IODP Proposal Cover Sheet

Corinth Active Rift Development

879 - Full

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.

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 1-10's 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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Drilling the Corinth Rift: Resolving the detail of active rift development

1. Introduction and Rationale

How rifting initiates and evolves to continental breakup and ocean basin formation is a major unanswered Solid Earth-Plate Tectonic question: continental rifting is the first stage of this process. Over the last 15 years, important insights have derived from numerical models (e.g. *1-5*) and from observations at mature, magma-poor passive margins (*6-10*) where activity has ceased, but early syn-rift stratigraphy is often difficult to image and sample due to deep burial and tectonic overprinting. Instead, we propose to study the young, seismically active Corinth rift with a unique existing dataset to resolve, at high temporal and spatial resolution, how faults initiate and link, how strain is distributed over time, and how the landscape responds during the first few Myrs of continental rifting. The entire interconnected rift system can be resolved and examined on a range of timescales and the Corinth rift lacks magmatism, reducing the number of variables contributing to rift morphology and stratigraphic fill. Numerical models indicate that strain rate is a key parameter controlling the style and magnitude of extension (Geoprisms Implementation Plan, 2013) and improved strain rate information will help constrain rheology. However, spatial and temporal patterns in strain rate are very poorly known for most extensional systems due to poor chronological constraints, other than over short (earthquake-cycle) timescales. Key questions include: What controls rift geometry and evolution? How does activity on faults change with time, and what are the implications for earthquake activity on a developing rift fault system and what does this tell us about crustal rheology? How does strain rate and distribution control landscape development and sediment flux into rifts?

The magnitude, rate and timing of deformation have rarely been quantified in a continental rift system at a resolution <1Myr. The Corinth Rift (Fig.1) offers the opportunity to do this at a resolution only achievable at a couple of locations. As the focus of extensional deformation within the Aegean, Corinth is one of few actively extending rifts where a near-complete syn-rift stratigraphic sequence is well preserved and easily accessible, partly onshore and partly offshore. Ocean drilling is the only way to resolve the chronology and paleoenvironment of the offshore syn-rift succession (only the earlier rift sequence is exposed onshore, with limited dating potential). We propose to drill, sample and log a significant part of this sequence to constrain in space and time the deformation rate, absolute timing of rifting processes, subsidence and sediment flux through time, and the interaction of rift development and climate on surface processes and sediment flux. This project will address Earth Connections, Earth in Motion, and Climate Ocean Change aspects of the IODP Science Plan.

Primary Scientific 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 1-10's 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.

Deliverables of drilling coupled with the fully integrated marine and onshore datasets include: (1) Early rift development history from inception to present; (2) The first comprehensive and high resolution record of spatial and temporal strain distribution within an active rift; (3) A record of fault linkage and fault array development constraining numerical and analogue models; (4) A model of the impact of tectonics, climate and sea level on rift surface processes and sediment supply; (5) New constraints on fault slip rates and geohazards; and (6) A Quaternary Eastern Mediterranean climate and sea level fluctuation record. These results will be readily transferrable to other active rifts and to the deeply buried elements of mature rifted margins, and will significantly improve modeling approaches.

2. Why the Gulf of Corinth and why ocean drilling?

International significance: The Corinth Rift is an ideal target for studying rift processes because it is deforming under high strain rates (*11*) and extension is focused, with well-constrained initial conditions, a sea-level reference frame and no tectonic overprinting. Corinth is a non-volcanic, non-oblique rift complementing work in other active rift systems (e.g., East Africa, Gulf of California). The Rift is currently a closed, small-scale clastic sedimentary system and the last ~2Myr of the syn-rift stratigraphic record is preserved offshore while earlier rift sediments are preserved onshore providing a clear spatial and temporal record of fault and rift activity. Late Quaternary paleoenvironments fluctuated between interglacial Mediterranean-type climates and glacial cool, wet conditions (*12*) allowing us to examine the impact of climatic change on surface processes (e.g. *13*).

Seismic database: The high density of seismic reflection data (Fig.2, Table 1) provides high resolution fault trace and stratigraphic control (e.g., *14*). These data have recently been comprehensively integrated through a **UKIODP-funded "Virtual Site Survey" (VSS) project** (*18)*. This database allows us to correlate dated stratigraphy around almost the entire active rift from a small number of boreholes. Published studies (e.g., *14*) have used sequence stratigraphy to model chronostratigraphy and the VSS reconciled the seismic stratigraphic interpretations (Fig.3), but absolute chronology is almost entirely unconstrained. Sampling is essential to generate a chronology to quantify absolute timing and rates.

Unique high resolution: We aim to achieve a resolution of tectonic and surface processes that will be an order of magnitude better than any other global rift system. Piston core analysis (*13,15*) demonstrates that we should be able to develop a chronostratigraphy for the most recent rift phase with a temporal resolution ~20kyr (equivalent to ~50 earthquake cycles) correlatable to the seismic stratigraphy for high resolution whole rift- and fault-scale analysis. If applied to the whole rift, this exceptional resolution will enable us to address rift-related structural and surface process objectives, constrain more realistic modeling of basin development, and generate a valuable record of Eastern Mediterranean Quaternary paleo-climate and environment.

Continental drilling does not have the scope to address our objectives: The complete syn-rift record cannot be obtained from onshore sampling alone. In addition, proximal coarse marginal lithologies will not yield the required chronostratigraphic resolution. ICDP drilled the 1000m AIG10 borehole across the active Aigion fault in the western marginal rift in 2002, but this project was focused on fault mechanics and fluid flow and only collected 100m of core with most sampling by cuttings (e.g., *16,17*).

3. Relationship to IODP and Supporting Programmes

Drilling within the Corinth Rift addresses several elements of the IODP Science Plan: fundamental **Earth Connections** science problems (e.g., dynamic processes that create ocean basins; the impact of deep processes on Earth's surface environment; processes that initiate new plate boundaries); **Earth in Motion Hazards on Human Time Scales** Challenge 12: Mechanisms controlling earthquakes, landslides and tsunami, including processes that underlie geological hazards; and secondarily, **Climate and Ocean Change** (e.g., a high resolution Quaternary climate record). Major international programs past and present have stressed the significance of continental rifting. GeoPRISMS has highlighted Rift Initiation and Evolution (RIE) including: how do fundamental rifting processes and their feedbacks evolve in time and space; how do border fault segments form; and how is strain distributed throughout the lithosphere? The self-contained Corinth Rift, with a complete syn-rift sequence, is a perfect complement to the GeoPRISMS RIE site, the East African rift. Arguably Corinth better addresses many GeoPRISMS objectives because it can provide a well-constrained spatial and temporal pattern of strain rate during early rifting. The significantly higher strain rates compared to East Africa make Corinth probably a better setting for comparison to rifts that evolve to oceans and to modeling results. Regionally, ICDP drilling (AIG10 borehole) provides useful information on proximal syn-rift sediment types and for drilling planning here. The MEDUSA project is improving resolution of crustal and lithospheric structure as part of a study of the Hellenic subduction system, the EPOS (European Plate Observing System) initiative is improving the local seismic-geodetic network, the SISCOR program is expanding high resolution seismic data in the westernmost rift, and ongoing projects are improving the chronology and mapping of the onshore rift sequence and analyzing the rift drainage network evolution. Results from these complementary programs, all with proponent involvement, will be integrated with drilling results.

4. Response to Pre-Proposal Review

Pre-Proposal 710 was submitted in 2006 and revised in 2008. Here we respond to SSEP reviews in 2006 and 2008, focusing on the latter.

The VSS project has now integrated all seismic data, generating a high resolution fault network map, reconciling different seismic stratigraphic interpretations, and allowing correlation of stratigraphic horizons and production of isochore maps throughout almost the entire offshore Rift (Figs.1,2,3,4; *18 after 14,19*). Drill sites have been rationalized based on the newly integrated data. Following the VSS, ongoing research, and a highly-successful workshop (February, 2014), the objectives and hypotheses have been considerably refined. The proposal now emphasizes the uniqueness of the resolution achievable within the Corinth Rift (as a function of the temporal resolution from drilling and spatial resolution from the seismic datasets). Regardless of rift-driving mechanism, the fundamental rifting processes to be resolved here at high resolution are generic and applicable to all rift basins, active and mature. Hence the proposal has high global significance. The proposed objectives have been framed as hypotheses with clear statements of how they will be tested by ocean drilling. A detailed explanation of the chronostratigraphic methodology is included, and many of the results here will contribute to the Secondary Objective of a regionally- and globally-relevant paleoclimate record.

5. Background

Early Stage Rifting - Structural and Surface Processes

Structural Processes: The style and variability of rift deformation in the first few Myr of rifting is often unknown due to deep burial and overprinting. Open questions include: how does rift geometry develop and on what timescale (e.g., rift polarity and symmetry change); does rift propagation or pre-existing structure influence rift segmentation (e.g., *20,21*); what is the role of strain localization with time (e.g., *22,23*)?

Models for rift evolution based on mature rifted margins often propose pure shear during early rift stages followed by depth-dependent stretching (e.g., *9*). This can only be demonstrated by comparing the timing, distribution and magnitude of subsidence since earliest rifting with crustal structure (e.g., *24*) which has never been done for the first few Myr of rift history. The geometry, number, location and strain rate of faults, together with patterns of syn-rift subsidence and sediment accumulation, record deformation processes within both the brittle and underlying ductile part of the crust. These results are used to develop and test thermo-mechanical models of deformation on a range of scales (e.g., *4,25,26*). These suggest that an initially broad zone of complex deformation becomes localized onto a smaller number of discrete and increasingly large faults while sedimentation becomes focused into fewer, larger depocenters (e.g., *27,28*). But does this occur synchronously along a rift and on what timescale? At what point in the rift's history do these changes occur? In most rifts rates and timings are very poorly constrained: in Corinth we can achieve an unprecedented precision of timing and spatial complexity.

Surface Processes: Rift faulting and consequent rift flank/footwall uplift are major controls on erosion and sediment flux, alongside climate and eustasy (e.g., *29*), from rift initiation to beyond rift climax when subsidence rates significantly increase (*30*). Semi-quantitative, source-to-sink relationships have been developed relating drainage catchment morphologies to basin deposition (*31,32*). Over Myr timescales, depositional architectures may be controlled by tectonic rejuvenation of hinterland catchments (*33*), with any source-to-sink system collectively controlled by tectonic activity, base level, climate change and catchment lithology. The response of simple catchment-fan systems to changing fault slip rates has been modeled (*34*), as have responses to combined tectonic and climatic forcing and sensitivities to response times (*35,36,37*). But few studies have examined these responses at basin scale and few quantitative, empirical data exist to test models.

High frequency (sub-millenial) climate events influencing erosion and sediment flux can have rapid impact, recorded as changes in sedimentation rate (e.g. *38,39*). What has not been achieved is to compare tectonic and climatic signal magnitude within sedimentary records of well-defined source-to-sink systems. The Corinth depocenters offer locations where high resolution stratigraphies, if dated, can constrain both longer term (10^5-10^6 year) tectonic control on catchment evolution and shorter term (10^3-10^4 year) climatic impacts upon sediment supply rates.

The Corinth Rift

The Corinth Rift (Fig.1) is one of Europe's most seismically-energetic areas. The Aegean represents a natural laboratory for the study of rapid continental extensional tectonics, beginning in the Oligo-Miocene (e.g., *40-44*). In the late Pliocene-early Pleistocene, deformation became strongly localized across a few zones, with Corinth the most prominent. The active rift is a ~100 x 30-40km band experiencing intense N-S extension; the entire rift is ~ 70-80km wide. Current extension rates reach 10-16mm/yr (e.g., *11,45-47*), some of the highest in the world, giving strain rates ~5 $x10^{-7}$/yr. There is continued debate on the origin of extension in the broader Aegean and focusing of strain at the Corinth Rift, with models typically combining gravitational collapse of thickened crust, subduction-driven rollback and backarc extension, westward expulsion of Anatolia and propagation of the North Anatolian Fault (e.g., *44,48*). Regional lithospheric structure, including that of the subducting African plate, is constrained by wide-angle seismic and teleseismic tomographic techniques and gravity data (e.g., *49-52*): thicker crust (~40-45km) runs NW-SE along the orogenic Hellenide/Pindos mountain belt in the west (Fig.5a).

Rift Evolution and Stratigraphy

Corinth rifting began ~5Ma with 3 main phases identified by integrating onshore deposits and offshore seismic stratigraphy (Fig.6; e.g., *44,53-55,14,19,18*). Initial Pliocene basinal deposition (preserved onshore) was continental, varying from alluvial fans in the west to lakes in the east ("Lower Group", *53,54,56,57*). Increased subsidence rates, depocenter deepening and linkage followed, with large marginal fan deltas (locally >800m thickness) now uplifted and exposed onshore ("Middle Group"). The timing of the marked deepening ("rift climax") may have occurred at different times along the rift (e.g., ~2.2Ma in the Alkyonides Gulf (eastern rift), ~3.0Ma in the central rift (*58,59*), and ~1.8Ma in the west (*55)*). This transition is thought to represent increased subsidence and sediment supply in the rift at the location of the modern Gulf of Corinth (Middle Group onshore, probable Seismic Unit 1 (SU1) offshore). During this phase, the rift was controlled by both S- and N-dipping bounding faults (*14,54*). At ~0.6Ma, fault activity stepped northward and the rift narrowed, establishing the modern rift asymmetry with southern boundary N-dipping faults dominating subsidence and with fan deltas developing along the southern Gulf margin ("Upper Group" onshore and Seismic Unit 2 (SU2) offshore). The rift environment has evolved from terrestrial to lacustrine to alternating lacustrine-marine between glacial-interglacial periods, respectively, as eustatic sea level fluctuated relative to the boundaries of the basin (west: Rion sill, east: Corinth Isthmus). The exact onset of regular marine deposition is not known, but is hypothesized to correlate with the distinct seismic stratigraphy of SU2 (earlier limited marine incursions have been described, e.g., *53,54*).

Throughout its evolution, the rift narrowed (strain localized) but also migrated northwards. The extension rate may have increased at specific times over rift history (*54*), suggesting a deviation from models with relatively constant net strain and increasing, gradual localization (*60-63*). The Gulf of California may have also evolved through episodic localization (*64*). Geodetic and microseismicity data indicate recent highest strain rates in the western rift (e.g., *46,47*). However, long-term extensional strain is greatest in the central rift (e.g., *14,65*).

Offshore rift architecture and syn-rift stratigraphy

Extension in the rift changes along axis and in time, with changing polarity and symmetry of fault networks, single versus multiple active faults and complex depocenter distribution offshore (Figs.1,4). Clear, traceable unconformities or sequence boundaries mark major changes in rift development <u>but their age is unknown</u>.

The syn-rift succession offshore is locally up to 2.5km thick and divided into two seismic stratigraphic units separated by a locally angular unconformity (“U”): older, lower amplitude Seismic Unit 1; and younger, well-stratified and higher amplitude Seismic Unit 2 (e.g., Fig.3). SU1 can be further divided into a non-stratified (limited clear reflections) lower sub-unit (SU1a) mainly found on the southern basin margin and a more widespread, stratified (although weakly in places) upper sub-unit (SU1b). Unit SU2 has been interpreted to record glacial-interglacial cycles (*55,66,14,19*) on the basis of marine and lacustrine conditions detected in short cores, clinoform sequences on some basin margins (e.g., *66-69*), and alternating low amplitude/high amplitude seismic sequences interpreted as lowstand lacustrine/highstand marine sequences, respectively (e.g., Figs.3,7). The integrated sequence stratigraphic interpretations of the VSS project suggest the base of SU1 is ~ 0.6Ma (*18*). The onshore ‘Middle Group” is thought to be time-equivalent to the lower unit offshore (SU1) and the onshore “Upper Group” equivalent to the upper unit (SU2) offshore. The onshore ‘Lower Group” is likely of minimal thickness offshore, if present at all, being north of the locus of rifting at that time.

Depth to basement maps (*14,19*) show a single depocenter below the current central Gulf, with reduced subsidence in the eastern (Alkyonides Gulf) and western rift. Isochore maps of the syn-rift sediments (Fig.4; *14,18,19*) indicate that before the ~0.6Ma unconformity, two primarily symmetric depocenters existed, but since the unconformity, these have linked into a single depocenter, coincident with transfer of strain from S-dipping to N-dipping faults (increased asymmetry) (Fig.4a,b,e). Specifically, a change in rift polarity and symmetry followed by depocenter linkage occurred. The switch to dominant N-dipping faults appears to be synchronous along the entire rift. Since ~200ka, these N-dipping faults have evolved from linkage of smaller fault segments and increased in size and activity with equivalent changes to depocenters. The increase in individual fault activity may be a combination of not only strain localization but also increased net strain rate. The timing, position and rate of switch in rift polarity/symmetry and of fault and depocenter linkage can only be constrained by drilling providing the chronology combined with the existing dense seismic network.

6. Proposed Drilling

The Gulf of Corinth is entered from the east by the Corinth canal and from the west by the Rion suspension bridge; the Joides Resolution cannot pass due to its height thus this proposal is for MSP non-riser drilling. In consultation with BGS/ESO, we have been advised that boreholes >~750m would likely require casing, increasing time and cost. MSP drilling platform specifics are not yet known, therefore our drilling time estimate is from BGS's comparison with previous expeditions. BGS has advised a maximum expedition length of 60-90 days.

Our drilling program targets the SU2, the unconformity and the upper part of SU1 of the syn-rift sequence at 3 sites in the Gulf (main basin) and Alkyonides Basin, with maximum TD of ~750m and total drilling time of 71 days. We cannot reach the oldest offshore syn-rift sediments without drilling >750m below seafloor, but by targeting specific sequences in different parts of the rift, we can gain high resolution syn-rift chronostratigraphy, and by integrating the dated offshore sequences with the partially dated onshore stratigraphy, resolve likely age and rift history of the complete syn-rift sequence. Drilling offshore provides a section that is either not present (Upper Group) or is much more difficult to access (Middle Group) onshore. This drilling program will allow us to resolve the last ~600ka (unit SU2) of rift and sediment flux history at ultra high resolution (10^4 years), constrain the age and nature of the rift-wide unconformity, determine the age and paleoenvironment of much of unit SU1 and extrapolate to the base of SU1 for its approximate basal age, and integrate the offshore and onshore sequences to generate a full syn-rift history.

7. Hypotheses to be Tested by Ocean Drilling

Fault and Rift Structural Evolution in an Active Continental Rift

Hypothesis 1*: Structural style, distribution of strain and strain rates within a rift are spatially and temporally variable over distances of <30-50km and timescales of <1Myr.*

Detailed studies of syn-rift deformation provide valuable insights into fault and rift evolution, e.g., in the North Sea Viking Graben (e.g., *70,28*), East African rift (e.g., *20*), Rio Grande rift (e.g., *71*), Gulf of Suez (e.g., *62*) and Gulf of California (e.g. *72*). For these studies, however, the finest achievable rift-scale temporal resolution is of the order of 1Myr. For example, studies that rely on onshore field observations (e.g. Gulf of Suez) or deep offshore basins (e.g. North Sea) lack fine temporal resolution. Some studies have investigated the evolution of individual fault systems at finer spatial and temporal scale (10's kyr), however, these studies have been restricted to recent activity or are not at rift scale (e.g. *63*). Therefore, details of variations in structural style, strain distribution and strain rate at high resolution (temporal resolution of 10^4-10^6yrs and spatial resolution of 1-10's km, e.g., Fig.10) at whole rift scale remain unresolved. High density, high-resolution marine seismic data combined with chronology from drilling mean small-scale spatial variations in strain distribution (<~1km) and temporal variations <1Myr can be resolved. In Corinth, relative fault activity and depocenter development have been resolved spatially in detail, but only through relative time: there is no chronology (Figs.4,6; e.g., *14,18,19*). The proposed 3 boreholes provide high-resolution chronology allowing basin-wide mapping of chronology and stratigraphy down to ~20kyr. The seismic database allows us to map units at this ~20kyr resolution over ~80-90% of the modern rift system, unprecedented for any rift. Only drilling provides absolute dating to resolve timings of changes in structural style, fault slip history, and deformation rates.

In order to test **Hypothesis 1,** we will determine slip rates of major faults through time by integrating our syn-rift chronostratigraphy from drilling with fault displacements both onshore and offshore, and then determine the relative significance of individual faults based on slip history and depocentre development. Incremental slip history on faults within the network can be resolved in Corinth with the combined high sedimentation and high fault slip rates. Understanding the lifespan of a fault, and details of how fault activity changes through time and over what timescales, and how strain is transferred across a fault network are all crucial but poorly understood elements of earthquake geology and relevant to assessing potential hazard within a fault system. Accurate age control for core integrated with log and high resolution seismic data will allow us to compare deformation at ~50 earthquake cycle (~20kyr) timescales and over different time intervals e.g., 10-20kyr, 100kyr, 500-1000kyr. We will use this fault slip and activity history to determine the evolution of rift segmentation and rift symmetry/asymmetry at a spatial resolution of 1-10's km, and by integrating onshore and offshore rift sequence history, establish rift segment evolution from inception to 5Myr into rift history. Because syn-rift sedimentation and basin subsidence are sensitive to details of lithosphere thinning, we can use extension and subsidence rates (from drilling) and patterns (from seismic and onshore data) to test for lithospheric-scale stretching patterns (pure shear versus depth-dependent stretching) and rheological properties. Extension rates will be constrained by restoration of rift cross sections using dated syn-rift stratigraphy. Strain rate history over multiple earthquake cycles is critical for understanding time-averaged geological strain rates to parameterize models and to assess lithospheric rheology, going beyond existing data time averaged over Myrs or over single earthquake cycles.

Hypothesis 2: *Strain localizes within rifts over time leading to active rift narrowing, and this localization of strain is an abrupt, not gradual process but typically synchronous along the rift.*

Progressive strain localization has been recognized as an important process in rifts on a variety of temporal and spatial scales: observations from evolving and mature rifts and modeling suggest that a broad zone of deformation at the onset of rifting becomes localized into fewer, increasingly large faults thus sedimentation focuses into fewer, larger depocenters (e.g., *27,28*). *73* identify strain localization onto large individual faults within a fault population during a 16Myr period in the northern North Sea. In the Suez rift and North Sea Viking Graben, strain localization has occurred over 20-30Myr since rift initiation (e.g. *70*). In contrast, some rifts show atypical strain localization and fault migration patterns, such as increasing strain distribution with time (e.g., *74*).

However, these studies do not look in detail at patterns of strain localization at timescales of < 1Myr, or consider when strain localization occurs or if it occurs synchronously (e.g., can it occur as early as ~2-3Myr since rift initiation, as suggested by Corinth?). In most rifts the rates and timings are very poorly constrained and nowhere else (than Corinth) can we achieve the same precision of both timing and space.

To test **Hypothesis 2**, we will constrain extension rates on geological timescales (10s kyr to 1Myr) from fault slip rates to compare with those from geodetic and seismological data (10 to 100yr) to determine how strain patterns and rates have evolved on different time scales (time-rate information from boreholes coupled with the spatial extent of strain from seismic data). Using fault and depocenter history and the timing of offshore (from drilling) and onshore syn-rift sequences across the rift axis, we will define the distribution of extensional strain in time and space. We will specifically compare the relative timings of segment, depocenter, regional unconformity and basin-bounding fault establishment, including the relative age and environment of unit SU1 (probable Middle Group) along the rift (using boreholes COR-02 and COR-03 integrated with the seismic database, Figs.8,9) to test for synchronous extension versus specific propagation patterns (across or along axis) or more complex patterns of rift development, e.g., rift segment abandonment and propagation of new segments.

Pre-existing structural weaknesses within the crust may also influence the location and geometry of rift normal faults, particularly during the initial stages of rifting. Crustal/lithospheric thickness, thermal structure and resulting rheology are predicted to strongly influence rift development (e.g. *75,76*) and basement structure can affect rift structure by reactivation of existing weaknesses or by deflecting the local stress field (*77-79*). If patterns of rift evolution timing (from drilling-derived chronostratigraphy) and style (e.g., degree and rate of strain localization from drilling and seismic data) differ along axis, we will compare with regional data on crustal thickness variation, and evidence for potential differences in basement composition, rheology, metamorphic grade and structural fabric caused by Cretaceous-Miocene Hellenide orogenic processes that affect the western rift region more than the east (Fig.5; e.g., *48*). Thus we can test for the role of pre-existing crustal properties or weaknesses in rift evolution.

Hypothesis 3*: Fault linkage timing and rate of linkage is a function of strain rate.*

The growth of normal fault systems is described in two end-member kinematic models. The 'isolated fault' model (*80-84)* proposes that extension is initially accommodated by a dispersed array of isolated and independent fault segments that grow by lateral propagation until some overlap and link. Fault linkage leads to fewer but larger fault zones (*81,85-87*). In the 'coherent fault' model (*88,89,73)*, fault segments initiate and grow as kinematically-related components of a fault array. Fault segment lengths and the position of relay zones are established rapidly so that most fault growth is characterized by increasing displacement on fault segments of constant length, thus giving steep fault growth paths on displacement-length graphs (*89*).

The best means of constraining fault linkage timing and rate of linkage and distinguishing between the two fault models using geological data are kinematic constraints on fault growth. The best record of fault growth is preserved where sedimentation rates and fault displacement rates are similar and high, and where well-defined stratigraphic horizons are well dated and resolvable on seismic reflection data. These requirements are all met within the Gulf of Corinth, making it an ideal natural laboratory, where we will be able to determine the record of fault growth for many of the faults within the rift.

Chronology is essential to quantify the rates of fault tip propagation and to date fault linkage events and deformation migration in time and space. Thus the birth, growth and death of faults across an evolving fault system can be constrained at a resolution of <<1 Myrs. The relative roles through time of strain migration between faults versus critical linkage of fault systems will be determined. We will thus use results from **Hypotheses 1 and 2** to determine how a "mature" fault network emerges and on what timescale as a test of **Hypothesis 3**.

Surface Processes in Active Rifts

Hypothesis 4*: Millennial to orbital timescale changes in climate and vegetation control sediment flux into a continental rift basin, but longer term (~0.5-1.0Myr) increases in clastic input into a rift depocenter reflect tectonic control of drainage systems by the growth of rift-margin topography.*

The Corinth Rift offers the opportunity to study evolution of a rift-controlled (source to sink) drainage system in time and space, at a sub glacial-interglacial timescale. Previous research on the Alkyonides Gulf (Fig.1; *13*) demonstrates major changes in sediment flux between interglacial and glacial periods. This terminal depocenter acts as a sediment trap for clastic input across basin-bounding faults (*90*). In the main Gulf, drainage catchments are more extensive and diverse in relief, tectonic history and lithology (Fig.5b). Calculation of sediment flux evolution over a range of timescales during the evolution of the currently-active fault system will reveal the relative magnitude of tectonic and climatic controls in both the more complex Gulf setting, and the simpler Alkyonides depocenter.

A high resolution chronostratigraphy will be generated by multidisciplinary methods also providing a proxy for climate change (see **Methodologies**). To test **Hypothesis 4**, decompacted sediment volumes will be derived from core, log and seismic data to establish changes in average sedimentation rates within successive ca. 100kyr glacio-eustatic cycles. This will test whether sediment flux increased with footwall drainage relief due to increasing fault displacement. Regressive and transgressive phases in each glacio-eustatic cycle can be differentiated by seismic geometry and character but require ground truthing. Core-log data and mapping of these will test changes in sediment flux between interglacial and glacial phases (20-50kyr timescale). Core data will allow us to test the timing of onset of marine conditions within the Gulf and the timing of marine-lacustrine conditions responding to glacio-eustacy through the Late Pleistocene. Millennial-scale changes in sediment supply rate may be achievable from higher resolution stratigraphic control from $\delta^{18}O$ records and/or tephra chronology and can be correlated with the record of high frequency climatic events in the region (e.g. *91*), highlighted in the pollen record, to test lag time between vegetation/climatic change and change in sediment flux. The combination of new borehole and existing seismic data in Corinth thus allows us to investigate how climatic and tectonic processes generate different signals in the stratigraphic record as suggested by simple catchment-fan analogue and numerical models (e.g., *92,93,94*).

***Hypothesis 5**: Changes in magnitude and rate of sediment mass transfer (through erosion and sediment deposition) cause changes in fault and rift evolution, such as localization of strain and fault death.*

Theoretical models show that erosion, sediment transport and deposition, through mass transfer, impact the tectonic evolution of rifts. In turn, tectonic uplift/subsidence drives surface processes and therefore a feedback emerges. Models suggest that the redistribution of material by surface processes should promote strain localization on the whole rift scale and prolong activity on individual faults (e.g., *95-97*). Furthermore, it has been shown that the style of deposition, e.g., deltaic versus hemipelagic sedimentation influences the degree of strain localization along a developing rift margin because of the differences in the spatial distribution of sediment loading (*98*). Although it has not yet been shown explicitly, the same principle should apply as a rift evolves from entirely subaerial, where fluvial processes dominate, to partially marine or lacustrine as the hanging wall areas in the rift subside below base level.

Only one published field-based study so far attempts to partition extensional fault slip history into tectonic and surface process-related isostatic responses (*99*). Few areas have sufficient data constraints in both space and time to evaluate the feedback effect(s) during rift evolution. By drilling in the Corinth rift and integrating onshore and offshore depositional histories and fault activity, we can derive a chronology of faulting and strain rate data for comparison with sediment mass transfer rates (from drilling) and volumes (from seismic data), thus testing **Hypothesis 5** and generating an important contribution to understanding the role feedback plays in rift development.

