9th FTSES 2024 Penghu, Taiwan

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

Probing into the Mudstone Piercement in Southwest Taiwan by Numerical Geodynamic Simulation

Fang-Yi Lee[1], Eh Tan[1], Chun-Yen Chen[2]

[1] Institute of Earth Sciences, Academia Sinica, Taiwan
[2] Dept. of Geosciences, National Taiwan University

Mudstone (Gutingkeng) formation piercing through the overlying layers is commonly observed onshore and offshore southwestern Taiwan. The piercement is usually regarded in the literature as “mud diapirs”, which imply buoyancy-driven piercement with a negative density contrast to the overlying rocks. However, recent gravity analysis has challenged the diapirism concept by revealing a positive density contrast over the piercements. Consequently, a new driving mechanism is needed to explain the piercement in southwest Taiwan. In this study, we employ numerical geodynamic simulations incorporating visco-elasto-plastic deformation and surface erosion/sedimentation to explore the formation of these piercements. In the models, the mudstone has a very low viscosity, likely due to its high fluid content, and is slightly denser than the overlying layer. The mudstone is under horizontal compression and starts to fold. The crests of the folds are eroded while the valleys of the folds are filled with sediment. As a result, the amplitude of the mudstone folds can grow with time while the surface topography remains low. Finally, the mudstone pierces through the crests of the folds. Our models successfully reproduce mudstone piercement with a positive density contrast. Two key findings emerge: (1) an increase in elastic moduli and viscosity of the overlying layer correlates with a longer wavelength between piercements, and (2) a high erosion rate leads to thinning of the overlying layer, facilitating piercement formation.

Keywords: Mud diapir, southwest Taiwan, and numerical simulation