2. TECTONICS OF TAIWAN

2.1 Tectonic Interpretation of the Taiwan Earthquake on Sept. 21,1999

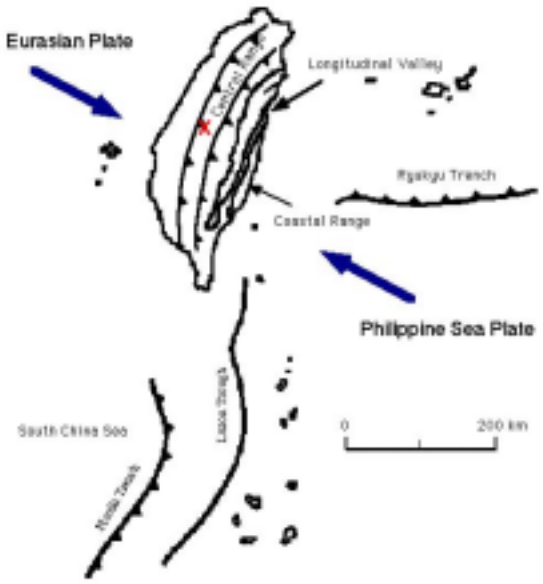

Figure 2.1 Plate boundaries and tectonic elements near Taiwan

The Philippine Sea plate (PH) subducts along the Ryukyu Trench beneath the Eurasian plate (EU).

In contrast, from south of Taiwan to Luzon, EU (South China Sea) subducts beneath PH. In Taiwan, EU is underthrusting beneath PH, and collision occurs there due to the obstruction of the continental crust of EU. Due to this collision, fold and thrust belts produces the uplift of the Central Range and the Western Foothills. The Western Foothills, where the surface faulting occurred, corresponds to the accretionary prism of the Manila trench - Luzon Trough system (Suppe, 1981).

The movement of EU beneath the Central Range in the main cause of this earthquake. The initial rupture probably occurred at the basal decollemant-ramp intersection, and extended toward inside of the accretionary prism-sedimentary wedge and to the deeper part, based on the hypocentral location and aftershock distribution.

The structure of the Coastal Plain - Western Foothills should be regarded as a subduction zone, rather than a collision zone. Therefore 1999 Taiwan earthquake should be regared as a subduction zone earthquake. The slip direction of the Harvard CMT solution is different only by 5 degrees from the EU-PH Sea plate motion expected from Seno *et al.* (1993).

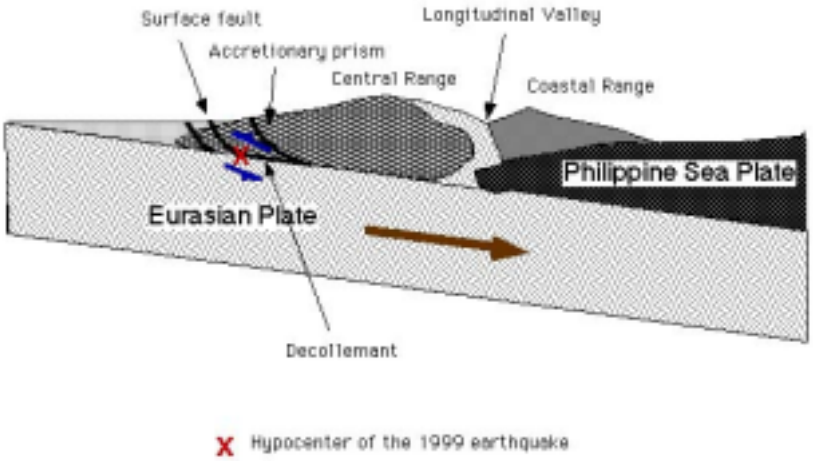

Figure 2.2 Cross-section of the structure of Taiwan (Seno,1994; modified from Suppe, 1981)

2.2 Tectonics of the Taiwan Region

Tectonics of the Taiwan region is reviewed. Relative plate motions so far obtained are described and rated. The most reliable solution gives 7.4 cm/yr Philippine Sea-Eurasian motion in the N50degW direction in central Taiwan. Plate boundary geometries and modes of plate consumption in the region are discussed on the basis of geophysical, geological and geomorphological data. The major thrust zones at the Western Foothills and the Longitudinal Valley constitute mechanical plate boundaries, but a considerable fraction of the relative plate motion is also consumed by the strike-slip faulting off the southeast coast of Taiwan.

