

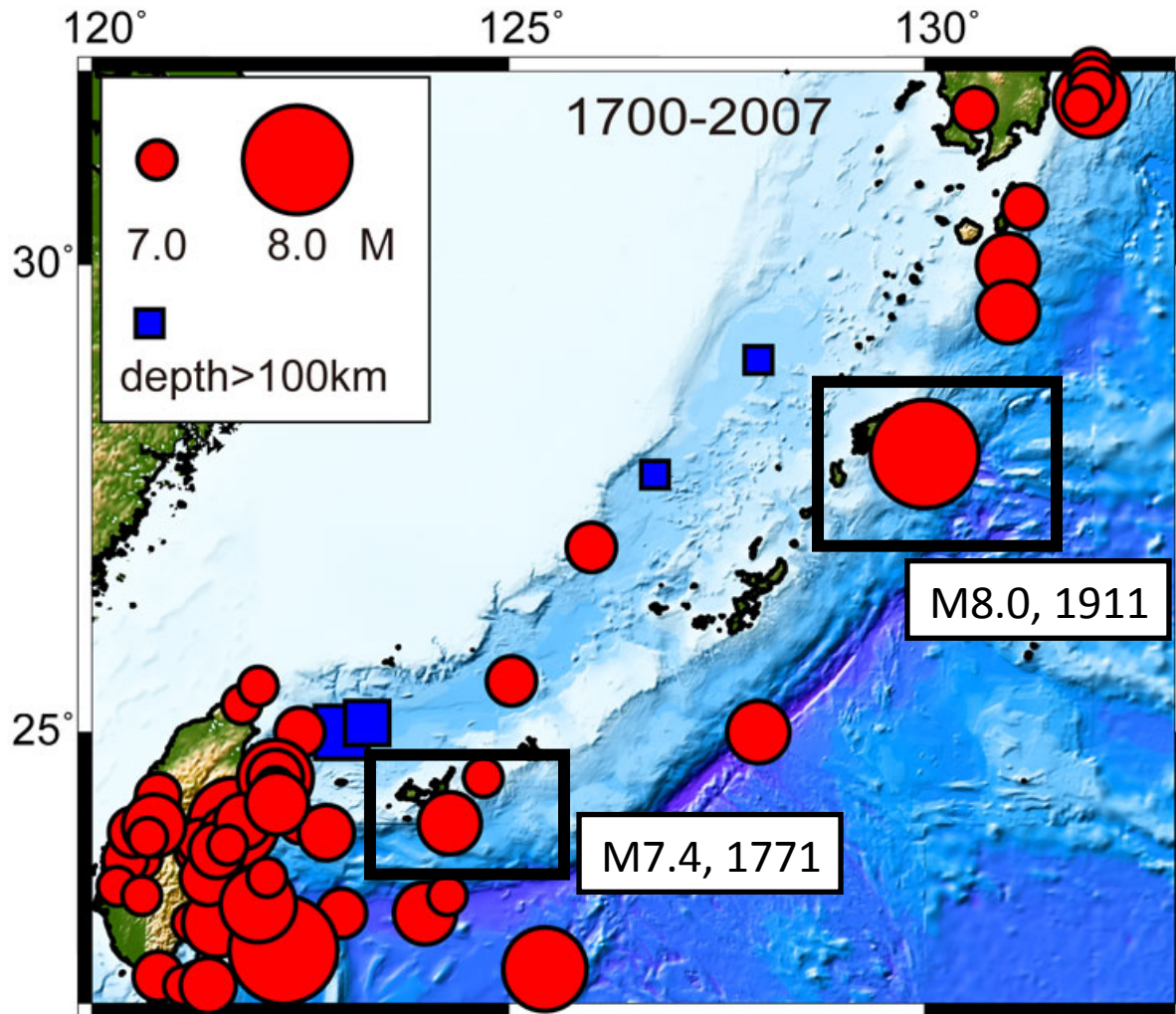
# Observation of Ocean Bottom Crustal Deformation in Ryukyu trench

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Keiichi Tadokoro, Takashi Okuda, Tsuyoshi Watanabe, Kouji Miyata,  
Shingo Sugimoto (Nagoya Univ.)

Masataka Ando (Academia Sinica, Taiwan)

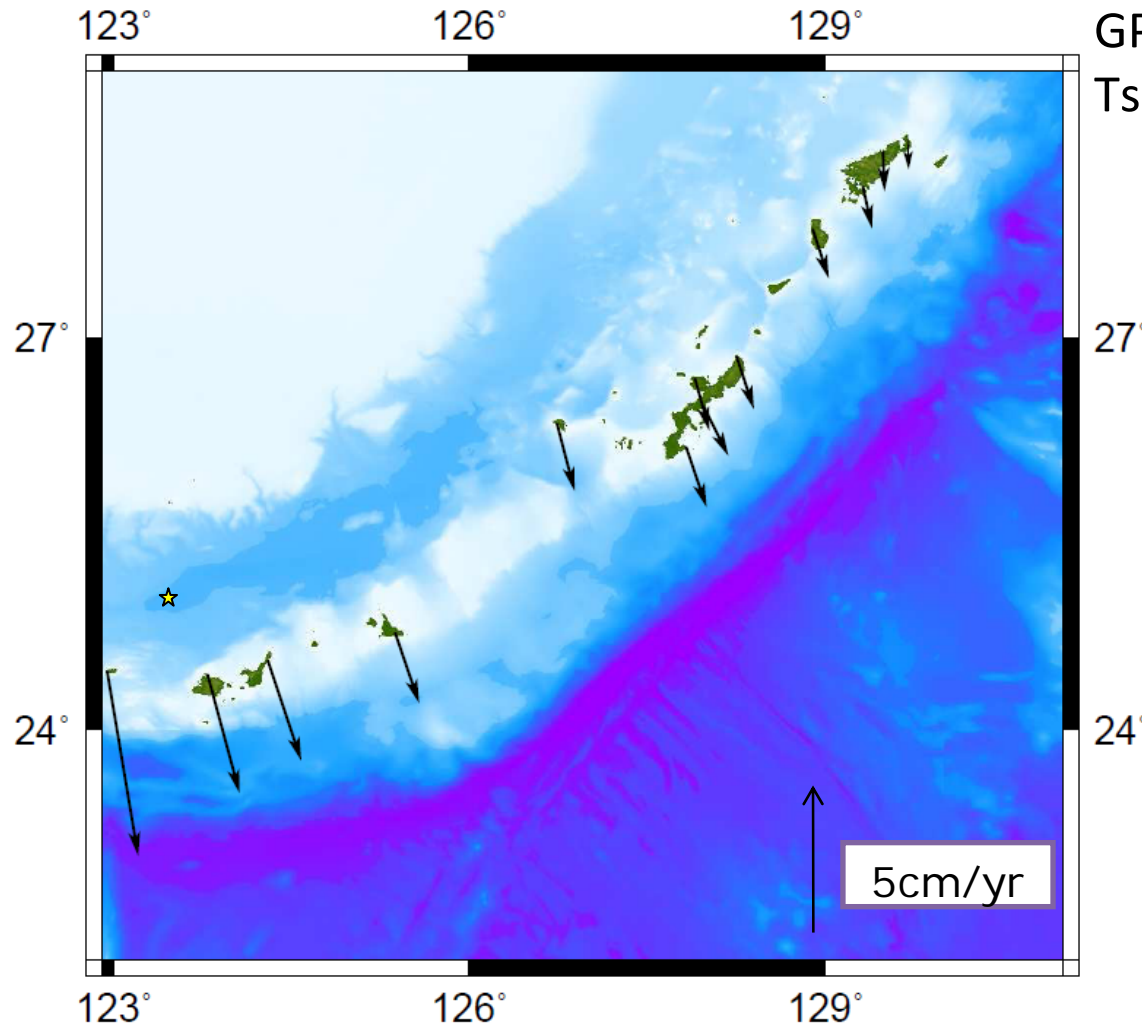
# Historical large earthquakes (1700-2007)



