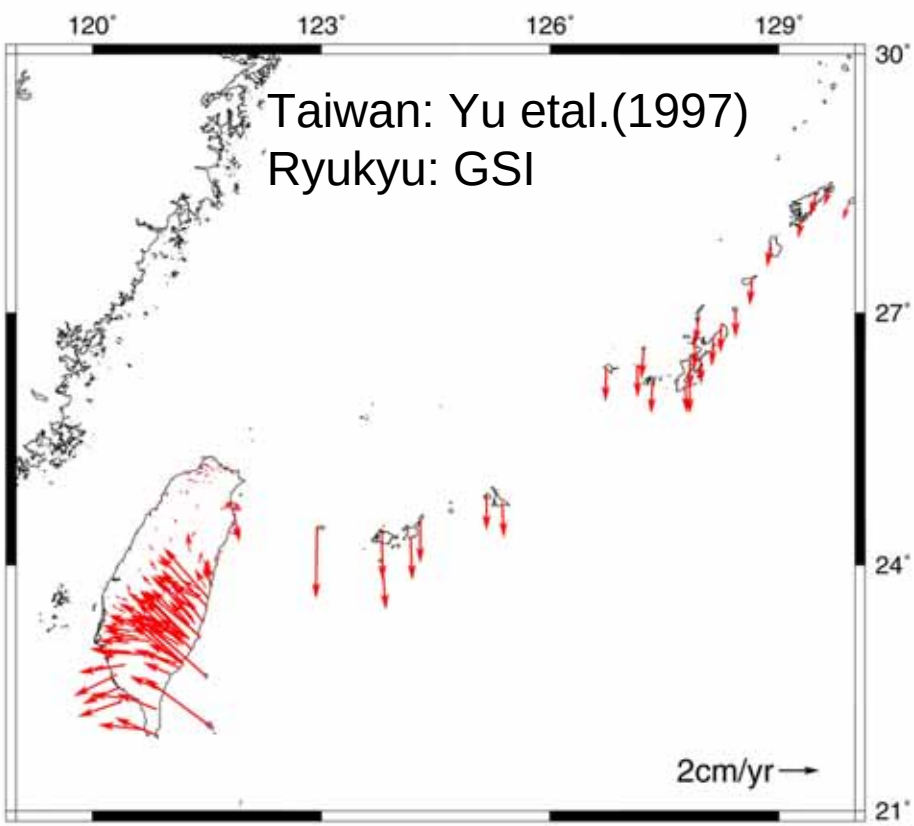
Results (3) velocity field in the PHS

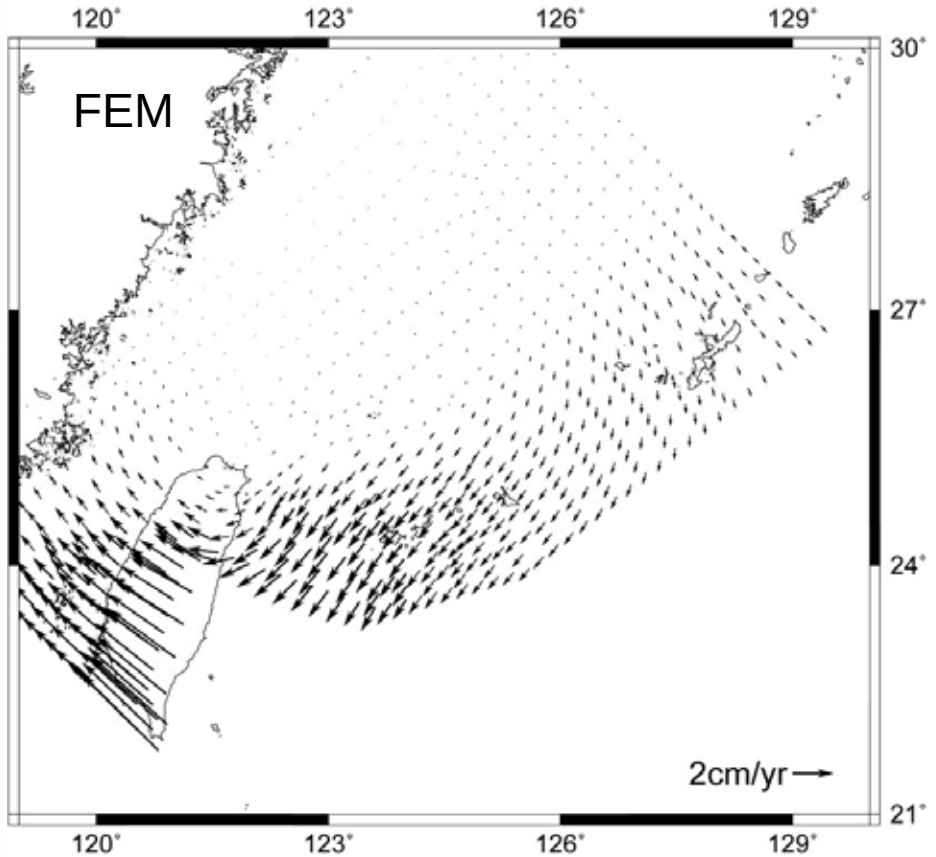


Results (4) velocity field in the EU



