IODP Proposal Cover Sheet

Corinth Active Rift Development

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Title	Drilling the Corinth Rift: Resolving the detail of active rift development
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Keywords	continental rifting, basin evolution, earthquakes
Area	Central Greece-Aegean

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Abstract

Continental rifting is fundamental for the formation of ocean basins and hydrocarbon-bearing rifted margins, and active rift zones are dynamic regions of high geohazard potential. But much of what we know from the fault to plate scale is poorly constrained and is not resolved at any level of spatial or temporal detail over a complete rift system. We propose drilling within the active Corinth Rift, Greece where deformation rates are high, the syn-rift succession is preserved and accessible, and a dense, seismic database provides a high resolution fault network and seismic stratigraphy for the recent rift history but with limited chronology. In Corinth we can achieve an unprecedented precision of timing and spatial complexity of rift-fault system development and rift-controlled drainage system evolution in the first 1-2Myr of rift history. We propose to resolve at a high temporal and spatial resolution how faults evolve, how strain is (re-)distributed, and how the landscape responds within the first few Myrs in a non-volcanic continental rift, as modulated by Quaternary changes in sea level and climate. High horizontal spatial resolution (1-3 km) is provided by a dense grid of seismic profiles offshore that have been recently fully integrated, complemented by extensive outcrops onshore. High temporal resolution (~20-50ka) will be provided by seismic stratigraphy tied to core and log data from three carefully located boreholes to sample the recent syn-rift sequence. Two primary themes are addressed by the proposed drilling integrated with the seismic database and onshore data. First, fault and rift evolutionary history (including fault growth, strain localization and rift propagation) and deformation rates: the spatial scales and relative timing can already be determined within the seismic data offshore. Dating of drill core will provide the absolute timing offshore, the temporal correlation to the onshore and the ability to quantify strain rates. Second, the response of drainage evolution and sediment supply to rift and fault evolution: core data will define lithologies, depositional systems and paleoenvironment, including catchment paleo-climate, basin paleobathymetry, and relative sea level. Integrated with seismic data, onshore stratigraphy and catchment data, we will investigate the relative roles and feedbacks between tectonics, climate and eustasy in sediment flux and basin evolution. A multidisciplinary approach to core sampling integrated with log and seismic data will generate a Quaternary chronology for the syn-rift stratigraphy down to orbital timescale resolutions and resolve the paleoenvironmental history of the basin in order to address our objectives.

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Scientific Objectives

We propose three drillsites in the offshore Corinth Rift in order to resolve the syn-rift chronology and paleoenvironment and integrate this with an existing seismic database and onshore stratigraphy to address the following objectives:

1. Fault and rift structural evolution in an active continental rift: To establish the distribution of tectonic strain in time and space and the timescales of fault evolution in a young rift at high resolution (20-50kyr and 1-10s of kms).

We will determine the growth and development of a rift-scale normal fault network, timescales of segmentation establishment, basin evolution in terms of strain localization, rift propagation and migration, and the impact of crustal structure and composition on strain rate and distribution. What are the controlling parameters on strain localization? How and when does a "mature" fault network emerge?

2. Surface processes in active rifts: To determine the evolution of a rift-controlled, closed drainage system in time and space at high temporal resolution (20-50kyr) and the relative impact of tectonics and climate on sediment flux.

What are the relative contributions of millennial to orbital periodicity Quaternary climate fluctuations (global and regional) and fault activity/rift evolution in controlling the supply of sediment into a rift basin? We will assess changes in sediment flux at a range of timescales, and determine the response to fault birth, death and migration, rift flank uplift, and changes in strain rate (tectonic forcing) in terms of sediment supply and the feedbacks between erosion, sediment transport and deposition and tectonic processes.

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	
COR-04	38.119675, 23.089213	365	480	0	480	Core and wireline log seismic unit 2 (SU2: expected Late Pleistocene interbedded marine-lacustrine deposits), regional unconformity, and seismic unit 1 (SU1: expected Plio-Pleistocene lacustrine-fluvial syn-rift deposits) to:Determine age, lithology, and paleoenvironment of most recent syn-rift stratigraphic sequence (SU2); Determine nature and age of regional unconformity and change in age and environment across the unconformity; Establish age and paleoenvironment of SU1 for integration with onshore syn-rift stratigraphy and rift evolution timing along the rift axis (by comparison with COR-02); Utilise chronostratigraphy of complete section to analyse fault and rift development and sediment flux history by core-log-seismic integration.

COR-03	38.117098, 23.108333	347	740	0	740	Core and wireline log seismic unit 2 (SU2: expected Late Pleistocene interbedded marine-lacustrine deposits), regional unconformity, and seismic unit 1 (SU1: expected Plio-Pleistocene lacustrine-fluvial syn-rift deposits) to: Determine age, lithology, and paleoenvironment of most recent syn-rift stratigraphic sequence (SU2); Determine nature and age of regional unconformity and change in age and environment across the unconformity; Establish age and paleoenvironment of SU1 for integration with onshore syn-rift stratigraphy and rift evolution timing along the rift axis (by comparison with COR-02); Utilise chronostratigraphy of complete section to analyse fault and rift development and sediment flux history by core-log-seismic integration.
COR-02	38.144942, 22.758405	862	750	0	750	Core and wireline log seismic unit 2 (SU2: expected Late Pleistocene interbedded marine-lacustrine deposits), regional unconformity, and seismic unit 1 (SU1: expected Plio-Pleistocene lacustrine-fluvial syn-rift deposits) to:Determine age, lithology, and paleoenvironment of most recent syn-rift stratigraphic sequence (SU2); Determine nature and age of regional unconformity and change in age and environment across the unconformity; Establish age and paleoenvironment of SU1 for integration with onshore syn-rift stratigraphy and rift evolution timing along the rift axis (by comparison with COR-03); Utilise chronostratigraphy of complete section to analyse fault and rift development and sediment flux history by core-log-seismic integration.
COR-01	38.157534, 22.695709	852	750	0	750	Core and wireline log seismic unit 2 (SU2: expected Late Pleistocene interbedded marine-lacustrine hemipelagic-gravity flow deposits), and underlying unconformity to: Determine age, lithology, and paleoenvironment of most recent syn-rift stratigraphic sequence; Determine nature and age of regional unconformity and change in age and environment across the unconformity; Utilise chronostratigraphy to analyse fault and rift development and sediment flux history by core-log-seismic integration.

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