

Briefing on

**Program of Earthquakes and Active-fault
Research (PEAR) in Taiwan**



Wen-Yen Chang
National Science Council

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Presentation Structure

1. Introduction :

Taiwan tectonic environment

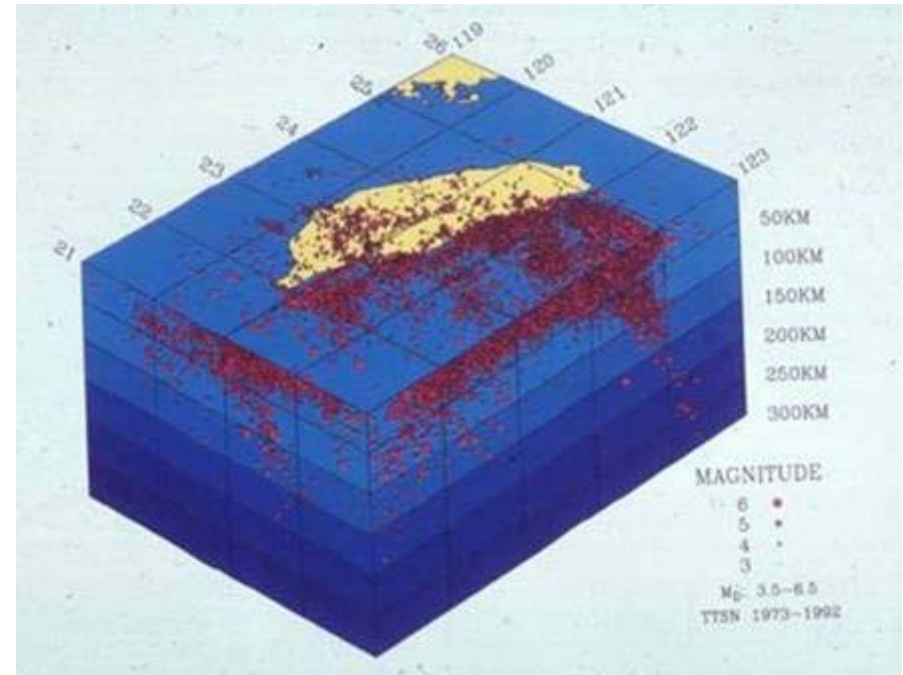
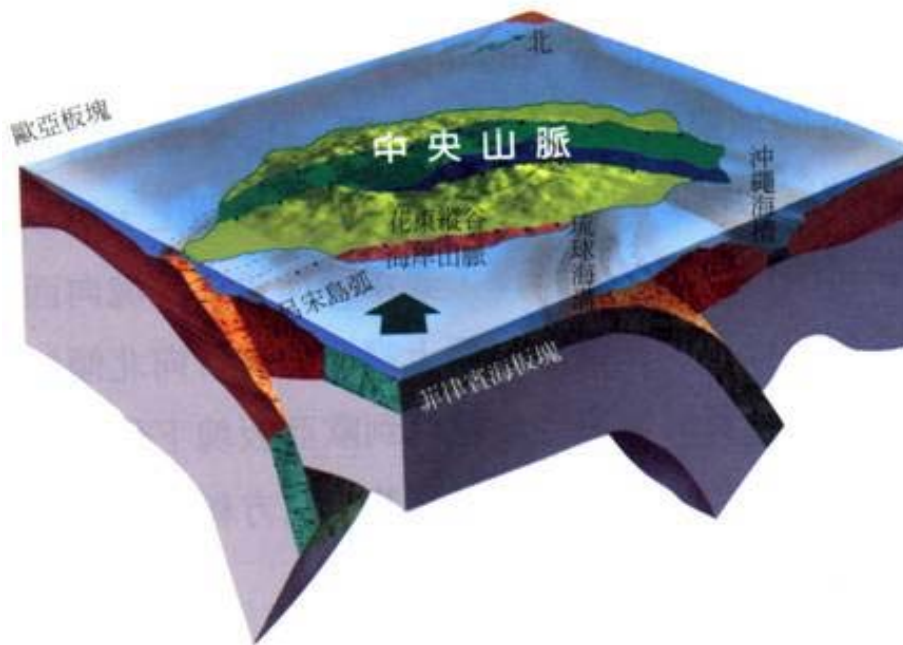
921 Chi-Chi earthquake

