Evolution of Stress State and Fluid Sources around the Westernmost Ilan Plain of NE Taiwan and Its implications for Geothermal Exploration

En-Chao Yeh1, Ping-Chuan Chen2, Yi-Chia Lu2, Fang-Yih Wu1, Hung-Yu Wu3, Tai-Tien Wang4, Weiren Lin5, Chi-Wen Yu6, Sheng-Rong Song2, Chien-Ying Wang7

1 Department of Earth Sciences, National Taiwan Normal University, Taiwan
2 Department of Geosciences, National Taiwan University, Taiwan
3 Research and Development Center for Ocean Drilling Science, JAMSTEC
4 Department of Civil Engineering, National Taiwan University, Taiwan
5 Graduate School of Engineering, Kyoto University, Japan
6 SinoTech Engineering Consultants Inc., Taiwan
7 Department of Earth Sciences, National Central University, Taiwan
E-mail: ecyeh@ntnu.edu.tw
Tel: +886-2-7734-6397

Abstract

Stress state is a key to understanding the dynamics of the solid Earth and also plays a vital role of manipulating plate tectonics, earthquake faulting, geological structures, and fracture conduit/barrier. NE Taiwan is influenced by oblique convergence and backarc extension between the Eurasian and Philippine Sea Plates. As a result, the Ilan Plain in NE Taiwan has high geothermal gradient due to the heat advection of rapid rock uplift and the backarc extension of the opening Okinawa Trough. It is important to comprehend the spatial distribution of stress state around the Ilan Plain for exploring the geothermal energy and deciphering the interaction between mountain building compression and backarc extension.
In-situ stress assessments from multi-scale observations such as regional focal mechanisms, local paleostress, borehole-based methods and core-based methods, show mainly the strike-slip stress regime with NNE-SSW compression in the western Ilan Plain. This result suggested that the N-S backarc extension has not strongly influenced the westernmost Ilan Plain yet. Isotope data of vein with various orientation suggested that NW-striking fractures probably due to the Okinawa opening are linked to the deep fluid of magmatic/metamorphic source and NE-striking fractures due to the mountain building are connect to the shallow fluid of meteoric source. These establishments between in-situ stress and fluid conduits can deliver the important information for developments of the enhanced geothermal system in Taiwan. Result of this study shed the lights on understanding the transition

from transpression to transtension due to the subduction flip.

Keywords: Stress state, Fracture, Enhanced geothermal system, Ilan Plain, Taiwan