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Thermal evolution of a continent ocean transition: The SE China margin case study

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Thermal evolution at rifted margins is controlled by the amount of lithospheric thinning and timing of rifting events. Hence, in theory it is possible for basin models to estimate thermal maturity in sedimentary basins, where the degree of thinning of continental crust is known along with the timing of the onset of rifting. However, high quality seismic images and deep-sea drilling has revealed that the Continent-Ocean Transition (COT) is a complex and "transitional domain" in which tectonic extension, magmatism and hydrothermal processes interact. In such distal settings it is necessary to test if specific processes need to be taken into consideration, for example the effects of magmatism, or the basement nature.

IODP 367-368 expeditions (International Ocean Discovery Program) sampled sedimentary succession and underlying basement rocks of the SE China COT. The integration of drilling results with geophysical data permits a reliable consideration of the interaction between extensional faulting and magmatism, which in this case gradually increase from continent to true oceanic crust. Altogether, this dataset represents a unique opportunity to investigate the thermal evolution of such a geodynamic setting. The analysis of the thermal maturity of sediment in this transitional zone aims to address several questions: 1) Can we record and characterize the thermal imprint of breakup in COT?, 2) What is the variation in paleo heat flow in the COT for each drilled site 3) What is the pre-, syn- and post-rift thermal evolution of COT?

In that scope, we setup an analytic strategy compiling organic petrography, Raman spectrometry, fossil-lipid biomarkers and pyrolysis data combined with 1D thermal models to assess the thermal maturity of the pre-, syn- and post-rift sediments. The thermal maturity of post-rift sediments across the entire COT is consistent with a model where heat flow decrease through time.

Over extremely thinned continental crust (6km thick, ridge A Site U1499) there are two significant anomalies in thermal maturity profiles: 1) a jump in thermal maturity below post-rift sediments, 2) a higher thermal maturity gradient with respect to depth in the syn-/pre- rift sediments. To successfully model this dataset it was necessary to invoke magmatic intrusions in the COT at the breakup time. Evidence for the emplacement of magmatic intrusions in the distal SE China margin are consistent with the available geological data even if no magmatic rocks were sampled at Site U1499. We suggest that the breakup related magmatic activity induces a high thermal maturity (up to ∼1.8 Ro%) in the pre- and/or syn- rift sequence of the SE China COT. This example highlights the complexity to predict thermal maturity of pre- and syn-rift sediments at COT due to the magmatic and hydrothermal activity.