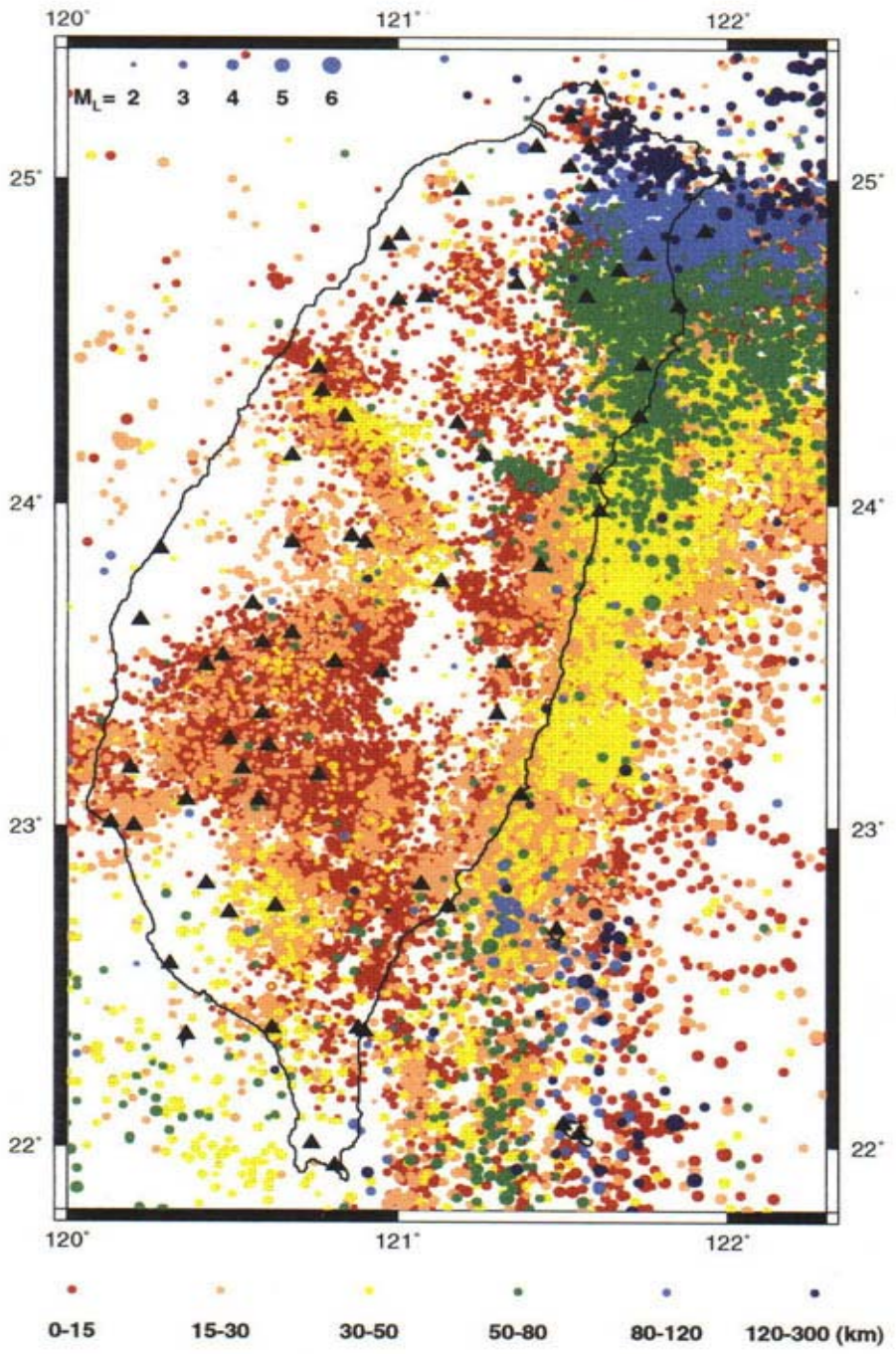
Seismic monitoring system

2. Integrated “PEAR” and the main works

3. Scientific results and future developments

Taiwan-style Collision and Seismicity





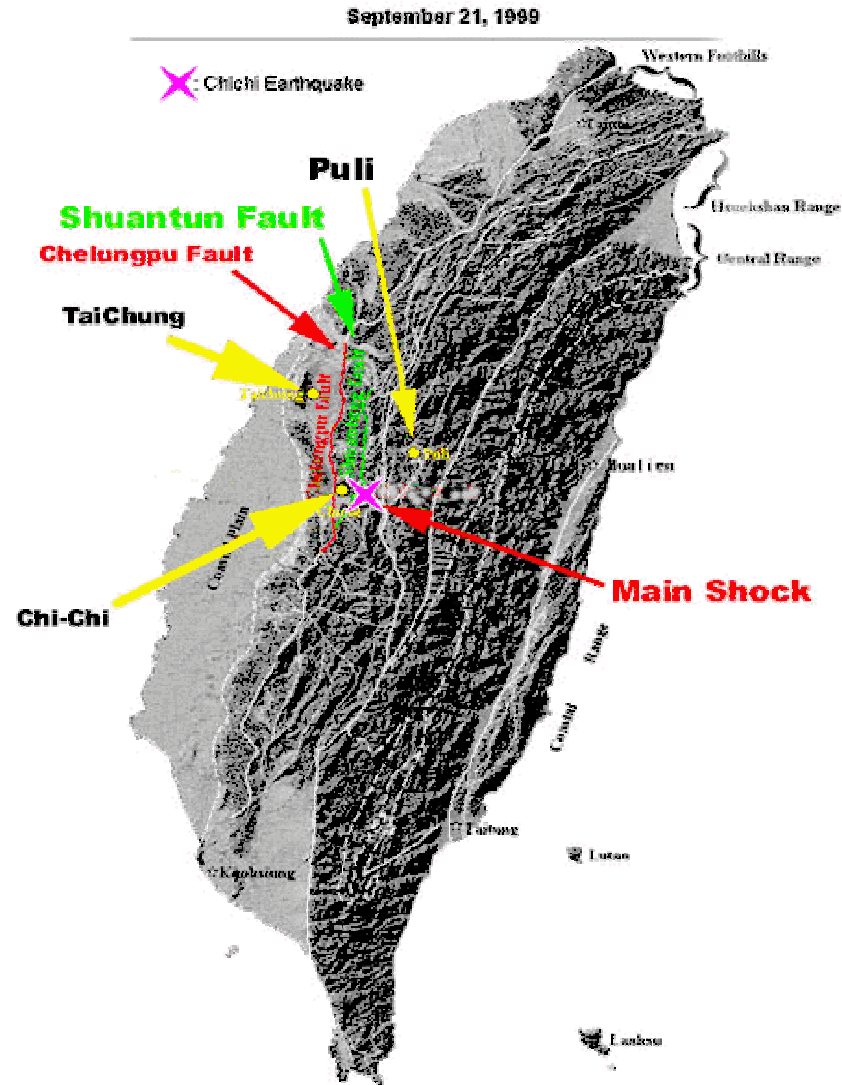


Chi-Chi Earthquake

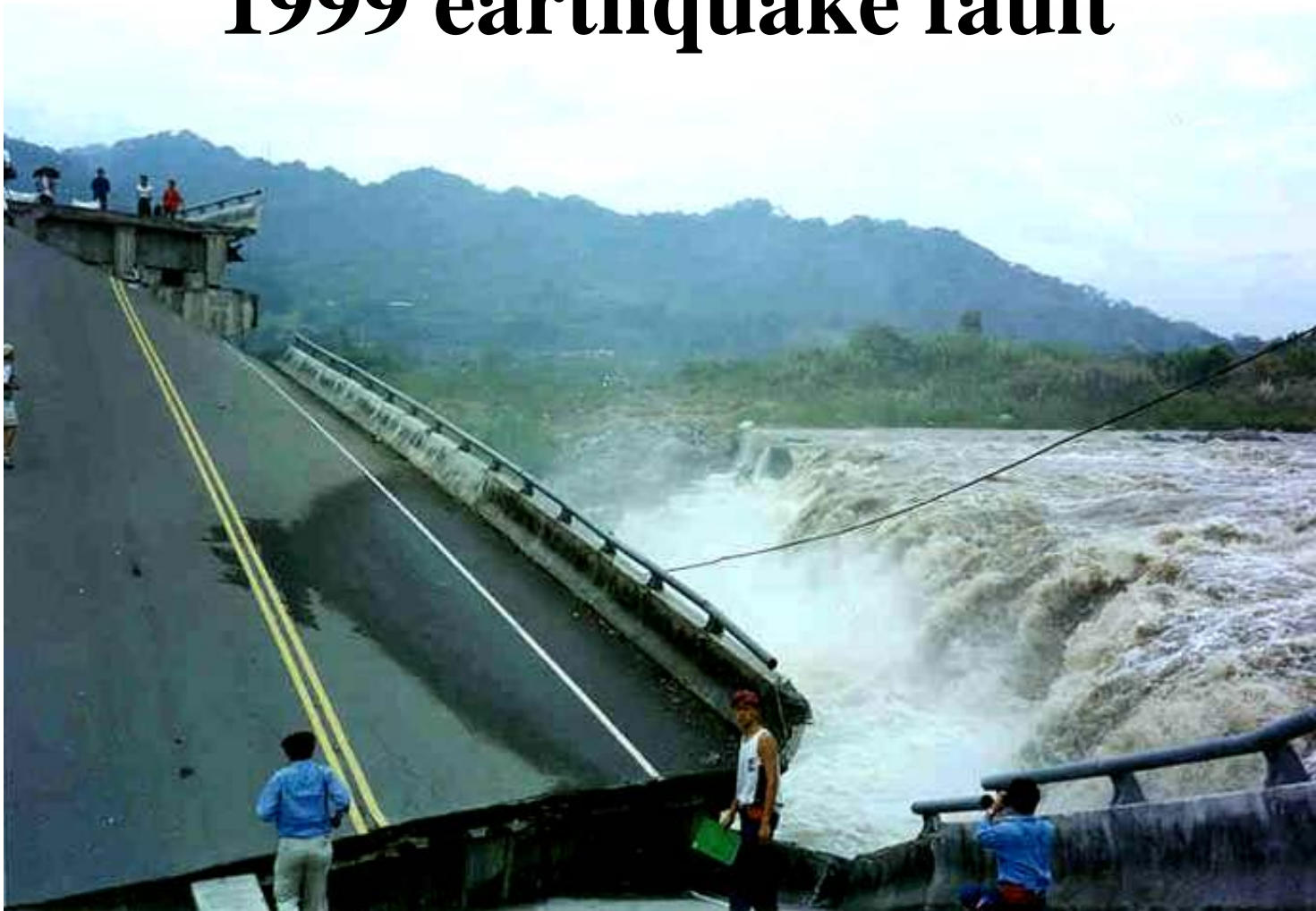
- **Origin Time: 1999 Sep. 21 1:47 AM**
- **Magnitude: 7.3 ML (The Largest Earthquake on the island in the past century)**
- **death toll : 2432**
- **injuries : 657**
- **missing : 46**
- **houses destroyed : >100,000**