No inter-plate earthquakes  
in Ryukyu Trench



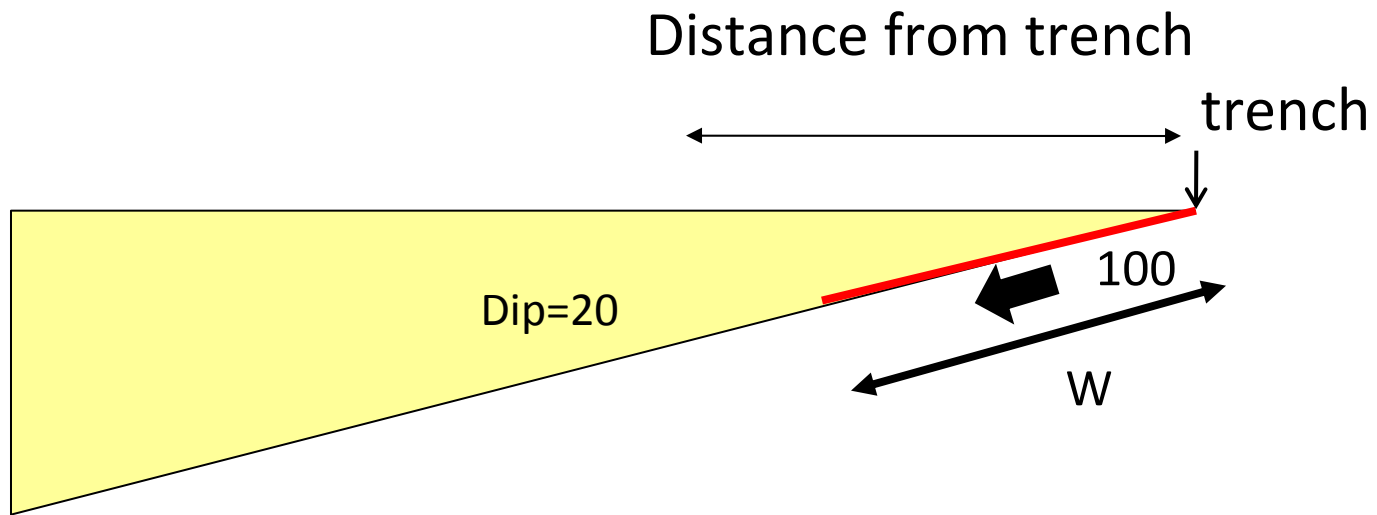
# GPS velocity field in Ryukyu area



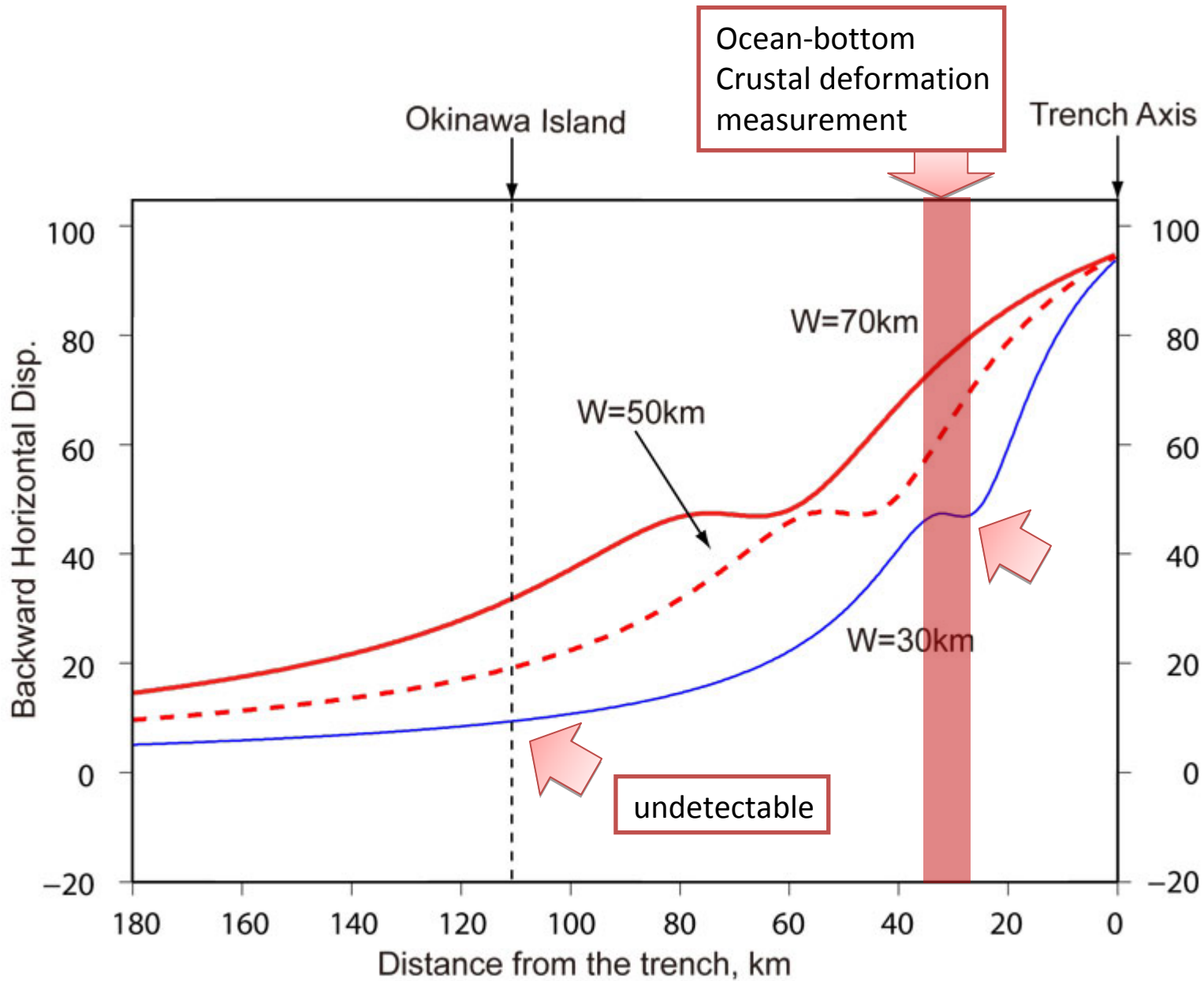
GPS horizontal velocity (1997-2006)  
Tsushima is fixed.

Non-coupled area in Ryukyu  
Trench?

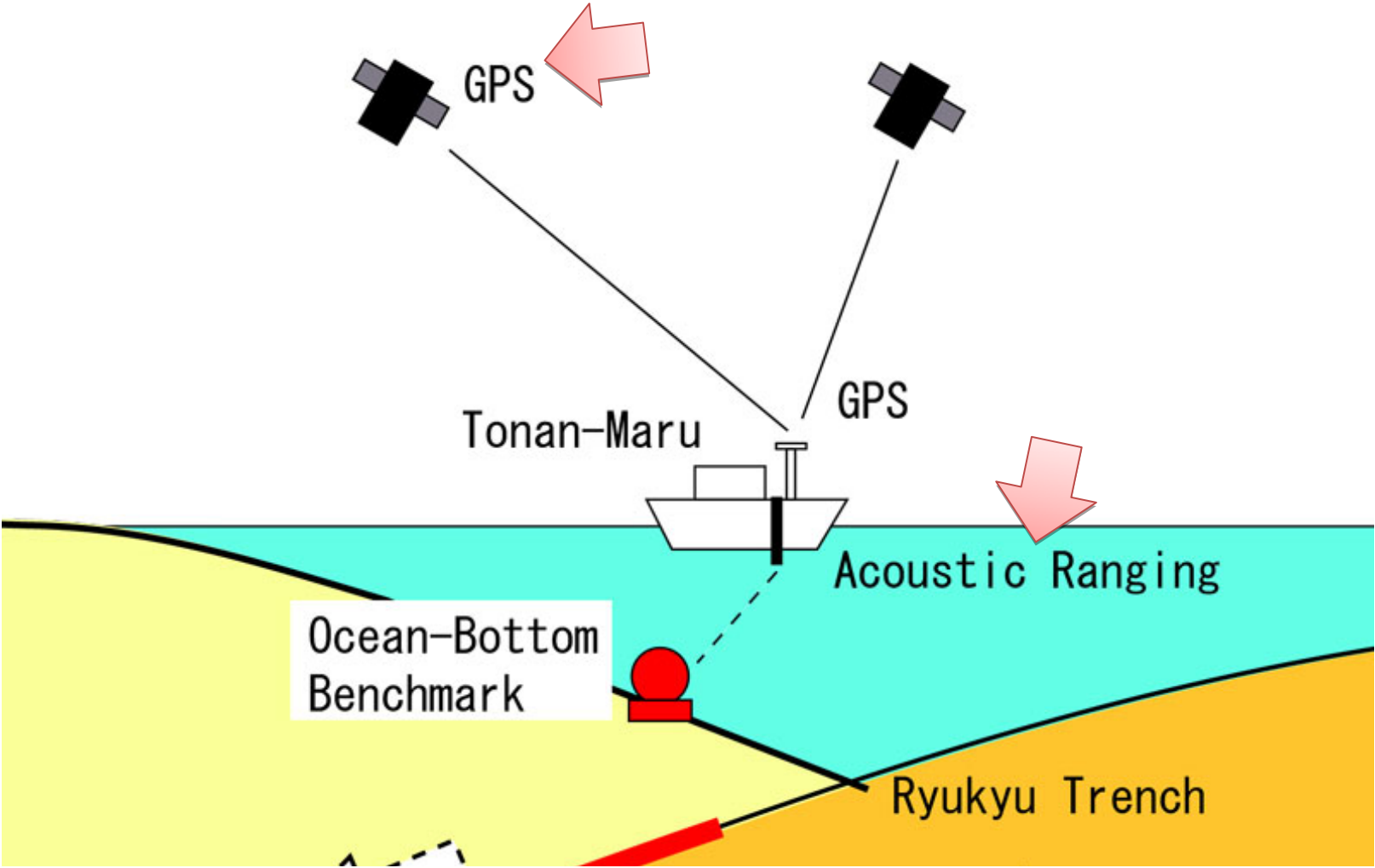
# Horizontal displacement by Back-slip model

