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Mechanism of Zhongtiao Aulacogen Related to Breakup of Columbia Supercontinent

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The mechanism of the breakup of supercontinent is a scientific frontier in the field of supercontinent study. The rifting and breakup of supercontinent has long been considered to be related to mantle plume. Paleo-Mesoproterozoic Zhongtiao aulacogen and Cuddapah basin are both known as intra-continental rift (basin) formed by a mantle plume that led to the breakup of Columbia supercontinent. In this paper, we attempt to investigate the mechanism of the Zhongtiao aulacogen and breakup of Columbia supercontinent with finite element numerical modeling. The trajectories of the horizontal maximum principal compressive stress (σ_{Hmax}) of the best fit model fit well with the trends of dyke swarms in the North China Craton (NCC) and the Indian Craton, suggesting that it is the result of such three factors as the mantle plume, the boundary subduction forces and rock mechanical properties. Furthermore, we develop another three models to analyze the influence of each factor. Compared the best fit model with the other three models, it can be found that the mantle plume beneath the Zhongtiao-Cuddapah area plays a vital role in developing the Zhongtiao aulacogen, Cuddapah basin and breakup of Columbia supercontinent, while the rock mechanical properties have little effect on the modeling results. Furthermore, the stress is not concentrated along the boundary of the NCC and Indian Craton when the boundary forces are not applied, indicating the boundary subduction forces are indispensable factors. Therefore, the mantle plume beneath the Zhongtiao-Cuddapah area, the northern margin of the NCC, the northwest and northeast margin of the Indian Craton subduction force altogether contributed to the formation of the Zhongtiao aulacogen, the Cuddapah basin and the initial breakup of Columbia supercontinent.

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