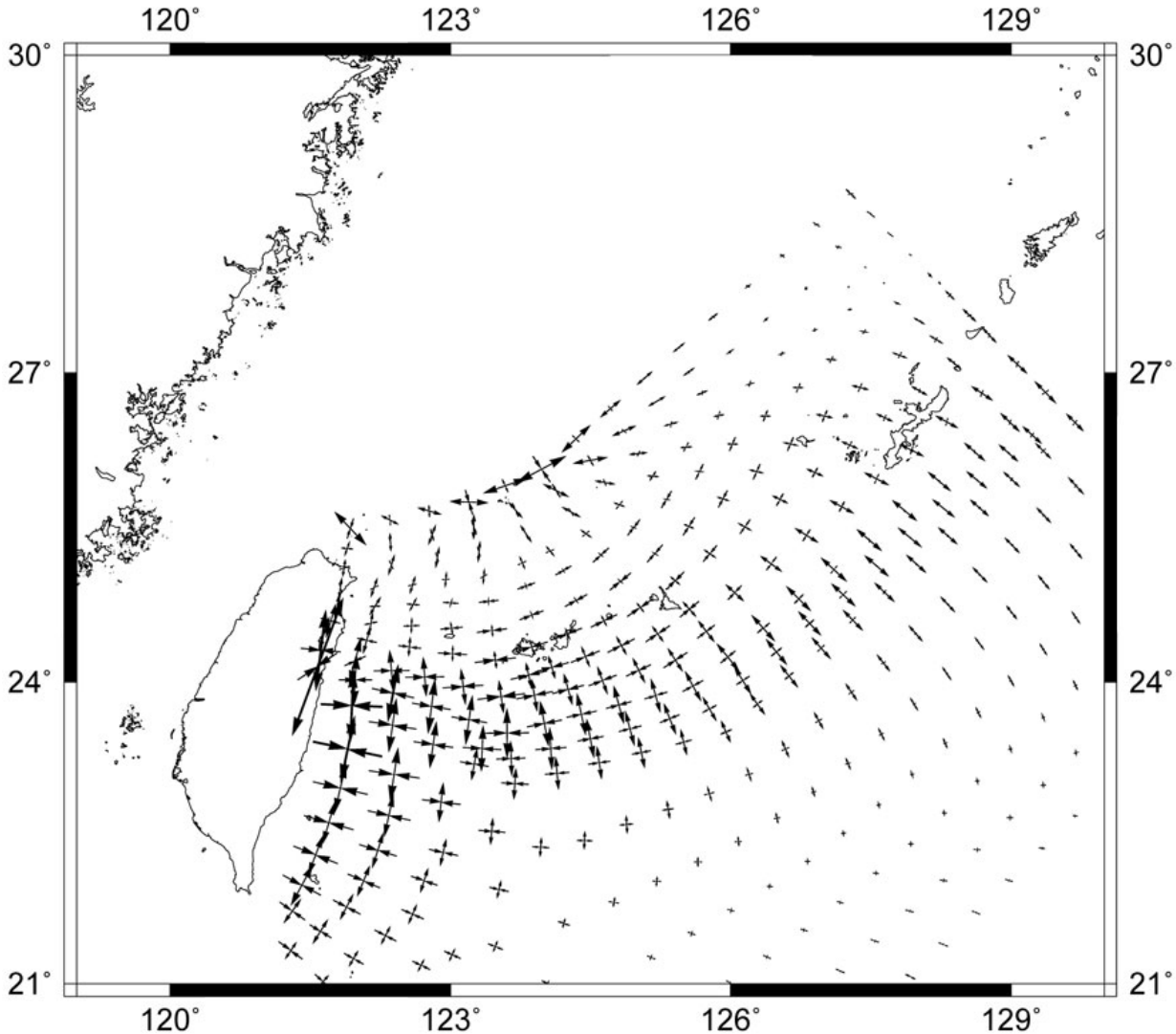
Observed and computed velocity field





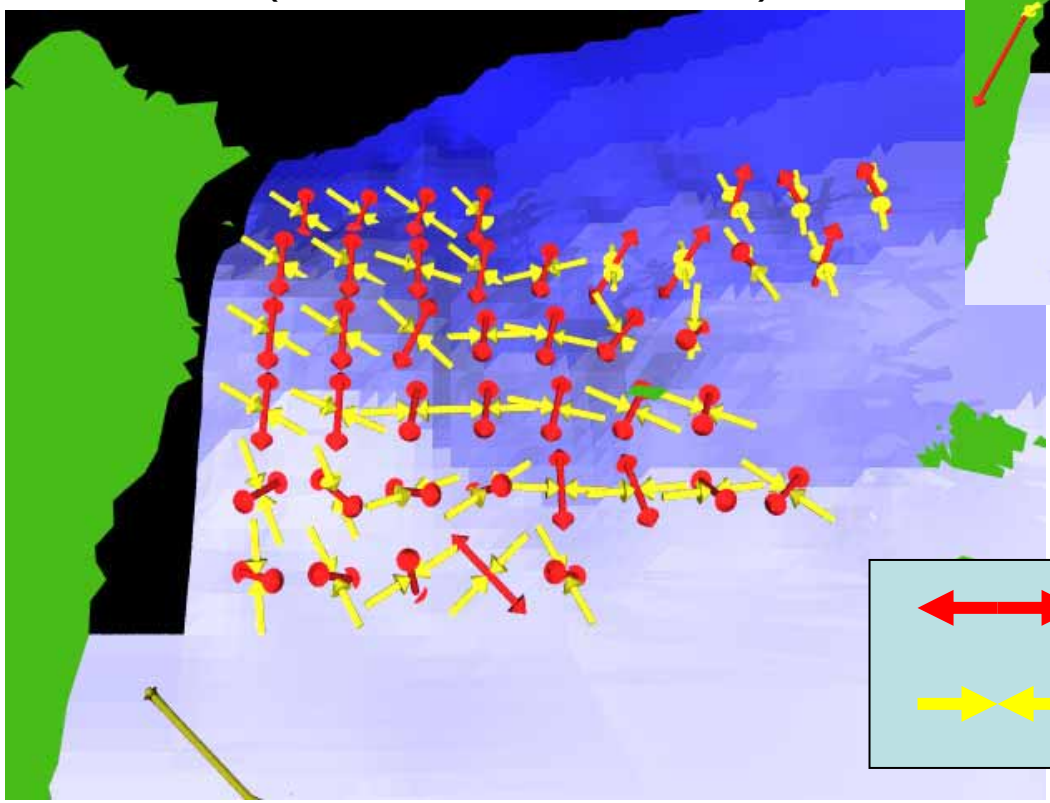
(Shanghai fixed)