8. Site Selection, Description and Prioritization, and Drilling Strategy

Three primary sites are in water depths 350-850m and have total penetration depths ≤750m. Sediments are expected to be predominantly Plio-Pleistocene turbidites, hemipelagic sediments, marls and debris flows. Unit SU1 is expected to comprise early rift lacustrine, distal equivalents of the major Gilbert fan deltas exposed onshore (Sites COR-01 and COR-02) and potentially fluvial-alluvial sediments (base of COR-03), and Unit SU2 to comprise alternating lacustrine-marine deposits. Sites have been selected based on drilling depth constraints, drilling time and hole stability. The two prime sites (COR-02, COR-01) are located:

- To sample the full upper rift sequence (SU2), prominent unconformity and upper section of the lower rift sequence (SU1);
- On crossing MCS lines that permit ties to the dense grid of MCS and high resolution data throughout the main basin.

The third site (COR-03), in the subsidiary basin, is located to test aspects of spatial/temporal variability.

COR-01: A complete SU2 sequence at high resolution with the ability to correlate to even higher resolution expanded seismic stratigraphic sections. Proposed drilling to the regional unconformity (U) and to uppermost SU1 sediments.

COR-02: Located on a horst block and therefore a more condensed section allowing access to earlier sections of SU1. A near-complete unit SU2, the regional unconformity, and the upper half/third of SU1.

COR-03: Relatively thin SU2, targeting SU1 (the majority of this sequence can be cored here). Comparing with COR-02 allows direct rift history comparison in two parts of the rift, addressing rift propagation and strain rate history of different parts of the rift through time (e.g., recent strain rates across the Alkyonides are almost an order of magnitude less than in the main basin (*100*) but has the along-axis strain pattern changed with time?).

COR-04 (COR-03 alternate): Similar stratigraphic sequence to COR-03 but a shorter borehole if drilling time is limited (but a more limited rift history record).

At all three primary sites, we propose full coring and wireline logging to TD. We propose single hole coring, using wireline physical property data and core measurements to cross correlate with seismic stratigraphy and geological timescales. High sedimentation rates and wireline data will compensate for incomplete recovery. Logging data are also required for site-to-site correlation, core-log-seismic integration, and deriving porosity data for decompaction calculations. We will use APC coring to refusal, followed by RCB. All cores will require lithological, paleoenvironmental and physical property analysis. Details of sampling for chronology/correlation and environmental indicators are in **Methodologies**. Standard log data are requested (e.g., natural gamma, resistivity, sonic, porosity) and magnetic susceptibility to aid chronostratigraphic methods.

Our prioritization of sites is: 1) COR-02 (to achieve a long and high resolution syn-rift record); 2) COR-01 (late Pleistocene rift history at ultra high resolution); 3) COR-03 (along-axis variations in rift history).

9. Details of Methodologies

Testing our hypotheses requires the age of syn-rift strata and key mappable surfaces in the Corinth basins. Studies of early rift sediments onshore and recent sediments offshore demonstrate that strata from a variety of marine and fluvio-lacustrine environments are datable. Offshore chronostratigraphy is constrained only by short (<30m) cores (*13,15*), limited ICDP coring in a proximal high sedimentation rate environment (*16*) and inferred ages of sequence stratigraphic surfaces (*69,101,67,66,14,19,18*). The short cores sample both interglacial and last glacial sediments (to ~50-80 ka) which we would expect to repeat in the entire sequence overlying the unconformity (interpreted as repeating glacial-interglacial sequences). These cores confirm the availability of chronological and environmental proxies (micro- and macro-fossils, palynology and stable isotope techniques). Onshore marine sediments have been dated locally using a variety of Plio-Quaternary techniques (e.g., calcareous nannofossils, U series, $\delta^{18}O$ and Sr isotopes, paleomagnetic stratigraphy, palynology, tephra Ar-Ar dating) thus providing a partial chronostratigraphy for the earlier rift sequence (references within *54,58,59*). Wireline data will help to generate the high resolution stratigraphy from cores, and will provide sediment physical property data for accurate decompaction calculations.

a) Chronostratigraphy

A successful test of our major hypotheses requires data that only ocean drilling can provide: Pleistocene sediment cores with orbital resolution (20-50kyr) age control on prominent reflectors created by episodes of significant base level change (within unit SU2); and absolute age constraints on the basin-wide unconformity and underlying SU1 sequence. Existing studies both in Corinth and elsewhere (e.g., *102,103,58*) demonstrate that the multidisciplinary chronological approach we propose can deliver the temporal precision required.

The Late Quaternary (SU2) includes sequence stratigraphic geometries of probable glacio-eustatic origin (e.g., clinoform examples). Older Plio-Pleistocene rift packages onshore (equivalent to SU1 offshore) are mainly fluvio-lacustrine in origin, but are interbedded with subordinate marine packages (*104,58,105,53*). Recent SU2 4th order lowstands are lacustrine in origin (*13,106*), but coral-bearing uplifted terraces illustrate that highstands since at least ~330 ka were established in marine conditions (e.g., *107,44,100*). The regular sedimentary alternations of SU2 are therefore thought to reflect orbital-scale variations in marine and lacustrine environments from ~0.6Ma to present, however drilling is required to test this hypothesis.

To achieve the Late to Mid Pleistocene age-depth resolution required for SU2, we will establish geomagnetic polarity reversal-based magnetostratigraphy (sediments from existing cores apparently carry a strong natural remanent magnetization) underpinned by AMS radiocarbon dating, tephra and stable oxygen isotope ($\delta^{18}O$) stratigraphies. Objectives related to SU1-Middle Group spatial shifts in depocenters and geometries can be addressed with a lower age-model resolution based upon a geomagnetic polarity stratigraphy and dateable tephras. In addition, relative paleointensity (RPI) records will be constructed from the drilled sequences and compared with well-established global RPI records (e.g., SINT2000, *108*; PISO1500, *109*) to build high-resolution (sub-orbital) stratigraphic correlation and chronology within polarity chrons and between oxygen isotope terminations (Fig.11). Our target interval includes the Brunhes-Matuyama boundary at 0.781Ma and Jaramillo subchron (1.072-0.988Ma) of the geomagnetic polarity timescale (GPTS) (*110,111*). We request non-magnetic core barrels be used where possible to avoid potential drilling-induced distortion/contamination of paleomagnetic records. Although we propose to drill only one hole at each site, the high sedimentation accumulation rates documented for the central basins (estimated ~1mm/yr; *15,18*) ensure that only small time gaps (typically <<5kyr) will exist between full core drives, and wireline log data will enable stratigraphic gaps to be bridged.

Marine deposits from the Gulf of Corinth contain sufficient planktic (*Globigerinoides ruber white*) and benthic (*Cibicidoides* species) foraminifera to permit the generation of $\delta^{18}O$ stratigraphies. If the transition between marine and lacustrine conditions in the Gulf is indeed related to times when water levels fell below the Rion sill (-60-70m), existing records of Mediterranean sea-level (*112*) indicate that $\delta^{18}O$ data could be tied to, e.g., benthic $\delta^{18}O$ stacks (*113*) and Antarctic Air temperature records (following the Red Sea method as *114*) for past interglacials and early glacial conditions.

Piston cores (e.g., *115,13*) and onshore Pliocene records (e.g., *58,59*) demonstrate that Corinth sediments contain cm-scale thick tephra. Based on existing Eastern Mediterranean (*116,117*) and Adriatic (*118-123*) tephra stratigraphies we anticipate recovering multiple proximally- and distally-sourced tephra deposited over the past 600ka that could be dated directly using standard techniques (*124,125*) and/or (for the <170ka portion of our target cores) be correlated to databases of regional eruption histories using chemical/mineralogical properties (e.g., *116,118-123,126*). In a dynamic sedimentological regime such as the Corinth Rift, fine-grained ashes likely undergo resuspension and dilution and may be preserved as crypto-tephra (not visible to the naked eye), and/or tephra may be reworked into turbidites. Recent analysis of Adriatic sediments demonstrates that crypto-tephra layers can significantly exceed the number of visible ash layers, but that they can be readily identified using standard procedures (*127,123*). Reworking should not prevent dating of tephra-rich turbidites because the time between eruption and final deposition is likely short relative to the uncertainty of individual eruption ages.

Along with this solid foundation, the chronostratigraphy of the target cores may also benefit from: (1) varve counting of annual layers, if present, deposited during glacial lacustrine conditions following well established methodologies for marginal marine and lake cores; and (2) tuning of shipboard-derived physical property and/or X-ray Flouresence core scanning data (e.g. Ti/Al ratios), used as proxies for Mediterranean aridity, to astronomical solutions following e.g. *128,129*.

b) Paleoenvironment and Surface Process Methodologies

Cored syn-rift sediments will be subsampled for micropaleontological and palynological analyses to enable a detailed study of paleoenvironmental indicators e.g., marine vs lacustrine, temperature, precipitation/aridity, paleobathymetry. Pollen analysis will provide important data on the palaeoenvironmental/palaeoclimatic context. Pollen-based indices (forest cover, humidity and runoff) developed for the Aegean Sea (*130,131*) will be used for the quantification of sediment influx. A linked pollen and $\delta^{18}O$ record from ocean drilling in the Corinth Rift will also test existing Eastern Mediterranean terrestrial pollen record age models. Cores will provide some indication of water chemistry during lowstand lacustrine phases, which can be used to analyze the rate of freshening or salination of Lake Corinth (*106,13*) as a function of the discharge/rainfall versus evaporation balance. We will focus on sampling across the marine-lacustrine transitions for e.g., microfossil and aqueous palynology assemblages, stable isotopes, pore fluid chloride, and REE content of carbonate (*132*) for details of changing marine-brackish-lacustrine conditions. These results contribute to the theme of environmental and sedimentary responses to marine salination and desalination events in global basins past and present. Benthic forams will be used to give broad constraints of paleo-water depth, and, by integration of cores with stratal geometries from the onshore syn-rift sequence and, locally with seismic geometry of fan delta sequences, can give time-averaged deepening rates of the basin.

We aim to quantify sediment flux to different parts of the basin through time to address the Surface Processes Objective and Hypotheses. Basinal sediment volumes can be calculated from the integrated seismic database, and chronology and accumulation rates for these sequences will be determined from drilling. Porosity data derived from cores and logs will improve the accuracy of decompaction and hence volumetrics calculations. Sediment provenance from cores may also show changing source catchments (exhuming different Hellenide tectonostratigraphic units comprising lithic-siliciclastic flysch, various carbonate facies, metamorphic and ophiolitic lithologies; *133-137*; Fig.5b). In addition, modeling the compositional/physical/magnetic properties of input sediments and cored sediments may constrain relative contribution of different catchments (*138*). We will actively support research programs to further characterize composition of the present day inputs. Funded supporting research programs (Gawthorpe, Cowie, Smithells, Bell et al) are improving our understanding of onshore drainage networks, erosion and input flux rates through time and are modeling drainage development in the context of an evolving rift fault network; these results will be integrated with results from proposed drilling and geophysical data offshore.

10. Site Survey Data Status

An exceedingly dense network of seismic reflection profiles (~100's m to 1-3km spacing) is available from collaborating groups and from published material (Fig.2, Table 1), including deep penetrating lines imaging basement (*55,52,139,140,51,19*) and high resolution single and multichannel data revealing detailed sequence stratigraphy of the syn-rift sequences (*14,66-69,101,141*). The ability to integrate these datasets and to correlate key horizons and sequences has been demonstrated in recent publications (e.g., *66,14,19*). The VSS project has now fully correlated the stratigraphic sequence and fault network throughout the rift (*18*). This project also scanned all high resolution analogue seismic data generating a complete digital seismic interpretation project. Shallow marine cores and onshore sediment records are discussed in detail in **Methodologies** and **Background**. Multibeam bathymetry and gravity data are available throughout the gulf.

11. Secondary Objectives

A. *Regional Natural Hazards*: *To resolve reliable active fault slip rates in order to improve regional earthquake (and secondary tsunami and landslide) hazard assessment.*

The Gulf of Corinth has high levels of seismicity and damaging historic secondary hazards such as slope failure and tsunami in a region of high coastal population density and tourism. Fault slip rates currently rely on paleoseismological and tectonic geomorphological studies of very recent fault slip (last ~200ka) and estimated horizon ages for longer timescales. These slip rate estimates include significant uncertainties (resolving the chronology of the marine syn-rift sequence will significantly reduce these), and slip rates remain unquantified on many faults. Ocean drilling will allow us to determine fault slip rates on 10-100kyr up to 1Myr timescales. We will integrate these with shorter timescale data (paleoseismological, geodetic, seismicity) to more fully understand the seismic hazard potential of individual faults. Cores may also allow us to assess the frequency of major slope failure (integrated with seismically-identified mass transport deposits), an indication of seismicity and of secondary hazards.

B. Quaternary Paleoclimate and Paleoenvironment*: To generate a new high resolution record of Quaternary paleoclimate of the Eastern Mediterranean with respect to global climate, and the paleoenvironment of the Corinth basin as a semi-isolated marine-lacustrine basin controlled by changing base level and climate.*

Details of the Corinth basin's changing environment from glacial to interglacial times are poorly known and the precise timing of transition from lacustrine to partly marine conditions is unconfirmed as well as the relationship to the interacting controls of basin subsidence, sill elevation and eustatic sea level. Offshore drilling of syn-rift sediments will provide a record of regional Quaternary paleoclimate and paleoceanography by sampling pollen, micro-macro fossils, stable isotopes and sediment physical and chemical properties. Innovative techniques in Plio-Quaternary chronostratigraphy can be applied to this very high sedimentation rate record to generate an extremely high resolution climatic record in the Mediterranean, as successfully conducted in the Saanich Inlet (Leg 169; *142*) and recently in the Gulf of Alaska (IODP 341; *143,144*). Long cores from the Gulf of Corinth would also provide the opportunity to generate a) a first high resolution relative paleointensity (RPI) record in the Mediterranean correlated with global RPI stacks (e.g., *108,109*) and other RPI curves (*145-148*) to help understand the dynamics of the geomagnetic field, and b) a linked terrestrial pollen and marine $d^{18}O$ record in the Eastern Mediterranean (at least for interglacial intervals), helping to constrain age models for existing Eastern Mediterranean long pollen records. See **Methodologies** for details of how this stratigraphic record could contribute to regional climate records over different timescales.

FIGURES AND TABLES

Source	Data Type	Rift distribution
Seismic Reflection:		
University of Hawaii	MCS, deep penetrating, digital (e.g., Fig. 7, 10c)	Throughout
University of Patras	Single channel, high res, scanned analogue	Throughout
HCMR	Single channel, high res, scanned analogue (e.g., Fig. 9b,c)	Throughout
HCMR	Single channel, high res, digital	Western Gulf
Southampton/Patras/Leeds	Multichannel sparker, high res, digital (e.g., Fig. 10d)	Western Gulf
Leeds/UEA/Patras	Single channel sparker, high res, scanned analogue	Throughout
DEP-Hellenic Petroleum & SEIS-GREECE	Multichannel, deep penetrating, digital	Central Gulf
Multibeam:		
Southampton	Reson Seabat 8160, 50 kHz	Western Gulf
HCMR	Seabeam 2120, 20 kHz (e.g., Fig. 1)	Throughout
University of Hawaii	Hydrosweep DS2, 15 kHz	Throughout

Table 1. Geophysical site survey data available to this project and fully integrated digitally as part of the UKIODP-NERC Virtual Site Survey “VSS” project (*18*, see also Figs. 1, 2, 3, 4, 7, 8, 9, 10).

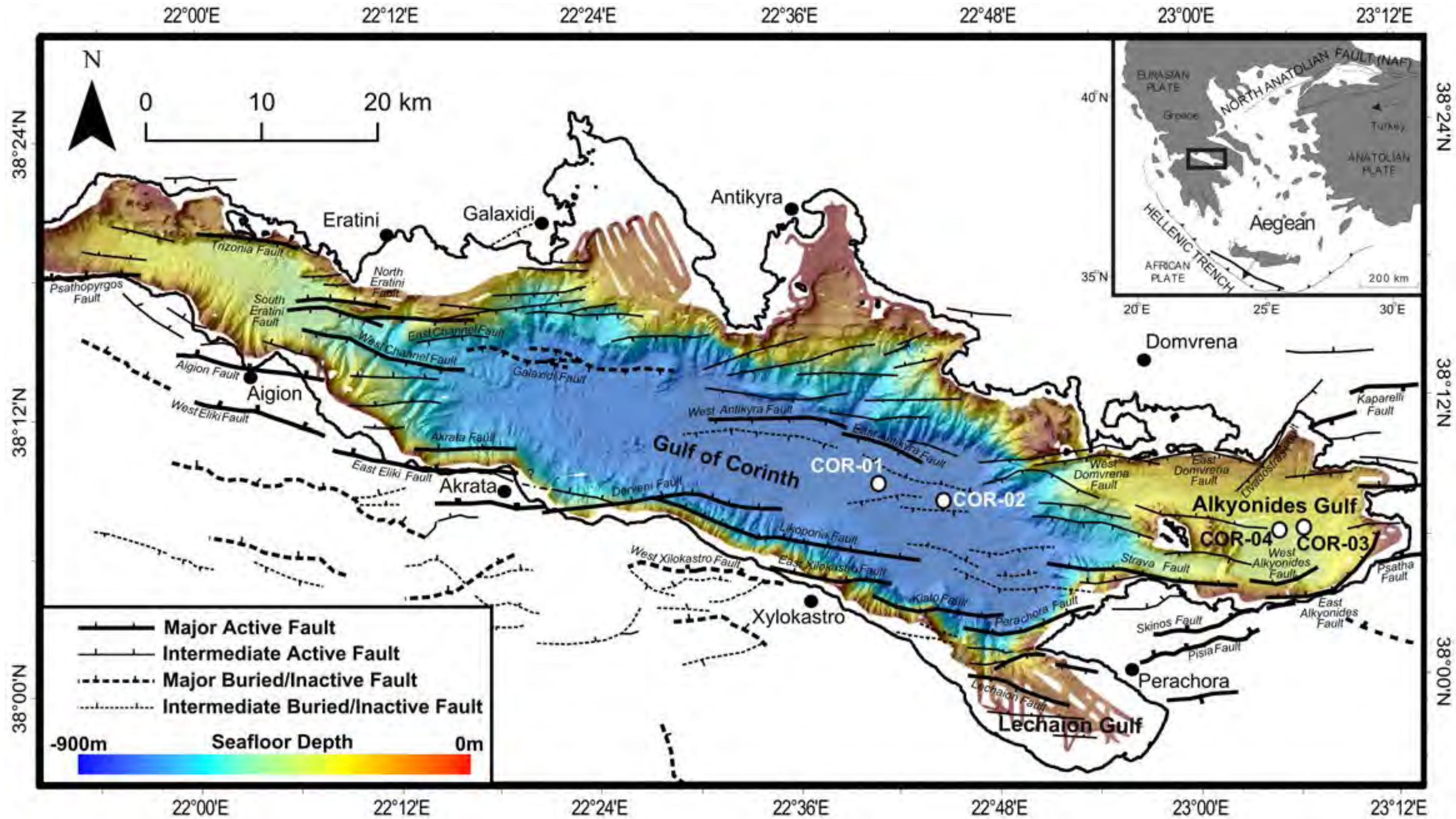


Figure 1. Overview map of Corinth Rift with primary rift-related faults (both active and currently inactive), multibeam bathymetry of the Gulf, and proposed drill sites. Fault traces are derived as follows. Offshore: *18*, building on *14,19*. Onshore: *53,54,59,148*. Inset shows tectonic setting of the Corinth Rift within the Aegean region, Eastern Mediterranean.

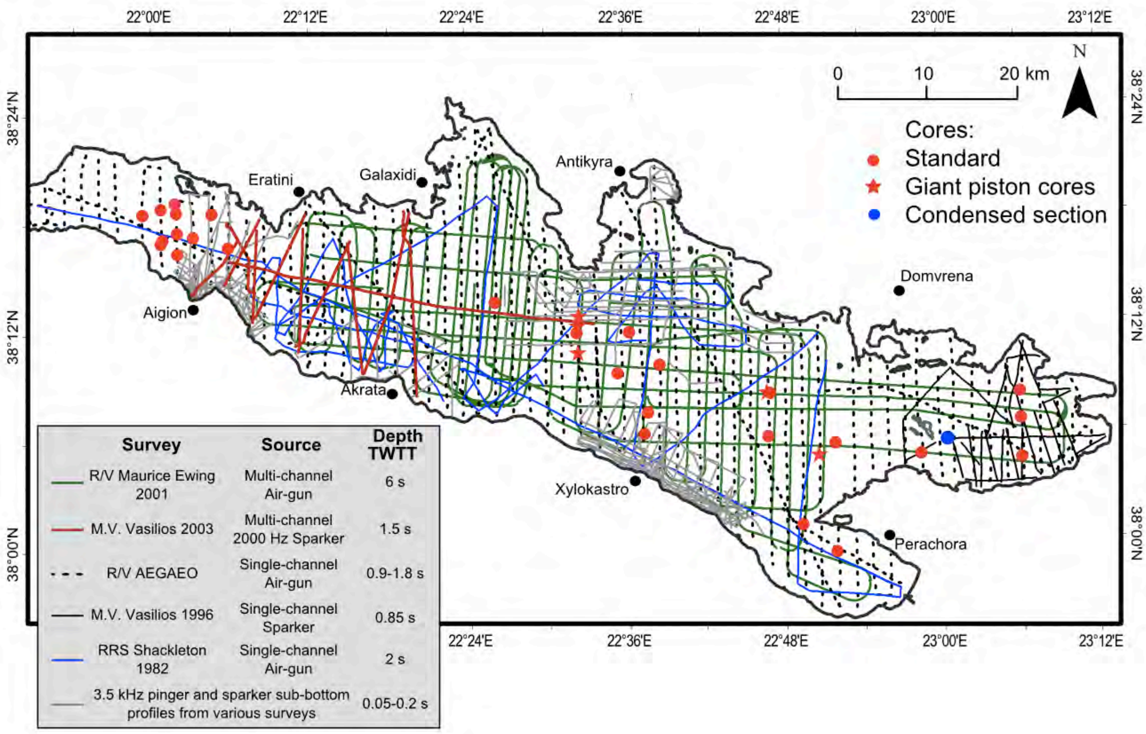


Figure 2. Map of data available to this project, including seismic data incorporated within the UKIODP Virtual Site Survey data integration and correlation exercise, and showing the extent and density of existing data and the range of data resolutions. Seismic profile spacing and hence horizontal resolution is 100's m to ~2 km for the majority of the active rift. Example publications showing different seismic datasets: Ewing, 2001 (*140,19*); Vasilios multichannel, 2003 (*68,66,14*); Aegeao (*67,101*); Vasilios single channel, 1996 (*90,69*); Shackleton, 1982 (*149,141*); high resolution pinger/sparker (*141,150*). Locations of existing piston and gravity cores are also shown (red dot: HCMR cores partly unpublished; red star: *15*; blue dot: *13*).

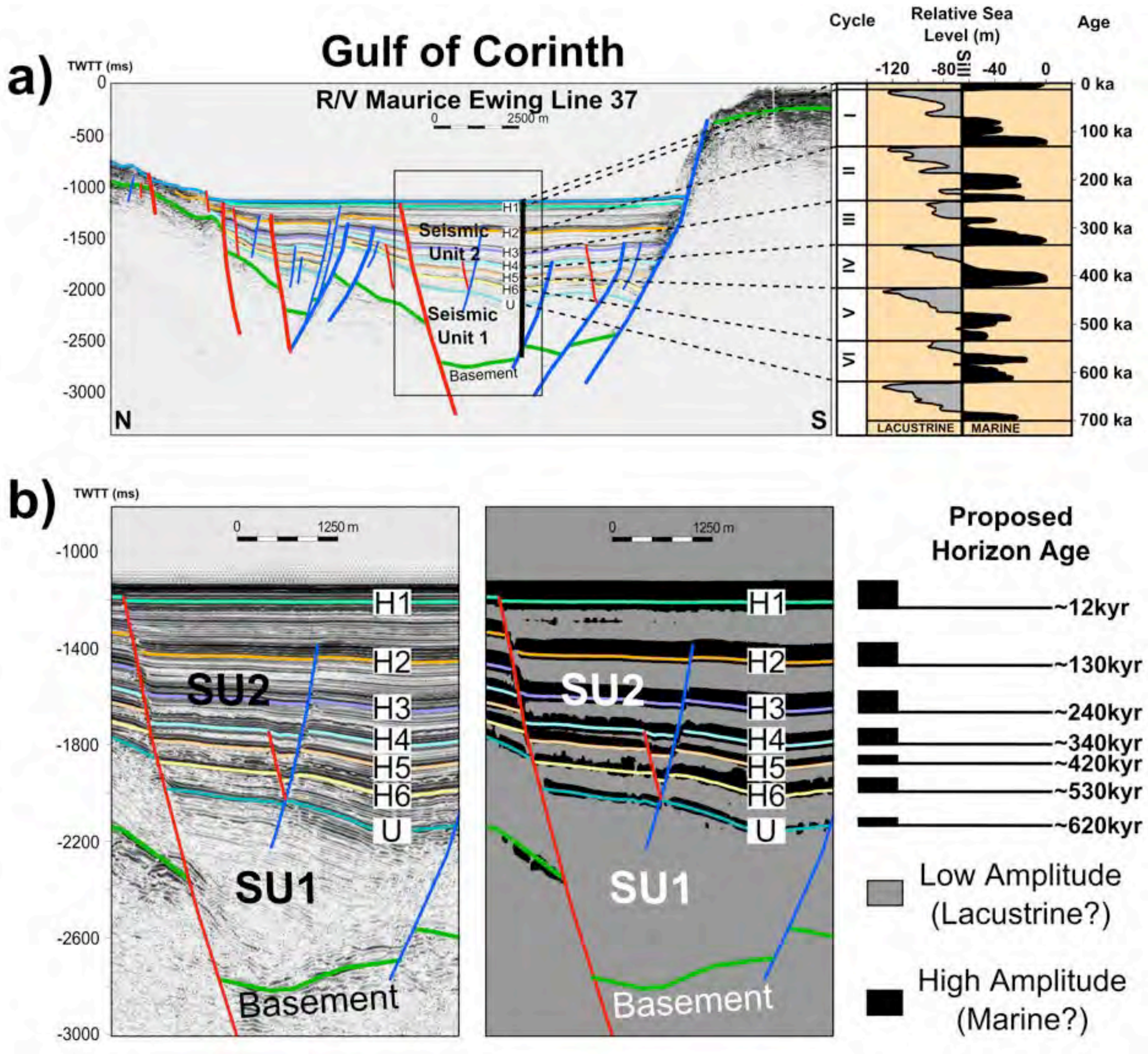


Figure 3. Proposed integrated and reconciled chronology for the seismic stratigraphy of the syn-rift sequence preserved within the Gulf of Corinth – the currently active rift zone. Based on a sequence stratigraphic interpretation and compiled as part of the Virtual Site Survey integration project (*18*, after *55,66,14,19*). a) The unit interpretation is shown for a typical Ewing MCS seismic profile with proposed correlations to the eustatic sea level curve (*151*) based on identification of low and high amplitude packages thought to represent individual ~100kyr cycles. b) Zoom of boxed area of the seismic profile showing details of the seismic stratigraphy and horizon age interpretation (left) and amplitude volume attribute applied to the data (right) highlighting the contrasting seismic character of the high amplitude (predicted marine highstand) and low amplitude (predicted lacustrine lowstand) packages.

