IODP Proposal Cover Sheet

976 - Pre

N Iceland Rift Propagation

Received for: 2019-10-01

Title	Rift propagation north of Iceland: A case of asymmetric plume dynamics?
Proponents	Hans Christian Larsen, Anett Blischke, Bryndís Brandsdóttir, Gry Barford, Anthony A. P. Koppers, Clinton Phillips Conrad, Sæmundur Ari Halldórsson, David Peate, Charles E. Lesher, Anders McCarthy, Colin Devey, Tobias Björn Weisenberger, Sun Yu, Garry D. Karner, John R. Hopper, Carmen Gaina, Joost Frieling, Asbjørn Johan Breivik, Jeffrey Alan Karson, Geoffrey Mohn
Keywords	Propagating ridge systems, plume-ridge interaction
Area	Jan Mayen Ridge and Iceland Plateau

Proponent Information

Proponent	Hans Christian Larsen
Affiliation	Geological Survey of Denmark and Greenland / School of Ocean and Earth Science, Tongji Univ., China.
Country	Denmark

☐ Permission is granted to post the coversheet/site table on www.iodp.org

Abstract

Our overarching goal is to constrain a possible S-N asymmetry in the dynamics and composition of the Iceland plume by investigating the temporal and compositional development of the crust between the Greenland-Iceland-Faeroe Ridge Complex (GIFRC) and the Jan Mayen Fracture Zone (JMFZ). This area experienced a different and more complex development than that south of the GIFRC, which formed by spreading along the Reykjanes Ridge (RR) ever since breakup at ~55 Ma. Spreading between the GIFRC and the JMFZ took place along the Aegir Ridge (AER) in the Norwegian sea for about 20 Ma forming a distinct igneous breakup margin along the Jan Mayen Microcontinent (JMMC). However, since ~50 Ma, the plume that generated the thick crust below the GIFRC, is interpreted to have sourced a north-ward propagating Iceland Plateau Rift (IPR) that worked in parallel with the AER, prior to the initiation of the Kolbeinsey Ridge (KR). The thickness of IPR igneous crust is considerably thicker than normal oceanic crust. The two overlapping spreading systems (AER-IPR) are interpreted as a coupled pair of propagation and retreating rifts connected by a pseudo transform fault (PTF). Four stages of IPR rifting can be mapped. The propagating IPR tore off a sliver of the East Greenland continental margin (JMMC), which suffered rift-tectonism as well as complex transpressive deformation of crustal block rotation within the JMMC domain. By ~23 Ma, the IPR developed into the present-day KR, the AER became extinct and tectonism within the JMMC ceased. The northward IPR propagation away from the plume centre, thickened crust and an anomalously shallow depth of the Iceland Plateau suggests that strong dynamic influence was exerted by the plume. Interestingly, zero-crust along the KR is more depleted than south of the GIFRC, along the RR, suggesting that the northern component of the Iceland plume exhibits different dynamics than its more enriched southern component. Mapping the temporal and compositional development of northward rift propagation back to ~50 Ma will constrain a fundamental asymmetry within the plume and how variable it has been. This is also the first testing of a large-scale propagating-retreating rift model by ocean drilling, rift propagation into continental lithosphere, and deformation along a PTF. Furthermore, the drilling enigmatic stratigraphic relationship between north Atlantic continental flood basalts and that of initial igneous crust forming along AER can be addressed on the JMMC hosting remnants of the East Greenland basalts.

976 - Pre

Scientific Objectives

Plume-ridge interaction has formed the Greenland-Iceland-Faeroe Ridge Complex (GIFRC) since initial breakup. However, crust south and north of this ridge has very different plate kinematic history and composition of zero age crust suggests that also a compositional asymmetry involving both enriched and depleted plume components exists between north and south. A key objective is to examine if this is a fundamental and long-standing asymmetry within the Iceland plume, how variable it has been, and if different plume components behaves dynamically differently. While spreading south of the GIFRC along the Reykjanes Ridge (RR) has been quite simple, our interpretation north of the GIFRC is that by ~50 Ma, a new spreading system, the Iceland Plateau Rift (IPR) propagated northward from the plume center, while the Aegir Ridge (AER) along the initial line of breakup within the Norwegian Sea responded by gradually retreating northwards. By ~23 Ma, all spreading eventually took place along the Kolbeinsey Ridge (KR). IPR propagation also detached the micro-continental Jan Mayen Ridge (JMMC) from the Greenland margin. Specific drilling objectives are to constrain: (1) the kinematics of this paired propagating and retreating rift system; (2) the temporal and compositional development of the crust that formed along the propagating IPR; (3) possible plume-lithosphere interaction during rift propagation; (4) possible changes in mantle source associated with the eventual formation of the KR; and (5) nature and tectonism of the JMMC, and (6) possible stratigraphic tie between East Greenland´s flood basalts and initial oceanic crust that formed along the AER.

