IODP Proposal Cover Sheet

South China Sea Rifting

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Title	Testing Hypotheses for Lithosphere Thinning During Continental Breakup: Drilling at the South China Sea Rifted Margin
Proponents	Z. Sun, H. Larsen, C. Li, J. Lin, P. Wang, W. Ding, N. Hayman, S. Hsu, C. Huang, X. Huang, C. Lei, C. Lesher, J. Li, Q. Li, C. Liu, K. McIntosh , Y. Niu, X. Pang, M. Perez-Gussinye, Y. Qiu, J. Ren, H. Shi, J. Stock, X. Su, X. Tan, H. Van Avendonk, S. Wu, S. Xia, Y. Yan, B. Yao, Y. Yao, Y. Yeh, X. Zhang, M. Zhao, G. Zhong, D. Zhou,
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Area	

Contact Information

Contact Person:	Zhen Sun		
Department:	South China Sea Institute of Oceanology, Chinese Academy of Sciences		
Organization:			
Address:	164 Xingangxi Road	Guangzhou	510301
Tel.:		Fax:	
E-mail:	zhensun@scsio.ac.cn		

Abstract

This CPP addresses the mechanisms of lithosphere extension during continental breakup. State-of-the-art, deep reflection seismic data show that the northern South China Sea (SCS) margin offers excellent drilling opportunities that can address the process of plate rupture at a non-volcanic rifted margin. The SCS margin shows similarities to the hyper-extended Iberia-Newfoundland margins, possibly including exhumed and serpentinized mantle within the Continent-Ocean-Transition (COT). However, recent modeling studies suggest that mechanisms of plate weakening other than serpentinization of the sub-continental lithospheric mantle exists. Two competing models for plate rupture (in the absence of excessively hot asthenospheric mantle) have widely different predictions for: (1) Crustal structure across the COT; (2) the time lag between breakup and formation of igneous ocean crust; (3) the rates of extension; and (4) subsidence and thermal history. The drilling proposed will be able to firmly discriminate between these models. We propose four drill holes across a 150-200 km wide zone of highly extended seaward-thinning crust with a well-imaged COT zone. Three 1423-1652 m deep holes will determine the nature of critical crustal entities within the COT, and constrain post-breakup crustal subsidence. These three holes will also help constrain how soon after breakup did igneous crust start to form. A fourth 1102 m deep hole on the continental margin landward of the COT will constrain the timing of rifting, rate of extension, and crustal subsidence. If serpentinized mantle is found within the COT, this will lend support to the notion that the Iberia-type margin is not unique, and hence, that weakening of the lithosphere by introducing water into the mantle may be a common process during continental breakup. If serpentinite is not found, and alternatively, scientific drilling results for the first time are gained in support of an alternative model, this would be an equally important accomplishment. Constraints on SCS formation and stratigraphy, including industry drilling, ODP Leg 184 and IODP Expedition 349 drilling, the young (Paleogene) rifting of the margin, and absence of excessively thick post-rift sediments, allow us to effectively address these key topics by JOIDES Resolution drilling within a well-constrained setting. Initial spreading rate of ~ 2 cm/yr half-rate reduces the potential complexity of magma starved, slow-spread crust forming after breakup. The proposed drilling requires ~120 days of operations.

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Scientific Objectives

1. Determine the nature of the basement within critical crustal units across the Continent-Ocean-Transition (COT) of the South China Sea rifted margin in order to discriminate between different competing models of breakup at non-volcanic rifted margins. Specifically, to determine if the sub-continental lithospheric mantle was exhumed during plate rupture.

2. To examine the scale of time-lag between plate rupture and asthenospheric upwelling that allowed decompression melting to generate igneous ocean crust.

3. To address the kinematics of breakup in terms of rate of extension and vertical crustal movements.

4. To improve the understanding of the Cenozoic regional tectonic and environmental development of the Southeast Asia margin through new as well as existing ODP/IODP sediment records from the South China Sea basin.

Non-standard measurements technology needed to achieve the proposed scientific objectives.

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
SCSII-1A	18.4547167, 116.13167	3715	1388	250	1638	Nature of basement: Exhumed serpentinized mantle? Or upper/lower continental crust, or igneous basement? Time and environment of final breakup, and subsequent subsidence. High priority for proposal objective 1,2,3,4.
SCSII-3B	18.93037, 115.85142	2928	1002	100	1102	Recover syn-rift and post-rift sediments To constrain age, duration and environment of rifting and breakup. Subsidence history High priority for proposal objectives 3,4.
SCSII-3C	18.86948, 115.88742	2910	743	100	843	Recover syn-rift and post-rift sediments To constrain age, duration and environment of rifting and breakup. Subsidence history Alternate to 3B. High priority for

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SCSII-8A	18.27145, 116.23985	3801	1323	100	1423	Nature of basement: Exhumed serpentinized mantle, or igneous ocean crust. Paleodepth and initial subsidence of the very earliest SCS ocean basin. High priority for proposal objective 1,2.
SCSII-9A	18.14346, 116.31445	3864	1552	100	1652	Nature of oceanic crust: Was a robust mantle-melting regime established shortly after breakup or not? High priority for objectives 2,1.
SCSII-13A	18.10495, 116.06523	3841	1776	100	1876	Nature of oceanic crust: Was a robust mantle-melting regime established shortly after breakup or not. Alternate to 9A. High priority for proposal objectives 2, 1.
SCSII-12A	18.27419, 115.96566	3781	1826	100	1926	Nature of basement: exhumed serpentinized mantle, or igneous ocean crust. Paleodepth and initial subsidence of the very earliest SCS ocean basin. Alternate to 8A. High priority for proposal objective 1,2.
SCSII-11A	18.41089, 115.88519	3739	1265	100	1365	Nature of basement:exhumed serpentinized mantle? Or upper/lower continental crust, or igneous basement? Time and environment of final breakup, and subsequent subsidence. Alternate to 1A. High priority for objectives 1,2,3,4.

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