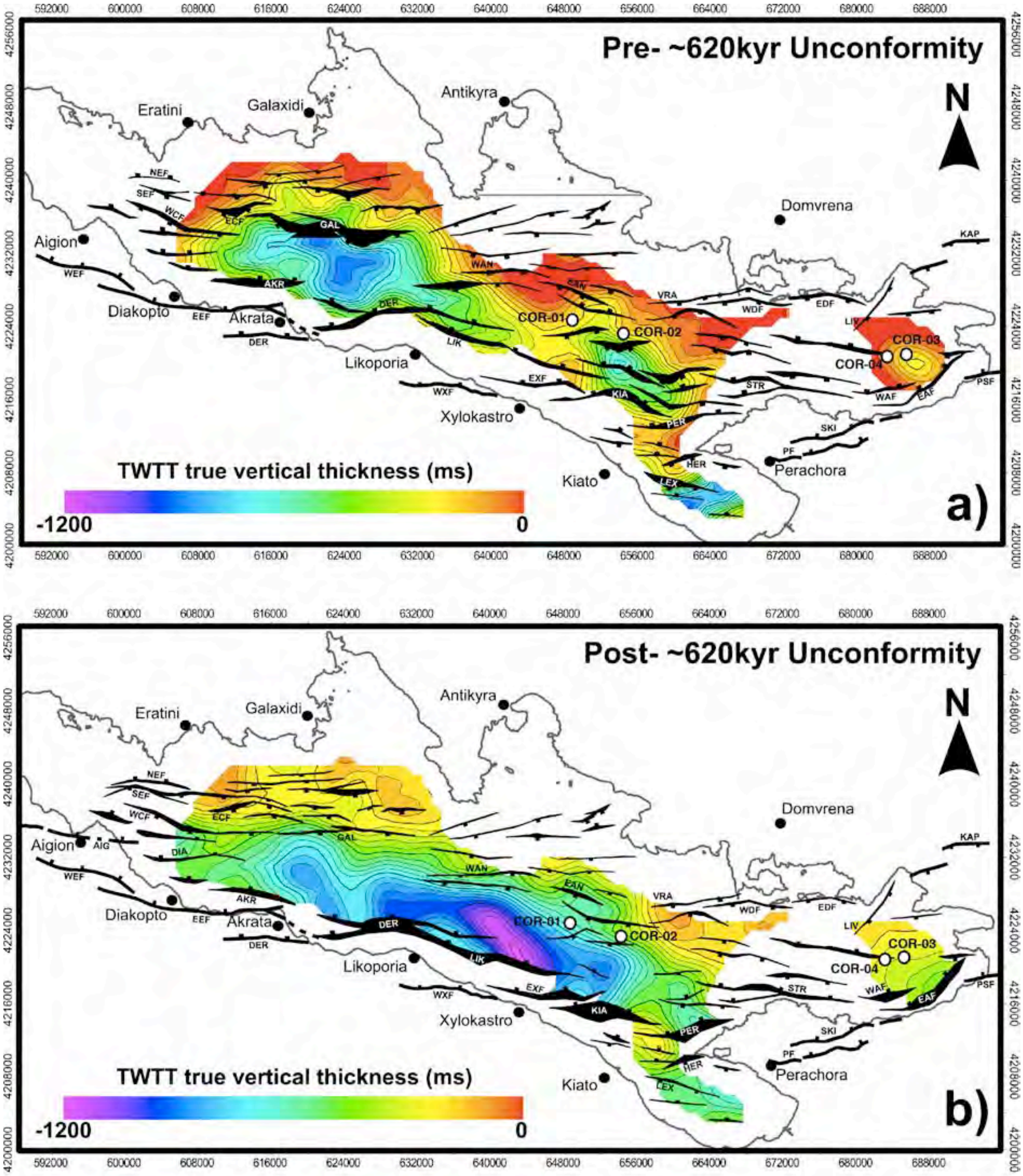


Figure 4. Isochore maps for syn-rift sequence offshore showing the two primary units separated by a regional unconformity (*18,14,19*). a) Sequence SU1 (pre regional unconformity, likely equivalent to onshore Middle Group, and estimated age of ≥ ~0.6 Ma) and b) sequence SU2 (post regional unconformity, likely equivalent to onshore Upper Group and estimated age of ≤ ~0.6 Ma). Faults represent those dominantly active during the time period shown.

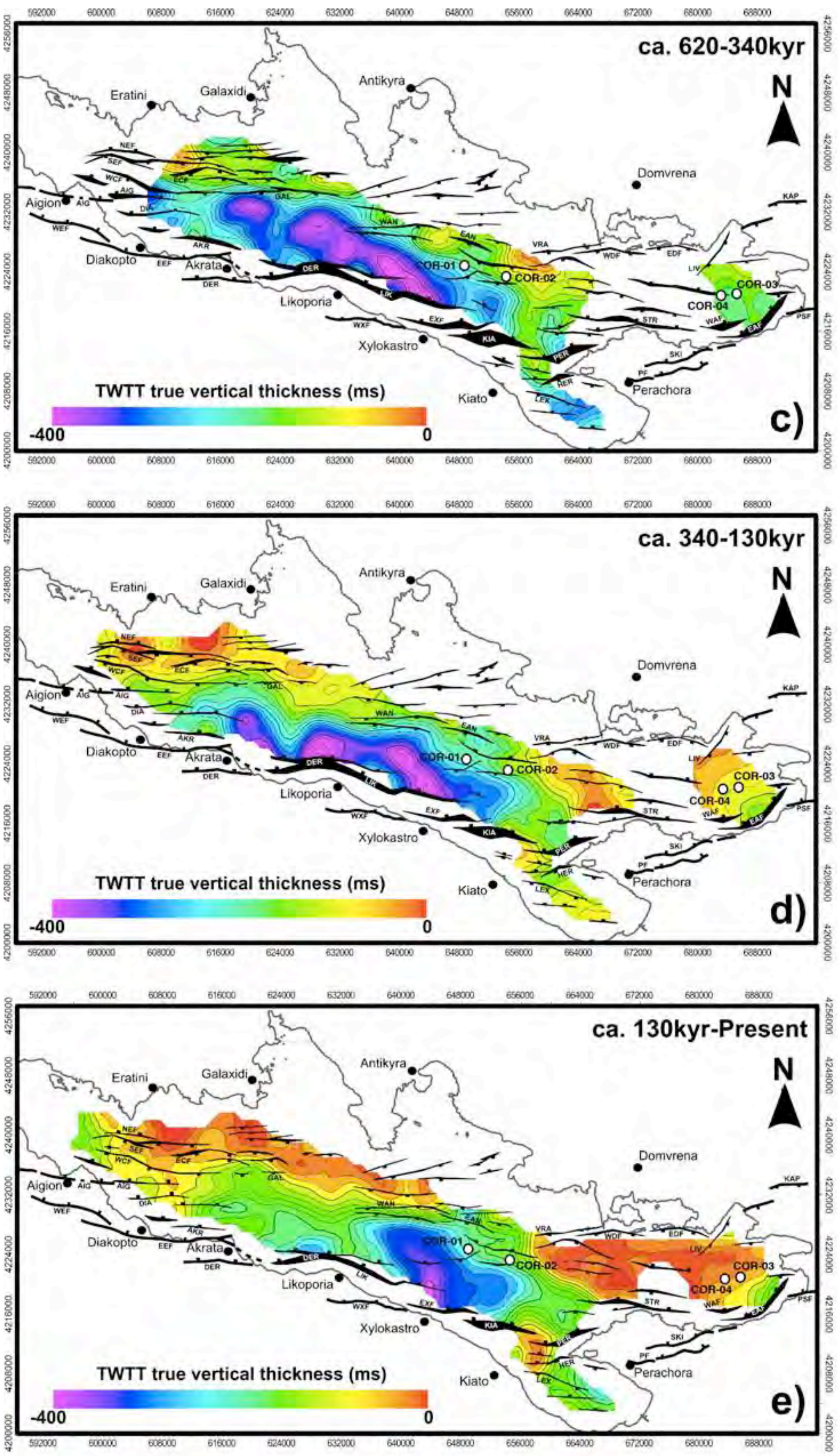
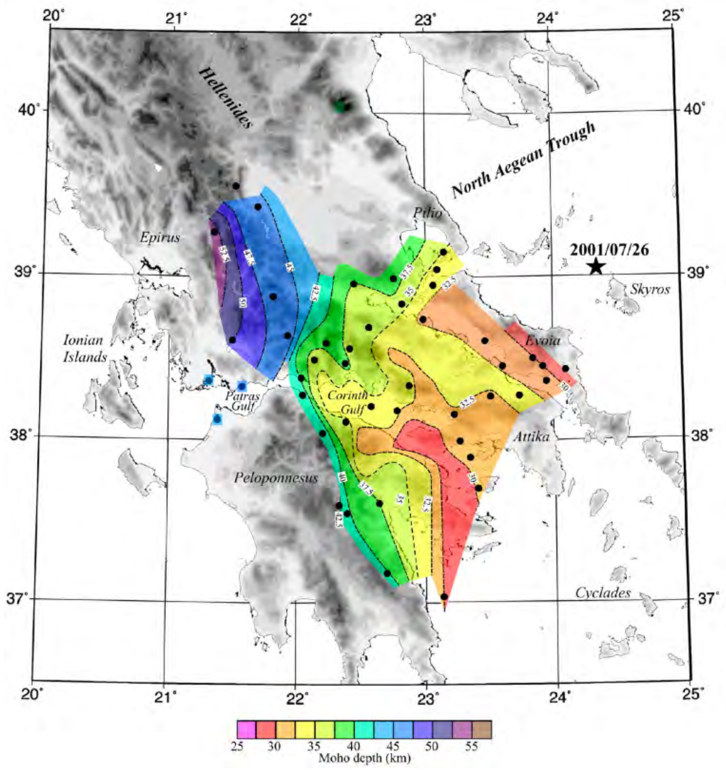


Fig. 4 (cont.) c), d), e) Isochore maps for three time intervals within SU2 (the youngest syn-rift package). Fault polygons/traces represent heave of the lower horizon of the interval shown. From (*18)*.

a)



b)

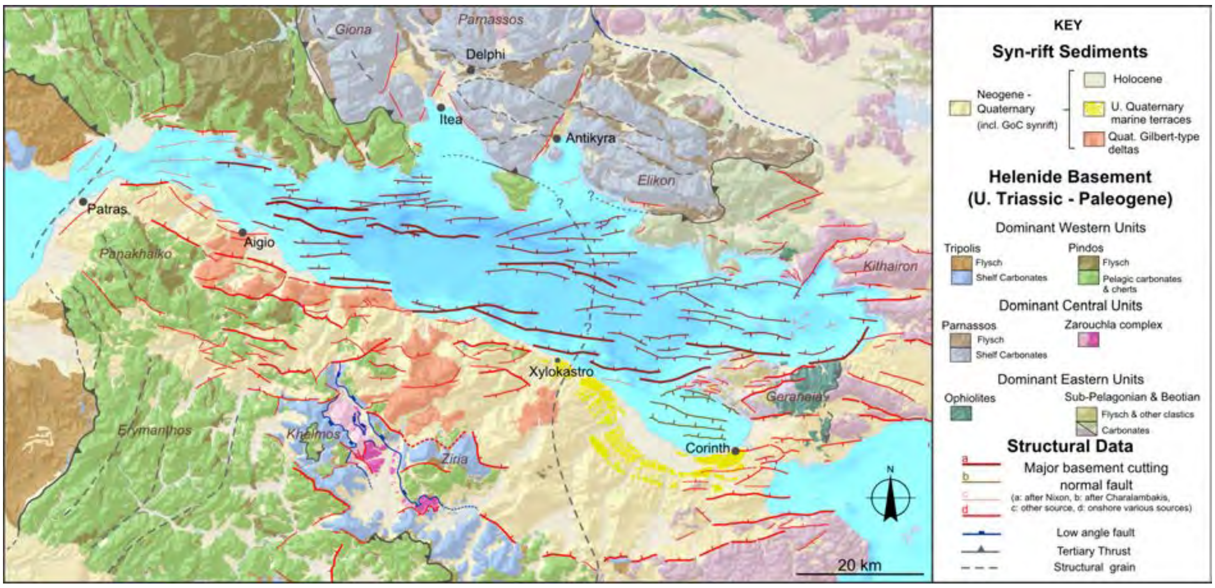


Figure 5. a) Crustal thickness map for Central Greece (*52*) showing thickened orogenic crust in the western Corinth rift and normal crustal thicknesses in the eastern Corinth rift including Alkyonides basin. b) Map of onshore geology including distribution of basement units (after *148*) and Plio-Quaternary syn-rift sequences. The NW-SE fabric of the Hellenide orogenic belt is also clear in the western half of the map area. Dashed line represents approximate eastern margin of Pindos units.

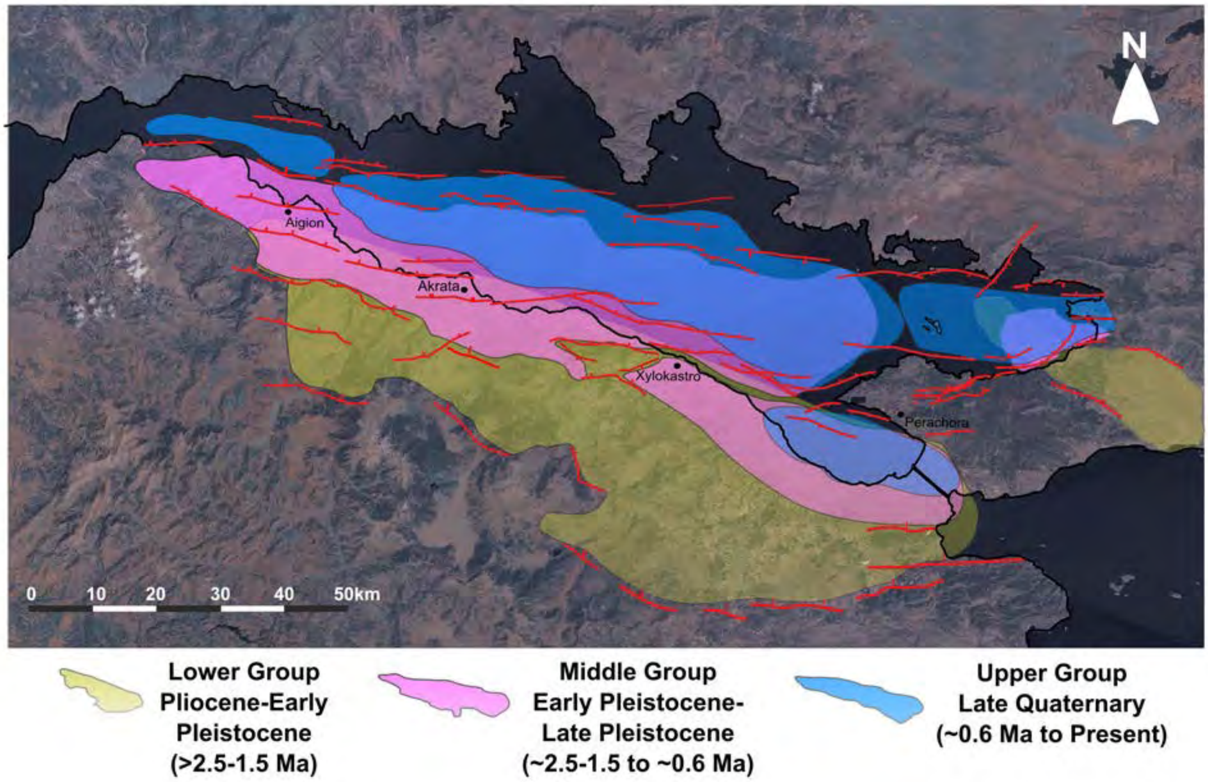


Figure 6. Cartoon demonstrating 3 proposed rift phases of the Corinth Rift system and currently resolved distribution of the rift basins for each phase (after *149*) with regional fault map overlain (*18*, see also Fig. 1 for details).

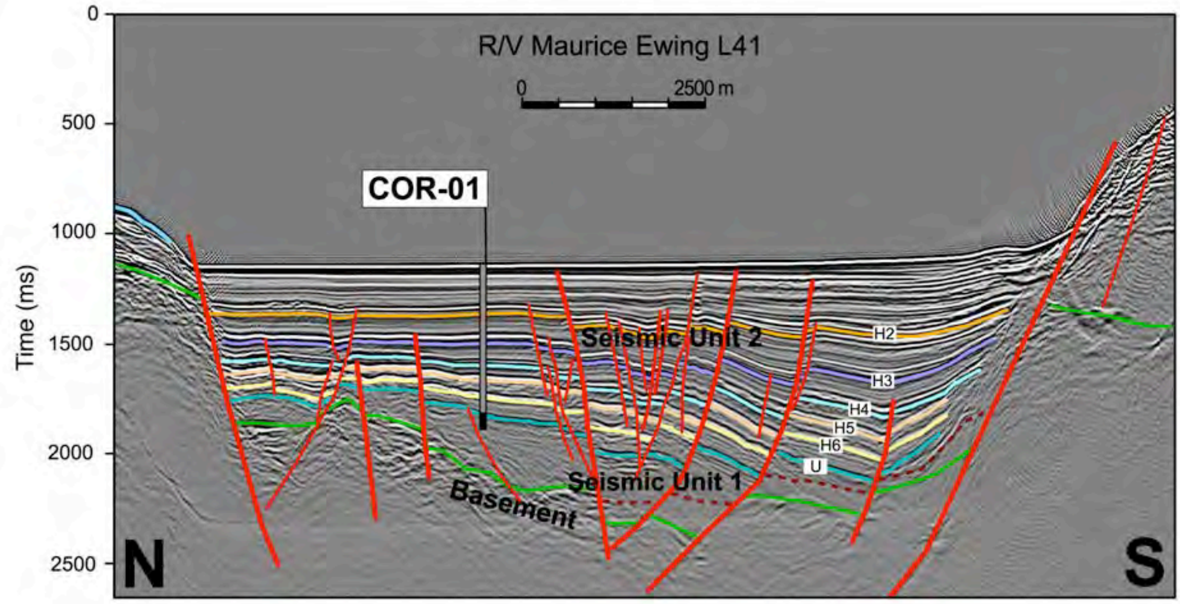


Figure 7. Seismic profile of proposed drill site COR-01 targeting the complete Seismic Unit 2 sequence and regional unconformity (U). Proposed borehole drilling depth also shown – black line marks estimated depth of a 750 m borehole using a realistic velocity model derived from multiple seismic velocity models. Grey line indicates estimated depth of a 750 m borehole with a conservative velocity model. We expect the velocity model applied (non-conservative) to be realistic and this is used in site form details.

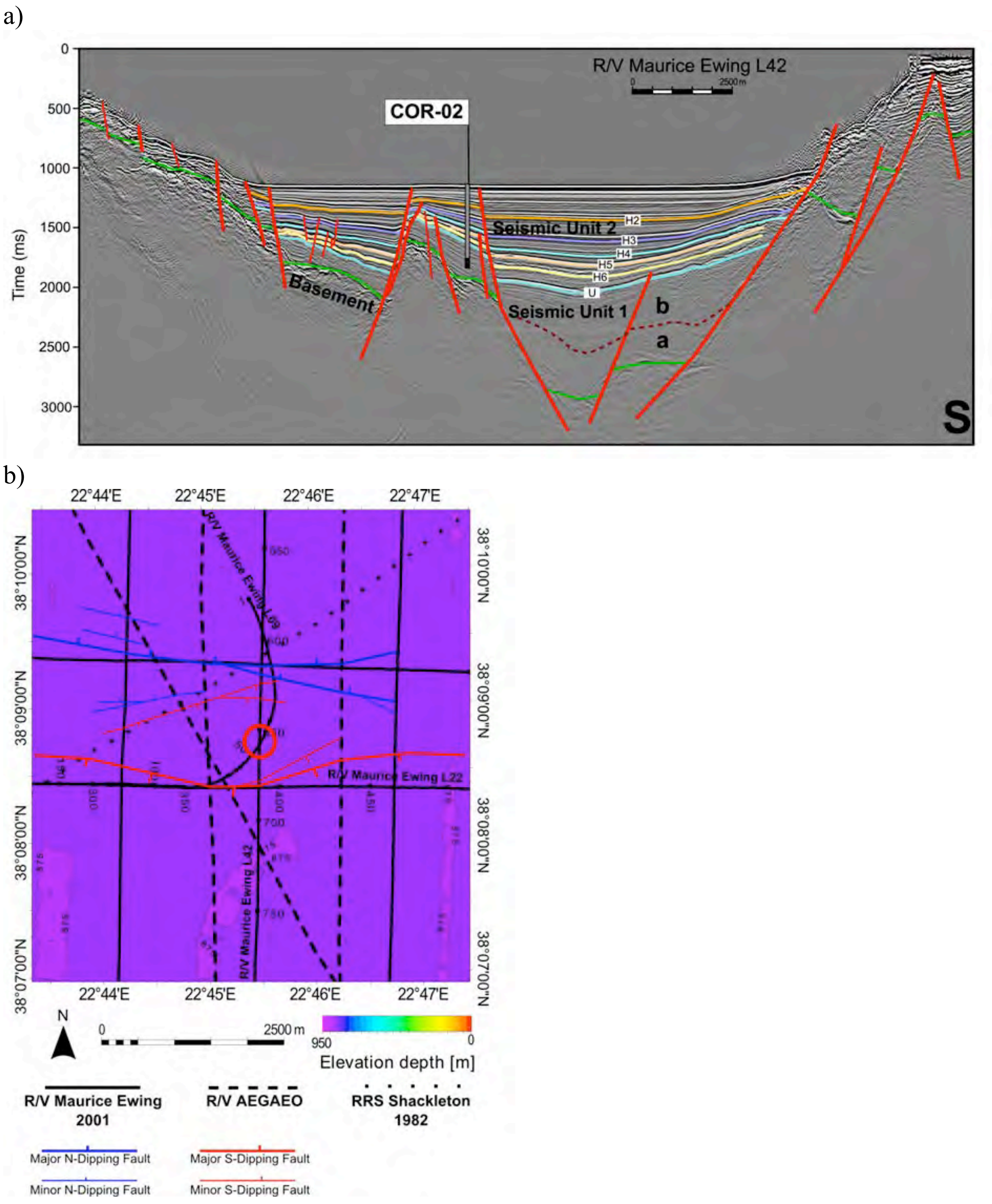


Figure 8. a) Seismic profile of proposed drill site COR-02 on a topographic high and relatively condensed section targeting Seismic Unit 2, the regional unconformity (U) and the upper 1/3-1/2 of Seismic Unit 1 (expected SU1b). Proposed borehole drilling depth also shown – black line marks estimated depth of a 750 m borehole using a realistic velocity model derived from multiple seismic velocity models. Grey line indicates estimated depth of a 750 m borehole using a more conservative velocity model. We expect however the velocity

model applied (non-conservative) to be realistic and this is used in site form details. b) Details of faults mapped around the horst block COR-02 sits within. Site COR-02 is the best site location, being away from faults and providing the correct combinations of thickness and completeness of SU2 and the underlying SU1 (prime target at this site). Crossing line (L09) is not at 90° to L42, however we believe together the network of lines provide the information required to select the site and to provide the structural context including with reference to closure (although we do not expect mature hydrocarbons in this basin).

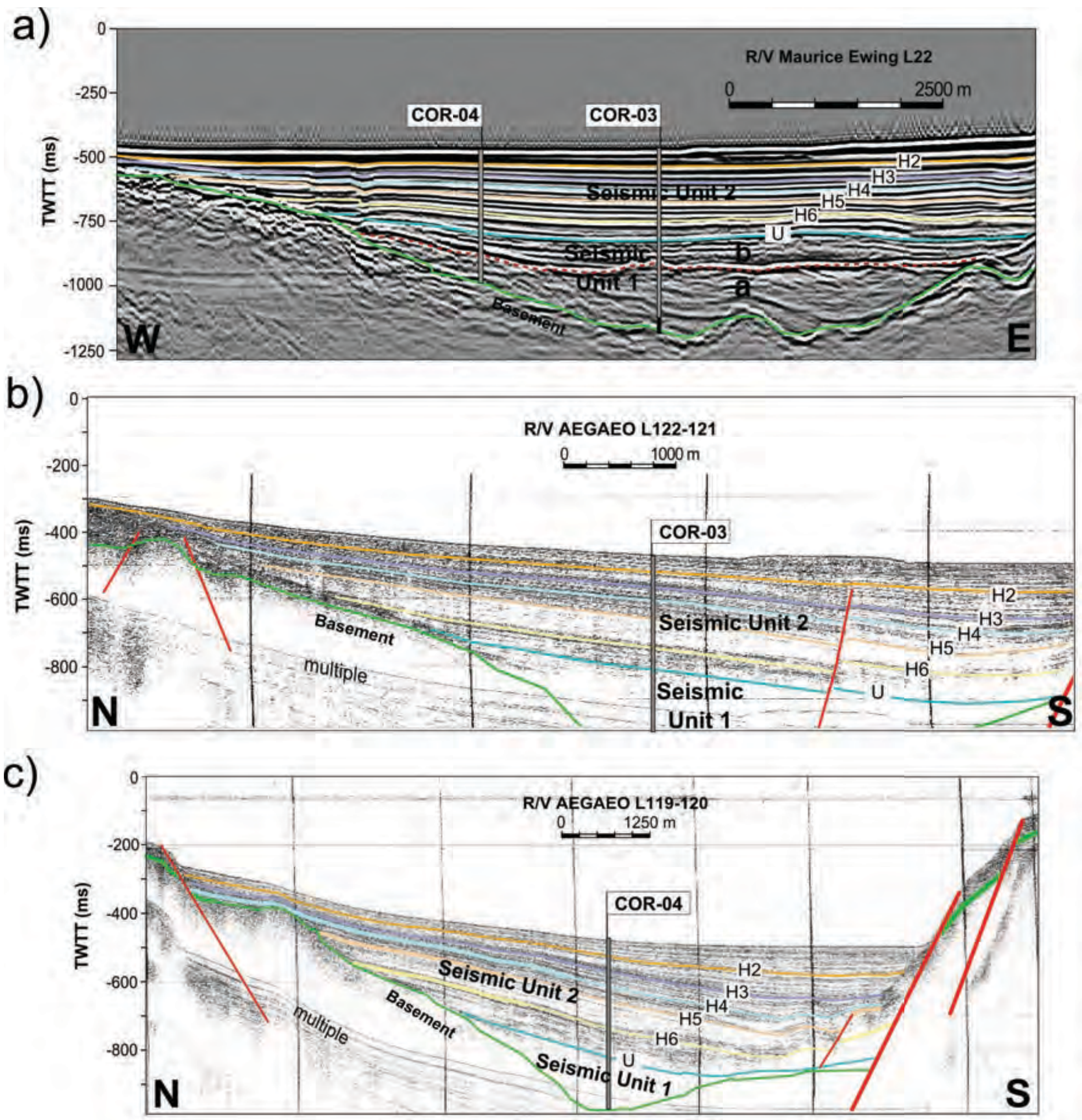


Figure 9. Seismic profiles of proposed drill sites COR-03 (primary) and COR-04 (alternate) targeting Seismic Unit 2, the regional unconformity and the underlying Seismic Unit 1. At preferred site COR-03, a significant proportion of Seismic Unit 1 can be reached in a 750 m borehole to basement. a) Is the along-rift profile, and b) and c) are the across-rift crossing profiles for COR-03 and COR-04, respectively, to show the rift structure context of each site. Proposed borehole drilling depths for the boreholes are also shown. For COR-03 (only fully imaged in profile a)), black line (partly covered by grey line) indicates proposed borehole to basement (700 m), with depth derived using a realistic velocity model. At this site, grey line overlain on black line indicates estimated depth of a 750 m borehole using a more conservative velocity model. For COR-04 (alternate), drilling is proposed to basement at 480 m (with this depth derived from realistic velocity model), indicated by grey line.

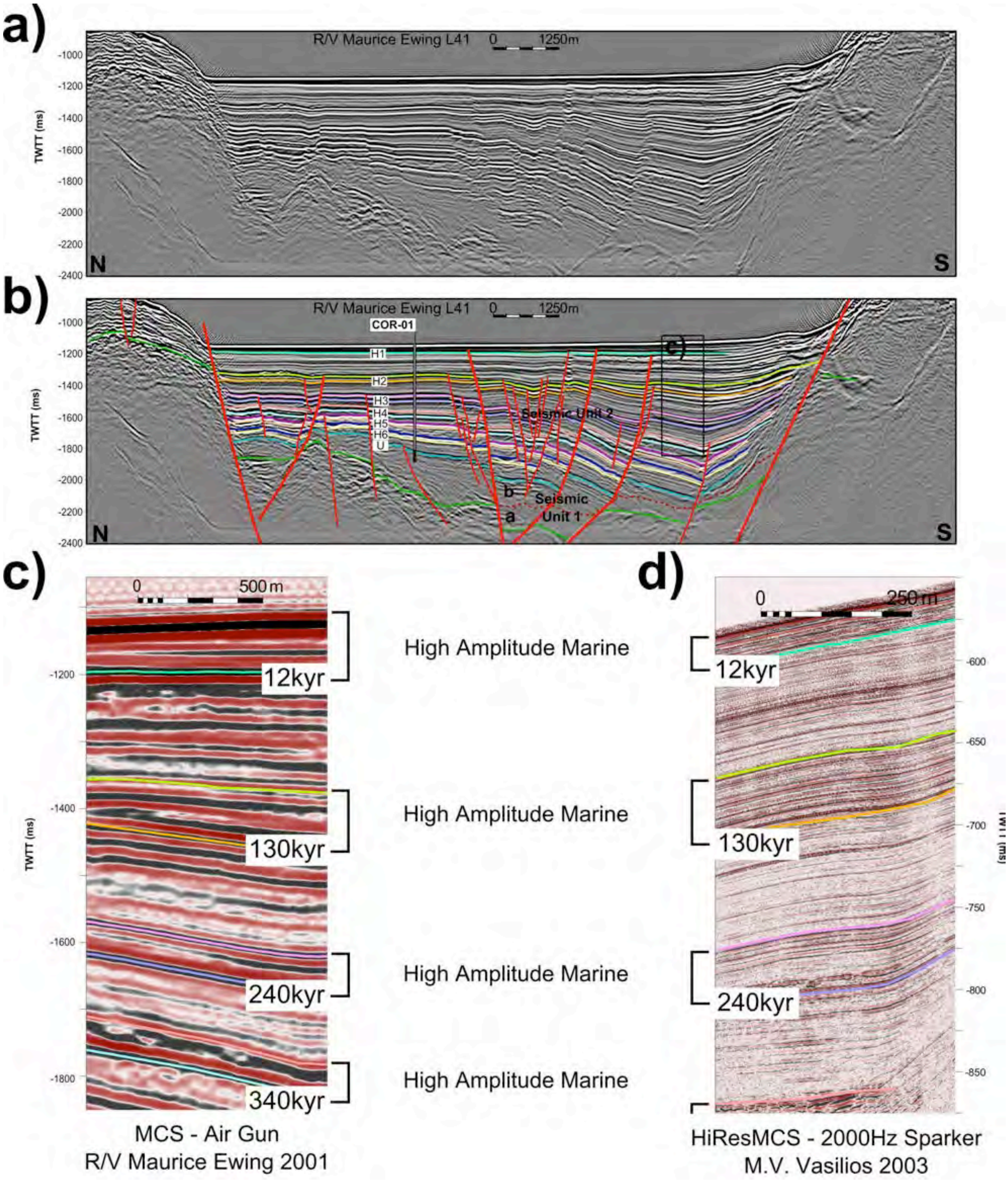


Figure 10. a) and b) Example MCS seismic profile (Ewing Line 41) demonstrating the potential spatial resolution achievable and hence likely temporal resolution (from current proposed chronology from sequence stratigraphic). c) Zoomed section of profile 41 where unit SU2 is expanded relative to the borehole site. Proposed borehole COR-01 samples SU2 in the central basin, but through correlation to more expanded parts of the section further

south along the profile (c) location of zoomed panel), an even greater resolution is possible (i.e., larger number of correlatable reflectors). d) Equivalent section of uppermost SU2 from high resolution sparker data elsewhere in the central basin (e.g., *66*), showing the even greater spatial and temporal resolution achievable where high resolution datasets are available. For c) and d) approximate ages of horizons are those proposed from the current sequence stratigraphic interpretation but unresolved as yet by drilling (see Fig. 3).