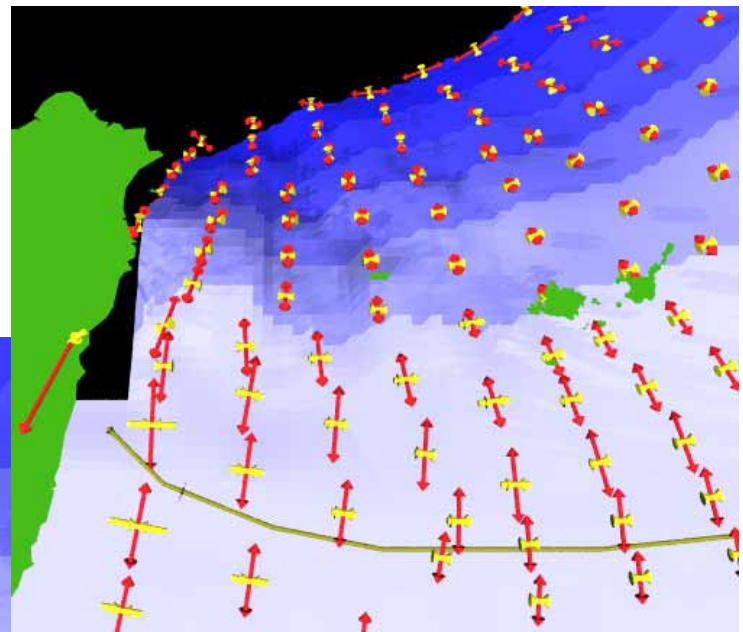
Strain (stress) field in the PHS slab



Observed stress tensor in the slab

Observed (stress tensor inversion)