as of 1999 Nov. 26

Chi-Chi Earthquake



Shihkang: the northern part of 1999 earthquake fault



Fengyuan region, the northern part of 1999 earthquake fault



Shihkang Dam: the northern part of 1999 earthquake fault

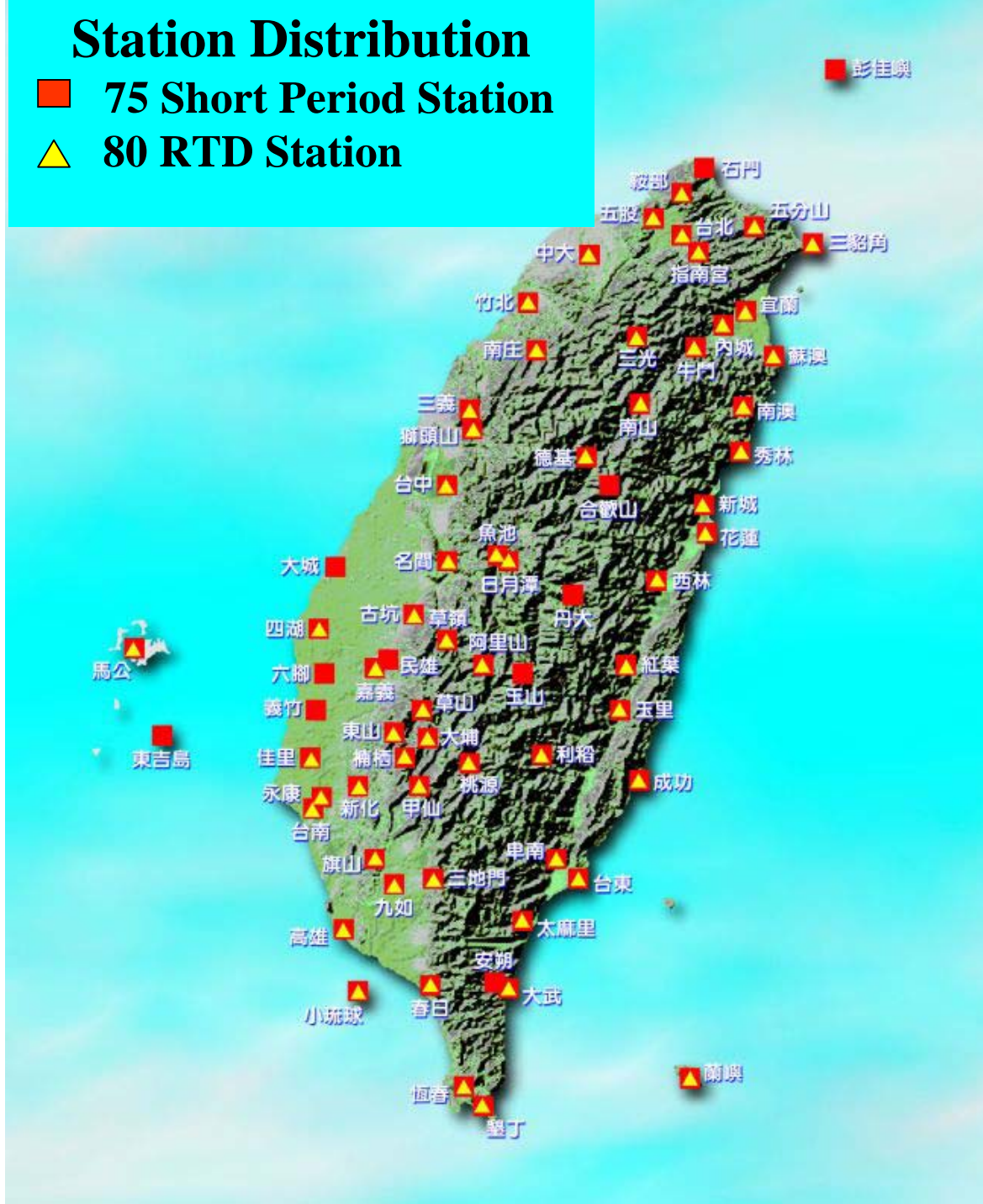


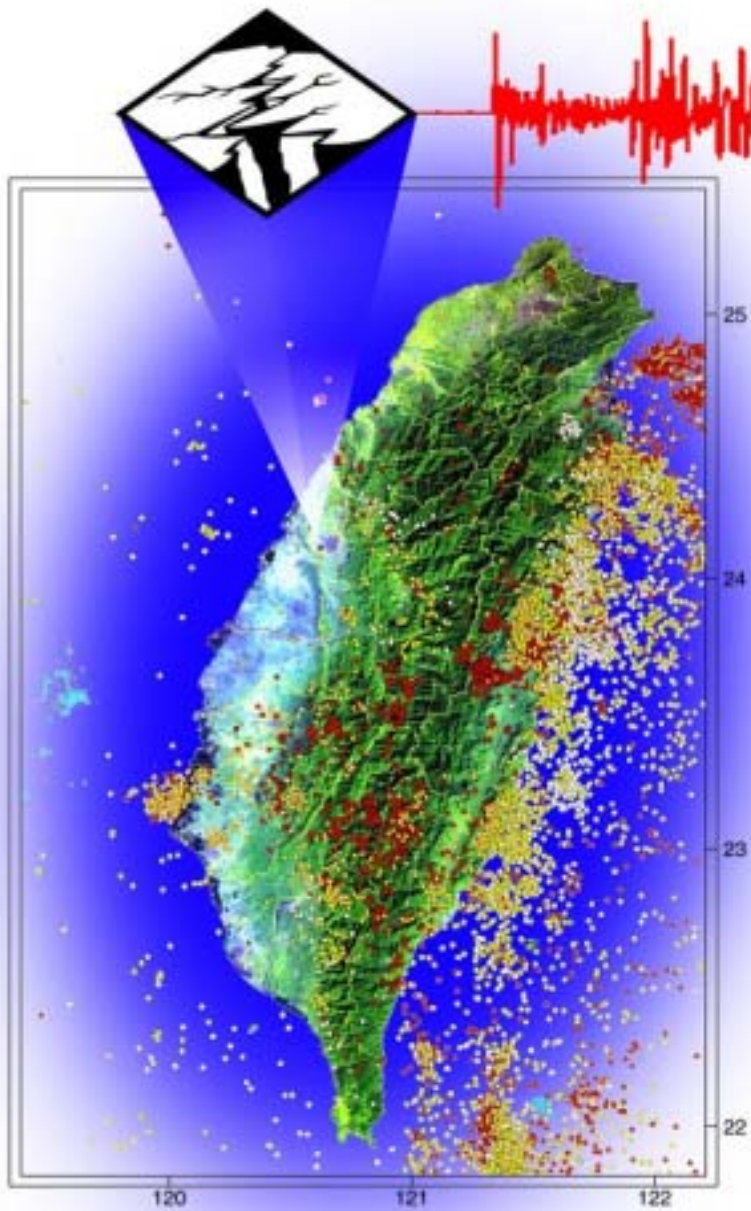
Shihkang: the northern part of 1999 earthquake fault



Station Distribution

- 75 Short Period Station
- ▲ 80 RTD Station





epicenter distribution during 1991-1997
(magnitude $ML \geq 3$, depths $\leq 40\text{Km}$)

