Data report: microprobe analyses of primary mineral phases from Site U1309, Atlantis Massif, IODP Expedition 304/305[1]

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Chapter contents

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Abstract

This contribution is a compilation of electron microprobe analyses of primary minerals in mafic and ultramafic oceanic crustal rocks from Atlantis Massif. The samples were recovered during Integrated Ocean Drilling Program Expedition 304/305, which was designed to investigate the formation and evolution of oceanic core complexes. The analyses were performed at five different institutions, and while common standard reference materials were not utilized at all institutions, internal standards and routine operational protocols were undertaken to assure analysis quality. More than 5000 analyses of plagioclase, pyroxene, olivine, and spinel are compiled here as a collaborative effort to provide mineral analyses to the expedition shipboard science party and other interested researchers.

Background

Integrated Ocean Drilling Program (IODP) Expedition 304/305 was conceived to investigate the formation and evolution of oceanic core complexes exposing lithologies from the lower oceanic crust and upper mantle via long-lived detachment faulting. This expedition was the fourth location where drilling penetrated an inside corner high and/or a corrugated dome associated with a transform fault along a slow-spreading oceanic ridge. Atlantis Massif is located along the Mid-Atlantic Ridge at 30°N (Fig. **F1**). Submersible surveys prior to this expedition suggested significant outcrops of serpentinized peridotite were a characteristic feature of Atlantis Massif. Particularly intriguing was gravity and seismic modeling, which suggested high velocity, dense rock, and potentially fresh mantle material at a depth within the dome that could be attained via ocean drilling.

With a penetration of more than 1400 m into oceanic basement and in excess of 80% recovery, Expedition 304/305 represents one of the hallmark achievements of scientific ocean drilling. To the delight of many and the dismay of some, the core was essentially entirely mafic; only rare thin screens of moderately to pervasive altered ultramafic rock were recovered. The primary lithologies represented in the Expedition 304/305 sample suite are, in decreasing abundance, gabbro, olivine gabbro, troctolite, oxide-bearing gabbro, oxide gabbro, gabbronorite, and oxide- and olivine-bearing gabbro and gabbronorite.

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As a resource for researchers interested in compositional variability in ocean crust materials, several disciplinary groups from Expedition 304/305 expressed an interest in compiling data sets for publication in the IODP *Proceedings* volume. This volume presents an ideal venue for these data compilations, making vast amounts of data available to not only other members of the shipboard science party but also to the earth sciences community.

Methods and data tables

Samples were processed at five institutions, Université Montpellier 2, France; University of Mainz, Germany; Hokkaido University, Sapporo, Japan; and Oregon State University and Texas A&M Universities, USA. Analytical conditions for each facility are listed in the **Appendix.** Analytical results are presented in Microsoft Excel format in MICROPROBE in **"Supplementary material."** All analytical data include estimated depth to the sample. This value is based on curated depth to the top of each core; thus the relative depth of samples in subsequent cores may be in error by as much as a few tens of centimeters. By IODP convention, when recovery is <100% all the recovered material is curated from the top of the cored interval, thus introducing another shift in the reported recovery depth. Most analyses are reported individually, but in some cases they are reported as the arithmetic average of several analyses (designated in data table by the number of individual analyses represented).