Computed strain field

extension

compression

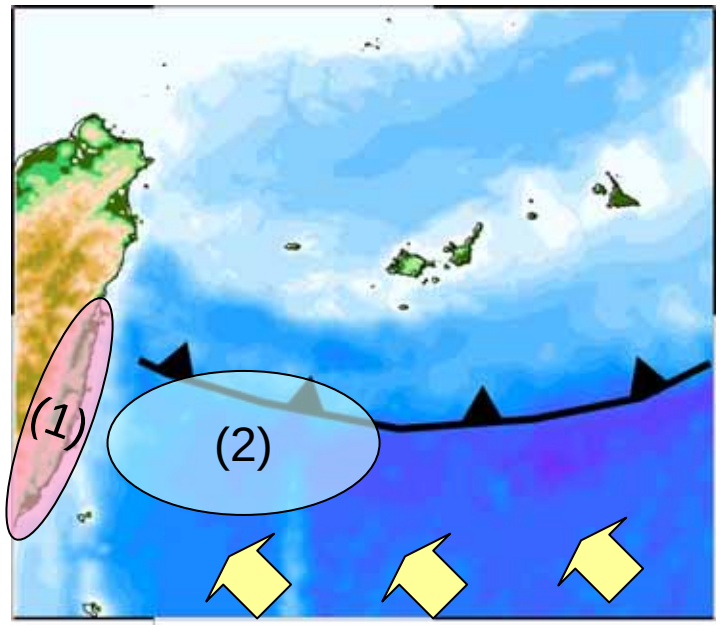
Mechanism from collision to backarc extension