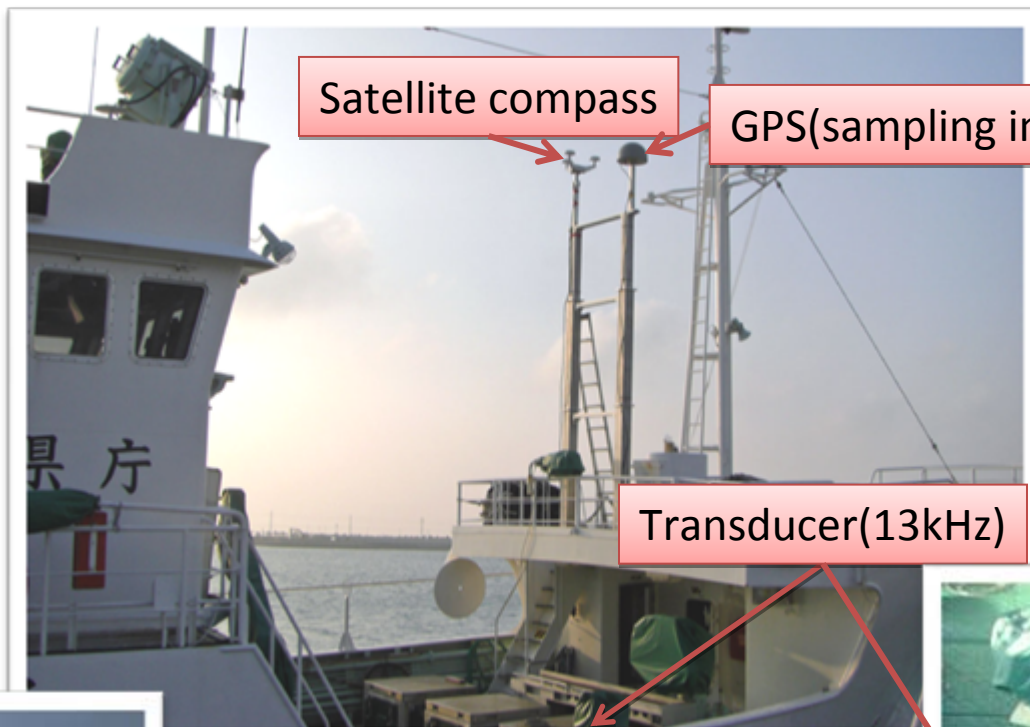


# Result of back-slip model



# Ocean-bottom crustal-deformation measurement

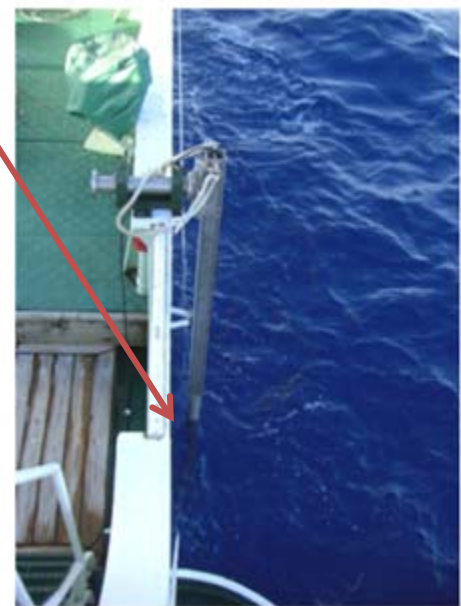




Satellite compass

GPS(sampling interval:0.2Hz)

Transducer(13kHz)

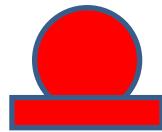
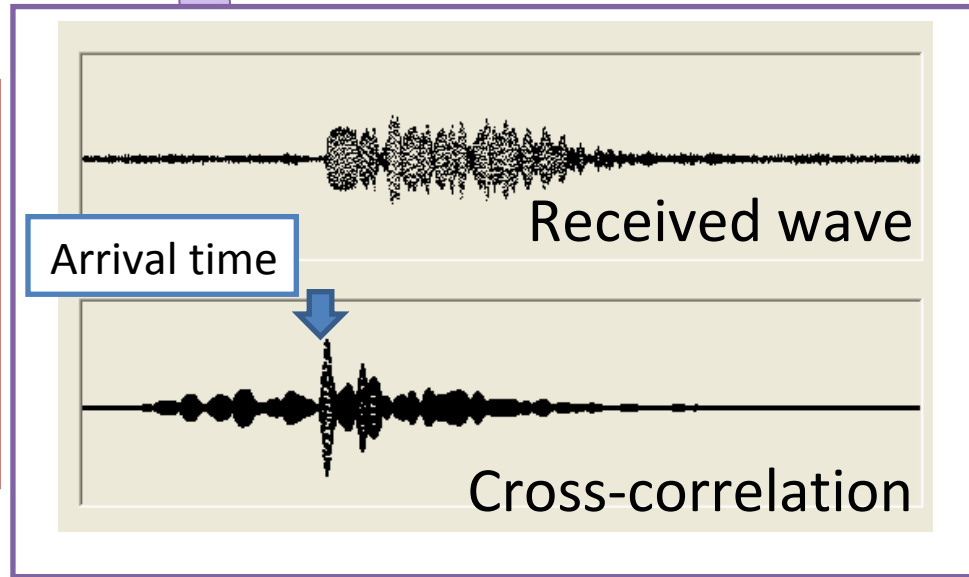
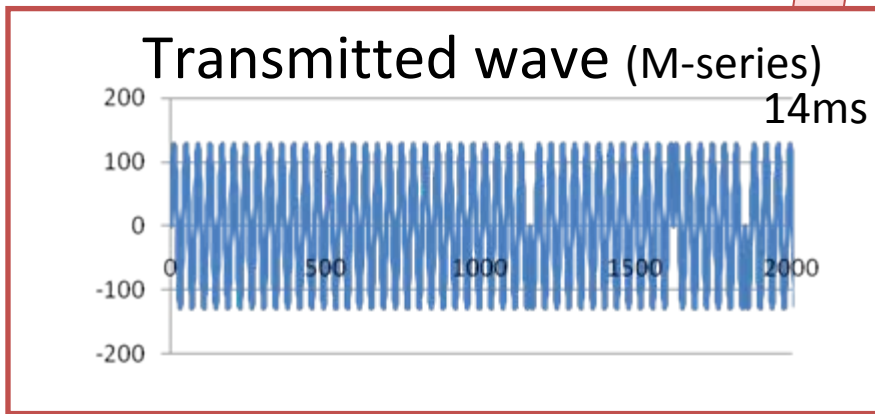
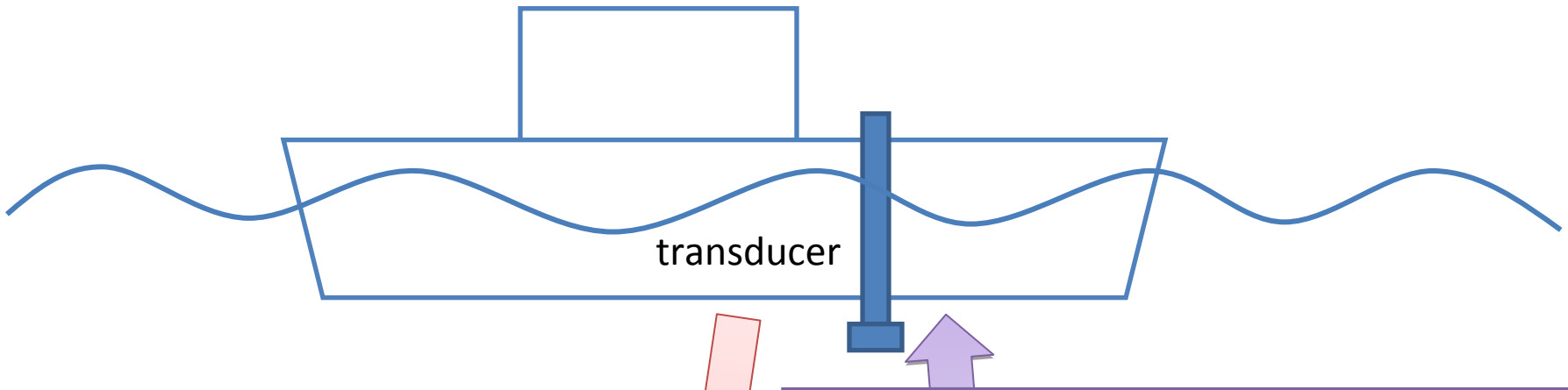


Tonan-Maru (176t)  
(Okinawa Prefectural Fisheries  
and Ocean Research Center )



