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Magmatic evolution in a sedimented margin and implications for lithospheric breakup: insights from high-resolution seismic data from the South China Sea

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The interaction between magmatic and extensional processes related to the formation of rifted margins has been and still is highly debated. The interpretation of magmatic additions, timing of onset and budget of magma during rifting and lithospheric breakup remain controversial and poorly understood. In contrast, the emplacement of magmatic additions in rift systems with high sedimentation rates provides an exceptional perspective towards resolving some of these problems.

In this paper, we present two new high-resolution seismic profiles imaging the complete transition from the hyperextended crust to oceanic crust in the northern South China Sea (SCS). Based on the observation of magma-related structures and the interrelationship with the sedimentary sequence, we define forms and timing of magmatic additions. We show that magmatic activity initiated during necking and then propagated together with the seaward formation of “new” basement , as indicated by the occurrence of sills and laccoliths during hyperextension, and ENE striking cone-shaped volcanos during the final breakup stage before the establishment of an embryonic and then steady-state oceanic crust.

First order estimations of the magmatic budget in order to decipher the magmatic evolution show that it strikingly increased during final hyperextension and the breakup stage and lasted until 23.8 Ma. Thus, magmatic activity continued even after cessation of rifting. This study enables for the first time to provide a semi-quantitative estimate of when, where and how much magma formed during final rifting and breakup at a magma-intermediate margin.