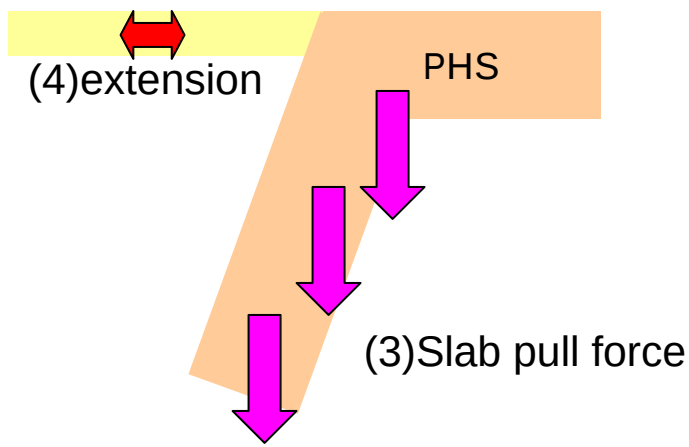
(1) Collision of PHS to Taiwan

(2) Downward bending of PHS

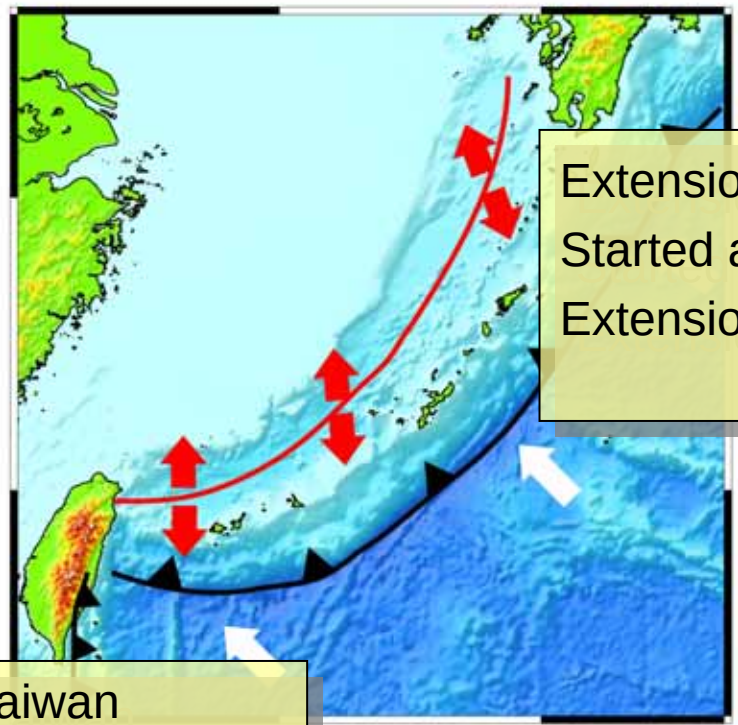
(3) Increase in slab pull force

(4) Backarc extension





Relation between collision and extension

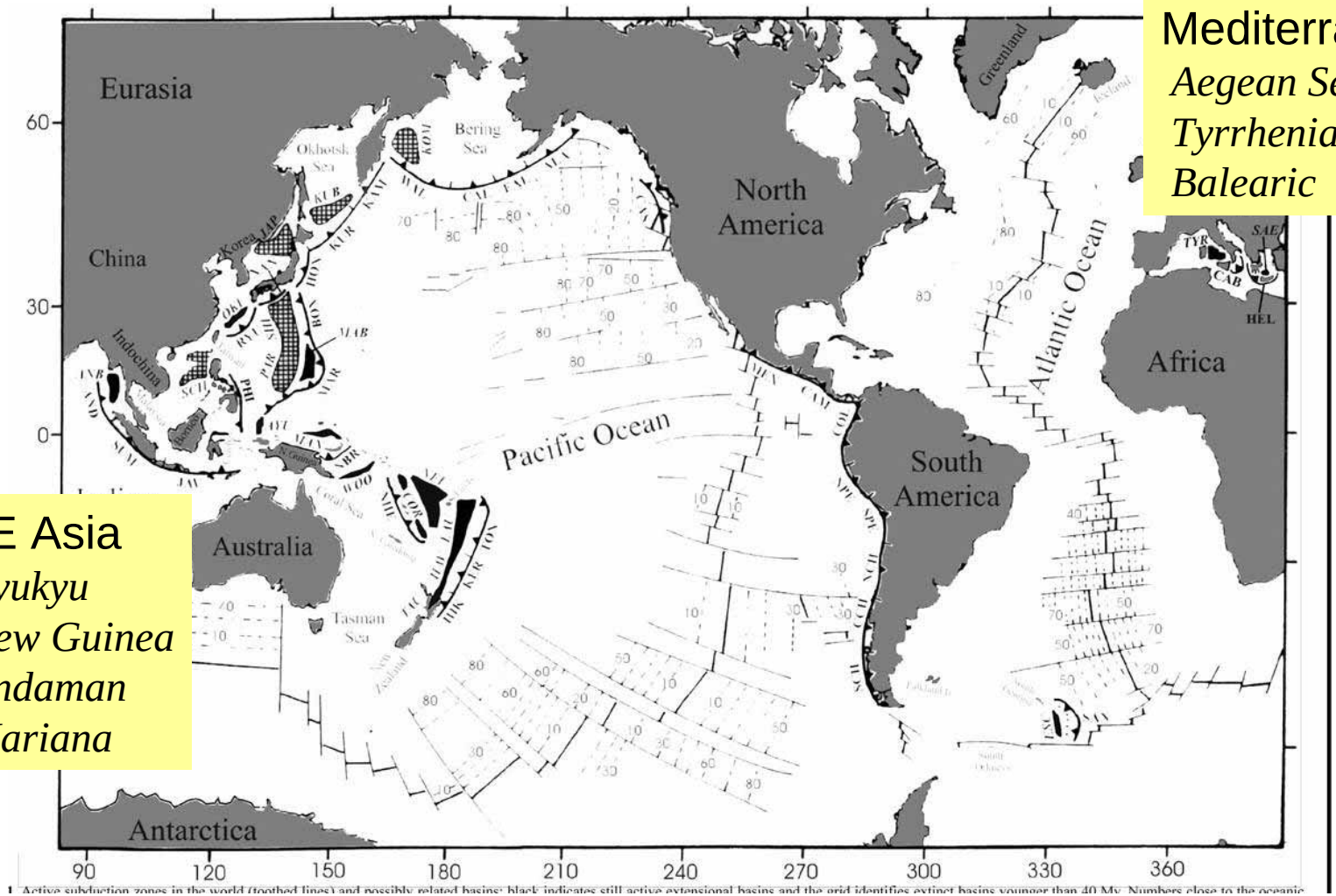


Extension of South Okinawa Trough
Started at 2Ma
Extension rate has increased at 0.12 Ma
(Sibuet et al. 1998)

Uplift of Taiwan
Started at 2 Ma
Accelerated since 2Ma
(Lan et al. 1990)

Collision and extension started at 2Ma.

Collision and backarc extension



Mediterranean
Aegean Sea
Tyrrhenian
Balearic

SE Asia
Ryukyu
New Guinea
Andaman
Mariana

Mantovani et al. (2002)

Conclusions

- PHS-deformation model can explain the strain field in the Taiwan-Ryukyu area.
- Direction of the computed velocity does not correspond to the observed one in southwestern Ryukyu area.
  - Improvement of collision model in Taiwan would be needed.
- Collision induces the bending of subducting plate.
  - Increase in slab pull force and reduce in normal force of plate boundary
  - Driving mechanism of backarc extension in the collision area