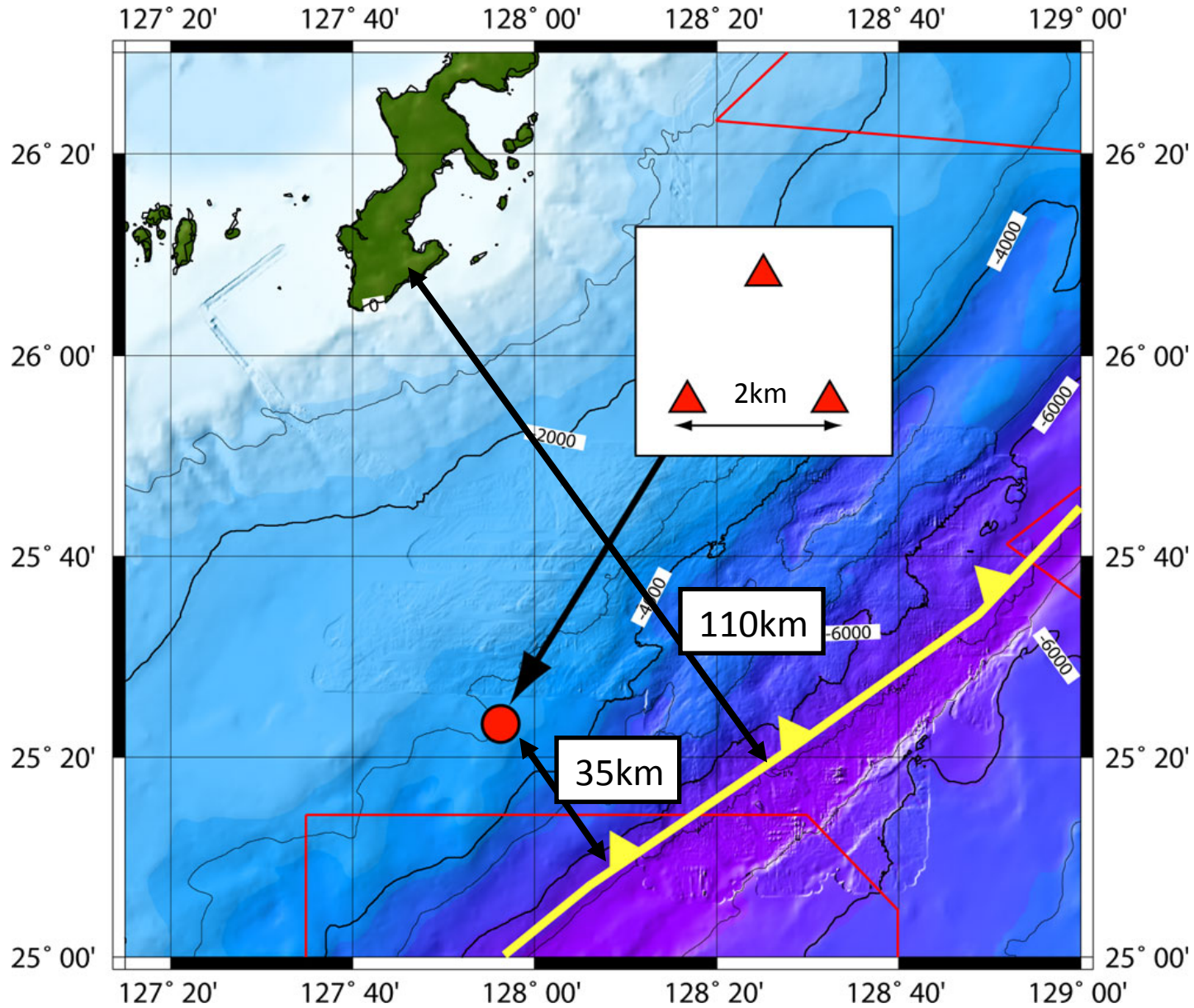
transducer





Software for analysis of ocean-bottom  
crustal deformation:  
OCDASAN (Nagoya Univ.)

# Ocean-bottom crustal deformation measurement in central Ryukyu trench



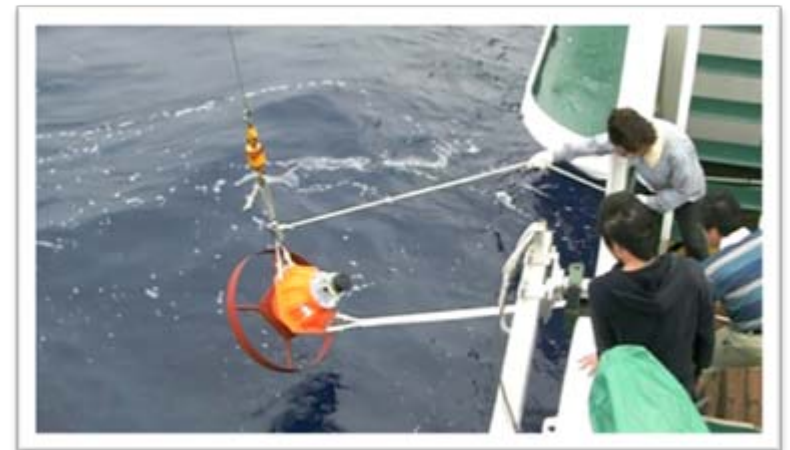
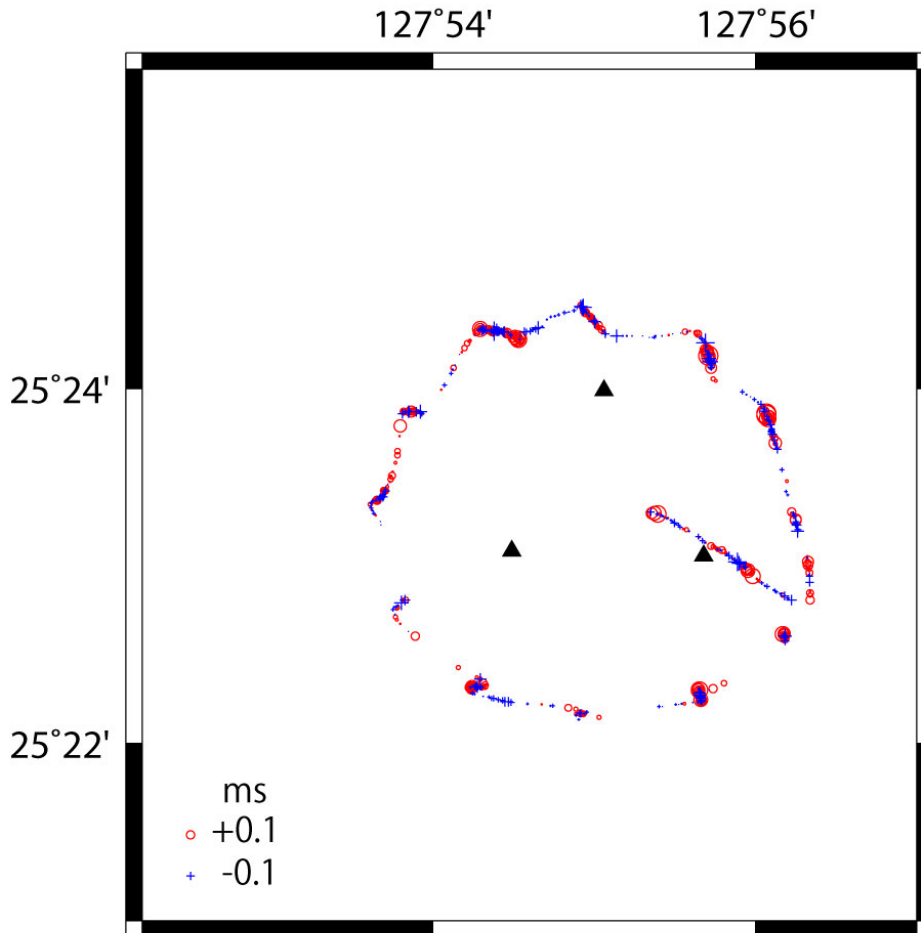
# First observation (15-17 January 2008)

Observation period: 48 hours  
(used: 12 hours)

