9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: Neotectonics/ Structural Geology/ Geomorphology

Numerical modelling of continental margin of the Eurasian Plate Rifting and Tectonic evolution. Causes of the highest metamorphic temperature in the Hsuehshan Range and Backbone Range

Ming-Jun Zheng[1], Yuan-Hsi Lee[1], Eh Tan[2]

[1] National Chung Cheng University, Minhsiung, Chiayi, Taiwan
[2] Institute of Earth Sciences, Academia Sinica, Nangang, Taipei, Taiwan

Many orogenic belts today preserve evidence of past crustal rifting. During the syn-rifting, the crust undergoes thinning, forming rift basins with thick sedimentary deposits. The upwelling of the mantle during this extensional phase increases the geothermal gradient within the basin, affecting the crust and sedimentary rocks. In this study, we used numerical models to simulate the temperature changes in sedimentary rocks within rift basins during both the active rifting phase and the passive continental margin phase after rifting cessation. We found that under a stretching rate of 0.7 cm per year, after 20 million years of continuous stretching, the geothermal gradient within the basin can reach 50-60°C per kilometer, with sedimentary rocks reaching temperatures as high as 450-500°C. After 20 million years of cooling following the end of stretching, the temperatures of the sedimentary rocks decrease by nearly 100°C, and the geothermal gradient reduces to approximately 30°C per kilometer. We believe that these phenomena can be correlated with the evolution of the Hsuehshan Range in Taiwan, which experienced a transition from rifting to a passive continental margin. During the rifting phase, the temperatures of the sedimentary rocks within the basin reached high metamorphic temperatures of 450-500°C, as indicated by carbonaceous material Raman spectroscopy (RSCM). As the region entered the passive continental margin phase, the rocks gradually cooled, with a temperature decrease of nearly 100°C prior to the onset of mountain building in Taiwan. Similar high-temperature metamorphic temperatures were obtained through RSCM analysis along the Central Cross-Island Highway and Northern Cross-Island Highway, exceeding the closure temperatures of zircon core tracks. However, some zircon core tracks in certain areas did not yield closure ages, suggesting that the high metamorphic temperatures obtained from RSCM analysis were inherited from previous stretching events rather than occurring during the Penglai orogeny.

Keywords: High-temperature metamorphism, numerical simulation, Rift basin