detection of felt earthquake

intensity report

earthquake report

dissemination of earthquake information



E-mail



Facsimile



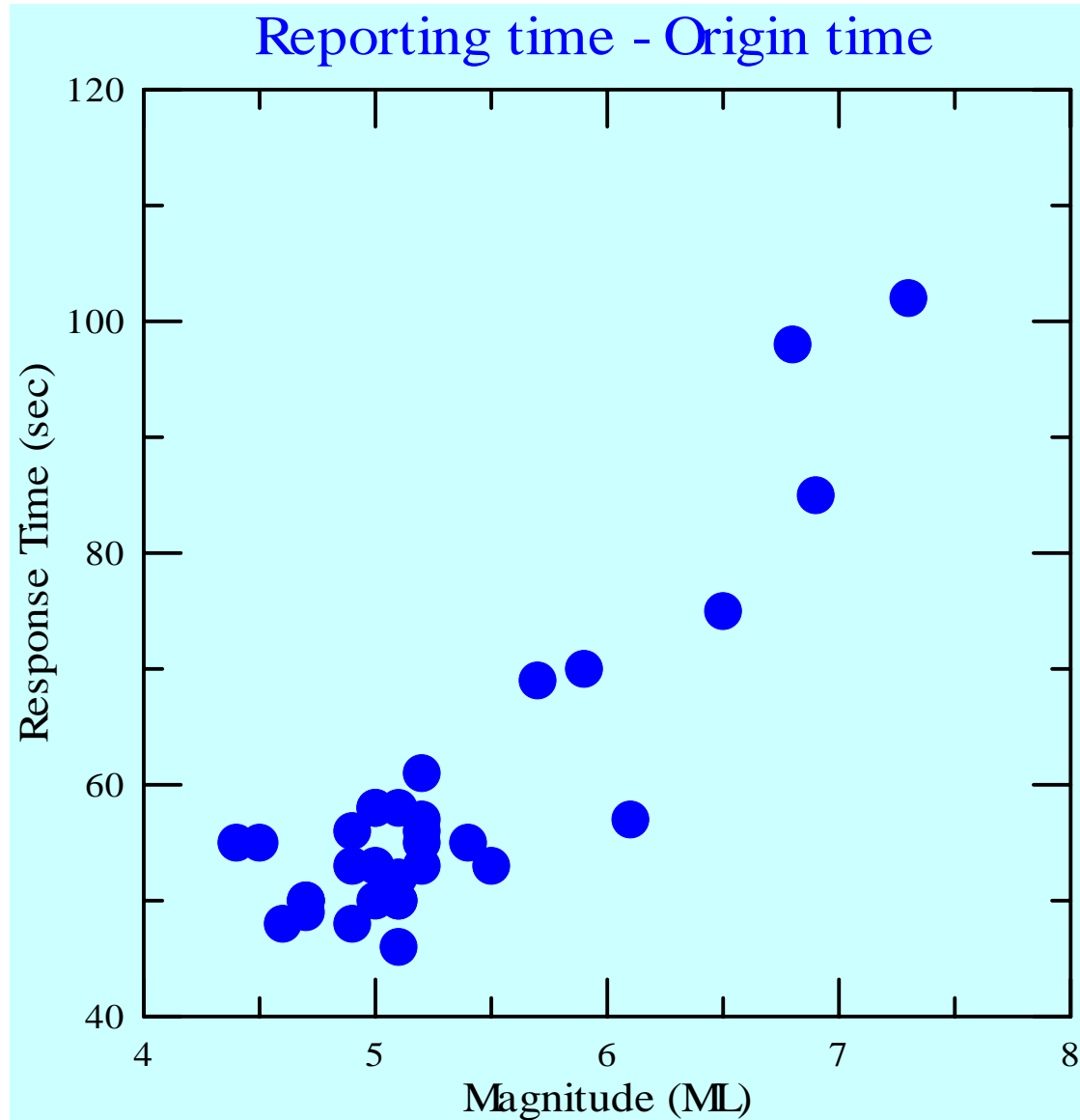
• Pager system

• FTP server

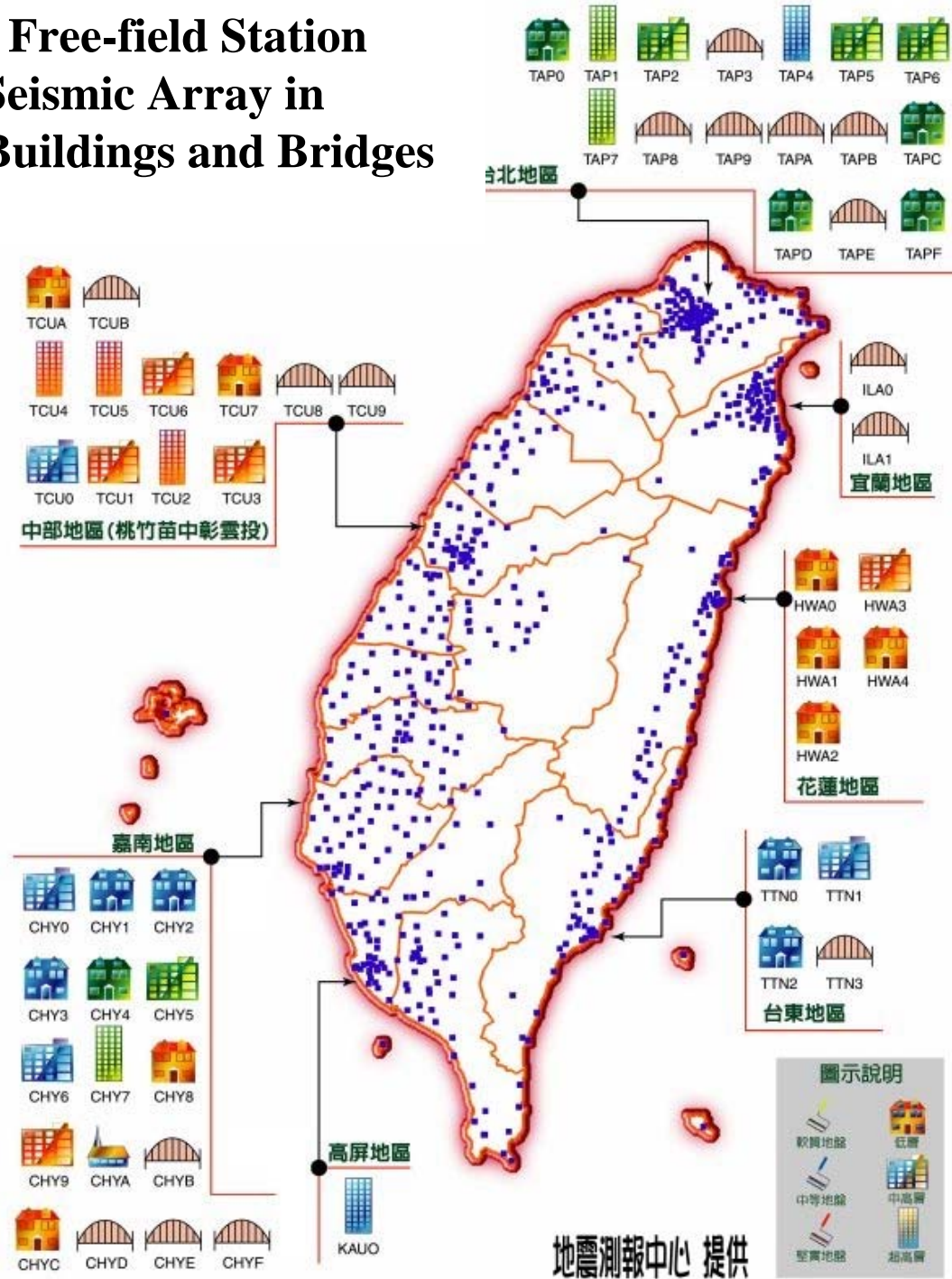
• WWW

• BBS

- emergency servies
- the general public
- the authorities
- the public media
- transportation system
- seismological institutes
- engineering system
- power(plants & grids)