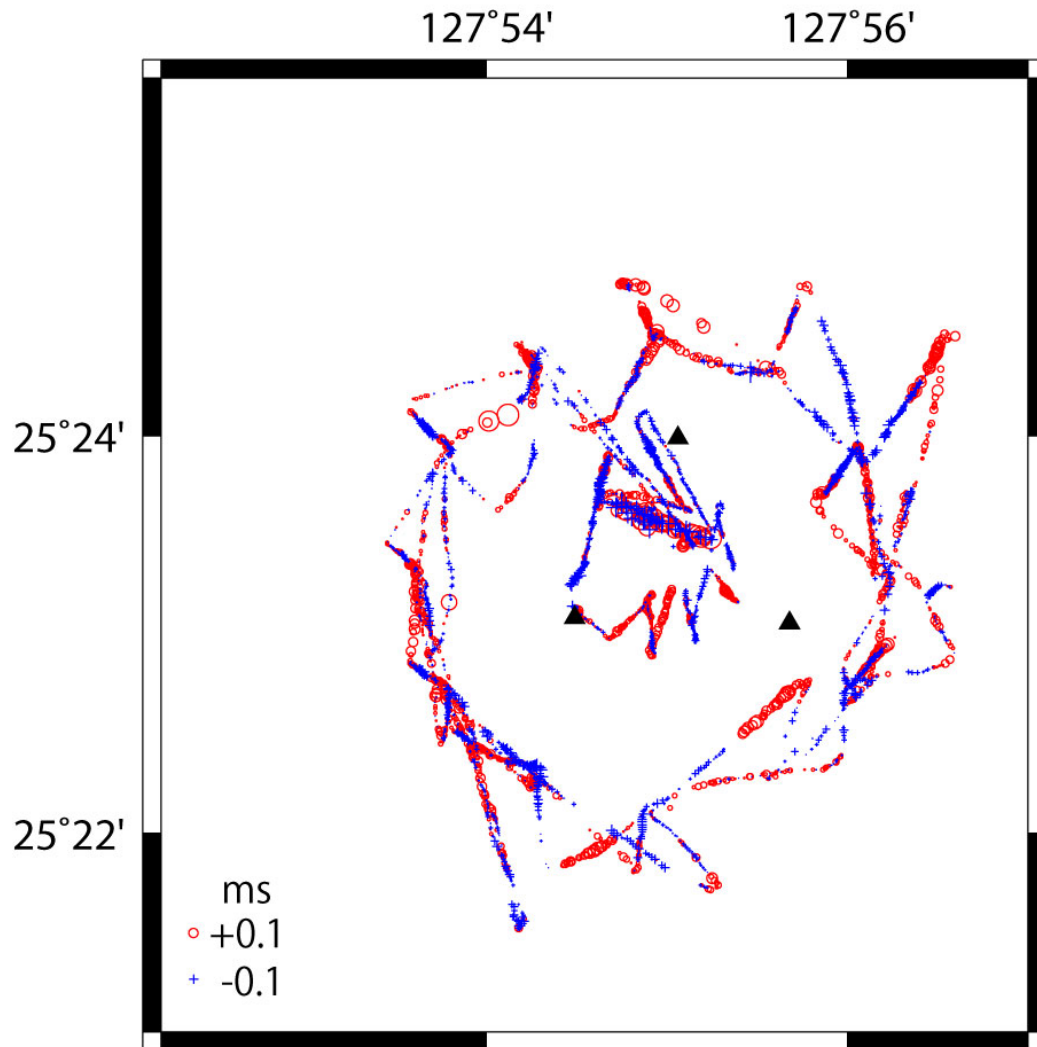
CTD: 3 hours interval

Events: 1045

rms(O-C): 0.064ms



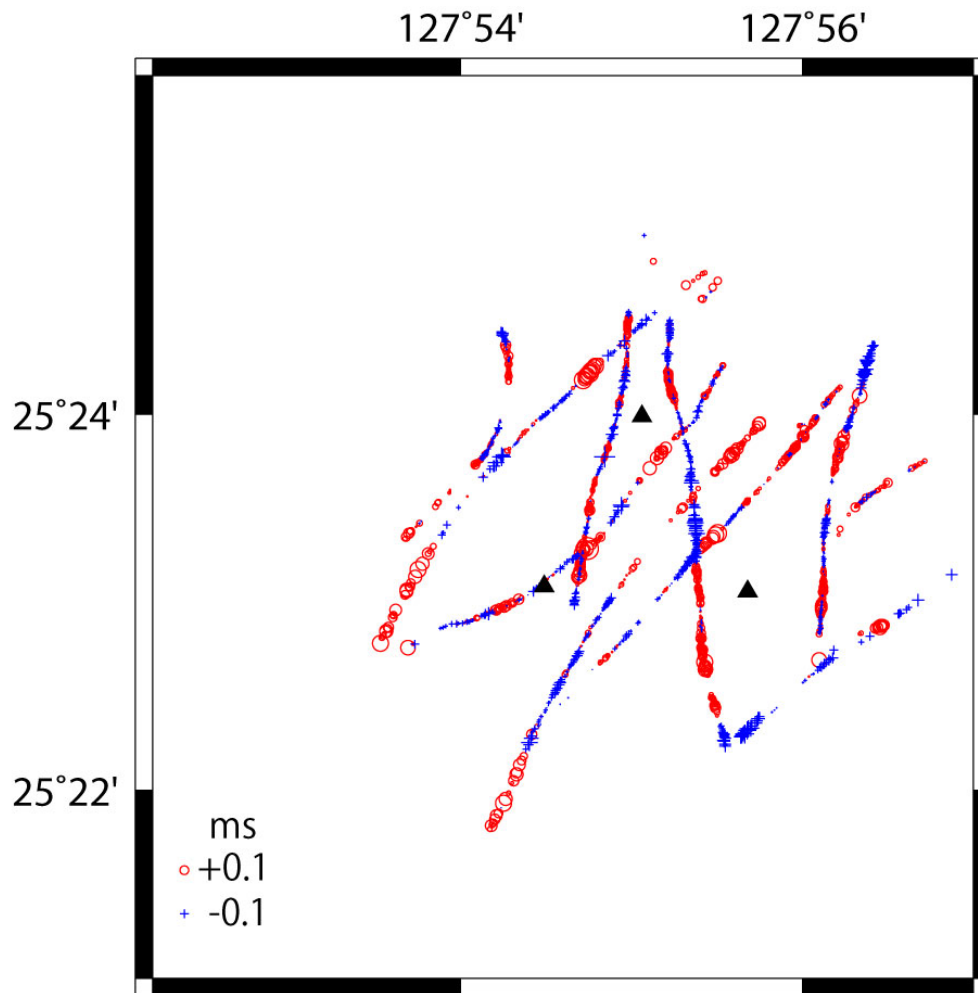
# Second observation (25-27 February 2008)



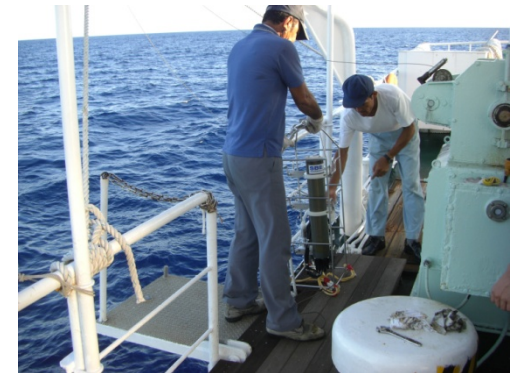
Observation period: 43 hours  
CTD: 3 hours interval  
events: 5113  
rms(O-C): 0.066ms



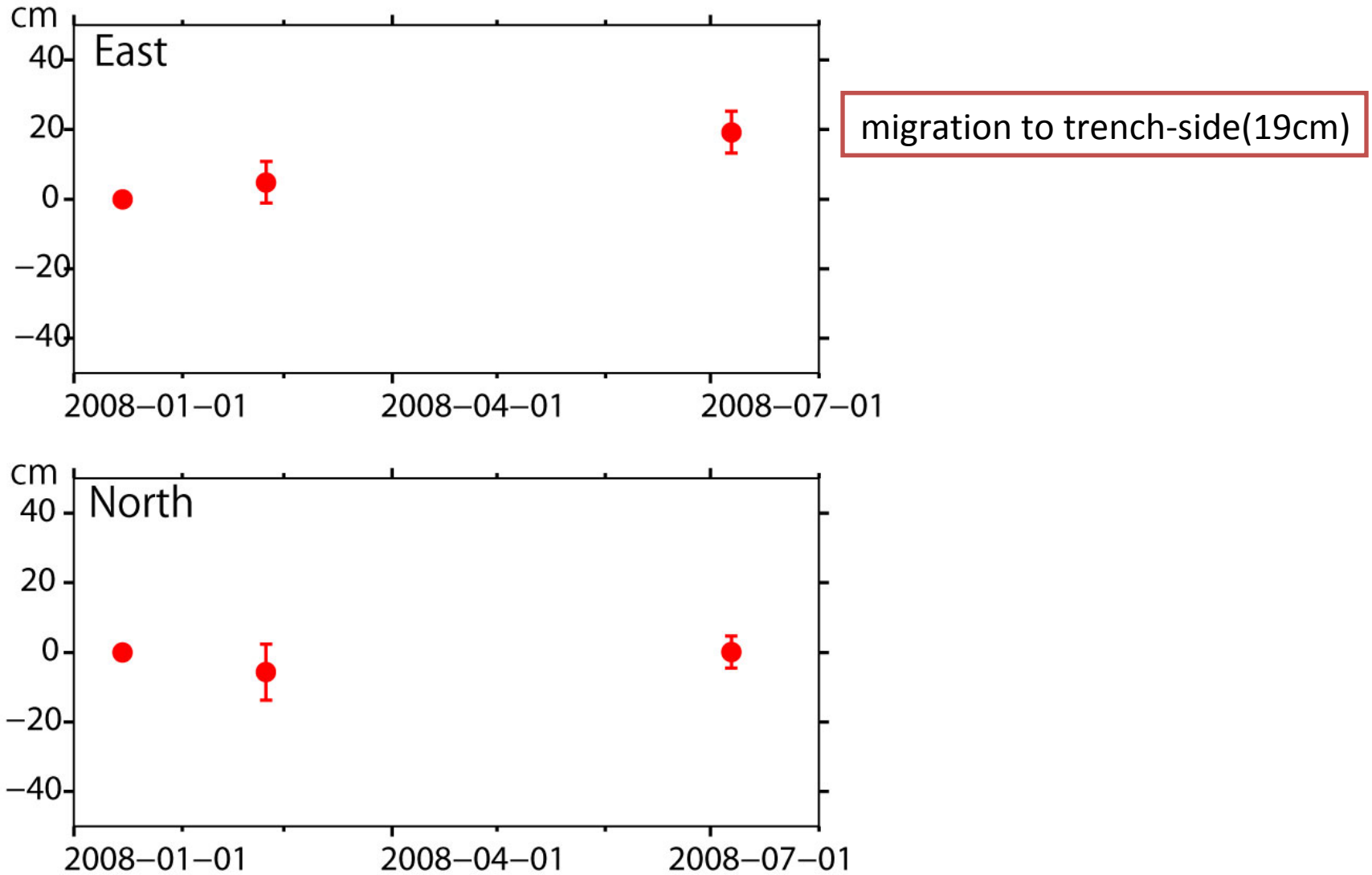
# Third observation(7-9 July 2008)



