SEISMIC EVALUATIONS FOR THE DEEP HEAT SOURCE AND EARTHQUAKE RISK OF GEOTHERMAL POWER PLAN CONSTRUCTION AT ILAN, TAIWAN

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ABSTRACT

In the western Pacific, the Philippine Sea plate moves northwestwardly and subducts beneath the Eurasian plate along the Ryukyu trench. The Ilan Plain, northeastern Taiwan is located at the southwest-most part of Okinawu trough which is a backarc basin spreading due to the Philippine Sea plate subduction. The complex 3-D plate interaction in the vicinity of northern Taiwan has been widely discussed. Beneath this region, the oblique subduction, regional collision and back arc opening are all actively taking place [*Lallemand et al.,* 2001]. The subducted plate shows a bended structure. It has been demonstrated that the slab subducts at a dip of 20-30 degrees down to 70 km and increases its dip angle to 50-60 degrees near 100 km [*Kao and Rau,* 1999]. Local intermediate-depth earthquakes (depths > 70 km) in the near offshore of northeastern Taiwan often produce some high-frequency strong S-wave signals beneath the main S-wave arrivals (Figure 1). A back projection method has been employed to image the shape of those S-wave radiations. The uncorrelated shear and compression velocity discontinuities of this reflector are possibly indicative of magma or hydrous structures inside the slab. It can be considered as the deep heat source beneath the Ilan Plain. Thus, the high heat flow in the Ilan area is due to the magma generated from the subducted Philippine Sea plate, and intruded underneath the Plain.

In surface, geological observations indicated that the Ilan Plain bounded by the normal fault systems and filled up with thick Pliocene–Pleistocene sedimentary sequences. It formed an extension environment with high seismic activity. Over there on 2005 March 5 two earthquakes with about the same magnitude (ML = 5.9) occurred within 68 s and produced intense aftershocks activity according to the records of Central Weather Bureau Seismic Network of Taiwan. The focal mechanisms of the two main shocks are both classified as normal type by first-polarity but strike-slip by centroid moment tensor inversion; however, two methods both yield consistent E–W strike. It therefore be interpreted as the result of dyke intrusion at the very tip of the Okinawa Trough, which is reasonably driven by backarc spreading (Lai et al., 2009). Similar earthquake doublet was continuously occurred in recent years. Those events were identified as shallow events beneath some potential geothermal power plan sites. Compared to other geothermal fields of world, the construction of power plan at Ilan, Taiwan, the earthquake issue should be carefully considered and the strong seismic shacking evaluation for hazard is necessary.

Keywords: Ilan, deep heat source, normal fault, geothermal power plan, seismic hazard evaluation.

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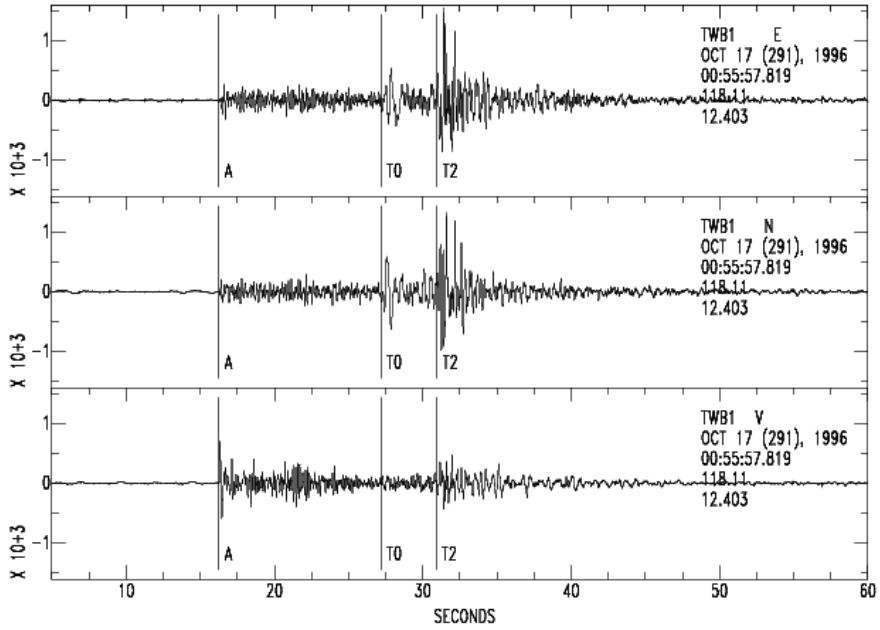

Figure 1. Example of three-component seismograms recorded by the seismic station (TWB1) located at northern Taiwan. Phase A and T0 are predicted P- and S-wave arrivals from the regional earth model. T2 is the S-wave later phase discussed in this study.