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Stress Dynamics of Magma Activity during Orogenic Evolution: An Example from Kinmen Island, SE China

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During orogeny, a mountain belt experienced different orogenic stages with various conditions of temperature, pressure, stress and fluid pressure. The speculation, that the orogenic stresses evolve from reverse faulting via strike-slip faulting to normal faulting stress regimes corresponding to syn-orogenic, post-orogenic and an-orogenic stage respectively, has been proposed but has not been proved yet. Here we report the study of dikes from Kinmen Island can shed light on understanding the stress evolution of orogeny.

The Kinmen Island, located in the southeastern continental margin of Mainland China, cropped out the middle to lower crust of NE structural grain, which was experienced deformation and metamorphism during Late Yenshanian Orogeny(LYO). Based on previous studies of geochemistry, geochronology, and P-T conditions, various types of dike have been identified. They are syn-orognic dikes of amphibolite (130-110Ma), post-orogenic dikes of pegmatite and aplite (110-100Ma), and an-orogenic dike of gabbro (94-76Ma).

During syn-orogenic stage of LYO, dike intrusion appeared as low-angle dip, which reflected that reverse faulting regime and horizontal maximum stress direction in E-W orientation. In post-orogenic stage, stress would be divided into two sub-stages. The early one was strike-slip faulting regime and horizontal maximum stress was in NW-SE orientation. The late one was normal faulting regime and horizontal maximum stress direction returned to E-W orientation. Finally, an-orogenic dike intrusion striked NE-SW with vertical dip, which displayed that normal faulting regime and NE-SW horizontal maximum stress direction.

Our observation is consistent with the expected stress evolution during orogeny. Deviatoric stresses from new findings were decreased at early post-orogenic stage but increased after late post-orogenic stage, indicating the change of fluid pressure ratio with time. The spatiotemporal variation of stress field might be suggested the change of mountain building processes during orogeny. The estimation of stress magnitude will further provide insights into understanding the mechanisms of the stress dynamics of orogenic evolution.