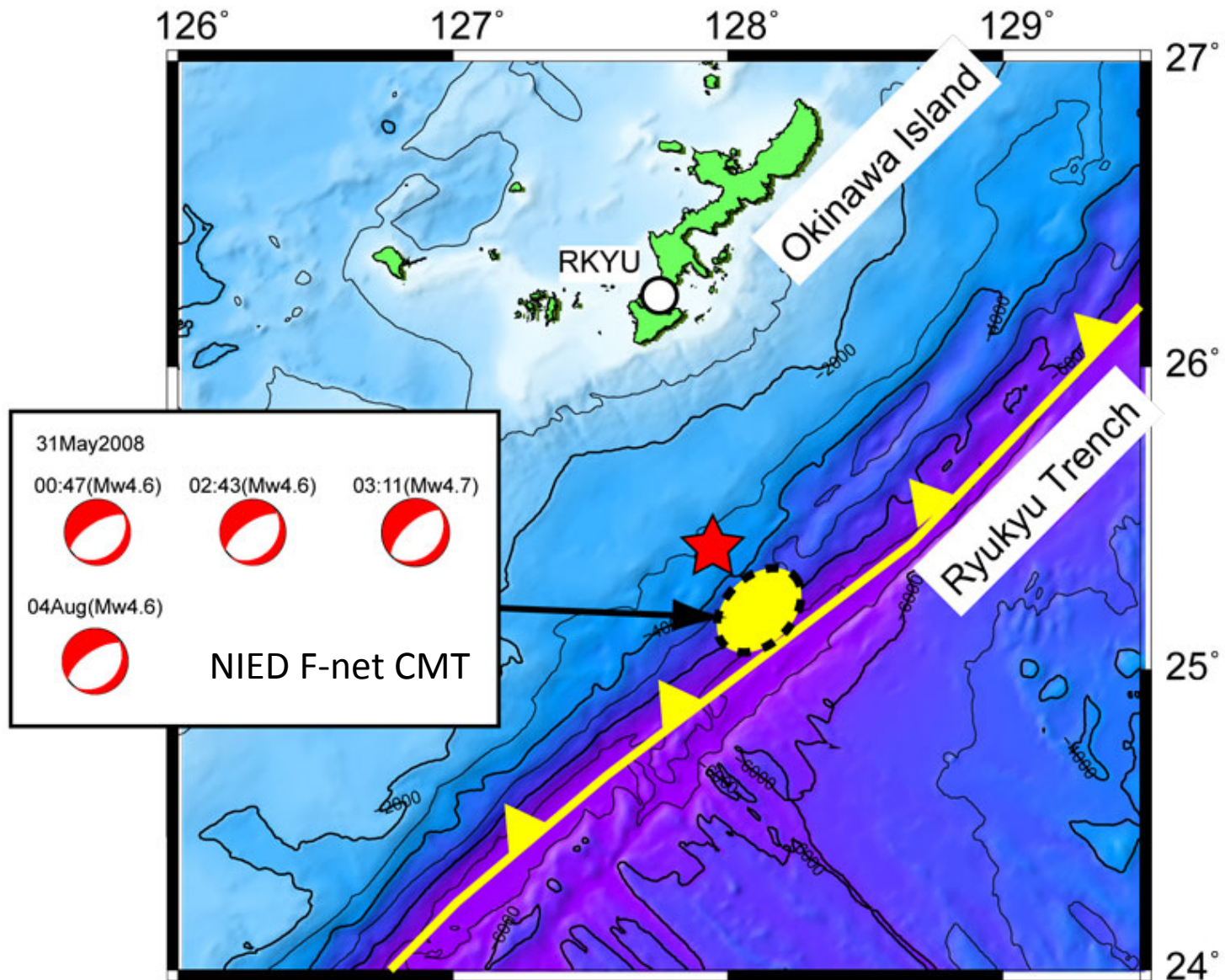
Observation period:45 hours  
CTD: 6 hours interval  
Events:2379  
rms error: 0.058ms



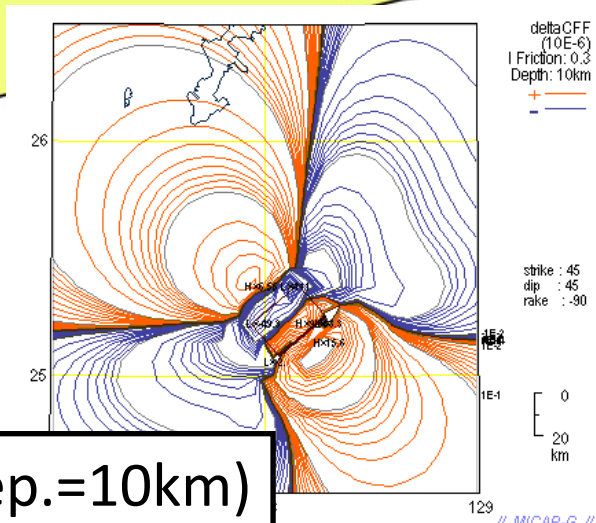
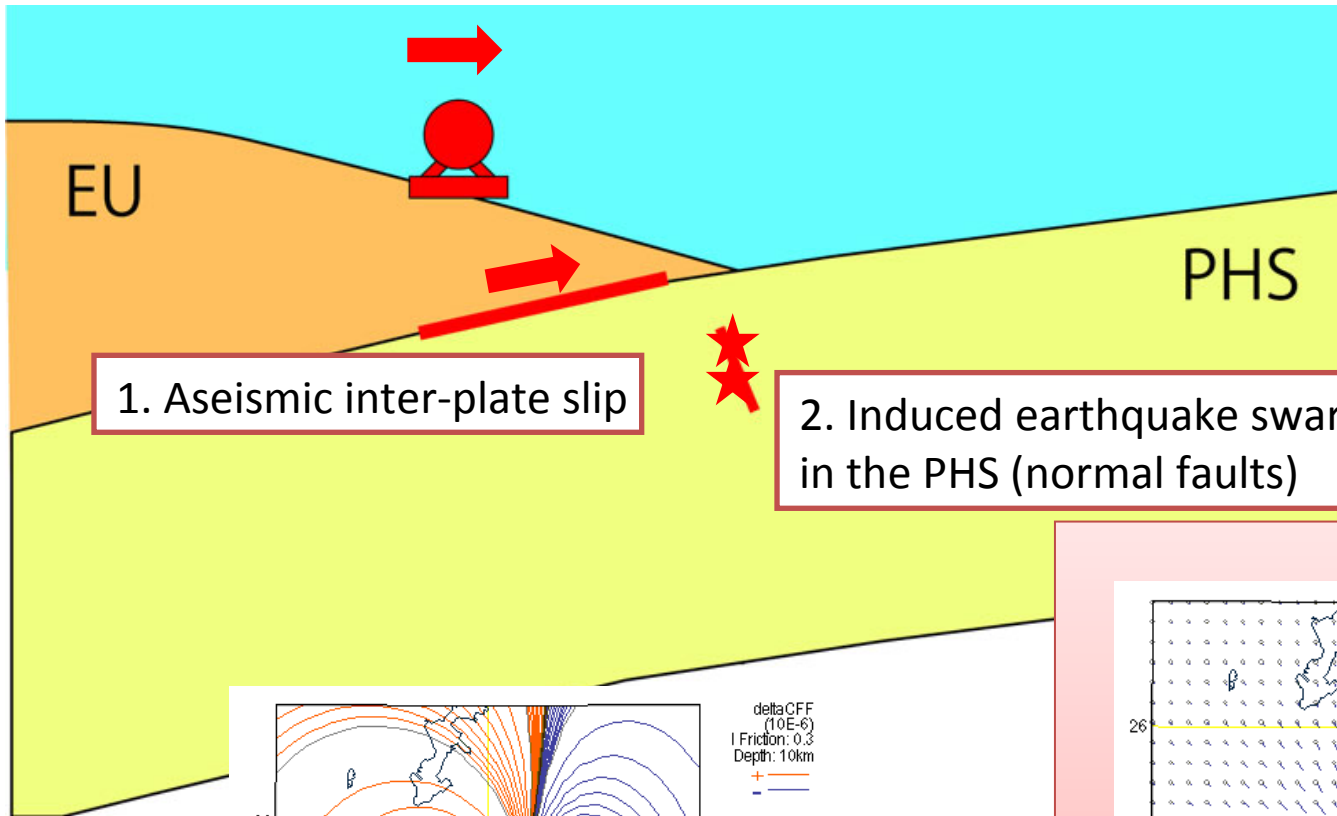
# Result of ocean-bottom crustal deformation measurements



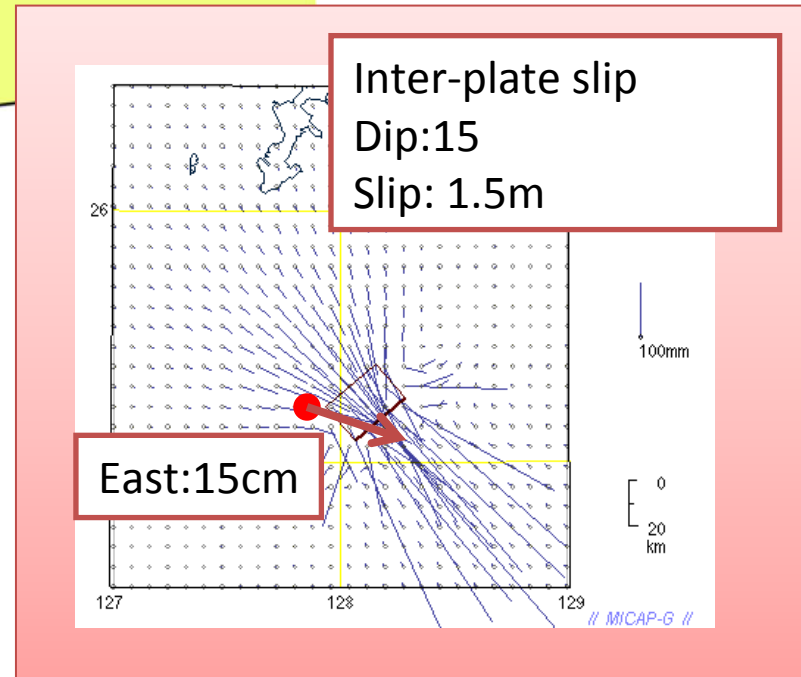
# Seismic swarm near the trench



# Interpretation 1: aseismic slip in the inter-plate



DCFF(dep.=10km)