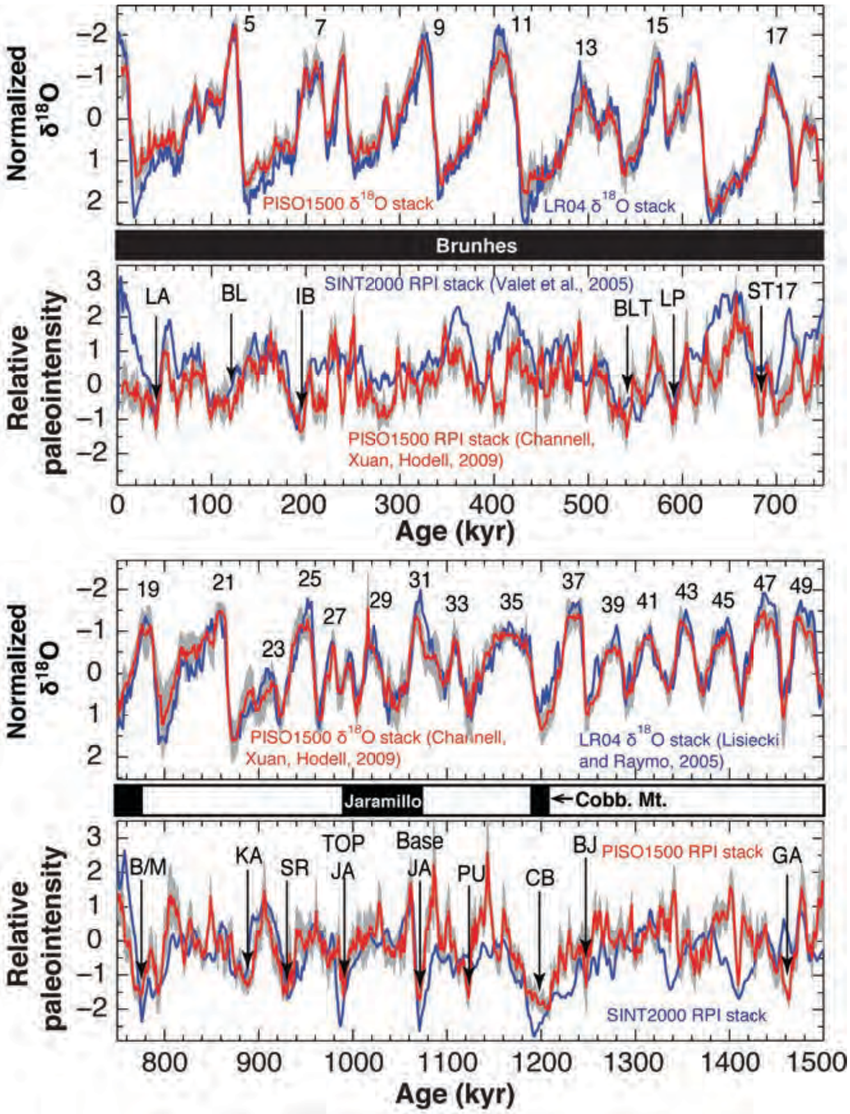


Figure 11. PISO1500 global relative paleointensity (RPI) and oxygen isotope stack records (*109*) compared with the LR04 global oxygen isotope (*113*) and the SINT2000 global RPI (*108*) stack records. High amplitude variation of RPI in-between $\delta^{18}O$ "terminations" provides a new tool for high-resolution suborbital stratigraphic correlation. Labeled numbers on the $\delta^{18}O$ plots are marine isotope stages. Vertical arrows on the RPI plots mark the timing of geomagnetic reversals and well-established excursions during the last 1.5 million years: LA-Laschamp, BL-Blake, IB-Iceland Basin, PR-Pringle Falls, BLT-Big Lost, LP-La Palma, ST17-Stage 17, B/M-Brunhes/Matuyama boundary, KA-Kamikatsura, SR-Santa Rosa, JA-Jaramillo Subchron, PU-Punaruu, CB-Cobb Mt. Subchron, BJ-Bjorn, GA-Gardar.

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144. Praetorius, S.K., and Mix, A.C., 2014. Synchronization of North Pacific and Greenland climates preceded abrupt deglacial warming: Science, 345, 444-448.

145. Channell, J.E.T., Hodell, D.A., Xuan, C., Mazaud, A., Stoner, J.S., 2008. Age calibrated relative paleointensity for the last 1.5 Myr at IODP Site U1308 (North Atlantic). Earth Planet. Sci. Lett. 274, 59–71.

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150. Charalampakis, M., Lykousis, V., Sakellariou, D., Papatheodorou, G., and Ferentinos, G., 2014, The tectono-sedimentary evolution of the Lechaion Gulf, the south eastern branch of the Corinth graben, Greece. Marine Geology, 351, 58-75.

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152. Sakellariou, D. & Lykousis, V., 2007. Spatial and temporal evolution of the neotectonic deformation in the Gulf of Corinth Rift. Symposium in honor of Prof. I. Mariolakos, Geological Society of Greece/Committee for Tectonic Geology, 7th Dec. 2007, Abstracts, p. 15, Athens (in Greek).

List of Potential Reviewers

Sanjeev Gupta, Imperial College, UK

Donna Shillington, LDEO, USA

John Underhill, Heriot Watt University, UK

Rebecca Dorsey, University of Oregon, USA

Chris Scholz, Syracuse University, USA

Dale Sawyer, Rice University, USA

Tim Reston, Birmingham University, UK

Ramon Arrowsmith, Arizona State University, USA

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EDUCATION

B.A. (Hons.) Natural Sciences, University of Cambridge, 1992
Ph.D. Structural Geology, "Structure and Seismic Hazards of the Offshore Cascadia Forearc and Evolution of the Neogene Forearc Basin", Dr. Robert S. Yeats (advisor), Oregon State University, 1998

PROFESSIONAL EXPERIENCE

8/14-present Professor, Ocean and Earth Science (NOCS), University of Southampton
10/00-12/02 Royal Society Dorothy Hodgkin Post-Doctoral Research Fellow, Southampton Oceanography Centre, School of Ocean and Earth Science, University of Southampton
1/99-9/00 Royal Society Dorothy Hodgkin Post-Doctoral Research Fellow, Department of Earth Sciences, University of Leeds.

CURRENT RESEARCH INTERESTS

- Early continental rift evolution and geometry (focus on Gulf of Corinth, Greece)
- High resolution fault growth and geometry of young rift faults, Gulf of Corinth
- Fault slip rates and strain distribution of western Gulf of Corinth from paleoseismology and tectonic geomorphology
- Quaternary paleoenvironments in active tectonic and depositional regions, e.g., continental rifts.
- Structure and evolution of the Sumatran subduction zone margin, earthquake rupture dynamics, subduction zone earthquake segmentation and geological history of megathrust earthquakes
- Comparison of forearc structure, morphology and earthquake dynamics of subduction zones (including Sumatra, Nankai, Makran margins)
- In situ stress, fault zone physical properties and development of the seismogenic zone, Nankai, Japan (IODP)
- Quaternary dating techniques applied to neotectonics (cosmogenic nuclide, radiocarbon, U series)
- Effects of sea level rise on seafloor geomorphology and sedimentary processes

RELEVANT RECENT GRANTS RECEIVED

12-14 "Corinth virtual site survey: integrating geophysical data for syn-rift stratigraphy, fault and basin evolution and advancing IODP proposed drilling", NERC, L McNeill et al.
10-12 “Core to regional scale synthesis of fault zone properties and fluids at subduction zones: Drivers of seismogenic behaviour”, NERC, L McNeill et al.
06-11 “Subduction zone segmentation and controls on earthquake rupture: The 2004 and 2005 Sumatra earthquakes”, NERC Consortium, T Henstock, L McNeill et al..
05-07 “Recent deformation associated with 2004 Sumatran earthquake”, Royal Society, L McNeill
02-05 “Distribution of extensional strain within a continental rift from high resolution marine geophysics: The offshore Corinth Rift (Central Greece)”, NERC Grant, L.C. McNeill et al.

SIGNIFICANT SEAGOING EXPERIENCE

2009 Co-Chief scientist, IODP Expedition 319, NantroSEIZE Stage 2, Chikyu (riser drilling)
08-09 Chief Scientist of 2 (of 4) marine geophysics and geology cruises offshore Sumatra investigating margin segmentation and earthquakes
2007 Scientific Party member (Logging specialist), IODP Exp. 314, NantroSEIZE Stage 1 (LWD)
2005 Scientific advisor, HMS Scott, multibeam survey of 2004 Sumatran earthquake rupture
2003 Chief Scientist, high resolution marine geophysics research cruise, Gulf of Corinth, Greece
2001 Co-chief scientist, marine geophysics research cruise, North Aegean Trough and North Anatolian Fault.
2001 Scientific Party member (Structural Geologist), ODP Leg 196, Nankai margin – LWD investigations of prism sediment and fault properties.

PROFESSIONAL SERVICE AND SOCIETIES

- Reviewing includes J. Geophysical Research, Geology (Editorial Board 08-10), Science, Basin Research, Tectonics, Marine Geology, BSSA, Geophysical Journal Int., GRL, NSF, NERC, IODP.
- Current member American Geophysical Union (1994-present).
- Member of IODP SEP (Proposal Evaluation Panel) from November, 2012.
- Member of UKIODP Programme Advisory Group (PAG) from November, 2012.

SELECTED RELEVANT PUBLICATIONS

Nixon, C., *McNeill, L., et al.,* in prep, History of high resolution basin development within the offshore Corinth rift, central Greece. To be submitted to Geophys. J. Int.

McNeill*, L.C., and Henstock, T.J.,* 2014. Forearc structure and morphology along the Sunda subduction zone: Tectonics, DOI: 10.1002/2012TC003264

Geersen, J., *McNeill, L., Henstock, T., Gaedicke, C.,* 2013, The 2004 Aceh-Andaman earthquake: early clay dehydration controls shallow seismic rupture: Geochem. Geophys. Geosyst., doi: 10.1002/ggge.20193.

Smith, G.L., *McNeill, L.C., Wang, K., He, J., and Henstock, T.J.*, 2013, Thermal structure and megathrust seismogenic potential of the Makran subduction zone: Geophys Res Lett., 40, 1-6, doi:10.1002/grl.50374.

Sumner, E., *Siti, M., McNeill, L., Talling,P., Wynn, R., Henstock, T., Djajadihardja, Y., and Permana, H.,* 2013, Can turbidites be used to reconstruct a paleoearthquake record for the Sumatran margin?: Geology, doi: 10.1130/G34298.1.

Saffer, D.M., *Flemings, P.B, Ito, T., Lin, W., Boutt, D., McNeill, L., Byrne, T., Araki, E., Conin, M., Doan, M., Kano, Y., Eiiguchi, N., Toczko, S. and Expedition 319 Scientists*, in press, In situ stress and pore pressure in the Kumano forearc basin, offshore SW Honshu from downhole measurements during riser drilling: Geochem., Geophys., Geosys., 14, doi:10.1002/ggge.20051.

Smith, G., *McNeill., L., Henstock, T., and Bull, J.*, 2012, The structure and fault activity of the Makran accretionary prism: J. Geophys. Res., 117, B07407, doi:10.1029/2012JB009312.

Bell, R., McNeill, L., Henstock, T., and Bull, J., 2011, Comparing extension on multiple time and depth scales in the Corinth rift, central Greece. Geophys. J. Int., 186, 463-470, doi: 10.1111/j.1365-246X.2011.05077.x

Gulick, S., *Austin, J.,* McNeill, L., *Bangs, N., Martin, K., Henstock, T., Bull, J., Dean, S., Djajadishardja, Y., and Permana, H., 2011,* Thick indurated sediments extend updip rupture propagation during 2004 Sumatra earthquake. Nature Geoscience, 4, 453-456.

Dean, S.M., *McNeill, L.C., Henstock, T.J., Bull, J.M., Gulick, S.P.S., Austin, J.A., Bangs, N.L.B., Djajadihardja, Y.S., and Permana, H.*, 2010, Contrasting decollement and prism properties over the Sumatra 2004/2005 earthquake rupture boundary: Science, 329, 207-210.

Lin, W., *Doan, M.-L., Moore, J.C., McNeill, L.C., et al.*, 2010, Present-day principal horizontal stress orientations in the Kumano forearc basin of the southwest Japan subduction zone determined from IODP NanTroSEIZE drilling Site C0009: Geophys. Res. Lett., 37, doi:10.1029/2010GL043158.

Bell, R., *McNeill, L.C., Bull, J.M., Henstock, T.J., Leeder, M., and Collier, R.*, 2009, Evolution of the Gulf of Corinth rift, Central Greece: Basin Research, 21, 824-855.

Bell, R., **McNeill**, L.C., Bull, J.M., and Henstock, T.J., 2008. Evolution of the western Gulf of Corinth continental rift, Greece. Geological Society of America Bulletin, 120, 156-178.

Henstock, T., *McNeill, L., and Tappin, D.*, 2006, Seafloor morphology of the Sumatran subduction zone: Surface rupture during megathrust earthquakes?: Geology, v. 34, 5, 485-488.

McNeill*, L*., Cotterill, C., Stefatos, A., Henstock, T., Bull, J., Collier, R., Papatheoderou, G., Ferentinos G., and Hicks, S. 2005. Active faulting within the offshore western Gulf of Corinth, Greece: implications for models of continental rift deformation. Geology, 33, 241-244.

McNeill*, L.C.*, Collier R.E.Ll., De Martini, P., Pantosti, D., & D'Addezio, G. 2005. Recent history of the Eastern Eliki Fault, Gulf of Corinth: Geomorphology, paleoseismology and impact on paleoenvironments. Geophysical Journal International, 161, 154-166.

McNeill, L.C., *Ienaga, M., Tobin, H., Saito, S., Goldberg, D., Moore, J.C., Mikada, H.*, 2004, Deformation and in-situ stress in the Nankai accretionary prism from Resistivity at Bit images, ODP Leg 196: Geophysical Research Letters, 31, L0260 10.1029/2003GL018799.

IAN BAILEY

Camborne School of Mines, Exeter University

EDUCATION AND AWARDS:

2013: UoS Vice-Chancellor's Teaching Award (£1000 prize money); **2011:** Professional Certificate in Academic Practice; **2005:** University College London, Ph.D., Palaeoclimatology (sedimentology), Geological Sciences, London, UK; **2000:** UCL, MSci., Geological Sciences, UCL, UK, 1st (Hons.).

EMPLOYMENT:

2013, October- Lecturer in Geology, University of Exeter, Camborne School of Mines; **2009-2013:** Teaching Fellow, University of Southampton**,** Ocean and Earth Science, NOCS; **2007–2008:** Temporary Lecturer, University of Cambridge, Department of Earth Sciences; **2005–2007:** PDRA, UoS, NOCS

GRANT CAPTURE:

2013 - UKIODP Rapid Response Grant: Integrated Ocean Drilling Program Expedition 341: Southern Alaskan Continental Margin - Interactions of Tectonics, Climate, and Sedimentation (PI: Bailey; **£2725**)

2007 - IODP NERC Small Grant 2007 (NE/F00141X/1): Sub-orbital climate instability and its relation to Late Pliocene intensification of Northern Hemisphere Glaciation, IODP Sites 1308 and 1313 (PIs: Wilson and Schiebel, Co-investigator: Bailey; **£79,554**).

2005 - IODP NERC Small Grant (NE/D006465/1): Pliocene intensification of northern hemisphere glaciation (PIs: Wilson and Schiebel, Named PDRA: Bailey; **£12,000**).

PROFESSIONAL SERVICES AND ASSOCIATIONS:

Reviewer for Nature, Nature Communications, EPSL, Quaternary Science Reviews, Geology, Paleoceanography, Quaternary International, Journal of Quaternary Science, Series Developments in Marine Geology (Elsevier), International Journal of Earth Sciences.

Peer Reviewer for NERC Standard grant (2013); UKIODP NERC grant (2010).

Member of American Geophysical Union (**AGU**; since 2007), Quaternary Research Association (**QRA**; 2000–2004 and since 2014) and European Geosciences Union (**EGU**; 2006). Fellow of Higher Education Academy (**HEA**; since 2011).

Ph.D RESEARCH STUDENTS:

Keziah Blake-Mizen, Exeter, September 2014-: Reconstructing iceberg calving locations and spatial extent of the Greenland Ice Sheet during the Plio-Pleistocene (co-supervised with Stephen Hesselbo).

Gabriella Jardine, SOES, September 2014-: A dust bowl future and a warm wet past? Palaeoclimatology of the warm Pliocene to glacial Pleistocene transition on North America recorded in marine sediments of the equatorial Pacific Ocean (co-supervised with Paul A. Wilson).

Anieke Brombacher, SOES**,** September 2013-: Disentangling synergistic climate drivers in planktic evolution (co-supervised with Thomas H.G. Ezard & Paul A. Wilson).

Camilla Watts, SOES, September 2013-: Understanding the triggers for past large submarine landslide events and quantification of impacts on the North Atlantic thermohaline circulation and climate: evidence from marine sediment cores (co-supervised with Jennifer D. Stanford, Peter J. Talling, Paul A. Wilson, James Hunt & Siwan Davies).

David C. Lang, SOES, September 2011-: Intensification of northern hemisphere glaciation, ice rafting, sea ice formation and ventilation in the Plio-Pleistocene North Atlantic Ocean (Nd-isotopes; co-supervised with Paul A. Wilson & Gavin L. Foster).

Anya Crocker, SOES, September 2009-2013: (passed; co-supervised with Heiko Pälike & Paul A. Wilson).

Clara T. Bolton, SOES, September 2006-April 2010: Orbital and sub-orbital scale climate variability during the Pliocene intensification of Northern Hemisphere Glaciation (passed; co-supervised with Paul A. Wilson, Samantha J. Gibbs & Ralf Schiebel).

SEMINARS:

2014. IODP Proposal Planning Workshop: Continental Rifting & the Corinth Rift (invited talk), Athens, Greece (11-14th February).

2013. Pliocene Workshop, Bristol, UK (9th September).

2012. Columbia University, USA. BPE Seminar, Lamont-Doherty Earth Observatory (October, 12th).
2012. University of Southampton, Palaeo-talk, National Oceanography Centre (September, 13th).
2011. University of Cambridge, Quaternary Discussion Group Seminar at Claire College (October, 26th)
2011. University of Oxford, Department of Earth Sciences (October, 12th).
2011. Imperial College, Earth and Planets Seminar at Department of Earth Science & Eng. (October, 5th).
2011. Sheffield University, Physical Geography Research Seminar, Dept of Geography (September, 28th).
2011. Cardiff University, School of Earth and Ocean Sciences (August, 26th).
2011. University of Southampton, National Oceanography Centre (July, 27th).
2011. University of Bristol, BRIDGES Seminar, School of Geographical Sciences (June, 15th).
2011. University of New England, Portland, USA. Guest Lecture (MAR568: Ad. Oceanog.; April, 29th).
2011. USGS, Reston, USA, Eastern Geology & Paleoclimate Science Center (April, 27th).
2011. Columbia University, LDEO, USA. Geochemistry Seminar (April, 25th).
2011. Brown University, Geological Sciences, Providence Rhode Island, USA (April, 22nd).
2011. Woods Hole Oceanographic Institute, USA. PaleoLunch Seminar Series (April, 21st).
2009. Rutgers University, USA. Institute of Marine and Coastal Sciences (November).
2005. Geological Society of Norfolk (December).

PUBLICATIONS (ISI only):

Gulick, S., Jaeger, J., Mix, A., Asahi, H., Bahlburg, H., Belanger, C., Bueno, G., Berbel, B., Childress, L., Cowan, E., Davies, M.H., Drab, L. Dottori, F., Forwick, M., Fukumura, A., Ge, S., Gupta, S., Kioka, A., Konno, S., LeVay, L., März, C., Matsuzaki, K., McClymont, E., Moy, C., Müller, J., Nakamura, A., Ojima, T., Ridgway, K., Romero, O., Slagle, A., Stoner, J., St-Onge, G., Suto, I., Worthington, L. **Bailey, I.**, Enkelmann, E., Reece, R. (revised, in review). Rapid response of tectonics to changes in glacial erosion constrained by Gulf of Alaska sedimentary record, Nature (since April 16th, 2014).

Lang, D.C, **Bailey, I.,** Wilson, P.A., Beer, C., Bolton, C.T., Newsam, C., Spencer, M.R., Friedrich, O., Gutjhar, M., Foster, G.L., Cooper, C.J., Milton, A., The transition on North America from the warm humid Pliocene to the glaciated Quaternary traced by eolian dust deposition at a benchmark North Atlantic Ocean drill site. Quaternary Science Reviews 93C, 125–141, doi:10.1016/j.quascirev.2014.04.005.

Bailey, I., Hole, G.M., Foster, G.L., Wilson, P.A., Storey, C.D., Trueman, C.N., Raymo, M.E., 2013. An alternative suggestion for the Pliocene onset of major northern hemisphere glaciation based the geochemical provenance of North Atlantic Ocean ice-rafted debris, *Quaternary Science Reviews*, 75C, 181–194, doi:10.1016/j.quascirev.2013.06.004.

Lawrence, K.T., **Bailey, I.**, Raymo, M.E., 2013. Re-Evaluation of the Age Model for North Atlantic Ocean Site 982 Arguments for a Return to the Original Chronology, *Clim. Past*, 9, 2391–2397, doi:10.5194/cp-9-2391-2013.

Bailey, I., Foster, G.L., Wilson, P.A., Jovane, L., Storey, C.D., Trueman, C.N., Becker, J., 2012. The flux and provenance of ice-rafted debris in the earliest Pleistocene sub-polar North Atlantic Ocean comparable to that of the last glacial maximum, *Earth and Planetary Science Letters* 341-344, 222-233, doi:10.1016/j.epsl.2012.05.034.

Bailey, I., Liu, Q., Swann, G.E.A., Jiang, Z., Sun, Y., Zhao, X., Roberts, A.P., 2011. Iron fertilisation and biogeochemical cycles in the sub-Arctic northwest Pacific during the late Pliocene intensification of Northern Hemisphere Glaciation, *Earth and Planetary Science Letters* 307(3–4), 253-265, doi:10.1016/j.epsl.2011.05.029.

Bailey, I., Bolton, C.T., DeConto, R.M., Pollard, D., Schiebel, R., Wilson, P.A., 2010. A low threshold for North Atlantic ice rafting from 'low-slung and slippery' late Pliocene ice sheets, *Paleoceanography* 25, PA1212, doi:10.1029/2009PA001736.
Research highlight in Nature Geoscience 3, 4 (2010) doi:10.1038/ngeo742.

Bolton, C.T., Wilson, P.A., **Bailey, I.**, Friedrich, O. Beer, C., Becker, J., Baranwal, S., Schiebel, R., 2010. Millennial-scale climate variability in the subpolar North Atlantic Ocean during the late Pliocene, *Paleoceanography* 25, PA4218, doi:10.1029/2010PA001951.
Research highlight in Nature Geoscience 3, 742 (2010) doi:10.1038/ngeo1011.

Dr. REBECCA EMMA BELL

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PROFESSIONAL EXPERIENCE

Research Lecturer, Imperial College London 2012 – present

- Co-investigator on the multi-institutional "MultiRift" project funded by the Norwegian Government and Statoil
- **Member** of the AAPG Wiki Advisory Board
- **Earth Science columnist** for the Observer, the Guardian's Sunday magazine
- **Visiting Research Scientist-** GNS Science, New Zealand 2014
- **Guest editor-** Basins Research thematic set (Deep water continental margins)
- Lecturer and coordinator of 3rd year undergraduate "Seismic Techniques" module
- Academic supervisor of undergraduate, MSci, MSc and PhD students
- Personal tutor for Undergraduate students

Statoil Post-Doctoral Research Associate, Imperial College London 2010 - 2012

- Tectonic Interaction during Multi-phase Extension (TIME) project
- Investigation of the relationship between Permo-Triassic and Jurassic rift phases in the North Sea
- Control of basement fabric on polyphase faulting
- Interpretation of 2D and 3D seismic reflection data and potential field modelling

Active Source Seismologist, GNS Science, Wellington, New Zealand 2008 – 2010

- Seismic reflection data interpretation to determine subduction thrust fault seismic characteristics and relationship to seismic and tsunami hazard along the east coast of North Island, New Zealand
- Participation in onshore-offshore seismic acquisition survey (SAHKE project)
- IODP workshop, Gisborne, New Zealand 2011, **steering committee member**
- New Zealand Geophysics Society **Council member,** 2009 - 2010

QUALIFICATIONS

Ph.D. Marine Geophysics, "Tectonic Evolution of the Corinth Rift, Central Greece", University of Southampton, 2008. NERC funded

MEarth Sc. Master of Earth Sciences, 1st class honours, University of Oxford, 2004

HONOURS AND AWARDS

Keynote Speaker invitation, SeisMix conference, Barcelona, 2014
Imperial College 5 year Research Fellowship, 2012 - 2017
Co-investigator on the NFR and Statoil MultiRifts program
Keynote Speaker invitation, AGU Fall Meeting, 2011
NERC, UKIODP Research Grant, £262000, 2012
Akademia Guest Researcher award, £2500, 2011
Arthur Holmes Centenary Research Grant, £1100, 2011
Royal Society of New Zealand Marsden Fund Award, £530000, 2009
Elected member of the **New Zealand Geophysics Society Council**, 2009 – 2010

RELEVANT PUBLICATIONS

Bell RE, Jackson CA-L, Whipp PS, Clements B, 2014, Strain migration during multiphase extension: observations from the northern North Sea, *Tectonics*, DOI: 10.1002/2014TC003551

Bell RE, Holden C, Power W, Wang X, Downes G, 2014, Hikurangi margin tsunami earthquake generated by slow seismic rupture over a subducted seamount, *Earth and Planetary Science Letters*, Vol:397, Pages 1-9

Alves TM, **Bell RE**, Jackson CA-L, Minshull TA, 2014, Deep-water continental margins: geological and economic frontiers, *Basin Research*, Vol:26, Pages:3-9

Bell R, Jackson CA-L, Elliott G, Gawthorpe R, Sharp IR, Michelsen L, 2014, Insights into the development of major rift-related unconformities from geologically constrained subsidence modelling: Halten Terrace, offshore mid Norway, *Basin Research*, Vol:26, Pages:203-224

Reeve MT, **Bell RE**, Jackson CA-L, 2014, Origin and significance of intra-basement seismic reflections offshore western Norway, *Journal of the Geological Society*, Vol:171, ISSN:0016-7649, Pages:1-4

Morgan J, Warner M, **Bell R**, Ashley J, Barnes D, Little R, Roele K, Jones C, 2013, Next-generation seismic experiments: wide-angle, multi-azimuth, three-dimensional, full-waveform inversion, *Geophysical Journal International*, Vol:195, ISSN:0956-540X, Pages:1657-1678

Jackson CAL, Chua S-T, **Bell RE**, Magee C, Structural style and growth of early-stage inversion structures: insights from 3D seismic reflection data, Egersund Basin, offshore Norway, **Journal of Structural Geology, 2013**, Vol:46, Pages:167-185

Bell RE, McNeill LC, Henstock TJ, Bull JM, Comparing extension on multiple time and depth scales in the Corinth Rift, Central Greece, **Geophysical Journal International, 2011**, vol. 186, Pages: 463 - 470

Wallace LM, **Bell RE**, Townend J, Ellis S, Bannister S, Henrys S, Sutherland R, Barnes P, Subduction Systems Revealed: Studies of the Hikurangi Margin, **EOS, Transactions American Geophysical Union, 2010,** Vol:91

Bell RE, Sutherland R, Barker DHN, Henrys SA, Bannister SC, Wallace LM, Beavan RJ, Seismic reflection character of the Hikurangi subduction interface, New Zealand, in the region of repeated Gisborne slow slip events**, Geophysical Journal International, 2010,** Vol:180, Pages:34-48

Bell RE, McNeill LC, Bull JM, Henstock TJ, Collier REL, Leeder MR, Fault architecture, basin structure and evolution of the Gulf of Corinth Rift, **Basin Research, 2009**, Vol:21, Pages:824-855

Wallace LM, Reyners M, Cochran U, Bannister S, Barnes P, Berryman K, Downes G, Eberhart-Phillips D, Fagereng A, Ellis S, Nicol A, McCaffrey R, Beavan RJ, Henrys S, Sutherland R, Barker DHN, Litchfield N, Townend J, Robinson R, **Bell RE**, Wilson K, Power W, Characterizing the seismogenic zone of a major plate boundary subduction thrust: Hikurangi Margin, New Zealand, **Geochemistry, Geophysics, Geosystems, 2009,** Vol:10, Q10006

Bell RE, McNeill LC, Bull JM, Henstock TJ, Evolution of the offshore western Gulf of Corinth, **GSA Bulletin, 2008,** Vol:120, Pages:156-178

McNeill LC, Cotterill CJ, Bull JM, Henstock TJ, **Bell RE**, Stefatos A, Geometry and slip rate of the Aigion fault, a young normal fault system in the western Gulf of Corinth, **Geology, 2007,** Vol:35, Pages:355-358

SUMMARY C.V.