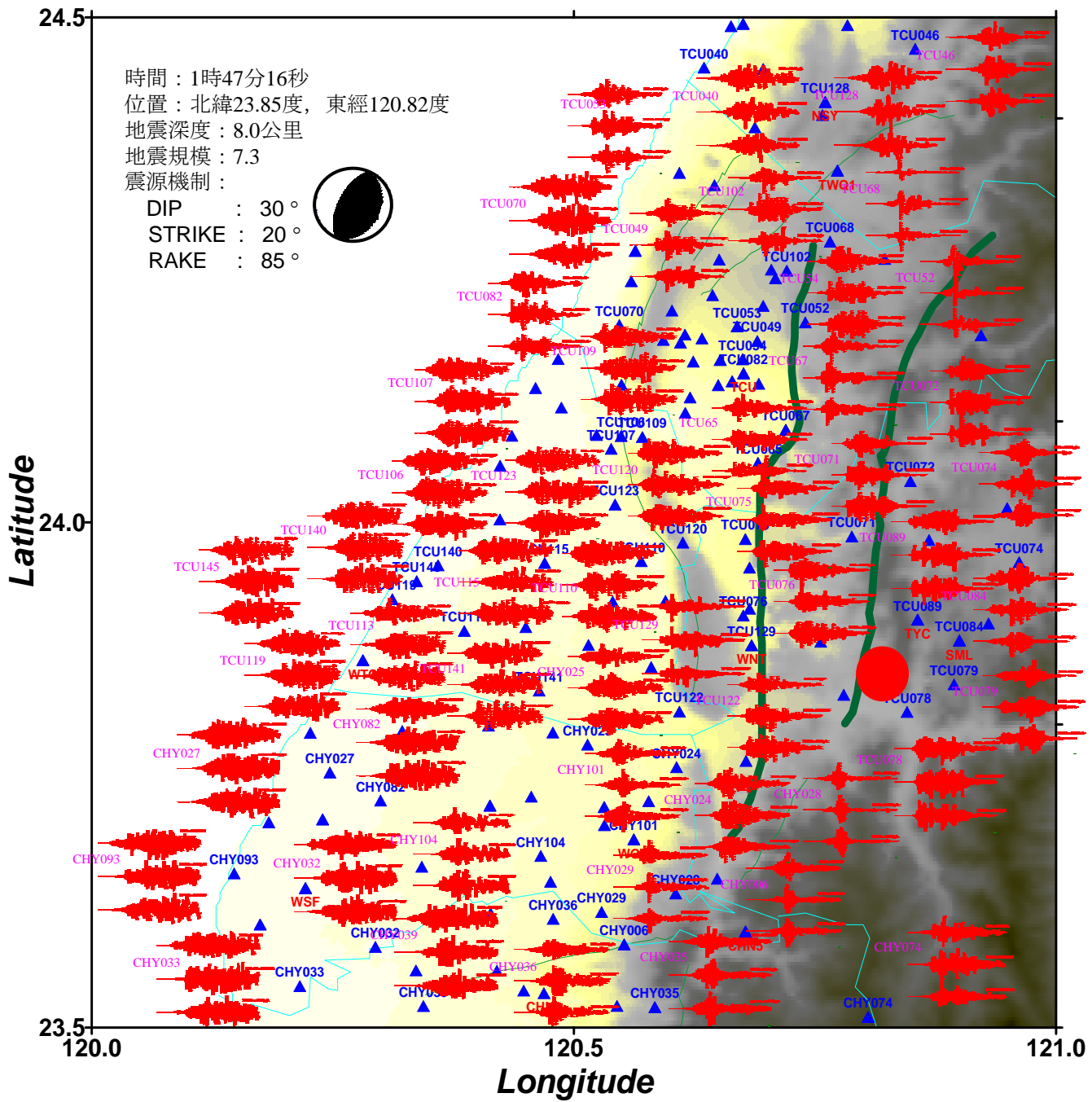


637 Free-field Station 56 Seismic Array in Buildings and Bridges



地震測報中心 提供





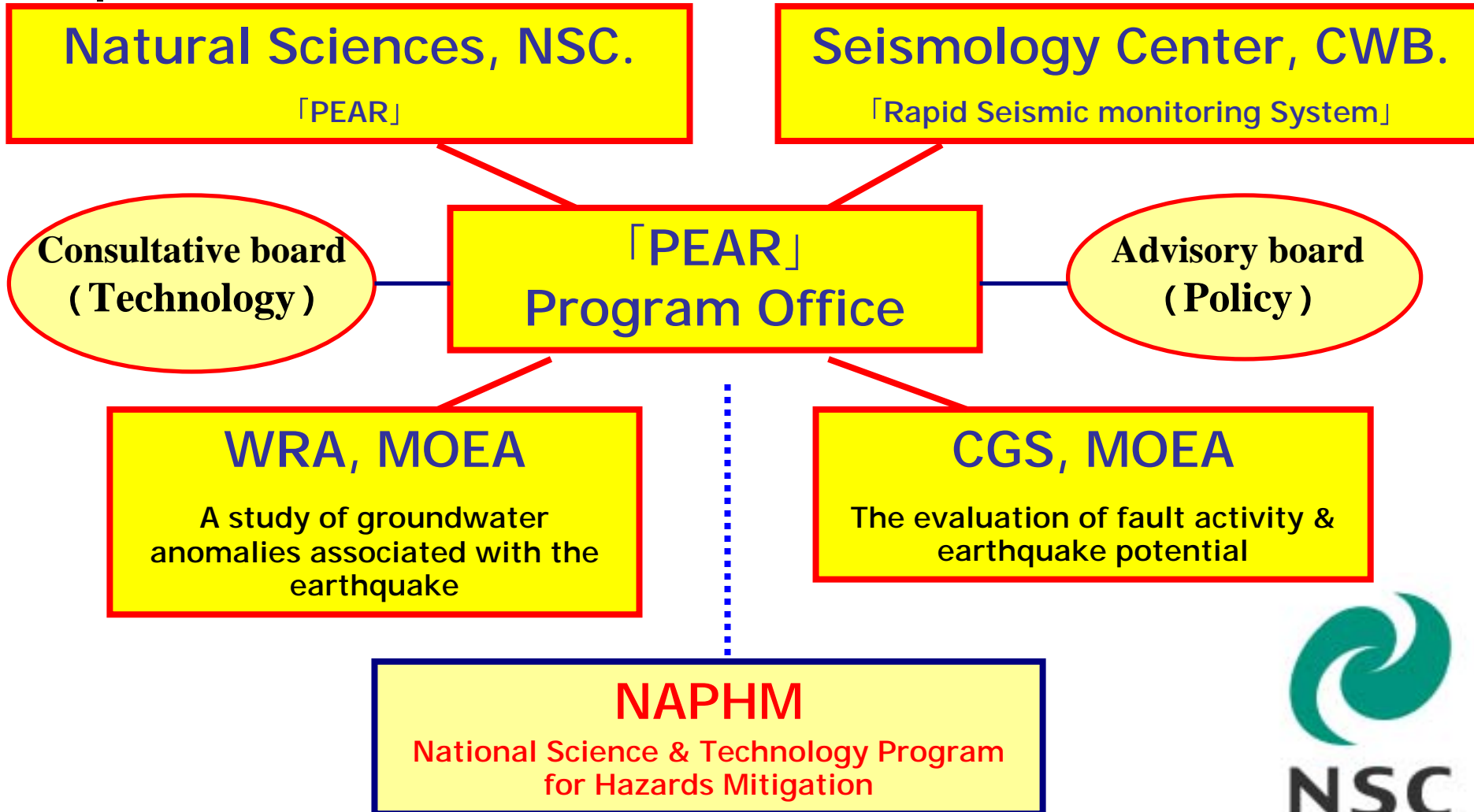
2. Integrated “PEAR” and the main works



Program for Earthquakes and Active-fault Research (PEAR)

- Seismogenic-zone structures
- Earthquake geology
- Seismicity and seismotectonics
- Crustal deformations
- Earthquake physics (including physics, chemistry, rock mechanics, and hydrology related to earthquakes)
- Strong-motion seismology and engineering seismology

PEAR Organizational Chart



Program for Earthquakes and Active-fault Research

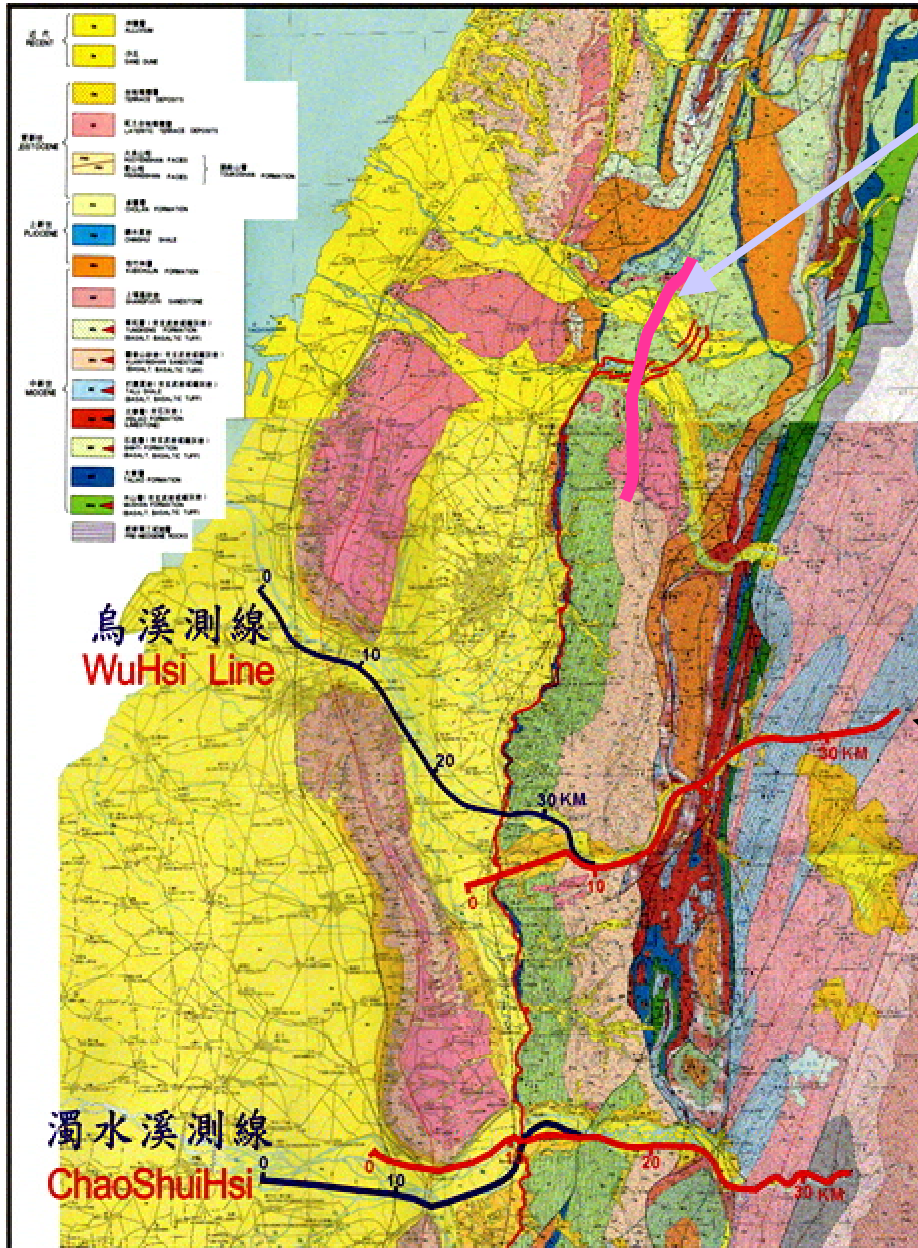
Budget for 5 years

National Science Council

FY.	2001	2002	2003	2004	2005
USD	3.1m	3.8m	4.4m	4.3m	4.3m

International Cooperative Countries

USA Japan France China



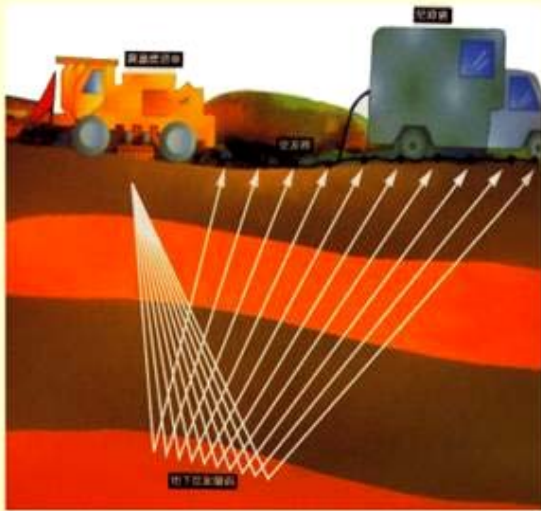
(northern line)

**Deep reflection
seismic lines**

**Wuhsi Line
(central line)**

**Choshuihsi Line
(southern line)**

Reflection Seismics



圖二 震測法野外施測示意圖。由震源車產生人工震源，震波經由地下傳播，並將地下層構造資訊帶到地表，由接收器 (Geophone) 接收，並由震測儀 (記錄車) 記錄。