The cause for the occurrence of the strike-slip faulting off the southeast coast of Taiwan is discussed based on the various models so far proposed. The bending of the Philippine Sea plate due to the subduction at the Ryukyu Trench and the collision in the Longitudinal Valley are similar to the tectonics of the Izu Peninsula region in Japan, and are the most likely cause for the strike-slip faulting.

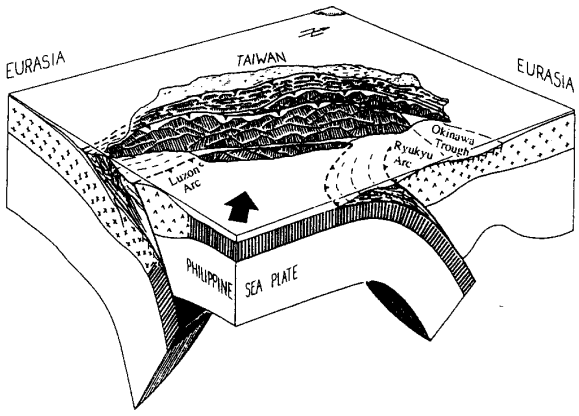

Figure 2.3 Schematic illustration of the plate geometry of the Taiwan region (after Angelier, 1986).

The reconstruction of the motion and plate boundaries in the vicinity of Taiwan for the past 4-6 million

years (Ma) is reviewed. The Philippine Sea-Eurasian motion for the past 4 Ma is similar to the present one. The motion prior to 4 Ma may be more northward than present due to the absence of subduction at the Philippine Trench. The Luzon arc started to collide with the continental margin of S. E. China around 4 Ma.

2.3 Image of faulting

Since the initial rupture occurred at the hypocenter, the earthquake faulting might have continued further to the shallower part of the accretionary prism and to the deeper part along the decollement. Figure 2.4 shows an image of faulting. The initial break which started around the hypocenter propagated upward along the Chelungpu fault, and downward along the decollement. The rupture within the prism should be slow already. If not, severe damages would have occurred around the surface fault area. Note that strong motions and seismic waves were generated in the deeper part of the earthquake fault and caused damages on the hanging wall to the east far from the surface ruptures (personal comm. with Prof. Y.-B. Tsai, National Central Univ). So the present event is regarded as a tsunami earthquake in the shallow part near the trench and an ordinary event in the deeper part. More intimate surveys are necessary in the near future before the morphological features are collapsed down and damages are repaired.

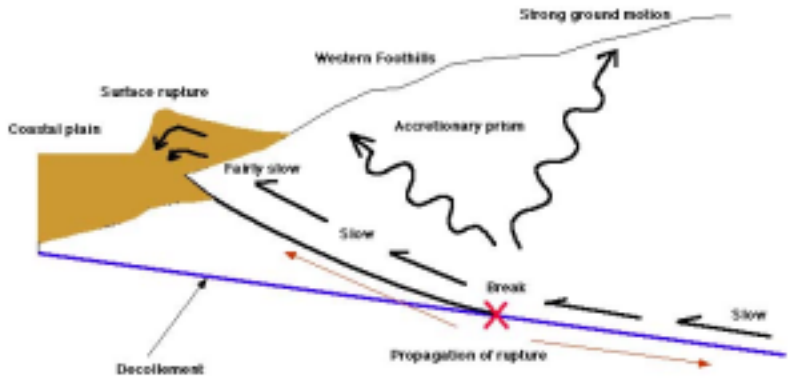

Figure 2.4
Image of faulting

REFERENCES
Davis, D., J. Suppe, and F. A. Dahlen, Mechanics of fold-and-thrust belts and accretionary wedges, J. Geophys. Res., 88 1153-1172, 1983
Seno. T., S. Stein, and A. E. Gripp A model for the motion of the Philippine Sea plate consistent with NUVEL-1 and geological data J. Geophys. Res. 89 17941-17948 1993
Seno, T., Tectonics in the Taiwan region, Jisin, 46 461-477 1994 (in Japanese with English abstract)
Suppe, J., Mechanics of mountain building and metamorphism in Taiwan Mem. Geol. Soc. China, 4, 67-89, 1981