Jonathan Mark Bull

Present Employment: **Professor in Geophysics**

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Married: 3 Children **Date of Birth** 23rd November 1965

Employment History:
February 2014 – date – Professor in Geophysics
Sept 2011-2014 Associate Dean Research and Strategy, Southampton University
Sept 2005 – present Professor in Geophysics, Southampton University
2004 – August 2005 Reader in Geophysics, Southampton University
1998 – 2004 Senior Lecturer in Geophysics, Southampton University
1990 – 1998 Lecturer in Geophysics, Southampton University

Education:
1987-1990 – PhD in Marine Geophysics. Edinburgh University.
1984-1987 – BSc in Geology and Geophysics, Durham University.

Summary

Prof. J. M Bull leads a group working on applications of high resolution marine seismology to topics as diverse as active faulting, remote determination of the physical properties of sediments, and object visualisation in 3-dimensions. He has worked extensively on determining active fault activity histories including studies in Iceland, Greece and New Zealand in the back-arc area north of New Zealand. He led a major EPSRC funded project (graded outstanding) to develop a 3D Chirp profiler, which has recently been licensed to a commercial company. He recently published a new methodology that can determine the time period of observation necessary to reliably constrain active fault behaviour. Since 2004 he has been lead PI on research grants totalling £900k, and co-PI on research grants totalling £2 million. He is funded on a major Framework 7 consortium on Carbon Capture and Storage (ECO2) which started May 2011. He is currently has three NERC grants - Megascours in Bangladesh, IODP Corinth, and on Galacia (3D seismic using the Langseth, Tim Reston P.I.). He has 5 current PhD students and one post-doc funded from industry sources on 3D chirp development.

Most recent Keynote Lectures

Bull, J.M., 2013. Development of monitoring techniques for potential seepage of CO2 from sub-seafloor storage sites (Invited Speaker) at I^{2}CNER International symposium on CO2 separation and concentration and Carbon Capture and Storage. 31st January 2013, Kyushu University, Japan.

Bull, J.M., 2013. Development of monitoring techniques for potential seepage of CO2 from sub-seafloor storage sites (Invited Speaker) at Workshop on Japanese plans for CO2 capture and storage for scientists and policy-makers. 2nd February 2013, University of Tokyo, Japan.

Recent Funding History (Southampton components)

2013-2016. Fluvial Megascours (with Sambrook-Smith). NERC grant £ 279k
2012-2014 UKIERI – links with IIT Bhubaneswar - £35k
2012-2014 Corinth IODP (with McNeill). NERC grant £208k
2013-2016 Galacia 3D (with Reston and Minshull). NERC grant £316k
2011-2015 ECO2. EU Framework 7. £102k
2010-2013 Windermere consortium. United Utilities, E.A. £58k
2006-2012. Sumatra Consortium. NERC consortium. £500k
2005-2014. Investment in Chirp Acoustic Research. GeoAcoustics Ltd. £290k
Prior to this c. £830 k of income from diverse funding sources (including c. 300 k from EPSRC).

Most significant Publications:

Bull, J.M. and Scrutton, R.A.,1990. Fault reactivation in the Central Indian Ocean Basin and the rheology of the oceanic lithosphere. *Nature*, 344: 855-858.

Pickering, G., **Bull, J.M.** and Sanderson, D.J. ,1995. Sampling power-law distributions. Tectonophysics, 248: 1-20.

Krishna, K.S., **Bull, J.M.**, and Scrutton, R.A., 2001. Evidence for multiphase folding of the central Indian Ocean lithosphere. *Geology*, 29: 715-718.

Taylor, S.K., **Bull, J.M.**, Lamarche, G., and Barnes, P.M., 2004 Normal fault growth and linkage during the last 1.3 million years: an example from the Whakatane Graben, New Zealand. Journal of Geophysical Research, 109, B02408, doi:10.1029/2003JB002412.

Bull, J.M., Gutowski M., Dix, J.K., Henstock, T.J., Hogarth, P., Leighton, T.G., and White, P.R., 2005. Design of a 3D Chirp sub-bottom imaging system. *Mar. Geophys. Res.*, 26, 157-169.

Bull, J.M., Barnes, P.M., Lamarche, G., Sanderson, D.J., Cowie, P.A., Taylor, S.K. and Dix, J.K., 2006. High-resolution record of displacement accumulation on an active normal fault Journal of Structural Geology, 28, 1146-1166. doi:10.1016/j.jsg.2006.03.006

Vardy, M.E., Dix, J.K., Henstock, T.J., **Bull, J.M.**, and Gutowski, M., 2008. Decimeter resolution 3D seismic volume: A Case Study in Small Object Detection. Geophysics, 73 (2), B33-B40. 10.1190/1.2829389

Krishna, K.S., **Bull, J.M.**, and Scrutton, R.A., 2009. Early (Pre-8Ma) fault activity and temporal strain accumulation in the central Indian Ocean. Geology, 37, 227-230. doi:10.1130/G25265A.1.

Bull, J.M., DeMets, C., Krishna, K.S., Sanderson, D.J. and Merkouriev, S., 2010. Reconciling plate kinematic and seismic estimates of lithospheric convergence in the central Indian Ocean. Geology, 38, 307-310. April, 2010.

Dean, S.M., McNeill, L.C., Henstock, T.J., **Bull, J.M.**, Gulick, S.P.S., Austin, Jr., J.R., Bangs, N. L.B., Djajadihardja, Y.S., Permana, H., 2010. Contrasting décollement development and prism deformation across the Sumatra 2004/2005 earthquake rupture boundary, Science, 329, 207-210.(doi:10.1126/science.1189373)

CURRICULUM VITAE

Dr Richard Edward Llewellyn COLLIER

Basin Structure Group,
Room 9.24, School of Earth & Environment, University of Leeds, Leeds LS2 9JT, U.K.
Tel: ++44-113-3435211 Fax: ++44-113-3435259
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Fellow of the Geological Society, London

Academic career history:

2002-present	Senior Lecturer in Tectonics and Sedimentation, School of Earth & Environment, University of Leeds
2006	Leverhulme Research Fellow
1991-2002	Lecturer, School of Earth Sciences, University of Leeds
1988-90	NERC Post-Doctorate Research Assistant, University of Leeds
1985-88	PhD, University of Leeds
1985	Exploration Department, Conoco (UK) Ltd., London
1982-85	BSc (Hons), Geology, Bedford College, University of London

Selected published papers:

2013. Milner, A.M., Muller, U.C., Roucoux, K.H., Collier, R.E.L., Pross, J., Kalaitzidis, S., Christanis, K. & Tzedakis, P.C. Environmental variability during the Last Interglacial: A new high-resolution pollen record from Tenaghi Philippon, Greece. *Journal of Quaternary Science*, 28(2), 113-117.
2013. Sarhan, M.A., Collier, R.E.Ll., Basal, A. & Abdel Aal, M.H. Late Miocene normal faulting beneath the northern Nile Delta: NNW propagation of the Gulf of Suez Rift. *Arabian Journal of Geosciences*, doi: 10.1007/s12517-013-1089-9
2012. Milner, A.M., Collier, R.E.L., Roucoux, K.H., Muller, U.C., Pross, J., Kalaitzidis, S., Christanis, K. & Tzedakis, P.C. Enhanced seasonality of precipitation in the Mediterranean during the early part of the Last Interglacial. *Geology*, 40, 919-922, doi: 10.1130/G33204.1
2009. Bell, R.E., McNeill, L.C., Bull, J.M., Henstock, T.J., Collier, R.E.Ll. & Leeder, M.R. Fault architecture, basin structure and evolution of the Gulf of Corinth Rift, central Greece. *Basin Research*, 21, 824-855.
2007. Collier, R.E.Ll. & Leeder, M.R. The Corinth Isthmus. In: Leeder, M.R., Andrews, J.E., Collier, R.E.Ll., Gawthorpe, R.L., McNeill, L., Portman, C. & Rowe, P. *The Gulf of Corinth, Classic Field Geology in Europe, 11*, Terra Publsihing, Harpenden, 176pp.
2005. Leeder, M.R., Portman, C., Andrews, J.E., Collier, R.E.Ll., Finch, E., Gawthorpe, R.L., McNeill, L.C., Perez-Arlucea, M. & Rowe, P. Normal faulting and crustal deformation, Alkyonides Gulf and Perachora peninsula, eastern Gulf of Corinth rift basin, Greece. *Journal of the Geological Society, 162, 549-561*.
2005. McNeill, L.C., Cotterill, C.J., Henstock, T.J., Bull, J.M., Stefatos, A., Collier, R.E.Ll., Papatheodorou, G., Ferentinos, G. & Hicks, S.E. Active faulting within the offshore western Gulf of Corinth, Greece: Implications for models of continental rift deformation. *Geology, 33, 241-244*.
2005. McNeill, L.C., Collier, R.E.Ll., Pantosti, D., De Martini, P.M. & D'Addezio, G. Recent history of the Eastern Eliki Fault, Gulf of Corinth: Geomorphology, paleoseismology and impact on paleoenvironments. *Geophysical Journal International, 161, 154-166.*
2004. McNeill, L.C. & Collier, R.E.Ll. Uplift and slip rates of the eastern Eliki fault segment, Gulf of Corinth, Greece, inferred from Holocene and Pleistocene terraces. *Journal of the Geol. Soc., London*, 161, 81-92.
2003. Leeder, M.R., McNeill, L., Collier, R.E.Ll., Portman, C., Rowe, P.J., Andrews, J.E. & Gawthorpe, R.L. Corinth rift margin uplift: new evidence from Late Quaternary marine shorelines. *Geophysical Research Letters,* 30 (12), 13-1.
2002 Leeder, M.R., Collier, R.E.Ll., Adbul Aziz, L.H., Trout, M., Ferentinos, G., Papatheodorou, G. & Lyberis, E. Tectono-sedimentary processes along an active marine/lacustrine half-graben margin: Alkyonides Gulf, E. Gulf of Corinth, Greece. *Basin Research*, 14, 25-41.
2002 Stefatos, A., Papatheodorou, G., Ferentinos, G., Leeder, M. & Collier, R. Seismic reflection imaging of active offshore faults in the Gulf of Corinth: their seismotectonic significance. *Basin Research*, 14, 487-502.
2000 Collier, R.E.Ll., Leeder, M.R., Trout, M., Ferentinos, G., Lyberis, E. & Papatheodorou, G. High sediment yields and cool, wet winters: Test of last glacial paleoclimates in the northern Mediterranean. *Geology*, 28, 999-1002.
1998 Collier, R.E.L., Pantosti, D., D'Addezio, G., De Martini, P.-M., Masana, E. & Sakellariou, D.

Paleoseismicity of the 1981 Corinth earthquake fault: Seismic contribution to extensional strain in central Greece and implications for seismic hazard. *Journal of Geophysical Research*, 103, 30,001-30,019.
1996 Pantosti, D., Collier, R., D'Addezio, G., Masana, E. & Sakellariou, D. Direct geological evidence for prior earthquakes on the 1981 Corinth fault (central Greece). *Geophysical Research Letters*, 23, 3795-3798.
1995 Collier, R.E.Ll. & Gawthorpe, R.L. Neotectonics, drainage and sedimentation in central Greece: insights into coastal reservoir geometries in syn-rift sequences. In: Lambiase, J.J. (Ed.) *Hydrocarbon Habitat in Rift Basins*, Special Publication of the Geological Society, London, no. **80**, 165-181.
1995 Collier, R.E.Ll., Leeder, M.R. & Jackson, J.A. Quaternary drainage development, sediment fluxes and extensional tectonics in Greece. In: Lewin, J., Macklin, M.G., & Woodward, J.C. (Eds.) *Mediterranean Quaternary River Environments.* Publ. A.A. Balkema, Rotterdam, 31- 44.
1994 Alexander, J., Leeder, M., Bridge, J., Collier, R. & Gawthorpe, R. Holocene meander belt evolution in an active extensional basin, SW Montana, USA. *Journal of Sedimentary Research*, **B64**, 542-559.
1994 Dart, C.J., Collier, R.E.Ll., Gawthorpe, R.L., Keller, J.V.A. & Nichols, G. Sequence stratigraphy of (?)Pliocene-Quaternary syn-rift, Gilbert-type fan deltas, northern Peloponnesos, Greece. *Marine & Petroleum Geology*, **11**, 545-560.
1994 Drury, S.A., Kelly, S.P., Berhe, S.M., Collier, R.E.Ll. & Abraha, M. Structures related to Red Sea evolution in northern Eritrea. *Tectonics*, **13**, 1371-1380.
1994 Gawthorpe, R.L., Fraser, A.J. & Collier, R.E.Ll. Sequence stratigraphy in active extensional basins: implications for the interpretation of ancient basin fills. *Marine & Petroleum Geology*, **11**, 642-658.
1992 Collier, R.E.Ll., Leeder, M.R., Rowe, P.J. & Atkinson, T.C. Rates of tectonic uplift in the Corinth and Megara Basins, central Greece. *Tectonics*, **11**, 1159-1167.
1991 Collier, R.E.Ll. & Dart, C.J. Neogene to Quaternary rifting, sedimentation and uplift in the Corinth Basin, Greece. *Journal of the Geological Society, London,* **148**, 1049-1065.
1991 Collier, R.E.Ll. & Thompson, J. Transverse and linear dunes in a Late Pleistocene marine sequence, Corinth Basin, Greece. *Sedimentology*, **38**, 1021-1040.
1990 Collier, R.E.Ll. Eustatic and tectonic controls upon Quaternary coastal sedimentation in the Corinth Basin, Greece. *Journal of the Geological Society, London*, **147**, 301-314.

Selected research grants:

- Mobil Lectureship and MSc studentships; Leeder & Collier, 1/91 - 12/95; £215,000
- Mobil North Sea Ltd; Project Alkyonides Gulf: Sediment Fluxes, Submarine Sediment Transport Pathways and the Isostatic Response to Erosion and Deposition in an Active Rift Basin; Collier & Leeder, 10/94-9/98; £35,000
- Royal Society Research Grant; Strain Rates from Palaeoseismology of the 1981 and 1861 Fault Scarps, Gulf of Corinth; Collier, 3/96; £2,760
- European Science Foundation Grant funding conference, "Frequency-Magnitude Relationships in Earthquake and Fault Populations: Implications for Seismic Hazard"; Collier, 5/98; £38,400
- BP/Marathon; The "Riza" massive, sand-rich turbidites, N. Peloponnesos: Tectono-sedimentary context and reservoir geometry; Collier, 4-11/98; £20,000
- NSF; Study of modern gravelly braided river deposits with special reference to spatial variations in porosity and permeability; Bridge (PI), Collier (RA) & Tye (RA) 8/99-7/02; £187,500
- NERC grant GR9/04448; Palaeoseismicity and slip rates of active faults, Gulf of Corinth Rift, Greece: Constraints on models of lithospheric deformation; Collier (PI) & McNeill (Co-PI), 6/99-5/01; £15,686
- Royal Society grant RSRG 21044; Cosmogenic 36Cl fault scarp dating; McNeill (PI) & Collier (Co-PI), 8/99-3/02; £10,000
- JREI grant, funded by HEFCW/HEFCE; Seabed imaging sonars for earth, environment, geohazards, coastal engineering and archaeological research; Mitchell (PI), Collier, J., Henstock, Searle, Collier, R., McNeill & Gupta (Co-PIs); £410,457
- NERC grant NER/B/S/2001/00269; Distribution of extensional strain within a continental rift from high resolution marine geophysics: The offshore Corinth Rift (central Greece); McNeill (PI), Bull & Collier (Co-PIs), 9/02-6/05; £30,501
- Leverhulme Research Fellowship RF/4/RFG/2005/0448; Continental rifting preconditioning break-up; Collier, 11/05-1/07; £18,278
- National Science & Technology Programme, Saudi Arabia; Sequence architectures of syn-rift carbonates: Midyan region, Saudi Arabia; Al-Ramadan, Kaminski, Cantrell, Collier & Hughes, 10/12-9/14; £346,000
- Trilateral Collaboration Fund, Saudi Arabia; Sedimentology, palaeoenvironment and diagenesis of the Tertiary Burqan Formation in the Midyan area, Saudi Arabia: Implications for subsurface reservoir quality; Al-Ramadan, Kaminski, Lowe, Graham, Hughes, Al-Shammary & Collier, 9/13-8/16; £1,400,000

CURRICULUM VITAE *PATIENCE ANNE COWIE*

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EDUCATION:

DOCTOR OF PHILOSOPHY IN GEOLOGY
February, 1992, Columbia University, New York, USA

MASTER OF PHILOSOPHY IN GEOLOGY
December, 1989, Columbia University, New York, USA

MASTER OF ARTS IN GEOLOGY
January, 1988, Columbia University, New York, USA

BACHELOR OF SCIENCE (HONOURS) IN GEOLOGY/GEOPHYSICS (2:1)
July, 1985, Durham University, England

PROFESSIONAL CAREER:

Apr 2011 – present Professor of Earth System Dynamics, U. of Bergen
Visiting Professor at U. of Edinburgh
Sep 2008 – Apr 2011 Professor of Geodynamics, U. of Edinburgh
Jan 2003 – Sep 2008 Reader in Structural Geology and Tectonics, U. of Edinburgh
Oct 1994 – Jan 2003 Royal Society of London Research Fellow, U. of Edinburgh
Feb 1993- Sep 1994 NERC Post-Doctoral Research Fellow, U. of Edinburgh
Feb 1992-Feb 1993 Post-Doctoral Research Fellow, U. of Nice, France

PUBLICATIONS OVER LAST 5 YEARS:

Faure Walker, J. P., G. P. Roberts, P. A. Cowie, I. D. Papanikolaou, P. R. Sammonds, A. M. Michetti, and R. J. Phillips, Horizontal strain rates and throw rates across breached relay zones: Implications for the preservation of throw deficits at points of normal fault linkage, *J. Struct. Geol., 31(10), 1145-1160, 2009.*

Roberts, G. P., S. L. Houghton, C. Underwood, I. Papanikolaou, P. A. Cowie, P. van Calsteren, T. Wigley, F. J. Cooper and J. M. McArthur, Slip-rate history of the 1981 Gulf of Corinth Earthquake fault, Greece, constrained by 234U-230Th coral dates from uplifted marine terraces and palaeoshorelines: implications for the structural evolution of the Gulf of Corinth, *J. Geophys. Res., 114, B10406, doi:10.1029/2008JB005818, 2009.*

Hobley, D. E. J., H. D. Sinclair, P. A. Cowie, Processes, rates and timescales of fluvial response in an ancient post-glacial landscape., *GSA Bulletin, 122, 1569-1584, doi: 10.1130/B30048.1, 2010.*

Wilkinson M., K. J. W. McCaffrey, G. P. Roberts , P. A. Cowie, R. J. Phillips, A. Michetti, E. Vittori, L. Guerrieri, A. Blumetti, A. Bubeck, A. Yates, G. Sileo, Partitioned postseismic deformation associated with the 2009 Mw 6.3 L'Aquila earthquake surface rupture measured using a terrestrial laser scanner., *Geophys. Res. Lett., 37, L10309, doi: 10.1029/2010GL043099, 2010.*

Roberts, G. P, B. Raithatha, G. Sileo, A. Pizzi, S. Pucci, J. Faure-Walker, M. Wilkinson, K. McCaffrey, R. J. Phillips, A. M. Michetti, L. Guerrieri, A. Blumetti, E. Vittori, P. A. Cowie, P. Sammonds, P. Galli, P. Boncio, C. Bristow, R. Walters, Shallow subsurface structure of the 6th April 2009 Mw 6.3 L'Aquila earthquake surface rupture at Paganica, investigated with Ground Penetrating Radar., *Geophys. J. Int., 183(2), 774-790, 2010.*

Attal, M., P. A. Cowie, A. C. Whittaker, D. E. J. Hobley, G. E. Tucker, and G. P. Roberts, Testing fluvial erosion models using the transient response of bedrock rivers to tectonic forcing in the Apennines, Italy, *J. Geophys. Res. Earth Surface*, *116, F02005, doi:10.1029/2010JF001875, 2011*.

Vittori E., P. Di Manna P., A. M. Blumetti, V. Comerci, L. Guerrieri, E. Esposito, A. M. Michetti, S. Porfido, L. Piccardi, G. Roberts, A. Berlusconi, F. Livio, G. Sileo, M. Wilkinson, K. McCaffrey, R. Phillips and P. A. Cowie, Surface faulting of the April 6, 2009, Mw 6.3 L'Aquila earthquake in Central Italy, *BSSA, 101(4), 1507-1530, doi: 10.1785/0120100140, 2011.*

Hobley, D. E. J., H. D. Sinclair, S. M. Mudd, and P. A. Cowie, Field calibration of sediment flux dependent river incision, *J. Geophys. Res. Earth Surface, 116, F04017, doi:10.1029/2010JF001935, 2011.*

Faure Walker, J. P., G. P. Roberts, P. A. Cowie, I. Papanikolaou, I., A. M. Michetti, P. Sammonds, P., M. Wilkinson, K.J. McCaffrey, and R. J. Phillips, Relationship between topography and strain rate in the actively extending Italian Apennines, *Earth Planet. Sci. Lett., 325/326, 76-84, doi:10.1016/j.epsl.2012.01.028, 2012.*

Cowie, P. A., G. P. Roberts, J. Bull, and F. Visini, Relationships between fault geometry, slip rate variability and earthquake recurrence in extensional settings*, Geophys. J. Int., 189, 143-160, doi: 10.1111/j.1365-246X.2012.05378.x, 2012.*

Wilkinson M., K. McCaffrey, G. Roberts, P. A. Cowie, R. J. Phillips, M Degasperi, E. Vittori, and A. Michetti, Distribution and magnitude of post-seismic deformation of the 2009 L'Aquila earthquake (M6.3) surface rupture measured using repeat terrestrial laser scanning, *Geophys. J. Int.,* 189, 911-922, doi: 10.1111/j.1365-246X.2012.05418.x, 2012.

Cowie, P. A., C. H. Scholz, G. P. Roberts, J. P. Faure Walker and P. Steer, Viscous roots of seismogenic faults revealed by geologic slip rate variations, *Nature Geoscience, 6(12), 1036-1040, doi: 10.1038/ngeo1991, 2013.*

Bubeck, A., M. Wilkinson, G. P. Roberts, P. A. Cowie, K. J. W. McCaffrey, R. Phillips and P. Sammonds, The tectonic geomorphology of bedrock scarps on active normal faults in the Italian Apennines mapped using combined ground penetrating radar and terrestrial laser scanning. *Geomorphology, in press. doi: 10.1016/j.geomorph.2014.03.011, 2014.*

Wilkinson, M., G. P. Roberts, K. J. W. McCaffrey, P. A. Cowie, J. P. Faure Walker, I. Papanikolaou, R. J. Phillips, A. Michetti, E. Vittori, L. Gregory, L. Wedmore and Z. Watson, Slip distributions on active normal faults measured from LiDAR and field mapping of geomorphic offsets: an example from L'Aquila, Italy, and implications for modelling seismic moment release. *Geomorphology, in press. doi: 10.1016/j.geomorph.2014.04.026, 2014.*

Pechlivanidou, S. , K. Vouvalidis, R. Løvlie, A. Nesje, K. Albanakis, C. Pennos, G. Syrides, P. Cowie and R. Gawthorpe, A multi-proxy approach to reconstructing sedimentary environments from the Sperchios delta, Greece. *The Holocene, in press, 2014*.

MEMBERSHIP OF SOCIETIES:

Sigma Xi Scientific Research Society; American Geophysical Union; Geological Society of America; European Geosciences Union

CURRICULUM VITAE 2014 MARY FORD

Professor, Université de Lorraine, Ecole Nationale Supérieure de Géologie, 54501 Nancy, France.
Research Laboratory Centre de Recherche Pétrographique et Géochimique
Rue Notre Dame des Pauvres, B.P. 20,
54501 Vandoeuvre-lès-Nancy Cedex,
France.
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mary.ford@univ-lorraine.fr
Date of Birth :30 August 1960, Vancouver, Canada.
Nationalité : Ireland

Career

PhD, 1985. National University of Ireland, University College Cork. Titre: *Structural studies along a transect through the Variscides of west County Cork, Ireland*. (Supervisor: Mark Cooper)
1985-1986 : Post-doctoral position (demonstratorship) at the University of Liverpool,UK.
1986-1990 : Lecturer-Senoir Lecturer, University of Plymouth , UK
1990-1998: Oberassistenin, Geologisches Institut, ETH-Zurich, Switzerland
1999 **:** Habilitation, ETH, Zurich, Switzerland *"Foreland basin systems: an Alpine Perspective*".
1998- present **:** Professor, l'Université de Lorraine, Ecole Nationale Supérieure de Géologie

Teaching 2009-2013

Ecole Nationale Supérieure de Géologie *2009-2013 : 192-280 h each year : field camp in mapping, petroleum geosciences, basic geological methods, structural geology and mapwork, basin dynamics, orogen geodynamics, general geology.*

Responsabilities and duties, local, national and international, 2009-2014

- Director of Studies (Dean) ENSG, 2009-2012
- Responsable for third year ENSG - Masters programme in Petroleum Geosciences 2000-2010
- Head of major research project funded by ANR (PYRAMID) on Northern Pyrenees 2012-2016
- Examiner and member of PhD Jurys (France, GB, Italy, Netherlands)
- Reviewer for J. of Structural Geology, Tectonics, Basin Research, Journal of Geodynamics, Marine and Petroleum Geology, …..
- Elected member of governing council of CRPG and governing Council of the ENSG (2014-2017)
- Member of scientific committees overseeing and reviewing the Geosciences departments of University college Dublin (2011), the ENS, Paris (2012-2015), IsTerre, at University of Grenoble (2012-2014) , the RGF of the BRGM (2012-2015), Geosciences at University of Toulouse (2014).
- Member of selection committees for professorial/lecturer positions at the universities of Chambery (2014), Montpellier (2014), Paris 6 (2012), Lorraine (ENSG : 2010, 2012), Lille (2013).
- EGU 2013, 2014 Session Convenor

Research activities

Main research domains : kinematic and geometric evolution of compressional and extensional tectonic systems ; internation of sedimentation and tectonics on local and regional scales, basin geodynamics (rifts and foreland basins) , evolution of normal fault systems.
Approach : Field studies and mapping. Structural analyses, section balancing, sedimentology/ stratigraphy, basin geohstory analysis and geodynamics, dating, fission track analyses, 3D modelling using GOCAD.

PhD projects supervised 2009-2016

Nicolas BACKERT May 2009. Interaction tectonique-sédimentation dans le rift de Corinthe, Grèce. Architecture stratigraphique et sédimentologie du Gilbert-delta de Kerinitis. Cosupervised with F. Malartre (UL).

Lise SALLES, Juin 2010. Contrôles structuraux en 3D de la sédimentation turbiditique dans les chaînes plissées : exemple des Grès d'Annot (SE France) Co-supervised with P.Joseph (IFPEN)

Pauline DURAND-RIARD, Novembre 2010. Gestion de la complexité géologique en restauration géomécanique 3D. Cosupervised with Guillaume Caumon (UL).

Charline JULIO. October 2015. Modélisation stochastique de réseaux de failles : Concepts structuraux incertitudes Co-encadré avec G. Caumon (UL).

Romain HEMELSDAEL, 2012-2015. Rivières et rifting: Evolution des systèmes fluviatiles précoces depuis la phase d'initiation du rift jusqu'à la phase climax. Étude du golfe de Corinthe. Cosupervised with F. Malartre (UL).

Arjan GROOL 2013-2016. Controlling factors in the evolution of foreland fold and thrust belts and associated basins – a case study of the North Pyrenean system. Cosupervised with R. Huismans (U. Bergen).

Paul ANGRAND 2014-2017. Evolution 3D d'un bassin d'avant pays de type retro-prisme riche en sel: le Bassin Aquitain, nord Pyrénées. Cosupervised wtih C. Carpentier (UL) and AG Bader (BRGM)

Publications 2009-2014

Hemelsdael, R. and **Ford, M.** (accepted) Relay zone evolution: A history of repeated fault propagation and linkage, central Corinth rift, Greece, Basin Research

Julio, C., Caumon, G. and **Ford, M.** (accepted) Stochastic downscaling for the modeling of segmented normal faults. Tectonophysics

Salles L., **Ford M.,** Joseph P., 2014. Characteristics of axially-sourced turbidite sedimentation on an active wedge-top basin (Annot Sandstone, SE France), Marine and Petroleum Geology, 56, 305-323.