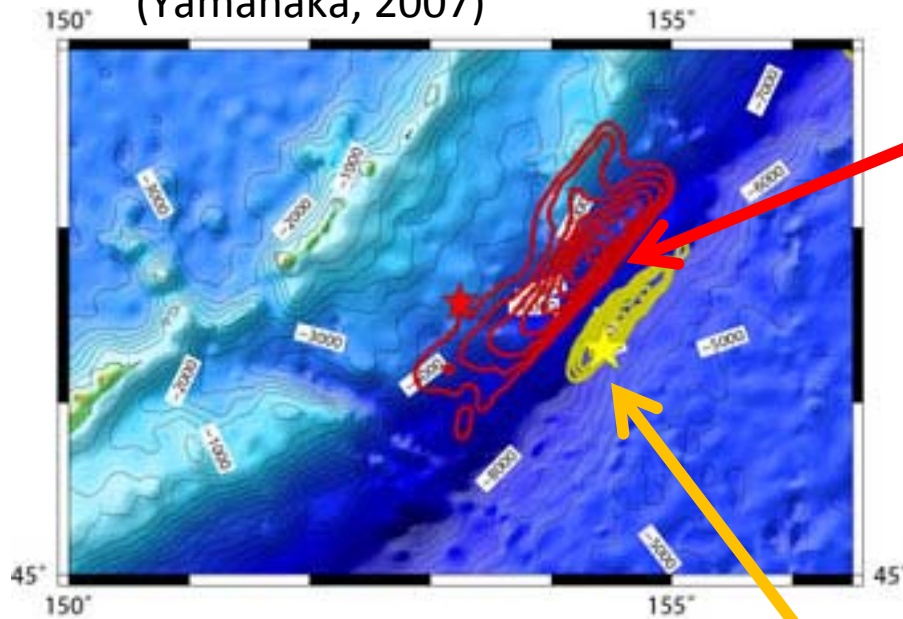




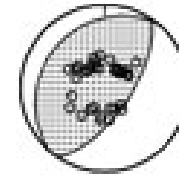
# Kuril Islands earthquakes

(5 Nov. 2006 and 13 Jan. 2007)

(Yamanaka, 2007)

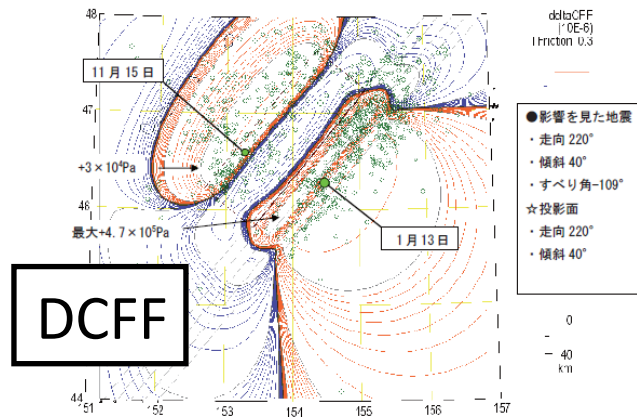


1. inter-plate earthquake (thrust)

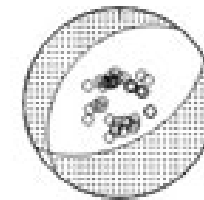


15/Nov/2006, Mw8.2

2006年11月15日の千島列島東方の地震が  
2007年1月13日の地震に与えた影響(ΔCFF)

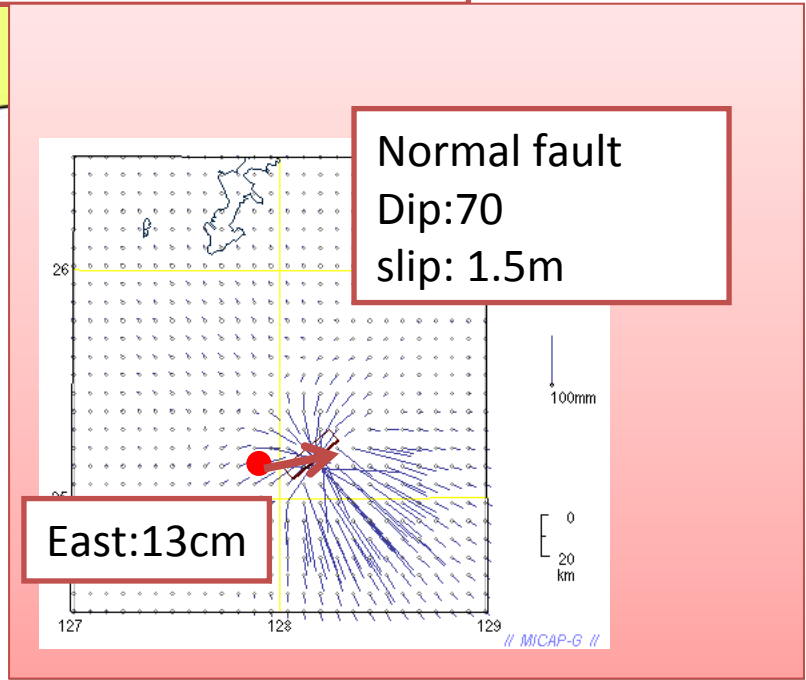
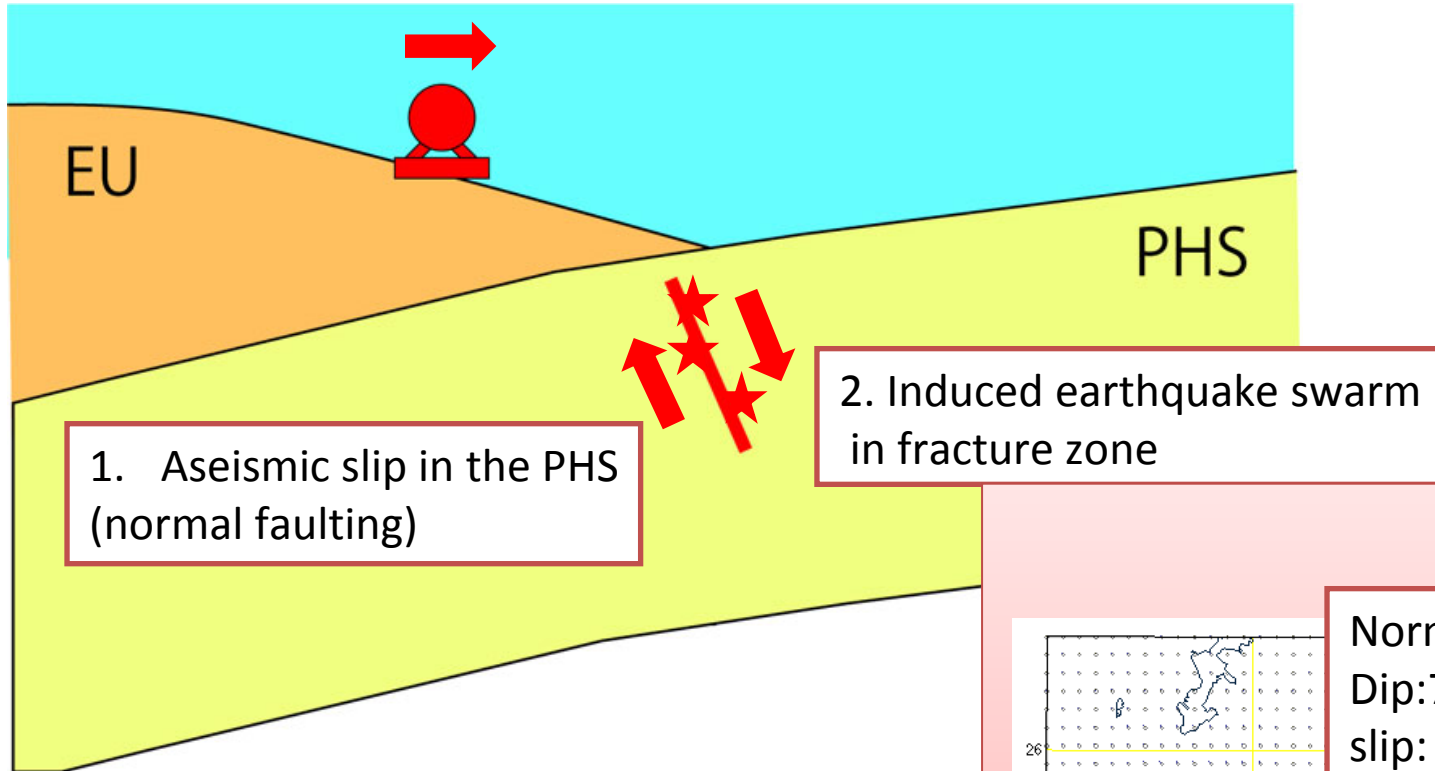


2. intra-plate earthquake (normal fault)