Acknowledgments

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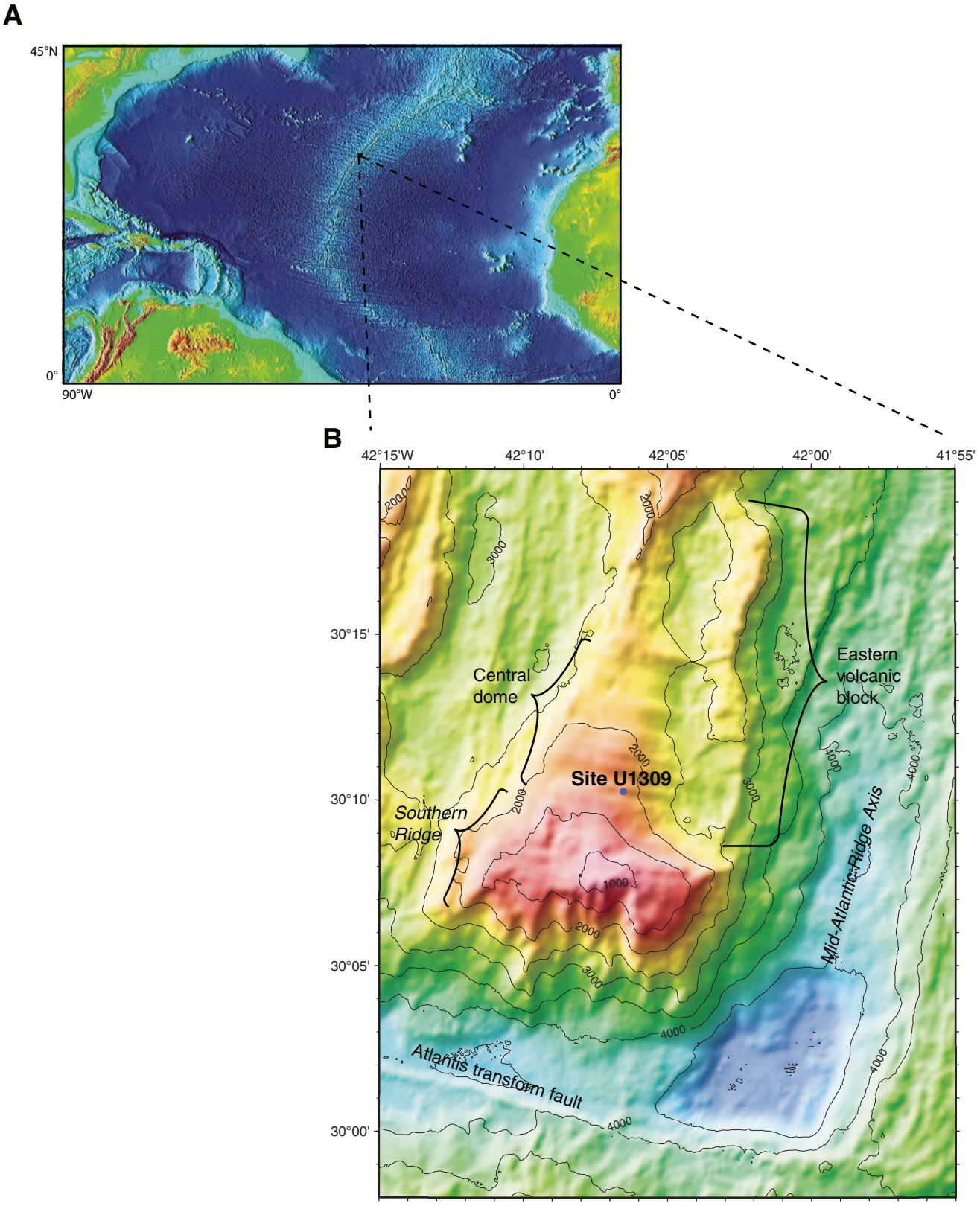
Figure F1. A. Mid-Atlantic Ridge bathymetry map. Base image from **www.ngdc.noaa.gov/mgg/image/2minrelief.html. B.** Map of Site U1309 on Atlantis Massif. Base map from the **"Expedition 304/305 summary"** chapter.



Appendix

Analytical conditions by facility

Laboratory: Institute of Geosciences, University of Mainz, Germany
EPMA Probe: JEOL JXA-8900RL
Acceleration voltage: 15 kV
Probe current: 12 nA
Beam diameter: 2 µm
Count time on peak:
- Major elements (Si, Na, K, Ti, Fe, Al, Mg, Ca): 15 s
- Trace elements (Cr, Mn, Ni): 30 s
- Count time on background:
- Major elements: 5 s
- Trace elements: 15 s

Standard reference materials (SRM): wolla, cor, mg, fe, mn-ti, dio

Laboratory: Montpellier 2 University
EPMA Probe: Cameca SX100
Acceleration voltage: 20 kV
Probe current: 10 nA
Count time on peak: 30 s for all elements
SRM: Al_2O_3, wolla, TiO_2, albite, forst, Cr_2O_3, rhodo, Fe_2O_3, orthose, Ni

Laboratory: Oregon State University
EPMA Probe: Cameca SX100
Acceleration voltage: 15 kV
Probe current: 30 nA
Beam diameter: 1 mm
Count time on peak: 20–40 s
SRM: labradorite, kakanui augite, basalt, K-feldspar

Laboratory: Texas A&M University
EPMA Probe: Cameca SX50
Acceleration voltage: 15 kV
Probe current: 30 nA
Beam diameter: 10 µm
Count time on peak: 20–40 s
SRM: albite, fayalite, olivine, orthoclase, $CaSiO_3$, $FeTiO_3$, spessartine, spinel, chromite

Laboratory: Hokkaido University
EMPA probe: JEOL Superprobe 733 and JEOL 8800R Superprobe
Acceleration voltage: 15 kV
Probe current: 20 nA
Beam diameter: 10 m
Count time on peak: 10–40 s
SRM: synthetic oxides and natural minerals