Ford, M., Rohais, S., Williams, E.A., Bourlange, S. Jousselin, , D., Backert, N. and Malartre, F. (2013). Tectono-sedimentary evolution of the western Corinth Rift (central Greece). *Basin Research*, doi: 10.1111/j.1365-2117.2012.00550.x

Salles L., **Ford M.,** Joseph P., Le Carlier C. and Le Solleuz, A. (2011). Progressive migration of a synclinal depocentre from turbidite growth strata: the Annot syncline, SE France. *Bull. Soc. géol. France,* **182,** 199-220.

Durand-Riard P., Salles L., **Ford M.,** Caumon G., Pellerin J. (2011). Understanding the evolution of synsedimentary faults : coupling decompaction and 3D sequential restoration. *Marine Petrol. Geol.,* **28**, 1530-1539.

Backert, N., **Ford, M.** & Malartre, F. (2010). Architecture and sedimentology of the Kerinitis Gilbert-type fan delta, Corinth Rift, Greece. *Sedimentology*, **57**, 543-586

Salles, L., Ford, M. & Joseph, P. (2010). 3D progressive evolution of a syncline depocentre from growth turbidite strata: the Annot syncline, SE France. Trabajos de Geología, Universidad de Oviedo,

Funded projects (2010-2014)

- **2012-2015 :** Leader of ANR project **PYRAMID** (North PYRenees: integrated Assessment of fluid Migration history, rift Inversion, the role of surface processes and Deformation in the evolution of an orogenic retrowedge and its foreland basin) Total funding 600k. 6 partners (Total, IFPEN, BRGM, CRPG, GET Toulouse, IStep Paris 6).
- **2011-2013 : ANR projet SISCOR, 600k Euro** Aléas, dynamique **sis**mogène, et couplages sismiques/asismiques d'un systeme de faille actives dans la région ouest du Rift de **Cor**inthe, Grèce, (Leader : Pascal Bernard, IPGP). Funding for Ford 34k Euro over 3 years.
- **2010-2013** : 98k Euro Thesis scholarship (N. Meyer) over 3 years from l'institut Carnot, ICEEL, Nancy, to work on SISCOR project, Corinth Rift.

CURRICULUM VITAE
Of
George Ferentinos

TITLE AND POSITION: Emeritus Professor of Geology, University of Patras.

INSTITUTION: Dept. of Geology, University of Patras,
Patras 26110, Greece. Tel/fax ++30-2610-991701
Email: gferen@upatras.gr

EDUCATION: B.Sc. (Hons.) in Natural Science and Geography, 1967, University of Athens. Greece.
Ph.D. (Hons.) in Geology, 1972 University of Patras, Greece.
Ph.D. in Oceanography, 1977, University of Wales, Britain.

MAIN POSITIONS: NATO Research Fellow (1973-1976) dept. of Oceanography, University of Wales, Britain.
Research Fellow (1976-1978) as above
Research Fellow (1978-1981) Dept. of Geology, Dundee University, Scotland, Britain.
Assistant Professor (1982-1987), Associate Professor (1988-1993), Professor (1993-2010), Emeritus Professor, Dept. of Geology, University of Patras.

PROFESSIONAL ACTIVITIES: Chairman of the Geology Dept., University of Patras (1993-1997 and 2001- 2005).
Chairman of the inter-departmental (Biology, Geology, Chemistry, Physics and Mathematics) in environmental sciences (1997-1999 and 1999-2001)
Member of the Editorial board of the Continental shelf Research (1990-1994).
Invited Speaker to Unesco Seminars, in Greece (1978) and China (1998).
Organizer of advance study courses within the framework of Erasmus and MAST programmes of European Union.

MAIN FIELDS OF INTEREST: Offshore Geological Hazards , Coastal, shelf and slope sedimentary transport processes. Marine geotechnics. Gas-charged Sediments.

PUBLICATIONS RELATED TO THE CORINTH GULF PROJECT

1. Brooks, M. and **Ferentinos, G.** (1984): Tectonics and sedimentation in the Gulf of Corinth and Cephalonia-Zante straits, Greece. *Tectonophysics*, *101 pp.25-52*

2. Ferentinos, G., Brooks, M. and Doutsos, Th. (1985): Quaternary tectonics in the Gulf of Patras, Western Greece. *Structural Geology.*

3. Ferentinos, G., Papatheodorou, G. and Collins, M. (1988): Sediment transport processes on an active submarine fault the escarpment of an asymmetric graben: Gulf of Corinth, Greece. *Marine Geology, 88: 43-61.*

4. Papatheodorou, G. and **Ferentinos, G.** (1993): Sedimentation processes and basin filling depositional architecture in an active asymmetric graben, Strava Graben, Gulf of Corinth, Greece. *Basin Research, vol. 5, pp. 235-253.*

5. Papatheodorou, G. and **Ferentinos, G.,** (1997): Submarine and coastal sediment failure, triggered by the 1995, Ms=6.1R, Aegion earthquake, Gulf of Corinth, Greece. *Marine Geology 137:287-304.*

6. Leeder M.R., Collier R., L.H.A. Aziz, Trout M., **Ferentinos G.**, Papatheodorou G and Lyberis E. (2002): "Tectono-sedimentary processes along an active marine/lacustrine half-graben margin: Alkyonides Gulf, E. Gulf of Corinth, Greece". Basin Research, vol. 14, issue 1, pp 25-42.

7. Hasiotis T., Papatheodorou G., Bouckovalas G., Corbau C. and **Ferentinos G.** (2002): “Earthquake-induced sediment instabilities in the coastal zone of a submarine alluvial fan in the western Gulf of Corinth, Greece”. Marine Geology, vol. 186, pp. 319-335.

8. Stefatos A., Papatheodorou G., **Ferentinos G.,** Leeder M and Collier R. (2002): “Active offshore faults in the Gulf of Corinth: Their seismotectonic significance”. Basin Research, vol. 14, pp. 1-14

9. Ferentinos, G. (2006) Fan delta development and processes offshore a seasonal river in a seismically active region, NW Gulf of Corinth. Geo-Marine letters 26, p: 199-211.

10. Charalampakis, M., Lykousis, V., Sakellariou, D., Papatheodorou, G., and Ferentinos, G. 2014. The tectono-sedimentary evolution of the Lechaeon Gulf, the south-eastern branch of Corinth graben, Greece. Marine Geology, 351, pp58-71

11 G. Ferentinos, V. Lykousis, G. Papatheodorou and M. Iatrou (2014). Hellenic Shelf: Late Quaternary tectonics, Sea-level changes, sendimentation and Geo-hazards. In, Chivas, A.R & Chiocci, F.L.(Eds). Continental shelves during the last glacio-eustatic cycle: Continental shelves of the world. The Geological Society, London (in press).

Professor Robert Leslie Gawthorpe

CURRICULUM VITAE (Short Version)

Date of birth:

17th November 1960

Nationality:

British

Present academic positions:

July 2010 - Present	University of Bergen	Professor of Petroleum Geoscience
Sept 2010 - Present	University of Manchester	Visiting Professor

Academic degrees:

1979-1982	BSc	Geological Sciences (First Class Honours), University of Leeds
1982-1985	PhD:	*Sedimentation, Tectonics and Diagenesis; the Dinantian Sequence of the Bowland Basin, Northern England.* University of Leeds

Previous academic and industrial positions:

Feb 2008 - Dec 2008	Statoil Research Centre, Bergen	Visiting Professor
July 2000- July 2010	University of Manchester	Professor of Sedimentology and Tectonics
July 1998- July 2000	University of Manchester	Reader in Geology
September 1996- July 1998	University of Manchester	Senior Lecturer in Geology
September 1989- September 1996	University of Manchester	Lecturer in Geology
January 1988- August 1989	University of Durham	Elf Aquitaine Research Fellow
November 1985- December 1987	BP Exploration Company Limited	Sedimentologist

Fields of interest and research achievement:

My research focuses on the sedimentology, stratigraphy and tectonics of sedimentary basins and understanding the processes that control the dynamics of the landscape-sedimentary system. It is multi-faceted and is held in high standing in both academia and industry (oil and gas exploration and production industry). This is demonstrated by being awarded the American Association of Petroleum Geologists (AAPG) Distinguished Lecturer in 2005.

I have published over 100 peer-reviewed articles in either specialist international geoscience journals or refereed special publications, many of which are widely cited. My research is supported by the petroleum industry and research councils, with projects typically employing 3-4 PDRAs and over 5 PhD students at any one time. To date, I have successfully supervised over 35 PhD students who completed their theses within an average of three-and-a-half years.

Recent and current research highlights include:

- Leading research on sedimentation and tectonics in rift basins, in particular the role of fault growth and linkage as a control on topography, drainage basin evolution and sediment supply, and on how these factors control facies location, geometry and sequence variability.
- Novel investigation of global vs local environmental controls on the 3D variability of basin margin depositional sequences through coupled 3D numerical modelling of sediment transport and deltaic deposition.
- First linkage of early diagenetic modification (cementation and leaching) to sequence stratigraphic evolution during sea-level fall and transgression.

- Pioneering work on the importance of fault-related folding during the growth of normal faults and in controlling syn-rift sedimentation and sequence stratigraphy.
- Coupling stratigraphic and structural analysis to provide new information about the growth and interaction of fault segments associated with strain localization onto major, crustal-scale normal faults.
- Using industry 3D seismic data to investigate structural and sedimentary processes and the link between climate change, sediment supply, tectonics and the stratigraphic product.
- Developed new and adapted existing techniques from other disciplines to understanding sedimentary and structural processes and quantification of geometry and heterogeneity in reservoir analogues. For example ground penetrating radar and terrestrial lidar.

At Manchester I conceived and headed the Basin Studies and Petroleum Geoscience Group (Basin Studies), which is one of the major research group within SEAES focusing on sedimentary basin analysis, earth surface processes and petroleum geoscience. As of 2010, the Group comprised eight academic (faculty) staff, a similar number of research assistants and about 20 PhD students. The Group has attracted many high calibre scientists and postgraduate students, and has established an international reputation for high quality basin analysis research.

Since moving to Bergen in 2010 I have set up new 3D seismic interpretation laboratories and led several interdisciplinary projects integrating expertise within the Department (particularly between the Petroleum and Geodynamics research groups) to investigate a range of tectonic, sedimentary and landscape evolution topics. This activity is supported by the both the Research Council of Norway and the oil and gas industry.

Most of my postgraduates and postdoctoral researchers have gone on to further their careers in either industry or academia; several are now recognised as leading geoscientists in their field. Several have won prizes, including Best Paper at the EAGE Annual Meeting, AAPG/SEPM best student oral or poster presentations (and several runners up), Midland Valley Structural Geology Prize and Young Explorer of the Year award from the Petroleum Group of the Geological Society of London.

Membership of academic and professional committees:

Academic awards

2005, American Association of Petroleum Geologists Distinguished Lecturer.

1993, Lyell Fund: awarded by the Geological Society, Britain's national learned society for geology, for my 'leading expertise in the dynamics of sedimentary systems'. The Lyell Fund is awarded to 'contributors to the earth sciences on the basis of noteworthy published research'.

1992, Partnership Awards: commendation for my third year undergraduate course in Sequence Stratigraphy.

1987, Fearnsides Prize: awarded by the Yorkshire Geological Society in respect of leading research into the geological evolution of northern England.

1985, Dunnington Memorial Prize: awarded for the best undergraduate dissertation, University of Leeds.

Society membership

- Fellow of the Geological Society
- Active Member of the American Association of Petroleum Geologists
- Member of the International Association of Sedimentologists
- Member of the Society for Sedimentary Geology (SEPM)
- Member of the Geological Society of America
- Member or the American Geophysical Union

Professional advisory work

- Member of Natural Environment Research Council Oil and Gas Doctoral College assessment panel, 2013
- Member or Society for Sedimentary Geology (SEPM) Pettijohn Medal Committee, 2010 -2013
- Research Assessment Exercise 2008, Specialist Advisor UoA 17, 2008
- Member of Natural Environment Research Council Peer Review College, 2006-2010
- Research Council of Norway, PETROMAKS peer review committee, 2006-2009
- American Association of Petroleum Geologists, Distinguished Lecturer Committee, 2006-2009
- Society of Sedimentary Geology (SEPM) Outstanding Paper Committee, 2006-2008
- Member of NERC Earth Sciences Peer Review Committee, 1999-2001

Timothy John Henstock: Short curriculum vitae

Contact details:

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University of Southampton
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Southampton SO14 3ZH UK

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Positions held:

2013- Reader in Geophysics, University of Southampton
2004-2013 Senior Lecturer in Geophysics, University of Southampton
1999-2004 Lecturer in Geophysics, University of Southampton
1998-1999 Lecturer, Rice University, Houston, Texas
1994-1999 Post-doctoral research associate, Rice University, Houston, Texas
1993-1994 NERC Post-doctoral fellow, Oxford University

Degrees:

1990-1993 PhD Geophysics, Cambridge. Thesis "The structure of oceanic crust" advised by Prof RS White.
1987-1990 BA (Hons, First class) Natural Sciences, Physics and Theoretical Physics, University of Cambridge. Project “A molecular dynamics study of CO on a Pt surface” supervised by Dr W. Allison

Awards and distinctions:

1994 Blackwell-Royal Astronomical Society prize for best geophysics PhD thesis, 1993-1994.
1997 Editor’s citation for excellence in refereeing, JGR Solid Earth
2000 Editor’s citation for excellence in refereeing, JGR Solid Earth
2005 Scientist in HMS Scott expedition to survey rupture zone of December 26, 2004, earthquake. Subsequently expert witness at inquest for UK victims of the tsunami
2007 Geological Society of London Lyell Fund
2009 Honorable mention in category “Best paper in Geophysics” for Pinson et al., 2008

Main areas of scientific interest:

Active tectonics.
Seismic methods for imaging the lithosphere, from 1000km to 0.1m scales.
Quantitative interpretation of seismic data.
Geodynamic modelling of active tectonic processes.

Scientific community service:

UK correspondent, Interridge steering committee 2004-2011
Chair, NERC Ocean-Bottom Instrument Facility 2011-present
Member of review committee for Irish shiptime 2008-2011

Relevant research experience:

Participant on 11 research cruises, including two as principal scientist.
Manager for 2 large land seismic experiments, with up to 100 people in the field.
Scientific adviser to UK Royal Navy for HMS Scott survey offshore Sumatra, Jan-Feb 2005.
Scientific expert witness at inquest for UK victims of the 2004 tsunami, December 2005.
Lead PI on NERC consortium grant “Subduction zone segmentation and controls on earthquake rupture: The 2004 and 2005 Sumatra earthquakes” (Henstock, McNeill et al., 2006-2013)

Teaching-related administration:
Programme Leader for Geophysics 2008-2011, 2013-present
Admissions Tutor for Geophysics 2006, 2008-2011
Graduate School of NOCS Committee, responsible for IT 1999-2005
Employability Officer for Geology and Geophysics 2012-2013

PhD Supervision:
Martin Gutowski (2000-2004), Christos Evangelides (1999-2003), John Armitage (2004-2008), Rebecca Bell (2004-2008), Mark Vardy (2005-2009), Luke Pinson (2005-2009), Michele Paulatto (2007-2010), Michelle Harris (2006-2011), David Limmer (2008-2012), Gemma Smith (2009-2013), Becky Cook (2010-2014), Tim Hughes (2012-date), Tom Hall (2012-date), John Emeana (2012-date), Guiseppe Provenzano (2014-date), Barbara Zihlmann (2014-date)

Publications:
I have 69 publications (Web of Knowledge, September 2014) with 1112 citations and an h-index of 19. Some examples relevant to this proposal include:

P.D. Clift, L. Ghiosan, **T.J. Henstock**, A.R. Tabrez, Sediment storage and reworking on the shelf and in the Canyon of the Indus River-Fan system since the last glacial maximum, Basin Research, 26, 183-202, 2014. (doi: 10.1111/bre.12041)
S.P.S. Gulick, J.A. Austin, Jr., L.C. McNeill, N.L.B. Bangs, K.M. Martin, **T.J. Henstock**, J.M. Bull, S. Dean, Y.S. Djajadihardja, and H. Permana , Updip rupture of the 2004 Sumatra earthquake extended by thick indurated sediments, Nature *Geoscience*, doi:10.1038/ngeo1176, 2011.
S.M. Dean, L.C. McNeill, **T. J. Henstock**, J.M. Bull, S.P.S. Gulick, J.A. Austin, Jr., N.L.B. Bangs, Y.S. Djajadihardja, and H. Permana, Contrasting decollement and prism properties over the Sumatra 2004/5 earthquake rupture boundary, *Science*, Science, 329, 207-210, 2010.
M.E. Vardy, L.J.W. Pinson, J.M. Bull, J.K. Dix, **T.J. Henstock**, J.W. Davis, and M. Gutowski, 3D seismic imaging of buried Younger Dryas mass movement flows: Lake Windermere, UK, Geomorphology, 118, 176-187, 2010.
J.J Armitage, **T.J. Henstock**, T.A. Minshull, and J.R. Hopper, Lithospheric controls on melt production during continental breakup at slow rates of extension: Application to the North Atlantic, *Geochem. Geophys. Geosyst*., Vol. 10, Q06018, doi:10.1029/2009GC002404, 2009.
R. Bell, L.C. McNeill, J.M. Bull and **T.J. Henstock**, Evolution of the offshore western Gulf of Corinth, Geol. Soc. Am. Bull., 120, 156-178, 2008.
L.C. McNeill, C.J. Cotterill, J.M. Bull, **T.J. Henstock**, R. Bell and A. Stefatos, Geometry and slip rate of the Aigion fault, a young normal fault system in the western Gulf of Corinth, *Geology,* 35, 355-358, 2007.
T.J. Henstock, L.C. McNeill and D.R. Tappin, Seafloor morphology of the Sumatra subduction zone: Seafloor rupture during megathrust earthquakes? *Geology*, 34, 485-488, 2006.
A. Levander, **T. J. Henstock**, A. S. Meltzer, B. C. Beaudoin, A. M. Trehu, and S. L. Klemperer, Fluids in the lower crust following Mendocino Triple Junction migration: Active basaltic intrusion? *Geology*, 26, 171-174, 1998.
T. J. Henstock, A. Levander, and J. A. Hole, Lower crustal deformation in the San Andreas Fault system, northern California, *Science*, 278, 650-653, 1997.
R. S. White, J. H. McBride, **T. J. Henstock** and R. W Hobbs, Internal structure of Mesozoic oceanic crust, Geology, 22, 597-600, 1994.
T. J. Henstock, A. W. Woods, and R. S. White, The accretion of oceanic crust by episodic sill intrusion, *J. Geophys. Res*., 98, 4143-4161, 1993.

Dr Casey William Nixon
Curriculum Vitae

Date of birth: 25/04/1988 | Telephone: 07792157861
Citizenship: Great Britain | E-mail: C.W.Nixon@noc.soton.ac.uk

1. Research Interests

I am interested in the brittle deformation of the Earth's crust with a particular interest in fault networks and active tectonics. Current research themes include: Evolution and development of basins within rift systems; Growth and development of fault networks; Topological characterisation of fracture and fault networks; Seismogenic hazard assessment; Application and use of GIS and Geophysical datasets (both onshore and offshore) as a tool for structural geology and tectonics.

2. Current Research, Employment and Education

March 2014 – Present: Teaching and Research Fellow (University of Southampton)

January 2013 – March 2014: Postdoctoral Research Fellow (University of Southampton)
Title: Corinth Virtual Site Survey: Integrating Geophysical Data for Syn-rift Stratigraphy, Fault and Basin Evolution and Advancing IODP Proposed Drilling
Supervisors: Dr Lisa McNeill, Dr Timothy Henstock, Professor Jonathan Bull
Funding: NERC

2009 – 2013: PhD (University of Southampton)
Title: Analysis of fault networks and conjugate systems
Supervisors: Professor Jonathan Bull, Professor Dave Sanderson
Funding: NERC-funded case studentship with BP

2006 – 2009: University of Edinburgh
BSc Honours Degree in Geology **1st**

2004 – 2006: Moray College, Elgin, Morayshire
4 Higher qualifications: 3 A's, 1 B

4. Awards and Achievements

-Committee member of the Tectonic Studies Group (Post Graduate Representative 2011-2013)
-*Winner of the Outstanding Student Paper Award for a presentation in the Hydrology Section at the 2011 American Geophysical Union Fall Meeting
-*Winner of the Shell Award for best post-graduate presentation at the 2011 Tectonic Studies Group Annual Meeting
-*Winner of the Mike Coward Prize for best post-graduate talk at the 2011 Tectonic Studies Group Annual Meeting
-President of the Southampton Waterfront Campus AAPG Student Chapter (2009-2011)
-Awarded a NERC funded PhD with a CASE Studentship at the University of Southampton (2009)
-Awarded funding for a small research proposal from the University of Edinburgh Laidlaw-Hall Trust (2009)
-Committee member for the Edinburgh University Geology Society (Field Trip Convener 2008-2009)
-Total Oil Marine Prize for outstanding performance in structural and soft rock disciplines, University of Edinburgh (2008)
-Class Medal Award for Mineralogy and Petrology, University of Edinburgh (2007)

5. Publications

Peer Reviewed –

Nixon, C.W., Sanderson, D.J., Bull, J.M., 2014. Localized vs distributed deformation associated with an active normal fault, Whakatane, New Zealand. *Journal of Structural Geology*. Doi:10.1016/j.jsg.2014.06.005.

Nixon, C.W., Sanderson, D.J., Dee, S., Bull, J.M., Humphreys, R., Swanson, M., 2014. Fault interactions and reactivation within a normal fault network at Milne Point, Alaska. *AAPG Bulletin*

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Nixon, C.W., Sanderson, D.J., Bull, J.M. 2012. Analysis of a strike-slip fault network using high resolution multibeam bathymetry, offshore NW Devon U.K.. *Tectonophysics,* **541-543**, 69-80. Doi:10.1016/j.jsg.2011.03.009

Nixon, C.W., Sanderson, D.J., Bull, J.M. 2011. Deformation within a strike-slip fault network at Westward Ho!, Devon U.K.: Domino vs conjugate faulting. *Journal of Structural Geology*, **33**, 833-843. Doi:10.1016/j.tecto.2012.03.021

McNeill, L.C., Sakellariou, D., **Nixon, C.W.,** 2014. Drilling to resolve the evolution of the Corinth Rift. *Eos Transactions*. **29**, 170. Doi: 10.1002/2014EO200009.

Sanderson, D.J., **Nixon, C.W.**, The use of topology in fracture network characterization. *Journal of Structural Geology* (In Review).

Ayele, A., Ebinger, C.J., van Alstyne, C., Keir, D., **Nixon, C.W.**, Belachew, M., Hammond, J.O.S, Seismicity and the Tendaho Dam safety, Afar (Ethiopia): risk implications for downstream population. *Geol. Soc. London. Spec. Publ.* (In Revision).

In Preparation –

Nixon, C.W., McNeill, L.C., Henstock, T., Bull, J.M., Bell, R., Christodoulou, D., Papatheodorou, G., Taylor, B., Ferentinos, G., Sakellariou, D., Lykousis, V., Sachpazi, M., Ford, M., Goodliffe, A., Leeder, M., Gawthorpe, R., Collier, R., Clements, B., History of high resolution basin development within the offshore Corinth rift, central Greece. *(In Final Prep for Geophysical Journal International).*

Nixon, C.W., Sanderson, D.J., Putz-Perrier, M.W., Bull, J.M., The contribution of small- and large-scale faults to extension in the Earth's upper crust. *(In Final Prep for Nature Geoscience).*

Nixon, C.W., Sanderson, D.J., Bull, J.M., Topological analysis of 2-D fault networks: assessing connectivity and clustering. *(In Final Prep for Tectonophysics).*

Hall, T., **Nixon, C.W.**, Keir, D., Ayele, A., Burton, P., Earthquake clustering and seismic hazard of the African-Arabian rift system. (*In Final Prep for Geophysical Research Letters).*

6. Invited Talks

February 2014: Invited to give a talk at Imperial College London.
Talk Abstract – 'Localization of deformation within rifts – from rift architecture to fault networks'.

February 2013: Invited to give a talk for the Structural Geology COP talk series at BP Exploration, Sunbury.
Talk Abstract – 'Characterising the deformation within fault networks'.

Dr Dimitris Sakellariou

Dr. Dimitris Sakellariou is Structural/Marine Geologist and Research Director at the Institute of Oceanography of the Hellenic Centre for Marine Research, Greece. He assumed his duties in January 1995 as researcher.

He holds a bachelor's degree in Geology from the Department of Geology of the Kapodistrian University of Athens, Greece. He obtained postgraduate courses on tectonics and sedimentology at the Ruhr University Bochum in Germany in 1984-1985. He completed his doctoral thesis in 1989 in the Institute of Geology of Johannes-Gutenberg University of Mainz, Germany.

Dr Sakellariou was appointed Head of the Department of Geology-Geophysics of the Institute of Oceanography for the period 2004-2009. Between 2009 and 2013 he held the position of the Scientific Coordinator of the Underwater Activities Department (Underwater Vehicles) of HCMR. His duties were to manage and coordinate the use and maintenance of the manned submersible Thetis, four remotely operating underwater vehicles (ROVs) and the scientific diving team of HCMR.

Dr Sakellariou has coordinated or has participated to more than 40 national, international and European research projects and his total publication record exceeds 150 papers in peer-reviewed journals, congress proceedings, contributions and invited lectures in congresses.

Research Interests

Dr Sakellariou's research interests fall in the field of Structural / Marine Geology with particular focus on Neotectonics, Active faulting, Evolution and Sequence Stratigraphy of Sedimentary basins, Tectonics – Sedimentation – Sea level changes relationship, Holocene Geology, Submarine landslides & Slope stability, Submarine volcanism, Cold seeps and Mud volcanoes.

Dr Sakellariou is active in Marine Geoarchaeological research, particularly in the search, survey and mapping of submerged archaeological remains in shallow and deep waters and the reconstruction of submerged prehistoric landscapes. He is Vice-Chair of COST Action TD0902 SPLASHCOS ανδ since 2008 he coordinates DEUKALION Planning Group (along with Dr N. Flemming), a European scale initiative to promote research on the submerged prehistoric landscapes and archaeology of the European continental self.

Selected Publications

Guest Editor

Lykousis, V., Sakellariou, D. & Locat J., (Editors), Advances in Natural and Technological Hazards Research, Vol. 27: Submarine Mass Movements and Their Consequences, Springer 2007, 424 pages, 1dvd-rom. ISBN: 978-1-4020-6511-8

F. Briand, D. Sakellariou & J. Mascle (Editors), Fluid seepages / mud volcanism in the Mediterranean and adjacent domains. CIESM Workshop Monographs No 29, 2006

Selected papers on Geology, Marine Geology, Active Tectonics

Lykousis, V., Sakellariou, D., Moretti, I. & Kaberi, H., 2007. Late Quaternary basin evolution of the Gulf of Corinth: Sequence stratigrapgy, sedimentation, fault-slip and subsidence rates. *Tectonophysics*, 440, p. 29-51.

Sakellariou, D., Lykousis, V., Alexandri, S., Kaberi, H., Rousakis, G., Nomikou, P., Georgiou, P., Ballas, D., 2007. Faulting, seismic-stratigraphic architecture and Late Quaternary evolution of the Gulf of Alkyonides basin – East Gulf of Corinth, Central Greece. Basin Research, 19/2, p. 273-295.

Sakellariou D., Rousakis G., Kaberi H., Kapsimalis V., Georgiou P., Kanellopoulos Th. & Lykousis V. (2007). Tectono-sedimentary structure and late quaternary evolution of the north Evia gulf basin, Central Greece: preliminary results. Bulletin of the Geological Society of Greece vol. XXXVII/1, p. 451-462.

T.M. Alves, V. Lykousis, D. Sakellariou, S. Alexandri & P. Nomikou (2007). Constraining the origin and evolution of confined turbidite systems: southern Cretan margin, Eastern Mediterranean Sea (34°30-36°N). GeoMarine Letters, 27, p. 41-61

V. Lykousis, D. Sakellariou, G. Rousakis, S. Alexandri, H. Kaberi, P. Nomikou, P. Georgiou, D. Balas (2007). Sediment failure processes in active grabens: the Western Gulf of Corinth (Greece). In:

Lykousis V., Sakellariou D., Locat J. (eds.), Submarine Mass Movements and their Consequences, 297-305, Springer.

Elias P., Kontoes C.C., Papoutsis I., Kotsis. I. and D. Sakellariou (2007), "Permanent Scatterer InSAR analysis and validation in the Gulf of Corinth". *Sensors* 2009, *9*, 46-55; doi:10.3390/s90100046

V. Lykousis, G. Roussakis and D. Sakellariou (2008): Offshore slope stability analysis of prograding sediment sequences at active margins, W. Greece, NE Mediterranean. International Journal of Earth Sciences, DOI 10.1007/s00531-008-0329-9

Voett, A., Brueckner, H., May, S.M., Sakellariou, D., Nelle, O., Lang, F., Kapsimalis, V., jahns, S., Herd, R., Handl, M. & Fountoulis, I., 2009. The Lake Voulkaria (Akarnania, NW Greece) palaeoenvironmental archive – a sediment trap for multiple tsunami impact since the mid-Holocene. Z. Geomorph. N.F. 53/1, 1-37, Berlin-Stuttgart.