13/Jan/2007, Mw8.2

# Interpretation 2: aseismic slip of fracture zone in the PHS



# Luzon-Okinawa fracture zone

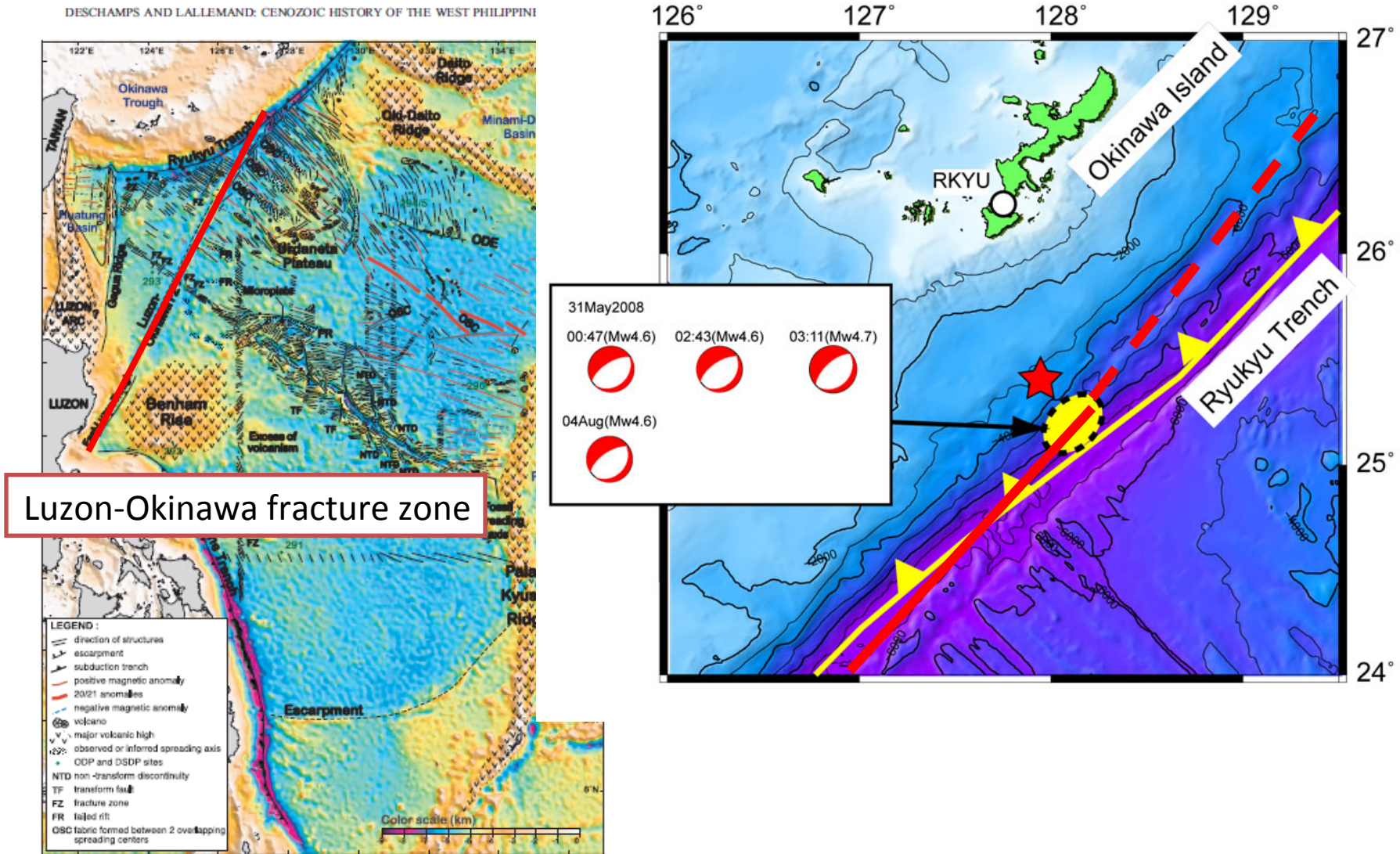


Figure 5. Structural map of seafloor structures, including orientation of main magnetic anomalies, when available. Bathymetric map is made with *Smith and Sandwell's* [1997] data.

# PC-based recording system

Present system



Note PC system

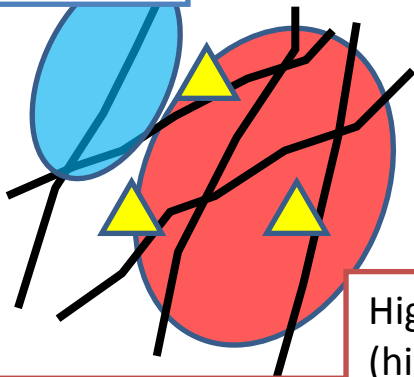


Analysis after the observation

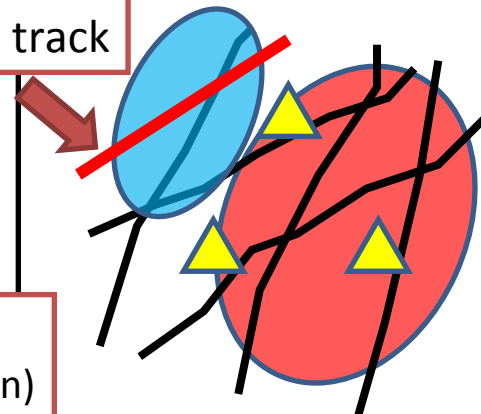
Real-time monitoring

Low quality data  
(low Cross-Correlation)

Where should we go  
next ?



Append track



High quality data  
(high Cross-Correlation)

Poor data distributions

Good data distributions

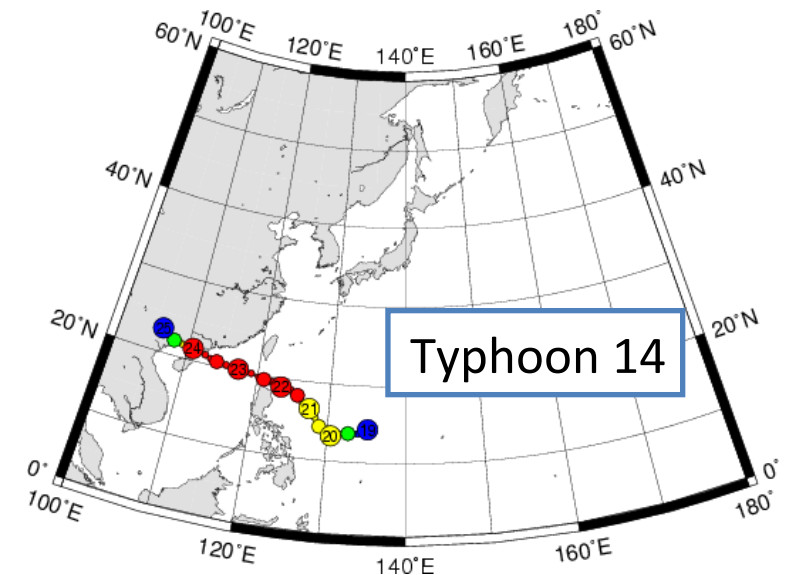


# System test in Taiwan (21-24, Sep. 2008)

21-24, Sep. 2008, Chi-lung.

Experiment with Academia Sinica's group.

Because of Typhoon 14, test was carried out at wharf



# System test in Taiwan



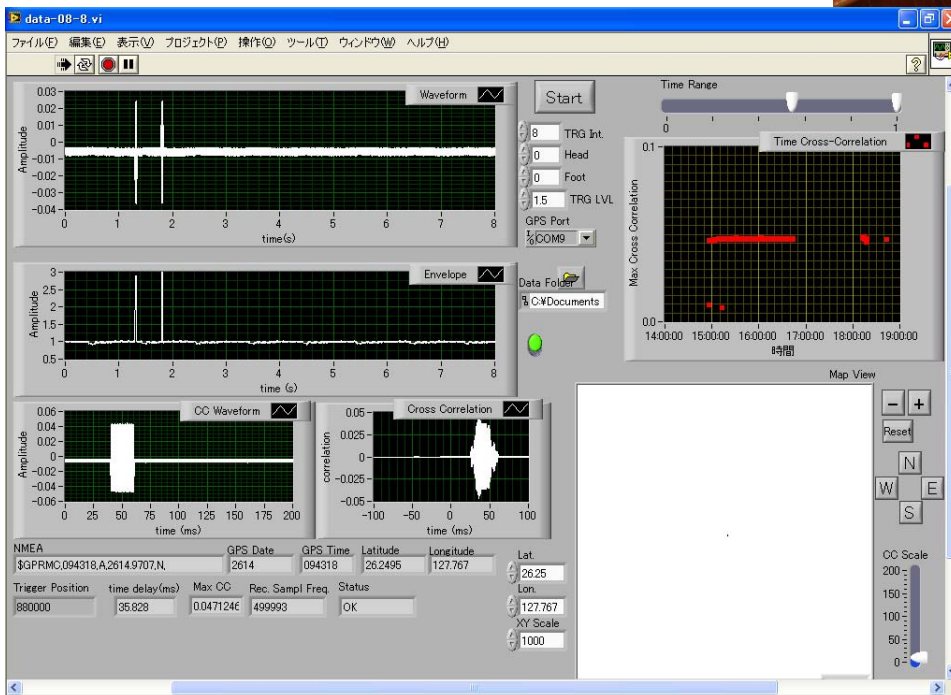
Setting GPS



Setting ocean-bottom benchmark



# Recording test in Taiwan



# Conclusions

- Observation of the ocean-bottom deformation in the central Ryukyu trench shows the eastward migration of land-side of the trench 19 cm for half a year.
- This is inconsistent with the predicted displacement (northwestward) from plate-coupling (back-slip) model.
- A slow-slip event was detected ?
  - fracture zone in the Philippine Sea plate?
  - Inter-plate slow-slip event?