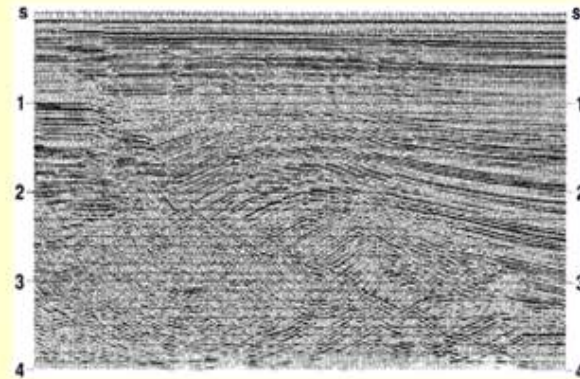
圖三 震源車。



圖五 野外施測時，接收器分布排列情形。

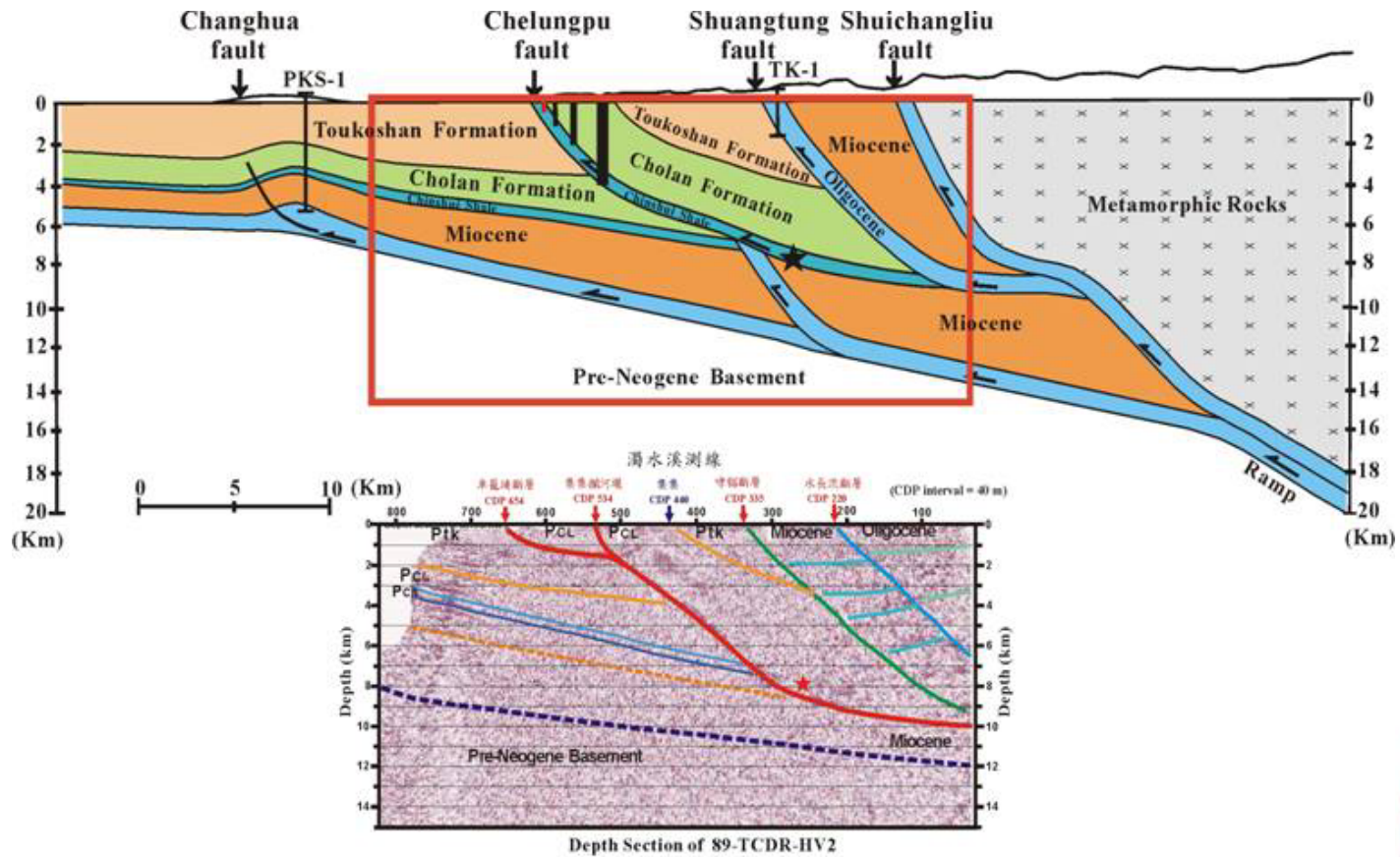


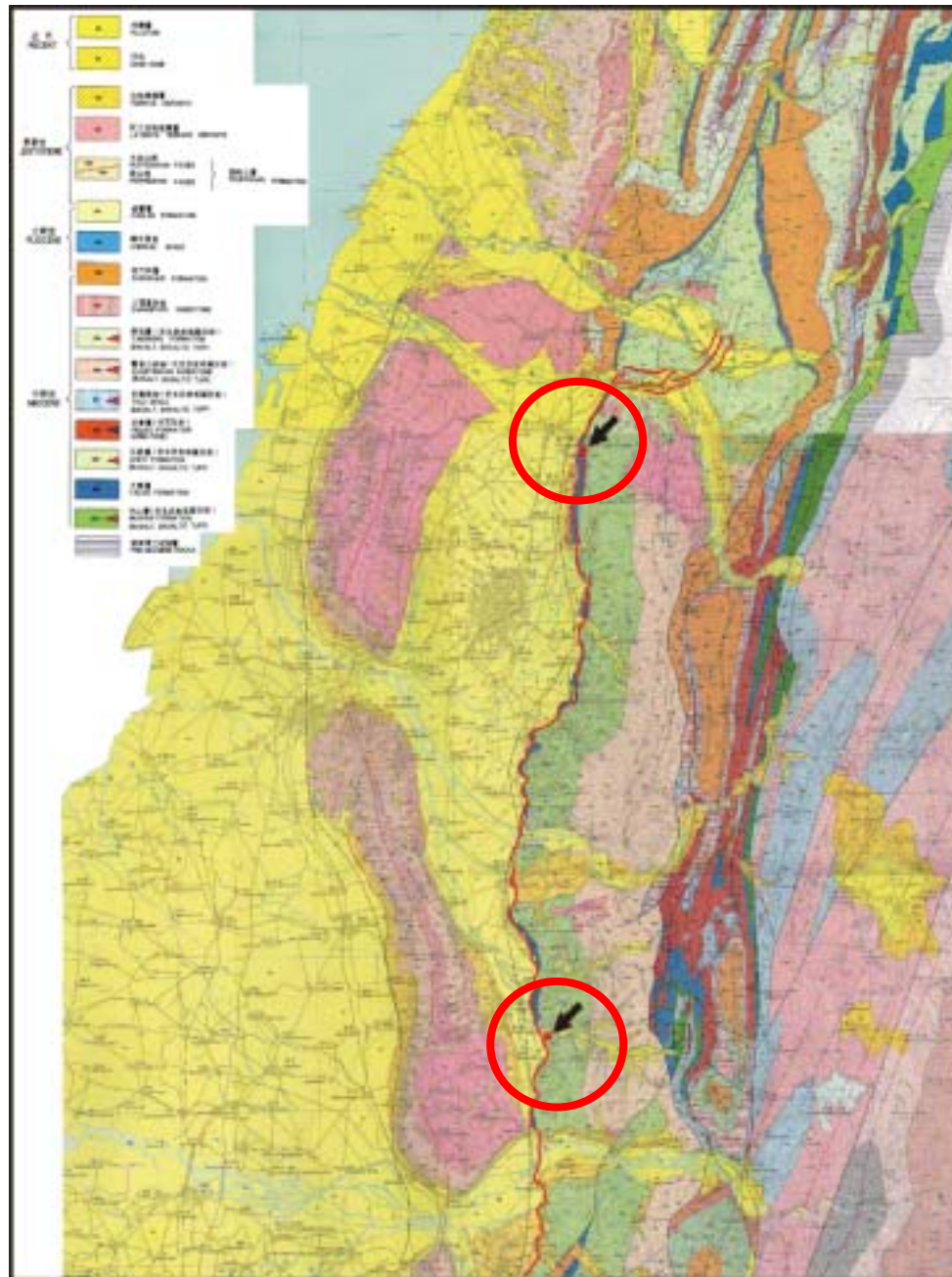
圖四 EWG-III 彈簧式重錘震源，主要應用於活動斷層調查。



圖六 此圖為典型的震測剖面，其中橫軸代表測向距離，縱軸代表記錄時間長度 (深度)。圖中斷層影像清晰可見。

A comparison





**Fengyuan well
(450m)**

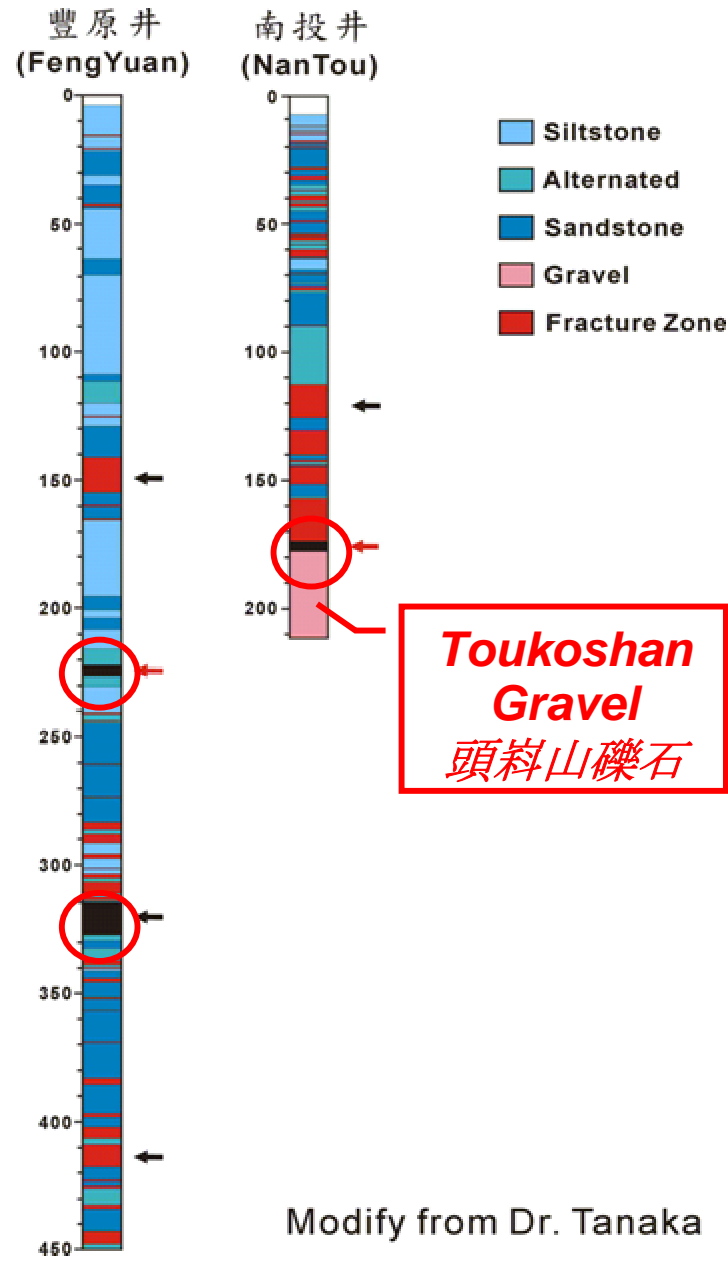
**Nantou well
(220m)**

Nantou Well: 南投井 176 m



Gouge
斷層泥

Gravel
礫石



Modify from Dr. Tanaka

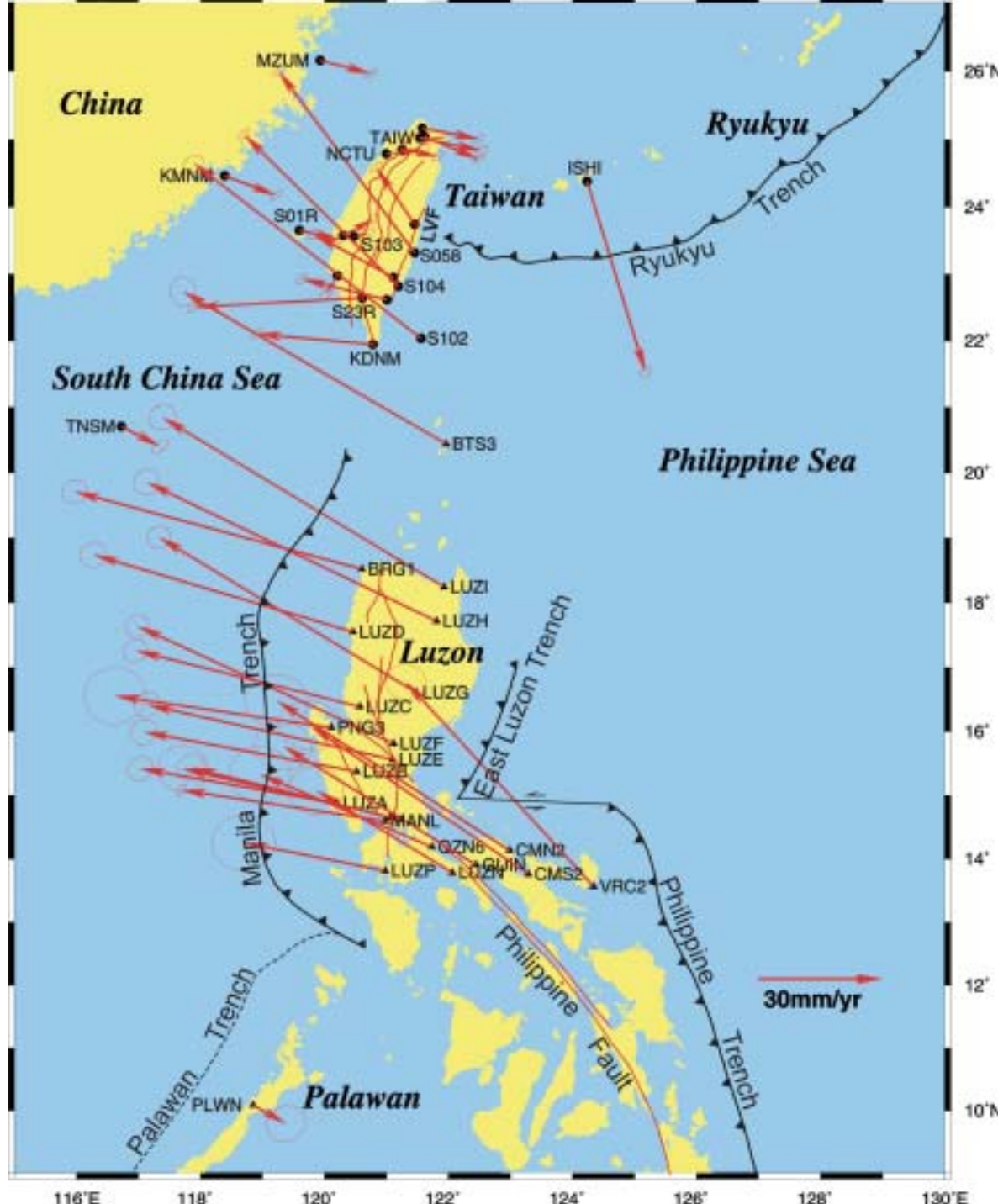


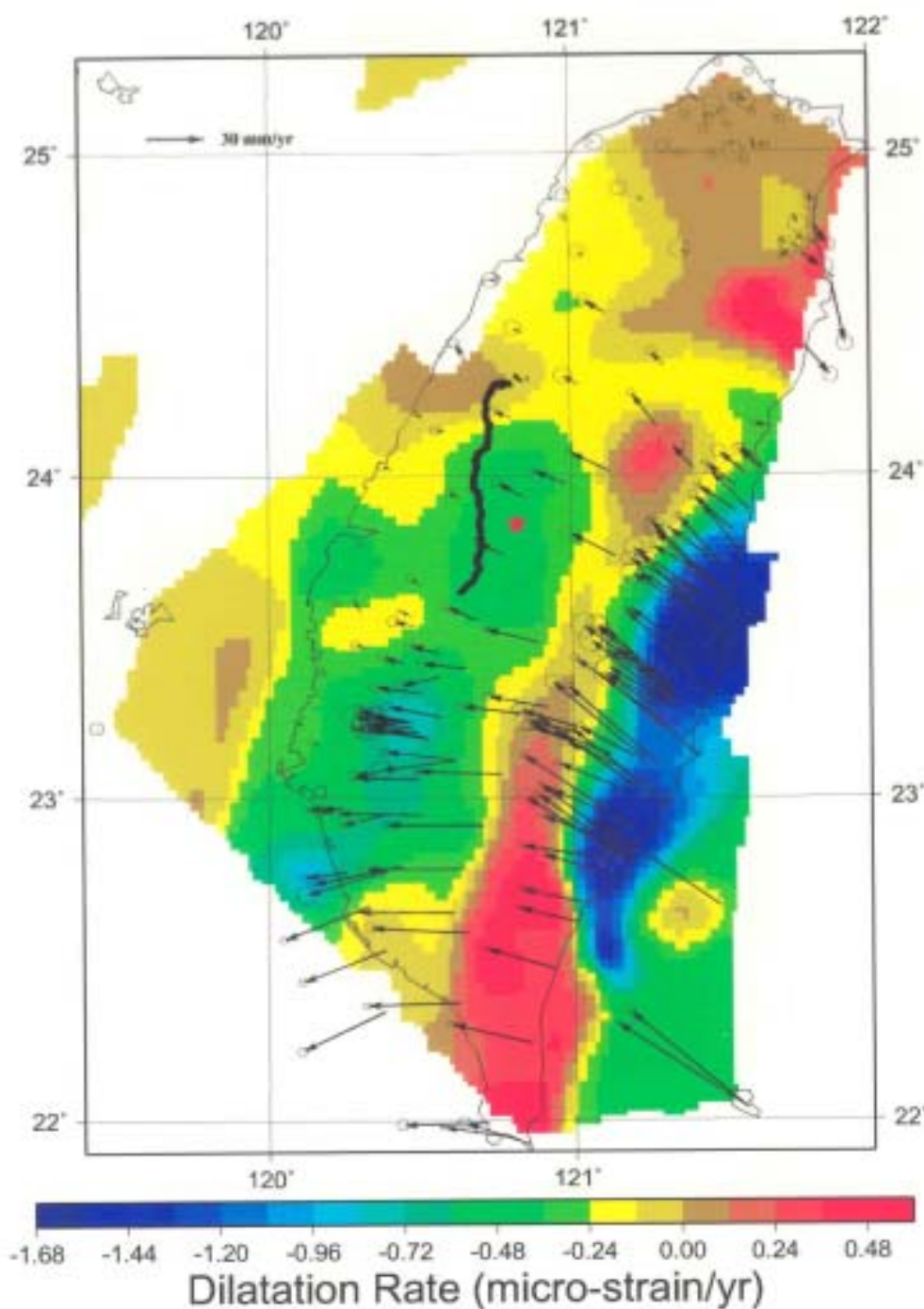
Taiwan-Luzon Velocity field

w.r.t stable
Eurasia

(1996-2000)

convergence
across the active
Taiwan arc-
continent
collision zone

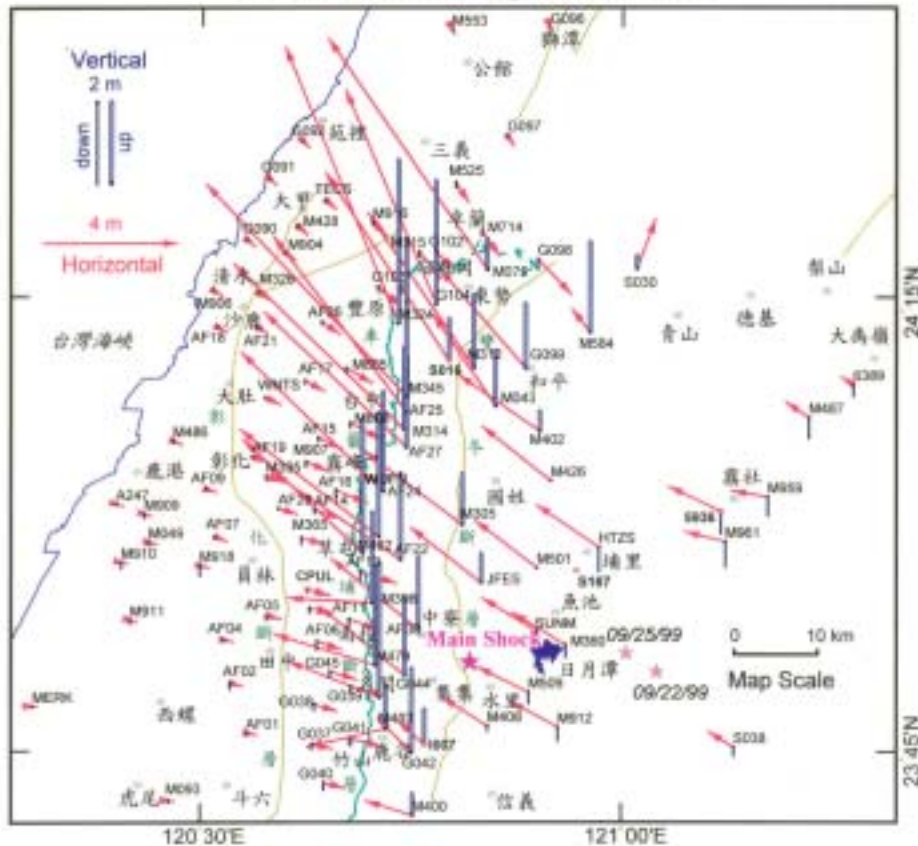




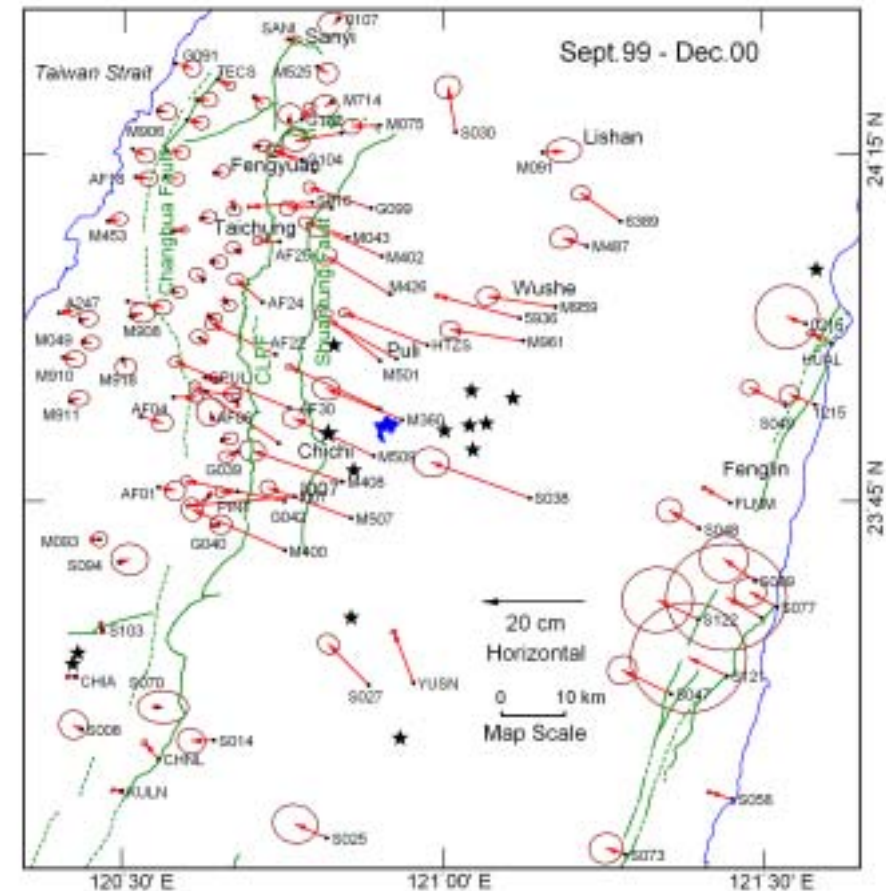
Velocity Field and Dilatation Rate (1992-1999)

- yellow - green-blue: *Contraction*
- red: *Extension*

Coseismic displacement



Chi-Chi Coseismic vs. Post-seismic displacements



