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Influence of foreland basin structural and stratigraphic inheritance on fold-and-thrust belt kinematic evolution in southwest Taiwan

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Southwest Taiwan is an area undergoing active orogeny and tectonic deformation, providing a unique opportunity for observation of ongoing geological processes. It has a high strain rate but very low seismicity, raising concerns about the occurrence of severe seismic hazards. The ANR SW-TAIWAN project aims to gain knowledge of this area's deformation mechanisms, which control tectonic stress and seismic events, and to gain also a better understanding of the long-term growth of geological structures and topography. Previous studies have reported that this area is composed of a shallow aseismic décollement and a deep seismic décollement. With the aseismic décollement, the discussion of the seismic cycle should involve the long-term visco-plastic deformation in relation to the bulk rheological properties of sedimentary rocks. In addition, early researches have demonstrated the significant impact of rheology on orogenic evolution. The rheology in southwest Taiwan has been constrained and discussed using various geophysical data. The region is characterized by seismic events concentrated within a shallow depth of 20 km and a thin effective elastic thickness of 13–16 km. Additionally, this area also exhibits complex structural inheritance affecting strength and controlling surface deformation. Altogether, this area is suggested to have low crustal strength.

To probe into this long-time-scale issue, we used experimental sandbox modeling and investigated the influence of basement rheology, including foreland basin structural and stratigraphic inheritance, on deformation in southwest Taiwan. In sandbox modeling, we reproduce the development of FTB under lateral convergence, and the experiments are recorded with high-resolution digital cameras to qualitatively monitor the morphotectonic evolution of the model and measure the topographic growth of structures and their kinematic evolution. Structural inheritance in the foreland basement, mechanical stratigraphic and surface processes are tested. Results provide new insights to understand the interplay between foreland basement geometry and orogeny in the young orogenic zones of southwest Taiwan.

Keywords: Southwest Taiwan, rheology, surface processes, and sandbox experiment