Seismotectonic Characterization of Northernmost Manila Subduction: OBS observation Offshore SW Taiwan

Emmy T.Y. Chang, and Ling-Yun Chiao
Institute of Oceanography, National Taiwan University

Abstract

The Manila trench is well-known as the convergent boundary where the South China Sea (SCS) plate subducting easternward beneath the Philippine archipelago. However, the tectonic frame of this subduction system is becoming obscure when approaching to Taiwan, in the vicinity of northern Manila trench. As the seismographic instrumentation is largely limited by inland territory, the seismogenic characteristics is as well not yet expanded for this area. Recently, two ocean bottom seismometer (OBS) experiments were conducted at the northern extreme of the Manila trench respectively in the years of 2005 and 2006. Local seismic signals have been well logged by the used short-period OBS machines. Hundreds earthquakes including many micro-events are successfully compiled from these seismograms. The preliminary study with these seismic data shows a clear subducting mechanism toward northeast beneath the Taiwan island. A clustering algorithm is applied to the relocated earthquakes in order to obtain tighter earthquake clouds and thus better-defined seismogenic zone. The relevant analyses reveal that the convergent force acting in this area is mainly in NW-SE direction, and the scenario of the SCS plate subduction may be complicated being close to Taiwan.

Introduction

The tectonic dynamics at south Taiwan is considered as that the Eurasian plate combining with the SCS plate subduct easternward to the Philippine Sea plate. In this tectonic model, the Manila trench is identified as the ground feature where the SCS plate converges to the Philippine archipelago at south Taiwan. As the oblique subduction/collision of plates taken place around the Taiwan area, the topographic feature of the Manila trench lose its topographic identification when approaching northernward to Taiwan. Systematic study for the seismic source parameters along the Manila trench is therefore an important clue to resolve the issue of the

complicated plate interaction in this area. However, seismographic instrumentation is largely limited by inland territory, and we therefore lost control for the earthquake exploration in the marine regime, same as for the mentioned area.

Recently, thanks to the successful development of OBS and its facility in detecting earthquake, we can have a better resolution for the marine seismicity. This study is constructed by two OBS arrays deployed at the northern extreme of the Manila trench respectively in the years of 2005 and 2006. Local seismic signals have been well logged by the used short-period OBS machines. Hundreds earthquakes including many micro-events are successfully compiled from these seismograms, and some near-field focal mechanisms can be determined for the large events. The preliminary focal location shows a clear subducting mechanism toward northeast beneath the Taiwan island, a clustering algorithm is applied to the relocated earthquakes in order to obtain tighter earthquake clouds and thus better-defined seismogenic zone. The near-field focal mechanical solutions reveal that the convergent force in NW-SE direction plays an important role for tectonic dynamics in this area. The seismic velocity structure of the relevant region is as well refined by means of joint-station travel-time inversion afterwards. It shows the existence of a slow-velocity layer just beneath the OBS array, which may generate from the considerable sedimentary deposition at that area.

As the limit of numbers of the OBS stations used in this study, the seismogenic structure in the SW offshore Taiwan can not fully depict its outline. However, the seismological experiments conducted by two OBS arrays have exhibited that the earthquake activity is quite vigorous at the northern tip of the Manila trench and the scenario of the plate interaction may be more complicated than what we thoughts before for this area.