Maximum horizontal & vertical displacement: 9.1 m & 4.2 m

15 months after the mainshock
Maximum displacement: 25 cm

Paleoseismology : Trenching



Chelungpu fault

Paleoseismology : Trenching



Picture shows a newly excavated trench in Hsinchu area

3. Scientific results and future developments




Published Papers in Journals

Topic	SCI+EI	Non-SCI	Non-TaiwanScholars
seismogenic structure	14	2	
Earthquake Geology	15	12	8
seismicity	7	6	2
Crustal Deformation	9		5
Earthquake Physics	24	1	8
Strong Motion	21	5	12
Earthquake Chemistry		1	
Earthquake Hydrology	4		1
Tectonic	6	2	3
Precursors Research	2	2	2
Σ	102	31	41



International Cooperation

- 
1. Plate Boundary Observatory in Taiwan, PBOT
 2. Taiwan Crustal Structures, TaiCrust
 3. Taiwan Continental Drilling Project, TCDP
 4. Earthquake Geology
 5. Integrated search for Taiwan Earthquake Precursors
 6. Source Physics
 7. Strong Ground Motion Prediction
 8. Early Warning System

Goals



☞ **To promote science development**

To improve our understanding of earthquake and fault behaviors : seismogenic structure, earthquake precursors, source physics, crustal deformation and strong ground motion prediction.

☞ **Application of seismic hazard mitigation**

The Chi-Chi earthquake heavily struck central Taiwan. However, it also brought a large amount of valuable seismic records to the world, and we are very glad to share these data with the scientists of the world for seismic hazard mitigation research.

☞ **Develop Early Warning System to decrease seismic hazards**

In the near future, we will apply the concept of seismic subnet configuration to improve the response time and as the basis of developing the Early Warning System.



Thank you for your kind attention.

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謝謝