Sakellariou D., Sigurdsson H., Alexandri M., Carey S., Rousakis G., Nomikou P., Georgiou P. & Ballas D. (2010): Active tectonics in the Hellenic Volcanic Arc: the Kolumbo submarine volcanic zone. Bulletin of the Geological Society of Greece, XLIII, No 2, 1056-1063

Sakellariou D., Fountoulis I., and Lykousis V. (2010): Evidence of cold seeping in Plio-Pleistocene sediments of SE Peloponese: the fossil carbonate chimneys of Neapolis region. Bulletin of the Geological Society of Greece, XLIII, No 2, 1046-1055

Sakellariou, D., Rousakis, G., Nomikou, P., Croff Bell, K., Carey, S., Sigurdsson, H., (2012). Tsunami triggering mechanisms associated with the 17th cent. BC Minoan eruption of Thera volcano, Greece. Proc. 22nd International Offshore and Polar Engineering Conference, Rhodes, Greece, June 17-22, 2012

Sakellariou D., Mascle, J., and Lykousis, V., 2013. Strike slip tectonics and transtensional deformation in the Aegean Region and the Hellenic Arc: preliminary results. Bul. Geol. Soc. Greece, vol. XLVII, 2013

Charalampakis, M., Lykousis, V., Sakellariou, D., Papatheodorou, G., Ferentinos, G., 2014. The tectono-sedimentary evolution of the Lechaion Gulf, the south eastern branch of the Corinth Graben, Greece. Marine Geology, 351 (2014) 58–75

Papadopoulos, G., Gràcia, E., Urgeles, R., Sallares, V., De Martini, P.M., Pantosti, D., González, M., Yalciner, A., Mascle, J., Sakellariou, D., Salamon, A., Tinti, S., Fokaefs, A., Camerlenghi, A., Novikova, T., Papageorgiou, A., 2014. Historical and pre-historical tsunamis in the Mediterranean and its connected seas: Geological signatures, generation mechanisms and coastal impacts. Marine Geology, 354 (2014) 81–109

Selected papers on Marine Geoarchaeology

Sakellariou, D. (2007). Integration of sub-bottom profiling and side scan sonar data in deep water archaeological research: site formation and interpretation of geophysical recordings. SKYLLIS, 8. Jahrgang 2007/08 / H.1-2, p. 155-164

Kapsimalis, V., Pavlopoulos, K., Panagiotopoulos, I., Drakopoulou, P., Vandarakis, D., Sakellariou, D., Anagnostou C., 2009. Geoarchaeological challenges in the Cyclades continental shelf (Aegean Sea). Z. Geomorph. N.F. 53/1, 169-190, Berlin-Stuttgart

Bingham, B., Foley, B., Singh, H., Camilli, R., Delaporta, K., Eustice, R., Mallios, A., Mindell, D., Roman, C., Sakellariou, D., 2010. Robotic Tools for Deep Water Archaeology: Surveying an Ancient Shipwreck with an Autonomous Underwater Vehicle Journal of Field Robotics, 1–16, DOI: 10.1002/rob.20350, 2010 Wiley Periodicals, Inc.

Flemming, N., Bailey, G.N., Sakellariou, D., 2012. Migration: Value of submerged early human sites (Letter). NATURE, Vol. 486, Issue 7401, 7 June 2012, Page 34

Flemming, N.C., Hağatay, M.N., Chiocci, F.L., Galanidou, N., Jφns, H., Lericolais, G., Missiaen, T., Moore, F., Rosentau, A., Sakellariou, D., Skar, B., Stevenson, A., Weerts, H. (2014) Land Beneath the Waves: Submerged landscapes and sea level change. A joint geoscience-humanities strategy for European Continental Shelf Prehistoric Research. Chu, N.C. and McDonough, N. (Eds.) Position Paper 21 of the European Marine Board, Ostend, Belgium. 171 pp. ISBN 978-94-920430-3-0

IODP Site Summary Forms:

Form 1 – General Site Information

879 - Full

Section A: Proposal Information

Title of Proposal:	Drilling the Corinth Rift: Resolving the detail of active rift development
Date Form Submitted:	
Site Specific Objectives with Priority (Must include general objectives in proposal)	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.
List Previous Drilling in Area:	

Section B: General Site Information

Site Name:	COR-04	Area or Location:	Alkyonides Gulf, Central Greece
If site is a reoccupation of an old DSDP/ODP Site, Please include former Site#			
Latitude:	Deg: 38.119675	Jurisdiction:	Greece
Longitude:	Deg: 23.089213	Distance to Land: (km)	6.5
Coordinate System:	WGS 84		
Priority of Site:	Primary: no Alt:	Water Depth (m):	365

Section C: Operational Information

	Sediments	Basement
Proposed Penetration (m):	480	0
	Total Sediment Thickness (m) 480	
		Total Penetration (m): 480
General Lithologies:	Hemipelagic, gravity flow and fluvial muds, silts, sands, possible gravels at depth	Triassic-Paleogene carbonate or ophiolite expected

Coring Plan: (Specify or check)

APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.

APC [x] XCB [ ] MDCB [ ] PCS [ ] RCB [x] Re-entry [ ]

Wireline Logging Plan:

Standard Measurements		Special Tools			
WL	[x]	Magnetic Susceptibility	[x]		
LWD	[ ]	Magnetic Field	[ ]	Formation Image (Acoustic)	[ ]
Porosity	[x]	Borehole Temperature	[ ]	Formation Fluid Sampling	[ ]
Density	[ ]	Nuclear Magnetic Resonance	[ ]	Formation Temperature & Pressure	[ ]
Gamma Ray	[x]	Geochemical	[ ]	VSP	[ ]
Resistivity	[x]	Side-Wall Core Sampling	[ ]	Others:	
Sonic (Δt)	[x]				
Formation Image (Res)	[ ]				
Check-shot (upon request)	[ ]				

Max. Borehole Temp.: °C

Mud Logging: (Riser Holes Only)

Cuttings Sampling Intervals

from m to m m intervals

from m to m m intervals

Basic Sampling Intervals: 5m

Estimated Days: Drilling/Coring: 13.7 Logging: 2 Total On-site:

Observatory Plan: *Longterm Borehole Observation Plan/Re-entry Plan*

Potential Hazards/ Weather:

Shallow Gas	[ ]	Complicated Seabed Condition	[ ]	Hydrothermal Activity	[ ]
Hydrocarbon	[ ]	Soft Seabed	[ ]	Landslide and Turbidity Current	[ ]
Shallow Water Flow	[ ]	Currents	[ ]	Gas Hydrate	[ ]
Abnormal Pressure	[ ]	Fracture Zone	[ ]	Diapir and Mud Volcano	[ ]
Man-made Objects (e.g., sea-floor cables, dump sites)	[ ]	Fault	[ ]	High Temperature	[ ]
H_2S	[ ]	High Dip Angle	[ ]	Ice Conditions	[ ]
CO_2	[ ]	Sensitive marine habitat (e.g., reefs, vents)			
Other:					

Preferred weather window: Relatively sheltered basin, therefore flexible

IODP Site Summary Forms:

Form 2 - Site Survey Detail

Proposal #:	879	Site #:	COR-04	Date Form Submitted:	

*** Key to SSP Requirements**

X=required; X=may be required for specific sites; Y=recommended; Y*=may be recommended for specific sites; R=required for re-entry sites; T=required for high temperature environments; † Accurate velocity information is required for holes deeper than 400m.*

Data Type	In SSDB	SSP Req.	Details of available data and data that are still to be collected
1a High resolution seismic reflection (primary)			Location:
1b High resolution seismic reflection (crossing)			Location:
2a Deep penetration seismic reflection (primary)	yes		Ewing MCS line L22 Location: CDP 1558
2b Deep penetration seismic reflection (crossing)	yes		HCMR line L120-119 Location: CDP 1549
3 Seismic Velocity	yes		Details of seismic velocity data available and velocity-depth profile applied here
4 Seismic Grid			
5a Refraction (surface)			
5b Refraction (bottom)			
6 3.5 kHz	yes		Shipboard 3.5kHz from Ewing profile
7 Swath bathymetry	yes		HCMR Seabeam 2120 data for site
8a Side looking sonar (surface)			
8b Side looking sonar (bottom)			
9 Photography or video			
10 Heat Flow			
11a Magnetics			
11b Gravity	yes		Shipboard gravity from Ewing profile
12 Sediment cores	yes		Details of piston cores in the gulf adjacent to proposed sites
13 Rock sampling			
14a Water current data			
14b Ice Conditions			
15 OBS microseismicity			
16 Navigation	yes		Navigation for primary and crossing seismic profile
17 Other			

IODP Site Summary Forms:

Form 3 – Detailed Logging and Downhole Measurement Plan

Proposal #:	879	Site #:	COR-04	Date Form Submitted:	
Water Depth (m):	365	Sed. Penetration (m):	480	Basement Penetration (m):	0

Are high temperatures or other special requirements (e.g., unstable formations), anticipated for logging at this site?

Estimated total logging time for this site: 2

Measurement Type	Scientific Objective	Relevance (1=high, 3=low)
Check Shot Survey		0
Nuclear Magnetic Resonance		0
Geochemical		0
Side-wall Core Sample		0
Formation Fluid Sampling		0
Borehole Temperature		0
Magnetic Susceptibility	Building chronostratigraphy through core-log integration	1
Magnetic Field		0
VSP		0
Formation Image (Acoustic)		0
Formation Pressure & Temperature		0
Other (SET, SETP, ...)		0

IODP Site Summary Forms:

Form 4 – Environmental Protection

Proposal #:	879	Site #:	COR-04	Date Form Submitted:	

Pollution & Safety Hazard	Comment
1. Summary of Operations at site.	APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.
2. All hydrocarbon occurrences based on previous DSDP/ODP/IODP drilling.	None
3. All commercial drilling in this area that produced or yielded significant hydrocarbon shows.	None
4. Indications of gas hydrates at this location.	No
5. Are there reasons to expect hydrocarbon accumulations at this site?	No, insufficient burial, no known source formation within expected lithologies (based on onshore exposures and shallow cored sections)
6. What "special" precautions will be taken during drilling?	No special procedures required
7. What abandonment procedures need to be followed?	No special procedures required
8. Natural or manmade hazards which may effect ship's operations.	None that we are aware of
9. Summary: What do you consider the major risks in drilling at this site?	No major risks

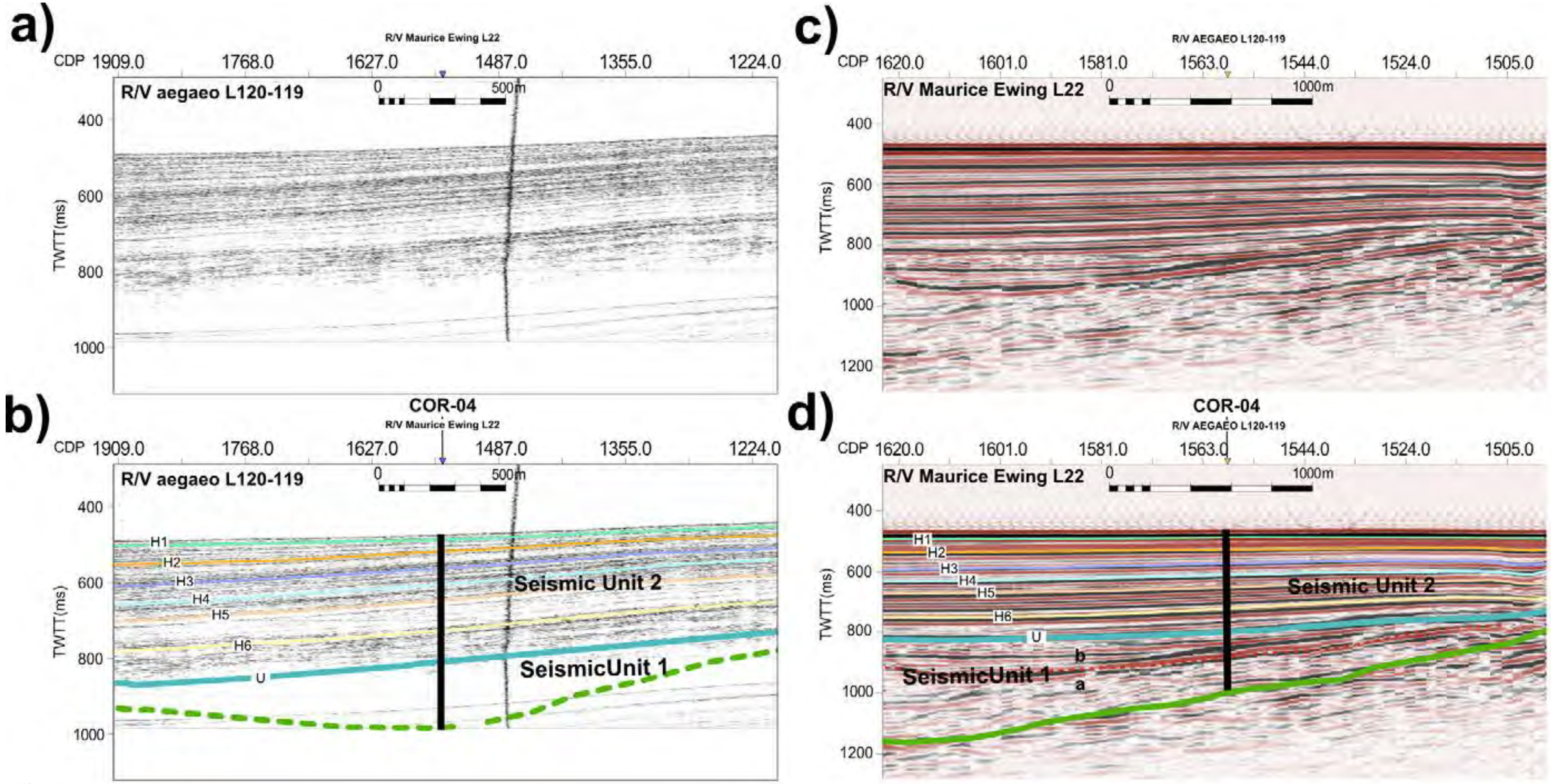
Proposal #:	879 - Full	Site #:	COR-04	Date Form Subm.:	2014-09-04 15:33:22

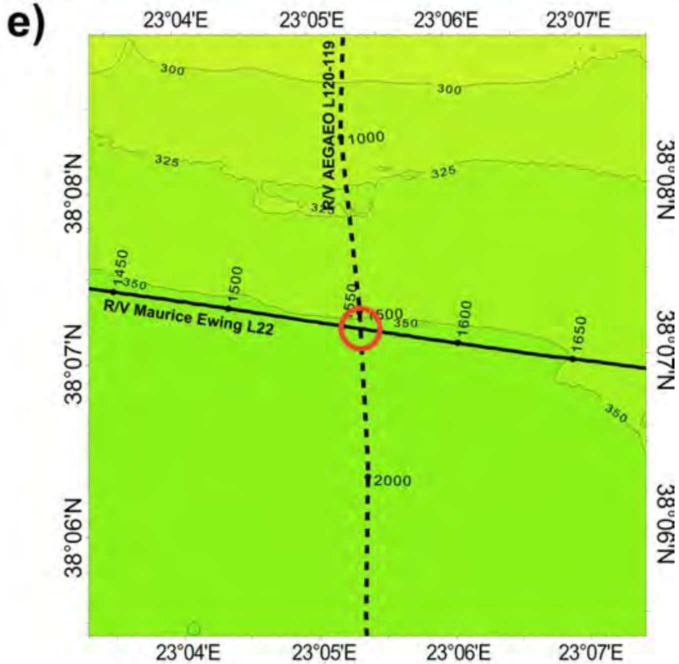
Subbottom depth (m)	Key reflectors, Unconformities, faults, etc	Age	Assumed velocity (km/sec)	Lithology	Paleo-environment	Avg. rate of sed. accum. (m/My)	Comments
0-320	Seismic Unit 2 syn-rift interbedded hemipelagic and gravity flow basin deposits	0 - ~0.6	2.1	interbeded hemipelagite-gravity flow muds, silts, thin sands	marine-lacustrine silled basin	1000	
320-480	Unconformity then Seismic Unit 1 syn-rift lacustrine, possible fluival-deltaic basinal deposits	~0.6 - 1.5	2.3	muds, silts, sands, ?gravel of likely lacustrine and fluvial origin	lacustrine basin, distal fluvial-deltaic system	unknown	

Proposal #:	879 - Full	Site #:	COR-04	Date Form Subm.:	2014-09-04 15:33:22

Site Summary Figure Comment	

COR-04





COR-04

Aegaeo L120-119, CDP 1549 (a and b)
Ewing L22, CDP 1558 (c and d)

Files to be uploaded to SSDB:

Location map: COR-04_location.pdf
Seismic figures: COR-04_L22_interp.pdf;
COR-04_L22.pdf; COR-04_L120-119_interp.pdf;
COR-04_L120-119.pdf
SEGY data: COR04_L22.sgy; COR-04_L120-119.sgy
Navigation: COR-04_L22_nav.txt;
COR-04_L120-119_nav.txt
Bathymetry: COR-04_bathy.grd
Velocity: Corinth_velocity_information.pdf
Gravity: L22_grav.txt; L120-119_grav.txt
Piston cores: Corinth_piston_cores.pdf

IODP Site Summary Forms:

Form 1 – General Site Information

879 - Full

Section A: Proposal Information

Title of Proposal:	Drilling the Corinth Rift: Resolving the detail of active rift development
Date Form Submitted:	
Site Specific Objectives with Priority (Must include general objectives in proposal)	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.
List Previous Drilling in Area:	

Section B: General Site Information

Site Name:	COR-03	Area or Location:	Alkyonides Gulf, Central Greece
If site is a reoccupation of an old DSDP/ODP Site, Please include former Site#			
Latitude:	Deg: 38.117098	Jurisdiction:	Greece
Longitude:	Deg: 23.108333	Distance to Land: (km)	6
Coordinate System:	WGS 84		
Priority of Site:	Primary: yes Alt:	Water Depth (m):	347

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Section C: Operational Information

	Sediments	Basement
Proposed Penetration (m):	740	0
	Total Sediment Thickness (m) 740	
	Total Penetration (m):	740
General Lithologies:	Hemipelagic, gravity flow and fluvial muds, silts, sands, possible gravels at depth	Triassic-Paleogene carbonate, ophiolite or flysch expected

Coring Plan: (Specify or check)

APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.

APC ☒ XCB ☐ MDCB ☐ PCS ☐ RCB ☒ Re-entry ☐

Wireline Logging Plan:

Standard Measurements		Special Tools			
WL	☒	Magnetic Susceptibility	☒		
LWD	☐	Magnetic Field	☐	Formation Image (Acoustic)	☐
Porosity	☒	Borehole Temperature	☐	Formation Fluid Sampling	☐
Density	☐	Nuclear Magnetic Resonance	☐	Formation Temperature & Pressure	☐
Gamma Ray	☒	Geochemical	☐	VSP	☐
Resistivity	☒	Side-Wall Core Sampling	☐	Others:	
Sonic (Δt)	☒				
Formation Image (Res)	☐				
Check-shot (upon request)	☐				

Max. Borehole Temp.: °C

Mud Logging: (Riser Holes Only)

Cuttings Sampling Intervals

from m to m m intervals

from m to m m intervals

Basic Sampling Intervals: 5m

Estimated Days:	Drilling/Coring: 20.2	Logging: 3	Total On-site:

Observatory Plan: *Longterm Borehole Observation Plan/Re-entry Plan*

Potential Hazards/ Weather:

Shallow Gas	☐	Complicated Seabed Condition	☐	Hydrothermal Activity	☐
Hydrocarbon	☐	Soft Seabed	☐	Landslide and Turbidity Current	☐
Shallow Water Flow	☐	Currents	☐	Gas Hydrate	☐
Abnormal Pressure	☐	Fracture Zone	☐	Diapir and Mud Volcano	☐
Man-made Objects (e.g., sea-floor cables, dump sites)	☐	Fault	☐	High Temperature	☐
H_2S	☐	High Dip Angle	☐	Ice Conditions	☐
CO_2	☐	Sensitive marine habitat (e.g., reefs, vents)			
Other:					

Preferred weather window: Relatively sheltered basin, therefore flexible

IODP Site Summary Forms:

Form 2 - Site Survey Detail

Proposal #: 879	Site #: COR-03	Date Form Submitted:

*** Key to SSP Requirements**

X=required; X=may be required for specific sites; Y=recommended; Y*=may be recommended for specific sites; R=required for re-entry sites; T=required for high temperature environments; † Accurate velocity information is required for holes deeper than 400m.*

Data Type	In SSDB	SSP Req.	Details of available data and data that are still to be collected
1a High resolution seismic reflection (primary)			Location:
1b High resolution seismic reflection (crossing)			Location:
2a Deep penetration seismic reflection (primary)	yes		Ewing MCS line L22 Location: CDP 1626
2b Deep penetration seismic reflection (crossing)	yes		HCMR line 122-121 Location: CDP 1354
3 Seismic Velocity	yes		Details of seismic velocity data available and velocity-depth profile applied here
4 Seismic Grid			
5a Refraction (surface)			
5b Refraction (bottom)			
6 3.5 kHz	yes		Shipboard 3.5kHz from Ewing profile
7 Swath bathymetry	yes		HCMR Seabeam 2120 data for site
8a Side looking sonar (surface)			
8b Side looking sonar (bottom)			
9 Photography or video			
10 Heat Flow			
11a Magnetics			
11b Gravity	yes		Shipboard gravity from Ewing profile
12 Sediment cores	yes		Details of piston cores in the gulf adjacent to proposed sites
13 Rock sampling			
14a Water current data			
14b Ice Conditions			
15 OBS microseismicity			
16 Navigation	yes		Navigation for primary and crossing seismic profile
17 Other			

IODP Site Summary Forms:

Form 3 – Detailed Logging and Downhole Measurement Plan

Proposal #:	879	Site #:	COR-03	Date Form Submitted:	
Water Depth (m):	347	Sed. Penetration (m):	740	Basement Penetration (m):	0

Are high temperatures or other special requirements (e.g., unstable formations), anticipated for logging at this site?

Estimated total logging time for this site: 3

Measurement Type	Scientific Objective	Relevance (1=high, 3=low)
Check Shot Survey		0
Nuclear Magnetic Resonance		0
Geochemical		0
Side-wall Core Sample		0
Formation Fluid Sampling		0
Borehole Temperature		0
Magnetic Susceptibility	Building chronostratigraphy through core-log integration	1
Magnetic Field		0
VSP		0
Formation Image (Acoustic)		0
Formation Pressure & Temperature		0
Other (SET, SETP, ...)		0

Proposal #: 879	Site #: COR-03	Date Form Submitted:

Pollution & Safety Hazard	Comment
1. Summary of Operations at site.	APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.
2. All hydrocarbon occurrences based on previous DSDP/ODP/IODP drilling.	None
3. All commercial drilling in this area that produced or yielded significant hydrocarbon shows.	None
4. Indications of gas hydrates at this location.	No
5. Are there reasons to expect hydrocarbon accumulations at this site?	No, insufficient burial, no known source formation within expected lithologies (based on onshore exposures and shallow cored sections)
6. What "special" precautions will be taken during drilling?	No special procedures
7. What abandonment procedures need to be followed?	No special procedures
8. Natural or manmade hazards which may effect ship's operations.	None that we area aware of
9. Summary: What do you consider the major risks in drilling at this site?	No major risks

IODP Site Summary Forms:

Form 5 – Lithologies

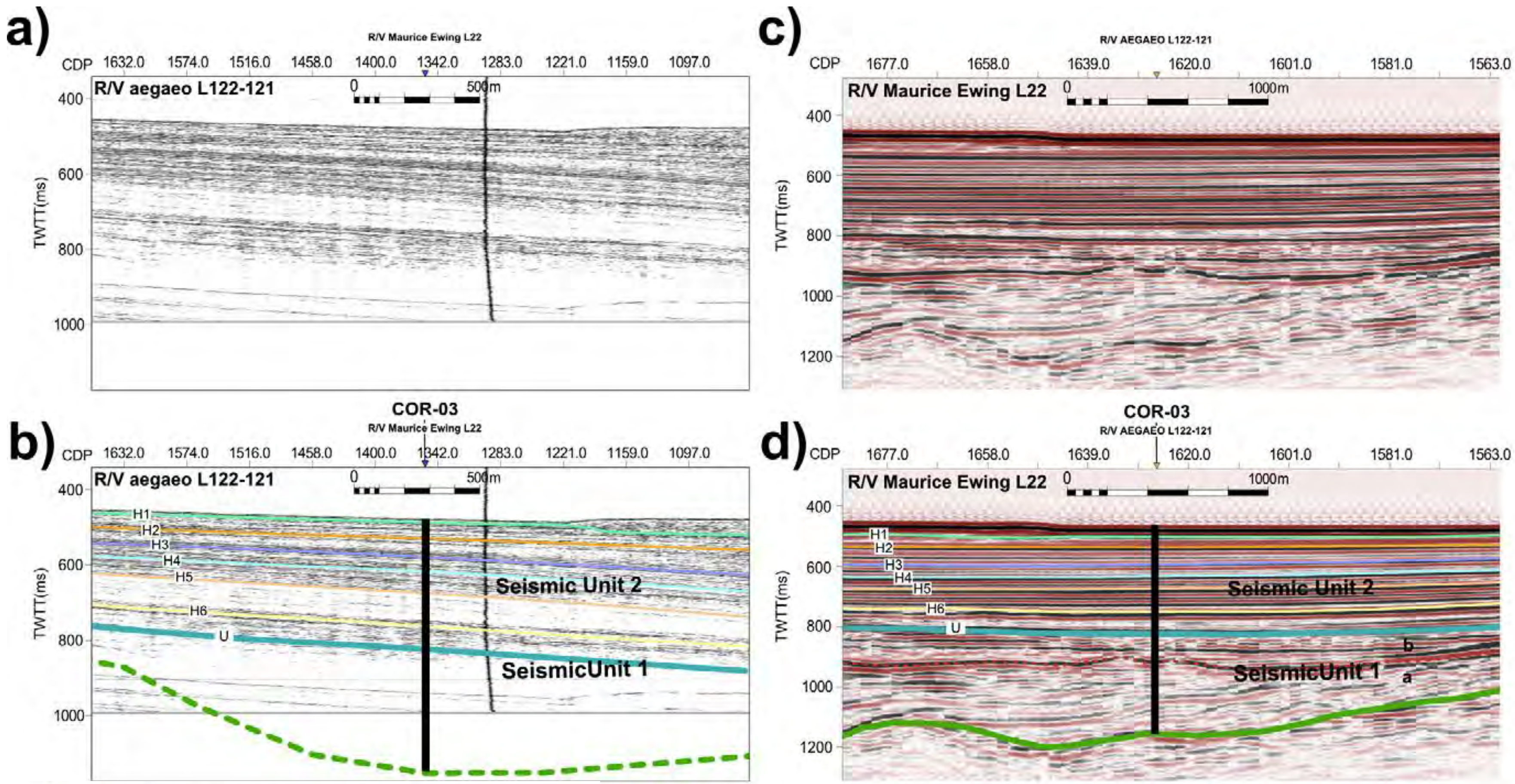
Proposal #:	879 - Full	Site #:	COR-03	Date Form Subm.:	2014-09-04 15:32:36

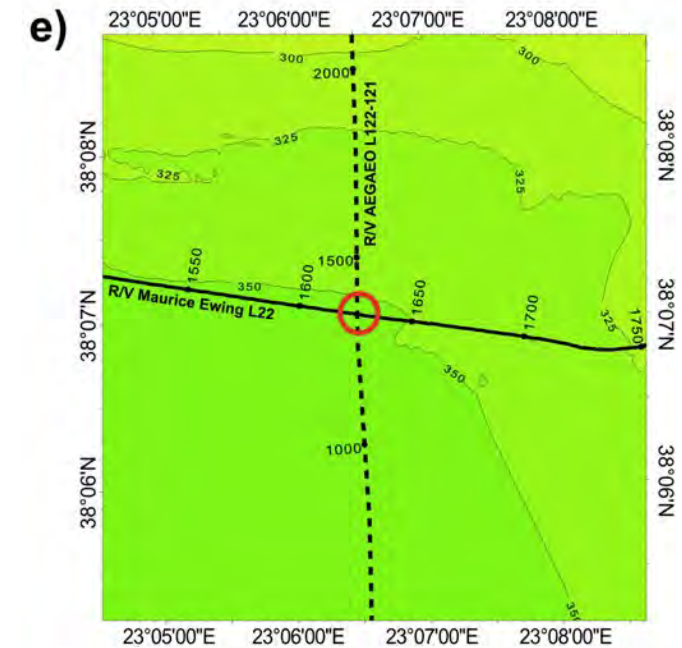
Subbottom depth (m)	Key reflectors, Unconformities, faults, etc	Age	Assumed velocity (km/sec)	Lithology	Paleo-environment	Avg. rate of sed. accum. (m/My)	Comments
0-330	Seismic Unit 2 syn-rift hemipelagic-gravity flow deposits	0 - ~0.6	2.1	interbeded hemipelagite-gravity flow muds, silts, thin sands	marine-lacustrine basin	~1000	
330-740	Unconformity then Seismic Unit 1 syn-rift lake basin, possible fluvial-deltaic deposits	~0.6 - 1-2	2.6	muds, silts, sands, ?gravel of likely lacustrine and fluvial origin	lacustrine basin, distal fluvial-deltaic system	unknown	

