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The crustal deformation of the Ilan Plain acted as a westernmost extension of the Okinawa Trough

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Abstract

We analyze the current deformation in Ilan Plain of northeastern Taiwan considered as the western extension of Okinawa Trough based on 34 geodetic sites observed between 2002 and 2006. The station velocities are between 1.9 mm/yr and 43.0 mm/yr in a direction between 38 ° and 143 ° relative to stable continent margin of Eurasian plate. This largest velocity is moving southeastward (143 °) at a rate of ~43 mm/yr was enhanced by a seismic doublet that occurred on March 6, 2005. The station velocities at the northern margin of Ilan Plain are insignificant with a magnitude of ~1.9 mm/yr to ~7.5 mm/yr. On the contrary, the station velocities increase approximately southward along the southern margin of Ilan Plain. The stations are moving roughly E–W with a magnitude of ~5.8 mm/yr to ~21.8 mm/yr. Further southward, the station velocities increase to a value of ~43.0 mm/yr in a direction of 143 °. The most prominent feature of the strain distribution patterns in Ilan Plain are the remarkable extensional strain rates observed in central and southern flank of the Ilan Plain. The largest extensional rate is found (2.66 μstrain/yr in 147°) with a shortening rate in the perpendicular direction (1.28 μstrain/yr in 57°), indicating transtensional deformation mode. In the northeastern flank of Ilan Plain, insignificant or minor deformations are observed. Overall the extensional rates in this area clearly increase from north to south. The extension directions in study area mostly trend E–W to NW–SE directions. Using the velocity field of 34 GPS stations and its strain rate filed, we suggest the lateral extrusion process towards mechanically weak domain adjacent Ryukyu subduction zone. The lateral extrusion is facilitated by the opening of the Okinawa Trough. We conclude that the northeast Taiwan is subjected to both the compressional force exerted by the indentation of Philippine Sea plate and the tensile force induced by trench retreat related to the suction force at the Ryukyu trench. Due to the interaction of two forces, the stress regime rapidly changes from pure compression in the Taiwan collision belt to transtension near Ilan Plain and its offshore area.
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Keywords: GPS; Okinawa Trough; Crustal deformation; Taiwan

1. Introduction

The Global Positioning System (GPS) is a powerful tool to better understand plate kinematics and crustal deformation (Dixon, 1991; Segall and Davis, 1997). In order to characterize the kinematics of deformation along the convergent plate boundary of Taiwan, the island-wide and local GPS Network was established since 1990 (Yu et al., 1997; Yu and Kuo, 2001). These GPS data provided the amplitude and orientation of tectonic motion across the plate boundary of Taiwan. To better reconstruct the ongoing deformation in different tectonic domains, the dense network was established by Central Geological Survey since 1996 in the Taiwan area, it thus became possible to monitor the regional deformation along and around major active structures in different tectonic regimes. In addition, the crustal deformation in Ryukyu arc estimated from GPS data provided the geodynamic constrain of tectonic implication (Nakamura, 2004; Nishimura et al., 2004).

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