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

976 - Pre

Proposed Sites (Total proposed sites: 9; pri: 6; alt: 3; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
JMMC-01A (Primary)	68.474285 -8.248551	1222	730	300	1030	Target continental flood basalt (plateau basalt equivalent in East Greenland) of actual breakup rift and forming of NE Atlantic SDR crust. Sample igneous and potential intra-basalt sediments, and the primary contacts of top SDRs and top plateau equivalent for geochronological, geochemical, and volcanological studies. Secondary, sample overlying sediments for estimating paleo-environment, depth of crustal formation, and subsequent subsidence.
IPI-01A (Alternate)	67.055214 -8.307984	1221	385	100	485	Target the southeastern IPR-I igneous margin of extensive and progressively younger lava plateaus covering the SDRs and plateau basalt equivalent. Sample igneous section for geochronological, geochemical, and volcanological studies. Reoccupation of Site 350 of DSDP Leg 38, that drilled 3 cores into basement by loosing 1 core and 43% recovery for the remaining 2 cores.
IPII-01A (Alternate)	67.620958 -8.770894	1530	940	100	1040	The IPR-II axial rift target is the objective that intersected IPR-I to SDRs and plateau basalt equivalent sections. Primary sampling for the igneous section for geochronological, geochemical, and volcanological studies. Secondary sampling for sediments for paleo-environment and subsidance history.
IPIII-01A (Primary)	67.798970 -9.848865	1740	703	100	803	This site targets the rift valley flood basalts of IRP-III phase within a clear separation area between the last two visible SRC blocks of the JMMC within the Jan Mayen Trough volcanic zone. The igneous section is the primary target for geochronological, geochemical, and volcanological studies. The fairly undisturbed sediment cover would shed light on the paleo-environment and subsidance history.
IPIII-02A (Alternate)	68.649419 -8.189013	2001	487	100	587	This site targets the rift valley flood basalts of IRP-III phase at the northern extent of the Jan Mayen Trough volcanic zone. Primary objectives are the sampling for geochemical and geochronological studies and volcanological interpretations. The sediment cover would tie into the the paleo-environment and subsidance history for the northernmot end of the JMT.
IPIV-01A (Primary)	67.586210 -12.253577	1720	340	100	440	Target flood basalts of rifting stage IPR-IV that overlays the TPU unconformity and IPR-III flood basalts of the Jan Mayen Trough to the east of the proposed site. Sampling is aimed for geochemical and geochronological studies and volcanological interpretations to compare these to the Kolbeinsey Ridge samples and potential influence of the proximal Iceland plume. The paleo-environmental and subsidance history study would require sediment sampling and bistratigraphic analysis.
IPIV-02A (Primary)	69.464838 -9.858744	2134	363	100	463	Target flood basalts of rifting stage IPR-IV that overlays the TPU unconformity and IPR-III flood basalts of the Jan Mayen Trough to the east of the proposed site. Sampling is aimed for geochemical and geochronological studies and volcanological interpretations to compare these to the Kolbeinsey Ridge samples and potential influence of the distal Iceland plume. The paleo-environmental and subsidance history study would require sediment sampling and bistratigraphic analysis.
PKR-01A (Primary)	69.684629 -10.397698	1852	454	100	554	Target the immediate transition from IPR-IV rifting stage into spreading along the Kolbeinsey Ridge along the outer western magmatic margin of the Jan Mayne Basin. Sampling the igneous section for difference in plume influence vs. mip-oceanic ridge basalts by detailed geochemical, age and petrographic analysis.
SRCT-01A (Primary)	68.149742 -8.472475	1518	430	0	430	Target the unconformity between deformed and non-deformed sediments within SRC syncline. Testing termination of transpressive faulting within the SRC of the JMMC and the complete rift propagation to the Kolbeinsey Ridge by detailed sediment biostratigraphic dating and paleo-environment analysis.