Proposal #:	879 - Full	Site #:	COR-03	Date Form Subm.:	2014-09-04 15:32:36

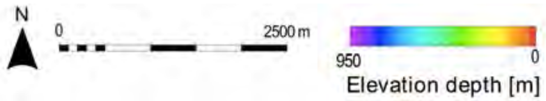
Site Summary Figure Comment	

COR-03





COR-03
Aegaeo L122-121, CDP 1354 (a and b)
Ewing L22, CDP 1626 (c and d)



Files to be uploaded to SSDB
Location map: COR-03_location.pdf
Seismic figures: COR-03_L22_interp.pdf; COR-03_L22.pdf; COR-03_L122-121_interp.pdf; COR-03_L122-121.pdf
SEGY data: COR03_L22.sgy; COR-03_L122-121.sgy
Navigation: COR-03_L22_nav.txt; COR-03_L122-121_nav.txt
Bathymetry: COR-03_bathy.grd
Velocity: Corinth_velocity_information.pdf
Gravity: L22_grav.txt
Piston cores: Corinth_piston_cores.pdf

IODP Site Summary Forms:

Form 1 – General Site Information

879 - Full

Section A: Proposal Information

Title of Proposal:	Drilling the Corinth Rift: Resolving the detail of active rift development
Date Form Submitted:	
Site Specific Objectives with Priority (Must include general objectives in proposal)	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.
List Previous Drilling in Area:	

Section B: General Site Information

Site Name:	COR-02	Area or Location:	Gulf of Corinth, Central Greece
If site is a reoccupation of an old DSDP/ODP Site, Please include former Site#			
Latitude:	Deg: 38.144942	Jurisdiction:	Greece
Longitude:	Deg: 22.758405	Distance to Land: (km)	10
Coordinate System:	WGS 84		
Priority of Site:	Primary: yes Alt:	Water Depth (m):	862

Section C: Operational Information

	Sediments	Basement
Proposed Penetration (m):	750	0
	Total Sediment Thickness (m) 800	
		Total Penetration (m): 750
General Lithologies:	Hemipelagic, gravity flow and fluvial muds, silts, sands, possible gravels at depth	Triassic-Paleogene carbonate expected

Coring Plan:
(Specify or check)

APC ☒ XCB ☐ MDCB ☐ PCS ☐ RCB ☒ Re-entry ☐

Wireline Logging Plan:

Standard Measurements		Special Tools			
WL	☒	Magnetic Susceptibility	☒		
LWD	☐	Magnetic Field	☐	Formation Image (Acoustic)	☐
Porosity	☒	Borehole Temperature	☐	Formation Fluid Sampling	☐
Density	☐	Nuclear Magnetic Resonance	☐	Formation Temperature & Pressure	☐
Gamma Ray	☒	Geochemical	☐	VSP	☐
Resistivity	☒	Side-Wall Core Sampling	☐	Others:	
Sonic (Δt)	☒				
Formation Image (Res)	☐				
Check-shot (upon request)	☐				

Max. Borehole Temp.: °C

Mud Logging:
(Riser Holes Only)

Cuttings Sampling Intervals

from m to m m intervals

from m to m m intervals

Basic Sampling Intervals: 5m

Estimated Days: Drilling/Coring: 20.4 Logging: 3 Total On-site:

Observatory Plan: *Longterm Borehole Observation Plan/Re-entry Plan*

Potential Hazards/ Weather:

Shallow Gas	☐	Complicated Seabed Condition	☐	Hydrothermal Activity	☐
Hydrocarbon	☐	Soft Seabed	☐	Landslide and Turbidity Current	☐
Shallow Water Flow	☐	Currents	☐	Gas Hydrate	☐
Abnormal Pressure	☐	Fracture Zone	☐	Diapir and Mud Volcano	☐
Man-made Objects (e.g., sea-floor cables, dump sites)	☐	Fault	☐	High Temperature	☐
H_2S	☐	High Dip Angle	☐	Ice Conditions	☐
CO_2	☐	Sensitive marine habitat (e.g., reefs, vents)			
Other:					

Preferred weather window

Relatively sheltered basin, therefore flexible

IODP Site Summary Forms:

Form 2 - Site Survey Detail

Proposal #:	879	Site #:	COR-02	Date Form Submitted:	

*** Key to SSP Requirements**

X=required; X=may be required for specific sites; Y=recommended; Y*=may be recommended for specific sites; R=required for re-entry sites; T=required for high temperature environments; † Accurate velocity information is required for holes deeper than 400m.*

Data Type	In SSDB	SSP Req.	Details of available data and data that are still to be collected
1a High resolution seismic reflection (primary)			Location:
1b High resolution seismic reflection (crossing)			Location:
2a Deep penetration seismic reflection (primary)	yes		Ewing MCS line L42 Location: CDP 659
2b Deep penetration seismic reflection (crossing)	yes		Ewing MCS line L09 Location: CDP 46
3 Seismic Velocity	yes		Details of seismic velocity data available and velocity-depth profile applied here
4 Seismic Grid			
5a Refraction (surface)			
5b Refraction (bottom)			
6 3.5 kHz	yes		Shipboard 3.5kHz from Ewing profiles
7 Swath bathymetry	yes		HCMR Seabeam 2120 data for site
8a Side looking sonar (surface)			
8b Side looking sonar (bottom)			
9 Photography or video			
10 Heat Flow			
11a Magnetics			
11b Gravity	yes		Shipboard gravity from Ewing profiles
12 Sediment cores	yes		Details of piston cores in the gulf adjacent to proposed sites
13 Rock sampling			
14a Water current data			
14b Ice Conditions			
15 OBS microseismicity			
16 Navigation	yes		Navigation for primary and crossing seismic profile
17 Other			

IODP Site Summary Forms:

Form 3 – Detailed Logging and Downhole Measurement Plan

Proposal #:	879	Site #:	COR-02	Date Form Submitted:	
Water Depth (m):	862	Sed. Penetration (m):	750	Basement Penetration (m):	0

Are high temperatures or other special requirements (e.g., unstable formations), anticipated for logging at this site?	
Estimated total logging time for this site:	3

Measurement Type	Scientific Objective	Relevance (1=high, 3=low)
Check Shot Survey		0
Nuclear Magnetic Resonance		0
Geochemical		0
Side-wall Core Sample		0
Formation Fluid Sampling		0
Borehole Temperature		0
Magnetic Susceptibility	Building chronostratigraphy through core-log integration	1
Magnetic Field		0
VSP		0
Formation Image (Acoustic)		0
Formation Pressure & Temperature		0
Other (SET, SETP, ...)		0

IODP Site Summary Forms:

Form 4 – Environmental Protection

Proposal #: 879	Site #: COR-02	Date Form Submitted:

Pollution & Safety Hazard	Comment
1. Summary of Operations at site.	APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.
2. All hydrocarbon occurrences based on previous DSDP/ODP/IODP drilling.	None
3. All commercial drilling in this area that produced or yielded significant hydrocarbon shows.	None
4. Indications of gas hydrates at this location.	NO
5. Are there reasons to expect hydrocarbon accumulations at this site?	No, insufficient burial, no known source formation within expected lithologies (based on onshore exposures and shallow cored sections)
6. What "special" precautions will be taken during drilling?	No special procedures needed
7. What abandonment procedures need to be followed?	No special procedures needed
8. Natural or manmade hazards which may effect ship's operations.	None. Shipping traffic to and from the Corinth canal pass through this area, but local collaborators do not foresee any issues
9. Summary: What do you consider the major risks in drilling at this site?	No major risks

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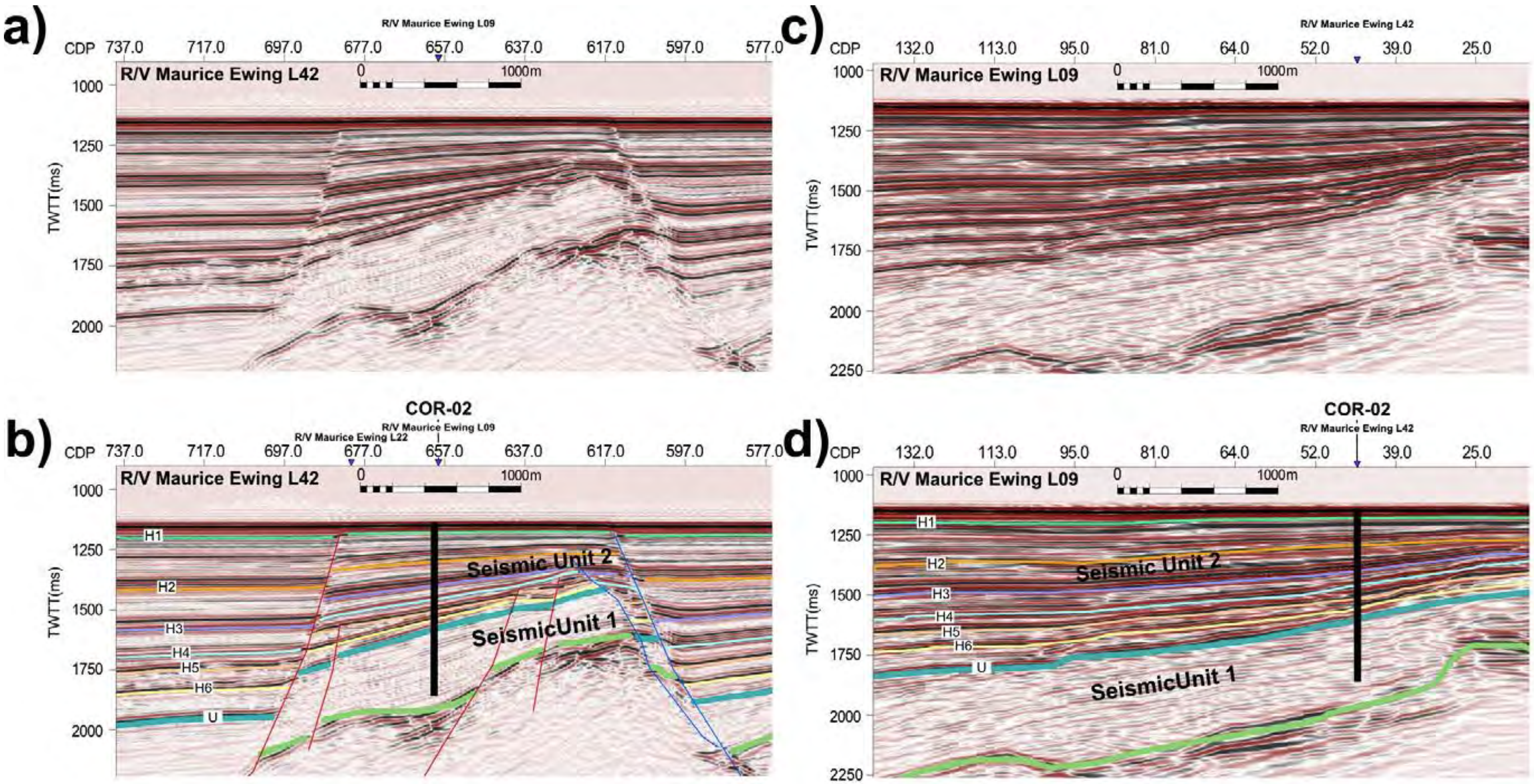
Proposal #:	879 - Full	Site #:	COR-02	Date Form Subm.:	2014-09-04 15:32:12

Subbottom depth (m)	Key reflectors, Unconformities, faults, etc	Age	Assumed velocity (km/sec)	Lithology	Paleo-environment	Avg. rate of sed. accum. (m/My)	Comments
0-440	Seismic Unit 2 syn-rift interbedded hemipelagite and gravity flow deposits	0 - ~0.6	2.2	interbeded hemipelagite-gravity flow muds, silts, thin sands	marine-lacustrine silled basin	~1000	
440-750	Unconformity then Seismic Unit 1, syn-rift lacustrine basin deposits	~0.6 - 1-1.5	2.7	muds, silts, sands, ?gravel of likely lacustrine and fluvial origin	lacustrine basin, distal fluvial-deltaic system	unknown	

Proposal #:	879 - Full	Site #:	COR-02	Date Form Subm.:	2014-09-04 15:32:12

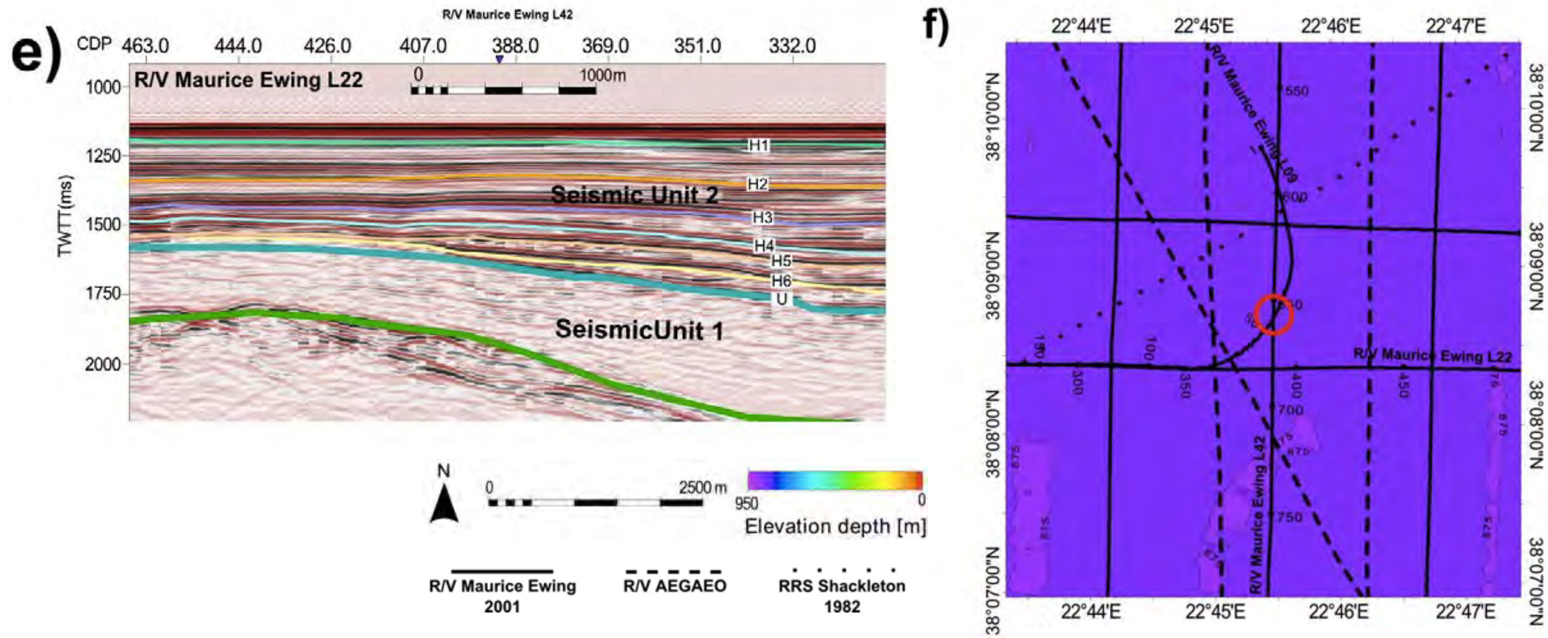
Site Summary Figure Comment	

COR-02



COR-02
Ewing L42, CDP 659 (a and b)
Ewing L09, CDP 46 (c and d)

Ewing L22 (e), south of the site and perpendicular to L42 is shown to illustrate 3D structure (due to non-90° crossing angle of L09). Other profiles within the surrounding grid can be made available.
See also Figure 8b for fault map illustrating why COR-02 is the preferred location and structural context around the horst.



Files to be uploaded to SSDB:

Location map: COR-02_location.pdf
Seismic figures: COR-02_L42_interp.pdf; COR-02_L42.pdf; COR-02_L22_interp.pdf; COR-02_L22.pdf;
SEGY data: COR02_L42.sgy; COR-02_L22.sgy
Navigation: COR-02_L42_nav.txt; COR-02_L22_nav.txt
Bathymetry: COR-02_bathy.grd
Velocity: Corinth_velocity_information.pdf
Gravity: L42_grav.txt; L22_grav.txt
Piston cores: Corinth_piston_cores.pdf

IODP Site Summary Forms:

Form 1 – General Site Information

879 - Full

Section A: Proposal Information

Title of Proposal:	Drilling the Corinth Rift: Resolving the detail of active rift development
Date Form Submitted:	
Site Specific Objectives with Priority (Must include general objectives in proposal)	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.
List Previous Drilling in Area:	

Section B: General Site Information

Site Name:	COR-01	Area or Location:	Gulf of Corinth, Central Greece
If site is a reoccupation of an old DSDP/ODP Site, Please include former Site#			
Latitude:	Deg: 38.157534	Jurisdiction:	Greece
Longitude:	Deg: 22.695709	Distance to Land: (km)	10
Coordinate System:	WGS 84		
Priority of Site:	Primary: yes Alt:	Water Depth (m):	852

Section C: Operational Information

	Sediments	Basement
Proposed Penetration (m):	750	0
	Total Sediment Thickness (m) 1060	
		Total Penetration (m): 750
General Lithologies:	Hemipelagic and gravity flow muds, silts, sands	Triassic-Paleogene carbonate expected

Coring Plan: (Specify or check)

APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.

APC ☒ XCB ☐ MDCB ☐ PCS ☐ RCB ☒ Re-entry ☐

Wireline Logging Plan:

Standard Measurements		Special Tools			
WL	☒	Magnetic Susceptibility	☒		
LWD	☐	Magnetic Field	☐	Formation Image (Acoustic)	☐
Porosity	☒	Borehole Temperature	☐	Formation Fluid Sampling	☐
Density	☐	Nuclear Magnetic Resonance	☐	Formation Temperature & Pressure	☐
Gamma Ray	☒	Geochemical	☐	VSP	☐
Resistivity	☒	Side-Wall Core Sampling	☐	Others:	
Sonic (Δt)	☒				
Formation Image (Res)	☐				
Check-shot (upon request)	☐				

Max. Borehole Temp.: °C

Mud Logging: (Riser Holes Only)

Cuttings Sampling Intervals

from m to m m intervals

from m to m m intervals

Basic Sampling Intervals: 5m

Estimated Days: Drilling/Coring: 20.4 Logging: 3 Total On-site:

Observatory Plan: *Longterm Borehole Observation Plan/Re-entry Plan*

Potential Hazards/ Weather:

Shallow Gas	☐	Complicated Seabed Condition	☐	Hydrothermal Activity	☐	Preferred weather window: Relatively sheltered basin, therefore flexible
Hydrocarbon	☐	Soft Seabed	☐	Landslide and Turbidity Current	☐	
Shallow Water Flow	☐	Currents	☐	Gas Hydrate	☐	
Abnormal Pressure	☐	Fracture Zone	☐	Diapir and Mud Volcano	☐	
Man-made Objects (e.g., sea-floor cables, dump sites)	☐	Fault	☐	High Temperature	☐	
H_2S	☐	High Dip Angle	☐	Ice Conditions	☐	
CO_2	☐	Sensitive marine habitat (e.g., reefs, vents)				
Other:						

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IODP Site Summary Forms:

Form 2 - Site Survey Detail

Proposal #: 879	Site #: COR-01	Date Form Submitted:

*** Key to SSP Requirements**

X=required; X=may be required for specific sites; Y=recommended; Y*=may be recommended for specific sites; R=required for re-entry sites; T=required for high temperature environments; † Accurate velocity information is required for holes deeper than 400m.*

Data Type	In SSDB	SSP Req.	Details of available data and data that are still to be collected
1a High resolution seismic reflection (primary)			Location:
1b High resolution seismic reflection (crossing)			Location:
2a Deep penetration seismic reflection (primary)	yes		Ewing MCS Line L41 Location: CDP 452
2b Deep penetration seismic reflection (crossing)	yes		Ewign MCS Line L18 Location: CDP 864
3 Seismic Velocity	yes		Details of seismic velocity data available and velocity-depth profile applied here
4 Seismic Grid			
5a Refraction (surface)			
5b Refraction (bottom)			
6 3.5 kHz	yes		Shipboard 3.5kHz from Ewing profiles
7 Swath bathymetry	yes		HCMR Seabeam 2120 data around site
8a Side looking sonar (surface)			
8b Side looking sonar (bottom)			
9 Photography or video			
10 Heat Flow			
11a Magnetics			
11b Gravity	yes		Shipboard gravity from Ewing profiles
12 Sediment cores	yes		Details of piston cores in the gulf adjacent to proposed sites
13 Rock sampling			
14a Water current data			
14b Ice Conditions			
15 OBS microseismicity			
16 Navigation	yes		Navigation for primary and crossing seismic profile
17 Other			

IODP Site Summary Forms:

Form 3 – Detailed Logging and Downhole Measurement Plan

Proposal #:	879	Site #:	COR-01	Date Form Submitted:	
Water Depth (m):	852	Sed. Penetration (m):	750	Basement Penetration (m):	0

Are high temperatures or other special requirements (e.g., unstable formations), anticipated for logging at this site?	
Estimated total logging time for this site:	3

Measurement Type	Scientific Objective	Relevance (1=high, 3=low)
Check Shot Survey		0
Nuclear Magnetic Resonance		0
Geochemical		0
Side-wall Core Sample		0
Formation Fluid Sampling		0
Borehole Temperature		0
Magnetic Susceptibility	Building chronostratigraphy through core-log integration	1
Magnetic Field		0
VSP		0
Formation Image (Acoustic)		0
Formation Pressure & Temperature		0
Other (SET, SETP, ...)		0

IODP Site Summary Forms:

Form 4 – Environmental Protection

Proposal #:	879	Site #:	COR-01	Date Form Submitted:	

Pollution & Safety Hazard	Comment
1. Summary of Operations at site.	APC to refusal, then RCB, single hole coring. Drilling times not clearly known as an MSP, but average rate of penetration of 40m/day and expected drilling times used here are supplied by BGS/ESO.
2. All hydrocarbon occurrences based on previous DSDP/ODP/IODP drilling.	None
3. All commercial drilling in this area that produced or yielded significant hydrocarbon shows.	None
4. Indications of gas hydrates at this location.	No
5. Are there reasons to expect hydrocarbon accumulations at this site?	No, insufficient burial, no known source formation within expected lithologies (based on onshore exposures and shallow cored sections)
6. What "special" precautions will be taken during drilling?	No special procedures needed
7. What abandonment procedures need to be followed?	No special procedures needed
8. Natural or manmade hazards which may effect ship's operations.	None. Shipping traffic to and from the Corinth canal pass through this area, but local collaborators do not foresee any issues
9. Summary: What do you consider the major risks in drilling at this site?	No major risks

IODP Site Summary Forms:

Form 5 – Lithologies

Proposal #:	879 - Full	Site #:	COR-01	Date Form Subm.:	2014-09-04 15:26:55

Subbottom depth (m)	Key reflectors, Unconformities, faults, etc	Age	Assumed velocity (km/sec)	Lithology	Paleo-environment	Avg. rate of sed. accum. (m/My)	Comments
0-695	Seismic Unit 2 syn-rift interbeded hemipelagite-gravity flow deposits	0 - ~0.6	~2.6 km/s	interbeded hemipelagite-gravity flow muds, silts, thin sands	marine-lacustrine silled basin	~1000	
695-750	Regional unconformity then uppermost Seismic Unit 1 syn-rift lake basin deposits	~0.6 - 0.8	~3.0 km/s	muds, silts, sands, ?gravel of likely lacustrine origin	Probable lacustrine basin	unknown	

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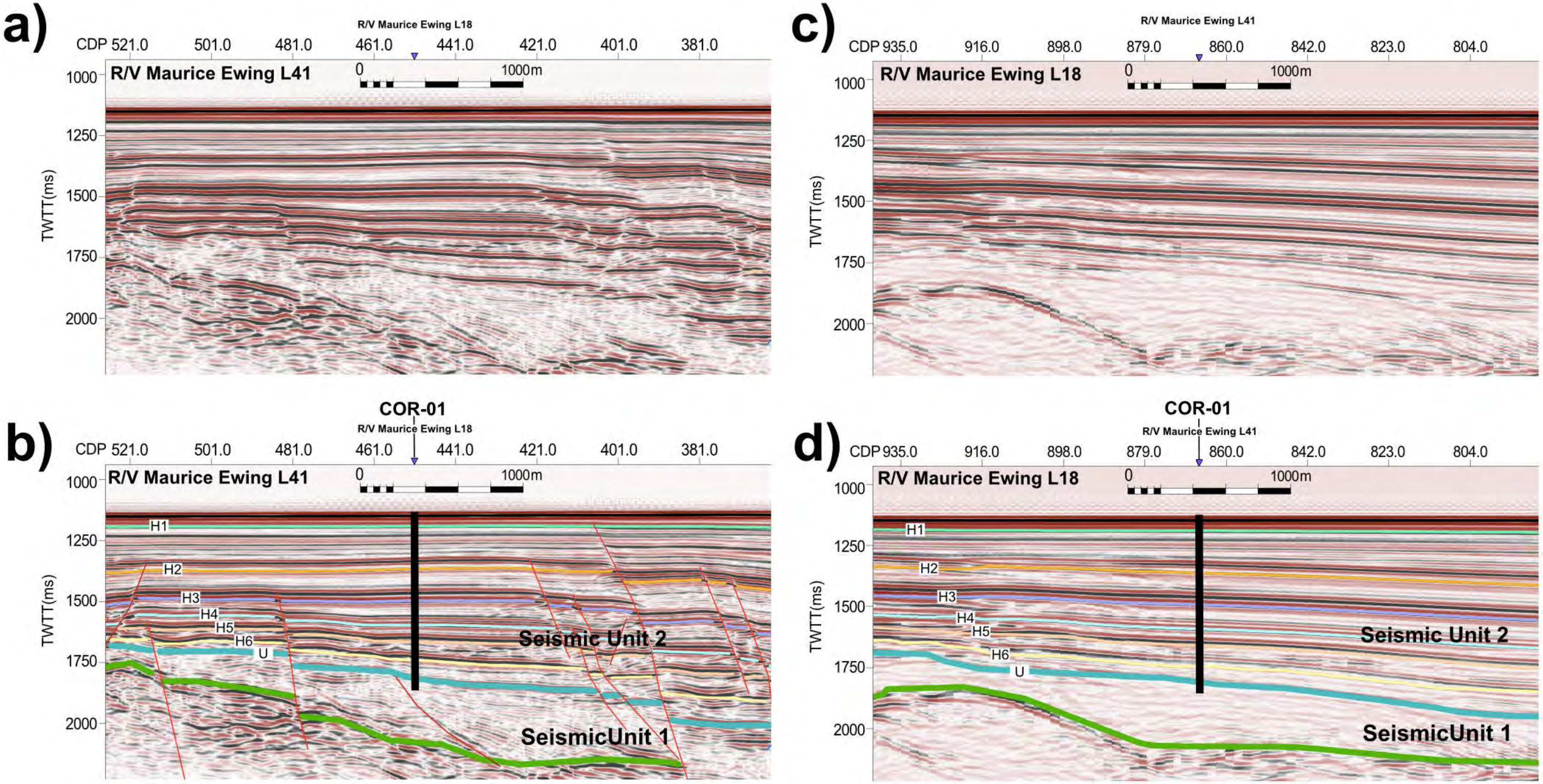
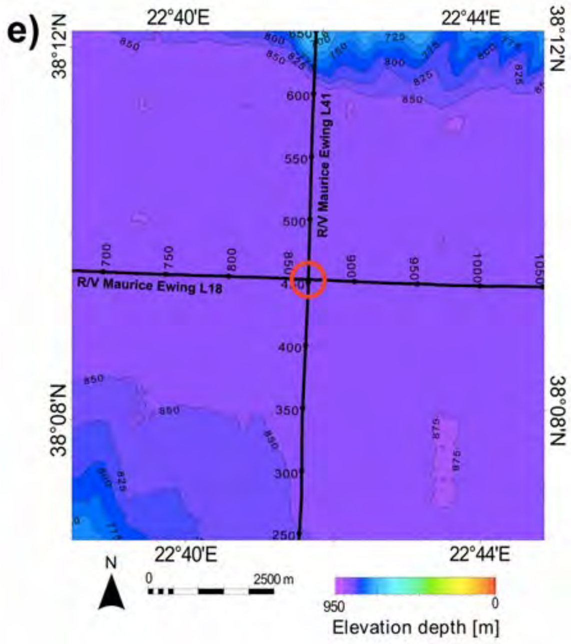
Proposal #:	879 - Full	Site #:	COR-01	Date Form Subm.:	2014-09-04 15:26:55

Site Summary Figure Comment	

COR-01





COR-01
Ewing L41, CDP 452 (a and b)
Ewing L18, CDP 864 (c and d)

Files to be uploaded to SSDB:
Location map: COR-01_location.pdf
Seismic figures: COR-01_L41_interp.pdf; COR-01_L41.pdf; COR-01_L18_interp.pdf; COR-01_L18.pdf
SEGY data: COR01_L41.sgy; COR-01_L18.sgy
Navigation: COR-01_L41_nav.txt; COR-01_L18_nav.txt
Bathymetry: COR-01_bathy.grd
Velocity: Corinth_velocity_information.pdf
Gravity: L41_grav.txt; L18_grav.txt
Piston cores: Corinth_piston_cores.pdf