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The structure and breakup mechanism of the South China Sea

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As one of the largest marginal seas in the Western Pacific, the structure and evolution of the South China Sea will provide important reference to the marginal sea research. In order to decode the continent-ocean transition and seafloor spreading process of the South China Sea, 3 normal and 1 extended IODP drilling expeditions were carried out from distal margin to the relict ridge of the South China Sea. However, large controversies still exist due to the lack of enough drill site-coordinated geophysical investigation to calibrate the drilling results. 30 active source OBSs were deployed along the 300 km long drilling transect and then a 3D network with 60 OBSs were deployed in the Continent-Ocean transition zone. The velocity models deduced from the OBSs suggest that thick and widespread magmatic underplating occurred below the northern continental margin, with the thickest underplating occurred below the continental slope where the crustal thickness is over 20 km. Correlated with the sedimentary history, the strong magmatic underplating is supposed to happen at late Eocene and caused strong uplift and erosion of early syn-rift sequences. Quantitative analysis suggests that up to 10 km thick magmatic underplating below the thick crust requires a highly attenuated if not fully devastated mantle lithosphere below the continental slope during Eocene. Therefore, the breakup of South China Sea is supposed to experience an earlier mantle breakup and then a crust breakup to generate the spreading ocean. In comparison with Atlantic, the mantle below the northern continental margin might be wetter to generate such large amount of syn-rift magmatic underplating. Forward mathematical modeling suggests that a pre-rift subduction may provide the mechanism of both unsteady lithospheric and more saturated mantle. This might explain why marginal sea basin usually has much wider underplating and more magma supply than the same spreading rate passive continental margin and ocean.