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Thermo-mechanical models on the missing forearc basement in Taiwan

Chih-Hsin Chen[1], Eh Tan[2], Shu-Huei Hung[1], Yuan-Hsi Lee[3]

[1] Department of Geosciences, National Taiwan University
[2] Institute of Earth Sciences, Academia Sinica
[3] Department of Earth and Environmental Sciences, National Chung Cheng University

Taiwan is located at the edge of the Eurasian plate and borders the Philippine Sea plate. The Philippine Sea plate is moving northwestward at a speed of 70 to 80 mm/yr and is converging with the Eurasian plate, forming the Luzon arc and the Taiwan orogenic belt. However, in the middle section of the Taiwan orogenic belt, the Luzon arc is directly adjacent to the edge of the Eurasian continental margin, and the forearc basement is missing. This phenomenon of missing forearc basement is also widely observed in similar plate convergence zones. Previous studies have suggested that this forearc basement has subducted between the Philippine Sea plate and the Eurasian plate. In order to explore the mechanism of forearc basement subduction, we used thermal-mechanical coupled numerical simulations combined with geological data to simulate the dynamic mechanism of forearc basement subduction in the middle section of the Taiwan orogenic belt. The simulation results show that when the subducting plate transitions from oceanic crust to continental crust, the continental crust has a lower density and is not easily subducted. The huge mass formed by the orogeny blocks the Philippine Sea plate from moving northwestward, causing the forearc crust to bend concavely and form a forearc basin. The basin begins to accumulate a large amount of sedimentary material. Later, the center of the basin breaks to form the Longitudinal Valley fault, the island arc to the east of the basin thrusts over the forearc basement, pushing the basin sediment to uplift rapidly, and finally the forearc basement subducts below the Philippine Sea plate. This model explains the mechanism for the missing forearc basement, the timing of the formation of the Longitudinal Valley fault, and the dramatic up and down movements recorded in the sedimentary rocks of the Coastal Mountains. It also explains the spatial pattern of the surface heatflow.

Keywords: arc-continent collision, missing forearc basement, dynamic model