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Numerical simulation of rifting controlled by magmatic underplating in the South China Sea

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South China Sea is one of the largest basins in the western Pacific marginal sea, which is located in the intersection area of the Eurasia, the India-Australian and the Pacific-Philippines plate. Although the duration of seafloor spreading and the extension mechanism are still controversial.It is widely accepted that the South China Sea was opened by seafloor spreading in the Cenozoic. From the point of its structural development history, South China Sea has its own unique development model, which is formed by the continent rifting and expansion, while the tectonic evolution has close relationship with geological peripheral units. According to the seismic detection and magnetic integrated geophysics, the studies found that high-speed lower crust layers are widespread in the northern South China Sea and the northeast of continental margin, these layers are mainly located in continental slopes and some high-degree tensional continental shelves. Researches suggested that materials of high-speed in lower crustal layers are formed by the bottom magmatic underplating rather than serpentinized mantle peridotite. These layers are formed in Cenozoic and has close relationship with extension. However, in most kinematic and dynamic models of rift formation and evolution, the effects of magmatism have been neglected. This study established a two-dimensional thermal - mechanical coupled finite element model to simulate the role of underplated magmatic bodies in the localization of deformation. We examine the response of the lithosphere to an applied constant boundary velocity at the edge of the model. The mamatic underplating is introduced as a material with an anomalous high temperture and a magic upper mantle composition. The mechanical problem is coupled with the thermal problem through temperature-dependent viscosity. Since extension of lithosphere and underlying mantle is associated with intense and simultaneous viscous and brittle/plastic(faulting) deformations, we use the approach that it suggests remeshing at every time time step, which can be easily done with marker-in-cell algorithm. Based on the numerical model behaviour in this study, the role of underplated magmatic bodies in localization is linked with an anomalously high temperature and rock melting. The most important factor in controlling localization of deformation is the strength contrast between the weakened and non-weakened regions. Studies show that the deformation can be redistributed into a different region if the underplated magmatic bodies emplacement in multiple multiple regions during the extensional process. we have discussed the microcontinent formations observed in the South China Sea.